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Nuclear Non-Proliferation in International Law

Volume III
Legal Aspects of the Use of Nuclear Energy for Peaceful Purposes

Jonathan L. Black-Branch
Dieter Fleck *Editors*

Springer

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Preface

Nuclear non-proliferation remains firmly in the focus of public debate, nationally, regionally and on a global level. While some issues are highly disputed and the role of law may be seen as ineffective and weak in relation to the questions to be solved, international law continues to play a distinct role and makes a relevant contribution in providing an enforceable regulatory framework for securing safety and security in this important area. Treaty law and evolving customary principles and rules may be used to balance diverging interests and protect the needs of peoples and individuals that would otherwise remain subject to arbitrary authority and decision-making. The important task of securing non-proliferation of nuclear weapons, to ensure the safety and security of peaceful uses of nuclear energy and to achieve nuclear disarmament under strict and effective international control, calls for the interpretation and application of international legal rules in their relevant context, a task that this book series endeavours to facilitate. Volume I,[1] which started with an exposé of relevant legal issues and international concerns, addressed a variety of critical questions that require strict and full application of rules stemming from more than one field of international law. Volume II[2] was dedicated to an in-depth review of controversial aspects of verification and compliance. It assisted to further develop international consensus on critical issues of law application that remains essential, both from a theoretical perspective and from the practices of States and international organizations. The positive reception of both Volumes underlines the need for continued efforts in this field, in order to explore such issues further.

The present Volume focuses on *Legal Aspects of the Use of Nuclear Energy for Peaceful Purposes*. The main body of contributions presented are the results of a research conference held in Cologne from 19 to 20 November 2015. This follows

[1] Black-Branch J and Fleck D (Eds), *Nuclear Non-Proliferation in International Law, Vol I* with Preface by Mohamed ElBaradei. Springer/Asser Press, 2014.

[2] Black-Branch J and Fleck D (Eds), *Nuclear Non-Proliferation in International Law, Vol II Verification and Compliance*. Springer/Asser Press, 2015.

in the tradition of gathering relevant experts to discuss areas pertinent to nuclear weapons, non-proliferation and contemporary international law through the Nuclear Round Table series, which have already lead to two comprehensive Reports, presented at the last two conferences of the International Law Association (Washington 2014[3] and Johannesburg 2016[4]). The Cologne conference provided an excellent forum for exchange of expertise and in-depth discussion of controversial issues of nuclear safety and security. It also offered an opportunity for a comprehensive legal evaluation of the 2015 Nuclear Accord with Iran and its implementation, a vital topic that is also reflected in this Volume.

We would like to express our sincere gratitude to Prof. Kerstin Odendahl, Executive Director of the Walther Schücking Institute of International Law at the University of Kiel, for co-organizing this event in conjunction with the ILA Committee on Nuclear Weapons, Non-Proliferation and Contemporary International Law and the Nuclear Round Table series. We are particularly indebted to the Fritz Thyssen Foundation for again supporting the event, and in particular to Dr. Thomas Suermann and his team for hosting our conference in a highly professional and forthcoming manner that has greatly supported our activities.

Special acknowledgement is again due to our peer reviewers who have offered their critical advice, encouragement and invaluable suggestions. As all co-authors appreciated the double anonymous review process, we may express our sincere gratitude on behalf of all of them.

TMC Asser Press/Springer has helped to secure the publication of this book series in a very diligent and effective manner. We would like to thank Philip van Tongeren, Frank Bakker and their team for their interest, outstanding diligence and encouragement.

Oxford, UK — Jonathan L. Black-Branch
Cologne, Germany — Dieter Fleck
April 2016

[3] *Legal Aspects of Nuclear Disarmament*, http://www.ila-hq.org/en/committees/index.cfm/cid/1025.

[4] *Legal Issues of Verification of Nuclear Non-Proliferation Obligations*, http://www.ila-hq.org/en/committees/index.cfm/cid/1025.

Contents

Abbreviations

ABACC	Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials
AEOI	Atomic Energy Organization of Iran
AFCONE	African Commission on Nuclear Energy
ALARA	‘as low as reasonably achievable’
AMP	Ageing management programme
AP	Additional Protocol
ARM	Advance Reference Material
ARSIWA	Articles on Responsibility of States for Internationally Wrongful Acts (2001)
BOT	Breakout time
BSC	Brussels Supplementary Convention (31 January 1963)
CANDU	CANadian Deuterium Uranium reactors
CBRN	Chemical Biological Radiological and Nuclear Risk Mitigation
CD	Conference on Disarmament
CERCLA	United States Comprehensive Environmental Response, Compensation, and Liability Act of 11 December 1980
CERN	Conseil européen pour la recherche nucléaire
CFSP	Common Foreign and Security Policy (EU)
CMC	Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material (17 December 1971)
CNS	Convention on Nuclear Security (20 September 1994)
CoCom	Coordinating Committee for Multilateral Export Controls
CPPNM	Convention on the Physical Protection of Nuclear Material (26 October 1979)
CSA	Comprehensive Safeguards Agreement
CSC	Convention on Supplementary Compensation for Nuclear Damage (29 September 1997)
CSDP	Common Security and Defence Policy (EU)
CSS	Commission on Safety Standards

CTBT	Comprehensive Nuclear Test-Ban Treaty (24 September 1996)
DEA	Drug Enforcement Administration (US)
DiD	Defence in depth
DoE	Department of Energy
DPRK	Democratic People's Republic of Korea
DRM	Dispute resolution mechanism
DS	Design safety
DSARS	Design and Safety Assessment Review Service
EAEC	European Atomic Energy Community (EURATOM)
ECHR	European Convention on Human Rights
ECSC	European Coal and Steel Community
ECtHR	European Court on Human Rights
EEC	European Economic Community
ENDC	Eighteen-Nation Committee on Disarmament
ENR	Uranium enrichment and spent fuel reprocessing
ENSREG	European Nuclear Safety Regulators Group
EPR	Nuclear off-site emergency preparedness and response
EPReSC	Committee on Emergency Preparedness and Response Standards
EU	European Union
EURATOM	European Atomic Energy Community
FAO	Food and Agriculture Organization of the United Nations
FMCT	Fissile material cut-off treaty
FMT	Fissile material treaty
FORO	Ibero-American Forum of Radiological and Nuclear Regulatory Agencies
GGE	Group of Governmental Experts
GNNPV	Global nuclear non-proliferation verification
GRS	Generic Reactor Safety
HEU	Highly enriched uranium
IACHR	Inter-American Commission on Human Rights
IACRNE	Inter-Agency Committee on Radiological and Nuclear Emergencies
IAEA	International Atomic Energy Agency
ICCPR	International Covenant on Civil and Political Rights (19 December 1966)
ICJ	International Court of Justice
ICNS	Draft International Convention on Nuclear Security
ICRP	International Commission on Radiological Protection
ICSANT	International Convention for the Suppression of Acts of Nuclear Terrorism (13 April 2005)
ILA	International Law Association
ILC	International Law Commission
ILM	International Legal Materials
INES	International Nuclear and Radiological Event Scale
INFCE	International Nuclear Fuel Cycle Evaluation

INFCIRC	Information Circulars, IAEA
INLA	International Nuclear Licensing Agency
INLEX	International Expert Group on Nuclear Liability
INRA	International Nuclear Regulators Association
INSAG	International Nuclear Safety Advisory Group
INSARR	Integrated Safety Assessment of Research Reactors
IPFM	International Panel on Fissile Materials
IPPNW	International Physicians for the Prevention of Nuclear War
IPSART	International Probabilistic Safety Assessment Review Team
IRENA	International Renewable Energy Agency
IRRS	Integrated Regulatory Review Service
ITDB	Illicit Trafficking Database System
ITER	International Thermonuclear Experimental Reactor
JCPOA	Joint Comprehensive Plan of Action
JP	Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (21 September 1988)
JPLAN	Joint Radiation Emergencies Management Plan
JPOA	Joint Plan of Action
LEU	Low-enriched uranium
LTO	Long-term operation
MTCR	Missile Technology Control Regime
NAM	Non-Aligned Movement
NNWS	Non-nuclear weapon States
NPP	Nuclear power plant
NPT	Treaty on the Non-Proliferation of Nuclear Weapons (1 July 1968)
NSaC	Nuclear Safety Center
NSaCoE	Nuclear Safety Center of Excellence
NSG	Nuclear Suppliers Group
NSGEG	Nuclear Security Governance Experts Group
NSS	Nuclear Security Series (IAEA)
NuPoC	Nuclear Power Plant and Reactor Exporters' Principles of Conduct
NUSS	Nuclear Safety Standards
NUSSC	Committee on Nuclear Safety Standards
NWFZ	Nuclear weapon-free zone
NWS	Nuclear weapon States
OECD/NEA	Organization for Economic Cooperation and Development, Nuclear Energy Agency
OEEC	Organization for European Economic Co-Operation
OFAC	Office of Foreign Assets Control
OP	Operative paragraph
OPANAL	Organismo para la Proscripción de las Armas Nucleares en la América Latina y el Caribe
OSART	Operational Safety Review Team
PLiM	Plant life management
PMD	Possible Military Dimensions

PP	Preambular paragraph
PRA	Probabilistic Risk Assessment
PROSPER	Peer Review of Operational Safety Performance Experience Review
PSA	Probabilistic Safety Assessment
PSI	Proliferation Security Initiative
PUI	Peaceful Uses Initiative (IAEA)
PWG	Procurement Working Group
R&D	Research & Development
RADWASS	Radioactive Waste Safety Standards
RAMP	Review of Accident Management Programmes
RASSC	Committee on Radiation Safety Standards
RevCon	Review Conference
ROpER	Regulator Operating Experience Review
SALTO	Safety Aspects of Long-Term Operation of Water Moderated Reactors
SARIS	Self-Assessment of Regulatory Infrastructure for Safety
SC	Security Council
SDGs	Sustainable Development Goals
SDN List	Specially Designated Nationals and Blocked Persons List
SDR	Special Drawing Rights as defined by the International Monetary Fund (IMF)
SEDO	Safety Evaluation of Fuel Cycle Facilities during Operation
SER	Safeguards Evaluation Report
SFAIRP	‘so far as is reasonably practicable’
SLC	State-Level Concept
SSRS	Site and Seismic Safety Review
SUA	Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (2005)
SUA Prot	Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (2005)
SWU	Separative Work Units (uranium enrichment)
TCA	Trade Cooperation Agreement
TECDOCS	Technical documents
TFEU	Treaty on the Functioning of the European Union (2012)
TRANSSC	Committee on Transport Safety Standards
UN	United Nations
UNAEC	United Nations Atomic Energy Commission
UNCIO	United Nations Conference on International Organization
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly

UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNIDIR	United Nations Institute for Disarmament Research
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UNTS	United Nations Treaty Series
USIE	Unified System for Information Exchange in Incidents and Emergencies
USNRC	United States Nuclear Regulatory Commission
VC	Vienna Convention on Civil Liability for Nuclear Damage (21 May 1963)
VCLT	Vienna Convention on the Law of Treaties (23 May 1969)
VOA	Voluntary offer agreement
VPF	Value of a prevented fatality
WANO	World Association of Nuclear Operators
WASSC	Committee on Waste Safety Standards
WENRA	Western European Nuclear Regulators' Association
WHO	World Health Organization
WMD	Weapons of mass destruction
WMO	World Meteorological Organization

Chapter 1
Peaceful Uses of Nuclear Energy and Its Interrelationship with Nuclear Non-proliferation and Disarmament

Jonathan L. Black-Branch and Dieter Fleck

Abstract The Nuclear Non-Proliferation Treaty (NPT) is based on three equally important pillars: non-proliferation of nuclear weapons or other nuclear explosive devices; the development and use of nuclear energy for peaceful purposes; and disarmament. Because of the strong interrelationship between these different objectives, none of them can be examined in isolation. This Chapter explores this interrelationship, focussing on the key issues of peaceful uses, i.e. safety and security of nuclear material and facilities. It provides a précis of tasks and activities towards this end, considers the relevant roles of nation States and the International Atomic Energy Agency, and ultimately presents some conclusions for international cooperation in this sensitive field where political discussion too often dominates over legal analysis.

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Keywords International Atomic Energy Agency (IAEA) · Nuclear Non-Proliferation Treaty (NPT) · Nuclear safety · Nuclear security · Peaceful uses of nuclear energy

Contents

1.1 Introduction

Post World War II countries around the world explored their nuclear technological options regarding both weapons as well as peaceful uses of nuclear energy. Early attempts to dissuade States from developing nuclear weapons were viewed sceptically as placing restrictions on their ability to develop nuclear energy for peaceful purpose. President Eisenhower's famous 'Atoms for Peace' speech in 1953[1] was a US conciliatory attempt to rein in nuclear ambitions following its earlier failure regarding non-proliferation efforts. Indeed, the earlier Atomic Energy Act, passed by U.S. Congress in 1946,[2] included provisions designed to keep nuclear technology secret from other countries, provisions that were later replaced by the Atomic Energy Act of 1954.[3] The 'Atoms for Peace' plan would provide assistance to other countries in the peaceful uses of atomic energy. That said, a comprehensive international agreement was necessary to effectively tackle the growing conundrum of States wanting to develop nuclear energy on the one hand and the international community wishing to address a growing concern relating to non-proliferation and disarmament on the other.

The adoption of the Nuclear Non-Proliferation Treaty (NPT)[4] was heralded as a progressive step in this regard. Under the NPT the United States, Russia, the United Kingdom, France and China are recognized as nuclear-weapon States.[5] They undertake 'not to transfer to any recipient whatsoever nuclear weapons …' (Article I), while all other State Parties undertake 'not to receive the transfer … of nuclear weapons …; not to manufacture or otherwise acquire nuclear weapons …; … not to seek or receive any assistance in the manufacture of nuclear weapons …' (Article

[1] Eisenhower 1953.

[2] Atomic Energy Act of 1946 (Public Law 585, 70th Congress), https://www.osti.gov/atomic-energyact.pdf, *inter alia* Sections 5, 7 and 10.

[3] Atomic Energy Act of 1954, as amended, *inter alia*, by the Nuclear Non-Proliferation Act of 1978 (Public Law 83–703, 68 Stat. 919 83rd Congress), http://pbadupws.nrc.gov/docs/ML1327/ML13274A489.pdf.

[4] Treaty on the Non-Proliferation of Nuclear Weapons (1 July 1968) 729 UNTS 161.

[5] Article IX(3) NPT states that, 'a nuclear-weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967'.

II); and 'to accept safeguards' (Article III). All Parties undertake to facilitate cooperation in the peaceful uses of nuclear energy (Article IV) and 'to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control' (Article VI).

The Treaty is thus based on three central pillars. The *first* pillar requires non-proliferation of nuclear arms or other nuclear explosive devices; the *second* pillar, which will be the primary focus of this Volume, ensures the inalienable right of all Parties to develop research, production and use of nuclear energy for peaceful purposes; the *third* pillar requires effective measures towards disarmament. These three pillars are inherently intertwined: As expected by the negotiating States, access to peaceful uses of the atom without discrimination and peaceful nuclear cooperation between States would support compliance with non-proliferation obligations, compliance with the Treaty obligations on nuclear disarmament would increase the effectiveness of nuclear non-proliferation, and cooperative activities would ensure security and safety of the use of nuclear energy for peaceful purposes.

The present state of nuclear energy underlines the relevance of these complex interrelationships on a global level. It also reveals continuing challenges for States in fulfilling their respective obligations regarding nuclear safety and security. This task is complex and demanding. As defined by the IAEA, nuclear safety comprises 'the achievement of proper operating conditions, prevention of accidents and mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards;' nuclear security is 'the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities'. Yet, at least in IAEA practice, an exact distinction between the general terms safety and security does not exist. There are borderline issues and significant overlap and synergy effects in the maintenance of nuclear safety and security.[6] This is well illustrated by the following figure:[7]

[6] See IAEA 2007. As noted in this Glossary, there is 'not an exact distinction between the general terms safety and security.—In general, *security* is concerned with malicious or negligent actions by humans that could cause or threaten harm to other humans; safety is concerned with the broader issue of harm to humans (or the environment) from radiation, whatever the cause. The precise interaction between security and safety depends on the context. "Safety and security synergies" concern, for example: the regulatory infrastructure; engineering provisions in the design and construction of nuclear installations and other facilities; controls on access to nuclear installations and other facilities; the categorization of radioactive sources; source design; the security of the management of radioactive sources and radioactive material; the recovery of orphan sources; emergency response plans; and radioactive waste management.—*Safety* matters are intrinsic to activities, and transparent and probabilistic safety analysis is used. Security matters concern malicious actions and are confidential, and threat based judgement is used.'

[7] © International Atomic Energy Agency (see IAEA 2007), reproduced here with kind permission of the IAEA.

It is important to consider that despite complex and highly professional regulatory efforts to secure safety[8] and security,[9] there are significant deficiencies in international cooperation, a fact that may seriously jeopardise the safe and secure use of nuclear energy. While international nuclear safety standards have been continuously improved, still today these standards are not mandatory, neither is compliance internationally controlled. Nuclear security continues to be under great risks. Furthermore, a global liability regime for nuclear damage could not be achieved so far.

The world-wide status of nuclear energy production for peaceful purposes, as reported by the IAEA on a regular basis, reveals a progressive development. As of 31 December 2014, there are 438 operational nuclear power reactors in 30 countries around the world and 70 are under construction. Nuclear power generated 2410.4 terawatt-hours (TW·h) of electricity in 2014, and while this presently corresponds to less than 11 % of world electricity production, the lowest value since 1982, it is still significant and may again increase in future.[10] In addition, there are

[8] For a general overview see ElBaradei et al. (Eds.) 1993, Vols. 1 and 2, 151–1400. Significant treaty improvements have been achieved since with the Convention on Nuclear Safety (20 September 1994), INFCIRC/449, 1963 UNTS 293; Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, INFCIRC/546 (29 September 1997); Convention on Early Notification of a Nuclear Accident (26 September 1986), 1439 UNTS 275, INFCIRC/335; Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (26 September 1986), 1457 UNTS 133, INFCIRC/336; International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (3 May 1996), 35 ILM 1406, 1415 (1996); Convention on Supplementary Compensation for Nuclear Damage—CSC—(12 September 1997), INFCIRC/567, 36 ILM 1454 (1997); and, at regional level, the Council of Europe Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment (21 June 1993), 32 ILM 1228, 1230 (1993).

[9] See below, Chap. 8 (Drobysz).

[10] See IAEA 2014a, p. 1; IAEA 2014b; and IAEA 2015a, presenting in detail the status of nuclear power as of 31 December 2014; see also IAEA, Power Reaction Information System (PRIS), https://www.iaea.org/pris/, and the map at http://www.theguardian.com/environment/interactive/2012/mar/08/nuclear-power-plants-world-map.

approximately 140 naval vessels using nuclear propulsion in operation.[11] Yet measures to ensure nuclear security and safety are often lagging behind and it is increasingly expressed by experts that safe radioactive waste disposal will remain an important burden for future generations.

Under the concept of State sovereignty, safety and security are the national responsibility of States. Yet there is a growing need for tighter international legal regulation. Damages would have border-crossing effects and physical requirements call for international observance and implementation. Moreover, existing challenges have heightened and become more diverse both in nature and intensity, due to increased activities by States and non-State actors. Yet such essential issues as nuclear safety and licensing, radioactive waste disposal, radiation protection, nuclear transport, and nuclear liability, are not fully regulated at international level and no common standards are accepted as universally binding legal norms.[12] The Safety Standards promulgated by the IAEA[13] have the advantage of meeting professional requirements worldwide, but to become legally binding they need to be fully transformed into national practice and effectively enforced. Still today, more than six decades after the first nuclear power plants have commenced operation and despite the major nuclear accidents which happened in Chernobyl 1986 and Fukushima Daiichi 2011, the serious accident in Kyshtym (Russia) 1957, two accidents with off-site risk (Windscale Pile, UK, 1957, and Three Mile Island off Harrisburg, USA, 1979), and a number of minor accidents and incidents notwithstanding,[14] a global settlement is not in place. In certain fields safety and security may be served effectively by cooperative approaches rather than by strict regulation, but in other fields a universally binding regulation would be desirable. More harmonization seems advisable in this respect, but sadly remains unrealistic. Thus access to peaceful uses of the atom, a cornerstone of the NPT, which is so important to ensure non-proliferation of nuclear weapons, remains loaded with problems. It is in no lesser degree than the control of nuclear non-proliferation as such, that nuclear safety and security requires continued international attention and monitoring.

[11] These naval vessels are powered by some 180 reactors; see World Nuclear Association, http://www.world-nuclear.org/info/Non-Power-Nuclear-Applications/Transport/Nuclear-Powered-Ships/#.UV5yQsrpyJM; see also Hirdaris et al. 2014.

[12] See Manóvil 2014, pp 135–306; 307–422; 423–468; 491–503; 633–807.

[13] IAEA 2015c.

[14] See The International Nuclear and Radiological Event Scale (INES), https://www.iaea.org/ns/tutorials/regcontrol/appendix/app96.htm?w=1Three+Mile+Island; https://www.iaea.org/sites/default/files/ines.pdf. Such events have occurred in Ascó (Spain); Atucha (Argentina); Blayais (France); Buenos Aires (Argentina); Chalk River (Canada); Forsmark (Sweden); Goiâna (Brazil); Gundremmingen (Germany); Gravelines (France); Jaslovské Bohunice (Czech Republic); Krško (Slovenia); Lucens/ Vaud (Switzerland); Mayak (Russia); Paks (Hungary); Penly (France); Saint-Laurent (France); Sellafield (UK); Shika (Japan); SL-1 Experimental Power Station Idaho (US); Tokaimura (Japan); Vandellos (Spain); and Windscale Reprocessing Plant (UK).

A risk assessment of current developments requires an inter-disciplinary approach today, which necessarily includes a solid evaluation of the state of compliance with existing law; a legal evaluation of current loopholes in regulation; and a realistic assessment of the effectiveness of implementation.

This Chapter undertakes to examine key legal aspects of the inalienable right to develop research, production and use of nuclear energy for peaceful purposes from its most important perspective, i.e. safety and security. Based on the comprehensive contributions gathered in this Volume, we explore deficiencies in regulation on the background of related legal obligations on nuclear non-proliferation and disarmament, endeavouring to identify important open tasks for international cooperation (Part 1.2). The Role of States and the IAEA is addressed with a view to highlight international responsibilities, to explore existing gaps and consider possibilities for improving current forms of cooperation (Part 1.3). Some conclusions are offered to facilitate implementation (Part 1.4).

1.2 A Précis of Tasks and Activities to Ensure Nuclear Safety and Security

Nuclear safety and security remain significant areas of concern requiring full compliance and progressive development at local, regional and international levels. Contemporary legal analysis will assist in identifying problems and offering direction for regulatory frameworks as well as cooperation in this important field where both States and non-State actors are increasingly asserting certain negligence, and even defiance. This volume seeks to provide a compendium of contributions to salient legal issues regarding the use of nuclear energy for peaceful purposes, combined with an assessment of the state of implementation in this field.

Daniel Rietiker takes an unusual, yet necessary perspective on the use of nuclear energy for peaceful purposes: the protection of human rights, whereby civil as well as economic, social and cultural rights are equally taken into account. Considering that an appropriate use of nuclear energy can contribute to the enjoyment of the right to health, the right to a good standard of living, including adequate food and drinking water, as well as the right to respect for private life, he argues that States are under an obligation to actively pursue the fulfilment of these human rights, in particular through electricity production and its practical applications in agriculture, industry, medicine, biology and hydrology. He also shows that the right to use nuclear energy is not unlimited and that those limits derive not only from the non-proliferation obligations established by the NPT, but essentially from safety for present and future generations from nuclear accidents, radioactive waste disposal and health dangers for workers in uranium mines. Human rights are thus not only an enabler for peaceful uses of the atom, but also a significant barrier to an unfettered exploitation. While States do enjoy a broad margin of appreciation as regards the question how to fulfil their human rights duties in a responsible manner, these rights and limitations are to be observed.

Seth A. Hoedl shows that a global expansion of nuclear power may challenge the present nuclear non-proliferation regime and inhibit movement towards a world with few, if any, nuclear weapons. To resolve the inherent dual use problems in the use of nuclear energy he advocates a new legal principle according to which peaceful use activities would be limited to those that are licensed by an international agency, while any non-licensed activity would be presumed non-peaceful. This licensing approach might provide an alternative to multinational enrichment and fuel banks for managing an expansion of nuclear power, without recourse to international ownership. It might be both easier to implement than multinational ownership proposals and provide additional non-proliferation advantages. After discussing how an expansion of nuclear power can challenge the existing regime, he explains the proposed licensing approach in detail, including key license terms, international relationships and obligations, an implementation path, and existing precedents for controlling sensitive technology through licensing. International licensing of nuclear technologies might constrain the most sensitive aspects of the nuclear fuel cycle, give confidence to the global community that uranium enrichment and spent fuel reprocessing facilities were not being misused, and concurrently preserve, in a non-discriminatory fashion, the right of all States to pursue peaceful use of nuclear energy.

Tariq Rauf and *Usman I. Jadoon* follow a different perspective by discussing requirements and possibilities for a treaty prohibiting the Production and Stockpiling of weapon-usable material. While a fissile material cut-off treaty (FMCT), or fissile material treaty (FMT), was originally conceived as a measure to prevent additional States developing nuclear weapons and to limit the stocks of fissile material for States already possessing nuclear weapons, no solution could be found for decades. Nuclear-weapon States pushed for a treaty that would only prohibit future production, while several non-nuclear-weapon States favoured two parallel objectives—nuclear non-proliferation and nuclear disarmament—and the inclusion of existing stocks and also their elimination. The two authors find it illogical to consider the start of FMT negotiations without the inclusion of existing stocks in the scope, as all weapon-usable material should be brought under accountability and transparency, a principle that is is essential for achieving a world without nuclear weapons.

Ilaria Anna Colussi again takes a broader perspective both on the advantages and the risks of the nuclear area by considering social, ethical, legal, environmental and political values based on a comprehensive analysis. Aiming at a balance between the freedom of research and development on the one side and the safety and security needs on the other, she develops the notion of 'responsible stewardship' based on cooperation between all stakeholders, a proportional balance of interests, values and rights at stake, and periodical review of the proper function of this balance in a responsible process.

Jürgen Grunwald, addressing specific requirements and opportunities of the European Atomic Energy Community, shows an important new dimension of the EURATOM Treaty: Whereas the promotional aspects highlighted by its founding fathers had almost vanished by now, the obligations imposed by the Treaty in the fields of radiation protection, nuclear safety and security as well as nuclear safeguards had been constantly broadened and intensified. As a supranational organisation the European Atomic Energy Community can exercise public power in its 28 Member States by adopting and enforcing measures which are not only binding on these States, but are also directly applicable to persons and undertakings in the European Community. Given its enormous legal potential, to a large extent still unexploited, the Treaty appears well equipped also to deal with future challenges, provided the political will exists to exercise the powers vested in it. More could and should be done, in particular by further developing the Community dimension through common solutions instead of re-nationalising problem areas.

Anguel Anastassov, commenting on the effectiveness of the nuclear safety regulatory framework, evaluates the role of the IAEA in promoting the harmonization of legal and regulatory regimes for nuclear safety and taking measures to ensure synergies between nuclear safety and nuclear security. He concludes that it is realistic to consider the establishment of an international verification of the national safety framework. The regulatory requirements for nuclear safety should be continually enhanced, as the need exists to strengthen capabilities to manage risks from beyond-design-basis events. The Agency's safeguards inspections could serve as a model for performing periodic evaluations of Member States' nuclear safety measures, based on prior consent.

It is important in this context to consider nuclear security risks that have emerged by unauthorized acts involving or directed at nuclear and other radioactive material, associated facilities, or certain activities, such as the illicit trafficking of nuclear material and nuclear terrorism. *Sonia Drobysz* portrays the legal framework adopted to prevent, detect and respond to such risks. She shows that efforts towards the consolidation and universalization of the international regime as well as the adoption of national nuclear security legislation give rise to a number of legal and practical challenges which should be overcome in international cooperation, using tools and processes that can help strengthen nuclear security globally and focussing on universalising and implementing the existing instruments with proper reporting and periodic review mechanisms, rather than by adopting a new international convention.

Still unsolved problems of radioactive Waste Management are analysed by *Kerstin Odendahl.* While satisfactory disposal means are available for low-level and most intermediate-level radioactive waste, no solution has yet been found for high-level waste generated by nuclear power plants. Today, this waste is merely stored while the States wait for disposal technology to develop. Also a technology able to reprocess all spent fuel and thus avoid high-level radioactive waste in energy production is yet to be found. When the existing nuclear power plants are decommissioned and dismantled additional measures have to be taken to ensure nuclear safety to allow for a solution which takes into account the extreme hazardousness and longevity of high-level radioactive waste, worldwide binding norms on safety and security of both storage and disposal facilities are needed. Furthermore, a symbol for identifying sites of disposal is yet to be found. It must be so clear and simple that even in several thousands of years human beings will be able to identify an extremely dangerous site and keep out. The existing radiation hazard symbol is definitely not suitable for such purposes.

Addressing environmental concerns connected with peaceful uses of nuclear energy, *Michael Bothe* explains that international legal regulation has so far been incomplete. The basic answer of customary law relating to the risk of transfrontier nuclear pollution is the so-called no harm rule. As to nuclear pollution, that rule needs further concretization, preferably by treaty law. IAEA environmental standards for nuclear installations, transportation and waste disposal have so far not reached the status of legally binding norms. The risk of radioactive fallout is not banned in a convincing manner. There is also no adequate answer for safe radioactive waste disposal, nowhere on the national level, far less on the international level. Yet there are multiple international standard setting procedures leading to a great array of soft law and highlighting an enhanced responsibility for relevant decision-makers. As the environmental and health risks involved in the production and use of nuclear energy are a long-term problem, they affect the fate of future generations, thus prompting an enhanced responsibility for relevant decision-makers. Yet as in other problem areas the international community is slow in living up to the challenge. Particularly in the long term storage of nuclear waste almost all States have violated and continue to violate the principle of intergenerational equity by presently using nuclear energy without taking the precautionary measures necessary to protect future generations against the dangers resulting from that use.

Off-site emergency preparedness and response (EPR) in nuclear accident management is characterised by *Günther Handl* as a matter of intrinsic international concern, not only between neighboring States, but at global scale. The author shows that transboundary emergency arrangements are still insufficiently anchored to a firm legal basis, and he concludes that enhanced independent peer review and stronger State support for IAEA's international emergency assistance mechanism should lead to an internationalization of these activities.

Assessing liability rules for nuclear accidents, *Norbert Pelzer* reveals certain weaknesses in legal regulation. In some cases it is difficult, if not impossible, to prove the causal link between incident and damage. While unlimited liability appears to be the only form of liability that is adequate to the nuclear risk, the amount of money available to the operator of a nuclear installation may be insufficient to fully cover nuclear damage, a fact that places an additional burden to States and civil societies. Only a minority of States adhere to the international nuclear liability conventions. While more comprehensive international harmonisation is still desirable, the request for a global nuclear liability regime based on worldwide treaty relations misjudges reality. Still today, harmonisation based on regional relations appears more realistic.

Dirk Roland Haupt analyses the legal aspects of the recent Security Council Resolution 2231 (2015), endorsing the comprehensive solution to the Iranian nuclear issue—the Joint Comprehensive Plan of Action (JCPOA)—reached in negotiations between China, France, Germany, the Russian Federation, the United Kingdom and the United States with the support of the High Representative of the European Union for Foreign Affairs and Security Policy ('E 3/EU +3') on the on side and Iran on the other side. The author comments on the outcome of these negotiations which were started in Geneva, continued in Lausanne and finalized in Vienna on 14 July 2015. He shows that certain arguments of concern that had been raised in the international discourse are not unfounded. He underlines that the implementation of this comprehensive solution will be decisive for a strengthening, or weakening, the NPT regime in the long term.

Maurizio Martellini and *Massimo Zucchetti,* summarizing the historical background of the relations between Iran, the EU and the USA, highlight the role of the IAEA in preparing the JCPOA. They commend the relevance of the Iran Accord as a potential model to be taken into consideration even for other global conflicts. If properly implemented and respected, it can ensure the peaceful nature of Iran's nuclear programme, prevent Iran from developing the nuclear bomb for at least ten years, strengthen the verification role of the IAEA, and lead to the normalisation of international relations with Iran, also opening up new channels of cooperation between Iran, the EU and the USA, as well as helping to stabilize the Middle East area. Furthermore, they develop suggestions on civilian nuclear cooperation between the EU and Iran and particularly address two specific areas: nuclear medicine and nuclear safety.

Jonathan L. Black-Branch explores the concept of due diligence in relation to obligations to ensure security and safety of peaceful uses of nuclear energy as well as nuclear non-proliferation and disarmament. Examining the development of this legal concept in various areas of international law, he shows its relevance as an emerging obligation in nuclear law. He emphasizes that States must establish various domestic and transboundary procedures to prevent significant damage relating to nuclear power, including impact assessments and permit procedures; they must notify and consult with a potentially affected States including the public likely to be affected in another State; and establish various domestic procedures and processes to monitor the implementation of nuclear safety, both immediate and on a continual and on-going basis. Furthermore, States must agree to the nature and scope of measures to be taken relating to due diligence standards and requirements in order to establish and clarify expectations regarding due diligence and establish good practice in this area. They should also consider options regarding States not complying with the non-proliferation, safety and disarmament due diligence obligations.

Finally *Dieter Fleck* examines the character and contents of the right to develop research, production and use of nuclear energy for peaceful purposes in context with corresponding obligations of States Parties. Assessing the relevant rights and obligations in view of their development over time and considering changes in global security, safety and environmental protection during the last decades, he identifies certain shortcomings and loopholes in legal regulation that need to be solved in international cooperation. The tension between the interest of States in keeping civilian nuclear options open as much as possible on the one side, and the interest in preventing acquisition or manufacture of nuclear weapons on the other is not fully balanced out by the provisions of the NPT. Cooperative and sustainable implementation efforts are required to solve this gap. What is needed is a joint effort to identify common interests and evolving new potentials for cooperation. To be successful, such efforts must go beyond the divide between nuclear-weapon States and non-nuclear-weapon States and the even more challenging divide between Parties and Non-Parties to the NPT. At the same time, the role of the IAEA in peer-reviewing compliance with safety standards needs to be strengthened.

While these contributions provide a comprehensive picture of contemporary legal problems regarding the use of nuclear energy for peaceful purposes, they also show the need for further activities to ensure strict compliance with, and full implementation of, the NPT and other relevant commitments. Even if full universality of the NPT, which has been extended indefinitely in 1995, cannot be reached,[15] there is no alternative to it in the foreseeable future. International cooperation between Parties and Non-Parties has to take this into consideration.

1.3 The Role of States and the International Atomic Energy Agency

It is important to note that both the competence for law making to ensure nuclear safety and the responsibility for compliance with existing rules rest primarily with States, notwithstanding the global character of professional safety and security standards and the boarder-crossing effects of most nuclear accidents. States, not international organizations, have the final say in nuclear affairs and it is ultimately for them to accept the consequences of any nuclear accident.

The services of the IAEA may, and should, be used in this respect, but the Agency, when providing its advice on safety and security issues, is offering no more than assistance to member States. It cannot act in lieu of States. As underlined by former Director General Mohamed ElBaradei,

> [t]o be truly effective, … this assistance must be complemented by self-assessments on the part of the States themselves, so that they may ensure that, in drafting new laws covering nuclear activities or in revising or consolidating existing legislation, their national nuclear legal infrastructures are in line with the relevant international undertakings and best practices in the field of nuclear law.[16]

[15] The NPT has a total of 190 States Parties, i.e. more than any other arms limitation and disarmament agreement, http://www.un.org/disarmament/WMD/Nuclear/NPT.shtml. India, Israel, and Pakistan have not joined the Treaty. The People's Republic of Korea, which acceded to it on 12 December 1985, has announced its withdrawal on 10 January 2003 and so far ignored requests by the Security Council to retract its withdrawal and abandon all nuclear weapons and existing nuclear programmes in a complete, verifiable and irreversible manner, see SC Res 1695 (2006), 1718 (2006), 1874 (2009), 1928 (2010), 2050 (2012) 2087 (2013, 2094 (2013), 2141 (2014), 2207 (2015), 2270 (2016).

[16] Stoiber et al. 2003, Editorial Note by M. ElBaradei.

Nevertheless questions must be raised as to the consequences of failures in compliance with existing international standards in this field. Is the IAEA fully mandated and equipped to monitor such failures? What action may be taken in such case? And what remedy would be appropriate?

Distinctions are made in the IAEA Statute between assistance provided 'by' the Agency or 'at its request' or 'under its supervision or control'.[17] Hence, while in the first case assistance is provided by the IAEA at the request of States, the Agency may also request States or third party institutions to provide assistance, and under relevant agreements or arrangements it may also be in a position to monitor or control such assistance. It is not stipulated in the Statute that Member States accept this assistance. Their ultimate responsibility may be facilitated, but it is not to be shared by the IAEA. Yet the Statute authorises the Agency, *inter alia*

> [t]o establish or adopt … standards of safety for protection of health and minimization of dangers to life and property … and to provide for the application of these standards to its own operation as well as to the operations making use of materials, services, equipment, facilities, and information made available by the Agency or at its request or under its control or supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangements, or, at the request of a State, to any of that State's activities in the field of atomic energy.[18]

In these IAEA standards apply—beyond the Agency's own operations—to States, irrespective of their IAEA membership, and also to other parties, such as operators of nuclear installations. There are, however, clearly limited fields of application, as set out in the aforementioned Article III A 6:

– 'use of materials, services, equipment, facilities, and information made available by the Agency or at its request or under its control or supervision';
– 'operations under any bilateral or multilateral arrangements'; and
– 'any activities' of a State, at the request of that State.

The application of safety standards is thus subject to an arrangement with the Agency. It cannot be imposed without consent, a fact that clearly limits the role of the Agency and certainly excludes any possibility to act as a 'watchdog' of States without specific acceptance.[19] Such role might also be questionable under Article III C of the IAEA Statute, which provides that 'the Agency shall not make assistance to members subject to any political, economic, military, or other conditions incompatible with the provisions of this Statute'.

Even in an area more strictly regulated by the NPT, i.e. nuclear non-proliferation obligations, the IAEA has no authority to control States against their will, or

[17] Statute of the International Atomic Energy Agency (IAEA Statute) of 26 October 1956, 276 UNTS 3988, amended 1963, 1973, 1989, and 1999, https://www.iaea.org/about/about-statute, Article II.

[18] Article III A 6 IAEA Statute. See *The Agency's Safety Standards and Measures*, INFCIRC/18/Rev. 1 (April 1976).

[19] Tonhauser 2013, at 180–184.

opine on compliance or non-compliance with the NPT, a Treaty between States the Agency is not a party of. It is rather authorised under its Statute to fulfil its verification tasks

> [t]o establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy.[20]

Thus cooperative verification and control, under relevant IAEA safeguards agreements, is possible to ensure compliance with nuclear non-proliferation obligations and the question is valid whether like activities could not be taken to ensure safety of peaceful uses of nuclear energy.

Safety of nuclear installations is, like nuclear non-proliferation, a national responsibility. But in both fields international cooperation is vital to achieving and maintaining agreed goals. Hence cooperation to ensure a strong safety performance in line with international standards is fully part of IAEA activities and includes information exchange, safety training, assistance missions and peer reviews.[21] But different from nuclear non-proliferation, monitoring and verification is not extensively performed in the field of nuclear safety. As confirmed in Article XII A 1 and 2 of the IAEA Statute, monitoring of compliance with safety standards is part of the Agency activities with respect to 'any Agency project, or other arrangement where the Agency is requested by the parties concerned to apply safeguards'. The term 'safeguards' is used in the IAEA Statute predominantly in the context of non-proliferation. Yet it is of like importance for safety and security matters.[22] Some sort of monitoring would be appropriate and even necessary to effectively ensure compliance with professional safety standards, a task not performed by States at global level. But this issue is not addressed in the IAEA Statute. Agency activities to enhance nuclear safety and security are limited to information exchange, training and peer reviewing of activities by States and non-State actors upon request. As early as 1961, the Agency deliberately separated inspections to verify compliance with non-proliferation safeguards from those designed to verify compliance with safety standards and a decade later, the concept of health and safety inspections was dropped altogether.[23] For a long time a

[20] Article III A 5 IAEA Statute.

[21] ElBaradei 2007, 108.

[22] Article IX H IAEA Statute confirms that the Agency shall ensure that fissile materials in its possession shall be safeguarded against hazards of weather, unauthorized removal and damage.

[23] Fischer 1997, 183 ff, 219.

merely advisory role in the field of nuclear safety and security was considered to be effective enough.[24] But such conclusion has become more and more questionable, and after the Fukushima Daiichi accident it can no longer be upheld.[25]

Below the level of strict international monitoring cooperative solutions are pursued to ensure full compliance with safety standards. States agreed to exchange information and facilitate assistance in the event of a nuclear accident or radiological emergency.[26] Peer-review meetings on the safety of land-based nuclear power plants are performed on a regular basis,[27] a process that was extended to peer review of the safety of spent fuel management and radioactive waste management.[28] The IAEA in turn has developed nuclear safety standards for radioactive sources, research reactors, the management of plutonium, and for the protection of people and the environment.[29] The Agency has discharged its emergency response role after nuclear accidents,[30] it also plays an accepted role in peer reviewing. But absent comprehensive agreements with Member States it cannot provide professional monitoring beyond special requests in individual cases. The Declaration adopted by the IAEA Ministerial Conference on Nuclear Safety (Vienna, 20 June

[24] Findlay 2011, at 104, 109–110, 113, 117, 119, 130, 164, 197, 202, 214, and in particular at 128 (‘Peer review, via the IAEA and WANO, is an innovation that appears to work well, making up for the lack of monitoring and verification.’), and 198 (‘peer review … appears to work surprisingly well’).

[25] See e.g. the statement in IAEA 2015b, at p. 49: ‘The vulnerability of the Fukushima Daiichi NPP to external hazards had not been reassessed in a systematic and comprehensive manner during its lifetime. At the time of the accident, there were no regulatory requirements in Japan for such reassessments and relevant domestic and international operating experience was not adequately considered in the existing regulations and guidelines. The regulatory guidelines in Japan on methods for dealing with the effects of events associated with earthquakes, such as tsunamis, were generic and brief, and did not provide specific criteria or detailed guidance.’.

[26] Convention on Early Notification of a Nuclear Accident (26 September 1986), 1439 UNTS 275, INFCIRC/335; Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (26 September 1986), 1457 UNTS 133, INFCIRC/336.

[27] Convention on Nuclear Safety (20 September 1994), INFCIRC/449, 1963 UNTS 293.

[28] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (29 September 1997), IAEA Document GOV/INF/821-GC(41)/INF/12, INFCIRC/546.

[29] IAEA Code of Conduct on the Safety and Security of Radioactive Sources and the Supplementary Guidance on the Import and Export of Radioactive Sources, INFCIRC/663, IAEA General Conference 47/RES/7 (8 September 2003); IAEA Code of Conduct on the Safety of Research Reactors (IAEA/CODEOC/RR/2006); IAEA (2002); IAEA Guidelines for the Management of Plutonium (2004), INFCIRC/549; IAEA 2015c.

[30] See e.g. IAEA 2015b. Already in the aftermath of the Three Mile Island accident in 1981 a program of operational safety advisory review teams (OSART) was instituted. Following the Chernobyl accident, the number of requests has increased significantly, see Scheinman 1987, at 104, Fischer 1997, at 192–210. After the Fukushima Daiichi accident the process of learning and acting upon lessons was again strengthened under the auspices of the IAEA, see Gioia 2012, p. 101.

2011), in the aftermath of the Fukushima Daiichi accident, eloquently shows what could not be achieved so far. The Conference, in particular, emphasized the need,

> to improve national, regional and international emergency preparedness and response to nuclear accidents, including through the possible creation of rapid reaction capacity and the development of training in the field of crisis management at the regional and international levels, as well as to strengthen cooperation among national authorities, technical safety organizations, operators and among relevant intergovernmental and non-governmental organizations; and call for a strengthened role of the IAEA in emergency preparedness and response by promoting and possibly expanding existing IAEA response and assistance capabilities.[31]

In the light of this huge agenda, not very much has been achieved to put it into practice. The IAEA has developed an *Action Plan on Nuclear Safety*[32] through an extensive process of consultations with Member States, which was endorsed by the IAEA General Conference in September 2011. This Plan includes *inter alia* measures to strengthen Agency safety standards and the international legal framework. That framework has, however, not changed since then, neither could international monitoring of safety standards be made common practice. While the IAEA, through its new Commission on Safety Standards (CSS), based on useful activities performed in the various Committees on Nuclear Safety Standards (NUSSC), Radiation Safety Standards (RASSC), Transport Safety Standards (TRANSSC), Waste Safety Standards (WASSC), and Emergency Preparedness and Response Standards (EPReSC) provides continuous professional work on the improvement of safety standards,[33] States are still hesitating to make such standards legally binding. An international verification and control of national licensing could strengthen the current peer review regime and effectively supplement the more incentive-based measures taken by States so far. Safeguards inspections could serve as a model for performing periodic evaluations of Member States' nuclear safety measures based on their advanced consent, but despite the fact that this might assist States in meeting their responsibilities, practice is still lagging behind such considerations.

The *Action Plan on Nuclear Safety* also recommended 'to work towards establishing a global nuclear liability regime that addresses the concerns of all States that might be affected by a nuclear accident with a view to providing appropriate compensation for nuclear damage'. While welcome steps have been taken by States to join and implement existing Conventions,[34] and the International Expert

[31] Declaration by the IAEA Ministerial Conference on Nuclear Safety in Vienna on 20 June 2011, INFCIRC/821, https://www.iaea.org/sites/default/files/infcirc821.pdf, para 19.

[32] The Action Plan on Nuclear Safety, IAEA Doc. GOV/2011/59-GC(55)/14 (5 September 2011), https://www.oecd-nea.org/nsd/fukushima/documents/IAEA_9_5_2011%20Action%20Plan_gc55-14.pdf; see also Nuclear Safety Review 2015, IAEA/NSR/2015, https://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-4_en.pdf.

[33] See http://www-ns.iaea.org/committees/.

[34] See also Progress in the Implementation of the IAEA Action Plan on Nuclear Safety Supplementary Information, https://www.iaea.org/About/Policy/GC/GC57/GC57InfDocuments/English/gc57inf-5-att1_en.pdf, para 133.

Group on Nuclear Liability (INLEX) is raising the awareness of the existing international legal instruments and their role for achieving a global nuclear liability regime, it seems to be still far from realistic to assume, that this goal will ultimately be reached.[35]

The present situation is less than sufficient, as it does not ensure verification of compliance with international safety standards and also lacks transparency to the disadvantage of victims of nuclear accidents. It would be essential to conclude appropriate safeguards agreements to ensure appropriate verification and control of the safety of nuclear installations, a task to be performed on a continuous basis as precautionary measure, and not only in retrospect. While the IAEA may be expected to perform this task with adequate manpower and financial support by Member States, it is for States to put it into practice.[36]

1.4 Conclusions and Outlook

Full awareness of the interconnectedness of nuclear non-proliferation, peaceful uses and disarmament may serve as a vehicle to support compliance with underlying legal principles and strengthen international cooperation to implement the NPT. This Treaty needs to be supplemented by effective international regulation and cooperation on such important issues as safety and security of nuclear installations; radiation protection; radioactive waste disposal; nuclear transport; and nuclear liability.

One of the emerging legal problems in this field stems from the complexity of treaty law and the imperfect state of adoption of multilateral obligations. Existing treaty provisions need to be better explained, overlapping regulation critically reviewed, and international cooperation strengthened to improve effective implementation.

Compliance with safety standards is an essential element of the reporting activities of the IAEA. Appropriate safeguards agreements should be concluded to ensure monitoring of compliance with applicable health and safety standards and include compliance with such standards in the verification and reporting activities of the Agency, a task to be performed on a continuous basis, and not only in retrospect.

Recent activities will influence further developments in this field. They may confirm the interrelationship that exists between the three pillars of the NPT and the often different degree of their implementation.

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[35] See Gioia 2012, at 99–100, and below, Chap. 12 (Pelzer).

[36] For similar proposals see Findlay 2011, Gioia 2012, and below Chap. 7 (Anastassov). On a strengthened role of the IAEA in the field of nuclear security see also Vassalli di Dachenhausen 2015, Drobysz and Persbo 2015.

The international conferences on the Humanitarian Impact of Nuclear Weapons (Oslo/Norway 2013, Nayarat/Mexico 2014 and Vienna/Austria 2014) have shown a growing consensus on the detrimental effects of a nuclear weapon detonation, irrespective of the cause: destruction, death and displacement of civilian populations would not be constrained by national borders. In addition, profound and long-term damage to the environment, health, and socioeconomic development could even threaten the survival of mankind. This process has alerted public opinion at global scale and initiated a development that will continue.[37]

At the 2015 NPT Review Conference no Final Document could be adopted, although in-depth exchange was possible at working level on all relevant issues.[38]

The Nuclear Security Summits initiated by President Barack Obama (Washington, D.C. 2010; Seoul 2012; Hague 2014) have identified priority tasks for securing all nuclear material worldwide and considered regulatory, legal and institutional measures to strengthen the global nuclear security architecture.[39] The more than 50 Heads of State and Government present, together with the United Nations, the European Union, the International Atomic Energy Agency, and Interpol, reaffirmed their support for existing agreements and mechanisms designed to secure the storage, handling and transport of nuclear material, in accordance with international guidelines and best practices, highlighting the central role of the IAEA in this process. A fourth and final Nuclear Security Summit was held in Washington D.C. March 31–April 1, 2016.[40] While one nuclear-weapon State—Russia—did not participate in this summit conference, stating that 'the format, in which it was devised, manifested the countries' inequality in preparing final documents and the attempts to substitute both the UN, Interpol and the IAEA',[41] the final Communiqué as well as the Action Plan in support of the United Nations was endorsed by the UN Secretary-General.[42] The Nuclear Security Summits have increased awareness for this threat and the need to improve international cooperation towards reducing existing stocks of nuclear materials; improving the security of nuclear and radioactive sources; and ensuring non-proliferation of nuclear weapons including nuclear materials used in nuclear weapons and nuclear facilities. It also underlined the need to support the roles of the UN, the IAEA, Interpol, the Global Initiative to Combat Nuclear Terrorism, and the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction to reach these goals.

On 26 April 2016, the 30th anniversary of the nuclear disaster at Chernobyl gave new publicity to the amount of safety efforts still to be taken. Donors around

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[37] See e.g. Williams et al. 2015.

[38] See Draft Final Document NPT/CONF.2015/R.3 (21 May 2015).

[39] Nuclear Security Summit 2014, http://www.nss2014.com/en/nss-2014/results.

[40] See https://www.whitehouse.gov/the-press-office/2016/04/01/nuclear-security-summit-2016-communiqué.

[41] See http://tass.ru/en/politics/866605.

[42] See http://tass.ru/en/world/866746.

the world pledged millions of euros towards a new underground nuclear waste facility in the region. Ukraine will still need to commit further capital to complete the new confinement construction which provides safety for the next hundred years, while a distinct burden for hundreds of generations continues to exist: radiation may last for one million years.

Three of the cases brought to the ICJ in April 2014 by the Marshall Islands against all nine nuclear-weapon States regarding their obligations on cessation of the nuclear arms race and to nuclear disarmament have reached a new phase. In March 2016 the Court concluded its public hearings on preliminary objections by India, Pakistan and the United Kingdom, the three States who are accepting the compulsory jurisdiction of the Court under Article 36(2) of the ICJ Statute,[43] and began its deliberation. All States Parties to the NPT (other than the Marshall Islands and the United Kingdom) have been notified by the Court in accordance with Article 63 of the ICJ Statute and Article 43 of the Rules of Court,[44] so that the construction to be given by the Court in this case will be equally binding upon those States exercising their right to intervene in the proceedings.—The other six cases (against China, the Democratic People's Republic of Korea, France, Israel, the Russian Federation, and the United States of America), in which the Applicant seeks to establish the Court's jurisdiction on consent, pursuant to Article 38(5) of the Rules of Court, have not been entered in the General List, and no action is being taken, unless and until the respective State consents to the Court's jurisdiction for the purposes of the case.

After the new nuclear test and missile launch in the Democratic People's Republic of Korea in January 2016 new sanctions were introduced by the United States[45] and on 2 March 2016 the Security Council unanimously adopted Resolution 2270 (2016), requiring States to inspect all cargo to and from the DPRK; banning leasing or chartering of vessels or airplanes and providing crew services to the country; imposing an asset freeze on all funds and other economic resources owned or controlled by the DPRK government or by the Worker's Party of Korea, if found to be associated with its nuclear or ballistic missile programme or any other prohibited activities; and deciding that States shall ban any flights and deny entry into their ports of any vessel suspected of carrying prohibited items.

The envisaged ILA *Declaration on Legal Issues of Nuclear Weapons, Non-Proliferation and Peaceful Uses of Nuclear Energy* will not be unaffected by these events. Its Black-Letter Text and Commentary, addressing both existing law and desirable new rules, still depends on an open and transparent process of discussion with a view to achieve frank dialogue and consensus-building exchange. It is to be hoped that substantive results may be achieved at the 2020 NPT Review Conference.

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[43] Statute of the International Court of Justice (26 June 1945), UNCIO XV, 355.

[44] Rules of Court, adopted on 14 April 1978, http://www.icj-cij.org/documents/index.php?p1=4&p2=3&.

[45] The Guardian (18 February 2016), http://www.theguardian.com/world/2016/feb/18/obama-administration-north-korea-tighter-sanctions.

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Chapter 2
Between Prosperity and Destruction: A Modern Interpretation of the Right to Peaceful Use of Nuclear Energy in Light of the Protection of Human Rights and Future Generations

Daniel Rietiker

Abstract This chapter takes a new approach to the right to use nuclear energy for peaceful purposes. The pros and cons of nuclear energy will be assessed in light of human rights standards, whereby civil as well as economic, social and cultural rights will be equally taken into account. Contrary to environmental law, the relevance of international human rights law has not yet fully been recognized in the assessment of nuclear energy. This is surprising since the welfare and development of the human being was one of the driving forces behind the inclusion of the right to peaceful use of nuclear energy in the NPT. It will be demonstrated that the appropriate use of nuclear energy can, indeed, contribute to the enjoyment of human rights, in particular through electricity production and its practical applications in agriculture, industry, medicine, biology and hydrology. Special attention will be paid to the right to development, the right to health, the right to a good standard of living, including adequate food and drinking water, as well as the right to life and the right to respect for private life. In these domains, States are under a positive obligation to pursue actively the fulfillment of these rights. The right to use nuclear energy is nevertheless not unlimited and essentially the same human rights set certain limits. For instance, they constitute a significant barrier to an unfettered exploitation of uranium, causing grave pollution of ground water by which miners and local populations, in particular indigenous communities, are

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equally affected. Further, radioactive waste disposal constitutes a huge challenge for the present and future generations. Finally, accidents such as Chernobyl and Fukushima have shown the destructive nature inherent in nuclear activities. States enjoy a wide margin of appreciation in the decision whether or not to embrace the nuclear avenue—the present Chapter does not purport to offer definitive solutions, but is rather meant to give some guidance and food for further reflexion.

Keywords Environmental law · Human rights · Peaceful uses of nuclear energy · Radioactive waste disposal

Contents

2.1 Introduction

The existence of the right to use nuclear energy for peaceful uses is not contested today, but the exact extent of this right is largely disputed. This right is often referred to as one of the three equal pillars of the NPT.[1] As such, keeping in mind the dual-use nature of nuclear technology,[2] the exercise of this right is conditional upon and subject to limitations by non-proliferation duties and other rules of international law.[3]

The idea of this chapter is to analyse the ‘inalienable right’ to peaceful use of nuclear energy not primarily through the security lens, but to try to define it, and in particular its limits, in light of the protection of the human being. It will be

[1] Nystuen and Graff Hugo 2014, p. 381.

[2] Shaker 2006, p. 118.

[3] Anastassov 2014, p. 161.

demonstrated that the appropriate use of nuclear energy is beneficial for the human being in many respects. Apart from production of electricity, peaceful nuclear energy is used extensively in other areas, such as agriculture, industry, medicine, biology and hydrology.[4] It will be shown that, through its various activities, the IAEA, in close cooperation with other organizations, such as the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), contributes directly to the enjoyment of different human rights.

The right to use nuclear energy is nevertheless not unlimited and modern human rights law sets certain limits. For instance, human rights constitute a significant barrier to an unfettered exploitation of uranium, in particular through the pollution of ground water. Further, waste disposal constitutes a huge challenge to the environment and the local population. Finally, catastrophes like Chernobyl and Fukushima have shown the destructive nature inherent in nuclear activities.

This Chapter will deal with this dilemma by weighing up the different interests at stake. After the general introduction, an outline of the legal framework of the right to use nuclear energy for peaceful purposes will be made as far as is necessary for the present study (Part 2.2). It will be followed by a section on the contribution of nuclear energy to the enjoyment of human rights (Part 2.3) and another dealing with the limits of the right to peaceful use of nuclear energy imposed by human rights law (Part 2.4). The chapter will be concluded by a set of general observations.

The present chapter does not purport to give definitive solutions, but is rather meant to offer an original approach and new criteria to States in the decision whether or not to embark on the nuclear avenue.

2.2 The Legal Framework for the Right to Peaceful Use of Nuclear Energy in Light of the Aim of Economic and Social Development

2.2.1 The NPT

President Eisenhower's famous 'Atoms for Peace' proposal at the UN General Assembly on 8 December 1953 opened a new chapter of international cooperation in the field of peaceful uses of nuclear energy.[5] The most significant result of this new area was the establishment of the IAEA in 1957. Its objectives were 'to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world'.[6]

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[4] Ibid, p. 160.

[5] Shaker 2006, p. 118. For the speech, see UNGA 470th Plen. Mtg., 8 December 1953, paras 79–126.

[6] Article II, 1st sentence, of the Statute of the IAEA.

In 1968, when the NPT was adopted, more than forty NNWS possessed functioning nuclear reactors.[7] During the negotiations of the NPT, the NNWS expressed in particular the fear that the future treaty would hamper their full access to the knowledge and technology of the peaceful atom, considered instrumental for their progress and prosperity.[8] The freedom to exploit nuclear energy for peaceful uses was considered as the most important concession to their renunciation to acquire nuclear weapons.[9] The compromise finally reached was to entrust the IAEA with regular inspections of all nuclear facilities in the NNWSs.[10]

As far as the universal level is concerned, Article IV NPT reflects the inherent right of sovereign States to use nuclear energy for peaceful purposes. Following a request of the NNWS, this provision was initially introduced by the United States and the former Soviet Union, and changed several times before it satisfied the NNWSs' demands.[11] Since the technology required for the peaceful use of nuclear energy is in essence the same as that used for military purposes, Article IV remains to date one of the controversial provisions of the NPT.[12] It reads as follows:

1. Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty.
2. All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the *developing areas of the world*.[13]

The first paragraph of Article IV recalls the 'inalienable right' to develop research, production and use of nuclear energy for peaceful purposes as well as its limitations, i.e. the principle of non-discrimination and the observance of the restrictions imposed by Articles I, II and III of the NPT. Paragraph 2 of Article IV strikes a balance of duties and rights of States Parties in the two activities addressed in the two sentences. As far as the first sentence is concerned, its wording is unambiguous, imposing on the States which are in the position to do so, in

[7] Fischer 1997, p. 9.

[8] Shaker 2006, p. 118. Moreover, they also feared that international control might turn into industrial espionage and that the new treaty would place them at the mercy of the NWS (Ibid).

[9] Ibid.

[10] Nystuen and Graff Hugo 2014, p. 382.

[11] Shaker 2006, pp. 118 ff.

[12] Ibid, p. 119.

[13] Emphasis added. See also paras 5–8 of the preamble of the NPT.

particular NWS and advanced NNWS,[14] a ‘positive’ duty to facilitate the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy.[15]

As far as the second phrase is concerned, it stipulates the obligation of States capable of doing so, to cooperate in contributing to the further development of the application of nuclear energy for peaceful uses. This is also a ‘positive’ undertaking imposed, in particular, on NWS and NNWS that are advanced in nuclear technology.[16] Interestingly enough, the duty to cooperate shall be ‘especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world’.[17] This aspect is an underlying principle of the present Chapter.

2.2.2 The IAEA Statute

In order to demonstrate the positive aspects of the use of nuclear energy it is appropriate to recall briefly the activities of the IAEA in this field. Article II of the Statute of the IAEA constitutes the starting point of the discussion, defining the organization’s objectives. In line with this provision, the Agency seeks to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It ensures, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.

In addition, Article III of its Statute enumerates the functions of the Agency. Paragraph 2 of this Article states that the Agency is authorized to make provision for materials, services, equipment, and facilities to meet the needs of research on, and development and practical application of, atomic energy for peaceful purposes, including the production of electric power, ‘with due consideration for the needs of the under-developed areas of the world’. The development aspect of the IAEA clearly derives from this provision that is worded almost identically with the second part of paragraph 2 of Article IV NPT (‘with due consideration for the needs of the developing areas of the world’).

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[14] Shaker 2006, p. 121.

[15] This was already underlined by the representative of the United States during the negotiations in 1968: ‘the right to such sharing is recognized explicitly not only as a right of non-nuclear powers, but also as a commitment to action by nuclear powers and all others in a position to contribute thereto’. (A/C.1/PV. 1577 [Prov., 31 May 1968], p. 77).

[16] Shaker 2006, p. 123.

[17] Emphasis added. The word ‘especially’ in Article IV NPT suggests that co-operation is not exclusively meant to happen with States Parties. Shaker mentions the nuclear deal between the United States and India as an example of nuclear co-operation between a State Party and a non State Party to the NPT (p. 124).

2.2.3 Treaties Establishing Regional NWFZs

On a regional level, the right to use nuclear energy for peaceful purposes is guaranteed in treaties providing for regional NFWZs.[18] Article 17 of the Tlatelolco Treaty, the first instrument concluded in this field, provides that this right shall be used 'in particular for their economic development and social progress'.[19]

Contrary to the NPT, the Tlatelolco Treaty does only mention 'use' of nuclear energy for peaceful purposes, but does not embrace the right of the parties to 'develop research [and] production'. Later, the preamble of the Pelindaba Treaty establishing a NWFZ in Africa reiterated the determination of the States Parties 'to promote regional cooperation for the development and practical application of nuclear energy for peaceful purposes in the interest of sustainable social and economic development of the African continent'.[20] Its Article 8 is similar to Article IV of the NPT and reads as follows:

> 1. Nothing in this Treaty shall be interpreted as to prevent the use of nuclear sciences and technology for peaceful purposes.
> 2. As part of their efforts to strengthen their security, stability and *development*, the Parties undertake to promote individually and collectively the use of nuclear science and technology for *economic and social development*. To this end they undertake to establish and strengthen mechanisms for cooperation at the bilateral, subregional and regional levels.[21]
>
> (…).

This Article underlines the need for individual and collective use of nuclear science and technology for economic and social development.[22] Like the Tlatelolco Treaty, Article 8 para 1 mentions only the 'use' of nuclear energy for peaceful purposes.[23] Pursuant to Article 12 para 1 of the Pelindaba Treaty, the African Commission on Nuclear Energy (AFCONE) was established with a view to ensuring compliance with the undertakings of the States Parties under the treaty.

When the Pelindaba Treaty was concluded, in 1996, South Africa was among the few States that possessed the technology necessary for peaceful application of nuclear energy and many States did not even have the nuclear reactors that are needed to develop the know-how in the field.[24] Therefore, paragraph 3 of Article 8

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[18] Article 8 of the Pelindaba Treaty, Article 17 of the Tlatelolco Treaty, Article 4 of the Bangkok Treaty, Article 4 of the Treaty of Rarotonga, and Article 7 of the Semipalatinsk Treaty.

[19] For this reason, the Preparatory Commission of the Tlatelolco Treaty decided, during its last session, to change the title of the treaty from 'Treaty on the denuclearization of Latin America' to 'Treaty prohibiting nuclear weapons in Latin America'. Robles 1971, pp. 78 ff.

[20] Paragraph 11 of the preamble; see also paras 5 and 10.

[21] Emphasis added.

[22] Nwogugu 1996, p. 235.

[23] Reddy 1997, p. 281, is of the opinion that it is unlikely that the drafters of the treaty intended to deny the right to 'develop research [and] production' to the States Parties since it is granted under the NPT.

[24] Reddy 1997, p. 281.

encourages States Parties to use the IAEA's Technical Assistance Programme and the tools to strengthen co-operation in the framework of AFRA.[25] The picture has dramatically changed recently: in 2009, the Forum of Nuclear Regulatory Bodies in Africa (FNRBA) was launched in response to the increasing use of radioactive material in peaceful nuclear applications such as health, agriculture and energy.[26] 33 African States are currently part of the Forum.[27] It works closely with AFCONE and AFRA, an IAEA initiative that seeks to maximize the use of the available infrastructure and expertise on the African continent and assists countries to achieve regional self-sufficiency through the use of peaceful applications of nuclear techniques.[28] The project areas of AFRA cover six thematic areas, namely human health, food and agriculture, water resources, sustainable energy development, industrial applications, radiation and waste safety and nuclear security.[29]

2.3 The Contribution of Nuclear Energy to the Enjoyment of Human Rights

2.3.1 Applications of Nuclear Energy and Positive Human Rights Obligations

Electricity production is the most common application of nuclear energy. It is normally achieved through the process of nuclear fission at nuclear power plants, the facilities that contain nuclear reactors.[30] It serves, *inter alia*, to supply domestic and industrial heating.[31] Other applications of nuclear energy concern the following domains: Human health, food and agriculture, as well as the environment, including clean drinking water. The present section will assess the relevance of nuclear energy for the enjoyment of human rights in light of the said applications.

In this regard, it is relevant to mention that modern human rights instruments do not only provide for protection against interference with the rights guaranteed, but impose on States Parties 'positive' duties to work towards full realizations of these rights. The tripartite typology of obligations to respect, protect and fulfil human rights is now well established.[32] In this typology, obligations to respect are 'negative' obligations, prohibiting the States from interfering in the rights guaranteed by a certain instrument. Obligations to protect and to fulfil are positive

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25 Nwogugu 1996, p. 235. See also UN Disarmament YB, Vol 20, 1995, pp. 65–87, 70 ff.

26 Stott 2011, p. 22.

27 https://gnssn.iaea.org/Pages/FNRBA.aspx.

28 Edwerd 2009, p. 53.

29 Ibid.

30 Fedchenko 2009, para 8.

31 Ibid, para 2.

32 Harris et al. 2009, p. 19.

obligations, requiring respectively State protection from the acts of other persons and other positive action within the power of the State to fulfil a human right.[33] The concept of positive obligations will help to better understand the role played by nuclear energy in the fulfilment of the rights under examination in the following sections.

2.3.2 The Right to Development

2.3.2.1 The Modern Right to Development as a Human Right

The right to development is considered today as a subjective human right that can be invoked by individuals and peoples.[34] On a universal level, the right to development stems, *inter alia*, from the UN Declaration on the Right to Development, adopted in 1986. Its preamble underlines that the human being shall be placed at the centre of the development debate.[35]

The essence of the right to development is summarized in the general clause enshrined in Article 1 para 1 of the Declaration, according to which the right to development is an 'inalienable human right' by virtue of which 'every human person and all peoples' are entitled to participate in, contribute to, and enjoy economic, social, cultural and political development, in which all human rights and fundamental freedoms can be fully realized.

It follows from this paragraph that, *first*, the right to development is—like the right to use nuclear energy for peaceful use under Article IV of the NPT—an inalienable right even though the holder of the right is different; *second*, that human beings, individually or as peoples, are the beneficiaries of the right to development; *third*, that, in order to promote development, equal attention should be given to the implementation of economic, social, cultural and political aspects of development, thereby enabling the enjoyment of all human rights, given their indivisibility and interdependence.[36] In other words, it was understood that economic development was not an end in itself, but rather a tool to achieve wider objectives, in particular social justice.[37]

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33 Ibid. See, for instance as far as positive obligations in the context of the right to water are concerned, Murillo Chávarro 2015, pp. 29–42.

34 Cançado Trindade 2013, p. 358.

35 Paragraph 13 of the preamble reads as follows: Recognizing that the human person is the central subject of the development process and that development policy should therefore make the human being the main participant and beneficiary of development….

36 See, in this regard, also Article 6 para 2: 'All human rights and fundamental freedoms are indivisible and interdependent; equal attention and urgent consideration should be given to the implementation, promotion and protection of civil, political, economic, social and cultural rights.'

37 Cançado Trindade 2013, p. 359.

Two main means to implement the right to development, in the sense of the 1986 Declaration, are the duty of States to co-operate with each other, on the one hand, and positive obligations to promote development and progress, as described above, on the other hand. As far as the first is concerned, Article 3 para 3 of the 1986 Declaration imposes on States the duty to co-operate with each other in ensuring development and eliminating obstacles to development.[38]

The duty to cooperate is even more critical considering the fact that poor and least developed countries do not have an adequate technical and resource capacity for the realization of development.[39] The logic of positive obligations, in the context of the right to development, is well described by Article 8 para 1, phrased as follows:

> States should undertake, at the national level, all necessary measures for the realization of the right to development and shall ensure, *inter alia*, equality of opportunity for all in their access to basic *resources, education, health services, food, housing, employment and the fair distribution of income.*[40] Effective measures should be undertaken to ensure that women have an active role in the development process. Appropriate economic and social reforms should be carried out with a view to eradicating all social injustices.

More recently, the trend to view poverty through a human rights lens has gained much support, building upon the assumption that poverty is a grave denial of human rights.[41] For instance, a lack of access to food prevents the poor from living free from hunger, while discrimination experienced in social and political life deprives them of their dignity. Such circumstances are today regarded as violations of human rights because they affect the ability of people to live a dignified life.[42] Poverty is, moreover, closely linked to discrimination; indeed, it is frequently acknowledged that poverty disproportionately affects members of socially disadvantaged groups, including certain ethnic or religious minorities, indigenous peoples, women, children, persons with disabilities and elderly people, as these groups are subject to increased vulnerability due to various forms of discrimination.[43] In other words, discrimination causes poverty, but poverty also causes discrimination.[44]

To sum up, it can be recalled that the right to development is, as it stands today, an 'umbrella' right,[45] aiming at the realization of all civil, political, economic, social and cultural rights, including the right not to be discriminated against.

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[38] See also Article 4 para 2 and Article 6 para 1.

[39] In this sense, Sengupta 2013, p. 82. See also Puvimanasinghe 2013, pp. 179–194.

[40] Emphasis added.

[41] Osmani 2006, p. 206. See also Hadiprayitno 2013, pp. 137–147.

[42] Sen 2010, p. 3.

[43] Report of the independent expert on the question of human rights and extreme poverty, Magdalena Sepúlveda Carmon, UN Doc. A/63/274, 13 August 2008, para 20.

[44] Ibid, para 29.

[45] Sen 2010, p. 11.

On a regional level, Article 22 of the African Charter on Human and Peoples' Rights provides for the right of all peoples to their economic, social and cultural development.[46] This provision is significant since it entails one of the few 'hard law' provisions guaranteeing the right to development in contemporary international human rights law.[47] As far as the right holders are concerned, Article 22 refers to '[a]ll peoples', thus indicating a collective approach to the right to development.[48] The African Commission of Human Rights had the opportunity to clarify the scope and meaning of the right guaranteed under Article 22 in the case of *Centre for Minority Rights Development (Kenya) and Minority Rights Group International (on behalf of Endorois Welfare Council) v. Kenya*.[49] The main grievance of the Endorois community was that the Government of Kenya had failed to adequately involve them in the development process. In particular, they claimed that they were neither consulted before a major development project was embarked upon nor were they compensated for its adverse consequences on their lifestyle. The Commission came to the conclusion that Kenya had violated Article 22:

> The Respondent State [Kenya] (…) is obliged to ensure that the Endorois are not left out of the development process or [its] benefits. The African Commission agrees that the failure to provide adequate compensation and benefits, or provide suitable land for grazing indicates that the Respondent State did not adequately provide for the Endorois in the development process. *It finds against the Respondent State that the Endorois community has suffered a violation of Article 22 of the Charter.*[50]

This case will be further referred to in the section dealing with the right of access to clean water.[51]

2.3.2.2 The New Concept of 'Sustainable Human' Development

The notion of sustainable development has evolved as a response to the possible conflict between economic development and environmental protection and conservation.[52] While it is difficult to define this notion and its actual implementation remains problematic, it is argued that, from a substantive point of view, it contains the fundamental principle of equity, intra- and inter-generational rights, and the

[46] Article 22: (1) All peoples shall have the right to their economic, social and cultural development with due regard to their freedom and identity and in the equal enjoyment of the common heritage of mankind. (2) States shall have the duty, individually or collectively, to ensure the exercise of the right to development.

[47] Okafor 2013, pp. 374–384.

[48] Ibid, pp. 378–380.

[49] African Commission on Human and Peoples' Rights, 276/2003, 4 February 2010.

[50] Paragraph 298 (original emphasis). See, for a comment on the case, De Feyter 2013, pp. 164–167.

[51] Below, Sect. 2.3.3.1.

[52] Boer 2015, p. 139, and Atapattu 2005, p. 357.

principle of integration.[53] These principles seek to ensure that the present generation as well as future ones will have an equitable share of natural resources in relation to their development and in relation to environmental protection.[54]

The notion of sustainable development can be traced back to the Rio Declaration on Environment and Development, adopted only a few years after the proclamation of the 1986 Declaration of the right to development, namely in 1992.[55] Principle 1 of the Rio Declaration states that 'human beings are at the centre of concerns for sustainable development' and that they are 'entitled to a healthy and productive life in harmony with nature.'

The concept of sustainable development has evolved over time. Between 20 and 22 June 2012, Brazil hosted the United Nations Conference on Sustainable Development in Rio de Janeiro. The outcome of this conference is summarized in Resolution 66/288 adopted by the UN General Assembly on 27 July 2012, entitled *The Future We Want*. Resolution 66/288 explicitly addresses the issue of energy and its significant role in the development process, in particular for the poor:

> We recognize the critical role that energy plays in the development process, as access to sustainable modern energy services contributes to poverty eradication, saves lives, improves health and helps to provide for basic needs. We stress that these services are essential to social inclusion and gender equality, and that energy is also a key input to production. We commit to facilitate support for access to these services by 1.4 billion people worldwide who are currently without them. We recognize that access to these services is critical for achieving sustainable development.[56]
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> We emphasize the need to address the challenge of access to sustainable modern energy services for all, in particular for the poor, who are unable to afford these services even when they are available. We emphasize the need to take further action to improve this situation, including by mobilizing adequate financial resources, so as to provide these services in a reliable, affordable, economically viable and socially and environmentally acceptable manner in developing countries.[57]

Resolution 66/288 builds the bridge to the right to water and the right to food by recognizing, first, that water is one of the key factors for sustainable development.[58] The same Resolution reiterates, furthermore, the right to adequate

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[53] Atapattu 2005, p. 357. This author adds that the procedural elements include the right to information, the right to participate in the decision-making process, the environmental impact assessment process and the right to effective remedies (Ibid).

[54] Ibid.

[55] UN Doc. A/CONF.151/5/Rev.1 (1992), adopted on 13 June 1992.

[56] Resolution 66/288, para 125.

[57] Ibid, para 126.

[58] Ibid, para 119.

food and the fundamental rights of everyone to live free from hunger.[59] It underlines in particular that farmers, including small-scale farmers, pastoralists and fishermen can make important contributions to sustainable development and enhance food security and livelihood of the poor.[60] Therefore, the conference emphasized the need to strengthen agricultural and rural development sectors, notably in developing countries, in an economically, socially and environmentally sustainable manner.[61] Special attention shall be paid to traditional sustainable agricultural practices and techniques of the local communities.[62]

Finally, access to clean, reliable and affordable energy is a precondition for sustainable economic growth and improved human well-being, affecting health, education and job opportunities.[63] In this respect, it is relevant to recall the Sustainable Development Summit held in New York in September 2015. During this event, new Sustainable Development Goals (SDGs) were adopted, which succeed the Millennium Development Goals (MDGs), the development objectives established by the international community for the period 2000–2015.[64] SDG 7 explicitly states the objective of 'ensur[ing] access to affordable, reliable, sustainable and modern energy for all'. The focus of the activities lies within the developing and the least developed countries, as it derives from it's paragraph b):

> By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular the least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support.

2.3.2.3 The Contribution of Nuclear Energy to the Enjoyment of the Right to Development

Having outlined the right to development and its different shapes, it becomes clear that the different applications of nuclear energy can contribute to the development

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[59] Resolution 66/288, para 108. In this regard, the conference acknowledged the commitment to enhancing food security and access to adequate, safe and nutritious food for present and future generations in line with the 'Five Rome Principles for Sustainable Global Food Security', adopted on 16 November 2009 (Food and Agricultural Organization of the United Nations (FAO), document WSFS 2009/2).

[60] Ibid, para 52.

[61] Ibid, para 109. See also General Comment 15 (The Right to Water), mentioned above, which reads as follows in the relevant parts: 'Attention should be given to ensuring that disadvantaged and marginalized farmers, including women farmers, have equitable access to water and water management systems…States Parties should ensure that there is adequate access to water for subsistence farming…' (para 7).

[62] Resolution 66/288, para 109.

[63] Ibid.

[64] https://www.iaea.org/newscenter/news/role-nuclear-technology-post-2015-development-agenda.

of people. As far as energy production is concerned, it is undeniable that the world has made big steps in the 20th century, and in particular in the last 30 years, in extending access to modern energy services to most of humanity.[65] In spite of this progress, many still lag behind. Indeed, while residual pockets of energy poverty can be found in various parts of the world, the vast majority of the energy-poor span two main regions: South Asia, especially India, and Sub-Saharan Africa.[66]

The relationship between energy use and economic development is well recognized. Recent studies examining the relationship of access to electricity and income confirm that, under the right conditions, electricity indeed plays an important role in raising levels of economic growth and development.[67] For instance, an empirical study of farm productivity in India indicates that small-scale farmers could increase their income by approximatively 50 %. Rural electrification raises productivity and income when farmers switch from manual to grid-powered irrigation and small industries begin using electric tools and machines.[68] With the advent of electricity, it is easier for farmers to irrigate their fields, as electric pumps require low maintenance and are more efficient compared to diesel alternatives. Irrigation also allows farmers to produce multiple crops in one year and therefore to improve the productivity of existing farms. All these elements lead to higher crop yields and income.[69]

It is also widely recognized that electricity is indispensable for raising households' standard of living and broader economic development. Once households connect to the electricity grid, they derive an immediate benefit from better lighting.[70] The higher quality electric lighting enables household members to read and study during evening hours, to develop new businesses (businesses in rural areas of developing countries often include home businesses, small commercial shops, grains mills, and coffee or tea processing)[71] and raises incomes, to socialize and improve quality of life.[72]

There is also a strong positive relationship between rural electrification and education. A recent study in Brazil suggests that countries achieving full electrification saw a drop of 22 % in illiteracy, a 19 % reduction in the population with less than four years of education, and an increase of 1.2 years in schooling completion.[73] Other studies confirm that electrification indeed contributes to better education and, therefore, to higher development whereas the source of electricity does not seem to matter.[74]

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65 Halff et al. 2014, p. 1.

66 Ibid.

67 Barnes et al. 2014, p. 56.

68 Ibid.

69 Ibid, p. 58.

70 Ibid, p. 56.

71 Ibid, p. 61.

72 Ibid, p. 58.

73 Ibid, p. 64, with further reference.

74 Ibid, p. 64 ff.

To sum up, nuclear energy can contribute to secure to poorer regions of the globe, in particular as part of an energy mix, reliable access to energy. In this context, it is relevant to mention that Director General Yukiya Amano represented the IAEA at the Sustainable Development Summit held in New York in September 2015. During this event, he underlined the importance of nuclear science and technology in achieving the newly adopted Sustainable Development Goals (SDGs) that explicitly recognize the importance of science and technology for development. He expressed his affirmations in the following terms:

> [l]ooking at the 17 Goals, I am struck by the very close overlap with the work of the IAEA…The new Goals cover poverty, hunger, human health, clean water, affordable and clean energy, industry and innovation, and climate change, to name just a few. These are all areas in which nuclear science and technology have much to offer.[75]

2.3.3 The Right to Health and to an Adequate Environment

2.3.3.1 The Legal Framework for These Rights

These rights are overlapping in practice. For this reason, they can be dealt with together in the present section. The human right to health is recognized in numerous international instruments, such as the Universal Declaration of Human Rights,[76] the International Convention on the Elimination of All Forms of Racial Discrimination of 1965,[77] the Convention on the Elimination of All Forms of Discrimination against Women of 1979[78] and the Convention on the Rights of the Child of 1989.[79] In addition, several regional human rights instruments also recognize the right to health, such as the European Social Charter of 1961 as revised in 1996,[80] the African Charter on Human and Peoples' Rights of 1981,[81] and the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights of 1988.[82]

Having said this, the International Covenant on Economic, Social and Cultural Rights of 1966 clearly contains the most comprehensive provision on the right to health in international human rights law. In accordance with Article 12 para 1 of the

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75 https://www.iaea.org/newscenter/news/how-iaea-will-contribute-sustainable-development-goals

76 Article 25 para 1 reads as follows: 'Everyone has the right to a standard of living adequate for the health of himself and of his family, including food, clothing, housing and medical care and necessary social services.'

77 Article 5 e) iv).

78 Articles 11 para 1 f) and 12.

79 Article 24.

80 Article 11.

81 Article 16.

82 Article 10. Similarly, the right to health has been proclaimed by the Commission on Human Rights, as well as in the Vienna Declaration and Program of Action of 1993 and other international instruments.

Covenant, States Parties recognize 'the right of everyone to the enjoyment of the highest attainable standard of physical and mental health', while its para 2 enumerates, by way of illustration, a number of 'steps to be taken by the States parties… to achieve the full realization of this right'. With a view to implementing this provision, the Committee on Economic, Social and Cultural Rights issued, on 8 November 2000, General Comment No. 14, on the 'Right to the highest attainable standard of health'.[83] The Committee recalled that the right to health is closely related to and dependent upon the realization of other human rights, as contained in the International Bill of Rights, including the rights to food, housing, work, education, human dignity, life, non-discrimination, equality, the prohibition against torture, privacy, access to information, and the freedoms of association, assembly and movement. These and other rights and freedoms address integral components of the right to health.[84]

As far as the right to a safe and sustainable environment is concerned—a relatively recent concept—no global human rights treaty contains this right explicitly.[85] On the regional level, the African Charter on Human and Peoples' Rights was the first international instrument to include an explicit guarantee of environmental quality: "All peoples shall have the right to a general satisfactory environment favourable to their development".[86] Subsequently, the Protocol of 1988 on Economic, Social and Cultural Rights (Protocol of San Salvador) to the American Convention on Human Rights enshrined the 'right to a healthy environment'.[87] Based on the innovative approach on the African continent, it is almost natural that it was the African Commission on Human and Peoples' Rights to decide first a contentious case involving the right to a safe and sustainable environment, namely the case of *The Social and Economic Rights Action Center and the Center for Economic and Social Rights v. Nigeria*.[88]

The right to adequate food is recognized in several instruments under international law, sometimes as a part of the right to health, sometimes in combination

[83] Doc. E/C.12/2000/4, 11 August 2000.

[84] Paragraph 3 of the General Comment No. 14.

[85] The UN Convention on the Rights of the Child refers at least to clean drinking water and the dangers and risks of pollution; Article 24 para 2 c): 'States Parties shall pursue full implementation of (the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health) and, in particular, shall take appropriate measures: to combat disease and malnutrition…through, *inter alia*…the provision of adequate foods and clean drinking-water, taking into consideration the dangers and risks of environmental pollution.'

[86] Article 24.

[87] Article 11: (1) Everyone shall have the right to live in a healthy environment and to have access to basic public services. (2) The States Parties shall promote the protection, preservation, and improvement of the environment.

[88] No. 155/96, Case No. ACHPR/COMM/A044/1, 13 to 27 October 2001, This case involved, *inter alia*, disposal of toxic wastes from oil exploitation in violation of applicable international standards and causing numerous avoidable spills near villages on the land of the Ogoni People, consequently poisoning much of the region's soil and water, http://www1.umn.edu/humanrts/africa/comcases/155-96.html.

with the right to an adequate standing of living.[89] The International Covenant on Economic, Social and Cultural Rights of 1966 deals more comprehensively than any other instrument with this right.[90] In accordance with its Article 11 para 1, States Parties recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions.[91]

Pursuant to Article 11 para 2, they recognize that more immediate and urgent steps may be necessary to ensure 'the fundamental right to freedom from hunger and malnutrition'. The Committee on Economic, Social and Cultural Rights devoted its General Comment No. 12 of 1999 to the right to adequate food, in which it recognized that this right is of 'crucial importance for the enjoyment of all rights'.[92]

The right to water has been recognized in a wide range of international documents. Again the Committee on Economic, Social and Cultural Rights detailed this human right in its General Comment No. 15 of 2002 ('Right to water'), where it interpreted the word 'including' in the above mentioned Article 11 para 1 as not being intended to draw up an exhaustive catalogue of rights, considering that the right to water clearly falls within the category of guarantees essential for securing an adequate standard of living, in particular because it constitutes one of the most fundamental conditions of human survival.[93] Access to water must be safe, indiscriminate and affordable.[94] Moreover, the African Commission of Human and Peoples' Rights has dealt with the right of access to water. In the case of *Centre for Minority Rights Development (Kenya and Minority Rights Group/Kenya),* it linked the right of access to sources of water, *inter alia*, to the right to development, as mentioned above.[95]

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[89] The Universal Declaration of Human Rights covers, in its Article 25, the right to adequate food under the right to an adequate standard of living that includes also the right to health.

[90] Committee on Economic, Social and Cultural Rights, General Comment 12, Right to adequate food (Twentieth Session, 1999), UN Doc. E/C.12/1999/5 (1999), para 1.

[91] It is noteworthy that Article 28 para 1 of the Convention on the Rights of Persons with Disabilities of 2006 largely took over the wording of Article 11 para 1 and reads as follows: 'Article 28 (Adequate standard of living and social protection): (1) States Parties recognize the right of persons with disabilities to an adequate standard of living for themselves and their families, including adequate food, clothing and housing, and to the continuous improvement of living conditions, and shall take appropriate steps to safeguard and promote the realization of this right without discrimination on the basis of disability.'

[92] Ibid.

[93] General Comment 15, para 3.

[94] Human Rights Council, Report of the United Nations High Commissioner for Human Rights on the scope and content of the relevant human rights obligations related to equitable access to safe drinking water and sanitation under international human rights instruments 2007, UN Doc. A/HRC/6/3 (16 August 2007), paras 22–23.

[95] *Centre for Minority Rights Development (Kenya) and Minority Rights Group International (on behalf of Endorois Welfare Council) v. Kenya*, African Commission on Human and Peoples' Rights, 276/2003, 4 February 2010, para 286: '…The Endorois were relegated to semi-arid land, which proved unsustainable for pastoralism, especially in view of the strict prohibition on access to the Lake area's medicinal salt licks or traditional water sources…'

As has already been observed above, the 2012 UN Conference on Sustainable Development recalled the importance of the 'human right to safe drinking water and sanitation' and reaffirmed the commitment to the International Decade for Action, 'Water for Life', 2005–2015,[96] stressing explicitly the need to adopt measures to significantly reduce water pollution.[97] These aspects and commitments are significant for the present study, in particular insofar as it is recognized today that the pollution of the ground water caused by uranium mining poses a real threat to access to drinking water, in particular in developing countries where water is already a scarce resource. This aspect will be further developed below.[98]

2.3.3.2 The Contribution of Nuclear Energy and Technologies to the Enjoyment of These Rights

The assessment of these rights will be made in light of certain of the Sustainable Development Goals proclaimed in September 2015 and as underlined by the Director General of IAEA.[99]

Health and Well-Being for All

Energy is critical for the delivery of health care, including for vaccine storage, powering diagnostic and surgical equipment, incubators, the provision of adequate light, and much more.[100] As far as latter is concerned, the World Health Organization estimates that, in some developing regions, more than half of health-care facilities either lack reliable electricity or do not have access to electricity at all. Even urban hospitals in these areas may not have electricity for hours each day. Without electricity, doctors and nurses struggle to provide patients with adequate care, often working by the light of candles or kerosene lanterns.[101] In these circumstances, patients may not receive timely care and procedures can be delayed until daylight hours or conducted in rudimentary conditions, often with tragic outcomes.

As far as the contribution of nuclear energy is concerned, the IAEA states that a general improvement in public health care in its Member States has been followed, as a result of improved economic conditions, by the development of medical services for the prevention of malnutrition, detection of health effects of pollution, and diagnosis and management of cancer, nutritional, infective and genetic

96 Ibid, para 121.

97 Ibid, para 124.

98 See below, Sect. 2.4.2.1.

99 See above, Sect. 2.3.2.3.

100 Bruce and Chen Ding 2014, p. 115.

101 Farhar et al. 2014, p. 156, with another reference.

disorders. Many of these significant health needs are effectively addressed using nuclear techniques.[102] The prevention and early diagnosis efforts of WHO and UNICEF are complemented by the Agency's collaboration wherever nuclear technologies are applicable, including the treatment of cancer and some benign tumors. In addition, the IAEA plays an important role in all human health issues involving the diagnostic and therapeutic administration of radiation for medical purposes, as well as in the assessment of health effects resulting from accidental irradiation.[103]

As a recent example, the IAEA assists Latin American and Caribbean countries in early detection of the Zika virus. Zika virus infection has been reported in 26 countries and there are indications of a link between infection during pregnancy and a neurological disorder, microcephaly, in new-borns.[104] The IAEA's support involves the transfer of technology for virus detection based on Reverse Transcription Polymerase Chain Reaction (RT-PCR), a proven nuclear-derived technique that has already been provided by the IAEA during the Ebola outbreak in West Africa in 2014.[105]

Food Security and Sustainable Agriculture

The benefits of energy to agriculture and development have already been highlighted above.[106] As far as nuclear energy is concerned, it is noteworthy that, over fifty years ago, the FAO and the IAEA created the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. The goal was to bring the resources and know-how of both organizations into assisting Member States in applying nuclear techniques for providing people with more, better and safer food and other agricultural products, while sustaining the natural resources base.[107]

According to their own website, the Joint Division's activities have evolved to respond to the changing landscape of agriculture and nuclear technology as well as the expectations of national and international organizations for cooperation in nuclear research and technology transfer. Today, the Joint Division strives to mobilize commitment and action to meet the World Food Summit and Millennium

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102 http://www-naweb.iaea.org/na/about-na/na-our-work.html.

Healthcare applications include sterilization by irradiation of food and medical equipment, as well as irradiation of insects in order to sterilize them and, as a result, eradicate infestation (Fedchenko 2009, p. 11).

103 Applications include diagnostic procedures, such as injection of radioactive tracer in order to scrutinize specific physiological processes, as well as radiotherapy, involving irradiation of areas containing growing cancer cells in order to eliminate or control their growth (Fedchenko 2009, p. 11).

104 https://www.iaea.org/newscenter/pressreleases/iaea-to-assist-latin-american-and-caribbean-countries-in-early-detection-of-zika-virus

105 Ibid.

106 Above, Sect. 2.3.2.3.

107 http://www-naweb.iaea.org/na/about-na/na-our-work.html.

Development Goals of reducing hunger, poverty and environmental degradation through sustainable agriculture and rural development.[108] More specifically, the joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture is focused on promoting applications of isotopes and radiation in food and agriculture, including plant breeding and genetics, insect pest control, soil fertility research, irrigation and crop production, animal husbandry and food preservation.[109]

As an example, the IAEA, through its Joint Division with FAO and its Technical Cooperation Programme helps to eradicate the tsetse fly, a large biting fly which populates most of mid-continental Africa.[110] This fly is the carrier of the parasites that cause nagana, a serious disease which is transmitted when these flies bite animals to feed on their blood. Many cattle die of the disease, while many others have spontaneous abortions or reductions in milk production. Since 2009, when the Government of Ethiopia started to implement an eradication programme with the help of the IAEA, the tsetse fly population has diminished by 90 % in that country.[111]

Combating Climate Change

The IAEA has, over the years, under its mandate of encouraging and assisting research and practical applications of nuclear techniques for development and environmental health, demonstrated that these play an important role in the protection of the environment from radioactive and non-radioactive pollutants. It contributes to the ecological and economic sustainability and conservation of clean and healthy environments and it provides scientific information and assistance to international organizations such as WHO, the United Nations Development Programme (UNDP), the United Nations Environmental Programme (UNEP) and the FAO. It enhances capacity building of Member States which experience elevated levels of radiation or pollution of either natural or anthropogenic origin.[112]

Nuclear science, including nuclear power, can play a significant role in both climate change mitigation and adaptation. According to the IAEA, nuclear power, along with wind and hydro, is one of the lowest-carbon technologies available to generate electricity.[113] Desertification, degrading land and eroding soils, can jeopardize peoples' lives and livelihoods. Isotopic techniques provide accurate assessments of soil erosion and help to identify erosion hot spots, providing an important tool to reverse land degradation and restore soils.[114] The IAEA's support in this

[108] Ibid.

[109] Rautenbach 2006, para 35.

[110] https://www.iaea.org/newscenter/news/suppressing-tsetse-flies-improve-lives.

[111] Ibid.

[112] http://www-naweb.iaea.org/na/about-na/na-our-work.html.

[113] https://www.iaea.org/newscenter/news/how-iaea-will-contribute-sustainable-development-goals.

[114] Ibid.

area helps many countries to gather information using these techniques to shape agricultural practices for more sustainable use of land and, ultimately, to increase incomes, while also improving conservation methods and protection of resources, ecosystems and biodiversity.[115]

Sustainable Management of Water and Sanitation

Energy plays a crucial role in the provision of adequate supplies of water for a range of purposes including clean water for human consumption.[116] From water pumping, transportation, and distribution to water treatment including boiling and wastewater treatment, energy access is an important part of the water usage chain.[117] In other words, energy access is one of the key determinants for access to clean water, which is in turn critical for the prevention of diarrhoeal disease, skin and eye infections, as well as typhoid.[118] Moreover, even when water is available, there is a risk of disease due to improper storage before consumption as well as the possibility of contamination if the water is not properly separated from human waste.[119]

Isotope and related nuclear techniques are effective and unique tools for obtaining hydrologic information for a broad range of water resource management issues. As isotope techniques are more effective when used as an integral part of hydrologic practices, the Agency's program also aims to co-ordinate its activities with other national and international organizations active in the water sector. In particular, collaborative programs with the World Meteorological Organization (WMO), UNESCO, the World Bank, FAO and UNEP are presently run.[120]

Nuclear energy is moreover used for providing potable water to regions where it cannot be obtained from streams or aquifers. Desalination of sea water or mineralized groundwater is a highly energy-intensive process and, therefore, various countries, including Kazakhstan, India or Japan, run projects aimed at supplying desalination plants with nuclear energy.[121]

2.3.4 The Right to Life

The right to life is the most fundamental human right and the condition for the enjoyment of many other rights and freedoms. It is guaranteed, *inter alia*, in

115 Ibid.

116 Bruce, Chen Ding 2014, p. 113.

117 Ibid, p. 121.

118 Ibid, p. 122, with other references.

119 Bruce and Ding 2014, p. 122.

120 http://www-naweb.iaea.org/na/about-na/na-our-work.html.

121 Fedchenko 2009, para 9.

Article 6 of the 1966 International Covenant on Civil and Political Rights (ICCPR),[122] whose first paragraph is phrased as follows:

> Every human being has the inherent right to life. This right shall be protected by law. No one shall be arbitrarily deprived of his life.[123]

The UN Human Rights Committee has asserted that States should adopt positive measures to protect the right to life, including those necessary to reduce infant mortality and increase life expectancy by eliminating malnutrition and epidemics.[124] Moreover, the Inter-American Court of Human Rights has found a violation of the right to life in a case where Paraguay had failed to adopt adequate positive measures to ensure that an indigenous group deprived of access to its traditional land had appropriate access to resources indispensable for survival, including food and drinking water. The conditions had led to the deaths of several members of the group, including children.[125]

In Europe, the ECtHR has developed a very far-reaching, particularly dynamic jurisprudence in the field of environmental protection, making the right to live in a certain environment an individual human right. Especially under Article 2 (right to life) and 8 of the ECHR (right to respect for private life and home), States are nowadays obliged to prevent environmental disasters, to inform the affected populations about possible risks and, in the event of a realization of such a risk, to investigate the accident, to pay compensation to the victims and, under certain circumstances, to punish the officials responsible for the human rights violation in an adequate manner.[126]

It is obvious that when malnutrition, under-development, ill-health, environmental pollution, poverty and lack of medical services reach a critical level, endangering human existence, the right to life is affected. Through its positive impact on environment, health, development and standard of living, including food and water, access to electricity can save millions of lives. In return, lack of energy is detrimental for the right to life in many respects. States might rely, among other sources, on nuclear energy in order to fulfil their duties under the relevant human rights instruments protecting the fundamental human right.

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[122] See, in particular, the submissions by Indonesia, Malaysia, Solomon Islands, as well as the statement given by Costa Rica: '[A]ny use or threat of nuclear weapons by a State would violate the international law obligations reflected under the rules for the protection of the human right to life, health, a clean and healthy environment, and peace; especially the universality, indivisibility and interdependence of those rights…[N]uclear threat or use cannot coexist with the achievement of a global order embodying common security that realizes the purposes of the United Nations and provides fundamental human rights for all persons…' (Verbatim Record, 14 November 1995, p. 31).

[123] See also Article 3 of the Universal Declaration of Human Rights.

[124] UNHRC, General Comment no 6, Right to life, 30 April 1982, para 5.

[125] *Sawhoyamaxa, Indigenous Community v. Paraguay*, IACHR, 29 March 2006, Series C, No. 146, paras 164, 168–173 and 178.

[126] For an overview, see Shelton 2006, pp. 129–171.

2.4 Limits of the Right to Peaceful Use of Nuclear Energy Imposed by Human Rights Law

In the last section, it has been demonstrated how the use of nuclear energy can contribute to the realization of various rights. The present Part will examine the negative impact that the production or use of nuclear energy—in particular uranium mining, nuclear accidents and storage of nuclear waste—can have on basically the same rights. It will be preceded by some preliminary remarks on the danger of radiation to human health.

2.4.1 Preliminary Observations: Radiation and Cancer

It is scientifically proven that radiation exposure can damage living cells, killing some and modifying others. The destruction of a sufficient number of cells will inflict noticeable harm on organs, which may result in death.[127] If altered cells are not repaired, the resulting modification will be passed on to further cells and may eventually lead to cancer. Modified cells that transmit hereditary information to the offspring of the exposed individual might cause hereditary disorder.[128] Radiation exposure has been associated with most forms of leukaemia, as well as cancer of the thyroid, lung and breast, although it is always difficult to assess the exact number of deaths that might be attributed to radiation exposure.[129]

2.4.2 Activities Endangering Human Rights

2.4.2.1 Uranium Mining and Milling

Means of Contamination

Uranium is a highly toxic substance and its exploitation has always been controversial.[130] It is not like other minerals and has unique features and risks that call for special regulatory measures. There are basically three main means through which uranium ore can be extracted—'open pit mining', 'underground mining'

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[127] Report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the UN General Assembly, 2000, para 8, http://www.unscear.org/docs/reports/gareport.pdf.

[128] Ibid.

[129] See, as far as nuclear weapons tests are concerned, the website of CTBT Preparatory Commission: http://www.ctbto.org/nuclear-testing/the-effects-of-nuclear-testing/general-overview-of-theeffects-of-nuclear-testing/.

[130] Sweeney 2014, p. 56.

and ‘in situ leaching’—[131] all of them creating similar health risks for mine workers and the local population. The two principal pathways by which contamination may reach the environment from uranium mining and milling are air and water.[132] The main radiological health problem in a mill is the dust produced in crushing and grinding the ore and raised during the drying, calcining and packaging of the ‘yellow cake’.[133] One of the hazards that exists during mining and milling of uranium is the release of by-product radio nuclides such as radon gas thorium 230 into the drinking water supply or the air and dispersed further by wind.[134] Furthermore, during mining and milling, waste is generated which includes barren rocks, tailings, runoff water from the mine and process water discharged from the mill. All these contain radium and other radioactive substances in the ore which cause environmental damage.[135]

Impact on the Health of Miners

As far as the health of miners are concerned, tuberculosis (TB) is reported to be the most serious health issue among workers, in particular because they work in damp and dusty environments where mineral particles lodge in their lungs and, as a result, make them more vulnerable to TB.[136] In fact, due to the mechanical extraction process of uranium ore from the rock around it, the miners are not only exposed to the fine particles of uranium, but to radon also, which is inhaled as well. The inhalation of such radioactive gas can lead to cancer, in particular in the lung.[137] Other common health problems are pneumonia, pulmonary hypertension, leukaemia, birth defects, and other cancers such as liver, bone and skin cancer.[138]

The miserable situation of mine workers, in particular in developing countries such as Namibia, is moreover aggravated by the lack of information by

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131 ‘Open pit mining’ is used to remove near-surface deposits and requires the removal of rock and soil to access the uranium ore. ‘Underground mining’ uses shafts and tunnels. ‘In situ-leaching’ is a combined mining and processing technology: A mix of chemicals is injected into the earth through a series of patterned holes, separating the uranium ore from surrounding rock (Fact Sheet Uranium Mining 4, http://www.ippnw.org/pdf/uranium-factsheet4.pdf).

132 OECD Nuclear Energy Agency/International Atomic Energy Agency, Environmental Activities in Uranium Mining and Milling, Paris 1999, p. 17, http://www.oecd-nea.org/ndd/pubs/1999/766-environmental-activities.pdf.

133 Nyanda 2014, p. 14, OECD Nuclear Energy Agency/International Atomic Energy Agency, p. 17.

134 Nyanda 2014, p. 14.

135 Ibid. See also IPPNW, Fact Sheet Uranium Mining 4, cited above.

136 Mtonga 2014, p. 20; see also Labour Resource and Research Institute (2009), Uranium Mining in Namibia, The Mystery behind ‘Low Level Radiation’, Windhoek, p. 42.

137 Shindondola-Mote 2014, p. 23.

138 Ibid, p. 27 and Pflugbeil 2014, p. 50.

the—generally private—employers about the health risks, absence of health insurance, insufficient salary and, thus, lack of resources. As a result of high unemployment rates, there is also a lack of real job alternatives.[139]

Effects on the Wider Population, in Particular Through the Pollution of Water

Probably the main problem of uranium mining and milling is that it may impact, due to the disruption of the land surface, both surface and underground water bodies.

First of all, the process of uranium mining requires an immense amount of water; considering that the mining is often undertaken in already dry environments, this represents a serious problem to the local population and environment.[140] After its use in uranium mining, the water—now heavily contaminated—is often dumped back into rivers and lakes.[141] The uranium so ingested through respiration, drinking water or food—in particular agricultural products such as milk and meat[142]—finds its way to the excretory organs, the kidneys, where it can cause a glomerular and tubular wall degeneration. Research has demonstrated that regions with elevated groundwater uranium levels have an increased incidence of renal and other forms of cancer.[143] Moreover, another study has shown a significantly increased risk of leukaemia in men in a certain exposure group as well as a seriously elevated risk with respect to kidney cancer in women.[144]

Apart from the direct health effects of contaminated water, its broad consumption harms the mining region both ecologically and economically. The extraction of water can lead to a reduction of the groundwater table and to desertification, as well as to the death of plants and animals. As a result, the traditional means of subsistence for the local population, such as fishing or cattle grazing, is threatened as a consequence of the destruction of the entire—often fragile—ecosystem.[145] And

[139] Shindondola-Mote 2014, p. 27; see also Labour Resource and Research Institute, pp. 36 and seq.

[140] According to Greenpeace and other NGOs, the mines in in Niger had used 270 billions liters of water over 40 years of operation (See also IPPNW, Fact Sheet Uranium Mining 4, cited above).

[141] In South Africa, it was reported that the West Rand Basin (the smallest of the mining basins) had fully flooded with acid mine water for ten years (2002–2012) and acid mine water had flowed uncontrolled and untreated during this period in the receiving environment. The acid water in the basin contained uranium, manganese, aluminium, copper and other toxic and potentially radioactive metals (Liefferink 2014, pp. 31 ff).

[142] Pflugbeil 2014, p. 51.

[143] Uhl 2014, pp. 21–23, referring to Wagner et al. 2011, pp. 41–50.

[144] Uhl 2014, p. 22, referring to Radespiel-Troeger and Meyer 2013, pp. 767–776. See also Shindondola-Mote 2014, p. 24.

[145] IPPNW, Fact Sheet Uranium Mining 4, cited above. See also Sweeney 2014, p. 58, and for the example of Tanzania, Lyamunda 2014, pp. 61–63.

even though the mines are closed and uranium is no longer extracted, the health risks remain. Usually, mines are flooded with water that is contaminated with radioactivity and heavy metals and slowly seeps into the groundwater.[146]

In the light of the problems caused by uranium mining and milling, it is noteworthy to mention that the 2012 UN Conference on Sustainable Development addressed the problems linked to mining activities in a separate sub-chapter that reads as follows in the relevant paragraphs:

> …We further acknowledge that mining activities should maximize social and economic benefits, as well as effectively address negative environmental and social impacts. In this regard, we recognize that governments need strong capacities to develop, manage and regulate their mining industries, in the interest of sustainable development.[147]
> We recognize the importance of strong and effective legal and regulatory frameworks, policies and practices for the mining sector that deliver economic and social benefits and include effective safeguards that reduce social and environmental impacts, as well as conserve biodiversity and ecosystems, including during post-mining closure. We call upon governments and businesses to promote the continuous improvement of accountability and transparency, as well as the effectiveness of the relevant existing mechanisms to prevent illicit financial flows from mining activities.[148]

Indigenous Peoples

It is well established that indigenous peoples are particularly vulnerable and suffer most from the negative effects of uranium mining.[149] The problems raised by uranium mining amid indigenous communities have already been analyzed by Katja Göcke in Volume 1 of this book series.[150] Therefore, the present contribution shall be very brief on this issue.

Apart from the direct consequences, in particular on their health as workers, the means of subsistence of indigenous communities are destroyed by the contamination of land and water. Therefore, displacement is frequent.[151] Moreover, cultural customs and traditions are heavily disturbed by the mining activities on their land.[152] This kind of difficulty affects many communities worldwide including the

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146 IPPNW, Fact Sheet Uranium Mining 4, cited above.

147 Paragraph 227 of the Resolution 66/288.

148 Ibid, para 228.

149 See IPPNW, Fact Sheet Uranium Mining 1, http://www.nuclear-risks.org/fileadmin/user_upload/pdfs/factsheet_E_1.pdf.

150 Göcke 2014, pp. 199–223.

151 Sweeney 2014, p. 57.

152 Ibid.

Tuareg in Niger, the Uraon in India, Lakotas or Navajo in the United States and Aborigines in Australia.[153]

The Inter-American Commission and Court on Human Rights have rendered important decisions in this field. In the judgment of *Xákmok Kásek Indigenous Community v. Paraguay*, the Court referred to the special, spiritual relationship that the indigenous populations maintain with their ancestral lands, emphasizing that:

> [t]he culture of the members of the indigenous communities corresponds to a specific way of life, of being, seeing, and acting in the world, constituted on the basis of their close relationship with their traditional lands and natural resources, not only because these are their main means of subsistence, but also because they are an integral element of their cosmology, their spirituality and, consequently, their cultural identity.[154]

More specifically with respect to access and quality of water, the Court stated as follows:

> 196. (…) the Court considers that the measures taken by the State (…) have not been sufficient to provide the members of the Community with water in sufficient quantity and of adequate quality, and this has exposed them to risks and disease.

One of the distinctive features of indigenous peoples lies in their high spirituality. Their lifestyles, traditions and cultural practices necessitate a positive interaction with the forces of Nature. One has to be in harmony and equilibrium with oneself and with Nature.[155] Moreover, their reaction to the confrontation with industrial uranium mining is obviously shaped by what they know and have experienced in their traditional, rural universe. When facing today's problems, indigenous communities try to understand them through their sacred traditions that go back to ancient times and are rooted in the close relationship to their natural environment.[156] It is obvious that the confrontation with modern uranium mining and milling projects and techniques poses tremendous difficulties for them.

The difficulties of indigenous peoples facing uranium mining and milling are aggravated by linguistic differences. Past experiences have shown that the people who were confronted with and engaged in uranium mining did often not speak English, were illiterate and hardly had formal education in the modern, Western sense.[157] Naturally, the indigenous peoples' language had no expression, *inter alia*, for 'uranium' or 'radiation'.[158] Vice versa, the authorities and private companies were largely ignorant of the indigenous languages. These language barriers

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[153] Ibid. See, concerning the Aborigines in Australia, Tatz et al. 2006, and as far as, in particular, the Sami in Lapland are concerned, see Watters 2001–2002, pp. 237–304.

[154] *Xákmok Kásek Indigenous Community v. Paraguay,* IACHR, para 174, Judgment of 24 August 2010.

[155] For instance, a primary goal of the Navajo in the United States of America is 'to walk in harmony' (*hozho nashaaddo*) (Markstrom and Charley 2006, p. 95).

[156] Yazzie-Lewis and Zion 2006, p. 5 ff.

[157] Brugge and Goble 2006, p. 30, and Johnston et al. 2010, p. 125.

[158] Brugge and Goble 2006, p. 30, and Johnston et al. 2010, p. 127.

aggravated, of course, the lack of accurate information and, as a result, it was almost impossible for the uranium-affected workers to introduce grievance procedures.[159]

Even though certain improvements in the protection of the workers and the local populations, as well as the liability of the owners of the mines have been observed recently, it can finally be claimed that uranium mining still causes high social and ecological costs, in particular in terms of degraded environment, contaminated drinking water, loss of agricultural land and illnesses and deaths of human beings.[160] Moreover, only a small fraction of the benefits of the business flows back to the local population through salaries or social security. The big slice of the cake goes to the private companies owning and running the mines. As an example, Niger is considered to be one of the poorest countries on earth, despite its rich natural resources, including uranium.[161]

2.4.2.2 Risks of Nuclear Accidents: The Examples of Chernobyl and Fukushima

Chernobyl (1986)

The accident at the Chernobyl nuclear power plant in 1986 was the most serious accident involving radiation exposure. It caused the deaths, within a few days or weeks, of 30 workers and radiation injuries to over a hundred others. It also brought about the immediate evacuation of around 116,000 people from areas surrounding the reactor and the permanent relocation, after 1986, of about 220,000 people from Belarus, the Russian Federation and Ukraine.[162] Moreover, it caused serious social and psychological disruption to the lives of those affected and vast economic losses over the entire region. Large areas of the three countries were contaminated and deposition of released radionuclides was measurable in all countries of the northern hemisphere.[163] The number of thyroid cancers in individuals exposed in childhood, in particular in the severely contaminated areas, turned out to be considerably greater than expected based on previous knowledge, and the high incidence and short induction period are considered unusual.[164]

In a report of 2011,[165] the German Affiliate of International Physicians for the Prevention of Nuclear War (IPPNW) and *Gesellschaft für Strahlenschutz*[166] summarized the tragic consequences of the Chernobyl accident on the Ukrainian

159 Johnston et al. 2010, p. 125.

160 Wippel 2014, pp. 41 ff.

161 Thiam 2014, pp. 35–37.

162 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the UN General Assembly, 2000, cited above, para 18.

163 Ibid, and para 99 ff.

164 Ibid, para 102.

165 Pflugbeil et al. 2011.

166 Society for Radiation Protection (Engl.).

population. The report comes to the conclusion that, even though the lack of large-scale independent long-term studies does not permit a complete picture to be made of the current situation, a number of trends can be shown, namely a high mortality rate and an almost 100 % morbidity rate among people, such as liquidators, who were exposed to high radiation levels.[167] Moreover, 25 years after the reactor catastrophe cancer and other diseases have emerged on a scale that, owing to the long latency period, might have appeared inconceivable immediately following the catastrophe. Further, the number of non-cancerous diseases is far more dramatic than had ever before been imagined. New symptoms, such as the premature aging of liquidators, raise questions that research is still unable to answer. The report estimates that, by 2050, thousands more cases of illnesses will be diagnosed that will have been caused by the Chernobyl nuclear catastrophe.[168]

From the authors' point of view, particularly tragic is the fate of the thousands of children who were born dead or died in infancy, who were born with malformations and hereditary diseases, or who are forced to live with diseases they would not have developed under normal circumstances. They argue that the genetic defects caused by Chernobyl will continue to trouble the world for a long time to come—most of the effects will not become apparent until the second or third generation. The report concludes that, even if the extent of the health effects is not yet clear, it can still be predicted that the suffering brought about by the nuclear disaster in Fukushima is, and will be, of a similar magnitude.[169]

Fukushima Daiichi (2011)

On 11 March 2011, Japan was hit by an earthquake and tsunami that caused the accident in the Fukushima Daiichi nuclear power plant. The earthquake, with a magnitude of 9.0, occurred off the east coast of Japan in the Pacific Ocean. It gave rise to a tsunami with waves of up to 40 m high.[170] As a result of the earthquake and the tsunami, almost 16,000 people died and more than 6000 were injured.[171] Designed to resist waves of a maximum height of 5.7 m, the walls of the power plant failed to contain the impact of the tsunami causing a total power blackout in units 1–5 as well as the breakdown of the communication system within and outside the plant. The complete power outage in units 1–3 led to the failure of the reactor cooling system causing damage to the fuel contained in the reactors. As a result of the meltdown, a series of explosions occurred ultimately.[172]

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[167] Pflugbeil et al. 2011.

[168] Ibid.

[169] Ibid.

[170] Report of the Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, Anand Grover, UN Doc. A/HRC/23/41/Add. 3, July 2013, para 6.

[171] Ibid.

[172] Ibid, para 7.

It is too early to predict the global impact of the disaster on the local population and its natural environment, let alone on humanity and future generations more generally. A decline in the birth rate was nevertheless observed already nine months after the nuclear catastrophe. Japan also experienced a rise in infant mortality, with 64 more children dying in their first year of life than expected statistically.[173] According to recent independent research opinion (IPPNW, German Section), we have to expect almost 20,000 cases of cancer as a result of the Fukushima accident and almost 10,000 cases leading to death.[174] Moreover, IPPNW, based on the experience in Chernobyl, expects many thousands of cases of illness among the persons having worked in the damaged Fukushima power plant between 2011 and 2012.[175]

To reduce the impact of the Fukushima tragedy on people to mere cancer statistics would nevertheless be too narrow and not responsive to the immense human suffering endured by the affected population.[176] It is very relevant for the present study to highlight that the Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, Anand Grover, visited Japan in November 2012, in order to ascertain the country's efforts to implement the right to health in the aftermath of the nuclear accident of 11 March 2011. In his report, he stated that the nuclear accident in Fukushima has affected the right to health of evacuees and residents alike, and has had an impact on physical as well as on mental health, particularly of pregnant women, older persons and children.[177] He adds that the evacuation has caused the breakdown of families and communities, giving rise to mental health concerns.[178] Certain of his findings deserve to be briefly exposed here.

In the aftermath of a nuclear accident, the right to health commands rigorous and continued monitoring of individual health because the health effects of radiation exposure are not always immediately known or treatable.[179] Early capture and

[173] IPPNW, German Section, 'Gesundheitliche Folgen von Fukushima', 2nd ed, Berlin 3 March 2015, p. 5.

[174] Ibid, p. 3.

[175] Ibid, p. 5.

[176] IPPNW, Critical Analysis of the UNSCEAR Report 'Levels and effects of radiation exposure due to the nuclear accident after the 2011 Great East-Japan Earthquake and tsunami', 5 June 2014, p. 18.

See also John F. Kennedy, 26th July 1963: 'The number of children and grandchildren with cancer in their bones, with leukemia in their blood, or with poison in their lungs might seem statistically small to some, in comparison with natural health hazards. But this is not a natural health hazard—and it is not a statistical issue. The loss of even one human life, or the malformation of even one baby—who may be born long after we are gone—should be of concern to us all. Our children and grand-children are not merely statistics towards which we can indifferent.' (cited by IPPNW, Critical Analysis of the UNSCEAR Report, *op.cit*., p. 19).

[177] Report Grover, para 11.

[178] Ibid.

[179] Ibid, para 22.

registration of information is crucial to the effective monitoring of the human health impact of radiation exposure.[180] The Special Rapporteur criticized the fact that a basic survey was sent out only three months after the nuclear accident occurred and relied solely on the memory of respondents about their activities around the time of the accident.[181] In health monitoring, special attention has to be paid to particularly vulnerable groups, such as children, as they are most at risk of thyroid cancer caused by radioactive iodine intake.[182] Anand Grover observed that the follow-up of thyroid screening of children was insufficient and delayed, which prevented parents from taking efficient mitigating action against potential thyroid cancer in breach of their right to health.[183] This problem was coupled with the difficulty of parents to obtain access to the results of their children's thyroid check-ups as a result of the bureaucracy and the cumbersome applicable legislation in the field of freedom of information.[184]

The Special Rapporteur also reiterated that the right to health imposes on States the duty to mitigate the effect of nuclear accidents on the mental health of the victims by alleviating stress and anxiety caused by radiation exposure and separation from families.[185] The effect of nuclear disasters on mental health was documented for the incidents in Three Mile Island as well as Chernobyl.[186] In fact, following the Chernobyl accident, women with young children were found to be most vulnerable to the effects on mental health of this nuclear tragedy and the negative consequences were still visible more than six years after the accident.[187] Anand Grover also noted that the anxiety and stress of evacuees, residents and their families were attributable to the effects of radiation leakage on their health, in particular of children, the cost of evacuation and the loss of livelihoods, as well as the uncertainty of the future.[188]

Furthermore, the Special Rapporteur recalled that the duty to respect, protect and fulfil the right to health extends to progeny. In this regard, he observed that Japan's pregnancy and birth survey is based on the—doubtful—assumption that the Chernobyl accident did not result in significant child anomaly increases or foetal deaths,[189] and does not include a provision for monitoring the health of either the foetus or the child after birth.[190] He encouraged the Government to take into

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[180] IAEA, Generic Procedures for Medical Response During a Nuclear or Radiological Emergency, Emergency Preparedness and Response, Vienna 2005, p. 138.

[181] Report Grover, para 27.

[182] Ibid, para 28.

[183] Ibid, para 31.

[184] Ibid, para 32.

[185] Ibid, para 36. See also, in this regard, Morris-Suzuki 2012, pp. 11–13, http://www.greenpeace.org/slovenia/Global/slovenia/Dokumenti/Lessons-from-Fukushima.pdf.

[186] See, for instance, Bromet et al. 1982, pp. 225–276.

[187] Havenaar 1997, p. 1606. See also Ginzburg 1993, p. 188, and Neria et al. 2008, pp. 467–480.

[188] Report Grover, para 38.

[189] Yasumura et al. 2012, p. 379.

[190] Report Grover, para 41.

account, in the survey, studies that establish a link between utero radiation exposure and mental health and to explore the still unclear relation between in utero exposure and leukaemia.[191]

Another aspect of the Anand Grover's report concerns the health of the Fukushima nuclear power plant workers, as it is established that in the aftermath of the Chernobyl accident, workers involved in the cleaning operations and first responders were exposed to the highest doses of radiation.[192] During the Fukushima accident, an estimated 167 workers were exposed to more than 100 mSv of radiation, a dose level that is unequivocally recognized to increase the risk of cancer,[193] and two operators received doses above 600 mSv.[194] The special rapporteur expressed its concern about the fact that the periodical medical check-ups required by law were not always conducted.[195] Moreover, he was informed that many workers employed in the nuclear power industry were poor and some even homeless, increasing their vulnerability.[196] Even though the legislation in place in Japan requires compulsory medical check-ups for workers when they are hired, it was reported that a significant number of workers, employed through layers of sub-contractors for short periods of time, were not provided with appropriate and effective monitoring of their health.[197]

To sum up, the Special Rapporteur for the right to health, Anand Grover, exposed relevant aspects of the right to health in situations of a big-scale nuclear accident. His conclusions and criticism of the responsible Japanese authorities' reactions are relevant for the present analysis dealing with human rights implications of nuclear activities, in particular when he focuses on the rights of vulnerable groups such as women, children and older people, or on especially exposed persons, in particular power plant workers. His broad analysis rightly goes beyond mere illness and death statistics, by taking into consideration social and economic aspects of the victims' right to health.

2.4.2.3 Radioactive Waste Management

The Problem of Radioactive Waste

A separate Chapter of the present book deals with radioactive waste in more detail.[198] Therefore, the current Chapter will be limited to a few legal aspects of the problem.

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[191] Ibid. See, for instance, Wakeford 2008, pp. 166–174.

[192] Report Grover, para 42, with further references.

[193] Official Report of the Fukushima Nuclear Accident Independent Investigation Commission, cited above, p. 9.

[194] Brumfiel 2012, www.nature.com/news/fukushima-s-doses-tallied-1.10686.

[195] Report Grover, para 43.

[196] Ibid, para 44.

[197] Hecht 2012, http://thebulletin.org/nuclear-nomads-look-subcontracted-heroes.

[198] See below, Chap. 9 (Odendahl).

Radioactive (or nuclear) waste is a by-product from nuclear reactors, fuel processing plants, hospitals and research facilities. It is also generated while decommissioning and dismantling nuclear reactors and other nuclear facilities.[199] High-level nuclear waste primarily is uranium fuel that has been used in a nuclear power reactor and is 'spent', or no longer efficient in producing electricity.[200]

The sound management of spent fuel and radioactive waste is one of biggest challenges for the nuclear industry and constitutes an inter-generational issues since radioactive waste—in particular plutonium that is not found in nature—can be radioactive for as long as 250,000 years.[201] Radioactive materials cannot be treated, but only become harmless once they have finished their decay.[202] After the fuel cools down, it is disposed of as waste in a permanent repository, underground or in above-the-ground facilities.[203]

Legal Responses to Radioactive Waste

In order to enhance safety aspects in this field, the IAEA member States adopted, in 1997, the Joint Convention on the Safety of Spent Fuel and Radioactive Waste Management. It follows the model of the 1994 Nuclear Safety Convention and has the same objectives of ensuring high safety standards and prevention of accidents.[204] The Joint Convention refers several times to inter-generational implications of nuclear waste disposal and the benefit of a sound management to human health and the environment:

Article 1: Objectives

> The objectives of the Convention are:
>
> (i)…
>
> (ii) to ensure that during all stages of spent fuel and radioactive waste management there are effective defenses against potential hazards so that individuals, society and the environment are protected from harmful effects of ionizing radiation, *now and in the future, in such a way that the needs and aspirations of the present generation are met*

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[199] United States Nuclear Regulatory Commission (USNRC), Backgrounder on Radioactive Waste, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html.

[200] Ibid. This paper also explains the difference between high-level and low-level waste: while the former is, as explained, primarily spent fuel removed from reactors after producing electricity, the latter comes from reactor operations and from medical, academic, industrial, and other commercial uses of radioactive materials. See also the European Commission, Seventh Situation Report Radioactive Waste and Spent Fuel Management in the European Union, Commission Staff Working Paper, Brussels, 22.8.2011, SEC(2011) 1007 final, res://ieframe.dll/acr_error.htm#europa.eu,http://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/sec/2011/1007/COM_SEC(2011)1007_EN.pdf.

[201] Sovacoo and Dworkin 2014, p. 136.

[202] Green Cross Switzerland, Radioactive Waste and Uranium Mines, http://www.greencross.ch/en/news-info-en/case-studies/environmental-reports/ten-worst-pollution-problems/2008/radioactive-waste-and-uranium-mines.html.

[203] Louka 2013, pp. 94 ff.

[204] Birnie, Boyle, Redgwell 2009, p. 503.

> *without compromising the ability of future generations to meet their needs and aspirations.*[205]
>
> (…)
>
> Article 4: General Safety Requirements
>
> Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, *individuals, society and the environment* are adequately protected against radiological hazards.[206]
>
> In so doing, each Contracting Party shall take the appropriate steps to:
>
> (…)
>
> (vi) strive to avoid actions that impose reasonably predictable impacts on *future generations greater than those permitted for the current generations;*[207]
>
> (vii) aim to avoid imposing undue burdens on *future generations.*[208]

As far as the European level is concerned, the jurisprudence of the ECtHR regarding environmental protection is remarkable and, most interesting for the present section, the Court's practice also concerned cases involving waste management. In the case of *Öneryildiz v. Turkey*, the first environmental case before the ECtHR involving loss of life (Article 2 ECHR), the two applicants asserted that the national authorities were responsible for the deaths of their close relatives and for the destruction of their property due to a methane explosion at the municipal waste dump in an area of Istanbul. The waste disposal site had originally been selected when the area was uninhabited, but over time dwellings were constructed. In April 1993, a methane explosion occurred, followed by a landslide that destroyed ten dwellings and killed 39 people. In its judgment of 30 November 2004, the Grand Chamber of the ECtHR reiterated that the right to life contains not only a negative obligation to refrain from the use of force by State agents, but also imposes a positive obligation on the State Parties to take appropriate steps to safeguard the lives of those within their jurisdiction.

Similarly, the former European Commission on Human Rights and the ECtHR have found that environmental harm attributable to State action or inaction which has significant injurious effect on a person's home or private and family life may amount to a breach of Article 8 ECHR. Some of the cases involve noise pollution, in particular caused by airports.[209] Others concern toxic environmental pollution and are, as such, more relevant for the present study. In the case of *López Ostra v. Spain*,[210] the applicant and her daughter suffered serious health problems from the fumes of a tannery

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[205] Emphasis added.

[206] Ibid.

[207] See also Article 11 (vi).

[208] See also Article 11 (vii).

[209] See *Powell and Rayner v. United Kingdom*, No. 9310/81, 21 February 1990, and in particular the leading case *Hatton v. The United Kingdom* [GC], No. 36022/97, 8 July 2003, and the following-up case *Ashworth and Others v. United Kingdom* (dec.), No. 39561/98, 20 January 2004 (inadmissible). Noteworthy also is the case of *Moreno Gómez v. Spain*, No. 4143/02, 16 November 2004, concerning noise pollution from nearby bars, pubs and discotheques and resulting in a violation of Article 8 ECHR.

[210] No. 16798/90, 9 December 1994.

waste treatment plant which operated alongside their home. The plant started operating without the requisite license and soon malfunctioned, releasing gas fumes and contamination, which immediately caused health problems and nuisance to people living in the district. Despite these problems, the authorities, after a suspension of its activities, allowed the plant to resume partial operation, but the problems remained.[211] The Court, noting that severe environmental pollution may affect individuals' well-being and prevent them from enjoying their homes in such a way as to affect their private and family life adversely, without necessarily endangering their health, came to the conclusion that Spain had exceeded the margin of appreciation that States usually enjoy in this kind of situation. Therefore, Article 8 ECHR had been breached.[212]

Dumping at Sea

A widespread practice of getting rid of radioactive material was dumping at sea, a practice that is now, with limited exceptions, illegal.[213] The major argument against dumping is that it allows a small number of industrialized states acting for their own benefit to impose pollution risks on many others, including future generations.[214] The main environmental risk of dumping at sea consists of radioactive contamination that can seriously impact on the marine food chain.[215] The Soviet dumping of radioactive material in the Arctic is well documented. The Arctic is an important global ecosystem, a nursery to many species and the feeding and breeding ground of many migratory fish, birds and mammals. These migratory species have the capacity to carry radioactive contamination over long distances, leading to serious, wide-ranging ecological consequences.[216]

In 1972, the Stockholm Conference called for an international regime to regulate dumping and only a few months later, the London Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter was adopted.[217] It was later supplemented by regional treaties and, considered insufficient, amended by a Protocol in 1996, that was again amended in 2006. Its preamble expresses the conviction of the States Parties that further international action to prevent, reduce and, where practicable, eliminate pollution of the sea caused by dumping 'can and must be taken without delay to protect and preserve the marine environment and to manage human activities in such a manner that the marine ecosystem will continue to sustain the legitimate uses of the sea and will continue to meet the needs of present and future generations.'

[211] Ibid, para 53.

[212] Ibid, para 57 ff.

[213] Ibid, p. 466.

[214] Ibid, p. 467.

[215] Guruswamy and Aamodt 2001, p. 107.

[216] Ibid, pp. 107 ff.

[217] Birnie, Boyle, Redgwell 2009, p. 466.

It is noteworthy that the 2012 UN Conference on Sustainable Development also addressed the problem of hazardous waste, even though its final document does not explicitly mention nuclear waste. It recognizes the lack of capacity of developing countries for appropriate management of waste,[218] and raises the problem of illegal dumping.[219]

International Transfer of Radioactive Waste

Another serious issue that nuclear activities raise is the transboundary impact of disposal of hazardous waste. Already Principle 14 of the 1992 Rio Declaration recognized the seriousness of the problem of relocation and transfer of waste, stating that States should effectively cooperate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

The underlying principle is the regime of shared responsibility that stems, *inter alia*, from the 1989 Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal (Basel Convention).[220] While this treaty explicitly excludes radioactive from its scope, certain regional treaty prohibit international trade of such waste. Regional groups of developing States condemned all trade involving export of waste from developed to developing countries for disposal in their territories, believing that mere regulation and restriction would only legitimize an unacceptable practice.[221] Among the strongest exponents of this view was the Organization of African Unity, which declared dumping of nuclear and industrial waste a crime against die African people and called on African States not to accept waste from industrialized countries.[222] This policy is reflected in the adoption of the 1991 African Convention on Transboundary Movements of Hazardous Wastes (Bamako Convention), prohibiting imports into Africa from non-parties and regulates trade in waste among member States of the Unity.[223]

[218] Resolution 66/288, para 215.

[219] Ibid, para 219: We urge countries and other stakeholders to take all possible measures to prevent the unsound management of hazardous wastes and their illegal dumping, particularly in countries where the capacity to deal with these waste is limited, in a manner consistent with the obligations of countries under relevant international instruments….

[220] Birnie, Boyle, Redgwell 2009, p. 473.

[221] Ibid, pp. 473 ff.

[222] Ibid, p. 474.

[223] Ibid. Regional treaties covering the Mediterranean and the South Pacific also prohibit export of hazardous waste to developing States Parties and small island States respectively, and ban imports by those States (1996 Mediterranean Protocol on Transboundary Movement of Hazardous Waste, and 1995 Waigani Convention on Hazardous Wastes within the South Pacific Region). Moreover, the fourth Lomé Convention, concluded in 1989, committed the EC to prohibit exports of radioactive or hazardous waste to any African, Caribbean or Pacific Island States parties, and prohibited those States from importing such waste from the EC or from anywhere else (Article 39, and Annexes VIII–X).

The object and purpose of the Bamako Convention, aimed at the protection of human health and the environment, is reflected *inter alia* in its preamble:

> *The Parties to the Convention,*
> 1. Mindful of the *growing threat to human health and the environment posed by the increased generation and complexity of hazardous wastes,*
> (…)
> 3. Aware of the *risk of damage to human health and the environment caused by transboundary movements of hazardous wastes,*
> (…)
> 5. Recalling relevant chapters of the Charter of the Organization of African Unity (OAU) on environmental protection, the *African Charter for Human and Peoples' Rights (…)*
> (…).[224]

In particular the reference in para 5 to the African Charter for Human and Peoples' Rights deserves mention and confirms the potentially negative impact of toxic—including radioactive—waste, on the human being and future generations.

2.5 Conclusions

As shown above (Part 2.2), the guiding principles underlying the legal framework for the right to use nuclear energy for peaceful purposes are economic and social development. These principles that can be traced back to President Eisenhower's 'Atoms for Peace' speech of December 1953. It is only natural to conclude then that the right to use nuclear energy is relevant for the enjoyment of human rights, civil as well as economic, social and cultural rights.

As explained in Part 2.3, the use of nuclear energy can be very beneficial for the human being. It has positive effects, *inter alia*, on the enjoyment of the right to development, the right to health, the right to social welfare, including adequate food and clean drinking water, as well as the right to life and the right to respect for private life.

It goes without saying that States enjoy a broad margin of appreciation as regards the question how to fulfil their human rights duties. In the light of positive obligations that impose human rights law, nuclear energy can be one of the numerous tools assisting States to fulfil their duties in enhancing the human conditions of their citizens. In this regard, it is relevant to underline the theoretical similarities between positive obligations stemming from modern human rights instruments, on the one hand, and the positive duties of States parties to the relevant arms control treaties to promote, facilitate and cooperate in the development and use of nuclear energy for peaceful purposes. This conceptual relationship is another tangible proof for the relevance of the human rights approach to nuclear energy adopted in the present chapter.

[224] Emphasis added.

The right to use nuclear energy is nevertheless not unlimited. It has to be analyzed in light of other norms of international law, in particular environmental law and, as has been shown throughout this study, in particular human rights law (Part 2.4). These norms are not only promoted by the use of nuclear energy, but they also put limits to such use. For instance, the human rights of the local population, mine workers and indigenous peoples constitute a significant barrier to an unfettered exploitation of uranium, in particular through the pollution of ground water. Having regard to their deep spirituality and special relationship with their ancestral lands, indigenous communities are affected by uranium mining and milling not only in the enjoyment of their civil, economic and social rights, but in the exercise of their cultural rights too.

Moreover, accidents like Chernobyl and Fukushima have shown the destructive nature inherent in nuclear activities. The recent report of Anand Grover on the impact of the Fukushima accident has, in particular, underlined the effects of this disaster on the mental health of particularly vulnerable groups, especially women, children and older people, or on especially exposed persons, such as power plant workers. In his report, he rightly suggests that the suffering and despair of the affected people cannot be reflected in cancer statistics alone.

Finally, it has also been demonstrated that radioactive waste disposal poses huge challenges to the environment and the local population. Various legal instruments set certain limits to dangerous nuclear waste management practices. Moreover, the jurisprudence of courts, in particular the ECtHR, demonstrates the possible impact of these activities on the enjoyment of human rights and illustrates that various human rights are at stake. The European experience can serve as an example how this kind of activities can be addressed in legal terms.

In the end, the decision to produce and use nuclear energy for peaceful purposes requires a pondering approach between economic and social prosperity, on the one hand, and the danger and risks of human destruction, on the other hand. Each State, acting in good faith, has to take this decision by taking all relevant factors into account, including the pros and cons of nuclear energy in the human rights balance.

The present Chapter does not pretend to give definitive answers to these complex questions, but it is rather meant to stimulate the public debate and to offer a fresh approach and new ideas in order to find appropriate and just solutions. As the situation stands today, it can be argued that nuclear power has doubtlessly its advantages—in particular in terms of carbon emissions or its practical applications in various domains—but the human costs for this type of energy is still very high. If, in future, uranium will be exploited in full respect of the health and rights of workers and the local and indigenous populations and the natural environment, if nuclear power plants will be completely safe (and secure) one day, and if sustainable solutions for the environmentally friendly management of spent fuel and radioactive waste have been found, nuclear energy could become a truly competitive alternative measured in light of the protection of human rights and the respect for future generations.

This raises finally the institutional question: where shall these topics be addressed? It has been demonstrated throughout this Chapter that certain tribunals, in particular the European and the Inter-American Courts of Human Rights, have played an important role in protecting the environment. It is not excluded that, one day, they will deal with cases of human rights violations caused, *inter alia*, by uranium mining and milling or unsound nuclear waste disposal. Moreover, the International Labour Organization (ILO) might address health problems of mine workers. Other remedies might be available in other human rights fora, regional as well as universal. In other words, it can be claimed that there are certainly legal avenues available, but they are often very limited, costly and slow. This raises the desirability of a more centralized institution where victims of nuclear activities could be heard more broadly. Is it too far-fetched to propose that the IAEA, the most important global player in the nuclear field and promoting the undeniable advantages of nuclear energy and techniques, but far from being experienced in human rights issues, might be the most natural candidate for this? Indeed, the IAEA might be best placed and have a legitimate interest in offering its expertise for discussing certain of the problems caused by nuclear activities, as shown in this Chapter.

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Chapter 3
Ensuring Peaceful Use via International Licensing of the Nuclear Fuel Cycle

Seth Hoedl

Abstract Under the NPT, all States have an inalienable right to the peaceful use of nuclear technology. However, what this right means in practice is uncertain because: (1) many technologies that can be used to produce fuel for nuclear power plants can also be used to produce materials for nuclear weapons; and (2) peaceful use is not defined in the NPT. As a consequence of this uncertainty, a global expansion of nuclear power, as advocated by some climate change experts, may lead to more States having enrichment facilities, increase the risk of proliferation, and inhibit movement towards a world with few, if any, nuclear weapons. This chapter presents a new idea for resolving the inherent ambiguity of peaceful use through a legal principle: peaceful use activities would be those that are licensed by an international agency, while any non-licensed activity would be irrebuttable presumed non-peaceful. This licensing approach is an alternative to other proposals for managing the proliferation risk of an expansion of nuclear power, such as international ownership of enrichment facilities or strengthened IAEA inspections. By resolving the ambiguity of peaceful use, the licensing approach may be able to manage the proliferation risks of an expansion of nuclear power better than these proposals and offers several other safety and security advantages. The licensing approach is discussed in detail, including key license terms, international relationships and obligations, an implementation path, and existing precedents for controlling sensitive technology through licensing. The author also explains why a new approach to non-proliferation may be needed if nuclear power expands substantially and compares licensing to other reform proposals, which are briefly described.

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Contents

3.1 Introduction

Since the dawn of the nuclear age, a complex system of international treaties, bilateral and multilateral agreements, and export regulations, often referred to as the international nuclear non-proliferation regime, has developed to manage the intrinsic dual-use nature of nuclear technologies and to limit the proliferation of nuclear explosives. While some argue that the regime is under stress today,[1] others argue that the regime has performed well over the past few decades because the number of States possessing nuclear explosives has remained constant over the past 25 years, despite the fact that some countries have recently acquired and

[1] For an overview of how the nuclear non-proliferation treaty is thought to be under stress, see Potter and Mukhatzhanova 2010, pp. 3–4; Potter 2010.

tested nuclear explosives.[2] Whether the non-proliferation regime will continue to prevent nuclear proliferation is an open question, particularly if nuclear power becomes an increasing source of energy worldwide.[3] Although expectations of an immediate expansion of nuclear power in the mid-2000s, the so-called 'nuclear renaissance', have dissipated, especially in light of the 2011 Fukushima tragedy,[4] nuclear power is still frequently discussed as a promising source of carbon-free energy to help mitigate climate change. In fact, many climate change experts argue that its use should be expanded dramatically, by at least a factor of ten.[5] In response to concerns regarding climate change and energy security, many governments,[6] established companies[7] and energy start-ups[8] continue to pursue new reac-

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[2] 'North Korea for South Africa may not be a great trade, but to have no net increase in 25 years—years that have included all the chaos after the collapse of the Soviet Union, the whole export period of the A.Q. Khan black market nuclear network globally, secret nuclear weapons programs in North Korea, Iran, Iraq, Libya, Syria—is an amazing public policy success story.' Blake et al. 2016, quoting Matt Bunn.

[3] See Miller and Sagan 2009.

[4] In 2009, the IAEA expected the worldwide nuclear generating capacity to double by 2030, and the U.S. Nuclear Regulatory Commission had 26 pending license applications for new reactors. See Joskow and Parsons 2009. However, the expectation for this growth in nuclear power has not been met. In fact, the total number of reactors in the world has declined over the past decade from a peak of 438 in 2002 to 391 in 2015. Annual nuclear electricity generation peaked at 2410 TWh in 2014, a 9.4 % decline from 2010. At present, there are 62 reactors under construction, 24 of which are in China. See Schneider and Froggatt 2015, pp. 12–14. For a brief discussion of why the renaissance has not materialized, see Brunnengräber and Schreurs 2015, pp. 49–61.

[5] In a recent editorial, four prominent climate scientists called for the construction of 115 new nuclear reactors per year for the next thirty years. See Hansen et al. 2015. Such a construction rate would increase the global nuclear power capacity by a factor of 10. The International Energy Agency (IEA) has also called for more nuclear power in response to climate change. In its '2DS Scenario,' the IEA calls for nuclear power to expand by a factor of about 3 worldwide in order for the global temperature rise to be below 2 °C. International Energy Agency, Energy Technology Perspectives 2015, www.iea.org/etp2015.

[6] For example, the U.S. Department of Energy recently announced an 80 million USD grant to two companies pursuing advanced nuclear reactor designs. See U.S. Department of Energy 2016. The Department of Energy also continues to support development of so-called 'small modular reactors'. See U.S. Department of Energy 2013. China is funding 700 nuclear engineers to develop a novel reactor, called a molten-salt reactor, and hopes to have it commercialized by 2030. See Martin 2015.

[7] General Atomics is developing the 'Energy Multiplier Module'. See http://www.ga.com/energy-multiplier-module. BWXT, a spin-off company from Babcock & Wilcox, is developing the 'mPower' small modular reactor. See http://www.bwxt.com/nuclear-energy/utility-solutions/smr.

[8] Some startups, such as NuScale Power, http://www.nuscalepower.com, are pursuing new light water reactor designs. Others, such as TerraPower, http://terrapower.com, are pursuing so-called 'travelling-wave reactors.' Others, such as Transatomic Power Corporation, http://www.transatomicpower.com, Flibe Energy, http://flibe-energy.com/, ThorCon Power, http://thorconpower.com, and Terrestrial Energy, http://terrestrialenergy.com, are pursuing molten salt type reactors. Others, such as Tri Alpha Energy, http://www.trialphaenergy.com, Helion Energy, http://www.helionenergy.com, and General Fusion, http://www.generalfusion.com, are pursuing novel fusion reactors.

tor types with the hope of rapidly growing nuclear power. This chapter neither argues for nor against such an expansion. Rather, the Chapter presents a proposal for strengthening the non-proliferation regime that could be implemented by nuclear companies, governments and the international community in the event that nuclear power does expand worldwide: the international licensing of all nuclear-related activities and trade.

Civilian nuclear power reactors at any scale present a proliferation risk because many technologies that are used to produce and process new and used nuclear fuel, in particular uranium enrichment and spent fuel reprocessing (ENR), can also be used to produce materials for nuclear explosives.[9] The dual-use nature of these technologies means, *inter alia*, that a State that has the capability to make fuel for civilian nuclear reactors or that has the capability to reprocess spent fuel from civilian nuclear reactors also has a latent nuclear weapons capability. The dual-use nature presents at least four proliferation risks: *First*, a civilian ENR facility is a proliferation risk because a civilian ENR facility could be repurposed to a weapons production program, even if the facility was operated under IAEA inspections up until the choice was made to repurpose the facility, the so-called break-out scenario. *Second*, storage of materials that are either inputs to or outputs from ENR facilities, for example, natural uranium, enriched uranium or separated plutonium, are a proliferation concern because storage of some kinds of these materials can shorten the time a State with ENR facilities needs to fabricate a nuclear explosive, the so-called 'break-out' time. For example, an enrichment facility fed 20 % enriched uranium can produce ten times more weapons-usable uranium per year than the same facility fed natural uranium. *Third*, trade in these materials is a proliferation risk as trade could be a cover for diversion to weapons purposes. *Fourth*, trade in ENR technology is a proliferation risk as legitimate trade for civilian ENR facilities could be a cover for trade that is used to build covert ENR facilities for weapons purposes that are not under IAEA inspections.

These proliferation risks are not new, and the current non-proliferation regime has evolved over the past seven decades to meet these risks at the current scale at which nuclear technology is deployed worldwide. However, as discussed in this chapter, an expansion of nuclear power at a scale necessary to make a difference for climate change may substantially increase the risk of proliferation by increasing the number of ENR facilities and the number of states hosting such facilities, increasing the amount of nuclear material in storage and trade, and increasing the amount of nuclear technologies in trade. These increases may, in turn, hinder efforts towards a world with few if any nuclear explosives and destabilize some

[9] Concerns regarding dual-use are not new. See, for example, Wohlstetter 1976. Note that the proliferation risks of enrichment and reprocessing facilities are very different. Reprocessing is generally believed to present a sufficiently high risk that it should not be undertaken at all. However, for the purpose of simplicity in this chapter, these risks will not be considered separately. For a brief technical explanation of the dual-use problem of enrichment and reprocessing, see National Academy of Sciences 2009, pp. 15–18.

international relations. Many believe that the current non-proliferation regime, or even a strengthened version of the current regime, is ill-equipped to handle these increased risks.[10] In fact, some climate experts are so concerned that they do not believe that nuclear power should be expanded unless such an expansion occurs under a new non-proliferation regime.[11]

The current regime is believed to be ill-equipped to handle these increased risks for at least four reasons. *First*, and perhaps most fundamentally, the foundation of the regime, the Nuclear Non-Proliferation Treaty (NPT),[12] does not, in itself, unambiguously limit states' latent nuclear weapons capability. The NPT recognizes that all States have an 'inalienable' right to the peaceful use of nuclear technologies,[13] yet it does not define what activities qualify as peaceful use; peaceful use is ambiguous under the NPT.[14] *Second*, limitations on technology transfer, ENR operations, and new ENR construction that are imposed by instruments other than the NPT, such as export controls, bilateral agreements, and multilateral agreements, are unlikely to survive in the long term as each State's technical capacity and economic sophistication grows, especially if nuclear power expands tenfold. *Third*, even at the scale of nuclear power today, the existing IAEA inspection regime has been imperfect, and non-nuclear weapon States party to the NPT have developed clandestine programs that were either nuclear weapons programs or strongly suspected to be weapons programs. *Lastly*, IAEA inspections are

[10] Richter 2008; Miller and Sagan 2009.

[11] Socolow and Glaser 2009.

[12] Treaty on the Non-Proliferation of Nuclear Weapons (1 July 1968) 729 UNTS 161 [herein after 'NPT'].

[13] NPT Article IV, para 1: 'Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty'.

[14] The fact that peaceful use is not precisely defined in the NPT is not surprising given the manner in which arms control treaties were drafted at the time. The Biological Weapons Convention (BWC), concluded in 1972, four years after the NPT entered into force, takes a similar approach. The BWC both bans the development, production, stockpiling or other acquisition or retention of biological weapons and recognizes a right to 'peaceful purposes.' Like the NPT, the BWC does not define what constitutes 'peaceful purposes.' See Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (26 March 1975) 1015 UNTS 164, Article I and X. In contrast, the more modern trend has been to precisely define what uses are or are not permissible for dual-use technologies. Thus, the Chemical Weapons Convention (CWC), which was signed in 1993, bans the development, production, stockpiling or other acquisition, retention or transfer or use of chemical weapons and recognizes a State's right to use chemical technologies, but does not reference peaceful purposes. Rather, the CWC recognizes a right to use chemical technologies for purposes that are not prohibited by the CWC, thus sidestepping the peaceful use ambiguity. See Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (29 April 1997) 1974 UNTS 317, Article I, and Article VI, para 1. The CWC constrains the dual use of chemical technologies by, *inter alia*, detailing specific verification and inspection measures that must be adopted by States that produce or store specific chemicals that can have dual-use purposes. *Id.*, Article VI, para 2.

presently funded under a limited budget that is provided by IAEA member states according to each State's GDP. Whether this budget could readily grow to accommodate the need for increased inspections in a world with ten times more nuclear power is an open question.

In light of the proliferation risks of an expansion of nuclear power and the limitations of the current regime, many international leaders and policy makers have called for the creation of a new non-proliferation regime.[15] Although this framework could be created through the negotiation of a new treaty, perhaps modeled after the very detailed Chemical Weapons Convention,[16] most proposals for reform are intended to be implemented under the existing language of the NPT. Some commonly discussed proposals include:[17] (1) operating at least some of the components of the nuclear fuel cycle under international ownership; and (2) strengthening IAEA inspections. However, with the notable exception of a new international fuel bank,[18] most of these proposals remain unimplemented.[19] Note that some leaders have alternatively proposed that ENR technology be restricted to the States that presently have ENR technology (hereinafter ENR-States).[20] However, as explained later in this chapter, this type of technology denial approach is almost certainly not viable in a world with a vast increase in nuclear power. A world with more nuclear power will require more ENR facilities, such as new enrichment plants, and these new facilities are likely to be built in at least a few new States.

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[15] For example, U.S. Pres. Obama has called for the development of a 'new framework' for nuclear power: 'And we should build a new framework for civil nuclear cooperation […] so that countries can access peaceful power without increasing the risks of proliferation. That must be the right of every nation that renounces nuclear weapons, especially developing countries embarking on peaceful programs. And no approach will succeed if it's based on the denial of rights to nations that play by the rules.' President Obama, Prague Speech, April 5, 2009, www.whitehouse.gov/the-press-office/remarks-president-barack-obama-prague-delivered. Former IAEA Director General Mohamed ElBaradei has similarly called for international control of the complete fuel cycle. Berlin Speech, April 17, 2008, www.iaea.org/newscenter/statements/nuclear-energy-need-new-framework. A study of nuclear power by the Massachusetts Institute of Technology concluded that an expansion of nuclear power would not be possible without a new non-proliferation framework. Deutch et al. 2003.

[16] See supra note 14, for a comparison of the NPT with the Chemical Weapons Convention.

[17] For a review of recent proposals, *see* Rauf and Simpson 2004; Rauf and Vovchok 2008. For a more comprehensive discussion of these proposals, *see* Yudin 2009; McCombie et al. 2010; Nikitin et al. 2012. For a comprehensive review of earlier proposals prepared as a result of the International Nuclear Fuel Cycle Evaluation ("INFCE"), *see* Stockholm International Peace Research Institute 1980.

[18] IAEA 2015b.

[19] Scheinman 2007.

[20] For example, U.S. President Bush proposed in 2004 that the export of any technology related to enrichment or reprocessing be prohibited to any state that did not already have such technology. See Boese 2004.

This chapter proposes and discusses an alternative reform framework to manage the proliferation risks of an expansion of nuclear power. In brief, this chapter proposes that Article IV of the NPT be interpreted so that all nuclear activities are presumed non-peaceful, i.e., undertaken in pursuit of nuclear explosives and in violation of the NPT, unless such activities are licensed[21] by an international agency. Such an interpretation would prohibit the operation of unlicensed activities under the current language of the NPT without the need for a new treaty. Through such prohibition, this interpretation would resolve the ambiguity of peaceful use. It would create a legal bright line between peaceful and non-peaceful use so that a State would have a right to own and operate ENR facilities only to the extent that those facilities were licensed. Thus, licensing would not impinge on a state's 'inalienable' right to peaceful use, but rather, would implement that right through the licensing process.

Licensing would manage the proliferation risks of an expansion of nuclear power by imposing detailed constraints on licensed entities through specific license terms. Most importantly, license terms would: (1) impose global constraints on the number, capacity and annual output of ENR facilities; (2) impose global constraints on storage of nuclear material; (3) require licensed entities to do business only with other licensed entities and thereby extend international inspections over the entire nuclear technology supply chain; and (4) require recurring payments to fund IAEA inspections and compliance verification. License compliance would be verified and enforced by a set of relationships between international organizations. In brief, States would commit to abide by the licensing principle, nuclear companies would conduct their operations in compliance with their licenses, a new international agency, the International Nuclear Licensing Agency (INLA) would issue licenses, the IAEA would verify compliance with license terms and the license principle by both States and nuclear companies, and the U.N. would enforce license compliance by authorizing international action, such as economic sanctions or military action, in response to license non-compliance. License terms and relationships are discussed in detail later in this chapter.

As further explained in this chapter, licensing has the potential to better manage the proliferation risks of an expansion of nuclear power than either the current regime or commonly proposed alternatives. *First*, licensing can better deter break-out. If a state violates the license principle, it would provide a strong and unambiguous signal of a state's intent, which the current regime and proposed alternatives do not. This unambiguous signal has the potential to illicit a much faster and stronger international response than has been the practice to date under the current regime, and would thereby deter break-out better than the current regime or reform proposals that do not create a stronger signal. *Second*, by imposing a global limit on ENR capacity, licensing controls the number of states that

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[21] Note that the word "license" is used in this Chapter in the broad sense of a grant of permission. It is not used in a technical sense that would necessarily confer jurisdiction over license terms, renewal, and denials by national or international courts.

have ENR facilities, and thus, a latent nuclear capacity, in a non-discriminatory fashion. Other than simply denying ENR technologies to States that do not presently have ENR technology, neither the current regime nor reform proposals have the ability to restrict the number of states that have a latent nuclear capability in the long term and in a non-discriminatory fashion. *Third*, licensing can lengthen the break-out time at ENR facilities by controlling both the capacity of such facilities and the amount of material stored at such facilities. States can dramatically shorten the break-out time by storing suitable material on-site at ENR facilities. Licensing directly controls this risk, whereas the current regime and reform proposals do not. *Fourth*, by placing the entire nuclear supply chain under international inspections, licensing increases the chance of detecting trade that supports construction of a clandestine ENR facility compared with the current regime or reform proposals. *Fifth*, in contrast with other reform proposals, licensing can be implemented through a bottom-up voluntary process by nuclear companies and States. It does not require lengthy negotiations between State governments in order to have effect. *Lastly*, by collection licensing fees, licensing directly provides a natural mechanism for funding its implementation and operation in a manner that the other proposals lack.

Licensing also offers broader benefits for governing nuclear technologies. Licensing can be a mechanism for requiring compliance with strict safety and security standards. Licensing can also change norms of behavior with respect to nuclear technologies by both States and nuclear engineers. Whereas today, States and nuclear engineers can, in principle, argue that any activity just short of assembly of a nuclear explosive is peaceful use, under a licensing regime, States and nuclear engineers would know prior to undertaking a nuclear activity, what activities are licensable, i.e., what activities are viewed as peaceful by the international community. This advanced knowledge could give pause to engineers who either contemplate activities that are unlikely to be licensed, or who are asked by States to undertake such activities. Licensing thereby narrows the range of nuclear activities that would be readily contemplated by engineers or States.

Similar, although less comprehensive, ideas have been proposed before.[22] However, these ideas were not given serious consideration as they were not believed to offer non-proliferation benefits.[23] In fact, licensing is commonly used in the national context to control sensitive or dangerous technologies without the complications of state ownership. For example, narcotic production in the U.S. is controlled through a licensing regime—narcotic production facilities are not owned by the U.S. government. Similarly, under the licensing approach proposed here, the INLA would, in effect, be intimately involved in the operation of an ENR facility, almost as if the agency owned the facility, but without actually owning the facility.

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[22] See Scheinman 1981, pp. 80–81.

[23] *Id.*

This chapter presents the international licensing proposal in five parts. *First*, it describes in more detail how an increase in nuclear power in response to climate change, increases proliferation risk. *Second*, it briefly describes the current regime and explains why the current regime may not be sufficient. *Third*, it explains commonly discussed reform proposals and the challenges that these proposals face. *Fourth*, it explains the licensing proposal in detail, including licensing terms and relationships between the IAEA, the INLA, and the U.N. Security Council. *Lastly*, it compares licensing to the other reform proposals.

3.2 Proliferation Risks of an Expansion of Nuclear Power

Nuclear power has always presented a non-proliferation challenge because the underlying technology can be used to produce nuclear weapons. A vast expansion of nuclear power worldwide would present an especial challenge. To appreciate the risks that such an expansion could create, it is worthwhile to place in perspective the scale of expansion of nuclear power that would be needed to, for example, mitigate climate change by replacing all fossil-fuel-fired electricity generation plants with nuclear plants.

At present, there are 391 reactors operating in 30 countries worldwide with a total capacity of 338 GW. These reactors produce a total of 2,410 TWh of electricity, which represents 11 % of the world's annual electricity supply.[24] According to the International Energy Agency, the world's annual supply is forecasted to almost double by 2040, rising from approximately 23,000 TWh in 2013 to 43,000 TWh in 2040, if current government policies remain unchanged.[25] Fossil fuels are expected to fuel 64 % of this electricity supply.[26] If nuclear power were to replace fossil fuels, nuclear plants would have to produce approximately 28,000 TWh of electricity in 2040, a tenfold increase over current production. Such an increase would require about ten times more nuclear reactors than today.[27] These reactors, in turn, would require ten times more enriched uranium fuel and produce ten times more spent nuclear fuel waste. The amount of nuclear fuel produced per year would rise from 7 million kg to 70 million kg, and the demand for natural uranium

[24] Schneider and Froggatt 2015, p. 13.

[25] International Energy Agency 2015, p. 310.

[26] *Id.*

[27] Climate change experts have called for such an expansion of nuclear power. In their editorial, Hansen et al. 2015 suggested that 115 new reactors should be built per year between now and 2050. Assuming that each new reactor has an electricity capacity of about 1 GW and that construction starts in 2020, their proposal is equivalent to a total worldwide fleet of 3400 GW by 2050, about ten times more nuclear capacity than exists today.

would rise from 67 million kg to 670 million kg.[28] The amount of spent fuel produced per year would rise from 7 million kg to 70 million kg.[29] Notably, the amount of spent fuel produced per year would be equal to about 30 % of the total amount of spent fuel that has accumulated over the past fifty years.[30]

Although there is presently a small surplus of enrichment capacity to produce the enriched uranium fuel that powers today's nuclear fleet, a tenfold expansion of nuclear power would need to be matched by an equally large expansion of enrichment capacity, if the expansion was based on today's nuclear fission technology. Worldwide enrichment capacity would have to rise from 59 million SWU/year to about 500 million SWU/year.[31] As a point of comparison, a small unsophisticated uranium-powered nuclear explosive requires about 50 kg of 90 % enriched uranium,[32] which in turn requires about 11,000 SWU worth of enrichment using natural uranium.[33]

This expansion in enrichment capacity and in the amount of material produced, traded, and potentially stored creates at least three proliferation risks. *First*, and most importantly, an expansion would increase the worldwide capacity of enrichment and reprocessing (ENR) facilities. This increase in capacity could occur through: (1) an increase of the capacity of existing facilities; (2) construction of new facilities in the States that already have ENR facilities[34]; or (3) construction of new facilities in States that presently do not have ENR facilities. This third option is thought to be most troubling from a proliferation perspective because it would increase the number of States that would have a latent nuclear weapons capability.[35]

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[28] In 2015, nuclear reactors are expected to have consumed 7 million kg of enriched uranium that is produced from about 67 million kg of natural uranium. See World Nuclear Association 2016a, b.

[29] Each year, the present reactor fleet produces about 7 million kg of spent fuel. See World Nuclear Association 2015a.

[30] Approximately 240 million kg of spent fuel waste has accumulated over the past fifty years. *Id.*

[31] Present enrichment demand is about 47 million SWU/year, but present capacity is about 59 million SWU/year. See World Nuclear Association 2015b.

[32] Bodansky 2004, p. 489.

[33] About 230 SWU of enrichment capacity is required to produce 1 kg of 90 % uranium. *Id.*, p. 204.

[34] Uranium is presently enriched by thirteen States, including France, Germany, Netherlands, UK, Japan, US, Russia, China, Argentina, Brazil, India, Pakistan and Iran. See World Nuclear Association 2015b. Commercial reprocessing is presently undertaken by five states including China, France, India, Russia and the UK. Belgium, Germany and the U.S. had commercial reprocessing plants, but these were shutdown in 1975, 1990 and 1992 respectively. See IAEA 2005, p. 45. Japan has reprocessed fuel in the past and is building a large reprocessing plant, which is presently expected to begin operations in 2018. See Japan Nuclear Fuel Limited, Nuclear Fuel Cycle, http://www.jnfl.co.jp/english/operation/. All states that have detonated a nuclear explosive, including the U.S., U.K., France, Russia, China, India, Pakistan, and North Korea, have reprocessing facilities.

[35] Richter 2008; Miller and Sagan 2009.

The proliferation risk of an increase in the number of ENR facilities is perceived to depend, in part, on the states that would undertake such an expansion. Although it is difficult to forecast exactly which States would pursue nuclear power and ENR facilities in the future under a tenfold expansion scenario, especially given the Fukushima tragedy and strong public opinions regarding nuclear technologies, a likely guess would be: (1) states that presently use nuclear power and that have large energy markets; and (2) states that have expressed an interest in either growing their existing nuclear power capacity or acquiring nuclear power capacity. In the first category, one would expect to include the U.S., China, Russia, India, and some EU member States. These States already have ENR technology and facilities, and thus, are perceived to be less of a proliferation risk. In the second category, one would expect to include the 30 developing States that have approached the IAEA to consider new nuclear power plants. These States generally do not have ENR technology or facilities. States in this category that are most advanced along the path of growing their nuclear power market include Belarus, the UAE, Bangladesh, Jordan, Poland, and Turkey.[36] As recently as 2014, some of these developing states, such as South Africa, expressed an interest in operating the full fuel cycle.[37]

Regardless of whether such a spread of ENR would actually result in more states having nuclear weapons, the perception that some states could use nuclear power as a cover for the development of a nuclear weapons program could be destabilizing and encourage States to match each other's latent nuclear capability or take other, perhaps military, action. For example, the lack of confidence in a State's true intentions with regards to its ENR facilities could lead to a 'sno-ball' scenario, in which a new ENR facility leads near-by and/or rival States to develop their own ENR facilities as a hedge against the latent nuclear weapons capability represented by the new ENR facility. This concern is not hypothetical; Saudi Arabia has stated that it may seek to match Iran's enrichment capacity allowed under the Joint Comprehensive Plan of Action (JCPOA).[38]

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[36] See IAEA, Newcomer, Expanding Nuclear Power States to Gather at Annual IAEA Meeting, February 2, 2015, www.iaea.org/newscenter/news/newcomer-expanding-nuclear-power-states-gather-annual-iaea-meeting. See also Adamantiades and Kessides 2009, who discuss the plans of Indonesia, Vietnam, Thailand, Philippines, Malaysia, Egypt, South Africa, Brazil, Argentina, Chile, Venezuela, and Uruguay. See also World Nuclear Association, Emerging Nuclear Energy Countries, February 2016, www.world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.aspx, which lists 45 countries as presently interested in nuclear power including: Albania, Algeria, Azerbaijan, Bangladesh, Belarus, Bolivia, Chile, Croatia, Egypt, Estonia, Indonesia, Israel, Jordan, Kazakhstan, Kenya, Kuwait, Laos, Latvia, Libya, Lithuania, Malaysia, Mongolia, Morocco, Namibia, Nigeria, Peru, Philippines, Poland, Qatar, Saudi Arabia, Serbia, Singapore, Sri Lanka, Sudan, Syria, Thailand, Tunisia, Turkey, UAE, Venezuela, and Vietnam.

[37] World Nuclear News, South Africa plans for sustainability, September 12, 2014, www.world-nuclear-news.org/NP-South-Africa-plans-for-sustainability-1209147.html.

[38] Sanger DE, Saudi Arabia Promises to Match Iran in Nuclear Capability. The New York Times, May 13, 2015.

Second, an expansion of nuclear power would increase the amount of nuclear material that is processed, stored, traded and in physical motion, which would in turn increase the opportunities for diversion to weapons purposes by state or non-state actors. This problem is particularly important for reprocessing facilities as it is difficult to measure how much plutonium is present in spent fuel, and thus, difficult to establish that plutonium has not been diverted from the facility.[39] Storage of some kinds of nuclear material, such as enriched uranium and reprocessed plutonium, would also reduce the time that a state with ENR facilities would need to produce weapons-usable[40] material and a nuclear explosive, the so-called 'breakout' time.

Third, an expansion in nuclear power would increase global trade in nuclear technologies, including dual-use equipment and supplies that can be used to build and operate ENR facilities. The increase in such trade would, in turn, increase the chance that clandestine trade which supports the construction of clandestine facilities would be undetected.

In addition to these proliferation risks, an increase in the number and/or capacity of ENR facilities and an increase in the amount of nuclear material in storage may also prevent progress towards a world with few, if any nuclear weapons.[41] For example, States that are considering abandoning their nuclear weapons may wonder if other nuclear weapon states with ENR capability that have claimed to have eliminated their weapons have really, in fact, given up their weapons because such states may have plans for quick re-assembly of their weapons using material provided by these facilities. Relatedly, States may view the latent weapons capability of ENR facilities as a threat that can only be countered by continuing to possess nuclear weapons. Even if a spread of ENR does not preclude the elimination of nuclear weapons, a world with wide-spread ENR and no nuclear weapons may be prone to substantial armed conflict as states would continually worry that ENR facilities could be used to produce a weapon and provide a first mover advantage.[42]

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[39] Modern reprocessing safeguard research aims to reduce uncertainty regarding the amount of plutonium introduced into a reprocessing plant to within 5 %. See Durst et al. 2007, p. 34.

[40] For the purposes of this chapter, 'weapons-usable' material is nuclear material that can be directly used as a nuclear explosive. 'Weapons-usable' material should be distinguished from 'weapons-grade' material. Weapons-grade material is of a suitable quality to power high-performing nuclear explosives. In contrast, 'weapons-usable' material may not be able to power a high-performing explosive but would be able to power a lower strength nuclear explosion.

[41] According to George Perkovich and James Acton: '[…] if no acceptable form of regulation can be established for the proliferation-sensitive activities that many states which today promote disarmament are seeking to conduct, the abolition of nuclear weapons may not prove possible.' Perkovich and Acton 2009, p. 93.

[42] Schelling 2009. Note that there is a counter argument that wide-spread enrichment is stabilizing in a world with few if any nuclear weapons because any weapons production could be countered quickly. In other words, a state that cheated on a global nuclear weapons ban would have less of a first mover advantage in a conflict because other states could use ENR capacity to quickly assemble their own weapons.

New enrichment technologies, such as laser enrichment, extenuate these non-proliferation concerns. Laser enrichment is a process that can enrich uranium using lasers instead of centrifuges or gas diffusion.[43] In principle, laser enrichment offers enrichment at a lower cost and with a smaller physical footprint. Although it has been studied for decades, only recently has the process been close to commercialization.[44] A tenfold expansion of nuclear power is likely to further encourage commercial development. However, laser enrichment presents unique non-proliferation challenges.[45] Because of its smaller footprint and lower energy consumption, clandestine laser enrichment facilities are likely to be easier to build and harder to detect.[46] Such facilities may also be easier to convert to weapons production than centrifuge facilities.[47]

When considering the proliferation risks of an expansion of nuclear power, one should also keep in mind that there are no simple technical solutions. Although some nuclear reactor technologies and their associated fuel-cycles may be more proliferation prone than others because they produce or separate more weapons-usable materials, a fission-based reactor technology has not yet been developed that avoids the underlying dual-use problem.[48] Even fusion-based reactor technologies that are not powered by uranium will need some kind of proliferation oversight because most of these reactors can be used to convert natural uranium into weapons-usable plutonium.[49] Thus, the need for a proliferation framework to govern nuclear energy will persist, regardless of developments in nuclear technology.

3.3 Challenges of Managing the Proliferation Risk with the Current Regime

This section briefly describes key components of the current regime and discusses why some experts believe that the regime is not sufficient.

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[43] Krass 1977.

[44] Weinberger 2012; World Nuclear Association 2015b.

[45] Krass 1977; Matishak 2009; Kemp 2012.

[46] Kemp 2012.

[47] *Id.*

[48] The International Nuclear Fuel Cycle Evaluation (INFCE), a Carter Administration initiative that gathered hundreds of nuclear experts from 46 countries, studied the proliferation risk of different nuclear fuel cycle options between 1978 and 1980. The INFCE came to the conclusion that all nuclear fuel cycles are proliferation prone and that there is no technical fix to the dual-use problem. See Donnelly 1980.

[49] Glaser and Goldston 2012. Note that some fusion reactor types that fuse hydrogen with boron do not produce neutrons and would not be able to convert uranium into plutonium. This type of fusion reaction is presently being pursued by Tri Alpha Energy, www.trialphaenergy.com.

3.3.1 The NPT, IAEA Safeguard Agreements and the Additional Protocol

The NPT manages the dual-use problem of nuclear technologies by prohibiting non-nuclear weapon States from acquiring or pursuing nuclear weapons[50] and by requiring these states to accept IAEA safeguards on 'all source or special fissionable material in all peaceful nuclear activities within the territory of such State under its jurisdiction or carried out under its control anywhere.'[51] As further discussed below, because peaceful use is not defined under the NPT, and because the NPT recognizes an 'inalienable' right to peaceful use,[52] the extent to which a State could pursue a latent nuclear weapons program under the NPT, by operating civilian ENR facilities or otherwise, is disputed.

IAEA safeguards give confidence that an ENR facility is not misused for non-peaceful purposes by imposing some operational requirements on ENR facilities and by providing strict accountancy on materials that could be used for weapons purposes.[53] Safeguards are designed to ensure that materials, equipment, and facilities are not used to 'further any military purpose.'[54] Safeguards achieve this objective by verifying that material that is weapons-grade or that could be made weapons-grade is not diverted to 'nuclear weapons or other nuclear explosive devices.' Techniques used for such verification include, *inter alia*: (1) analysis of commercially available satellite imagery; (2) audits of materials at nuclear facilities; (3) chemical analysis of materials at nuclear facilities; (4) design verification in which inspectors verify that a facility operates according to its design as declared to the IAEA; (5) video camera surveillance; (6) environmental sampling to verify that a facility is operating as declared to the IAEA; and (7) sophisticated seals on nuclear materials.[55]

Additional Protocols are bilateral legal agreements between the IAEA and IAEA member States that improve the ability of the IAEA to verify that a State is not pursuing undeclared, non-peaceful nuclear activities. An Additional Protocol supplements a Safeguards Agreement and gives the IAEA additional authority to conduct inspections and other activities.[56] For example, an Additional Protocol requires, *inter alia*, that a State give the IAEA: (1) information about and access to

[50] NPT Article I and II.

[51] NPT Article III, para 1.

[52] NPT Article IV, para 1.

[53] For a general overview of Safeguards, see IAEA Department of Safeguards 2015.

[54] Statute of the International Atomic Energy Agency—IAEA Statute—(26 October 1956), 276 UNTS 4, amended 1963, 1973, 1989, and 1999), [herein after 'IAEA Statute'], Article III.A.5.

[55] See IAEA Department of Safeguards 2015.

[56] See IAEA Department of Safeguards 2015, pp. 10–11. The Additional Protocol is not compulsory under the NPT, and at present, 127 Additional Protocols are in force. See IAEA 2015a. For an example of an Additional Protocol agreement, See INFCIRC/540 (Corrected).

all parts of a State's nuclear fuel cycle; (2) short-notice access to all buildings on a site; (3) information about and access to fuel cycle research and development activities, even if they do not involving nuclear material; (4) information on the manufacture and export of nuclear equipment; (5) access to manufacturing and import locations; and (6) permission to collect environmental samples beyond declared locations.[57] These additional authorities help the IAEA to conclude whether or not 'all nuclear material remain[s] in peaceful activities.'[58]

Note that neither Safeguards nor Additional Protocols in and of themselves resolve the peaceful use ambiguity as they do not define what does or does not constitute peaceful use.

3.3.2 Bilateral and Multilateral Agreements

Bilateral agreements between states that have nuclear technologies and those that do not constrain ENR activities and thereby address the peaceful use ambiguity of the NPT. Typically, these agreements require signatory states to constrain their operation of ENR activities in exchange for nuclear technology cooperation or supply of nuclear technologies or materials, such as nuclear reactors. U.S. 123 Agreements are perhaps the most prominent example of these agreements, but many nuclear technology supplier states, such as Russia, France, Korea and Japan, enter into such agreements with their customers.[59]

U.S. 123 Agreements address the peaceful use ambiguity under the NPT by imposing constraints on a State's ENR activities in exchange for U.S. technical assistance and cooperation on nuclear technologies.[60] 123 Agreements are required by the U.S. Atomic Energy Act of 1954 and as amended by the Nuclear Nonproliferation Act of 1978 in order for U.S. government and any 'persons'[61] to, *inter alia*, export uranium, natural and enriched, or plutonium,[62] components for

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[57] See IAEA Department of Safeguards 2015, pp. 10–11.

[58] *Id.* at 11.

[59] Unlike the U.S., none of these states explicitly require a bilateral nuclear cooperation agreement in order to export nuclear technologies. However, bilateral agreements facilitate export in Russia, Japan and France; current practice in Korea is to only export to countries with such an agreement in force. See Glasgow et al. 2012.

[60] See Kerr and Nikitin 2015.

[61] Under the Atomic Energy Act, 'person' has a very expansive definition and means '(1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.' 42 U.S.C. § 2014(s)(2015).

[62] 42 U.S.C. § 2074(a)(2015) limits exports of 'special nuclear material,' defined to be plutonium and uranium, enriched in uranium-233 or uranium-235. 42 U.S.C. § 2014(aa)(2015). 42 U.S.C. § 2094 (2015) limits exports of unenriched uranium and thorium. 42 U.S.C. § 2014(z)(2015).

ENR facilities[63] or otherwise 'directly or indirectly engage or participate in the development or production of any special nuclear material outside of the U.S.'[64] In order to conclude a 123 Agreement, the cooperating State must meet nine non-proliferation requirements. Notable requirements include that: (1) all nuclear material and equipment transferred to the cooperating party be put under safeguards[65]; (2) a guarantee by the cooperating party that transferred material and equipment, and material made with transferred equipment, not be retransferred to another party without the consent of the U.S.[66]; and (3) a guarantee by the cooperating party that enrichment and reprocessing will not be undertaken without prior consent of the U.S.[67] Some 123 Agreements impose additional restrictions. For example, the U.S.-UAE 123 Agreement commits the UAE to not possess enrichment or reprocessing facilities.[68] However, not all 123 Agreements are so restrictive. For example, the U.S.-Japan 123 Agreement allows Japan to enrich uranium to 20 %[69] and allows Japan to reprocess[70] and enrich beyond 20 % if the U.S. consents.[71]

Multilateral agreements can likewise address the peaceful use ambiguity by constraining ENR activities. The recently concluded JCPOA with Iran is an example of such an agreement. Under the JCPOA, *inter alia*, Iran commits to: (1) not enrich uranium to levels above 3.67 % uranium-235 for 15 years; (2) limit the capacity of existing enrichment facilities for 10 years; and (3) limit the amount of enriched U-235 that is stored for 15 years.[72] After the expiration of these limitations, Iran will be required to comply with its NPT obligations and an Additional Protocol.[73]

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63 42 U.S.C. § 2133(d)(2015) requires that 123 Agreement be in place before the Department of Energy can issue a a license for the export of 'utilization or production facilities,' which includes components of ENR facilities. 42 U.S.C. § 2014(v)(2015).

64 42 U.S.C. § 2077(b)(2015).

65 42 U.S.C. § 2153(a)(1)(2015).

66 42 U.S.C. § 2153(a)(5)(2015).

67 42 U.S.C. § 2153(a)(7)(2015).

68 Blanchard and Kerr 2010, p. 7.

69 Agreement for Cooperation between the Government of the United States Of America and the Government of Japan Concerning Peaceful Uses of Nuclear Energy (November 4, 1987), Article 6, available at http://nnsa.energy.gov/sites/default/files/nnsa/05-13-multiplefiles/2013-05-02%20Japan_123.pdf.

70 *Id.*, Article 5, para 1.

71 *Id.*, Article 6.

72 See Davenport et al. 2015, p. 25.

73 *Id.*, p. 3.

3.3.3 Export Controls

Export controls address the peaceful use ambiguity by constraining the construction of new ENR facilities through limitations on the export of ENR technology from ENR States to non-ENR States. Nuclear export controls by nuclear technology exporting states are informed, in part, by guidelines issued by the Nuclear Suppliers Group (NSG), a group of 49 nuclear technology exporting states, including, *inter alia*, the U.S., France, Russia, China, the U.K., the Republic of Korea, and Japan.[74] NSG member states commit to implement export controls that, at a minimum, abide by the NSG guidelines. With respect to ENR technologies, the guidelines require, *inter alia*, that NSG members not export ENR technologies to states unless such states have agreed to implement the IAEA's Additional Protocol or, pending such implementation, a regional accounting and control agreement with the IAEA.[75] The guidelines further require that NSG members seek legally binding commitments by purchasing states to not enrich uranium above 20 % uranium-235 and, to the greatest extent practicable, to design enrichment facilities so that they are not capable of enriching above 20 %.[76]

Exporting States frequently impose additional constraints that go beyond NSG guidelines and that control ENR technology transfer.[77] For example, the U.S. requires that any person or entity subject to U.S. jurisdiction be granted specific authorization by the U.S. Department of Energy prior to transferring ENR technology to any foreign country.[78] Authorization is only granted if the U.S. Department of State, the Nuclear Regulatory Commission, the Department of Commerce, and the Department of Defense concur that the transfer is not 'inimical' to the interests of the U.S.[79] The U.S. also imposes different export controls on different

[74] NSG members include: Argentina, Australia, Austria, Belarus, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Kazakhstan, Republic Of Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and the United States. See Nuclear Suppliers Group, Participants, www.nuclearsuppliersgroup.org/en/participants1. For a discussion of recent changes to NSG guidelines, see Viski 2012.

[75] INFCIRC/254/Rev.12/Part 1, Article 6(c).

[76] *Id.*, Article 7(a).

[77] For a comparison of U.S., French, Korean, Japanese and Russian nuclear export control regimes, see Glasgow et al. 2012.

[78] 10 C.F.R. § 810.7(b)(2015).

[79] 10 C.F.R. § 810.9(b)(2015). When making a determination of whether the transfer is 'inimical' to the interests of the U.S., the Department of Energy considers ten factors including, *inter alia*: (1) whether the recipient country is a party to or adhered to the NPT and in good standing with its acknowledged non-proliferation commitments; (2) whether the recipient country has accepted IAEA safeguards on all nuclear materials used for peaceful purposes; and (3) the significance of the assistance or transferred technology relative to the existing nuclear capability of the recipient. 10 C.F.R. §§ 810.9(b)(1) through (b)(10) (2015).

destination countries. For example, the U.S. Nuclear Regulatory Commission requires a special license for the export of even very small quantities of nuclear material to States thought to be proliferation risks, including Cuba, Iran, Iraq, North Korea, Sudan and Syria.[80]

3.3.4 Concerns Regarding the Regime

Non-proliferation experts are concerned that the current regime is insufficient to manage the proliferation risks of a tenfold expansion of nuclear power for at least four reasons. *First,* and most importantly, the foundation of the regime, the Nuclear Non-Proliferation Treaty (NPT), does not, in itself, unambiguously limit the latent nuclear weapons capabilities of member states. The NPT does not specify which States can possess ENR facilities nor does it impose limits on the capacity of such facilities, even if such facilities are under safeguards.

As a consequence of the peaceful use ambiguity, the degree to which a State's right to ENR can be constrained under the NPT is debated. At one extreme, some argue that the latent capability of ENR facilities, in combination with a State's obligation under Articles II and III to not pursue nuclear weapons, means that a state does not have an inalienable right to pursue ENR under the NPT[81]; at the opposite extreme, others take the position that under the clear text and history of the treaty, all states have an inalienable right to pursue ENR without condition.[82] Under this interpretation, all States could build ENR facilities, and thus a latent nuclear weapons capability, and yet still comply with their NPT obligations as long as these facilities are under IAEA safeguards. IAEA safeguards and the Additional Protocol do impose operational constraints, but they do not limit who can own and operate ENR facilities, nor do they limit the capacity to which these facilities are designed.

Second, limitations on technology transfer, ENR operations, and new ENR construction that are imposed by bilateral agreements, multilateral agreements, and export controls are unlikely to survive in the long term. Determined states have already found ways around these restrictions.[83] In the decades ahead, States inter-

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[80] General licenses for the export of minor reactor components and small quantities of nuclear materials are denied to 'Embargoed' and 'Restricted' States. See 10 C.F.R. §§ 110.21 through 110.24 (2015). These restrictions apply to Cuba, North Korea, Iran, Sudan, Iraq, Syria, Afghanistan, Andorra, Angola, Myanmar, Djibouti, India, Israel, Libya, Pakistan and South Sudan. 10 C.F.R. §§ 110.28, 29 (2015).

[81] See Boese 2004.

[82] See Joyner 2011. This interpretation emphasizes Article IV para 2 of the NPT, under which "All the Parties to the Treaty undertake to facilitate, and have the right to participate in the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy." For a critique of this interpretation, see Wulf 2011.

[83] For a discussion of how states have recently evaded these export control regimes, see Braun and Chyba 2004.

ested in ENR will be able to develop their own indigenous ENR technology so that they will not need assistance from States with ENR technology to build ENR facilities and will not be constrained by export controls.

As a consequence, States may choose to not renew bilateral or multilateral agreements, especially if they perceive constraints in such agreements as a means of reinforcing a divide between nuclear technology 'haves' and 'have nots'. A tenfold expansion of nuclear power would likely further encourage indigenous ENR technology because such an expansion would both drive down the cost of owning and operating ENR facilities and increase the need for such facilities.

Third, even at the current scale of nuclear technology deployment worldwide, the existing IAEA inspection regime has been imperfect, and non-nuclear weapon states party to the NPT have developed clandestine nuclear programs that were either nuclear weapons programs or strongly suspected to be weapons programs.[84] Prominent examples include clandestine nuclear programs in North Korea, Iran, Syria, Libya, and Iraq.[85] Although these cases occurred prior to the implementation of stricter IAEA inspections under the Additional Protocol, a tenfold expansion of nuclear power may exacerbate the challenge of deterring and detecting clandestine programs because such an expansion will stretch the capabilities of IAEA inspectors. In some of these cases, the international community was slow to respond to the discovery of clandestine programs.[86] A history of slow response, in turn, limits the ability of the current regime to dissuade future proponents of clandestine weapons programs.

Fourth, IAEA inspections are presently funded under a limited budget that is provided by IAEA member states and allocated according to each State's GDP. Adjusted for inflation, this budget has been flat for three decades.[87] A tenfold expansion of nuclear power would require far greater funding for IAEA inspections and a far greater IAEA budget. Whether the IAEA would be allocated such funds by member states is an open question.

3.4 Existing Proposals for Managing the Proliferation Risks

This section briefly discusses three proposals for reforming the existing non-proliferation regime and the challenges that each proposal faces.

[84] For a critique of IAEA safeguards, see Sokolski 2008.

[85] For an overview of nuclear activities in these States, see Country Profiles, Nuclear Threat Initiative, www.nti.org/learn/countries/.

[86] For example, it took four and a half years for the U.N. Security council to impose its first sanctions resolution on Iran after Iran's clandestine enrichment program was revealed. Perkovich and Acton 2009, p. 88.

[87] Findlay 2016, p. 1.

3.4.1 International Ownership of ENR Facilities

International ownership proposals address the proliferation risks of an expansion of nuclear power by giving multinational organizations ownership and control of especially sensitive components of the nuclear fuel cycle. These proposals are not new. For example, the 1946 Baruch Plan[88] proposed that all nuclear fuel cycle activities, including mining, enrichment, fuel fabrication, and reprocessing would be owned and controlled by an international agency. Recent proposals are more modest. A few examples include:[89] (1) the creation of regional or international enrichment centers, in which multiple states jointly own and operate enrichment facilities; (2) fuel lease-back arrangements, whereby uranium is enriched, and fuel is fabricated by an international organization, which then leases the fuel to civilian nuclear power plants and takes back the fuel once it has been used in a reactor; and (3) fuel banks, by which enriched uranium is stored in an international facility for distribution to civilian nuclear power plants.

The modern proposals address the proliferation risks of expanding nuclear power through at least three mechanisms. *First*, they reduce the number of facilities undertaking enrichment or reprocessing because they reduce the economic and security motivations for states to build new enrichment facilities. For example, multinational enrichment centers are intended to offer enriched uranium at a price lower than a state could enrich uranium itself, while fuel banks are intended to offer security of supply so that states do not have a security rationale for building their own ENR facilities. *Second*, these proposals reduce the chance that an international ENR facility operator will misuse the facility for clandestine weapons-usable material production. An international institution is far less likely to misuse an ENR facility than a sole state-owned facility. *Third*, these proposals raise barriers to states repurposing ENR facilities to dedicated weapons production. A State would likely refrain from taking over an international facility located on its territory. If a State did, in fact, commandeer an international facility, its actions would be an unmistakable signal to the international community of the state's hostile intent, which would, in turn, trigger an international response.

International ownership is intuitively appealing from a non-proliferation perspective. However, these proposals may not be up to the challenge of a tenfold expansion of nuclear power because, despite their seventy year history, they have yet to be adopted. Implementation of international ownership is difficult because,

[88] Baruch 1946.

[89] For a review of recent proposals, *see* Rauf and Simpson 2004; Rauf and Vovchok 2008. For a more comprehensive discussion of these proposals, *see* Yudin 2009; McCombie et al. 2010; Nikitin et al. 2012. For a comprehensive review of earlier proposals prepared as a result of the International Nuclear Fuel Cycle Evaluation ("INFCE"), *see* Stockholm International Peace Research Institute 1980.

inter alia: (1) creating and siting multi-national facilities is challenging; (2) the economic arrangements of operating multinational facilities is complicated; (3) many of the proposals are viewed as discriminatory against states that do not presently have ENR; and most critically, (4) the current international market for nuclear fuel operates well, and states are unwilling to relinquish their rights, whatever they may be, to ENR technologies in exchange for participation in new, international ENR facilities.

To put in perspective how challenging starting an international ENR facility would be consider the steps involved. *First*, at least two States would have to agree to jointly build, own, and operate a facility. *Second*, these States would need to agree on how the facility would be funded, i.e., which State would contribute what fraction of the capital expense. *Third*, these States would need to agree on how operational responsibilities would be shared—in other words, would the facility be operated by a State government, a private company, or a joint venture. *Fourth*, they would need to agree to who would be in charge of the facility—which State's nationals would be the leadership of the facility. *Fifth*, they would have to come to an agreement as to how much fuel to produce, what form it would be produced in, and how any profits from the production of such fuel would be shared. They would have to undertake this economic analysis while being sensitive to the interests of their own commercial ENR facilities—in other words, they would likely have to make sure that the new facility did not economically impair their existing ENR facilities. *Sixth*, they would have to agree on where to site the facility—which State would host the facility and benefit from the economic activity created by the facility. *Seventh*, the states would have to agree as to which technology to use for the ENR facility. Almost certainly, incumbent interests in the respective states would lobby to have their technology used in the facility. *Eight*, they would have to determine how they would market the fabricated fuel—who would be the customers and what conditions would be imposed on its customers. For example, would the international facility only sell to customers that agree to not pursue their own ENR facilities or to send back their spent fuel? And if take-back were a condition, which State would take the fuel back? Relatedly, how would the States convince their customers that fuel supply would not be used as a political tool to influence their customer's domestic or foreign policies?

Although some States have collaboratively pursued enrichment facilities as cooperative commercial ventures, such as Urenco,[90] the challenge of overcoming all the steps above has prevented implementation of international ownership as fully envisioned as a non-proliferation strategy. The challenges faced by recent international scientific collaborations are illustrative. For example, governments and scientists debated the location of the international fusion experiment, ITER,

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90 Hibbs and Rengifo 2013.

before selecting a final site in 2005.[91] The international management of ITER has also been hampered by the need to attend to the interests of the international collaborators.[92] An internationally owned enrichment facility would likely be just as, if not more, difficult to site and operate as it would implicate commercial interests, customers, and national security concerns.

An additional challenge for modern versions of international ownership is that they do not comprehensively address the dual-use nature of nuclear technologies. Although they reduce the economic need for new ENR facilities in non-ENR states, they do not preclude such construction. In other words, even if internationally owned ENR facilities are built, non-ENR states could still choose to build domestic ENR facilities for energy security or as a point of national pride. In addition, these proposals do not address proliferation concerns regarding existing facilities. Until all ENR facilities are operated as multinational facilities, these proposals do not increase confidence that existing or expanded ENR facilities will not be misused in the future for a nuclear weapons program. The proposals also do not address storage of nuclear materials or trade in ENR technologies. Nor do they address other dual-use technologies, such as research reactors that can produce plutonium[93] or medical isotope production that uses highly enriched uranium.[94] Thus, modern proposals are a stepping stone to a long term solution for dual-use nuclear technologies, such as eventual international ownership of the complete nuclear fuel cycle, but they are not a long term solution in and of themselves.

3.4.2 Strengthened IAEA Inspections

Another option for managing the proliferation risk of an expansion of nuclear power would be to strengthen the current nuclear non-proliferation regime by strengthening IAEA inspections and safeguards. Suggestions have included: (1) applying safeguards to more parts of the nuclear fuel supply chain, such as refined uranium ore; (2) increasing the frequency of inspections; and (3) redesigning the inspection system to detect very small quantities of materials.[95]

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91 Smith CS, France Will Get Fusion Reactor to Seek a Future Energy Source. The New York Times, June 29, 2005.

92 Clery 2014.

93 For example, the Arak research reactor in Iran was a critical point of negotiation leading up to the JCPOA, which imposed constraints on the design and operation of the reactor. For a technical description of how the Arak reactor presents a proliferation risk and how the reactor can be redesigned and operated to minimize these risks, *see* Willig et al. 2012; Ahmad et al. 2014. For a discussion of how JCPOA solved these concerns, *see* Davenport et al. 2015, pp. 17–18.

94 Many medical isotopes have historically been produced with weapons-usable uranium, which could be stolen or diverted. *See* Von Hippel and Kahn 2006. Note that medical isotope production is one of the few nuclear technologies for which there are alternatives that do not pose a proliferation risk. *See* Hoedl and Updegraff 2015.

95 Perkovich and Acton 2009, pp. 87–88.

Although these steps would certainly make the non-proliferation regime stronger, they likely would not address all the concerns created by expanding nuclear power. *First*, even under a strengthened regime, ENR facilities still provide a latent nuclear weapons capability. Strengthened inspections do reduce the time between when a State decides to repurpose an ENR facilitate and when the international community is notified that they have so repurposed a facility. However, inspections do not increase the break-out time, i.e., the time that it would take a State with ENR facilities to produce a nuclear explosive. In addition, a strengthened regime does not limit the number of such facilities. *Second*, strengthened inspections may be addressing the wrong problem with the current regime. Perceived failures with regards to States that have built clandestine facilities are often due to failures of the international community to respond rather than failures of the IAEA to detect clandestine activity. For example, when Iran's clandestine ENR facilities were revealed, it took four and a half years for the U.N. Security Council to respond with sanctions, in part because Russia, China and other states insisted that the IAEA provide proof of Iran's intentions.[96] Stronger inspections are unlikely to have resulted in a quicker international response. Thus, improved inspections in a world with ten times more nuclear power are unlikely on their own to give additional confidence that the international community would quickly respond to and deter the conversion of a latent nuclear weapons capability into a weapons program.

3.4.3 Technology Denial

A third approach to limiting the proliferation risk of an expansion of nuclear power would be to constrain ownership and operation of ENR facilities to the ENR States. Under this approach, any expansion of ENR capacity that was needed to fuel a larger global fleet of nuclear reactors would be undertaken in these States alone. This technology denial approach has the benefit that it would limit the number of States that have a latent nuclear capability. Technology denial could be achieved either through state-level policy, for example a NSG prohibition on transfer of nuclear technologies,[97] or it could be achieved by nuclear companies that simply refuse to sell ENR technologies to states that presently do not have such technology. Despite its intuitive appeal, technology denial is almost certainly not viable in a world with ten times more nuclear power.

There are at least two approaches to technology denial. In the first approach, a nuclear power expansion is confined exclusively to ENR States so that non-ENR States do not have a need to acquire ENR. Because CO_2 is a global pollutant, this

[96] Perkovich and Acton 2009, pp. 88–89.

[97] See Boese 2004.

approach would achieve the same climate benefits as a scenario in which nuclear power is spread more widely. In the second approach, all states are allowed to build and operate nuclear power plants, but only the ENR States are allowed to continue to make or process nuclear fuel; non-ENR States are not allowed to build their own ENR facilities. Under this second approach, the ENR states would provide fuel to non-ENR States, and perhaps, take back spent fuel for disposal or reprocessing. However, neither approach is likely feasible because: (1) denial of either nuclear power or ENR technology would create an unsustainable divide between nuclear 'haves' and 'have nots' in a world with a massive expansion of nuclear power[98]; and (2) states denied nuclear power or ENR technologies would likely argue that denial violates the NPT.

The energy divide created by either technology denial approach would be substantial in a world with ten times more nuclear power. The ENR States[99] represent approximately 60 % of the world's present population[100] and consume 70 % of the world's present energy supply.[101] Notably, they are some of the world's most developed States. By 2050, ENR States are expected to have only 50 % of the world's population[102] and to consume approximately 65 % of the world's energy supply.[103] If the most developed states embrace nuclear power as a fundamental energy source for their economies in the decades ahead, it would be unrealistic to expect the other half of humanity to forego nuclear energy to power their own, developing economies. Thus, if nuclear power expands in the ENR States, it will likely also expand in the non-ENR States.

98 Kazimi et al. 2011, p. 116.

99 See supra note 34, for a list of ENR States. Because of the close economic ties between countries within the EU, limiting the expansion of enrichment only to those States that presently have enrichment would likely not create a divide between States with and without enrichment within the EU. For that reason, all the statistics in this paragraph consider the EU as if it were a single state with ENR capability.

100 United Nations, Population Division 2015, pp. 18–28. The medium variant scenario was chosen for these population statistics.

101 U.S. Energy Information Administration, International Energy Statistics, Total Primary Energy Consumption, https://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=44&pid=44&aid=2 Accessed March 14, 2016.

102 United Nations, Population Division 2015, pp. 18–28. 2050 is chosen because the comparison date as that is the date by which climate experts have called for the operating nuclear capacity to increase by a factor of 10. See supra note 27.

103 International Energy Agency 2015, pp. 582–659. Strictly speaking, the energy consumption estimate is for 2040; however, consumption in 2050 is likely to be very similar. Note that the International Energy Agency (IEA) does not explicitly list consumption forecasts for Pakistan, Argentina and Iran. To compensate, the estimate presented here assumes that these three States will consume the same amount of Energy in 2040 as they do today, which is equal to 3 % of the world's total energy supply. Note also that this estimate assumes that current energy policies remain unchanged.

Likewise, a technology denial approach, in which non-ENR States expand nuclear power but never acquire ENR technology, is unsustainable as it would mean, in effect, that half of humanity would be dependent on thirteen ENR States for their energy security. Such dependence would give the ENR States a foreign policy tool that they could use to influence the domestic or international policies of non-ENR States dependent on nuclear fuel imports. Concerns regarding the use of such a foreign policy tool is not hypothetical. For example, in the past several decades, Russia is believed to have manipulated the price and supply of its natural gas exports to its neighbors in order to exert influence on its neighbor's domestic and foreign policies.[104] Thus, in the long term, non-ENR states that rely on nuclear power would likely seek ENR facilities to fuel their own reactors so that they would not be at risk of being subject to foreign policy pressure by the ENR States. Non-ENR States may also pursue ENR technologies as a point of national pride. Note that their desire to build ENR facilities does not necessarily imply that they would do so outside of IAEA inspections.

An explicit technology denial may also be untenable under the NPT as States are likely to argue that an explicit technology denial approach violates Article IV of the NPT. Under Article IV para 2 of the NPT, 'All the Parties to the Treaty undertake to facilitate, and have the right to participate in the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy.' Although it is disputed as to whether this Article imposes a duty on nuclear exporting States to transfer nuclear technologies to non-ENR States,[105] even if the provision does not impose a duty to transfer, States could argue that an explicit denial of nuclear technologies to non-ENR states would violate this provision because explicit denial would certainly not be facilitating 'fullest possible exchange.' Such an argument would be especially persuasive if the ENR States decided to rely on nuclear technology to power their economies through a tenfold expansion of nuclear power. In addition, non-ENR States may also argue that an explicit technology denial approach violates a State's inalienable right to peaceful use under Article IV para 1.

Note that a technology denial approach would likely succeed if it is applied to all States in a non-discriminatory fashion so that nuclear power is phased-out worldwide. In other words, if the ENR States decide to abandon nuclear power as an energy source and stop operating ENR facilities accordingly, they could argue that non-ENR States should likewise not adopt nuclear power and should not build their own ENR facilities.

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[104] 'Russia has shown in the past twenty years how eager it is to use energy exports as a weapon, cutting off gas supplies at one time or another more than 40 times. Russian neighbors such as Belarus, Lithuania, Moldova, and Azerbaijan have all faced threats of Russian energy cutoffs as they flirted with pro-European policies in the past few years.' Johnson 2014.

[105] See supra note 82.

3.5 The Licensing Proposal

The licensing approach resolves the inherent ambiguity of peaceful use under the NPT and governs the dual-use nature of nuclear technologies by proposing that nuclear companies, States, and the international community adopt the following principles:

- All nuclear-related activities that produce or use nuclear materials in any form,[106] and all research, development, and manufacturing of technology that could be used in the production of nuclear materials, must be licensed by an international agency.
- Any unlicensed nuclear-related activity is irrebuttable presumed non-peaceful.

The license would be granted to entities undertaking nuclear-related activities, whether States or private enterprises, by an international agency, referred to here as the International Nuclear Licensing Agency (INLA). The INLA would be separate and distinct from the IAEA.

A license would include specific terms that would govern a nuclear facility's operation and construction. These terms would be crafted for different facility types to ensure that a facility is not misused for weapons purposes. Compliance with the licensing approach would be verified and enforced through a set of relationships between nuclear companies, individual States, the INLA, the IAEA and the U.N. Security Council. This section discusses: (1) key license terms; (2) international relationships to support licensure, verification and enforcement; (3) an implementation scenario; and (4) precedents for licensing.

3.5.1 Key License Terms

A fundamental feature of the licensing approach is that license terms would dictate how facilities are constructed and operated. Although the licenses would be crafted differently for different facility types, they would include at least nine common terms:

[106] What constitutes nuclear material for non-proliferation purposes is a debate in and of itself. For the purposes of the licensing proposal, nuclear material is considered to be any material that can either be directly used for nuclear explosive purposes or that after further processing could be so used. This, definition would include, for example, materials that are known to have been used for nuclear explosives, such as uranium and plutonium. The definition would also include materials that are not commonly thought of as suitable for weapons but that could, in principle, be used in weapons, such as thorium, the uranium isotope uranium-233, and neptunium-237. The definition would cover all materials in the present nuclear fuel cycle, from uranium mining to spent fuel reprocessing or disposal. It would also cover new nuclear fuel cycles, such as those needed for thorium reactors. The definition would not cover radioactive isotopes that could be used for radiological explosives, i.e., explosives that spread radioactive materials but that do not use a nuclear reaction to drive the explosion.

(1) *A commitment to accept and cooperate with IAEA safeguards and inspections.*

Although any nuclear facility in a non-nuclear weapon member state is already obligated by the NPT to accept IAEA safeguards and inspections, this term would re-emphasize this obligation and make clear that a lack of cooperation with the IAEA would constitute a license violation, and thus, presumptively non-peaceful.

(2) *A limit to the quantity and type of fissile material that could be produced per year and subsequently stored.*

By imposing a limit on the quantity of fissile material that can be produced, the license ensures that the facility is not producing excess material for weapons purposes. By imposing a limit on the quantity of fissile material that can be stored, the license ensures that the facility is not stockpiling excess fissile material that can be converted into weapons-usable material by the same facility at a later date.

In the case of enrichment facilities, the global quantity of fissile material that can be produced by licensed facilities would ideally be matched to the global demand by nuclear power plants. This match would ensure that there is little excess enriched fuel being produced and would further give confidence that facilities were not being misused because such misuse would appear as a deficit in the nuclear fuel market. In order to achieve this match, the INLA would set an annual global production limit and then allocate individual facility production limits by auction, lottery or negotiation. As discussed below, other industries are controlled through similar production quotas.

(3) *A limit to a facility's capacity.*

By imposing a limit on a facility's capacity, the license further ensures that a facility cannot be misused. For example, in the case of an enrichment facility, a license could specify that a facility could have a capacity no greater than 1 million SWU/year. Ideally, this limit would be matched to the expected annual output limits in term number 2 above, so that a facility would have minimal excess capacity that could be used for weapons purposes.

The INLA could also impose a global limit to facility capacities, and thereby, in effect, limit the number of facilities of a certain type. For example, the INLA could impose a global enrichment capacity limit of 70 million SWU/year in 2020, nearly the expected global demand in that year. Assuming that the cap was reached that year, the cap, would, in effect, preclude construction of new enrichment facilities as they would exceed the cap. If a licensed entity wanted to build a new enrichment facility or expand its enrichment capacity, it would need to negotiate a reduction in the capacity of an existing facility so that the global limit was not exceeded. The INLA would need to adjust the limit in future years based on changes in demand for enriched uranium.

In order for the licensing approach and the INLA not to be perceived as perpetuating an enrichment cartel, limits on individual facility's production and capacity would have to be allocated in such a way that new market participants could participate in global markets. For example, in order to build confidence in the licensing approach, one of the large State-owned enrichment companies could voluntarily choose to defer increasing its enrichment capacity so that enrichment facilities in another State could expand.

(4) *A requirement that international inspectors be embedded in operations.*

As discussed under term 1, a licensed facility would be subject to all IAEA safeguards and inspections. This term would go beyond that obligation for the purpose of creating greater international confidence that a facility is complying with the term of its license. These inspectors would be an integral component of a facility's operation and would provide assurance that a facility was operating in accordance with its license.[107] They would not be paid by the facility and ideally would rotate through facilities to prevent collusion with facility owners and operators. They would be employees of the IAEA. If license terms required compliance with safety and security standards, these inspectors would operate as a sort of peer-review of facility operation and performance.[108] Although these inspectors would be expensive and might be considered superfluous to modern unattended surveillance and inspection techniques, embedded inspectors serve a critical signaling function under the licensing approach. Repurposing an ENR facility for weapons material production would require expulsion of embedded inspectors. Such an expulsion would send an unmistakable signal regarding a State's intent to the international community under a licensing approach. In contrast, tampering with remote monitoring equipment that would also be required for ENR facility repurposing, would not send the same level of unmistakable signal—it is always possible to explain such tampering as equipment failure or an inadvertent mistake.

(5) *A restriction that licensed facilities can only trade with other licensed entities.*

This term would extend the licensing principle to the entire nuclear technology supply chain by requiring licensed facilities to trade only with other licensed entities. In combination with the accounting term below, this term would aid detection of clandestine diversion. Because suppliers and consumers of nuclear equipment and supplies would both keep account of their equipment and supplies, any discrepancy in the accounting books between sellers and purchasers of nuclear equipment and supplies would be evidence of diversion.

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[107] The U.S. Nuclear Regulatory Commission has similar on-site inspectors at U.S. nuclear power plants to ensure that such plants comply with safety and security regulations. *See* Reactor Inspection Basics, U.S. Nuclear Regulatory Commission, www.nrc.gov/reactors/operating/oversight/inspection-basics.html.

[108] The Institute of Nuclear Power Operations (INPO) provides a similar peer-review service with respect to safety for U.S. nuclear power plants. See About Us, Institute of Nuclear Power Operations, www.inpo.info/AboutUs.htm. The World Institute for Nuclear Security provides a similar service with regards to security issues. See Howsley 2009 and Introducing WINS, World Institute for Nuclear Security, www.wins.org/index.php?article_id=52.

(6) *A requirement to abide by best practice accounting standards.*

A license would require a license holder to abide by best practice accounting standards so that dual-use materials, equipment and supplies would be continuously tracked through nuclear trade. Although IAEA safeguards and inspections presently impose accounting standards on some types of nuclear material, the license would apply accounting standards more broadly to include dual-use equipment and supplies at equipment and supply manufacturers, in addition to all nuclear material production facilities. Because a licensed manufacturer would be subject to inspections and oversight, the accounting standards would reduce the chance that a diversion of dual-use equipment would go undetected.

(7) *Security Standards.*

This term would specify that facilities must operate according to best practice security standards. Although many of these practices may not be public in the interest of security, licenses could create a forum for the confidential exchange of best practices. In addition, licenses could dictate specific operational principles to increase operational security. For example, licenses for enrichment plants could specify that the enrichment technology must operate on a so-called 'black-box' basis so that the individual operators would not have access to the underlying technology and would not be in a position to copy the technology at another clandestine facility.[109]

(8) *A limited duration so that the license is subject to renewal and revocation.*

In order to incentivize continual compliance with the license terms, a license would be subject to renewal and revocation. A facility that lost its license would be required to stop operations. Continued operation after non-renewal or revocation would be considered a violation of the license principle and presumptively non-peaceful.

Note that unlike some types of national licenses for other activities, the licenses proposed here would not be subject to national judicial oversight. In other words, a national court could not compel the INLA to issue or renew a license. If the license approach was adopted through a voluntary process, as described below, then courts would have no jurisdiction over licensing grants or renewals. The INLA would, however, likely adopt some kind of appeals process by which license applicants could appeal license revocations or denials. If the license approach was adopted by international agreement, the agreement itself would create an appeals process and also remove national court jurisdiction over licensing. The exact legal means by which this could occur would be jurisdictionally dependent and requires further analysis.

[109] URENCO presently operates its enrichment facilities on a black-box basis. See Hibbs and Rengifo 2013.

(9) *An annual fee to fund inspections and compliance verification measures.*

A licensed entity would be required to pay an annual fee to the INLA that would, in turn, fund inspections and other compliance and verification measures by the IAEA and the INLA.

This fee would be very small compared to the costs of operating a nuclear reactor or ENR facility. The present total IAEA budget for nuclear inspections is 135 million euros.[110] A conservative estimate in a tenfold expansion of nuclear power scenario would be that the inspection expense would rise by a factor of ten to 1.35 billion euros. Given that the nuclear fleet in this scenario would produce 28,000 TWh of electricity, the inspection expense is equivalent to about 0.00005 €/kWh, which is about a factor of 1000 below the price of electricity produced by a modern nuclear power plant. A modern 1 GW nuclear power reactor would pay an annual fee of about 400,000 €. This total amount could be paid by the power reactor directly, or it could be paid by the nuclear fuel supplier, and it would cover inspections at both the reactor and ENR supplier facilities.

3.5.2 International Relationships and Obligations: Licensure, Verification and Enforcement

The licensing approach could operate through a variety of international relationships and obligations. One key feature of the licensing approach is that these relationships and obligations could evolve with time—they need not be implemented all at once. This section describes one possibility for the relationships and obligations under a licensing approach between five key parties: (1) States; (2) the INLA; (3) the IAEA; (4) nuclear companies, including state-owned corporations and laboratories that undertake nuclear activities; and (5) the U.N. Security Council.

In brief, States commit to abide by the licensing principle; nuclear companies conduct their operations in compliance with their licenses; the INLA issues licenses; the IAEA verifies compliance with license terms and the license principle by both States and nuclear companies; and the U.N. enforces license compliance by authorizing international action, such as economic sanctions or military action in response to license non-compliance. Notably, under the licensing approach, the responsibilities of the IAEA and INLA would not duplicate or replace either other; rather, the IAEA and INLA's responsibilities would complement each other as the IAEA would be exclusively responsible for licensure compliance verification and referrals to the UN for non-compliance, and the INLA would be exclusively responsible for issuing licenses and setting license terms. These relationships and obligations are illustrated in Fig. 3.1.

[110] Findlay 2016, p. 17.

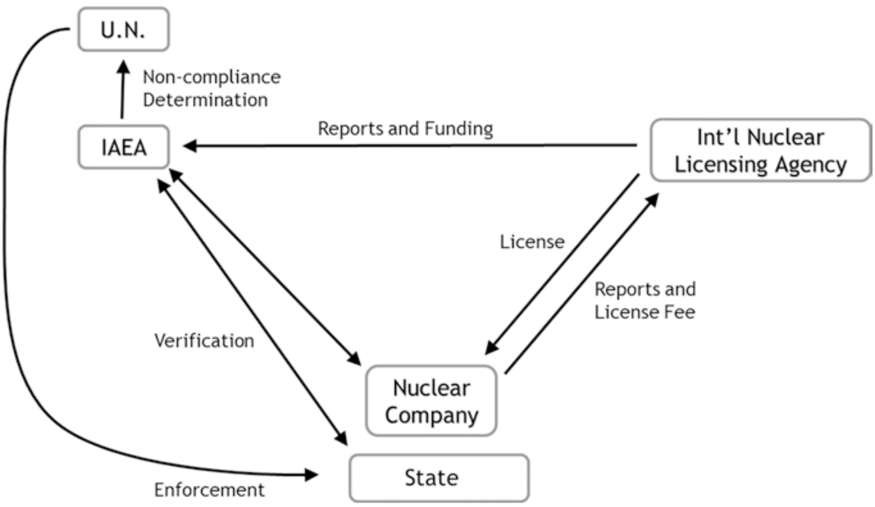

Fig. 3.1 A diagram of possible international relationships and obligations under a licensing approach

States

States would implement the licensing approach through three actions. *First*, they would prohibit all nuclear activities that are not licensed by the INLA. For example, they could make INLA licensure a requirement of their already existing domestic licensing process. *Second*, they would prohibit trade, both domestic and international, between INLA licensed and unlicensed entities. *Third*, they would conclude an agreement with the IAEA, hereinafter 'licensure agreements,' that are supplemental to their IAEA safeguards and Additional Protocol agreements and that would: (1) authorize the IAEA to evaluate whether any unlicensed activities are being undertaken within territory under the State's jurisdiction; (2) authorize the IAEA to evaluate whether nuclear companies operating within the State's jurisdiction were operating in accordance with their licenses; and (3) reemphasize the IAEA's duty to report non-compliance to the U.N. Security Council as required by the IAEA's Statute.[111] These three obligations would be in addition to, and would not replace nor duplicate, a State's existing obligations under its IAEA safeguards and Additional Protocol agreements. However, as explained in more detail below, IAEA verification of licensure compliance would not duplicate existing IAEA inspections under safeguards or Additional Protocols.

Nuclear Companies

To meet their licensure obligations imposed by state governments, nuclear companies would: (1) apply for licenses from the INLA; (2) pay recurring license fees; (3) conduct their operations in compliance with the terms of their INLA licenses;

[111] IAEA Statute, Article XII.C.

(4) cooperate with all IAEA inspections; and (5) apply for license renewals. In addition, to help the INLA perform its mission of setting ENR capacity and production limits, nuclear companies would report to the INLA, on at least an annual basis, the type and quantity of nuclear materials that were produced, stored and sold during the past year and the expected capacity of the company's facilities. Optionally, nuclear companies could participate in INLA efforts to set safety, security and accounting standards.

International Nuclear Licensing Agency (INLA): Licensure

The INLA would have at least eight responsibilities. *First*, it would issue, renew, suspend and revoke licenses for nuclear activities undertaken by nuclear companies. As part of this responsibility, it would have an appeals process for license denials, revocation or suspension. Note that denials, revocation or suspension could be in response to a prior license violation. Note also that the INLA would provide a copy of the licenses to the IAEA for the IAEA's verification responsibility. *Second*, it would receive license fees and impose fines. Fees would be recurring to fund INLA operations. Fines would be applied in response to a license violation. *Third*, it would transfer funds to the IAEA for IAEA licensure compliance verification. *Fourth*, it would set limits on global annual production of nuclear materials, ENR capacity to make such materials, and the total amount of materials allowed to be in storage. *Fifth*, it would allocate these limits, through auction, negotiation or another process to licensed facilities on an annual basis. *Sixth*, it would collect production, storage and capacity data from licensed entities and provide such data to the IAEA. *Seventh*, it would provide a forum for nuclear companies and other stakeholders to discuss and evaluate safety, security and accounting standards. *Lastly*, it would develop, partly in cooperation with licensed entities and States that adopted the licensing principle, key license terms for particular nuclear activities. The INLA would not have any verification or inspection responsibilities.

The INLA would also have a role in enforcing compliance, especially for violations that do not pose an imminent threat and that do not require Security Council action. In response to a license violation, the INLA could use its licensing authority to revoke or suspend a license and impose additional fees. It could also bar a violator from applying for future licenses for a fixed duration of time.

The INLA could be an international organization created by treaty or governmental agreement, or it could be a free-standing non-governmental organization that would be recognized by the nuclear industry and the international community as the INLA. Note that there are many examples of international organizations, not created by treaty, that have an international regulatory effect.[112]

[112] For example, the Basel Committee promulgates banking regulations that are widely adhered to worldwide, despite the fact that the Committee was not created by a formal treaty, but rather, by informal agreements between national banking regulators. Likewise, the International Accounting Standards Board sets global accounting standards, even though it is a non-governmental organization that is not based on treaty or government agreement. For a review of how these organizations develop soft-law with global impact, see Bodansky et al. 2015.

The INLA would purposefully not be the IAEA for three reasons. *First*, and most importantly, as further discussed below, licensing is most likely to be implemented through a bottom-up process, which starts with a few nuclear companies and/or States voluntarily adopting the licensing principle. In order for a voluntary process to evolve quickly, the INLA should have maximum flexibility to set license terms and engage with nuclear companies and States that adopt the licensing principle. Such flexibility likely requires that the INLA be an independent organization that is not part of the IAEA, even if IAEA verification is instrumental to the success of the licensing principle. For example, it would be much easier for a few nuclear companies and States to agree to license terms amongst themselves than for the far larger number of IAEA member states to so agree when the licensing approach is first implemented.

Second, the IAEA should likely not be the organization that sets the license terms because it will be the organization that verifies compliance with those terms. In the same spirit that legislators should not be law enforcers, the license terms should likely not be enforced by the same organization that sets the license terms. Such a separation would minimize the perception of any conflict of interest between the organization that sets license terms and the organization that verifies compliance with those terms.

Third, in order to maximize its non-proliferation credentials, the organization that sets the license terms for ENR capacity and material storage should make a realistic assessment of nuclear fuel market conditions, and as a consequence, should not be in the business of promoting nuclear power. Thus, because the IAEA encourages the use of nuclear energy for peaceful purposes,[113] it should likely not be the licensing organization. However, this concern would not prevent the IAEA and other organizations from advocating at the INLA for license terms based on their forecasts of future demand for nuclear fuel.

IAEA: Verification

Under the licensing approach, the IAEA would have primary responsibility for verifying licensure compliance by both States and nuclear companies. It would fulfill this responsibility by evaluating whether unlicensed activities were occurring on territory under a State's jurisdiction and whether nuclear companies were operating in compliance with their INLA license. IAEA verification would be funded by license fees paid to the INLA and then transferred to the IAEA. Note that as part of its verification responsibility, the IAEA would receive reports from the INLA regarding nuclear company activities. These reports would provide additional assurance that nuclear companies were truthfully reporting their activities and complying with their license terms by allowing IAEA inspectors to compare their inspections to these reports.

Licensure verification would neither duplicate nor replace IAEA inspections under either IAEA safeguards or Additional Protocols. Rather, it would

[113] IAEA Statute, Article III.A.1 authorizes the IAEA to promote nuclear energy for peaceful purposes.

piggy-back on these existing inspection mechanisms by adding a complementary question to the IAEA's existing inspection responsibilities. A second set of inspections exclusively for the purpose of verifying compliance with licensure would not be required. Thus, during IAEA inspections of ENR facilities, in addition to confirming that nuclear material is accounted for and not diverted to non-peaceful use, IAEA inspectors would also evaluate the operation and capacity of inspected facilities to confirm that those facilities are operating in conformance with their license. In addition, as part of its licensure verification responsibilities, the IAEA would employ embedded inspectors at ENR facilities who would monitor, in real time, ENR facility compliance with its license terms. The added expense of these inspectors would be paid for by the license fees. These inspectors would not be superfluous to remote monitoring equipment. Instead, they would provide the international community assurance that an ENR facility was not repurposed for weapons production as such repurposing would require that these inspectors be expelled, an action which would be immediately reported to the IAEA and the international community. Furthermore, when undertaking an inspection of a particular site or facility for the purpose of ascertaining whether a State was undertaking any undeclared activities, an IAEA inspector would ask both whether an undeclared activity took place on that site or in that facility and whether that activity was licensed. Note that although an undeclared activity would likely also be an unlicensed activity, a declared activity could be an unlicensed activity, at least as the licensure approach was new and being adopted.

Licensure verification would add to the scope of IAEA inspections by expanding the total number of sites and facilities subject to inspection. Because licensure requires that licensed entities only do business with other licensed entities, the entire nuclear supply chain would require licenses and be subject to IAEA licensure verification. For entities that deal with nuclear materials, this verification would be simply a component of existing IAEA inspections. For entities that deal with other types of materials and supplies, licensure verification would likely be a new type of inspection or audit. However, for these entities, licensure verification would likely take the form of an audit of sales and receipts to ensure that trade was only undertaken with other licensed entities and that all dual use items were accounted for.

Although license verification would be undertaken by the IAEA in a similar fashion as current IAEA inspections, licensure likely has two advantages from a compliance verification perspective that makes licensure verification more powerful than IAEA safeguard and Additional Protocol inspections or a strengthened version of these inspections. *First*, and most importantly, a licensure verification inspection is easier to interpret than a typical IAEA inspection and thereby provides a clearer signal to the international community regarding a State's intent with respect to its nuclear technologies. An IAEA inspection asks whether nuclear material has been diverted from peaceful use. Licensure verification asks the more straightforward question of whether a nuclear company has complied with its license. A violation of a license provides far more convincing evidence of a State's intent than an IAEA's determination that a State may not be complying with its

NPT obligations. For example, a State that stockpiled 20 % enriched uranium but that complied with IAEA safeguards on that uranium may be setting aside future fuel for a research reactor or may be stockpiling material that can be readily converted to weapons-grade material under a break-out scenario. A strict materials accountancy inspection cannot distinguish these two intents. In contrast, under the license approach, unless the nuclear company performing the enrichment had a license to enrich and stockpile, the production and stockpiling would be a license violation with unambiguous intent. Note that the INLA would be unlikely to grant such a license as research reactors do not require a lot of fuel and are not refueled frequently.

Second, because licensure verification extends inspections throughout the entire nuclear industry supply chain, detection of clandestine activity is more likely. In other words, under a licensing approach, there are more opportunities to detect diversion of dual-use technologies because both the buyers and sellers of such technologies must be licensed and maintain appropriate records. Systematic discrepancies between these records would be indicative of diversion for clandestine activity.

The IAEA will also serve an important role in enforcing licensing compliance, modeled after its responsibilities for reporting safeguard or Additional Protocol non-compliance to the U.N. Under the licensing approach, if the IAEA determined that unlicensed activities have occurred or are underway in a territory within a State's jurisdiction, or if the IAEA discovered that an activity is occurring which is not in compliance with a license, the IAEA would report the non-compliance determination to the INLA and to the U.N. Security Council. The INLA and U.N.'s role in enforcement is described in more detail below.

The IAEA likely has authority under its existing statute to undertake both the license verification and enforcement responsibilities. Under the IAEA Statute, IAEA inspectors are authorized to determine compliance with 'any other conditions' of an agreement with the IAEA and a State.[114] Thus, as long as the IAEA and a State have a licensing agreement authorizing the IAEA to determine licensure compliance, IAEA inspectors would have authority to evaluate nuclear activities within a State for license compliance. Furthermore, the IAEA statute requires inspectors to report non-compliance with conditions of an agreement between the IAEA and a State to the Director General, who is then required to report the non-compliance to the Board of Governors, who are in turn required to report the non-compliance to the U.N. Security Council and General Assembly.[115] Thus, the same agreement that would authorize IAEA inspectors to evaluate licensure compliance would also require the IAEA to report any violations to the U.N. Note that

[114] IAEA Statute, Article XII.A.6.

[115] *Id.*, Article XII.C: "The inspectors shall report any non-compliance to the Director General who shall thereupon transmit the report to the Board of Governors. The Board shall call upon the recipient State or States to remedy forthwith any non-compliance which it finds to have occurred. The Board shall report the non-compliance to all members and to the Security Council and General Assembly of the United Nations".

in contrast to safeguard agreements, in which the IAEA reserves discretion to report its findings to the U.N. Security Council,[116] because there is a bright-line between compliance and non-compliance under the licensing approach, licensing agreements would not reserve discretion to the IAEA, but rather, would require the IAEA to report license violations, such as expulsion of IAEA inspectors from ENR facilities, to the U.N. Security Council.[117]

U.N. Security Council: Enforcement

Like under the current regime, under the licensing approach, the U.N. Security Council would have authority to enforce the licensing approach by authorizing an international response to license violations through, for example, negotiation, economic sanctions, or military action. As in the current regime, the IAEA would notify the U.N. Security Council of a license violation and the international community would then respond. In the case of violations which do not pose an immediate threat of weapons production, for example, if a state was undertaking unlicensed R&D activities, the response could take the form of a Security Council resolution that (1) calls on the State to suspend unlicensed activities until they are licensed; and (2) imposes economic sanctions. In the case of a violation that posed an imminent threat of weapons production, for example, a State expels IAEA inspectors from an enrichment facility and then is suspected of using the facility to produce weapons-usable material, the Security Council could, as a last resort, authorize military action.

Although enforcement under the licensing approach is very similar to enforcement under the current regime, the actual implementation of enforcement would likely be different because of the fact that licensure resolves the ambiguity of peaceful use. Under the current regime, a State's decision to undertake nuclear activity with dual-use sends an ambiguous signal to the international community, and the State can use the ambiguity to justify its continued pursuit of the nuclear activity. The ambiguity can be especially effective when other States engage in similar activity. For example, after it was discovered, and Iran disclosed, in 2002 that Iran was in the process of constructing undeclared enrichment facilities, some

[116] INFCIRC/153 (Corrected), para 19: "The Agreement should provide that if the Board upon examination of relevant information reported to it by the Director General finds that the Agency is not able to verify that there has been no diversion of nuclear material required to be safeguarded under the Agreement to nuclear weapons or other nuclear explosive devices, it may make the reports provided for in paragraph C of Article XII of the Statute and may also take, where applicable, the other measures provided for in that paragraph. In taking such action the Board shall take account of the degree of assurance provided by the safeguards measures that have been applied and shall afford the State every reasonable opportunity to furnish the Board with any necessary reassurance".

[117] There may be a small exception to this requirement for truly trivial violations. For example, a failure to file a report by a specified reporting deadline would not necessitate reporting the violation to the Security Council.

experts suggested that Iran was not pursuing a nuclear weapon, but rather, pursuing a latent nuclear weapons capability just short of a weapon and similar to Japan's.[118] Iran furthered this interpretation by publically claiming that its facilities were exclusively for peaceful purposes.[119] Some States, such as Russia and China, insisted that the IAEA provide proof of Iran's non-peaceful intent.[120] Others, particularly the U.S., UK and France, argued that the Iranian nuclear program was a clandestine military program.[121] These contradictory interpretations of Iran's nuclear intentions may have been responsible, in part, for the fact that it took twelve years after Iran's disclosure for Iran and the international community to enter into an agreement that resolved tensions regarding Iran's nuclear activities.[122]

In contrast, detection of an unlicensed activity in a State that accepted the licensing principle would be strong, unambiguous and convincing evidence of a State's intent to pursue non-peaceful nuclear technologies, such as a nuclear weapon. The detection would send an unambiguous and clear signal to the international community that would likely strengthen the international community's resolve to take strong action. It would be more difficult under a licensing approach than under the current regime for the international community to delay a response to a license violation. As a consequence, a timely international response would be more likely than under the current regime.

The fact that an international response would be more likely under the licensing approach than the current regime may in turn deter States from violating the license principle in the first place. For example, a State's leadership could not argue to its citizens and nuclear engineers that unlicensed nuclear activities were for peaceful purposes. Although some of these citizens and engineers might be enthusiastic for the State to undertake non-peaceful nuclear activities, others might not. The bright-line between peaceful and non-peaceful nuclear activities and the threat of international response for a violation under the licensing approach would likely strengthen the arguments of domestic and international parties who would oppose the unlicensed nuclear activity.

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118 Cirincione 2006.

119 For example, Iran claimed that its enrichment facilities were intended to provide fuel for its nuclear power plants and research reactor and that its heavy-water research reactor was intended for medical isotope production. See Fitzpatrick 2006.

120 Perkovich and Acton 2009, p. 89.

121 See for example, BBC News, 'France Steps up rhetoric on Iran,' February 16, 2006, http://news.bbc.co.uk/2/hi/middle_east/4718838.stm.

122 For example, in 2010, when Iran announced that it intended to further enrich uranium, the U.S., U.K., France and Germany sought increased economic sanctions while Russia and China did not. See BBC News, 'Iran Confuses again with further enrichment,' April 16, 2010, http://news.bbc.co.uk/2/hi/middle_east/8503751.stm.

3.5.3 Implementation

The licensing approach could be implemented through a ‘top-down’ interpretation of Article IV of the NPT that is memorialized by a new treaty, a new international agreement or a NPT Review Conference. However, the licensing approach could also be implemented through a voluntary, bottom-up reinterpretation of the NPT. Given the present debates in the international nuclear community regarding peaceful use, the voluntary path is likely more expedient than a ‘top-down’ reinterpretation. Fortunately, the licensing approach is very amenable to a bottom-up implementation trajectory.

The licensing approach could begin with a decision by a few nuclear companies to abide by the license principle.[123] They could collectively agree to undertake the licensing approach as a confidence building measure to support the nuclear industry. These companies, perhaps in partnership with a few state governments, could form a new, international non-governmental organization, which would serve as the INLA. The INLA would, in turn, grant licenses to these companies, who would then seek, through their State government, IAEA oversight to verify compliance with the license terms. Although it would likely be impractical for the first licenses to have all nine core terms discussed above, the licenses would still have several of the core terms, such as limits on uranium enrichment and storage.

As the licensing approach gained acceptance, the original founding companies would pressure their suppliers and customers to abide by the license principle so that they could give effect to the requirement that a licensed entity can do business only with other licensed entities. The INLA would gain experience sufficient to set accounting and security standards that licensed entities would be expected to follow. As more companies and states joined the licensing approach, a behavioral norm would be created that companies seeking to fulfill the highest non-proliferation standard would accept and comply with the licensing principle. This behavioral norm would, in turn, create pressure on other companies and states to adopt the licensing approach. As the international community gained experience with licensing, and as the nuclear industry evolved, the license terms would evolve accordingly. Eventually, after many years of experience with the licensing approach, a sufficient number of states and companies would accept the licensing approach that the licensing principle, i.e., that unlicensed activities are presumptively non-peaceful, would be readily recognized as an interpretation of Article IV of the NPT.

One may ask whether it is realistic to expect States and nuclear companies to voluntarily adopt the licensing principle as such adoption is likely to increase the cost of doing business. However, there are at least two examples of industries implementing or cooperating with regulation schemes in order to promote their business. *First*, the worldwide chemical industry participated in negotiations of

[123] Note that voluntary coordination by nuclear companies under the licensing approach may require an exemption from national anti-trust laws.

the Chemical Weapons Convention and helped craft the verification measures in the Convention as the industry saw such participation in their best long term interest.[124] *Second*, the worldwide aviation industry has long participated in setting standards for its operation through its trade association, the International Air Transport Association (IATA),[125] and the International Civil Aviation Organization (ICAO).[126] In fact, IATA's Articles of Association explicitly list one purpose of the Association as cooperation with ICAO.[127] As a result, since ICAO's founding in 1944, IATA has helped ICAO develop standards and recommended practices.[128] IATA also implements its own safety audit as a condition of IATA membership.[129]

Similarly, States and nuclear companies may voluntarily adopt the licensing principle when they seek to substantially grow the nuclear power market and their share of the market. For example, nuclear companies in States that seek to export their nuclear technology or nuclear power startups in other states may see the license principle as a way to distinguish themselves from the competition and to demonstrate their non-proliferation commitment to both prospective customers and the international community. These companies may ask their governments to adopt the licensing principle as a further competitive advantage. Likewise, States that seek to build new nuclear power plants may adopt the license principle as a way to convince the international community that their intentions are truly peaceful, i.e., that their desire for nuclear power is not a cover for a military nuclear program. States have voluntarily limited their nuclear activities in the past for non-proliferation confidence building. For example, the UAE has committed to not

124 For a history of the Chemical Weapons Convention, see Genesis and Historical Development, Organisation For The Prohibition Of Chemical Weapons, www.opcw.org/chemical-weapons-convention/genesis-and-historical-development/.

125 The International Air Transport Association is an aviation trade organization that represents 260 airlines worldwide. It was founded in 1945 to promote safe, reliable, secure and economical air services for the benefit of the world's consumers. See The Founding of IATA, International Air Transport Association, www.iata.org/about/Pages/history.aspx.

126 The International Civil Aviation Organization (ICAO) is a specialized UN agency that was established in 1944 by the Convention on International Civil Aviation (REF). ICAO works with Member States and industry groups, including IATA, to reach consensus on international civil aviation Standards and Recommended Practices to support safe, efficient, secure, economically sustainable and environmentally responsible civil aviation. The ICAO also audits Member State's civil aviation oversight capabilities in the areas of safety and security. See About ICAO, International Civil Aviation Organization http://www.icao.int/about-icao/Pages/default.aspx.

127 See Early Days, International Air Transport Association, www.iata.org/about/Pages/history_2.aspx.

128 IATA helped the ICAO draft its first Standards and best Practices in 1949. Id.

129 An IATA Operational Safety Audit (IOSA) examines the operational management and control systems of airlines. Passing an IOSA is a condition of IATA membership, but airlines who are not members can also request an IOSA. In fact, 36 % of airlines that have requested an IOSA are not IATA members. See IATA Operational Safety Audit (IOSA), International Air Transport Association, www.iata.org/whatwedo/safety/audit/iosa/Pages/index.aspx.

pursue enrichment or reprocessing as part of its nuclear cooperation agreement with the U.S.[130]

Whether licensing would be more difficult to implement than other recent non-proliferation reforms, such as the Additional Protocol, is difficult to determine as these reforms took place in the context of a stagnant nuclear industry and not within an industry undergoing an expansion. In the context of an expansion, both nuclear companies and States seeking to expand their nuclear power capacity would likely be more amenable to licensing than they were to the Additional Protocol if they believed that licensing would expedite the nuclear power expansion.

3.5.4 Precedents for Licensing from National Contexts

Licensing as an alternative to State ownership as a means of control over sensitive technology is not a new concept. There are several precedents in the national context that demonstrate that licensing can be as effective as state ownership. For example, the production and trade in controlled substances, i.e., narcotics, in the U.S. is governed by a registration process that is very similar to the licensing approach proposed here for nuclear activities. In the U.S., every entity that manufactures or distributes any controlled substance must be registered with the Drug Enforcement Administration (DEA).[131] Registration subjects the registered entity to physical inspection.[132] Registration permits the manufacture and distribution of controlled substances, but only to the extent authorized by the DEA.[133] Similar to the license terms discussed above, registration explicitly limits the amount and type of controlled substances that can be manufactured or distributed.[134] The DEA establishes these limits each year by setting an annual quota for U.S. production to meet 'estimated medical, scientific, research, and industrial needs of the United States' and need for lawful export.[135] The national quota is then allocated to individual registered manufacturers.[136] The quota system has been in effect in the U.S. since passage of the Controlled Substances Act in 1970.[137]

[130] Blanchard and Kerr 2010, p. 7.

[131] 21 U.S.C. § 822(a)(1)(2015). Note that although the statute gives registration authority to the U.S. Attorney General, the Attorney General has delegated such authority to the DEA. 28 C.F.R. 0.100 (2015). See also 21 C.F.R. § 1300.01 (2015).

[132] 21 U.S.C. § 822(f)(2015).

[133] 21 U.S.C. § 822(b)(2015).

[134] 21 U.S.C. § 823(c)(2015).

[135] 21 U.S.C. § 826(a)(2015). See also 21 C.F.R. § 1303.11 (2015).

[136] 21 U.S.C. § 826(c)(2015).

[137] U.S. Controlled Substances Act of 1970, Pub. L. No. 91-513, 84 Stat. 1236 [codified at 21 U.S.C. § 801 *et seq*. (2015)].

Although controlled substances are certainly less dangerous than weapons-usable nuclear materials, the fact that a licensing principle has controlled the production and trade of controlled substances suggests that licensing can be an effective alternative to international ownership and control of nuclear activities.

3.6 Summary: A Comparison to Existing Proposals

This section briefly compares the licensing approach with the existing reform proposals.

3.6.1 Break-Out Risk

Deterrence

One of the key benefits of licensing is that licensing may be able to better deter States from using their ENR facilities to build weapons-usable material, i.e. break-out, than either the current regime or other reform proposals. As described above, a license violation would provide clear and unambiguous evidence of a state's intent. Because, under licensing, a State would agree that only licensed activities are peaceful use, any undertaking of unlicensed activity would signal to the international community non-peaceful intent. This signal is in contrast to the current regime, under which States can engage in a range of ambiguous nuclear activities that could either be peaceful or a weapons program. In the past, this ambiguity has delayed an international response to detection of ambiguous nuclear activity. The unmistakable nature of a license violation has the potential to illicit a much faster and stronger international response than has been the practice of the international community to date. The potential for a stronger international response, in turn, is likely to better deter states from attempting break-out than the current regime.

Detection of ambiguous nuclear activities at internationally owned ENR facilities would likely send the same unmistakable signal to the international community as a license violation and thereby deter break-out at such facilities. In order to misuse an internationally owned ENR facility, a host state would have to physically commandeer the facility. However, if a host state were to so commandeer the facility, it would send a clear and unambiguous signal of hostile intent to the international community similar to, if not stronger than, the signal that a state would send by, for example, expelling inspectors from a licensed facility. Thus, commandeering would illicit the same strong international response as detection of a license violation and would be likewise deterred.

The international ownership proposal would not change the interpretation of a detection of ambiguous nuclear activity at ENR facilities other than the internationally owned ENR facilities. Thus, the proposal would not deter break-out at facilities other than internationally owned ENR facilities any more than break-out is deterred under the current regime. Note, however, that ambitious versions of international ownership, such as the Baruch Plan, that place all ENR facilities under international ownership and that ban non-internationally owned ENR facilities would likely have the same break-out deterrence value as the licensing proposal.

The existing reform proposals other than international ownership would likely not improve the ability of the international community to deter break-out. Strengthened IAEA inspections would shorten the time between when a State made a choice to pursue break-out and when the international community was notified, but this shortening would likely not provide any additional insight into the State's intention beyond what is provided by the current regime. Thus, strengthened inspections would not illicit a stronger international response, and would not deter break-out any more than the current regime. Technology denial does not address break-out from ENR facilities once they are built.

Note that licensing cannot physically prevent break-out. Under the licensing approach, new ENR facilities in non-ENR States would increase the number of states that could, in principle, build nuclear explosives. Thus, even under licensing, the number of states with a latent nuclear weapon capability may be higher in a world with ten times more nuclear power and correspondingly more ENR facilities than today. However, the point of comparison should not be the proliferation risk today, but rather, the proliferation risk under the other regime reform proposals. Like licensing, none of the proposals other than technology denial can physically prevent break-out—they all rely on deterrence by the international community. For example, an internationally owned facility cannot physically prevent commandeering by a host State because the internationally owned facility is unlikely to be secured with a force sufficient to repel a hostile takeover by a host State government. However, as described above, licensing has the potential to better deter break-out than international ownership, strengthened inspections, or technology denial. Thus, even though licensing cannot physically prevent break-out, it has the potential to reduce the risk of break-out more than the other reform proposals.

Lengthening the Break-Out Time

For States that do have ENR facilities, licensing lengthens the time that they would need to produce material for a nuclear explosive. The break-out time depends on both the capacity of ENR facilities and on the amount and type of material available to feed the ENR facilities. For example, an 11,000 SWU/year enrichment plant fed natural uranium could produce enough enriched uranium for about one unsophisticated nuclear explosive.[138] If the same enrichment plant was fed 20 % enriched uranium, it could produce enough enriched uranium for 10 unsophisticated nuclear explosives per year.[139] Thus, even a very small enrichment

[138] A unsophisticated uranium-based nuclear explosive requires about 50 kg of 90 % enriched uranium. Bodansky 2004, p. 489. Producing 1 kg of 90 % enriched uranium using natural uranium as input to the enrichment facility requires about 230 SWU of enrichment capacity. *Id.* at 204.

[139] Enrichment from 20 % enriched uranium to 90 % enriched uranium requires about 20 SWU. *Id.* at 204.

plant can present a substantial proliferation risk if it is combined with storage of enriched materials. Licensing addresses this risk by controlling both the capacity of ENR facilities and the storage of nuclear materials at the facility and within a State more broadly. Strengthened IAEA inspections address this risk by reducing the time between when a State chooses to break-out and when the international community is notified of such break-out, but strengthened inspections alone cannot reduce the actual break-out time. Similarly, international ownership does not address this risk. Technology denial only addresses this risk to the extent that it prevents States from having ENR facilities at all. In fact, technology denial might have the perverse consequence of encouraging a State to stockpile nuclear materials so as to protect itself against being cut-off from nuclear trade.

Licensing also provides a mechanism to monitor and control a wide range of nuclear activities that that are not ENR, but that could shorten a state's break-out time. For example, some types of research reactors or medical isotope production facilities can be used to produce material that a reprocessing facility could use to extract plutonium for explosive purposes. Licensing could address this risk by, for example, banning research reactors or medical isotope production facility designs that had an excessive capacity to produce plutonium. International ownership proposals do not provide a mechanism to address this risk. Strengthened IAEA inspections would be better able to detect diversion from research reactors or medical isotope production facilities than the current regime, but they would not prevent States from having a research reactor or medical isotope production facility that could produce plutonium. Technology denial would likely be ineffective against this risk as the technology for plutonium production with some types of research reactors and medical isotope production facilities is already widespread.

Controlling the Number of States that have a Latent Nuclear Capability

Licensing controls the number of states that have a latent nuclear capacity in a non-discriminatory fashion. By imposing a global limit on ENR capacity that is matched to the global need for nuclear fuel, licensing, in effect, imposes a total limit on the global number of ENR facilities, and thereby, a limit on the number of states that have ENR facilities. Because this limit is based on the global need for nuclear fuel and not on a State's present technical capacity, it is inherently non-discriminatory.[140] That does not mean that all states would be able to license an ENR facility. A license would require compliance with very detailed safety and security requirements that not all States could meet at present. In contrast, only the technology denial approach provides a mechanism for limiting the number of

[140] Note that it is possible that licensing could be implemented in a discriminatory fashion. For example, the INLA could only give licenses for ENR activities to the existing ENR-States. States and nuclear companies that adopt licensing would need to carefully approach implementation so as to not undercut the non-discriminatory nature of licensing. States and nuclear companies could take concrete steps that would give confidence that the licensing principle would be applied in a non-discriminatory fashion. For example, if there is a need for more enrichment capacity to meet a growing need for nuclear fuel, existing ENR states could refrain from expanding their facilities so that a new ENR facility could be built in a non-ENR State.

states that have ENR facilities, and that approach is explicitly discriminatory and likely not viable in the long term. International ownership lessens the economic need for new ENR facilities, but does not constrain the construction of such facilities for non-economic purposes, such as energy security or national pride. Strengthened IAEA inspections do not prevent the construction of new ENR facilities in non-ENR States.

3.6.2 Clandestine Trade and Facilities

Licensing controls the risk of an increase in nuclear trade leading to clandestine ENR facilities. By extending inspections over the entire nuclear supply chain, licensing can detect a diversion of equipment or supplies to clandestine activities at many points along the supply chain, not just when the equipment or supplies cross a national boundary. This extension strengthens existing IAEA safeguards and inspection techniques. Strengthened IAEA inspections would likely achieve a similar oversight. Internationally owned ENR facilities, however, would not address this risk. Although international ownership can lessen the economic justification for States to pursue their own ENR, international ownership does not change how clandestine trade could be detected. Technology denial would address this risk by simply limiting trade in ENR technologies that support clandestine facilities. However, technology denial is likely not feasible in the long term in a world with ten times more nuclear power.

3.6.3 Implementation and Funding

Although, ultimately, licensing will require some kind of international agreement, as described above, licensing can be initially implemented through a bottom-up voluntary process. States and nuclear companies can voluntarily commit to abide by the license principle and operate the facilities and nuclear companies accordingly. In contrast, the other proposals cannot be adopted voluntarily. As detailed above, international ownership requires a long and drawn-out international negotiation between at least two states. Strengthened IAEA inspections would require amendments to Safeguard agreements between the IAEA and each member state, analogous to the process that was employed to adopt the Additional Protocol. Technology denial is likely not feasible in the long term. Thus, while the other proposals require a long implementation process to achieve some non-proliferation benefits, the licensing principle could be adopted today by willing States and nuclear companies.

Licensing, as presented, here has the added benefit of providing a funding mechanism for both its implementation and the increased inspections that will be required in a world with ten times more nuclear power. The other reform proposals will also require more funding, but their source is not as natural a fit as asking the regulated industry to pay for the regulatory system. Strengthened IAEA inspections would likely be paid for by additional contributions by IAEA member states. International ENR facilities would likely be funded by capital contributions from the States that agree to build and host such facilities. In contrast, under licensing, increased inspections would be paid for by the nuclear reactors that drive the need for the inspections.

3.6.4 Other Benefits

Safety and Security

Non-proliferation concerns are only one of many issues implicated by nuclear technologies. Safety and security concerns are also paramount. As the recent accident at Fukushima reconfirmed, nuclear reactors can have catastrophic accidents that affect hundreds of thousands of people and that can in turn impact the global nuclear power industry. Security lapses at reactors and ENR facilities could lead to theft of nuclear materials by non-state actors who could use the material to assembly a radioactive explosive, i.e., a dirty bomb. At present, safety and security standards are typically set and enforced by domestic regulators. Although domestic regulations are informed by the World Institute for Nuclear Safety (WINS), the World Association of Nuclear Operators (WANO), and voluntary guidelines developed by the IAEA,[141] there are no mandatory detailed safety or security standards for the global nuclear industry.[142]

There have been proposals to clearly define safety and security standards and to assess compliance, perhaps through a new international convention.[143] Licensing would provide an alternative mechanism to create and enforce safety and security standards. For example, the INLA, in cooperation with the IAEA and industry NGOs, such as WANO, WINS, and the Institute of Nuclear Power Operations

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[141] IAEA safety standards are available at www.ns.iaea.org/standards/. IAEA security standards are available at www.ns.iaea.org/security/nuclear_security_series.asp.

[142] Decker and Rauhut 2016, pp. 2–3. Note that an amendment to the Convention on the Physical Protection of Nuclear Material will go into force on May 8, 2016 and pertains to the security and physical protection of nuclear material. IAEA, 'Road Towards Entry Into Force of Key Nuclear Security Agreement,' April 8, 2016, www.iaea.org/newscenter/news/road-towards-entry-into-force-of-key-nuclear-security-agreement. Although certainly strengthening the security of nuclear material worldwide, the Amendment does not create detailed security standards for the operation of nuclear facilities. Rather, the Amendment requires states to implement an appropriate physical protection regime in general. Nuclear Security—Measures to Protect Against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA GOV/INF/2005/10-GC(49)/INF/6, available at www.iaea.org/About/Policy/GC/GC49/Documents/gc49inf-6.pdf.

[143] For example, the Nuclear Security Governance Experts Group has published a draft convention on nuclear security that would impose strict security standards and provide for a compliance mechanism. Bernhard et al. 2015.

(INPO), could develop standards and best practices that licensees would be required to adopt as a condition of their license. Compliance would be enforced through the same mechanism as compliance with other license terms. Thus, through licensing, the nuclear industry could adopt global safety and security standards and best practices, and more closely resemble the civil aviation and maritime industries, which operate in compliance with international safety standards set by the International Civil Aviation Organization and International Maritime Organization, respectively.[144]

Norms of Behavior

A subtle, but perhaps far reaching consequence of adopting the licensing approach is the potential for changing norms of behavior with regards to nuclear technologies. At present, because of the ambiguity of peaceful use, engineers, companies and States can have different conceptions of what constitutes peaceful use. For example, an engineer designing and operating an ENR facility may believe that an ENR facility that produces and stockpiles 20 % enriched uranium is for peaceful use because he/she himself has no intention of using the facility for weapons. Likewise, a State government can presently argue to both a domestic and international audience that such a facility is for peaceful use as there is a legitimate need for 20 % enriched uranium for some reactors. Under a licensing regime, however, a nuclear engineer will know that such a facility is only peaceful if it is licensed. Because there is a limited need for 20 % enriched uranium, stockpiling such material is unlikely to be a licensed activity. Thus, the engineer asked to design, build or operate such a facility will know that it is likely intended to be non-peaceful. Although some engineers may welcome the opportunity to build a covert weapons program, others may not. By removing the ambiguity of peaceful use, licensing strengthens the arguments of opponents and narrows the view of what nuclear activities are acceptable to both engineers and States.

3.7 Conclusion

This chapter has described an alternative for managing the proliferation risk that would be created by a vast expansion in the use of nuclear energy worldwide. As mentioned in the introduction, the Chapter is not intended to argue either for or against such an expansion. Whether such an expansion will occur remains uncertain. In fact, in recent decades, nuclear power has been eclipsed by renewable energy sources, such as wind and solar power. More than 40 times more renewable

[144] Decker and Rauhut 2016, p. 7.

power than nuclear power has been connected to electrical grids worldwide over the past fifteen years.[145]

Nevertheless, nuclear power has many advantages over intermittent renewables—it is always on and it requires very little land. The rapid increase in solar and wind power may not continue—either because the price for these technologies may stop falling or because government policies supporting these technologies may cease. Many climate and energy experts remain very pro-nuclear, and the need for carbon-free sources of electricity is increasing, especially in light of the recent Paris Agreement on climate change.[146] As a consequence, governments and private companies are investing in new nuclear fuel cycles and nuclear technologies.

Thus, it is not inconceivable that nuclear power will become a substantial source of energy for many states world-wide in combination with renewables. Although reform to the existing non-proliferation regime will take time and may be unnecessary if nuclear power declines, it is worth considering now how a possible expansion of nuclear power can be governed in a way that does not increase proliferation risk before such an expansion is underway. International licensing layered on top of the NPT may be one such governance path and should be further studied. It would constrain the most sensitive aspects of the nuclear fuel cycle, give confidence to the global community that ENR facilities were not being misused, and balance, in a non-discriminatory fashion, each State's right to pursue peaceful use of nuclear energy with its obligation to not pursue nuclear weapons.

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[145] Schneider and Froggatt 2015, p. 93. The growth in renewables has been driven, in part, by the rapid decline in their price. For example, the price of utility-scale solar power plants has fallen by a factor of two between 2007 and 2014. Bolinger and Seel 2015, p. 13. Electricity storage prices are also falling rapidly. For example, the price of Li-ion electric car batteries is currently falling at a rate of about 14 % per year. Nykvist and Nilsson 2015.

[146] United Nations Framework Convention on Climate Change, Paris Agreement, (December 12, 2015), *available at* http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf.

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Chapter 4
Perspectives on a Treaty Prohibiting the Production and Stockpiling of Weapon-Usable Nuclear Material

Tariq Rauf and Usman Iqbal Jadoon

Abstract Negotiations on a treaty banning the production of fissile materials for nuclear weapons, and other nuclear explosive devices, has been on the international agenda for nuclear non-proliferation and disarmament for decades. A fissile material cut-off treaty (FMCT), later known as a fissile material treaty (FMT), was originally conceived as a measure to prevent additional States developing nuclear weapons and to limit the stocks of fissile material for States already possessing nuclear weapons. Over time, nuclear-weapon States pushed for a treaty that would only prohibit future production, while several non-nuclear-weapon States favoured two parallel objectives—nuclear non-proliferation and nuclear disarmament—and the inclusion of existing stocks and also their elimination. In 1993, the United Nations General Assembly adopted a Resolution calling for the negotiation of a FMCT in the Conference on Disarmament (CD). The CD took up the matter in 1994 and by March 1995, a compromise-negotiating mandate was cobbled together by Ambassador Gerald Shannon that envisaged negotiations on a treaty with the proviso

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Only the personal views of the two co-authors are presented here solely for discussion purposes.

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that any delegation could raise any relevant matter during the negotiations. Until now States have not been able to coalesce around a common negotiating mandate. This chapter reviews the ups and downs of the efforts to discuss treaty related issues and provides a technical yet accessible discussion on issues of definitions of fissile and nuclear material; the scope of coverage of a treaty; verification models; institutional aspects; and negotiating approaches, and suggests a practical way for making progress on this overdue important non-proliferation and disarmament measure.

Keywords Conference on disarmament (CD) · Enrichment · Fissile material · Fissile material · FMCT · FMT · Nuclear material · Plutonium · Reprocessing · Shannon mandate · Weapon-usable nuclear material

Contents

4.1 Introduction

A treaty prohibiting the production and stockpiling of nuclear material for nuclear weapons and other nuclear explosive devices has been on the international nuclear non-proliferation and disarmament agenda since the 1950s.[1] This paper examines the various perspectives on objectives, definitions, scope, verification dimensions,

[1] According to US President Dwight D. Eisenhower, the first to propose a cut-off, 'we have always said it is not technically feasible to ban the bomb now but we have actively urged the cut-off as a first step'. The concept of controlling fissile material production had been discussed since the Baruch Plan, but a key moment in the history of the cut-off took place on 11 September 1956 when President Eisenhower considered a proposal by disarmament advisor Harold Stassen for international inspection of fissile material production with future production to be 'used or stockpiled exclusively for non-weapons purposes under international supervision'. Joint Chiefs

institutional aspects, and possible negotiating approaches for a treaty prohibiting the manufacture and stockpiling of fissile material for nuclear weapons with the objective of contributing indivisibly and irreversibly to nuclear disarmament and nuclear non-proliferation. In its early iterations and until 1998, the proposals for such a treaty as explained below covered only the prohibition of future production and stockpiling of fissile material for nuclear weapons, i.e. a 'fissile material *cut-off* treaty' (FMCT). Following the nuclear explosive tests first by India, and then by Pakistan, in May 1998, the discussion in the CD also focused more specifically on a treaty that should cover existing stocks, or past production, of weapon-usable fissile materials, i.e. a 'fissile material treaty' (FMT). In light of current developments, such as the 2005 nuclear cooperation agreement between the US and India, the subsequent 'waiver' of its restrictions on nuclear exports to India in 2008 by the participating governments of the Nuclear Suppliers Group (NSG); the controversy over Iran's nuclear programme resulting in the July 2015 Joint Comprehensive Plan of Action limiting Iran's enrichment and reprocessing capabilities; the earlier undeclared reprocessing activities in the Republic of Korea reported by the IAEA in 2004; the nuclear explosive tests by the Democratic People's Republic of Korea (in 2006, 2009, 2013 and 2016); and the focus on securing and strengthening the security of weapon-usable nuclear materials as evidenced in the Nuclear Security Summits (2010, 2012, 2014 and 2016), among others, the authors believe that only a FMT covering future production and stockpiling *as well as* current stocks can contribute *inter alia* to regional and international security in terms of irreversibility of nuclear disarmament.

The era of nuclear weapons was ushered in on 16 July 1945 with the explosion of the 'Gadget', the world's first nuclear explosive device. This was followed shortly thereafter with the use of nuclear weapons over Hiroshima and Nagasaki, on 6 and 9 August 1945, respectively. The 'Gadget' was an implosion-type plutonium (Pu-239) device. The Hiroshima nuclear weapon, code-named 'Little Boy', used the 'gun' design with highly enriched uranium U-235 as its source nuclear material. The Nagasaki nuclear weapon, code-named 'Fat Man', also was an implosion-type plutonium device. Nuclear materials that can sustain a chain reaction are called 'fissile' or 'special fissionable materials'. The two 'fissile' materials used in nuclear weapons are: U-235, i.e. highly enriched uranium (HEU) sometimes referred to as 'oralloy' meaning Oak Ridge Alloy; and plutonium Pu-239. HEU is produced in enrichment facilities, using a variety of technologies, the most common being gas centrifuges. Plutonium (Pu) for nuclear weapons is produced in dedicated production reactors, though plutonium recovered from research and power reactors also can be used for weapons but it is of a lower grade. Lower grades of uranium and plutonium are used in the civilian fuel cycle and higher

Footnote 1 (continued)
of Staff Chairman Arthur Radford objected on the grounds that 'we would have to revise all our war plans if we stopped atomic stockpiling', but Eisenhower disagreed: '[Some] other way must be found.' U.S. State Department (1956), Memorandum of a Conversation, White House, 11 September 1956, Foreign Relations of the United States 1955–1957 Volume XX (Washington, D.C.: Government Printing Office, 1990), http://nsarchive.gwu.edu/nukevault/ebb321/, 423–427.

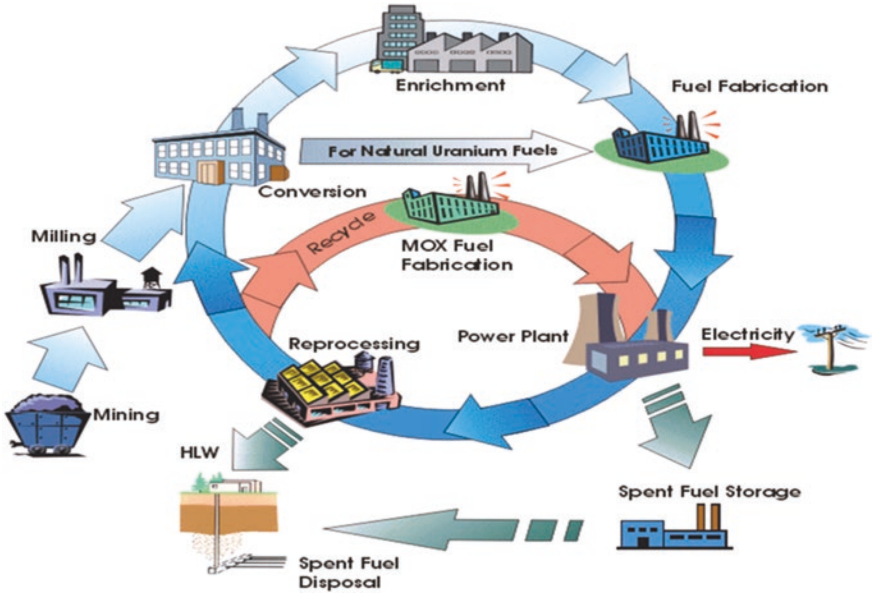

Fig. 4.1 The nuclear fuel cycle. © International Atomic Energy Agency (see IAEA 2005), reproduced with kind permission of the IAEA

grades for weapons. Uranium enrichment or (plutonium) reprocessing facilities can be used to produce both weapon-grade and reactor-grade nuclear materials. The nuclear fuel cycle was created for military purposes and later was adapted to produce nuclear material for peaceful purposes, hence its dual nature—see Figs. 4.1 and 4.2.

4.1.1 Overview of Approaches to a Fissile Material (Cut-off) Treaty: 1950s–2016

The first known proposal to constrain the production and stockpiling of weapon-usable nuclear material is to be found in the Franck Report of 11 June 1945.[2] The Agreed Declaration on Atomic Energy of 15 November 1945 proposed the establishment of a United Nations Atomic Energy Commission (UNAEC) with a mandate *inter alia* to ensure the peaceful use of atomic energy.[3] This was followed by the Acheson-Lilienthal Report on the International Control of Atomic Energy of

[2] Franck Report 1945, Bulletin of the Atomic Scientists, Vol. 1, No. 10, 1 May 1946.

[3] Agreed Declaration by the President of the United States, the Prime Minister of the United Kingdom, and the Prime Minister of Canada, Washington (15 November 1945), https://www.loc.gov/law/help/us-treaties/bevans/m-ust000003-1304.pdf.

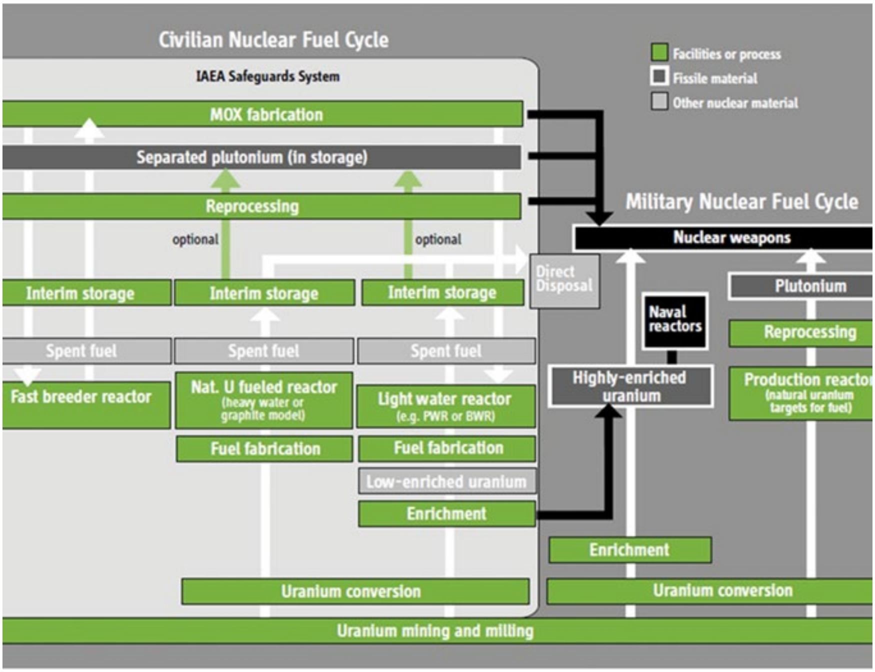

Fig. 4.2 The nuclear fuel cycle: civil and military. © International Panel on Fissile Materials (see IPFM 2006), reproduced with kind permission of the IPFM

16 March 1946.[4] It proposed that an international agency to be called the Atomic Development Authority should own all fissile material and production and release small quantities of nuclear material to individual States for peaceful uses of atomic energy. On 13 June 1946, Bernard Baruch presented to the UNAEC his plan that proposed the creation of an International Atomic Development Authority (IADA) that would be entrusted with 'managerial control or ownership of all atomic energy activities potentially dangerous to world security'. The nuclear-weapon tests by the USSR in 1949 and by the United Kingdom in 1952, and the USSR's test of a thermonuclear device in August 1953, confirmed the erosion of the US' nuclear monopoly and led to the 8 December 1953 'Atoms for Peace' speech by US President Dwight Eisenhower that called for drawing the fissile materials of the nuclear-weapon States into a common pool to be used by all States for peaceful purposes.[5] Indian Prime Minister Jawaharlal Nehru proposed an FMT in 1954,[6] President Dwight Eisenhower in 1956,[7] President Lyndon Johnson

[4] Acheson-Lilienthal Report 1946.

[5] Eisenhower 1953.

[6] Cortright and Mattoo 1996.

[7] Fetter and von Hippel 1995.

in 1964,[8] President Richard Nixon in 1969, Canadian Prime Minister Pierre Trudeau in 1978,[9] USSR Foreign Minister Andrei Gromyko in 1982, USSR General Secretary Mikhail Gorbachev in 1989,[10] Russian President Boris Yeltsin in 1992, and US President Bill Clinton in 1993. In 1978, the First Special Session of the UN on Disarmament (UNSSOD-I) called for a cessation of the production of fissionable material for weapons purposes, as did UNSSOD-II in 1982.[11]

The General Assembly adopted its first Resolution on prohibiting the production of fissionable material for nuclear weapons in 1957. Resolutions on prohibiting the production of fissionable material for nuclear weapons were tabled in the General Assembly following UNSSOD-I, proposed by Canada, and adopted by vote; but negotiations could not be started due to differences in the positions of States. In September 1993, President Bill Clinton speaking at the General Assembly proposed an international agreement on such a prohibition and this eased the way for a Canadian co-sponsored resolution to be adopted by consensus for the first time.[12] This resolution recommended the 'negotiation in the most appropriate international forum of a non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices' and requested 'the International Atomic Energy Agency to provide assistance for examination of verification arrangements for such a treaty as required'.

The Clinton proposal grounded a FMT within the US' nuclear non-proliferation strategy with a view to curtail access to weapon-usable nuclear materials to potential proliferators. The US envisaged a treaty that would prohibit the production of fissile material for nuclear weapons or other nuclear explosive devices, but it would not address existing stocks nor would it include non-fissile materials such as tritium, nor exotic materials such as americium, and exclude fissile material for non-prohibited purposes such as naval and space propulsion systems.[13] The Clinton fissile material initiative excluded existing stocks partly as a result of a commitment given to Israel at the latter's specific request and as such Israel did not block consensus on the 1993 resolution.[14] Israel did not support a treaty as in its view it would seriously impact on its long-standing policy of opacity regarding its nuclear weapon programme—in recent years, given the controversy over Iran's nuclear programme, Israel's position opposing a FMCT has hardened though it has kept a low profile.

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[8] Burns and Coyle 2015.

[9] Thompson 2009.

[10] Fetter and von Hippel 1995.

[11] United Nations, S-10/2, Final Document of the Tenth Special Session of the General Assembly, para 50(b), http://www.un.org/disarmament/HomePage/SSOD/A-S-10-4.pdf; and A-S/12-32, UNSSOD-II, http://www.un.org/ga/search/view_doc.asp?symbol=A/S-12/32&referer=http://www.un.org/disarmament/HomePage/SSOD/ssod4-documents.shtml&Lang=E.

[12] UNGA Res 48/75L.

[13] McGoldrick 1995.

[14] Benn 1999. Benn wrote that in 1998 Prime Minister Benjamin Netanyahu told President Clinton: 'We will never sign the treaty, and do not delude yourselves—no pressure will help. We will not sign the treaty because we will not commit suicide'. See also IPFM 2008, pp. 29–31.

It may be noted that by this time four of the five NPT nuclear-weapon States (France, Russian Federation, United Kingdom and the United States), having amassed excessive stockpiles of weapon-usable fissile materials that were far in excess of their foreseeable defence needs, already had announced unilateral moratoria on the further production of weapon-grade plutonium and highly enriched uranium. Therefore, a treaty banning the future production of fissile material, without the inclusion of existing stocks, was completely cost-free for them and placed them at an advantage over others. This luxury was not available to China and the later entrants to the nuclear weapons club, sequentially Israel, India, Pakistan and the DPRK, which not surprisingly did not find it in their respective national security interest to endorse a FMT that excluded existing stocks.

Following up on the momentum of the United Nations General Assembly (UNGA) Resolution of September 1993, in January 1994 the Conference on Disarmament (CD) decided to appoint a Special Coordinator to explore the views of States on the most appropriate arrangement to negotiate a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices as requested by the UNGA. Accordingly, Ambassador Gerald Shannon (Canada) was appointed as Special Coordinator. By June, following extensive consultations, Ambassador Shannon announced that there was consensus in the CD that it was the appropriate forum for the negotiation of a treaty. In March 1995, the Conference on Disarmament (CD) agreed on a mandate for negotiations based on the 1993 UN General Assembly Resolution:

- The CD decides to establish an *ad hoc* committee on a ban on the production of fissile materials for nuclear weapons or other nuclear explosive devices;
- The CD directs the *Ad Hoc* Committee to negotiate a non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices; and
- The *Ad Hoc* Committee will report to the CD on the progress of its work before the conclusion of the 1995 session. (The committee did not meet as it could not agree on its programme of work, and as a consequence, it did not produce a report.)

Ambassador Shannon, in his report on consultations on the most appropriate arrangement to negotiate a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices, stated that during the course of his consultations many delegations had expressed concerns about a variety of issues relating to fissile material, including the appropriate scope of the treaty. He added that some delegations had expressed the view that this mandate would permit consideration in the CD only of the future production of fissile material, while other delegations were of the view that the mandate would permit consideration not only of future but also of past production. Still others were of the view that consideration should not only relate to production of fissile material (past or future) but also to other issues, such as the management of such material. As such, Ambassador Shannon made his conclusion that it had been agreed by delegations that the mandate for the establishment of the *Ad Hoc* Committee did not preclude any delegation from raising for consideration in the *Ad Hoc* Committee any of the above noted issues. He noted that delegations with strong views were able to join consensus such that all delegations could move forward on this issue, and that an *Ad Hoc* Committee on a fissile material cut-off treaty could be established and negotiations could begin on this important topic, which had for some time been the common objective of all delegations of the CD.[15]

The 24 March 1995 Report of the Special Coordinator (CD/1299), submitted by Ambassador Gerald Shannon of Canada, contained an agreed mandate that basically repeated the operative language from Resolution 48/75L together with the understanding that all issues pertaining to scope could be addressed in the context of the treaty negotiation. Hence, the key differences were fudged, in particular on the issue of scope—whether the treaty would be limited to banning the *future* production of fissile material or it also would cover *existing stocks* of fissile material (a critical area of disagreement in view of the asymmetries in fissile material holdings between the various nuclear-armed States). The Shannon Report and mandate contained therein reflected the maximum agreement possible at the time, given the sharp differences in the negotiating positions of States as well as in their objectives for a nuclear (fissile) material control treaty (FMT). Both Resolution 48/75L and the Shannon Report with the mandate contained therein essentially glossed over certain crucial issues relating to the negotiation of any non-discriminatory and multilateral treaty controlling weapon-usable nuclear material.

In this context, it needs to be recalled that the Shannon Report was cobbled together rather quickly as many Western delegations felt it important to achieve some consensus on a FMT negotiation at the CD before the opening of the critically important 1995 Review and Extension Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPTREC). Hence, Western delegations that were opposed to the notion of including existing stocks in the negotiating mandate successfully manoeuvred consensus on the so-called 'Shannon mandate' contained in the Report of Ambassador Shannon to the effect that while stocks were not included specifically, any delegation could raise the matter during negotiations in an *ad hoc* committee. This in-built defect in the 'Shannon mandate' has blighted discussions on a FMT for more than two decades.

Differences over the scope and other important issues prevented the adoption of any other General Assembly resolutions from 1994 through 1997, and stymied any progress at the CD until 11 August 1998 when preliminary negotiation started on the basis of CD/1299. On 11 August 1998, the CD agreed to establish an *ad hoc* committee to negotiate a fissile material cut-off treaty on the basis of the Shannon Mandate. The 1998 CD session formally ended on 8 September and this short time (of less than one month) that was available to the *ad hoc* committee was used up for general not substantive discussions. The CD's Annual Report for 1998 (CD/1557) noted that, '[d]uring the meetings of the *Ad Hoc* Committee,

[15] CD/1299, Report of Ambassador Gerald E. Shannon on 'Consultations on the most appropriate arrangement to negotiate a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices' (24 March 1995).

delegations had a general exchange of views, as a first step in the substantive negotiations'. Therefore, while a decision on commencement of negotiations was adopted by the CD in August 1998, it did not lead to actual negotiations, and the CD would need to start anew in its 1999 session to reach agreement on an agenda and a programme of work in keeping with its rules of procedure.

On 4 December 1998, General Assembly Resolution 53/77I was adopted by consensus and it encouraged the CD to resume negotiation on a FMT during its 1999 session on the basis of the Shannon report and its mandate. Since then, the CD has been stalemated on the matter of adopting a programme of work and following that to start negotiations on items pursuant to its programme of work. The UN General Assembly has continued to adopt non-consensus resolutions on the negotiation of a FMT on the basis of CD/1299.

During the 1990s, some countries such as China and the Russian Federation linked treaty negotiations in the CD to other issues on the CD's agenda such as the prevention of an arms race in outer space (PAROS), and other countries to nuclear disarmament [Group of 21 non-aligned States (NAM)]. During and following the negotiations on a Comprehensive Nuclear-Test-Ban Treaty (CTBT) in 1996 in the CD, several NAM states emphasized the importance of negotiating in the CD measures on nuclear disarmament as well as negative security assurances for non-nuclear-weapon states. And, India clearly stated that it would not support the start of negotiations in the CD on any matter unless negotiations were started in parallel on nuclear disarmament.

During the better part of 2000s, the US under the Bush administration was not ready to negotiate a verifiable treaty and this emerged as the most significant obstacle to the adoption of a programme of work and commencement of negotiations. India only agreed to support the start of FM(C)T negotiations as a result of its NSG waiver of 2008 and subsequent civil nuclear cooperation agreements with NSG States. China and the Russian Federation have openly stated that a FM(C)T is not their priority and for them PAROS is much more important. NAM/G-21 States, for their part, have repeatedly called for the inclusion of stocks in the treaty's negotiating mandate.

During the Bush Administration (2000–2008), the US advocated a simple FMT devoid of any verification provisions and without the inclusion of stocks and, contrary to previous UNGA resolutions, even tabled a draft FMT[16] without verification provisions leading to a holdup in the start of negotiations in the CD. President Obama reversed the Bush Administration's opposition on verification and announced in his Prague speech of April 2009 that the US would now support a verifiable treaty.[17] However, by this time, given the 'waiver' granted by the

[16] CD/1777(2006), Working Paper by the United States of America, 'Draft Treaty on the Cessation of Production of Fissile Material for Use in Nuclear Weapons or Other Nuclear Explosive Devices', (http://daccess-dds-ny.un.org/doc/UNDOC/GEN/G06/615/55/PDF/G0661555.pdf?OpenElement).

[17] President Obama 2009.

Nuclear Suppliers Group (NSG) to India in September 2008 followed by its civil nuclear cooperation agreements with several major nuclear suppliers including Australia, Canada, France, Russian Federation and the US, the asymmetry was compounded in fissile material holdings in South Asia[18] leading to the prevention of the start of FMT negotiations in the CD on the basis of the Shannon Mandate, as several CD Member States remained unwilling or uncommitted to include existing stocks upfront in the negotiating mandate.[19] Since 2010, however, once Pakistan adopted a strong position against FM(C)T negotiations on the basis of the Shannon mandate, many other States have opted to let Pakistan take the lead in opposing the start of negotiations unless stocks are included. This does not mean, as is sometimes mistakenly reported, that Pakistan is the only country opposing the start of FM(C)T negotiations in the CD—many other States such as Brazil, Cuba, Egypt and Iran, among others, support the inclusion of stocks in the treaty's scope/negotiating mandate.

The lack of movement in the CD on the issue of fissile materials encouraged some States to consider the possibility of pursuing negotiations in some other forums outside the CD. In 2012, certain States succeeded in agreement on a resolution albeit non-consensually in the UNGA that called for the establishment of a Group of Governmental Experts (GGE)[20] (Resolution 67/53), to make recommendations on possible aspects that could contribute to *but not negotiate* a treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices (emphasis added). The 25 experts taking part in the GGE were personally and arbitrarily selected by the UN Secretary-General without consultations with UN member States. Some important stakeholders (fissile material producers) were not part of the GGE, such as the DPRK, Iran, Israel and Pakistan.

The GGE met in Geneva in four sessions of two weeks each, in 2014 and 2015 and produced a report (A/70/81) that was presented to the UN General Assembly at its 2015 session. The GGE failed to reach consensus on any element of the treaty as States stuck with their maximalist positions. The GGE's report presents merely a compilation of the differing views on a FMT, recycling some previous discussions, identifying certain new areas of divergence and it breaks no new ground nor advances the discussion either politically or technically. Moreover, its limited composition of 25 States (experts) coupled with its contentious genesis resulting from a divisive UN General Assembly resolution failed to give it any traction inside the CD. It is important to recognize that the CD today is composed of 65 member States. When established in 1979, its initial membership of 40 States was the result of a consensus decision by the first special UNGA session devoted to disarmament (SSOD-I). The two subsequent membership expansions

[18] Akram 2010.

[19] Khan 2005.

[20] UNGA Res 67/53(2013).

in 1995 and 2003 also were agreed in consensus decisions of the CD. The membership of the CD is limited by design, for functional reasons, and is decided by the UN member States themselves. The CD includes all militarily and politically significant States including the five nuclear-weapon States, Brazil, DPRK, Egypt, India, Iran, Israel, Japan, Pakistan and South Korea among others. No major stakeholder has been left out of the CD. This contrasts sharply with the FMCT GGE that was established through a divisive UNGA resolution adopted by majority voting. Given the limitations noted above, it remains doubtful whether the report of the GGE can be a useful contribution to further advancing the consideration of a FMT or achieving a breakthrough in starting negotiations.

4.1.2 Definitions

There exists no internationally recognized or established definition of fissile material[21] for FMT negotiation purposes; however, the IAEA has defined fissionable material for safeguards purposes.[22] The main challenge for future negotiators of a FMT would be to 'specify those fissile materials that will be banned and those that will not, distinguishing between fissile materials that have a strictly civilian application and those that are capable of being used in nuclear weapons'.[23] *Prima facie*, this appears to be an uncontroversial scientific question. In reality, however, there are several related issues that complicate the matter.

All nuclear weapon possessing States, with the exception of Pakistan, prefer a narrow definition of fissile material that is either limited to 'direct use' or strictly 'weapon-grade' uranium-235, uranium-233 and plutonium-239 only. Although these are the most common fissile materials, constricting the definition to this extent ignores the other weapon-useable fissile materials such as neptunium-237 and americium-241. As noted by the International Panel on Fissile Materials (IPFM):

[21] United Nations Office for Disarmament Affairs (UNODA) Fact Sheet 2016: 'Fissile materials are those elements that can sustain an explosive fission chain reaction and are essential in all nuclear explosives'. The most common fissile materials in use are highly enriched uranium (HEU) and plutonium. Fissile materials that can be directly used in nuclear weapons do not occur in nature. They must be produced through complex physical and chemical processes'.

[22] IAEA Safeguards Glossary, 2002, para 4.6. Fissionable material—in general, an isotope or a mixture of isotopes capable of nuclear fission. Some fissionable materials are capable of fission only by sufficiently fast neutrons (e.g. neutrons of a kinetic energy above 1 meV). Isotopes that undergo fission by neutrons of all energies, including slow (thermal) neutrons, are usually referred to as fissile materials or fissile isotopes. For example, isotopes U233, U235, Pu239 and Pu241 are referred to as both fissionable and fissile, while U238 and Pu240 are fissionable but not fissile.

[23] United Nations Institute for Disarmament Research (UNIDIR), 2010, p. 15.

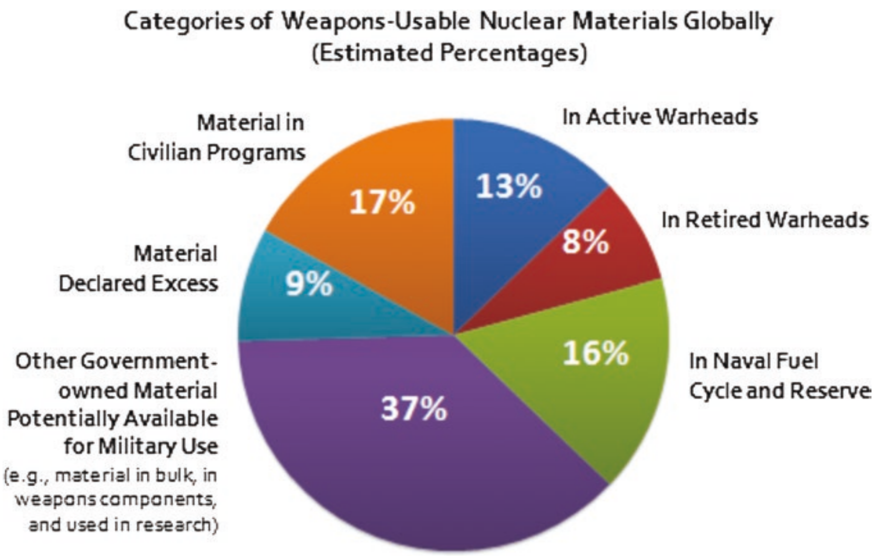

Fig. 4.3 © Nuclear Threat Initiative (see NTI 2016), reproduced with kind permission of the NTI

> While Pu-239 and U-235 are the only fissile materials known to be used in deployed nuclear weapons, the United States has tested designs containing U-233 and France may have experimented with neptunium-237 in nuclear tests. We are unaware of any public report of weapons experiments involving americium, but U.S. weapons designers have concluded that designs using americium as a nuclear weapon fuel could be made to work.[24]

It is presently estimated that about 1800 metric tonnes of weapon-usable materials are located across 25 countries, with about 83 % of these materials in non-civilian use and thus relevant for purposes of a FMT.[25] As shown in the diagram above, not all weapon-usable nuclear materials are contained in active nuclear warheads, but also in retired warheads, naval fuel cycle and reserve, material declared excess to defence requirements, in government-owned stocks as well as civilian use (Fig. 4.3).

How fissile materials end up being defined in the treaty will also have a direct consequence on the overall scope and verification requirements of the treaty. While a broader definition that covers materials that could be fissile but are less common, such as americium and neptunium, could close possible loopholes, some argue that this could also lead to more verification effort and expense.

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[24] International Panel on Fissile Materials (IPFM) 2013, p. 10.

[25] Browne et al. 2015, p. 2.

All in all, a Fissile Material Treaty would need to apply to the following materials: (a) high enriched uranium; (b) separated (unirradiated) plutonium; (c) separated U-233; (d) (possibly) separated neptunium; and (e) (possibly) separated americium. Besides the significant differences of opinion on the inclusion of neptunium and americium in the treaty's scope, there is also a wide divergence of views on the enrichment level of uranium and the isotopic composition of plutonium that would be stipulated in the definition of fissile material. The four principal options in this regard are elaborated below. The *first* option is based on Article XX (1) and (2) of the Statute of the International Atomic Energy Agency (IAEA), which provides as follows:

1. The term "special fissionable material" means plutonium-239; uranium-233; uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing; and such other fissionable material as the Board of Governors shall from time to time determine; but the term "special fissionable material" does not include source material.
2. The term "uranium enriched in the isotopes 235 or 233" means uranium containing the isotopes 235 or 233 or both in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is greater than the ratio of the isotope 235 to the isotope 238 occurring in nature.[26]

This definition would encompass all uranium enriched above the natural level of 0.7 % and is thus considered overly broad by some States which feel that it sets the threshold too low. Yet many countries have expressed their preference for basing the treaty definition of fissile material in accordance with Article XX of the IAEA Statute.

The *second* option draws from the IAEA Safeguards Glossary's categorization of 'direct-use material': nuclear material that can be used for the manufacture of nuclear explosive devices without transmutation (e.g. through irradiation) or further enrichment. It includes Plutonium containing less than 80 % plutonium-238; Uranium-235 enriched to 20 % or above; Uranium-233; any combination of the above in chemical compounds, oxide mixtures (i.e. MOX fuel) and plutonium in spent fuel. Unirradiated direct use material is direct use material which does not contain substantial amounts of fission products; it would require less time and effort to be converted to components of nuclear explosive devices than irradiated direct use material (e.g. plutonium in spent reactor fuel) that contains substantial amounts of fission products.[27] The definitions put forward in the U.S. draft treaty[28] and the French draft treaty[29] as well as the draft treaty put forward by IPFM[30] are almost identical to this concept. This definition corresponds to

[26] Statute of the International Atomic Energy Agency (IAEA Statute), 276 UNTS 4, amended 1963, 1973, 1989, and 1999), https://www.iaea.org/about/about-statute, Article XX (1) and (2).

[27] IAEA 2002, para 4.25.

[28] CD/1777, 2006.

[29] CD/2020 (2015), France, 'Draft Treaty Banning the Production of Fissile Material for Nuclear Weapons or Other Nuclear Explosive Devices', Conference on Disarmament.

[30] International Panel on Fissile Materials (IPFM), 2009.

concepts that are already used by IAEA safeguards and seem to cover strictly weapon-usable material. The critics, however, point to its insufficient coverage of the nuclear fuel cycle and use of nuclear material, thereby decreasing the effectiveness of verification. Moreover, the verification efforts under this definition would lead to a distinction between the nuclear-weapon and non-nuclear-weapon States leading to charges of discrimination and non-uniform application.

The *third* option put forward by some nuclear-weapon States (notably the Russian Federation) is to develop a narrow definition of weapon-grade material containing 90 % or more of uranium-235 or uranium-233 or plutonium containing more than 90 % of plutonium-239. Evidently, such a restricted definition of fissile material would leave a considerable degree of weapon-usable material outside the scope and verification coverage of the treaty, causing significant loopholes that would diminish the credibility of the treaty, as it is possible to manufacture nuclear explosive devices with highly enriched uranium at enrichment levels below 90 %.

The *fourth* option is a compromise position between the second and third options. It provides for a specific isotopic composition, to be determined during negotiations based on the scope and verification requirements of the treaty. Some suggestions have been put forward in this regard such as the so-called 'Skotnikov-B' formula specifying HEU above 60 % enrichment in the isotope U-235 and plutonium with more than 60 % Pu-239 as fissile material.[31] Switzerland also has proposed that an 'appropriate FMT compromise would be… plutonium with an isotopic concentration of Pu-239 of more than 70 %; and highly enriched uranium containing more than 40 % of the isotope U-235; as well as U-233 and neptunium-237'.[32]

The future negotiations will have to decide how to address both the types of fissile material that may be included in the treaty's scope (i.e. Uranium-233, Uranium-235, Plutonium-239, Neptunium-237 and Americium-241), as well as the thresholds (enrichment levels and isotopic composition) at which their future production will be banned and existing stocks brought under the treaty's verification coverage. It is clear that for an effective and credible treaty, the widest possible practical definition would have to be agreed. It should be free of any loopholes and cover all fissile materials that can even remotely be used in nuclear weapons or other nuclear explosive devices—at present or with technical refinements in the future. The question of escalated financial costs in verifying such treaty provisions should not affect the finalization of a robust treaty.

[31] Conference on Disarmament 2011, Australia–Japan Experts Side Event on FMCT Definitions, Geneva, 14–16 February 2011.

[32] CD/1771, 2006, Working Paper by Switzerland, 'A pragmatic approach to the verification of an FMCT', Conference on Disarmament, p. 3.

4.1.3 Scope

The scope is the most contested aspect of the treaty. At the heart of the issue of scope lies a major divergence: whether the treaty should only ban the future production of fissile material, or it should also cover fissile material produced prior to entry-into-force. Over the years, the issue of scope has become synonymous with the issue of existing stocks of fissile material and has been the main issue preventing the start of treaty negotiations. This has even led to the use of two different names for the proposed treaty: Fissile Material Cut-Off Treaty (FMT) and Fissile Material Treaty (FMT).

When talking of fissile material, it is clear that only 'weapon-grade' and 'weapon-usable' material (elaborated in the section on definitions) would be covered in the scope of treaty's prohibition. The fissile material for civilian and military non-explosive purposes such as marine propulsion would be encompassed to the extent of being subjected to a safeguards regime verifying the non-diversion to proscribed uses; their production and use would not be affected.

In 1995, the Conference on Disarmament agreed under the so-called Shannon mandate to establish an *Ad Hoc* Committee to 'negotiate a non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices'. The Shannon mandate intentionally left a 'constructive ambiguity' regarding the issue of existing stocks. Shannon's report, after noting the different points of view regarding the inclusion/exclusion of past production, stated: 'It has been agreed by delegations that the mandate…does not preclude any delegation from raising for consideration in the *Ad Hoc* Committee any of the [stocks related] issues'.

Several non-nuclear-weapon States contend that the treaty should go beyond a simple ban on the future production of fissile material, and also cover past production, since the stockpiles are so huge that a prohibition on future production alone would have little practical effect on the number of nuclear weapons that could be produced.[33] The nuclear-armed States generally oppose this view, arguing that the main purpose of the production ban is to cap global inventories of fissile material. Pakistan remains the only nuclear-armed State that insists on the inclusion of existing stocks in the treaty's scope. Pakistan also has presented to the CD a detailed proposal for dealing with existing fissile material stocks in a comprehensive manner.[34]

The nuclear-weapon States also assert that it would be extremely difficult, if not impossible to credibly account for and verify past fissile material production. However, as noted by Meerburg and von Hippel:

[33] Meerburg and von Hippel 2009, pp. 16–23.

[34] CD/2036, 2015, Working Paper by Pakistan, 'Elements of a Fissile Material Treaty', pp. 2–3.

> The work done by the IPFM thus far encourages us to believe that it should be feasible technically for an FMT to capture under IAEA safeguards pre-existing stocks of fissile material in civilian use, declared excess for military use, and in naval fuel reserves and to verify the treaty about as well as the NPT can be verified in non-nuclear-weapon States. The political task of persuading States to agree to such constraints and access, however, may be the more difficult challenge.[35]

The debate over scope is also split on another level—whether the treaty is meant to further the goal of nuclear disarmament, or is it merely a non-proliferation instrument. The cause of nuclear disarmament would get a huge boost if the treaty covered the existing stocks of fissile materials as well as future production. In the words of one expert, '[a] legal prohibition on the production of fissile material for weapons purposes would do nothing to reduce already accumulated stocks of material and would consequently help to preserve the status quo in nuclear arms levels'.[36] Also, from a practical perspective, in case existing stocks are excluded from the treaty's scope, 'a major loophole would exist if the prescribed verification regime were unable to differentiate between stocks held at the date of entry- into-force and stocks produced illegally after that date'.[37]

Several non-nuclear-weapon States believe that only through the inclusion of existing fissile material stocks would the treaty be able to make a contribution towards nuclear disarmament. In addition, some nuclear-armed States, such as Pakistan, are worried that a freeze of the *status quo* would solidify the strategic advantage of their competitors that possess much larger stockpiles. The other nuclear-weapon States, comfortable that their fissile material holdings not only fulfill their current needs but also provide them the hedge against future risks and uncertainties, do not accept any linkage of the treaty with nuclear disarmament or bilateral asymmetries.

Given this polarized situation, some options have been presented that lie on the spectrum between the two extreme positions on the inclusion/exclusion of existing stocks. Although these ideas have not been able to bridge the divide and have largely been rejected by the nuclear-weapon States, they are briefly outlined below. The phased approach advocates a framework treaty containing basic norms and general principles along with transparency measures and other compulsory or voluntary steps that may be undertaken in parallel or in further phases of the process. The follow-up phases could include a Protocol dealing with the existing stocks of fissile material. In 2010, Brazil proposed such a general structure for a treaty, comprising a framework or umbrella treaty containing provisions on objectives, definitions and final clauses, and two protocols dealing respectively with future production of fissile material and fissile material which is not, at the moment of entry-into-force, contained in a nuclear weapon or in any other nuclear explosive device.[38]

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35 Meerburg and von Hippel 2009, pp. 16–23.

36 Persbo 2009.

37 UNIDIR 2010.

38 CD/1888, 2010, Working Paper by Brazil, 'Proposal on the structure of a treaty on fissile material for nuclear weapons or other nuclear explosive devices'.

Some have argued for a functional approach concentrating on developing bans on specific activities such as on the weapon use of at least three categories of pre-existing fissile materials including: (i) materials in civilian use; (ii) materials from dismantled weapons that have been declared excess for future military use; and (iii) highly-enriched uranium that has been reserved for future use in naval reactors.

For a treaty to be comprehensive, non-discriminatory and credible, and make a genuine contribution to nuclear disarmament, it would have to include all types of existing stockpiles of fissile material in its scope. This is not a technical or legal choice, but a political decision that is both desirable and doable.

4.2 Verification

An FMT foreseen by the 'Shannon mandate', General Assembly Resolutions and the States Parties to the NPT would include an undertaking not to produce any fissile material for use in nuclear weapons or other nuclear explosives, nor to assist other States in pursuing such activities. In so far as the production of such material for other legitimate purposes is concerned, it would follow that verification arrangements would need to be such as to meet all the requirements of the undertaking of an FMT.[39] The technical objective of verifying compliance with an FMT would be to provide assurance against any new production of weapon-usable fissile material and the diversion of fissile material from the civilian nuclear fuel cycle to nuclear weapon purposes—see Figs. 4.1 and 4.2 for the civil and military fuel cycles. Thus, there would be the need to ensure that stocks of plutonium and highly enriched uranium to be used for nuclear weapon purposes, where they exist at the date of entry-into-force of an FMT, are not increased thereafter. A key related issue would be how to deal with existing stocks of weapon-usable material.

A number of issues will have to be addressed by the States in order to clarify the basic undertaking of the States Parties and the scope of an FMT verification regime. These issues, as far as verification is concerned, can be reduced to two basic questions:

- How is the undertaking not to produce fissile material for weapon purposes to be verified? Could the undertaking, as agreed, be verified with a high degree of assurance by simply focusing on verification activities at core nuclear facilities—uranium enrichment and plutonium reprocessing facilities; or should the verification activities be comprehensive—i.e., focus on the entirety of the nuclear fuel cycle in States?
- How, and to what extent, should verification ensure that stockpiles for nuclear weapon purposes, where they exist, are not increased, and where they do not exist, are not created thereafter?

[39] This discussion on verification draws and builds upon the presentation by Rauf 2006; and Conference on Disarmament 2006.

The way in which States will address these issues would determine:

- the verification architecture and the scope of activities under the verification system (i.e., application of verification measures to the entire nuclear fuel cycle or to only parts of it);
- the ability of the verification organization to provide a high degree of assurance that no activity proscribed by the treaty is being conducted in or by a particular State, particularly through provisions to enable the verification body to detect possible undeclared nuclear facilities and activities, including undeclared fissile material production; and
- the overall costs of the verification system for the States party to an FMT.

An important question that follows is whether a FMT would create an entirely new international nuclear verification organization or whether it would rely on the existing safeguards (nuclear verification) system of the International Atomic Energy Agency (IAEA) with suitable additive features to deal with weapon-usable nuclear materials and their associated production and storage facilities? This matter is addressed in some detail in Sect. 4.3 below on Institutional Aspects. In any case, a FMT verification regime would not be able to function credibly without taking into account existing IAEA safeguards practices for verification of the sensitive parts of the nuclear fuel cycle: enrichment and reprocessing.

4.2.1 IAEA Safeguards Measures and Technology Related to Reprocessing and Enrichment

As the scope and verification requirements for an FMT are established, the relevance of IAEA experience and existing requirements for applying safeguards at enrichment and reprocessing facilities would be useful. It should be understood that the safeguards approach employed by the IAEA at enrichment and reprocessing facilities under safeguards in NPT non-nuclear-weapon States, nuclear-weapon States, and in non-NPT States, utilizes the *same* technical and measurement goals and thus the IAEA employs the same standard verification tools and concepts.[40] The IAEA, the Russian Federation and the United States have developed an

[40] IAEA safeguards are a set of technical measures devised to verify that nuclear materials are not diverted from peaceful uses to military uses. There are three types of safeguards agreements: Comprehensive Safeguards Agreements (CSA) for non-nuclear-weapon States party to the NPT and nuclear-weapon-free zones cover the entirety of nuclear materials and activities; Voluntary Offer Agreements (VoA) for the five NPT nuclear-weapon States cover specified nuclear materials and facilities made available by each State for safeguards; and Item-specific Agreements for non-NPT States cover specified nuclear materials and facilities. The same safeguards technical measures are applied by the IAEA in all three cases. See, IAEA 2015.

attribute verification system with information barrier for the monitoring of the Trilateral Initiative that covered ex-weapons plutonium declared excess by the two NWS.[41]

4.2.2 Declared Reprocessing Plants

The plutonium produced in nuclear reactors is separated from the uranium, fission products and other actinides in reprocessing plants. With very few exceptions, all plutonium reprocessing plants employ the same process technology, the Purex process.[42] Reprocessing plants require processing of intensely radioactive materials and hence require remote processing within very substantial structures to contain the radioactivity. These characteristics, together with difficulties inherent in measuring accurately the amounts of plutonium (or Uranium-233) at the starting point of the processing, make the application of safeguards complex and more expensive than any other safeguards application. IAEA safeguards at a plutonium reprocessing facility are intended to meet three objectives:

- to verify production of Pu as declared by the State;
- to detect excess or clandestine Pu production; and
- to detect diversion from the declared Pu product stream.

The safeguards approach for a reprocessing plant would depend on a range of considerations, chief among which is its operational status—whether it is in operation, stand-by mode, decommissioned or abandoned. The cost and effort required can vary from almost no cost for decommissioned or abandoned facilities up to continuous inspection with tens of millions of euros of verification effort and equipment.

The advantages of this option include the several decades' long experience of the IAEA in nuclear verification, the credibility of the Agency's safeguards conclusions, and the recognized independence and impartiality of the IAEA. Only the IAEA has the legal authority, under its Additional Protocol to comprehensive safeguards agreements, to confirm the absence of undeclared nuclear material and activities in non-nuclear-weapon States.

4.2.3 Declared Enrichment Plants

IAEA safeguards at a uranium enrichment plant are intended to meet three objectives:

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[41] Shea 2001.

[42] Uranium-233 is produced in a similar manner by irradiating thorium, and separated through a similar process; however, no uranium-233 reprocessing plants are in operation.

- to detect the undeclared production of HEU, or excess high enrichment production if high enrichment production is declared;
- to detect excess LEU production (that might subsequently be further enriched at a clandestine plant or within a plant under safeguards, with a higher risk of detection);[43] and
- to detect diversion from the declared uranium product, feed or tails streams.

Nuclear material accountancy verification applied to detect diversion from the declared feed, product and tails streams in an enrichment plant provide, in combination with other measures, a means to assure that a plant is not being used to produce undeclared HEU, and in those cases where a low enrichment plant has been used earlier to produce HEU, this method assumes increased importance.

For a given enrichment technology, in a manner similar to that for declared reprocessing plants, the safeguards approach for an enrichment plant will depend to a great extent on the operational status of the facility.

4.2.4 Clandestine Enrichment Plants

The methods used to detect undeclared enrichment plants are essentially the same as for undeclared reprocessing. Enrichment operations normally result in the release of aerosols—especially at locations where connections to the process piping are made, but also through the plant ventilation system. These aerosols may not travel very far, and thus environmental sampling is likely to be effective close by such facilities.

The difficulty in finding emissions from clandestine enrichment plants is further compounded by advances in enrichment technology that greatly reduce the size of plants and reduce the electrical power requirements.

4.2.5 Verification Coverage

A brief description follows of the possible verification scenarios, their associated costs and the level of assurances that those alternatives may provide with respect to compliance by States party to an FMT.

From a technical perspective, applying verification arrangements to anything less than a State's entire nuclear fuel cycle could not give the same level of

[43] More than 80 % of the separative work required to produce uranium-containing concentrations of uranium- 235 of 90 % or more is spent in raising the enrichment from natural levels (0.71 % uranium-235) to approximately 4 % enriched. A much smaller top-end facility would be needed to increase the enrichment from 4 % to high enrichment levels than if the facility were to start with natural uranium.

assurance of non-production of nuclear material for nuclear explosive purposes, as is provided by the IAEA in implementing comprehensive safeguards agreements in non-nuclear-weapon States. In order to provide States party to an FMT with a level of assurance analogous to the assurance provided by the IAEA under comprehensive safeguards agreements, the verification system would have to apply to the entire declared fuel cycle in those States and should be geared to the detection of undeclared production facilities and of treaty limited nuclear material.

Verification measures of an FMT would benefit by paralleling the existing strengthened IAEA safeguards system. Such measures are designed to take account of current and future technological developments as they may help increase the level of assurance provided by safeguards practices. In addition, they provide increased assurances with respect to the detection of undeclared facilities and fissile material, as mentioned earlier. Any fissile material produced after the entry-into-force of an FMT, either in fissile material production plants or through the operation of civil nuclear facilities would be subject to safeguards during processing, use and in storage.

To what extent States would be permitted to exempt from verification any existing fissile materials in their inventories, at the time of entry-into-force, would need to be discussed by States. For the purpose of clarity these stocks can be identified as follows:

- military stockpiles for weapon purposes (including nuclear material released from weapon dismantlement);
- military stocks of nuclear material for uses in non-proscribed activities; and
- civilian stocks.

If the verification regime were to be strictly limited to the task of verifying the undertaking not to produce fissile material for purposes proscribed by an FMT, it would not provide the assurance that existing stocks of fissile material to be used for the said purposes are not increased by means other than production—e.g. by declared and/or undeclared (illicit) imports of fissile material for use in nuclear weapons or other explosive devices, or by use of existing civil stocks or military stocks for non-proscribed military purposes—after the entry-into-force of the treaty.

Under a comprehensive verification scenario, where the entire civilian nuclear fuel cycles of the nuclear-weapon and the non-NPT States were under safeguards (as in the non-nuclear-weapon States), the in-field verification burden in these States would approximately quadruple by 2020 compared to the current level. However, under a more focused verification approach, which would place only more directly relevant facilities under safeguards, this effort would be 2.5 times more. Moreover, additional effort might be required to check that there is no clandestine production and to verify the shut down or conversion of former military facilities. An estimate of the necessary effort for that activity would require more information on relevant facilities.

Notwithstanding the fact that technically a comprehensive system of verification under an FMT would appear to be the best alternative; States might opt for a less resource intensive alternative, with a trade-off regarding the non-proliferation and disarmament benefits of a comprehensive approach against the reduced costs of more focused (nuclear facility targeted) approaches. States could, for example, constrain the technical objective of verification to the provision of assurance that all production facilities of direct-use material are either shut down or operated subject to verification; and that all stocks of fissile material not specifically excluded from verification once an FMT enters into force would remain subject to verification.

One important question is: will the international verification regime include measures to detect undeclared nuclear facilities and fissile material? Depending on the answer to this question, the verification system would or would not be able to deter potential violators and provide assurances against undeclared production of fissile material for weapon purposes in civil and/or military production facilities, and against the production of fissile material for weapon purposes in undeclared facilities.

Needless to say, any limitations placed on the verification system with respect to the items subject to verification would seem to reinforce the need for a well-defined and efficient mechanism allowing the verification organization to look for potential violations of an FMT, so that an acceptable or credible assurance can be given to all parties by any limited verification alternative that no violation has been perpetrated by a party.

In addition to the issues of coverage and scope, States would have to consider a number of specific issues relevant to the verification of an FMT. Although IAEA-type safeguards would need to be applied in many of the facilities which could become subject to verification; virtual turn-key application of IAEA safeguards may not always be possible because of the unique characteristics of monitoring former nuclear weapon facilities (specific security and safety issues, operational constraints stemming from decades of nuclear weapon material production, the 'unfriendly character' of such facilities with respect to safeguards, and the need to protect sensitive information against the risks of proliferation).

In some States, the military and civilian nuclear fuel cycles are not entirely separated therefore verification arrangements will have to be devised in such a manner as to take account of such States' legitimate concerns regarding the protection of classified information without hampering verification requirements.

Some States might continue to use HEU for naval propulsion reactors and for fuelling tritium production reactors; verification that no HEU has been diverted to proscribed explosive uses would have to be addressed in such a way as to keep intrusiveness at an acceptable level, while concurrently enabling the verification agency to provide the appropriate level of assurances of compliance with the treaty's provisions.

Tritium production would impact on verification of an FMT in two respects: first, HEU used as fuel in tritium production reactors could be diverted to weapons; and second, reactors dedicated to tritium production could also be used to produce plutonium for weapons. Thus, verification approaches would have to be devised to ensure that no proscribed activity is being conducted.

With regard to separated americium and separated neptunium, the IAEA has been implementing a voluntary reporting scheme in non-nuclear-weapon States based on a decision by the IAEA Board of Governors. In its Safeguards Implementation Report for 2014, the IAEA reported that the quantities of separated americium and separated neptunium in the non-nuclear-weapon States remain small and that therefore there is no indication of a proliferation risk. None of the nine nuclear-weapon possessing States are currently known to use these two materials in nuclear weapons; however, some experts have noted concerns that the non-inclusion of these materials might create an incentive for their use in the design of new nuclear weapons. As the CTBT prohibits all nuclear explosive testing, it is very unlikely that any State would design nuclear weapons using americium or neptunium as such designs could not be certified through explosive testing and thus not worth the risk or investment.

4.2.6 Existing Stocks

As noted above, one of the fundamental schisms in the approach to the scope of a treaty is existing stocks. The reasons advanced by some NWS against the inclusion of stocks primarily is that an accurate and complete accounting may not be possible as in the early years of the Cold War—1950s and 1960s—nuclear material accountancy was not the priority and was subservient to production of weapon-usable material. Other reasons include sanctuaries for weapon-usable material reserved for nuclear weapons, nuclear propulsion systems and strategic reserves. Nuclear material accountancy deficiencies can be addressed through initial declarations that are updated on a regular basis, openness and transparency in production records, and access to laboratories and storages. However, the objections to the exclusion of stocks have less to do with technical considerations and everything to do with political considerations as alluded to in an earlier section.

4.3 Institutional Aspects

An important question relates to the verification and oversight of the implementation of a FMT. Three possible options could be considered: (1) assigning the FMT verification to the IAEA; (2) the establishment of a Fissile Material Treaty [Verification] Organization (FMTO); and (3) a hybrid arrangement in which FMT verification is assigned to an independent new Department for FMT Verification (FMTV) within the IAEA.

4.3.1 IAEA Verification

While the IAEA could be given the verification responsibilities for a FMT, the Agency thus far does not have the expertise and experience to carry out verification or safeguards activities of the military nuclear fuel cycle. Though the IAEA has for decades carried out credible safeguards at enrichment and reprocessing facilities in non-nuclear-weapon States, and in some nuclear-weapon possessing States, this has covered civilian not military facilities and has relied on full disclosure of the isotopic content of the nuclear materials involved. With regard to verification or monitoring of nuclear materials and facilities in the military nuclear fuel cycle, the IAEA together with the Russian Federation and the United States developed a monitoring regime in connection with the Trilateral Initiative regarding excess weapon-grade plutonium in the two States. No actual monitoring has ever been carried out under the Trilateral Initiative and a monitoring system for the Plutonium Management and Disposition Agreement has not yet been developed. The IAEA's experience regarding the dismantling of nuclear weapon related programmes in South Africa, Iraq and Libya also did not cover any advanced military nuclear fuel cycle items. Furthermore, the IAEA safeguards inspectors are highly specialized in nuclear material accountancy for the civilian fuel cycle and the safeguards department lacks expertise and procedures for verification of the military nuclear fuel cycle. In addition, the IAEA Board of Governors is still based on a geographic group structure of 1957 and does not include all nuclear-weapon possessor States as continuously serving members. Thus, for the IAEA to carry out FMT verification, it would require to develop a verification and methodology system, recruit suitably qualified inspectors and reform its governance structure and practices.

4.3.2 Fissile Material Treaty [Verification] Organization

FMT verification could be done by establishing an entirely new nuclear verification organization from the ground up—sometimes referred to as a Fissile Material Treaty [Verification] Organization (FMTO)—involving the recruitment and training of a cadre of international nuclear inspectors, preparing the appropriate documentation and procedures, the setting up a secretariat along with hiring of technical and management staff, as well as a Director General or Executive Secretary, and finding a host State to provide appropriate headquarters space as usual privileges and immunities. This is bound to be a costly exercise and one that would face the immediate challenge of finding the required technical personnel with appropriate experience, as well as establishing an on-site verification regime along with its associated technical and administrative systems.

4.3.3 Hybrid Verification Arrangement

A feasible alternative could be a hybrid arrangement that assigns the verification of a FMT to the IAEA, sometimes referred to as the 'world's nuclear watchdog', which has accumulated more than a half-century of experience in nuclear verification and monitoring. Under its Statute, the Agency already has the authority to accept verification or safeguards responsibilities when requested by its Member States. Eight of the nine States currently possessing nuclear weapons are members of the IAEA, and all eight States are implementing safeguards either under Voluntary Offer Agreements (VOAs), as in the case of China, France, Russian Federation, United Kingdom, and United States; or pursuant to Item-specific agreements (India, Israel and Pakistan). The DPRK renounced its membership of the Agency in 1994 and withdrew from the NPT in 2003, and in fact the IAEA has never been able to fully implement safeguards in the DPRK pursuant to its NPT safeguards agreement.[44]

As noted above since the IAEA Safeguards Department as presently constituted has neither the expertise nor the experience in verification of military nuclear fuel cycle facilities, as that is not what it is mandated to do in the execution of its safeguards responsibilities. As such, the FMT verification and monitoring responsibilities could be assigned to a new independent Department to be created in the IAEA, headed by a Deputy Director General. This Department for FMT Verification (FMTV) would rely on verification of a FMT in non-nuclear-weapon States with comprehensive safeguards agreements in force, as well as Additional Protocols, and rely on the safeguards conclusions as provided in the annual Safeguards Implementation Report (SIR), by the IAEA Department of Safeguards. The FMTV department would have access to the Safeguards Evaluation Reports (SERs) of the IAEA Safeguards Department. It would be a misuse of scare resources and a needless technical task for a separate FMTO to establish a verification system in NNWS that parallels the one in place of the IAEA.

Verification and monitoring in the States possessing nuclear weapons and weapon-usable materials would be carried out by the FMTV department of the IAEA drawing upon the procedures and experience of the Safeguards Department in implementing CSAs but would also have to develop special procedures and practices for purposes of a FMT. The existing experience of the IAEA for the Trilateral Initiative and the Plutonium Management and Disposition Agreement (PMDA), involving the Russian Federation, the United States and the Agency, in developing verification techniques and technologies could be usefully employed, however additional procedures, techniques and technologies would need to be developed and deployed to fulfill the requirements of a FMT.

Another significant matter would be to constitute a separate independent Governing Board or Executive Council to review the findings and conclusions of

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44 IAEA 2016.

FMT verification, to address matters of breaches of the FMT, failures and non-compliance. This Board or Council would comprise Commissioners from all of the States possessing nuclear weapons and weapon-usable materials, as well as one Commissioner from NNWS from each of the regional groups under the IAEA Statute. This Board or Council would be independent of the IAEA Board of Governors and its decisions could not be challenged or reviewed by the IAEA Board.

The threshold for the treaty to enter-into-force must require, at a minimum, ratifications by all States possessing weapons-usable material. This paper does not examine the various legal and other bureaucratic arrangements and details that would need to be worked out.

4.4 Negotiating Approaches

As previously noted, the 1993 Resolution (48/75L) and the 1995 Shannon Report and the mandate contained therein, essentially glossed over crucial issues relating to the negotiation of a 'non-discriminatory' and 'multilateral' treaty limiting weapon-usable fissile material. Differences over the scope, objectives, etc. for such a treaty still remain to be bridged. Logic would dictate that there needs to be a common understanding on the definitions of terms as they appear in the Shannon report and in General Assembly resolutions. And, again logically, the practical way would be to assign the commonly understood meanings in the English language to the terms. The traditional interpretation of the term 'non-discriminatory' would appear to be one that would be equally applicable to all States, irrespective of their status as NWS, NNWS or nuclear-weapon possessor States. However, given the events of May 1998 and October 2006,[45] and the undesirability of formally recognizing any new 'NWS', an appropriate interpretation of 'non-discriminatory' could be in terms of a FMT as equally applicable to all States possessing unsafeguarded weapon-usable fissile material (and nuclear facilities) and to those States where all fissile materials and nuclear facilities are under full-scope or comprehensive safeguards.[46]

Another interpretation of 'non-discriminatory' could refer to the *purpose* of a FMT: is it aimed at nuclear non-proliferation or nuclear disarmament? While it is clear that some of the NWS and their allies regard a FMT as essentially a non-proliferation measure, given that proliferation has occurred in the Middle East, South Asia and the Korean peninsula, a FMT should be seen as serving the inseparable twin objectives of nuclear non-proliferation as well as nuclear disarmament.

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[45] Nuclear tests were carried in May 1998, first by India and then by Pakistan; and on 9 October 2006, the Democratic People's Republic of Korea conducted its first nuclear test.

[46] Rauf 1999.

Hence, in order to be effective and credible, a FMT would have to ban future production and also cover all unsafeguarded stocks of weapon-usable fissile material.

Yet another meaning of 'non-discriminatory' could be formulated in terms of not disadvantaging any among the five *de jure* NWS and the three/four nuclear-weapon possessor States. Thus, discrimination would need to be avoided at two levels: (1) in terms of available stocks of weapon-usable material—most of the five NWS already possess sufficient or even excess stocks, whereas China, the DPRK, India and Pakistan apparently continue with production for some further time period, and Israel's position remains unclear; and (2) in terms of providing for international monitoring or safeguards that would apply equally and evenly in all States possessing unsafeguarded stocks of weapon-usable fissile material (as well as in those NNWS where such material either does not exist or, if it exists, is under safeguards). Thus, in practice, there appears no good or truly non-discriminatory way of reconciling the different interpretations that could be ascribed to the term non-discriminatory as it is used in CD/1299 or 48/75L, other than agreeing on a definition that uniformly treats all nine States with unsafeguarded weapon-usable fissile material. Consequently, a FMT would necessarily need to capture both a halt on future production as well as accountability and transparency of all existing stocks (except for material contained within intact warheads), as well as establishing uniform verification and monitoring measures for weapon-usable material in all States parties. HEU for naval or space propulsion reactors would also require to be under appropriate accounting and transparency measures, as new technologies could permit long-lived fuel, thus eliminating the need for refuelling.

Regarding the term 'multilateral', the traditional interpretation would refer to a FMT involving multiple parties, which could mean all United Nations Member States, all CD members, or all States with nuclear facilities or materials; or it could also mean 'global' or 'universal'—i.e. all NWS, NNWS, and States possessing nuclear weapons. In any case, multilateral should mean as necessarily involving the participation of *all* States with nuclear weapons and weapon-usable nuclear materials.

Another important consideration that impacts on the legitimacy of any FMT is the forum in which the FMT would be negotiated. It is universally recognized that the world's sole multilateral negotiating forum for arms control and disarmament treaties is the Conference on Disarmament. The CD and its predecessors have successfully negotiated all important multilateral arms control and disarmament treaties, including the Sea-Bed Treaty in 1971, the Biological and Toxin Weapons Convention in 1972, the Environmental Modification Convention in 1977, the nuclear Non-Proliferation Treaty in 1968, and the Chemical Weapons Convention in 1993; with the latest being the Comprehensive Nuclear-Test-Ban Treaty in 1996. It is no secret that the stalemate in the CD on the negotiation of a FMT has been the issue of the inclusion of stocks. This has led to frustration for some States which have argued for taking the FMT outside of the CD and to negotiate a treaty in a stand-alone process or at the United Nations. Other suggestions have referred to changing the consensus rule for decision-making. In this discussion it is conveniently forgotten that for several decades some of the NWS blocked negotiations on a CTBT at the CD when they did not regard such a treaty as being in their national security interest. Furthermore, despite a majority of the international community supporting negotiations at the CD on nuclear disarmament, negative security assurances, and the prevention of an arms race in outer space, some of the NWS and their allies in nuclear-armed alliances continue to oppose such negotiations at the CD.

For the time being taking the FMT negotiation outside of the CD has not been followed through. For an FMT to be credible and to have international legitimacy, there is no option other than for negotiations in the CD—nearly all militarily significant and politically relevant States are represented there and it is the only internationally legally mandated forum to negotiate multilateral arms control and disarmament treaties.

4.5 Conclusions and Recommendations

The commencement of negotiations on a FMT at the CD can be started as soon as States can agree on the scope of a treaty that should be comprehensive, including a prohibition on future production of weapon-usable nuclear material and accountability for and transparency of existing stocks. Given the excessive overhang of nuclear weapons and weapon-usable materials, and the relatively small quantity needed for a single nuclear weapon, as shown in the Fig. 4.4, a FMT of any value should not only turn off the tap on weapon-usable nuclear material as an essential step towards irreversible nuclear disarmament, but also drain the swamp of some 1800 tonnes of weapon-usable in existing stocks in the nine States possessing nuclear weapons for the same purpose. Such a FMT would be a useful and integral complement to the NPT and to the CTBT in checking further nuclear proliferation and facilitating nuclear disarmament irreversibly.

As for verification, the establishment of an entirely new verification organization is not considered practical both for reasons of cost effectiveness and also for technical reasons. It is not necessary to duplicate the safeguards system of the IAEA for the verification of a FMT in NNWS, as these States already are under a *de jure* and de facto regime not to produce nuclear material for nuclear weapons and the entirety of the nuclear fuel cycles are subject to IAEA comprehensive safeguards. Thus, the principal focus of a FMT verification regime would be to cover past production and stocks of weapon-usable nuclear materials and related nuclear fuel cycle facilities in the nine States with nuclear weapons. An independent FMTV verification system established at the IAEA, with the necessary governance provisions, would be technically possible and cost effective.

The issue of a multilateral FMT has acquired a strong orthodoxy harking back to the Cold War. During the Cold War, a FMT was conceived primarily as a nuclear disarmament measure, i.e. to cut-off the material for the production of nuclear warheads by the five original nuclear proliferators. With the end of the Cold War and the deep cuts in nuclear warheads under the INF and START

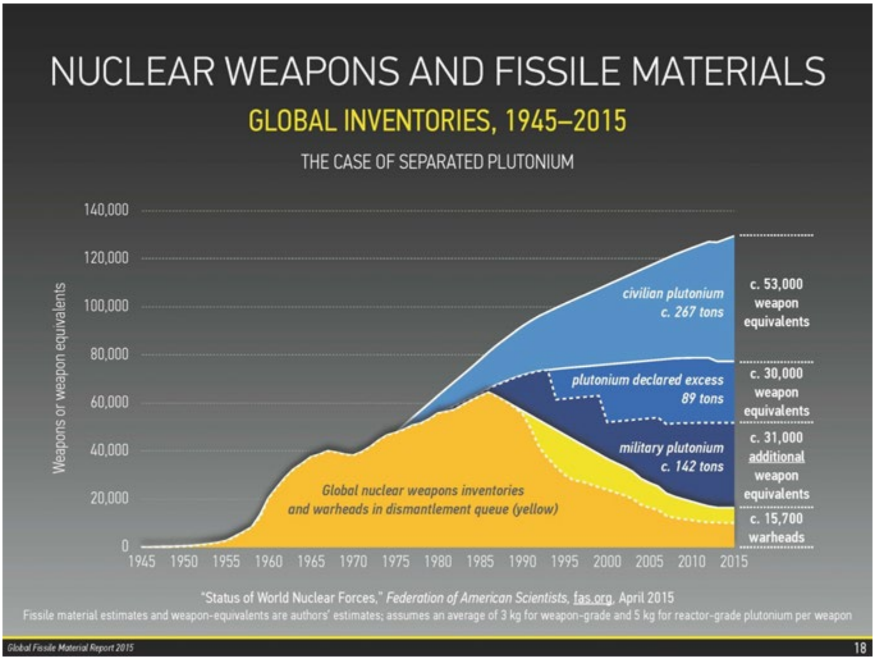

Fig. 4.4 © International Panel on Fissile Materials (see IPFM 2015), reproduced with kind permission of the IPFM

agreements between the Russian Federation and the United States,[47] a FMT was portrayed by some of the NWS, notably the United States, as serving primarily a nuclear non-proliferation purpose. Furthermore, the impasse at the CD between those favouring an incremental, step-by-step approach to nuclear disarmament and those pushing for a time-bound framework for the elimination of nuclear weapons, has led to an artificial hierarchy of measures, i.e. the CTBT, followed by a FMT, accompanied by the START series of agreements and negotiations in good faith leading eventually to nuclear disarmament and general and complete disarmament.

[47] Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles—INF Treaty—(8 December 1987); Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms (Start I Treaty) and Associated Documents (31 July 1991); Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms (Start II Treaty) and Associated Documents (3 January 1993); Treaty Between the United States of America and the Russian Federation on Strategic Offensive Reductions—SORT—(24 May 2002); and Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms—The New START Treaty—and Protocol (8 April 2010).

Lost in this discourse was the practical and common-sense approach focusing on the roots of the proliferation/disarmament dilemma, i.e. the NWS and the non-NPT States with nuclear weapons. While a grand FMT negotiated along the lines of the CTBT might be desirable, there is no pressing logic for following that tortuous and time-consuming path. In the aftermath of the nuclear tests in South Asia and Korean peninsula, one must liberate the arms control process from the lingering legacy of the Cold War and shed the old thinking that has so heavily influenced discussions on a FMT both by officials and NGO experts. For a FMT to be effective and credible, it must deal *both* with verifiably halting further production of weapon-usable nuclear material and bringing accountability and transparency to existing stocks in the nine States with nuclear weapons, weapon-usable materials and associated nuclear fuel cycle facilities.

A treaty prohibiting the production and stockpiling of weapon-usable nuclear material draws a wide range of opinions and perspectives. While almost every aspect of the treaty is contested, the most fundamental issue impeding progress is the sharp divergence of views on its central objective. States have not been able to decide whether the treaty will be a non-proliferation instrument prohibiting only the future production of fissile material, or whether it will promote nuclear disarmament by also covering existing stockpiles of weapon-usable material.

Further progress on the treaty at the multilateral front will remain deadlocked as long as States remain unable to find an acceptable basis for the commencement of negotiations. Reliance on the Shannon mandate to resolve all issues before and during negotiations has been shown to be a flawed approach. Supporters of commencing negotiations on a FMT on the basis of the Shannon mandate assert that the mandate allows for States to bring on the table issues of relevance. This, however, is a different approach when compared to the start of negotiations, for example, on the Biological and Toxin Weapons Convention, Chemical Weapons Convention and the Comprehensive Nuclear-Test-Ban Treaty. In the cases of these three multilaterally negotiated non-discriminatory treaties that were successfully negotiated at the CD, the proponents at the very outset made clear the overall objectives including prohibitions and limitations to be included in each treaty—to prohibit biological and toxin weapons, chemical weapons, and all types of nuclear explosive tests—with the details to be worked out in the negotiations. The proponents did not argue for starting negotiations without knowing what weapons and activities would be prohibited, and how treaty limited biological and chemical agents would be treated. As such, it is illogical to consider the start of FMT negotiations without the inclusion of existing stocks in the scope—how the FMT will dispense with stocks will be the subject of negotiations. It is in the interest of the non-nuclear-weapon States that all weapon-usable material in all nuclear-weapon possessing States is brought under accountability and transparency under a FMT—this is essential for achieving a world without nuclear weapons.

The experiment of establishing a Group of Governmental Experts (GGE) outside the CD, under a UNGA mandate, also proved ineffective and problematic. It was hamstrung from the start due to its non-representative character and divisive genesis, and hence failed to gain ownership by the CD. The GGE's outcome, or lack of it, reinforced the need to develop a broad-based consensus *within* the CD. The CD's slow pace linked with the painstaking process of consensus-building can be frustrating and despairing, but in the long run the only sustainable way forward is one that enjoys universal acclaim and is negotiated in the duly mandated forum—the Conference on Disarmament.

The following recommendations address some key areas that can help in unlocking the FMT logjam:

1. It is evident that no country would agree to the start of negotiations on a treaty that would either circumscribe its security or be perceived as affecting it interests negatively. Such concerns should therefore be addressed upfront for all relevant States to approach treaty negotiations from a level playing field on the generally accepted principle of undiminished security for all concerned States.
2. Chart a roadmap for nuclear disarmament and clearly identify where FMT lies on the path to global zero. As long as some States continue to envision a FMT as yet another non-proliferation instrument, the prospects for progress on a treaty remain slim.
3. Revisit the mandate for negotiations along the lines of the Shannon report to arrive at a new, commonly acceptable basis for negotiations. Alternatively, explore the start of negotiations in a subsidiary body of the CD without any pre-conditions or pre-defined mandate.
4. As long as States are unable to agree on the launching of negotiations in the CD, the Conference should hold fully inclusive focused and structured discussions on different aspects of the treaty, in particular its possible technical details. This will allow the CD to use its assets productively, help build common ground and compromise, and thus move towards creating the atmosphere for result-oriented negotiations when the political will forms.
5. Lastly, the nuclear-weapon possessor States have to collectively arrive at a solution to the question of scope and the large asymmetries in military fissile material holdings. Without a concrete and mutually acceptable resolution of this issue, there would be little hope for the treaty's effectiveness, entry-into-force and universality, even if the treaty could be negotiated and adopted.

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Chapter 5
Mitigating the Nuclear 'Dual-Use Dilemma': Suggestions for the Enhancement of the Culture of Responsibility

Ilaria Anna Colussi

Abstract This Chapter aims at delineating a proper ethical and legal response to the 'dual-use dilemma' of nuclear science and technologies. After assessing the different models of governance proposed so far for addressing the 'dual-use' feature of nuclear technologies, and based on precautionary, proactionary and cost/benefit approaches, it develops a framework based on the notion of 'responsible stewardship'. This framework is based on a comprehensive analysis—through the involvement and cooperation, as much as possible, of all the stakeholders in the field—of both the advantages and the risks of the nuclear area, considering social, ethical, legal, environmental and political values. The policies then adopted are periodically and constantly revised (according to a 'step by step' principle) and based on the proportional balance of interests, values and rights at stake. A multilevel framework of sources and actors is involved in such a responsible process. A specific attention is devoted to the balance between the freedom to research and the security needs at the individual and at the State level, in particular focusing on Article IV of the Treaty of Non-Proliferation of Nuclear Weapons. Concrete ways for applying such model are explained, in particular with regard to the control of materials, education of people, and control of information. Finally, the historical steps in the governance of nuclear technologies are explored and some examples provided for the suggested approach.

Keywords 'Dual-use dilemma' · Responsibility · Freedom of scientific research · Security · Treaty on Non-proliferation of nuclear weapons · Proportionality

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5.1 Introduction: Nuclear Science and Technologies and the 'Dual-Use Dilemma'

When nuclear sciences and technologies started developing, they were immediately devoted to the elaboration of explosive devices and weapons. This led to the production of nuclear weapons, which soon became one of the most destructive WMD (Weapons of Mass Destruction). The possible uses of nuclear technology in civilian areas and for energy production with large peaceful applications were discovered only later on. Nuclear proliferation has posed a severe threat to the international community. However, nuclear devices may have many non-military usages too, and thus they are intrinsically 'dual-use' involving the so-called 'dual-use dilemma'.[1]

The same dilemma occurs nowadays in the context of biology and genetics (for instance, in the area of synthetic biology)[2] or other new and emerging technologies (e.g., nanotechnology).[3] Yet, historically, the issue of 'dual-use' was born in the years of nuclear energy and atomic weapons research, as demonstrated by Nobel Prize laureate Richard Feynman:

> Once in Hawaii I was taken to see a Buddhist temple. In the temple a man said, 'I am going to tell you something that you will never forget'. And then he said: 'To every man is given the key to the gates of heaven. The same key opens the gate of hell'. And so it is with science. In a way it is a key to the gates of heaven, and the same key opens the gate of hell, and we do not have any instructions as to which is which gate.[4]

[1] See, for example, UK Parliamentary Office of Science and Technology 2009. About the multiple meanings of 'dual-use' see Atlas and Dando 2006, pp. 276–286.

[2] See Douglas and Savulescu 2010, pp. 687–693, and Kelle 2013, pp. 1121–1139.

[3] See Whitman 2013, pp. 13–28.

[4] Quoted by Schweber 2000, p. 64.

'Dual-use' is an aspect that could be referred to: (a) research, or (b) technological items that are the result of that research. For instance, a case of dual-use as intrinsic to research is the case of the experiments conducted by Nazis doctors during the World War II (i.e., the Nazi programs in extermination camps, such as 'Aktion T4' and 'Neue Aktion 14F13').[5] An example of dual-use pertaining to the application of research could be the one of dynamite, which could be used both for digging water wells in poor countries and for killing people.[6]

In the nuclear field, such dilemma involves '[…] researchers, governments, the community at large, and […] the private and public institutions, including universities and commercial firms that fund or otherwise enable research to be undertaken. Moreover, in an increasingly interdependent set of Nation-States—the so-called global community—the dual-use dilemma has become a dilemma for international bodies such as the United Nations.'[7] The ethics and the law could play an important role in the management and governance of such dual-use ambivalence of nuclear technologies.

The purpose of this contribution is to propose a workable ethical and legal framework for addressing this dilemma, and to verify its effectiveness and applicability. The *first* part will describe the different models of governance that have been suggested so far in the field; the *second* part will focus on the proposal of a different approach, based on responsibility and fundamental rights; and the *third* part will check the concrete application of the suggested approach, through the consideration of the historical developments occurred so far.

5.2 The Governance of Nuclear Technologies

Technologies, *per se*, are neither bad nor good. The area of the 'could' is theoretically infinite, as scientific and technical possibilities are enormous at the moment, and research could lead to many new discoveries. Therefore, the difficulty lies in the area of the 'should', not of the 'could': indeed, technologies are like 'empty boxes' that should be filled in with a sense, and this sense depends on the use that we make of them.

At the core of any ethical discourse, there is the following question: What *should* we do in a certain situation, or in front of a certain technology? This is why an ethical and legal reflection upon nuclear technologies is urgent, and we cannot

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5 See Browning 2005, pp. 186–190.

6 See the reference of 'dual-use' to research, technology and artefacts (i.e., the products of technology), by Forge 2010, pp. 111–118.

7 Miller 2013, p. 188.

abstain from looking for a 'moral operating system'[8] guiding our actions and decisions. With respect to nuclear technologies, considering the literature in this regard, it appears that three main frameworks compete here: the Kantian deontological framework;[9] the pragmatic model, elaborated on by John Dewey;[10] and the Millian[11] or Benthamite[12] utilitarian one. The *first* one refers to the fact that the morality of an action is based on the adherence of an action to a rule or a set of rules, to something that is intrinsically just, such as the respect of human dignity, human rights, and autonomy. This leads to a generalized maxim as applied to nuclear technologies: 'One shall utilize and develop nuclear technologies *if, and only if,* they do not harm the people'. Moreover, people should always be treated as ends, not means, and thus their safety and security remain a priority. The *second* theory, which is relativistic, insists on the progress in ethics through evolution: as science evolves, so does the ethics, whose moral criteria are improved as a result of inquiry. The *third* position, instead, affirms that we have an obligation to take the action that achieves the most positive outcome or consequence, in order to minimize the pain and maximize the happiness or pleasure. Therefore, the focus is on the consequences of an action in order to decide how to act: the best consequence is happiness or pleasure, considered as an absolute good.

In the light of the aforementioned ethical frameworks, three (legal) principles are adopted in front of nuclear technologies, in order to ground the policy approaches to these technologies. Such principles are: (a) the 'precautionary principle' (near to the Kantian duties), according to which a technology should be considered dangerous until proved to be safe, in line with the commonsense motto 'better safe than sorry';[13] (b) the 'proactionary perspective' (that can be assimilated to pragmatic ethics), supporting the idea that 'emerging science and technology should be considered safe, economically desirable and intrinsically good unless and until it is shown to be otherwise, which means that the burden of proof is on those who want to slow down a given line of research';[14] and (c) 'cost/benefit' analysis (utilitarian and consequentialist view).[15]

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8 Horowitz 2011.

9 Kant [1785a] 2002.

10 Dewey 1922.

11 Mill 1863 [1995].

12 Bentham [1789] 2005.

13 See, for example, UN, World Charter On Nature. GA Res. 37/7. 11, U.N. Doc. A/RES/37/7. 1982, http://www.un.org/documents/ga/res/37/a37r007.htm; WTO, World Trade Organization 1994. Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). http://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm.

14 More 2005.

15 Boardman 2006.

5.2.1 The Precautionary Principle

The precautionary principle has, according to some, a millenary tradition,[16] while others are of the opinion that it was born in the late 19th Century when a doctor's recommendation to remove the handle of a water pump to stop a cholera epidemic was enacted (1854).[17] Despite its historical origins, the spread of the precautionary principle occurred in Germany during the Seventies, when it appeared as *Vorsorgeprinzip.*[18]

It is very hard to conceptualize, due to its different interpretations and versions.[19] In general, it means that: (a) when an action is suspected to pose a severe harm to the environment or to health or to the public, and (b) a scientific consensus regarding the probability of the harm or even the cause and effect relationship between action and harm is absent (but, however, a certain level of scientific knowledge—although incomplete—should be present), *ergo* (c) some kind of anticipatory regulation is called upon to be introduced, i.e. before strong scientific proof of harm is developed.

The different versions are the following:—A 'weak'[20] one requires (1) the presence of a threat, (2) a serious and irreversible damage to occur, (3) a lack of scientific knowledge, and (4) the necessity to opt for the least risky alternative among the possible ones (according to a principle of proportionality). Some proof of the likelihood of occurrence of harm and the severity of consequences is required, and the burden of proof generally falls on those advocating of liability for harm;—A 'strong'[21] one asks for a 'zero risk' situation for admitting the introduction of a technology: it imposes the need not to use it, unless its harmlessness is certain, thus reversing the burden of proof about the safety of a technology upon those who argue that a proposed activity will not cause significant harm;—A

[16] Martin 1997, p. 276.

[17] Harremoes et al. 2001, pp. 14–15.

[18] *Vorsorge* means 'foresight of consequences and taking care of'. The first reference to precautionary policy was made while drafting the new statute about atmosphere pollution in 1970 in Germany, but the first legislation that adopted the principle was the *Bundesimmissionschutzgesetz* (federal law about the protection against emissions) in 1974. Then, the precautionary principle has been mentioned in a lot of German laws about environment, such as the law on chemical products (*Chemikaliengesetz*), 1980; law on the use of atomic energy (*Atomgesetz*), 1985; law on the proof of tolerance on environment (*Umweltverträglichkeitsprüfung*), 1990. For this topic, see Trouwborst 2007.

[19] Vanderzwaag 1999 identifies fourteen versions, while Sandin 1999 arrives up to nineteen formulations.

[20] The weak version is embedded, for instance, in Principle 15 of Rio Declaration (UN Report of the United Nations Conference on Environment and Development, Annex I—Rio Declaration on Environment and Development, UN Docs. A/CONF.151/26 (Vol. I), 1992).

[21] A strong version can be found within the 1982 UN World Charter for Nature, A/RES/37/7, 28 October 1982.

'moderate'[22] one simply requires a potential damage that a threat could provoke, in order to trigger the application of the principle;—An 'anti-catastrophe' one[23] asks for the hypothesis of potentially catastrophic scenarios connected to a certain situation, even if the knowledge of them to occur is not complete but only a suspicion;—Lastly, a 'procedural' one[24] stresses the importance of a consultative and democratic process for choosing and applying precautionary measures. This version does not specify what the measures are and when to introduce them.

In sum, as applied to the area of nuclear technologies, this principle would mean that these devices should not be absolutely used for civilian application, until it is proven that they are completely safe and secure. This principle is often recalled to block nuclear power and related industries, arguing that nuclear energy is not completely safe, and it entails potentially catastrophic risks and damages on health.

5.2.2 The Proactionary Principle

The proactionary perspective, based on the proactionary principle (that has been elaborated by the transhumanist Extropy Institute),[25] stresses the freedom of research, and requires the adoption of restrictive measures only if the impact of an activity has both significant probability and severity, and it is really imminent to occur. The proactionary approach encourages the pursuit of technologies and progress, without blocking it a priori. In the nuclear field it means to allow technologies develop without any control, or only if and when a very urgent harm is going to happen, and unless proven unsafe.

5.2.3 The Cost/Benefit Analysis

Cost/benefit analysis consists of the calculation of the relevant possible benefits and possible costs of particular outcomes of an action or inaction, and the comparison of results, so that, on the basis of the calculation, the policy in which the benefits are more than costs should be adopted. This model is based on the concept of efficiency as elaborated in the market economy, and it grounds on utilitarian reasoning and monetary evaluations.

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[22] A moderate version is quoted by the 1994 United Kingdom Biodiversity Action Plan, enacted by the UK Department of Environment (http://jncc.defra.gov.uk/PDF/UKBAP_Action-Plan-1994.pdf).

[23] For this proposal, see Sunstein 2005, pp. 109–115.

[24] See Jordan and O'Riordan 1999, pp. 15–35.

[25] See http://www.extropy.org/.

As applied to nuclear technologies, it leads to the assumption that when economic benefits overturn the disadvantages, the progress should be boosted. On the opposite case of risks overwhelming the benefits, the technology should be limited or stopped.

5.2.4 The Notion of ‘Responsibility’: Hans Jonas and Günther Anders

In our perspective, the aforementioned approaches have many limitations that need to be addressed. A procedural approach rather than a substantive one is suggested. It is centred on the notion of ‘responsibility’. Hans Jonas’ and Günther Anders’ thoughts are milestones in this regard,[26] as they fix this notion as an imperative for the protection of present and future generations. Summarising very briefly their positions, it appears that Jonas was worried by the unrestrained and fast technological development able to threaten the survival of humanity on the earth and characterised by uncertainty. He insisted on the fact that such progress was growing without an ethical framework, while ethics and science should be inextricably linked. Starting from the experience of atomic bomb, but broadening the attention on the relationship between technology in general and values, he shaped the idea of the ‘imperative of responsibility’ as the basis for a comprehensive ethics, which could embrace not only people in society but living organisms, animals, plants, etc. Since human beings have started experiencing an unprecedented progress and engaging in non-humans issues (such as their relation to nature), a new guide for addressing their actions was needed, in his opinion. Recalling Kant’s imperative (‘Act so that you can will that the maxim of our action be made the principle of a universal law’),[27] he reformulated it as ‘Act so that the effects of your action are compatible with the permanence of life on earth’ or ‘Act so that the effects of your action are not destructive of the future possibility of such life’.[28] He started from a sort of ‘heuristic of fear’, which meant to have awareness of the possible future (even if uncertain) dangers of technology upon humanity. Such fear especially for the survival of future generations was the boost for the sense of responsibility, entailing not only to ensure a proper quality of life for future human beings, but preliminarily their existence.

Jonas’ discourse is extremely important and grounded on the vulnerability of humans, on the uncertainties of technology and on the rational construction of human action and serious engagement based on responsibility, care and trust, and

[26] Jonas [1979] 1984 and Anders 1957.

[27] Kant [1785b] 2008, p. 24.

[28] Jonas [1979] 1984, p. 11.

it is projected on the future rather than on the past (so the future is the dimension for the ethics of the technological society); however, his notion is left at the individual level and it is inflexible and fixed, as he believes that the responsibility should be always the same for any generation,[29] and thus it would be impersonal. Moreover, the notion of fear can risk becoming a paralyzing instrument for State action, or an instrument used for demagogic purposes for moving the public opinion to one or another direction. It seems to us that such idea should be reshaped, in order to draw an appropriate and 'workable' notion of responsibility that entails negotiation, discussion, and involvement of stakeholders.

Günther Anders, on the other hand, considered negatively the advancement of *techne* and affirmed that, through such progress, the human being has arrived at the point of building the instrument for determining his own destruction, i.e. the atomic bomb. We are like inverted utopians because we cannot imagine what we can produce. Indeed, '[a] new age began on August 6, 1945: the age in which we are able at any moment to transform any location, in fact the entire planet, into a Hiroshima. Ever since this day we have become *modo negativo* almighty. However, since we can now be exterminated at any moment, this also means that since this day we have become totally powerless'.[30] The atomic bomb is not a domain of a single State, but it should be an enemy for all human beings, as it does not have borders and men can foresee neither the victims and the targets, nor the consequences of their action. Thus, men are in a state of total uncertainty. The bomb produces 'the effect of the daily growing gap between our two faculties; between our *actions* and our *imagination;* of the fact that we are unable to conceive what we can construct; to mentally reproduce what we can produce; to realize the reality which we can bring into being'.[31] Conscience and knowledge have become distant one to another, and human beings have renounced to take their own responsibilities, thus turning into an 'antiquated creatures'. However, Anders finally considered that the knowledge, the imagination and the morals were the instruments to be retaken into account for facing reality. Since we lost our capacity to feel responsible when we lost the ability to think and fully grasp the impact of our technological power, Anders insisted on the restoration of responsibility, which could occur by broadening the limits of our mind and boosting fear and imagination about the possible scenarios, so as to find stimulus to act. Such responsibility is based not on hope but on desperation, which can be the key for a public and political passion. He stated that we cannot start any single day without the thought of instability, weakness and dangers of society and the fact that the Apocalypse can be determined by us. This thought should encourage us not to desist from taking positions and being involved in the serious problems of our world. If we do not act like this, we would fail our democratic duties, considering that the issue of the survival of humanity is the most 'democratic' one as it involves all the society.

[29] For this criticism, see Kemp 1992, pp. 106–111.

[30] Anders 1981, p. 93.

[31] Anders 1957, pp. 11–12.

Anders’ position goes further than Jonas’ one, as the peril does not depend on the use of technology but it is inside the technology itself. Therefore, the notion of responsibility is boosted to superhuman levels: it extends to immediate and mediate effects of our actions and omissions.[32] In this pessimistic and tragic view of the world, Anders found a little light in the realism of imagination that should orient ethics and guide States’ intervention and policies. Thus, his perspective also overcame individual responsibility, moving at the global side.

5.2.5 The Model of Responsible Stewardship

Starting from Jonas’s and Anders’s discourses on responsibility and trying to develop them further for applying them to nuclear area, it is worth considering as a source of inspiration a report enacted in another context by the US Presidential Commission on Bioethics. It is the report on synthetic biology, which mentions the concept of ‘responsible stewardship’.[33] In reality, the concept of ‘stewardship’ is not a new one, and it refers to a ‘moral obligation […], a behaviour of personal commitment and care that springs from the intrinsic value and inherent dignity of each human being’.[34] Such a notion of dignity is conceived in a collective sense, in so far as it is a feature belonging not only to the mere individual sphere, but to the whole humanity. It also includes past and future generations, as the existence and integrity of humankind as such deserves to be protected.

The governance model based on this notion, thus, does not consider ‘responsibility’ as a strict principle that, at the end of the day, becomes paralyzing, being non negotiable and fixed. On the contrary, the model intends responsibility as a guideline to follow: it does not say *what* actions to take against risks, but *how* to face them. It entails that, when considering nuclear technology, it is worth starting with a proper analysis of both the advantages and risks in a comprehensive manner which considers social, ethical, legal, environmental and political values that are usually avoided by cost-benefit analysis, risk-benefit analysis, and precautionary principle. Moreover, ‘being responsible’ does not mean to look for a ‘zero-risk’ situation, as in the strong version of the precautionary principle: this would be impossible to achieve and would lead to nowhere. Nor would it take into consideration merely hypothetical risks, or the ones not having a scientific and concrete basis. However, at the same time, it is necessary to pay attention not to use science as a demagogic means that justifies whatever political decision.

[32] Anders 1981, p. 34.

[33] US Presidential Commission for the Study of Bioethical Issues 2010.

[34] WYA, World Youth Alliance, Declaration on Responsible Stewardship for the World Summit on Sustainable Development, 2002, http://www.wya.net/getinvolved/declarationsandstatements/declarationonresponsiblestewardship.html.

The analysis of nuclear technology, both on the side of risks and of benefits, should be conducted through the involvement and cooperation—as much as possible—of all the stakeholders in the field (governments, industries, scientific community, researchers, consumers, and so on). Then, responsible policies after being taken need to be periodically revised (according to a 'step by step' principle) and based on the proportionality principle: a balance among all the interests, values and rights at stake should be done. This is why fundamental rights must be properly considered.

After showing the main features of the model, it is important to reflect upon the 'whom' could be in charge of adopting such model. Instead of opting for a unilateral intervention by the legislator (or government in a broad sense) through 'top down' and 'hard law' sources, or by the scientific community ('bottom up' and 'soft law' sources), the preference goes to a mix model of actors and sources, entailing both the 'bottom up' and 'top down' level, and thus 'hard law' and 'soft law' integrate reciprocally. Therefore, it is a multilevel framework of sources and actors intervening for regulating nuclear technologies and facing with 'dual-use dilemma' (thus realizing an 'engagement' approach).

Governments and international organizations are involved in (a) establishing the general rules for nuclear scientists (such as licenses for dealing with products, or the duty to keep the State informed of developed research) and (b) in the phase of control of trade of these items (through specific authorizations to suppliers, for instance, or the regulation of export, transit, transhipment and re-export), or (c) control of the sources of risks (providing the sharing of information, or end-user controls, border controls, and law enforcement rules). The legislators are called upon to draft rules referred to the field of criminal law, public health (and medical) law, emergency management law, national security law, and trade law.

Then, the statutory source shall be complemented by the deontological one, which is enacted by the scientific community in terms of codes of conduct and guidelines. These rules are apt for increasing the awareness of the risks posed by nuclear technologies and for the assignment of professionalization as a tool for governance. Programs for education and training of researchers cannot be underestimated, in order to create a real culture of responsibility. In this way, the governance of nuclear technologies would be ensured through the involvement, in concentric circles, of: (a) individual scientists; (b) educational and research institutions; (c) scientific communities and/or organisations; (d) national governments; and (e) international bodies, such as United Nations, the International Atomic Energy Agency (IAEA), and the World Health Organization.

5.3 The Rights Involved in the 'Dual-Use Dilemma' and Their Possible Balance

The model of 'responsible stewardship' aims at finding a proportional balance among rights and freedoms at stake. At the core of the 'dual-use dilemma' there is the freedom of research and its possible limitations. As affirmed at the beginning, when nuclear technologies started their development, the legal attention concerned the prohibition of the risk of non proliferation. Therefore, the accent was posed on security needs over the freedom to develop research. So, it was 'natural' to elaborate on restrictions to access to information, to import/export of devices, and data sharing.

In the course of time, a slightly open policy and access to peaceful nuclear applications was inaugurated, provided that adequate safeguards were taken (for instance the Atoms for Peace Plan, presented by the US President Dwight D. Eisenhower in December 1953, established research reactors, and proper trainings for many countries). Therefore, the right to develop nuclear research for peaceful purposes (such as for producing energy and civilian applications) started to be shaped. However, even the possible civilian uses can generate dangers and risks, and thus the right of research had to face with the right to health, to life and with environmental issues. The aforementioned rights and their possible balance are explored hereafter.

5.3.1 The Freedom of Scientific Research and the Proportionality Principle

The human 'instinct' of broadening knowledge and enriching the scientific progress and life conditions has been a part of humankind since time immemorial. Nuclear science and technologies are fruit of this progress, and thus the freedom of research comes into question.[35] It is embedded mainly at the Constitutional level, where it is sometimes provided as part of the content of the freedom of thought and expression (in the Universal Declaration of Human Rights, Article 19, or at the First Amendment of the U.S. Constitution), other times as a fundamental freedom having an autonomous content (European Charter of Fundamental Rights, Article 13; the Constitutions of Germany, Article 5; Italy, Article 33; Spain, Article 20; UN Covenant on Economic, Social, Cultural Rights, Article 15), while in other cases as a freedom which is connected to a duty for the State in improving and promoting science and research (Italian Constitution, Article 9; Spanish Constitution, Article 44; title XIX of The Treaty on the Functioning of European Union).

Conceived at the individual level, as entitled upon the single researcher, it appears in its multiple dimensions: on a first level, it entails the researcher's right to investigate on the topic that he/she freely chooses; on a second level, there is the right to spread the knowledge to others, to communicate results to other colleagues or community; on a third level lies the check of hypothesis according to the

[35] With regards to the feature of the freedom of scientific research, see Colussi 2014, pp. 277–287.

scientific method (it includes the right to experiment too), and on a fourth level, the economic exploitation of the products or results of research. This freedom can be also referred to equips or groups of research or to the scientific community as a whole (meant as a collective right).

According some perspectives, it would be also possible to see this freedom on the other side 'of the coin', i.e. from the society's perspective, and it would lead to shape it as a collective right vested upon the society, which could claim to have access to the benefits of research without any discrimination in terms of geographical, cultural, economic provenience.[36] This freedom entails 'negative' and 'positive' obligations for the State. On the one hand, there is the duty for the State not to interfere in the choice of topics of research and in its developments without any imposition upon researchers ('freedom from', typical of liberal societies). On the other hand, it should be indicated that the State has the duty to promote and sustain this freedom of scientific research ('freedom to', typical of welfare states), assuming the responsibility of developing scientific investigation for the benefit of the whole humanity (general interest). It is important to find a proper balance between these two duties. Indeed, if the State interferes too much in the determination of tools and structures for the realization of research, and thus orienting research, it could infringe the individual's liberty. On the other hand, the State cannot be denied the essentiality of its support and contribution, in order to put the conditions (and resources) for conducting investigations.

The freedom of research can come into conflict with other rights or interests or values, such as security (if we imagine that the development of a science or technology can lead to the production and proliferation of nuclear weapons, thus threatening public security, or to misuse by possible terrorists) or with the right to life, environment and health (if we consider the possible dangers caused by nuclear radiation and environmental accidents affecting human, animal and plant lives and health). Therefore, a core element is the issue of the absoluteness, or the existence of limits for such freedom. For answering this question and finding a proper balance among rights, the principle of proportionality should be called into question. It consists of three sub-principles[37]: the principles of suitability, of necessity, and of proportionality in the narrow sense. The principle of suitability means to opt for a rational relationship between the means chosen and the ends pursued. The principle of necessity requires that, when two means promoting one goal are equally suitable, the one that interferes less intensively in another goal ought to be chosen. The principle of proportionality in the narrow sense means that, if possible, a right cannot be suppressed in the face of the competing one, and its 'essential core' must be protected.

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[36] With regards to a society's right to do science, see Salvi 2002, pp. 125–134; and Edsall 1981, pp. 11–14.

[37] See Alexy 2003, pp. 131–140.

Considering proportionality from the perspective of the freedom of scientific research, it entails that the ‘nucleus’ of the freedom of research should never be suppressed. This is represented by the freedom of theoretical investigation, which includes the choice of topics of investigation and the exercise of theoretical speculations. Going further from that ‘nucleus’ and moving to the level of the application and diffusion of scientific discoveries, this freedom can be more limited, or more broadened. It results that the freedom of scientific research moulds like a rubber band: (a) if nuclear science and technologies affect other fundamental rights and freedoms, the research should be limited; (b) on the contrary, if they increase and promote the achievement of other rights and freedoms, the research ought to be encouraged.

More specifically, if nuclear technologies pose at risk humanity such as in the case of proliferation and in warfare context, it is legally and ethically convincing that the freedom of scientific research should be limited and balanced with other rights and interests at stake.[38] Instead, if these technologies encourage the progress in medicine, agriculture, industry, etc. for beneficial purposes, this freedom should be boosted.

5.3.2 The Right to Develop Nuclear Energy for Peaceful Purposes

Moving at the State level, it is questionable if the same freedom of research vested on people can be recognised upon the State too. In this regard, the following sources must be taken into account: Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT); Article 7 of the Treaty on a Nuclear-Weapon-Free Zone in Central Asia (Semipalatinsk Treaty);[39] Article. 4 of the South Pacific Nuclear Free Zone Treaty (Raratonga Treaty);[40] Article 4 of the Treaty on the Southeast Asia Nuclear Weapon-Free Zone (Bangkok Treaty);[41] Article 8 of the African Nuclear Weapon Free Zone Treaty (Pelindaba Treaty);[42] and Article 17 of the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco Treaty).[43] All these provisions establish the right to peaceful use of nuclear energy, which entails to develop nuclear energy for peaceful purposes. The central provision, which inspires the treaties establishing the nuclear free-weapons zones, is the NPT that provides in Article IV.1:

[38] Cole 2002, pp. 953–955.

[39] Treaty of Semipalatinsk (8 September 2006), 2212 UNTS 257.

[40] Treaty of Raratonga (6 August 1985), 1676 UNTS 223.

[41] Treaty of Bangkok (15 December 1995), 1981 UNTS 129.

[42] Treaty of Pelindaba (11 April 1996) 35 ILM 698.

[43] Treaty of Tlatelolco (14 February 1967), 634 UNTS 326.

> Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty.

As known, the NPT is based on a bargain between nuclear-weapon States (NWS) and non-nuclear-weapon States (NNWS) around three major provisions: (a) *non proliferation*: NWS pledge not to transfer nuclear weapons to any recipient or in any way assist, encourage or induce any non-nuclear-weapon state in the manufacture or acquisition of a nuclear weapon (Article I), while NNWS pledge not to acquire or exercise control over nuclear weapons and not to seek or receive assistance in the manufacture of them (Article II), and to accept IAEA safeguards to verify that their nuclear activities serve only peaceful purposes (Article III); (b) *disarmament*: all the Parties engage in activities moving towards nuclear disarmament (Article VI), and (c) *peaceful uses*: all the Parties have the right to develop nuclear energy for peaceful purposes and to benefit from international cooperation in this area (Article IV).

Under Article IV, the right to peaceful energy is labelled as 'inalienable'. At first sight, it seems to mean that such right cannot be transferred to anyone, and it is a pre-existing right with respect to the Treaty,[44] which can be invoked but not conferred, and the NPT simply recognizes it. Following a liberal tradition, it can be said that all what is not prohibited is allowed. It is a widespread view in international law, frequently referred to in context with the '*Lotus*' case,[45] according to which there exists a presumption of freedom of action in international law, unless such action is banned. The same approach can be found in the *Kosovo* Advisory Opinion by the International Court of Justice with respect to the Kosovo unilateral declaration of

[44] See Joyner 2011, pp. 75–95.

[45] Case of the S.S Lotus (*France v. Turkey*), 7 September 1927, Permanent Court of International Justice, PCIJ Series A, No. 10 1927. http://www.icj-cij.org/pcij/serie_A/A_10/30_Lotus_Arret.pdf. As known, the *Lotus* case concerns a criminal trial for the accident occurred in High Seas between the S.S. *Lotus*, a French steamer, and the S.S. *Boz-Kourt*, a Turkish steamer, resulting in the death of eight Turkish nationals aboard the *Boz-Kourt*. The case focused on whether there could be Turkish jurisdiction on Monsieur Demons, the French officer on watch duty at the time of the collision. France considered that the State whose flag the vessel flew had exclusive jurisdiction. The case, which was submitted to the Permanent Court of Justice, is one of concurrent jurisdiction, an issue that was not specifically regulated here and is still lacking a general international regulation today. The Court stated that there was no rule of international law excluding Turkey from exercising jurisdiction on acts committed by the French officer. While this decision has often been held as pronouncing a fundamental principle of international law, according to which sovereign States may act in any way they wish, unless they do not contravene an explicit prohibition, it should be considered that in reality the Court was evenly split on the issue of Turkish jurisdiction, and the decision was reached due to President Max Huber's casting vote. In his dissenting opinion Judge Loder, the former President of the Court, criticized the judgment stating that it was based on the 'contention that under international law everything which is not prohibited is permitted', a position which, as Fleck underlines (Fleck 2014, pp. 55–56), had not been held in such general terms in the decision itself.

independence.[46] So, if the international law permits a behaviour unless it is expressly prohibited, this would mean that Article IV is a residual provision, collecting the residual activities and totally admitting them without any limitation or ban. Therefore, the inalienable right would mean that the right should be preserved untouched and nothing can affect it, as it deals with the States' sovereignty. However, it cannot be neglected that the article specifies that this right is exercised 'without discrimination' and 'in conformity with Articles I and II'. Moreover, since Article III states that for preventing diversion from peaceful purposes the IAEA Safeguards should be followed, it derives that the conditions of Article III should be respected too and both NNWS and NWS cannot use unsafeguarded materials, nor conduct unsafeguarded activities, even when conducting peaceful research. So, Article IV cannot be considered in isolation, but a systematic interpretation in the context of the whole Treaty is necessary. 'In conformity with' means 'as limited by': thus, the development of peaceful uses of nuclear energy material and technologies should occur without discrimination between States and in conformity with non-proliferation obligations delineated by Articles I, II and III of the Treaty, which means that peaceful activities should entail a low risk of proliferation and should be safeguardable. Furthermore, the issue of non-discrimination must be linked to the *benefits* of the results of nuclear research, as provided by para 7 of the Preamble, and such use of nuclear energy for peaceful purposes is linked to economic and social development of countries.[47]

In a nutshell, the right to peaceful energy is not a *per se*/absolute right, but it comes with the responsibility to respect some conditions (non-discrimination and obligations embedded in Articles I, II and III NPT, as systematically interpreted) and some purposes, such as the 'benefit-sharing' approach.[48] The latter consists of reversing the freedom of research, by viewing it not from the perspective of the State exercising it, but from the viewpoint of public society that claims to enjoy the benefits of that research. Under this interpretation, then, the inalienable right would rather consist in a policy, based on sharing and safeguards, rather than in a right.

5.4 How to Mitigate the 'Dual-Use Dilemma'?

An approach based on responsibility entails not only the maximization of benefits of nuclear technologies, where aimed for the promotion of humanity, and the minimization of risks, where nuclear technologies are deemed to be used for harmful

[46] ICJ, Kosovo Advisory Opinion of 22 July 2010, ICJ Reports 2010, p. 403. The Court, involved by the UN General Assembly, declared that the adoption of a declaration of independence was not in violation of international law, as nothing is provided in the rules on this issue. It is worth reminding of Judge Bruno Simma's dissenting Opinion (http://www.icj-cij.org/docket/files/141/15993.pdf), where he states that the Court's interpretation reflects an 'old tired' view of international law.

[47] See Resolution adopted by the General Assembly 32/50. Peaceful use of nuclear energy for economic and social development, 97th Plenary Meeting, 8 December 1977, A/RES/32/50.

[48] Ford 2009, pp. 1–80.

purposes. It also includes and boosts a proper protection of rights and freedoms, and a balance between them. Healthcare professionals, scientists, governments are involved in the design of the concrete ways for regulating nuclear technologies and programs that could improve safety and security, protect health and encourage research.

This balance of rights should be borne in mind when drafting the rules for: (1) scientific practice (rules for laboratories), (2) information dissemination (rules for research publication), (3) technology application, and (4) the cooperation between the scientific community and authorities, in order to create a culture of responsibility and make scientists aware of responsibilities and risks connected to their work. The ways for mitigating the 'dual–use dilemma' consist of various groups of rules: (1) *Rules focused on people*, i.e. rules for scientists, such as in reference to the phases of acquirement, possession and use of materials. It is relevant to have a comprehensive view of the scientists' activities, but it should be taken into account that it is difficult to map and control researchers, since they are interested in spreading their research as soon as possible, without too much caring of the risks concerned.[49] Thus, any type of policy in the area should address these problems and focus on strong assessment, identification and registration of people, in order to ensure the traceability and screening of the personnel. It is also necessary to enact programs providing a proper education and training of the professionals in the field. (2) *Rules focused on materials and technological applications*. These norms are about the possession, trade, transport and transfer of nuclear material. It is important to operate at the level of prevention (*ex ante*) and response (*ex post*). (3) *Rules concerning research results and information*. The issue of censorship or free publication of scientific results is a sensitive one. The results could increase research and progress or could be used by malevolent people for harmful purposes. According to some positions, censorship would limit research and would represent an infringement to the freedom of research.[50] In the perspective of others, censorship would be a better option, as the spread of such 'sensitive' information that could be misused by malevolent people is a danger in itself.[51]

This 'conflict' between censorship and publication has been emblematically demonstrated by the opposite views by Leo Szilard and Enrico Fermi in the nuclear area. While Szilard thought that only keeping information secret the projects to build the atomic bomb by Nazi could be avoided, Fermi stated, on the contrary, that the secrecy would have meant a victory for the Nazi, and another fundamental freedom would have been suppressed.[52] The conflict is still vivid in the scientific community, and not only. A proper balance could be reached, as mentioned above, from the mixture of self-governance and government

[49] Michel 2013.

[50] See Trevan 2012, p. 295.

[51] About the history of censorship, see Martin 2001, pp. 2167–2170.

[52] For deepening the issue, see Rhodes 1986.

intervention, avoiding a unilateral control, and improving a fruitful debate among scientists, journal publishers and State authorities, so as to opt for the most balanced solution. The choice between censorship and publication should be assessed on time and rapidly too.

5.5 The 'State of Art' in the Nuclear Area: Historical Steps

The analysis of some historical steps can be useful to check whether the model of responsible stewardship can work for the mitigation of 'dual-use dilemma'. It is well known that the first atomic bombs were produced within the so-called Manhattan Project. This research project was led by the United States with the support of the United Kingdom and Canada. An isolated location (in Los Alamos) was chosen for the design of the bomb for safety reasons, and many scientists (Nobel prizes as well) participated to the activities, among which there was the physicist Robert Oppenheimer. 'The nuclear weapons age began at 5:29:45 a.m. Mountain War Time, July 16, 1945, when the first atom bomb was tested in a portion of the bleak barren Alamogordo bombing range in the New Mexico desert chillingly named Jornado de Muerto (Journey of Death)'.[53] This was the first atomic test, followed by the sadly famous weapon attacks in Hiroshima and Nagasaki.

It is relevant to observe Oppenheimer's position (shared by Enrico Fermi too) with regards to the aforementioned conflict between the freedom of research and security. Indeed, as a physicist, Oppenheimer was strongly supporting the progress of science, the importance of curiosity, adventure and advancement, as they are inherent to science. Moreover, he exalted the cooperation between scientists. For this reason, he suggested opting for an isolated place where experiments could take place and ideas could be expressed freely. However, he was also convinced of the fact of carrying on a moral and social responsibility as scientist towards humanity as such. In his famous speech given in front of the Association of Los Alamos Scientists on 2 November 1945, he stated:

> We are not only scientists; we are men, too. We cannot forget our dependence on our fellow men. I mean not only our material dependence, without which no science would be possible, and without which we could not work; I mean also our deep moral dependence, in that the value of science must lie in the world of men, that all our roots lie there. These are the strongest bonds in the world, stronger than those even that bind us to one another; these are the deepest bonds - that bind us to our fellow men.[54]

Therefore, Oppenheimer believed and insisted on 'responsible stewardship'. He was aware of having contributed to create instruments of death (it is famous his

[53] Granoff 2000, p. 1413.

[54] See http://www.atomicarchive.com/Docs/ManhattanProject/OppyFarewell.shtml.

quotation from the Hindu scripture, the Bhagavad-Gita, stated just after the first experiments in Los Alamos: ‘Now I have become Death, destroyer of worlds’), and he was afflicted by remorse after Hiroshima. He also accused the scientists to have committed terrible sins, and thus he preferred dedicating himself to teach and to a civil role for the control and dismantlement of nuclear arsenals in the last years of his life.

What interests us in this context is its view of the existence of an inextricable link between science and ethics: in his perspective, science is sterile and exhausts itself without an ethical basis. The scientist cannot be neutral, but is called upon to operate in a responsible way for the protection of current and future generations. Other scientists followed Oppenheimer’s example. For instance, Einstein and Russell signed the Manifesto of Pugwash (1955), asking for nuclear disarmament and intending science as a means for peace.

Unfortunately, the position of the scientists in Los Alamos clashed with the States’ and governments’ position in the run to obtain nuclear arsenals. From the years of the Cold War and in the 1980s, the threat posed by nuclear weapons was at the top of the global agenda. The two superpowers, the United States and the Soviet Union, were amassing stockpiles of nuclear weapons. The States forgot the scientists’ lesson of responsibility. Then, NATO Members suggested the creation of multilateral export control regimes that could discipline the trade of nuclear devices. Therefore, in 1950, the Coordinating Committee for Multilateral Export Controls (COCOM) was born with the purpose to ban the export of sensitive items to Warsaw Pact countries and China. It adopted the so called ‘strategic list’, which included nuclear items submitted to export authorization and materials ‘designed’ for nuclear energy.

From the legislative point of view, it was only in 1968 that the Treaty on the Non-Proliferation of Nuclear Weapons, commonly known as the Non-Proliferation Treaty or NPT, was opened for signature (and entered into force in 1970). As aforementioned, although the treaty admitted the existence of Nuclear Weapons States, it aimed at achieving a complete nuclear disarmament, and recognized right to nuclear energy for peaceful purposes. This Treaty was accompanied by other treaties banning the weapons of mass destruction in certain areas (regional approach), for instance the treaty on the prohibition of proofs of nuclear weapons in the atmosphere and submarine territories (Moscow 1963),[55] the Treaty on the use of nuclear weapons in the depth of sea and ocean (Washington, London, Moscow 1971)[56] and the Nuclear Weapons Free Zones Treaties (NWFZs) quoted above.[57]

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55 The Partial Test Ban Treaty (5 August 1963), 480 UNTS 43.

56 The Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and Ocean Floor and in the Subsoil Thereof, Seabed Treaty (11 February 1971), 955 UNTS 115.

57 It can be noted that the NWFZs treaties, that follow a regional approach, have been drafted after the NTP with the exception of the Treaty of Tlatelolco (14 February 1967).

In the last years, politically (not legally binding) acts have been drawn for regulating the trade of nuclear materials; more precisely the lists of goods to be traded have been enacted by the trigger lists enacted at the Zangger Committee (1974)[58] and at the Nuclear Suppliers Group (1994).[59] States have also started establishing national laws and controls for preventing the proliferation of nuclear weapons, encouraged by the UN Security Council Resolution 1540 (2004).[60] Therefore, the notion of responsibility has slightly entered the international organization and States' policy domain.

From the judicial side, it is relevant to remember a judicial ruling intervened in the field of the use of nuclear weapons in 1996. The International Court of Justice (ICJ) provided an opinion[61] as whether the use or threat or use of nuclear weapons (therefore not the possession) was consistent with international law. Although it did not clearly affirm that in any circumstances nuclear weapons were unlawful (leaving aside the extreme circumstance of self-defence in which the very survival of a State would be a stake), yet it gave a boost to nuclear disarmament as a duty to be accomplished by States, stating that there exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to disarmament in all its aspects. Pursuant to this Opinion, States are called for multilateral negotiations to achieve a nuclear weapons convention, i.e. a global treaty to prohibit and eliminate nuclear weapons,[62] and several movements campaigned in the same direction.[63] In the same 1996, negotiations on the Comprehensive Test Ban Treaty (CTBT) were

[58] See Communications Received from Members Regarding the Export of Nuclear Material and of Certain Categories of Equipment and Other Material, 3 September 1974, INFCIRC/209, http://www.foi.se/en/Customer--Partners/Projects/zc/zangger/.

[59] See the Guidelines for Nuclear Transfers (trigger list) and the Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology. http://www.nuclearsuppliersgroup.org/en/.

[60] S/RES/1540(2004), April 2004.

[61] International Court of Justice (ICJ), Advisory Opinion, Legality of the Threat or Use of Nuclear Weapons, ICJ Reports 1996, 226–267, 8 July 1996, http://www.icj-cij.org/docket/files/95/7495.pdf.

[62] Moreover, in 2012 the United Nations General Assembly established an Open-Ended Working Group on Taking Forward Multilateral Nuclear Disarmament Negotiations (OEWG). This group has discussed new approaches to nuclear disarmament, and explored compromise approaches such as concurrent work on both building blocks and a roadmap or framework for a nuclear weapon–free world.

[63] See Abolition 2000, global network of over 2000 organizations campaigning for an NWC. See the settlement of an International Day for the abolition of Nuclear Weapons, fixed by the UN on 26 September of each year (Resolution A/RES/ 68/32, proposed in October 2013 and approved by the First Committee of the UN General Assembly). See the European Parliament's written declaration on 26 September 2012, under Rule 123 of Parliament's Rules of Procedure, on support for the Global Zero Action Plan for the phased and verified elimination of all nuclear weapons worldwide (n. 26/2012). See the UN Secretary-General's Five-Point Proposal for Nuclear Disarmament (http://www.un.org/disarmament/WMD/Nuclear/sg5point.shtml?lang=en).

completed. However, the situation is still difficult, since the CTBT has not yet attained sufficient ratifications to enter into force; the modernization of nuclear forces in all nuclear-armed states is ongoing; and there has been little progress on reduction of the operational status of nuclear forces.

Moreover, another recent case has been brought to the International Court of Justice's attention: indeed, in 2014, the Republic of the Marshall Islands has filed a lawsuit against the nine nuclear weapons states (namely, the United States, the United Kingdom, France, Russia, China, India, Pakistan, Israel, and North Korea), claiming they have violated their nuclear disarmament obligations under the Non-Proliferation Treaty (Article VI) and customary international law.[64] The initial hearings on preliminary issues are under discussion at the time being,[65] while the proceedings on the merits are expected to occur in 2017–2018; the final decision will represent the second relevant intervention of the ICJ on the matter of nuclear disarmament.

From the perspective of the development of nuclear energy, it can be noted that several conventions have been drafted for the regulation of this issue, thus providing rules for people, materials and equipments, and they seem to be in line with the responsibility model: for instance, the Vienna Convention on Civil Liability for Nuclear Damage,[66] the Convention on Early Notification of a Nuclear Accident,[67] the ,[68] the Convention on Nuclear Safety,[69] the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.[70]

5.6 Conclusion

Nuclear science and technology offer potentially enormous possibilities in several fields. At the same time, they entail many risks and perils. This great power to create and to destroy gives the nuclear area a 'Janus double face', which constitutes the basis of the 'dual-use dilemma'.

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64 So far, three of the nine states possessing nuclear arsenals, the UK, India, and Pakistan, have accepted the compulsory jurisdiction of the Court, provided that the Marshall Islands has accepted too. The others have declined to accept the Court's jurisdiction in this matter.

65 See http://www.icj-cij.org/.

66 1963, INFCIRC/500.

67 1986, INFCIRC/335.

68 1986, INFCIRC/336.

69 1994, INFCIRC/449.

70 1997, INFCIRC/546.

How to manage and govern this dilemma without impeding nuclear research to go further in case it can reach some benefits for humanity, such as the energy or medical or industrial application, but at the same time preventing risks and the 'slippery slope' to nuclear weapons of mass destruction is a big challenge for law and ethics. Indeed, on the one hand, it appears that nuclear disarmament is still far to be reached and 'the world has become one of nuclear apartheid, in which the means of unimaginable mass destruction are permitted for some, eschewed by most, and yet envied by others'.[71] On the other hand, the claims for increasing nuclear power and energy in many countries pose new challenges to the international community, especially considering that many countries invoke this right as linked to 'untouchable' sovereignty.

Thus, in order to face with such situation, our approach based on responsibility and stewardship can give some suggestions for addressing the issues at stake. The following principles summarise our approach:

1. policies and regulations should pursue a balance between, on the one hand, the necessity to pursue the progress and exploit the benefits that nuclear science and technology could bring, and on the other hand the attention to security issues (disarmament) and to the dangers to lives and environment;
2. for developing good policies and regulations, preliminarily both the risks and the benefits of nuclear field should be considered attentively, taking into account—in a comprehensive way—all the different aspects, from the scientific, social, environmental, economic and political perspective;
3. the governance should be based on the notion of 'responsibility', which entails that all the stakeholders in the area (i.e., governments, international organizations, scientists, industries, researchers, consumers, citizens) are involved in a cooperative manner and in constant dialogue for a proper comprehension of the risks and benefits;
4. as regards the sources of law to adopt for addressing the topic in an exhaustive way, a multilevel set of rules characterised by a mixed combination of 'hard law' and 'soft law' shall be required, which includes State or international norms with a legally binding value, complemented by politically binding rules and deontological sources, such as codes of conduct and guidelines, especially for the scientific community;
5. the 'responsibility' requires that the scientists are trained through specific educational programs to exercise their role and research in an ethical manner, aware of the risks that their research can entail and the benefits they can generate;
6. the different sources of law (both 'hard' and 'soft' ones) are called upon to intervene in drafting rules that are focused on *people* (scientists and other stakeholders, such as the rules for acquisition, possession, and use of materials), on *nuclear items* (e.g.: rules on possession, use, trade, transport), and on *research results and information* (about censorship or publication);

[71] Granoff 2014, p. 12.

7. the balance between the freedom of scientific research (at the individual level) and other rights, interests and values such as security, environment, life and health should be found through the principle of proportionality, which entails that the ‘nucleus’ of each right is not suppressed, and research in nuclear field is boosted if it promotes the exercise of other rights, but it is limited if it threatens other rights;
8. at the State level, the right to develop nuclear energy for peaceful purposes should be protected and boosted, provided that the State exercises this right without discrimination, according to a system of safeguards and to a benefit-sharing approach, for the protection and interests of present and future generations; and
9. States should develop new forms of cooperation and trust, characterised by information-sharing, and aimed at reaching a proper harmonization of rules.

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Chapter 6
Peaceful Uses of Nuclear Energy Under EURATOM Law

Jürgen Grunwald

Abstract In the European Union the peaceful uses of nuclear energy are not only governed by the NPT but also by the Treaty establishing the European Atomic Energy Community (EAEC, EURATOM). This poses the question as to the relationship between the two treaties, their differences and their similarities. It also raises the question how EURATOM accommodates the fact that two of its Member States (France, UK) are nuclear powers while the others are non-nuclear-weapon States. Whereas the choice to use or not to use nuclear energy for peaceful purposes is to be made by the Member States in their sovereign capacity, it is for EURATOM to create the conditions necessary for the establishment and operation of nuclear industries. These conditions are set out in ten policy chapters of the EURATOM Treaty which address the following subject matters: promotion of research, dissemination of information, health and safety, investment, joint undertakings, supplies, safeguards, property ownership, the nuclear Common Market and external relations. In contrast to traditional international organisations, EURATOM as a supranational organisation can exercise public power in its Member States by adopting and enforcing measures which are not only binding on its Member States, but also directly applicable to persons and undertakings in the Community. Paradoxically, despite its progressive legal character and its political achievements over a period of almost 60 years, in particular in the areas of radiation protection and nuclear safeguards, numerous attempts have been made to scrap the Treaty on various political grounds. The Treaty, however, having been

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concluded for an unlimited period, has survived all of them. Given its enormous legal potential, to a large extent still unexploited, the Treaty is well equipped also to deal with future challenges, provided the political will exists to exercise the powers vested in it.

Keywords Common Foreign and Security Policy (CFSP) · Common Security and Defence Policy (CSDP) · Conseil européen pour la recherche nucléaire (CERN) · European Commission · European Atomic Energy Community (EURATOM) · European Union · International Atomic Energy Agency (IAEA) · International thermonuclear experimental reactor (ITER) · Lisbon Treaty · Non-Proliferation Treaty (NPT) · Nuclear common market · Nuclear energy · Nuclear safety · Nuclear security · Nuclear waste · Peaceful uses of nuclear energy · Safeguards · Sanctions · Source material · Special fissile material · Supranational organisation · Verification agreement · Weapons of mass destruction

Contents

6.1 Introduction

In contrast to the other Chapters of this book, the present contribution is not devoted to a specific legal aspect of the use of nuclear energy for peaceful purposes, but will present an international organisation established almost 60 years ago to develop and govern the nuclear sector in Central Europe. It is the law of this organisation, however, that covers, in one way or another, many of the legal aspects addressed in the other chapters of this book. This international organisation is the European Atomic Energy Community (EURATOM). It was established in 1958, together with the European Economic Community (EEC)—the forerunner of the present European Union (EU)—by the six Member States of the European Coal and Steel Community (ECSC). Today, EURATOM comprises the 28 Member States of the EU of which 14 States produce atomic energy in 131 nuclear power reactors.[1] These 14 Member States represent in number nearly half of those 30 States worldwide which use nuclear power for the production of electricity. In terms of nuclear installations, EURATOM's 131 power plants account for almost one third of the total of 437 nuclear reactors worldwide.[2] Providing the sites for the International Thermonuclear Experimental Reactor (ITER) in France,[3] IAEA Headquarters in Vienna[4] and the Nuclear Energy Agency (NEA) in Paris,[5] EURATOM Member States host three major players in the nuclear world in Europe. At Olkiluotu in Finland, the first site worldwide for a permanent repository for high-level nuclear waste will be established in the territory of a EURATOM Member State. And yet to this day, despite its economic weight and its undisputed standing in the nuclear world as a factor of stability, progress and inspiration for almost 60 years, EURATOM and the Treaty establishing it have not got the attention they deserve—neither inside nor outside Europe. Overshadowed by the political dynamics and high visibility of its consecutive twin treaties, the EEC-, EC- and now EU-Treaties,[6] the EURATOM Treaty (EAEC),[7] whose legal substance is still the same as in 1958, has been denounced as stagnant, outdated and obsolete, at best to be dominated and held in tutelage by its twin treaties on

[1] EURATOM Supply Agency, Annual Report 2014, p. 9.

[2] Ibid, p. 15.

[3] At Cadarache. See Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project, OJ L 358, 16.12.2006, p. 62.

[4] International Atomic Energy Agency, established by Statute of 26.10.1956.

[5] Nuclear Energy Agency, established as European Nuclear Energy Agency (ENEA) by the OEEC Council in December 1957.

[6] Treaty on European Union (TEU) and Treaty on the Functioning of the European Union (TFEU).

[7] Articles in this Chapter without a specific reference are those of the EURATOM Treaty. For a consolidated version of the Treaty see OJ C 203, 7.6.2016, p. 1.

the EEC-, EC- and EU-side,[8] and at worst to be scrapped.[9] And yet, it is precisely the fact that the EURATOM Treaty has preserved the enormous political and legal courage, the inspiration and powers that were vested in it in an age when Europeans still believed in Europe, that makes the Treaty more modern and intelligent than many later attempts at further uniting the continent at the risk of overstretching, false compromises, glossing over of manifest discrepancies and of unleashing national egoisms, all of them phenomena present in today's EU.

Owing to the wisdom, courage and foresight of its founding fathers, the EURATOM Treaty provides solutions to most of the pressing problems posed by the peaceful uses of nuclear energy today, provided politicians are willing to deploy the legal potential of the Treaty by using the powers vested therein.[10] In order to explore the extent of these powers, it will be appropriate first to present EURATOM's specific character as a supranational organisation, followed by an outline of its policy objectives. Next, the notion of peaceful uses as opposed to military uses should be examined in order to determine the exact scope of the Treaty. Thereafter, the cohabitation of the NPT and the EURATOM Treaty in Europe should be looked at, followed by an outline of current problems and possible solutions under EURATOM law. Finally, an outlook to the future and EURATOM's place in it will conclude the present Chapter.

6.2 EURATOM as a Supranational Organisation

As one of the three Communities aiming at uniting Western Europe after the Second World War, EURATOM has been conceived with a triple finality: to ensure a lasting peace among the Member States through integration, to foster economic progress through cooperation and to secure Europe's place and standing in the world through

[8] See on the relationship between Euratom and EC: Cusack 2003, p. 117. In purely legal terms, however, the relationship is governed by Article 106a(3) EAEC: 'The provisions of the Treaty on European Union and of the Treaty on the Functioning of the European Union shall not derogate from the provisions of this Treaty.' *Lex specialis derogat legi generali*.

[9] The opposition to the Treaty is based on three different motives, all of them based on blatant misunderstandings:
(1) The Treaty is bad because it is 'nuclear'. The fact that the Treaty seeks to ringfence the dangers of nuclear energy through radiation protection and safeguards is overlooked.
(2) The Treaty is antidemocratic because the European Parliament has no significant role to play. Parliaments, however, are *legislative* bodies, whereas the Treaty is essentially about performing *executive* tasks. To the extent that legislation is required, it is to be guided by scientific expert knowledge.
(3) The Treaty is outdated and has become obsolete. Here, no attention is paid to those provisions of the Treaty which allow Euratom law to be adapted by simplified procedures 'where new circumstances so require' (see in particular Articles 4(2), 32, 41, 76, 85, 90).

[10] See Grunwald 2014a, p. 21.

the development of appropriate external relations with other countries and international organisations. It was the conviction of the Communities‘Founding Fathers[11] that these objectives could not be attained through a classical organisation of the intergovernmental type but that a new institutional concept would be necessary to guarantee independence, stability and success. This new concept led to the establishment of three supranational organisations of which one was to become EURATOM.

6.2.1 Legal Character and Mission

Following the model of the ECSC, EURATOM was established in 1958 as an independent supranational organisation designed to create 'the conditions necessary for the speedy establishment and growth of nuclear industries'.[12] While the ECSC Treaty had integrated the coal sector, the most important energy sector of the past, the EURATOM Treaty was looking to the future by creating, *ab ovo*, 'the conditions necessary for the development of a powerful nuclear industry which will provide extensive energy resources, lead to the modernization of technical processes and contribute, through its many other applications, to the prosperity of … peoples'.[13] In order to give effect to these ambitious intentions, a Community was created which possesses legal personality,[14] institutions,[15] a budget,[16] and, most importantly, the power to adopt measures which are binding in their entirety and directly applicable in all Member States.[17] Whereas traditional international organisations may only adopt measures which are binding on their Member States, EURATOM is authorised to exercise public power within its Member States by directly imposing obligations on persons and undertakings under their jurisdiction. It is this position "above" the Member States and their 'subjects' that is reflected in the term and concept of a "supranational" organisation. It is evident that in a Community based on the rule of law the exercise of such powers must be subject to judicial review, hence the need for an independent judicial system in which the European Court of Justice 'shall ensure that in the interpretation and application of (the) Treaty the law is observed'.[18]

[11] In particular Jean Monnet, Robert Schuman and Paul-Henri Spaak.

[12] Article 1.

[13] Third recital of the preamble.

[14] Article 184.

[15] Article 106a EAEC in conjunction with Articles 13 to 19 TEU and Articles 223 to 270, 272 to 274, 277 to 281, 285 to 287 TFEU.

[16] Articles 171 to 182 and Article 106a EAEC in conjunction with Articles 310 to 320, 322 to 324 TFEU.

[17] Article 106a EAEC in conjunction with Article 288 TFEU.

[18] Article 106a EAEC in conjunction with Article 19(1) TEU.

6.2.2 Powers

In terms of their legal nature, the powers vested in EURATOM are threefold: they are legislative, administrative and treaty-making powers. The *legislative powers* are exercised by the Council which is composed of national Ministers who, as members of their governments, represent their Member States.[19] Depending on the procedure foreseen by the respective empowering provision, the Council may decide by unanimity, qualified majority, or simple majority. However, according to the so-called ‘Community method’, the Council may only legislate on the basis of a proposal made by the Commission,[20] which in certain cases has to take scientific advice before it formulates its proposals.[21] The Commission, as EURATOM’s central institution, is today composed of 28 members (one for each Member State) who are to be chosen on the ground of their general competence, European commitment and personal independence.[22] Legislative powers are mainly exercised in determining the Community’s research and training programmes.[23] in adopting its security regulations for the protection of national defence interests,[24] in fixing the health and safety rules[25] and in establishing Joint Undertakings.[26]

The *administrative powers* are vested in the Commission.[27] These powers can be of a regulatory, executive, supervisory and advisory nature. A few examples may suffice: Regulatory rules in the form of Safeguards Regulations determine the reporting and accounting obligations of undertakings in the field of nuclear safeguards.[28] Executive measures range from the implementation of research programmes[29] to the granting of export authorisations[30] and the imposition of sanctions in cases of infringement of safeguards obligations.[31] Since the Commission does not dispose of an administrative substructure in the Member States, it is for the national authorities to give effect to all administrative measures which the Commission cannot execute itself through its own administration at Community level.[32]

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[19] Article 106a EAEC in conjunction with Article 16(2) TEU.

[20] Article 106a EAEC in conjunction with Article 17(2) TEU.

[21] See Articles 7 and 31.

[22] Article 106a(1) EAEC in conjunction with Article 17(3) TEU.

[23] Article 7.

[24] Article 24.

[25] Articles 31 and 32.

[26] Articles 47 to 49.

[27] Article 106a EAEC in conjunction with Article 17(1) TEU.

[28] Article 79.

[29] Article 7.

[30] Article 59(b).

[31] Article 83(1).

[32] See e.g. Article 164.

Supervisory functions are exercised in a specific manner through control measures in the field of radiation protection,[33] in the supervision of the EURATOM Supply Agency,[34] through the inspection of undertakings for the purposes of nuclear safeguards[35] and in commenting on draft agreements to be submitted by the Member States.[36] Moreover, in a general manner, the Commission has to ensure in its capacity as 'Guardian of the Treaty', that the provisions of the Treaty and the measures taken by the institutions are correctly applied,[37] if necessary by bringing an action before the Court of Justice to have an infringement established[38] and sanctions imposed.[39] In its advisory capacity the Commission can give its opinion on national research programmes,[40] particularly dangerous experiments,[41] plans for the disposal of radioactive waste[42] and on projects for establishing Joint Undertakings.[43] It may make recommendations in the fields of radiation protection,[44] prospecting and mining,[45] and on any other matter within its remit.[46] It may publish illustrative programmes,[47] give its views on investment projects[48] and comment on draft agreements to be submitted by the Member States.[49] Although opinions and recommendations as such are not binding in law,[50] some of these soft-law instruments, when adopted in the context of a supervisory function, may, when ignored, easily lead on to more stringent measures based on the respective empowering provisions.

The Community's *treaty-making powers* are vested in the Commission and in the Council.[51] In contrast to the more inward-looking ECSC Treaty, EURATOM

[33] Articles 33 to 38.

[34] Article 53.

[35] Articles 81 and 82.

[36] Article 103.

[37] Article 17(1) TEU.

[38] Articles 38, 82, 104 *in fine*, Article 106a EAEC in conjunction with Article 258 TFEU.

[39] Articles 83 and 145, Article 106a EAEC in conjunction with Article 260(2) TFEU.

[40] Article 5.

[41] Article 34.

[42] Article 37.

[43] Article 46.

[44] Article 33.

[45] Articles 70 and 71.

[46] Article 106a EAEC in conjunction with Article 292 TFEU.

[47] Article 40.

[48] Article 43.

[49] Article 103.

[50] See Article 106a EAEC in conjunction with Article 288 TFEU.

[51] Articles 29 and 101.

has been actively developing its external policy since the beginning, establishing 'with other countries and international organizations such relations as will foster progress in the peaceful uses of nuclear energy.'[52] EURATOM agreements are negotiated and concluded by the Commission, based on directives and the approval given by the Council. In certain cases the Commission may act on its own account, keeping the Council informed. Once in force, Community agreements are also binding on the Member States[53] and, if their provisions have direct effect, also on persons and undertakings. Special attention is given to mixed agreements where the European side is composed of EURATOM and its Member States, each of these Parties acting within their own competences. Such agreements only enter into force once all Member States concerned have completed their national ratification procedures.[54]

6.2.3 EURATOM and Its Member States

It is in the nature of a supranational organisation that it receives its powers through a joint transfer of national powers on the terms and conditions set out in the treaty establishing it. However, once established, the supranational organisation begins to develop an autonomous life of its own. This is particularly true of its legal order which follows its own rules, is independent of national legal orders and which, in cases of conflict, must take precedence over conflicting national rules in order to preserve its existence and unity.[55] Just like the ECSC Treaty and the EEC-, EC- and EU-Treaties, the EURATOM Treaty takes special care in safeguarding the supremacy of Community law over national law by establishing principles and procedures designed to avoid conflicting legal situations,[56] to preserve the uniformity of Community law[57] and, if need be, to force unwilling Member States to fulfil their obligations under Community law.[58]

Although the relationship between the Community and its Member States has not always been free of conflict, EURATOM history shows an impressive list of achievements despite often diverging views.[59] As a common legal framework accommodating two Nuclear Weapon States, 26 Non-Nuclear Weapon States, 14

[52] Article 2(h).

[53] See Article 216(2) TFEU and Case 104/81 *Hauptzollamt Mainz v Kupferberg* (1982) ECR 3644.

[54] Article 102.

[55] Case 6/64 *Costa v ENEL* (1964) ECR 1251.

[56] See Articles 33, 103, 192 and 193.

[57] See Article 106a(1) EAEC in conjunction with Article 267 TFEU on the preliminary ruling procedure.

[58] See Articles 38, 82 and 106a(1) EAEC in conjunction with Articles 258, 259 and 260 TFEU.

[59] See Grunwald 2008, p. 1075.

nuclear Member States and 14 non-nuclear Member States, old Member States and new Member States, the Treaty has shown utmost flexibility in dealing with divergent interests in the face of new challenges. It has survived six intergovernmental conferences amending the treaties on European Integration and eight rounds of accession without any changes to its political substance. What has changed, however, and regrettably so, is its legal presentation: Before the Lisbon Treaty,[60] the EURATOM Treaty had always been an autonomous, stand-alone document in its own right, on an equal footing with its EEC- and EC counterparts. Now, after Lisbon, the Treaty only exists in an amputated form since its institutional and financial provisions were repealed and replaced by a mere reference to the respective provisions of the EU Treaties.[61]

6.3 Nuclear Policy Under EURATOM Law

Article 1 of the Treaty provides:

> It shall be the task of the Community to contribute to the raising of the standard of living in the Member States and to the development of relations with the other countries by creating the conditions necessary for the speedy establishment and growth of nuclear industries.

Pursuant to Article 2 the performance of this task is translated into 10 specific policy areas the objectives of which are to be achieved through the measures set out in the 10 policy chapters of Title Two of the Treaty ('Provisions for the encouragement of progress in the field of nuclear energy'). As the language quoted already indicates, the Treaty is thus based on the assumption that all Member States would indeed wish to develop a nuclear industry for the benefit of their economies. While this inherent assumption is still valid, it is to be noted, however, that there is no strict obligation in law for the Member States to actually establish or only to tolerate a nuclear industry on their territory.[62] Paradoxical as it may seem, Member States may therefore lawfully refrain from using nuclear power or even ban it, provided that they comply with their obligations under the Treaty. These obligations are specific, as set out in the individual policy chapters, or general in nature.[63] From the nuclear industry's perspective most of EURATOM's

[60] OJ C 306, 17.12.2007, p. 1.

[61] See Article 106a(1). See also Grunwald 2015, p. 543.

[62] The Member States‘ discretion is expressly enshrined in Article 194(2) TFEU which recognizes the 'Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply, …'.

[63] See Article 192: 'Member States shall take all appropriate measures, whether general or particular, to ensure fulfilment of their obligations arising out of this Treaty or resulting from action taken by the institutions of the Community. They shall facilitate the achievement of the Community's tasks. They shall abstain from any measure which could jeopardize the attainment of the objectives of this Treaty.'

policy objectives are designed to impose a strict discipline on nuclear operators, while only some objectives may be qualified as being promotional in character, as will now be seen in detail.

6.3.1 Promotion of Research (Articles 4 to 11)

Chapter 1 is about research, the basis for any development in the nuclear area. This Chapter does not only cover research in the field of nuclear fission, but also fusion, nuclear medicine, material testing and other uses of nuclear energy in industry and agriculture.[64] EURATOM support for research is twofold: First, EURATOM may provide and coordinate financial and technical assistance in support of national research programmes[65] and second, EURATOM has to adopt and implement its own multiannual research and training programmes,[66] to be carried out either by the Community's own Joint Research Center[67] or by third parties under contracts.[68] The Community's present research and training programme 2014 to 2018[69] constitutes the European pillar for ITER,[70] the biggest international research project since the ISS. In total 1.6 bn EUR are foreseen in the programme of which 0.7 billion are earmarked for ITER.

EURATOM research rules also served as a model for today's EU research law.[71] Only 30 years after the adoption of the Treaty, the first provisions on research were introduced into the EEC Treaty. Both EURATOM and EU research efforts are intended to facilitate and complement national research activities[72] and to integrate European research capacities into the international research

[64] Pursuant to Article 4(2) the fields of research are listed in Annex I to the Treaty. That list may be amended by simplified procedure.

[65] See Articles 5 and 6.

[66] See Article 7.

[67] See Article 8.

[68] See Article 10.

[69] Council Regulation (EURATOM) No 1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014–2018) complementing the Horizon 2020 Framework Programme for Research and Innovation, OJ L 347, 20.12.2013, p. 948.

[70] Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project, OJ L 358, 16.12.2006, p. 62.

[71] See Articles 179 to 190 TFEU.

[72] See Article 4 EAEC and Article 180 TFEU.

community.[73] In financial terms, research policy is ranking on place 3 on the list of European subsidy policies,[74] behind agriculture[75] and cohesion.[76]

6.3.2 Dissemination of Information (Articles 12 to 29)

Chapter 2 is devoted to the dissemination of information gained through research and designed to create a European Research Area for the exchange and dissemination of knowledge,[77] with the European Commission in its center, acting as hub, clearing house and knowledge broker. Unfortunately, this chapter has remained largely a dead letter. Still, to this day its Article 24 forms the basis and model for all EU security and security grading rules.[78] Its Article 29 on technology transfer agreements, unfortunately hardly ever applied, centralises in the Commission the power to conclude agreements or contracts with third countries on the exchange of scientific or industrial information when the matter, on either side, requires the signature of a State acting in its sovereign capacity.

6.3.3 Health and Safety (Articles 30 to 39)

Chapter 3 on health and safety is today by far the most important and visible chapter of the Treaty and also constitutes the first environmental law at European level. It governs the entire radiation protection law in Europe and foresees far-reaching legislative-, control- and enforcement powers for the Community. Based on Chapter 3, a comprehensive body of Community legislation has been adopted over the years, with Chernobyl[79] and Fukushima[80] having served both as wake-up calls

[73] See Article 101 EAEC and Article 186 TFEU.

[74] See Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020—the Framework Programme for Research and Innovation (2014–2020), OJ L 347, 20.12.2013, p. 104, which provides for a financial envelope of 77 bn EUR.

[75] Articles 38 to 44 TFEU.

[76] Articles 174 to 178 TFEU.

[77] The Lisbon Treaty has also introduced the concept of a European Research Area in Articles 179(1) and 182 (5) TFEU. See also Grunwald 2011, p. 637–642.

[78] Regulation No 3 implementing Article 24 of the Treaty establishing the European Atomic Energy Community, English special edition: Series I Volume 1952–1958, p. 63–70.

[79] See Grunwald 1988, pp. 33–48.

[80] See Communication from the Commission to the Council and the European Parliament on the comprehensive risk and safety assessments ('stress tests') of nuclear power plants in the European Union and related activities, COM(2012) 571 final, 4.12.2012.

and boosters for improved radiation protection measures, in particular in the field of nuclear safety.[81] The task assigned to EURATOM is comprehensive: the Community shall 'establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied' (Article 2(b)). While it is not possible to set out in detail all measures adopted in the last decades, a listing of relevant legal instruments in force will reflect the scope and variety of the Community's radiation protection legislation.[82] These instruments show that the nuclear industry and the Member States are subject to strict rules governing the operation of nuclear facilities as well as the production, use and transport of nuclear material. In this context it is to be noted that whereas EURATOM safeguards only apprehends fissile materials, EURATOM radiation protection law applies to all ionizing radiation, whatever their source and origin,[83] including natural radiation such as cosmic radiation and radon.

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[81] See in particular Council Directive 2014/87/EURATOM of 8 July 2014 amending Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations, OJ L 219, 25.7.2014, p. 42.

[82] See:

Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against dangers arising from exposure to ionising radiation, OJ L 13, 17.1.2014, p. 1.

Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption, OJ L 296, 7.11.2013, p. 12.

Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, OJ L 199, 2.8.2011, p. 48.

Council Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations, OJ L 172, 2.7.2009, p. 18.

Council Directive 2006/117/EURATOM of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel, OJ L 337, 5.12.2006, p. 21.

Council Regulation (EURATOM) No 1493/93 of 8 June 1993 on shipments of radioactive substances between Member States, OJ L 148, 19.6.1993, p. 1.

Council Regulation (EURATOM) No 3954/87 of 22 December 1987 laying down maximum permitted levels of contamination of foodstuffs and of feedingstuffs following a nuclear accident or any other case of radiological emergency, OJ L 371, 30.12.1987, p. 11.

Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency (87/600/Euratom), OJ L 371, 30.12.1987, p. 76.

[83] See Case C-70/88 *Parliament v Council* (1991) ECR I-4561, para 14: 'The indications are … that the purpose of the articles … is to ensure the consistent and effective protection of the health of the general public against the dangers arising from ionizing radiations, whatever their source and whatever the categories of persons exposed to such radiations.' Unfortunately the Court did not care to mention this important passage when it ruled later on in Case C-61/03 *Commission v United Kingdom* (2005) ECR I-2511 with regard to radiation protection that 'activities falling within the military sphere are outside the scope of (the) Treaty' (para 36), thus leaving the general public and workers unprotected against the dangers arising from ionizing radiation having their source in the 'military sphere' (see also point 6.4.2 below).

EURATOM's radiation protection system is based on *six levels of responsibility*, with inbuilt redundancies to detect and correct system failures:

Level 1: It is for the Council of Ministers to adopt legislation on uniform safety standards to protect the health of workers and of the general public in the Community. The concept of 'basic standards' is defined in Article 30.[84] The adoption procedure is governed by Article 31 which foresees a leading role for scientific experts, in particular in the field of public health. Special care is taken to ensure that the Community's radiation protection legislation will respond at all times to new and unforeseen challenges and reflect the state of the art. To this end, Article 32 provides: 'At the request of the Commission or of a Member State, the basic standards may be revised or supplemented in accordance with the procedure laid down in Article 31.'

Level 2: It is for the Member States to give effect to Community legislation by adopting and implementing appropriate national measures. Article 33 first paragraph provides:

> Each Member State shall lay down the appropriate provisions, whether by legislation, regulation or administrative action, to ensure compliance with the basic standards which have been established and shall take the necessary measures with regard to teaching, education and vocational training.

Level 3: It is for the Commission to check *ex-ante* the conformity of those national provisions with Community legislation. Pursuant to Article 33 third paragraph, the Member States are required to communicate to the Commission their draft provisions, thus allowing the Commission to issue any recommendations it may wish to address to the Member States with regard to such draft provisions. Although recommendations are not binding in law, any detected incompatibility with Community law may give rise to infringement procedures[85] if such incompatibility persists after the adoption of the national provision.

Level 4: It is for the nuclear industry to comply with applicable Community law and national provisions adopted to give effect to it. The persons and undertakings to which the Community provisions apply are defined in Article 196 as persons or undertakings which pursue all or any of their activities in the territories of Member States within the fields specified in the relevant chapters of the Treaty. The term undertaking also applies to institutions with a public status.

Level 5: It is for the Member States and the Commission to control and ensure compliance by the nuclear industry. As regards the violation of national

[84] 'The expression "basic standards" means:
(a) maximum permissible doses compatible with adequate safety;
(b) maximum permissible levels of exposure and contamination;
(c) the fundamental principles governing the health surveillance of workers.'

[85] See Article 106a EAEC in conjunction with Article 258 TFEU.

provisions, the measures to be taken by the Member State are a matter of national law. As regards the violation of obligations under Community law, Article 145 applies:

> If the Commission considers that a person or undertaking has committed an infringement of this Treaty … it shall call upon the Member State having jurisdiction over that person or undertaking to cause sanctions to be imposed in respect of the infringement in accordance with its national law.

Level 6: Finally, it is for the Commission to supervise the Member States in their controlling function in order to ensure compliance with all regulations. To this end, Articles 34 to 37 require the Member States to fulfil specific obligations in the interest of their own population and those of other Member States. Articles 35 and 36 provide respectively:

> Article 35
> Each Member State shall establish the facilities necessary to carry out continous monitoring of the level of radioactivity in the air, water and soil and to ensure compliance with the basic standards.
> The Commission shall have the right of access to such facilities; it may verify their operation and efficiency.

> Article 36
> The appropriate authorities shall periodically communicate information on the checks referred to in Article 35 to the Commission so that it is kept informed of the level of radioactivity to which the public is exposed.

In cases of urgency, such as nuclear accidents or other radiological emergencies, Article 38 empowers the Commission to issue a directive requiring the Member State concerned to take all necessary measures to prevent infringements and to ensure compliance. In cases of non-compliance with this directive the Commission may directly submit the matter to the Court of Justice.

6.3.4 Investment (Articles 40 to 44)

Chapter 4 bears the heading 'Investment' and is embedded in the EU's general energy policy.[86] It is about industrial development in the nuclear sector, and in particular about guidance and transparency which are to be applied in both directions: top down and bottom up. *Top down*: Article 40 provides:

> In order to stimulate action by persons and undertakings and to facilitate coordinated development of their investment in the nuclear field, the Commission shall periodically publish illustrative programmes indicating in particular nuclear energy production targets and all the types of investment required for their attainment.

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[86] See Article 194 TFEU. See also the recent document: 'Energy Union Package', Communication from the Commission: A Framework Strategy for a Resiliant Energy Union with a Forward-Looking Climate Change Policy, COM(2015) 80 final, 25.2.2015, with further references.

The last Nuclear Illustrative Programme was updated by the Commission in 2008.[87] *Bottom up*: Undertakings engaged in the nuclear industry have to communicate their investment projects to the Commission (Articles 41 and 42)[88] so that the latter can discuss with them all aspects which relate to the objectives of the Treaty (Article 43).[89] In the interest of transparency the 'Commission may, with the consent of Member States, persons and undertakings concerned, publish any investment projects communicated to it' (Article 44).

Although Chapter 4 itself does not foresee any financial support for investment projects, loans may be made available under Article 172(4).[90] The total ceiling for such loans is at present fixed at 4 billion EUR,[91] an amount which is now basically earmarked for safety upgradings of existing nuclear installations.

6.3.5 Joint Undertakings (Articles 45 to 51)

Chapter 5 makes provisions for the establishment of Joint Undertakings.[92] These are defined as 'undertakings which are of fundamental importance to the development of the nuclear industry in the Community' (Article 45). In order to provide special incentives for their establishment, these undertakings may enjoy specific advantages, such as expropriations in their favour, tax relief, exemption from duties and charges, as well as public interest status.[93] The last Joint Undertaking established by the Council is acting as interface between the Community and the ITER Organisation.[94]

[87] COM(2008) 738/3 of 11.11.2008. See also Grunwald 2010, p. 425–427.

[88] The industrial activities referred to in Article 41 are listed in Annex II to the Treaty. See also Council Regulation (EURATOM) No 2587/1999 of 2 December 1999 defining the investment projects to be communicated to the Commission in accordance with Article 41 of the Treaty establishing the European Atomic Energy Community, OJ L 315, 9.12.1999, p. 1. As regards the general reporting obligation applicable to the energy sector see Council Regulation (EU, EURATOM) No 617/2010 of 24 June 2010 concerning the notification to the Commission of investment projects in energy infrastructure within the European Union and repealing Regulation (EC) No 736/96, OJ L 180, 15.7.2010, p. 7.

[89] This discussion should in particular relate to the objectives of Chapters 3 and 7 of the Treaty and should cover all nuclear safety and security aspects of the investment project.

[90] See Council Decision 77/270/EURATOM of 29 March 1977 empowering the Commission to issue Euratom loans for the purpose of contributing to the financing of nuclear power stations, OJ L 88, 6.4.1977, p. 9. See also Grunwald 2003, p. 231 et seq.

[91] See Council Decision 90/212/EURATOM of 23 April 1990, OJ L 112, 3.5.1990, p. 26.

[92] The model of Joint Undertakings was copied by Article 187 TFEU.

[93] These advantages are listed in Annex III to the Treaty ("Advantages which may be conferred on Joint Undertakings under Article 48 of this Treaty").

[94] Council Decision 2007/198/EURATOM of 27 March 2007 establishing the European Joint Undertaking for ITER and the Development of Fusion Energy and conferring advantages upon it, OJ L 90, 30.3.2007, p. 58.

6.3.6 Supplies (Articles 52 to 76)

Chapter 6 on 'Supplies' is not only the longest chapter of the Treaty but it has also been the most controversial one in political terms.[95] It organises the supply of nuclear material to users in Europe from sources inside (Articles 57 to 63) and outside the Community (Articles 64 to 66), as well as the sale of such material to purchasers and users outside the EURATOM area. To this end the Treaty establishes the EURATOM Supply Agency (ESA)[96] which is to carry out all these operations under the supervision of the Commission (Article 53). In legal terms, the Agency is the single buyer and single seller of nuclear material in the Community. In economic terms, it holds a monopoly under public law. Its task consists in matching supply and demand in a non-discriminatory manner, based on commercial principles (Article 60). In fulfilling this task, the Agency is obliged to 'meet all orders unless prevented from doing so by legal or material obstacles' (Article 61). Legal obstacles may result from international commitments of the Community[97] or from the principles of the Community's own supply policy,[98] such as the need for geographical diversification of supply sources, the requirement of market-related prices, or the principle of non-discrimination.[99] Material obstacles may exist in case of a serious shortage of supply.

It is to be noted, however, that in practice the operation of Chapter 6 has been somewhat simplified (without depriving that Chapter of its legal effect)[100] in that producers and users are allowed to negotiate supply contracts directly.[101] The draft contracts then need to be submitted to the Supply Agency for approval and signature. Despite the simplified procedure the proper functioning of Chapter 6 was constantly obstructed by France so that in 1969 the Commission had to launch its

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[95] See Weilemann 1983; Allen 1983, Chapter VI, p. 473.

[96] See Articles 52(2)(b) and 54. See also Council Decision 2008/114/EC (sic!), EURATOM of 12 February 2008 establishing Statutes for the EURATOM Supply Agency, OJ L 41, 15.2.2008, p. 15. The Agency has its offices in Luxembourg.

[97] Such as 'conditions imposed by suppliers outside the Community' (Article 52 *in fine*).

[98] This policy is qualified by Article 52(1) as a 'common supply policy'. As a common policy it is equivalent to policies for which the Union has an 'exclusive competence' under Article 3 TFEU.

[99] See Case C-161/97 P *Kernkraftwerke Lippe-Ems v Commission* (1999) ECR I-2116 and Joined Cases T-149/94 and T-181/94 *Kernkraftwerke Lippe-Ems v Commission* (1997) ECR II-161.

[100] See Case 7/71 *Commission v France* (1971) ECR 1004 para 43: 'In any case, the fact that market conditions may during a given period have rendered less necessary the use of the supply mechanisms prescribed by the Treaty does not suffice to deprive the provisions relating to these mechanisms of their mandatory character.'

[101] Rules of the Supply Agency of the European Atomic Energy Community determining the manner in which demand is to be balanced against the supply of ores, source materials and special fissile materials of 5 May 1960, as amended by Regulation of the Supply Agency of 15 July 1975, OJ L 193, 25.7.1975, p. 37.

first EURATOM infringement procedure against that country. The Case was brought before the Court of Justice and France lost,[102] remaining disgruntled for many years to come.

A specific non-proliferation objective can be seen in Article 59(b), according to which ores, source materials and special fissile materials may only be exported from the Community with the authorisation of the Commission:

> The Commission may not grant such authorisation if the recipients of the supplies fail to satisfy it that the general interests of the Community will be safeguarded or if the terms and conditions of such contracts are contrary to the objectives of (the) Treaty.

In 1985 the Commission published its criteria for the application of Article 59(b) in a proposal submitted to the Council:[103]

> The Commission shall authorize the export of source materials or special fissile materials outside the Community to a non-nuclear-weapon State as defined in Article IX(3) of the Treaty on the Non-Proliferation of Nuclear Weapons, if such materials and the materials derived therefrom are subject in that State to the following conditions:
>
> (a). use for non-explosive purposes;
> (b). application of the safeguards of the International Atomic Energy Agency;
> (c). application of measures of physical protection corresponding to the levels set out in the Annex;
> (d). application of the conditions in points (a), (b) and (c) in the event of retransfer to another non-nuclear-weapon non-Community State and in the event of subsequent retransfers of that type.

Chapter 6 is closed by special provisions on the exemption of small quantities of nuclear materials from the supply rules (Article 74),[104] on the treatment of processing, conversion and shaping operations (Article 75)[105] and on the simplified amendment of Chapter 6.[106]

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[102] Case 7/71 *Commission v France* (1971) ECR 1004.

[103] Proposal for a Council Regulation adopting criteria for the granting of Commission authorization for exports of nuclear materials outside the Community, OJ C 29, 31.1.1985, p. 10.

[104] See Commission Regulation (EURATOM) No 66/2006 of 16 January 2006 exempting the transfer of small quantities of ores, source materials and special fissile materials from the rules of the chapter on supplies, OJ L 11, 17.1.2006, p. 6.

[105] See on the interpretation of this Article Joined Cases C-123/04 and C-124/04 *Industrias Nucleares do Brasil and Siemens v UBS and Texas Utilities Electric Corporation* (2006) ECR I-7861.

[106] No amendment has ever been adopted. The last three proposals submitted by the Commission based on Article 76 are the following:

Proposal for a Council Decision adopting new provisions relating to Chapter VI (Supplies) of the Treaty establishing the European Atomic Energy Community, OJ C 330, 16.12.1982, p. 4. This proposal is the subject of Allen (1983) The EURATOM Treaty, Chapter VI;

Proposal for a Council Regulation adopting criteria for the granting of Commission authorization for exports of nuclear materials outside the Community, OJ C 29, 31.1.1985, p. 10;

Proposal for a Council Regulation adopting conditions relating to transfers of nuclear materials between Member States and to imports from outside the Community, OJ C 29, 31.1.1985, p. 5.

6.3.7 Safeguards (Articles 77 to 85)

Chapter 7 on 'Safeguards' is closely linked to Chapter 6 on Supplies in that it requires the Commission to satisfy itself that the provisions relating to supplies as well as international commitments are complied with and that nuclear materials are not diverted to purposes other than those for which they are intended (Article 77).[107] In operational terms, the EURATOM safeguards system is based on record keeping-, accounting- and reporting obligations on the part of the nuclear industry (Articles 78 and 79)[108] and on physical on the spot inspections carried out by more than 200 inspectors posted in Luxembourg.[109] These inspectors report their findings and in particular any infringements to the Commission[110] which may impose sanctions ranging from a simple warning to a total withdrawal of all nuclear materials.[111] It is for the Member States to ensure that sanctions are enforced and infringements remedied.[112] Unwilling or uncooperative Member States may be called to order by way of Commission directives and, in case of non-compliance, may be subject to enforcement proceedings before the Court of Justice.[113]

6.3.8 Property Ownership (Articles 86 to 91)

Chapter 8 is about 'Property Ownership' and modelled on the corresponding US regime of the 1950s. Special fissile materials[114] are the property of the Community (Article 86). Lawful holders of such materials only have a right of use and consumption, subject to the obligations imposed on them by the Treaty (Article 87). Ores and source materials acquired by the Agency become the property of the Agency (Article 57(1)(b)) and, when sold by the Agency to their users,

[107] For a detailed account see Kilb 2015, p. 151.

[108] See Commission Regulation (EURATOM) No 302/2005 of 8 February 2005 on the application of EURATOM safeguards, OJ L 54, 28.2.2005, p. 1. The Regulation is complemented by two Recommendations of 15 December 2005 (OJ L 28, 1.2.2006, p. 1) and 11 February 2009 (OJ L 41, 12.2.2009, p. 17).

[109] Article 81. For the continuous inspection of the reprocessing plants at La Hague (France) and Sellafield (UK) the Commission is operating on-site laboratories.

[110] Article 82 first and second paragraphs.

[111] Article 83(1). See also Case C-308/90 *Advanced Nuclear Fuels v Commission* (1993) ECR I-349.

[112] Article 83(2) and (4).

[113] Article 82 third and fourth paragraphs.

[114] See the definition in Article 197.

the title is passed on to the latter (Article 91). The Community's right of ownership extends to all special fissile materials which are produced in or lawfully imported into the Community and are subject to safeguards. Unless these special fissile materials are used, transported or stored by the Agency[115] or the Commission itself,[116] the Community's property ownership does not entail a specific owner's responsibility for such materials on the part of the Community.[117] This is especially true for stolen vagabonding material which is confiscated by the police and dealt with under national police and criminal law.[118]

6.3.9 Nuclear Common Market (Articles 92 to 99)

Chapter 9 establishes 'The Nuclear Common Market' which, just like the Common Market under former EEC law,[119] and the present Internal Market under EU law, is defined as 'an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured in accordance with the provisions of the Treaties' (Article 26(2) TFEU). While in practice the nuclear common market has become part of the EU internal market, there are still two distinctive features of the nuclear common market which deserve attention: *First*, nuclear materials, facilities and equipment are listed in category 0 of Annex I of the Dual-Use Regulation[120] and are also included in Annex IV to which Article 22 of that Regulation applies: Pursuant to Article 22(1) an 'authorisation shall be required for intra-Community transfers of dual-use items listed in Annex IV'. *Second*, of all provisions of Chapter 9 only one has not been applied to date: Article 98 calls upon the Member States to 'take all measures necessary to facilitate the conclusion of insurance contracts covering nuclear risks' and upon the

115 Pursuant to Article 72 first paragraph the Agency may build up commercial stocks. On the conditions laid down in Article 80 special fissile materials may 'be deposited with the Agency or in other stores which are or can be supervised by the Commission'.

116 By virtue of Article 72 second paragraph the Commission may build up emergency stocks.

117 The Community's non-contractual liability is governed by Article 188 s paragraph.

118 After the collapse of the Soviet Union several attempts were made by criminal dealers to sell diverted nuclear material of Soviet origin in European countries.

119 In its Ruling 1/78 (1978) ECR 2127 the Court of Justice held (para 15): 'Like the EEC Treaty the EAEC Treaty seeks to set up, with regard to matters covered by it, a homogeneous economic area; it is within this area from which barriers have been removed that the Commission and the Supply Agency are called upon to exercise their exclusive rights in the name of the Community.'

120 Council Regulation (EC) No 428/2009 of 5 May 2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items, OJ L 134, 29.5.2009, p. 1.

Council to issue directives for the application of that Article. To this day neither mandate has been fulfilled so that the potential of Article 98 still remains to be explored.[121]

6.3.10 External Relations (Articles 101 to 106)

Chapter 10 on 'External Relations' is the last policy chapter of the Treaty. Its objective is to 'establish with other countries and international organisations such relations as will foster progress in the peaceful uses of nuclear energy' (Article 2(h)). To this end, Article 101 provides:

> The Community may, within the limits of its powers and jurisdiction, enter into obligations by concluding agreements or contracts with a third State, an international organisation or a national of a third State.
>
> Such agreements or contracts shall be negotiated by the Commission in accordance with the directives of the Council; they shall be concluded by the Commission with the approval of the Council, which shall act by a qualified majority.
>
> Agreements or contracts whose implementation does not require action by the Council and can be affected within the limits of the relevant budget shall, however, be negotiated and concluded solely by the Commission; the Commission shall keep the Council informed.

Based on this provision, bilateral and multilateral agreements have been concluded in the fields of nuclear research,[122] including ITER,[123] of radiation protection,[124]

[121] For recent reflections on nuclear liability and insurance see the contributions in Raetzke 2014, pp. 279–355.

[122] See Agreements on Fusion Research with the United States of America (OJ L 148, 1.6.2001, p. 80), Canada (OJ L 346, 22.12.1998, p. 65), Switzerland (OJ L 242, 4.9.1978, p. 2; OJ L 116, 30.4.1982, p. 21 and OJ L 20, 24.1.2008, p. 11), Japan (OJ L 57, 28.2.1989, p. 63 and OJ L 246, 21.9.2007, p. 32), Russia (OJ L 287, 31.10.2001, p. 30), Ukraine (OJ L 322, 27.11.2002, p. 40), India (OJ L 242, 15.9.2010, p. 26), Brazil (OJ L 242, 15.9.2010, p. 34) and Kazakhstan (OJ L 143, 7.6.2005, p. 28). See also Memorandum of Understanding between the European Commission and the European Organization for Nuclear Research (CERN), OJ L 161, 24.6.2009, p. 14.

[123] Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project, OJ L 358, 16.12.2006, p. 62.

[124] Commission Decision 2005/844/EURATOM of 25 November 2005 concerning the accession of the European Atomic Energy Community to the Convention on Early Notification of a Nuclear Accident (1986), OJ L 314, 30.11.2005, p. 21; Commission Decision 2005/845/EURATOM of 25 November 2005 concerning the accession of the European Atomic Energy Community to the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency, OJ L 314, 30.11.2005, p. 27.

including nuclear safety,[125] of supplies[126] and safeguards,[127] including physical protection,[128] and on cooperation in the peaceful uses of nuclear energy in general.[129]

In contrast to EU law which is silent on mixed agreements, Article 102 contains a specific rule concerning their entry into force. Another specific feature of EURATOM law which has no parallel in EU law consists in a mandatory scrutiny procedure empowering the Commission to check *ex ante* whether nuclear draft agreements or contracts which the Member States intend to conclude with a third State, an international organisation or a national of a third State are compatible with the Treaty. Article 103 *in fine* provides:

> The State shall not conclude the proposed agreement or contract until it has satisfied the objections of the Commission or complied with a ruling by the Court of Justice of the European Union, adjudicating urgently upon an application from the State, on the compatibility of the proposed clauses with the provisions of this Treaty.

In a similar vein but *ex post*, the Commission may request all information relating to agreements or contracts concluded by persons or undertakings with a third State, an international organisation or a national of a third State. Article 104 *in fine* provides:

> The Commission may require such communication only for the purpose of verifying that such agreements or contracts do not contain clauses impeding the implementation of this Treaty.
>
> On application by the Commission, the Court of Justice of the European Union shall give a ruling on the compatibility of such agreements or contracts with the provisions of this Treaty.

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[125] See Nuclear Safety Convention (1994), OJ L 318, 11.12.1999, p. 21.

[126] See EURATOM Supply Agency, Annual Report 2014, p. 27 et seq.: Origins of uranium delivered to EU utilities, 2014 (in tonnes and % share), Purchases of natural uranium by EU utilities by origin, 2006–14 (tU).

[127] Agreement between the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the European Atomic Energy Community and the International Atomic Energy Agency in implementation of Article III(1) and (4) of the Treaty on the non-proliferation of nuclear weapons, OJ L 51, 22.2.1978, p. 1, and Additional Protocol of 22 September 1998 (1999/188/EURATOM), OJ L 67, 13.3.1999, p. 1. Agreement of 6 September 1976 between the United Kingdom of Great Britain and Northern Ireland, the European Atomic Energy Community and the Agency in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/263, October 1978; Accord conclu le 27 juillet 1978 entre la France, la Communauté européenne de l'Énergie Atomique et l'Agence Internationale de l'Énergie Atomique relatif à l'application de garanties en France, AIEA, INFCIRC/290, Décembre 1981.

[128] Commission Decision 2008/99/EC (sic!), EURATOM of 19 December 2007 concerning the accession of the European Atomic Energy Community to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, OJ L 34, 8.2.2008, p. 3.

[129] Agreements for cooperation in the peaceful uses of nuclear energy were concluded with the United States of America (OJ L 120, 20.5.1996, p. 1), Uzbekistan (OJ L 269, 21.10.2003, p. 8), Ukraine (OJ L 261, 22.9.2006, p. 26), Japan (OJ L 32, 6.2.2007, p. 64), Kazakhstan (OJ L 10, 15.1.2009, p.16), Australia (OJ L 29, 1.2.2012, p. 4), South Africa (OJ L 204, 31.7.2013, p. 3), Canada (SEC(2011) 969 final, 26.7.2011).

6.4 Scope of the Treaty: Peaceful Uses, Military Uses and 'Intended Uses'

In a book devoted to 'Legal Aspects of the Use of Nuclear Energy for Peaceful Purposes' the notion of 'peaceful uses' deserves special attention. While there is no doubt that the EURATOM Treaty was concluded to encourage the peaceful development of atomic energy, its legal repercussions on the military uses of nuclear energy are less clear. In the opinion of the Court of Justice the Treaty does not apply to the 'military sphere' at all.[130] There are good reasons, however, to question the legal soundness of the Court's reasoning. As will be seen, the Treaty's design is much more complex and *nuancé* than the picture painted by the Court's broad brush.

6.4.1 Peaceful Uses

At the outset it should be emphasised that the idea of peace was the single most important driving force for European integration after the Second World War. Already the preamble to the ECSC Treaty is dominated by terms such as 'world peace', 'peaceful relations' and 'works of peace', bringing together 'peoples long divided by bloody conflicts'. The preamble to the EEC Treaty, on its part, also stresses the Parties'resolution 'to preserve and strengthen peace'. The same conviction finds its expression in the preamble to the EURATOM Treaty: The emphasis on peace is already present in the first recital in which the Parties recognise 'that nuclear energy represents an essential resource for the development and invigoration of industry and will permit the advancement of peace'. Likewise, the fifth recital refers to 'the peaceful development of atomic energy', while Article 2(h) calls upon the Community to 'establish with other countries and international organisations such relations as will foster progress in the peaceful uses of nuclear energy'.

However, at this point a distinction needs to be made. As the language quoted from the preambles of the three Treaties shows, the common denominator 'peace' points to the fact that European integration as such is meant to secure peace in Europe. This finality, however, does not bar the Member States from determining their own national defence policies in an autonomous manner, including the

[130] Case C-61/03 *Commission v United Kingdom* (2005) ECR I-2511.

nuclear option. It is in this context that the notion of peace acquires a second significance through the juxtaposition of 'peaceful' and 'military' uses of nuclear energy. While the Treaty seeks to foster progress in the peaceful uses of nuclear energy, it is fully aware of the fact that atomic energy can also be used for military purposes, be they explosive or non-explosive. By expressly acknowledging the 'defence interests of one or more Member States', such as in Article 24, the Treaty shows its sensitivity to the dual use problem present, *inter alia*, in nuclear research. Likewise, Article 194 of the Treaty subjects any unauthorised disclosure of protected information committed by or within the Community's institutional system to the national rules on 'acts prejudicial to the security of State' or the disclosure of professional secrets. These provisions clearly show that the Treaty, being conscious of the sometimes fine line between peaceful and defence uses of nuclear energy, does not intend to interfere with the defence policies of Member States. This restraint is also reflected in Article 84 according to which 'safeguards may not extend to materials intended to meet defence requirements which are in the course of being specially processed for this purpose or which, after being so processed, are, in accordance with an operational plan, placed or stored in a military establishment'.

The fact, however, that the Treaty does not wish to interfere with the defence policies of the Member States does not necessarily imply that the Treaty has no bearing on nuclear defence activities. But before this point can be further developed it is appropriate first to turn to the Court's reasoning as to why in its opinion the Treaty does not apply to the 'military sphere'.

6.4.2 Military Uses

The case in which the issue of military uses of nuclear energy was brought up was initiated in 2001 in the context of an infringement procedure launched by the Commission against the United Kingdom. By its application the Commission sought from the Court a declaration that, by failing to provide general data relating to a plan for the disposal of radioactive waste associated with the decommissioning of the Jason reactor at Royal Naval College, Greenwich, the United Kingdom had failed to fulfil its obligations under Article 37 of the Treaty.[131] The Jason reactor had been operated by the UK Ministry of Defence from 1962 to 1996 and was used for research and to train personnel in support of the nuclear propulsion

[131] Article 37 reads as follows: 'Each Member State shall provide the Commission with such general data relating to any plan for the disposal of radioactive waste in whatever form as will make it possible to determine whether the implementation of such plan is liable to result in the radioactive contamination of the water, soil and airspace of another Member State. The Commission shall deliver its opinion within six months, after consulting the group of experts referred to in Article 31.'

programme implemented by the UK Government for the nuclear submarines of the Royal Navy.

While the opinion of the Advocat General supported the Commission,[132] the Court dismissed the application. Instead of limiting the examination to the scope of the provision at stake, namely Article 37 in Chapter 3 on Health and Safety, the Court chose to determine, as its starting point, the scope of the Treaty as a whole. By thus broadening the issue at the outset, the Court claimed that the Commission had 'not stated that the provisions of that chapter might be afforded a field of application which differs from that of the Treaty as a whole' (para 24). Consequently, the Court then focussed on the question whether 'the military uses of nuclear energy may fall within the scope of this Treaty' (para 25). Finding that the 'objectives pursued by the Treaty are essentially civil and commercial' (para 27), that the guidance provided by historical documents, such as interpretative declarations and travaux préparatoires, was inconclusive (para 29), and that the text of Articles 34, 35 and 37 and the provisions in Chapter 1 on promotion of research 'does not in any way specify whether the activities thus governed are exclusively civil' (para 35), the Court arrived at the following conclusion (para 36):

> However, it is clear that the application of such provisions to military installations, research programmes and other activities might be such as to compromise essential national defence interests of the Member States. Consequently, … the absence in the Treaty of any derogation laying down detailed rules according to which the Member States would be authorised to rely on and protect those essential interests leads to the conclusion that activities falling within the military sphere are outside the scope of the Treaty.

The derogation which the Court found to be absent in the Treaty was Article 296(1) EC Treaty which, after Lisbon, has become Article 346(1) TFEU. This provision reads as follows:

> The provisions of this Treaty shall not preclude the application of the following rules:
>
> (a) no Member State shall be obliged to supply information the disclosure of which it considers contrary to the essential interests of its security; (b) any Member State may take such measures as it considers necessary for the protection of the essential interests of its security which are connected with the production of or trade in arms, munitions and war material; such measures shall not adversely affect the conditions of competition in the common market regarding products which are not intended for specifically military purposes.

Having gone from the general (the Treaty as a whole), to the particular (Article 37) and then back again to the general (the Treaty as a whole), the Court concluded its judgment, by adding the following afterthought as *obiter dictum*, which looks like an excuse for what had been decided (para 44):

> It is necessary, however, to emphasise that the fact that the Treaty is not applicable to uses of nuclear energy for military purposes and that, accordingly, the Commission is not justified in relying on Article 37 EA in order to require Member States to provide it with information on the disposal of radioactive waste from nuclear installations does not by any

[132] Opinion of Advocate General Geelhoed (2005) ECR I-2481.

> means reduce the vital importance of the objective of protecting the health of the public and the environment against the dangers related to the use of nuclear energy, including for military purposes. In so far as that Treaty does not provide the Community with a specific instrument in order to pursue that objective, it is possible that appropriate measures may be adopted on the basis of the relevant provisions of the EC Treaty.

Both the conclusions drawn by the Court and the *obiter dictum* just quoted give rise to serious objections which shall now be looked at in detail.

6.4.3 Intended Uses

To begin with, it is to be noted that the key notion used by the provisions of the Treaty is neither 'peaceful uses' nor 'military uses' but 'intended uses'. This is evidenced by Article 2(e) ('… that nuclear materials are not diverted to purposes other than those for which they are intended'), Article 52(2) *in fine* ('… the use which they intend to make of the supplies requested …'), Article 60 first paragraph ('… Potential users shall … inform the Agency of … the intended use …'), Article 77(a) ('… are not diverted from from their intended uses as declared by their users …'), Article 84 first paragraph ('… no discrimination shall be made on grounds of the use for which ores, source materials and special fissile materials are intended'), Article 84 third paragraph ('… may not extend to materials intended to meet defence requirements …'). This leads on to the question whether these intended uses may also be military uses or only peaceful uses.

Leaving aside all considerations based on the NPT which entered into force at a much later date, the answer to this question can only be found in the Treaty itself as it stood in 1958. In essence, the answer to this question hinges on the answers to be given to the following questions up-stream, namely: (1) Does the Treaty *require* the Member States to procure nuclear material intended to meet defence requirements through the mechanisms of Chapter 6? Or, conversely: (2) Does Chapter 6 *prohibit* the supply of nuclear material intended to meet defence requirements? Or: (3) Does the Treaty *allow* the supply of such nuclear material through the mechanisms of Chapter 6 without excluding a procurement outside the provisions of this Chapter? It goes without saying that the replies to these questions are mutually exclusive. They converge in the interpretation of this chapter and in particular in the assessment of the scope of the mandate conferred on the Supply Agency.

As set out above, the Supply Agency is conceived in legal terms as single buyer and single seller of nuclear material in the Community, holding in economic terms a monopoly position in nuclear trade. Article 52(2)(b) provides:

> … an Agency is hereby established; it shall have a right of option on ores, source materials and special fissile materials produced in the territories of Member States and an exclusive right to conclude contracts relating to the supply of ores, source materials and special fissile materials coming from inside the Community or from outside.

If a Member State wishes to develop a nuclear capability for defence purposes, it has two options: it may either procure the necessary nuclear material through normal market channels by buying the material at the stage of the production process it chooses (as ores, source material or special fissile material) to have it then further processed for its specific purposes, or the Member State may avoid the market by setting up its own production line covering all production stages from ore to final nuclear device.

In the first scenario the Member State would need to act as a 'potential user' within the meaning of Article 60 first paragraph, having to place its order with the Agency and having to specify 'the quantities, the physical and chemical nature, the place of origin, the intended use, delivery dates and price terms, which are to form the terms and conditions of the supply contract …' As 'intended use' the Member State would have to indicate the use for defence purposes. Pursuant to Article 61 first paragraph the Agency would have to meet that order 'unless prevented from doing so by legal or material obstacles'. Today, it is the NPT which determines for which Member States a *legal* obstacle exists, in 1958 there was, at least in principle, no such legal obstacle. Likewise in cases of *material* obstacles, such as shortages, the Agency could not claim that orders for intended civil uses would have priority over uses for defence purposes since Article 52(2)(b) second paragraph provides:

> The Agency may not discriminate in any way between users on grounds of the use which they intend to make of the supplies requested unless such use is unlawful or is found to be contrary to the conditions imposed by suppliers outside the Community on the consignment in question.

In practice, the most important condition imposed by suppliers outside the Community is the insistence on peaceful uses of the material supplied, a condition that would be superfluous if at any rate by law the Agency could only supply material for peaceful purposes under Chapter 6. The same non-discrimination rule applies to safeguards by virtue of Article 84 first paragraph:

> In the application of the safeguards, no discrimination shall be made on grounds of the use for which ores, source materials and special fissile materials are intended.

The fact that the use of nuclear material intended for defence purposes qualifies as an 'intended use' under the Treaty is finally evidenced by Article 84 third paragraph:

> The safeguards may not extend to materials intended to meet defence requirements which are in the course of being specially processed for this purpose or which, after being so processed, are, in accordance with an operational plan, placed or stored in a military establishment.

It follows *e contrario* that materials intended to meet defence requirements which have not (yet) reached the (final) stage of being specially processed for their military purpose or placed or stored in a military establishment are apprehended by the safeguards system. In other words: Before nuclear materials can be released from the safeguards system they must have entered the safeguards system. Upon their entry into this system their 'intended uses' need to be declared pursuant to Article 77(a). This use is qualified by Article 84 third paragraph as being 'intended to meet defence requirements'. One of the reasons why these materials need to be released from the safeguards system at the point of time laid down in Article 84 third paragraph is the following one: As special fissile materials within the meaning of Article 197(No 1) these materials are the property of the Community by virtue of Article 86. Pursuant to that provision, the Community's property ownership of special fissile material comes to an end when these materials are no longer 'subject to the safeguards provided for in Chapter 7'. Thus, by releasing the special fissile materials from the Community's safeguards system at the relevant (and last possible) moment, Article 84 third paragraph also releases that material from the Community's property ownership regime. Only from that moment onwards the further use of that material for defence purposes becomes the sole responsibility of the Member State concerned as far as property ownership and safeguards are concerned, but not necessarily as far as radiation protection is concerned.

The second option set out above, namely the attempt to avoid the application of Chapter 6 by setting up a production line from ore to nuclear device which is organised and run by the Member State itself, is, upon closer look, not a legally viable option since the obligations laid down in that Chapter will apply all the same. If the Member State itself acts as a producer, it pursues an activity within the field specified in Chapter 6 and will fall under the definition of an undertaking with a public legal status within the meaning of Article 196(b). To producers inside the Community Article 57(2) second paragraph applies:

> Subject to Articles 58, 62 and 63, every producer shall offer to the Agency the ores, source materials or special fissile materials which he produces within the territories of the Member States before they are used, transferred or stored.

This general rule is supplemented by Article 58 in order to take account of the specific needs of producers which combine successive production stages:

> Where a producer carries out several stages of production from extraction of the ore up to and including production of the metal, he may offer the product to the Agency at whichever stage of production he chooses. The same shall apply to two or more connected undertakings, where the connection has been duly communicated to the Commission and discussed with it in accordance with the procedures laid down in Articles 43 and 44.

Even if the Agency does not exercise its right of option right away, the obligation to offer the material again to the Agency at a later stage of the production process will persist. Article 59 first paragraph provides:

> If the Agency does not exercise its right of option on the whole or any part of the output of the producer, the latter
>
> (a) may, either by using his own resources or under contract, process or cause to be processed the ores, source materials or special fissile materials, provided that he offers to the Agency the product of such processing …

While the Member State acting as a producer of nuclear materials intended for defence purposes will thus not escape from the obligations laid down in Chapter 6, its wish to keep the special fissile material in order to further process it for future uses ‘intended to meet defence requirements’ can be accommodated all the same. If the Agency definitively does not exercise its right of option on special fissile materials, Article 62(2)(b) can apply: ‘… while continuing to be subject to the provisions of Chapter 7, such materials and fertile wastes shall be left in the possession of the producer, so that he may … use them within the limits of his own requirements …’. If such is the case, the ‘intended uses’ to be declared for safeguards purposes pursuant to Article 77(a) of Chapter 7 are those uses which Article 84 describes as being ‘intended to meet defence requirements’.

In conclusion on this point, the analysis has shown that a Member State intending to use nuclear materials to meet defence requirements cannot, in law, escape EURATOM rules on supply and safeguards until the moment when such materials enter the stage ‘of being specially processed for this purpose’. It is thus the first of the three questions formulated above that has to be answered in the affirmative while the other two must be answered in the negative.

Returning to the jurisprudence quoted above, the Court can also not be followed in its global dismissal of historical documents, such as interpretative declarations and *travaux préparatoires*. Indeed, all relevant historical sources prove that the supply of nuclear material for defence purposes was intended to follow the rules of Chapter 6.[133] It was only the political desire of Member States to minimize the functioning of that

[133] See Errera et al. 1958, pp. 118–119, on Article 52 in fine according to which the Agency may not discriminate between users on the grounds of the use which they intend to make of the supplies requested: ‘Cette interdiction de discrimination en ce qui concerne l‘emploi porte aussi sur l‘approvisionnement des programmes civils et militaires. En effet, le droit d‘option et le droit exclusif de conclure les contrats de fournitures assurent à l‘Agence un monopole … en matière d‘approvisionnement ; toute discrimination au détriment des programmes militaires reviendrait donc à les condamner indirectement, ce qui n‘entre en aucun cas dans la compétence d‘Euratom.’—See also Neri and Sperl 1962, p. 170, quoting from the relevant document of the French Conseil de la République, discussing Article 52: ‘… le Traité ne comporte aucune interdiction de principe de l‘utilisation à des fins militaires, des matières fissiles spéciales mises à la disposition d‘un Etat membre de la Communauté et ceci résulte en particulier des Articles 52 et 87 et indirectement de l‘article 84.’—Likewise Neri, Sperl 1962, p. 200, quoting from the relevant parliamentary document of the French Assemblée Nationale, discussing Article 62: ‘Cette disposition s‘applique aussi bien à des matières fissiles qui seraient produites par exemple par les piles de production en vue d‘approvisionner telle ou telle centrale d‘E.D.F. qu‘à une production réalisée pour les besoins de la défense nationale. Ainsi, le Traité assure que nous pourrons … conserver … pour nos besoins de défense nationale, le plutonium que nous produirons ou la plus grande partie de celui-ci. … De ce fait nous restons libres pour tout programme militaire, tout en ayant la certitude indispensable pour les approvisionnements …’—See Gaudet 1958, p. 54, on intended uses: ‘Cette formule implique la liberté de choix de la destination, qu‘aucune autre disposition du Traité ne limite par ailleurs. Il s‘agit donc d‘un controle de conformité. Les usages militaires en particulier ne sont pas interdits par le Traité d‘Euratom.’—See Weilemann 1983, p. 177: ‘Nachdem Frankreich sich die Option militärischer Nutzung prinzipiell offengehalten hatte, gelang es der französischen Delegation, die Vertragsbestimmungen so zu gestalten, daß ein militärisches Nuklearprogramm ungehindert durchgeführt werden konnte… Nachdem … in Paris grünes Licht für die französische Nuklearrüstung gegeben worden war, forderten seine Unterhändler … , dass unter Durchbrechung des Prinzips des gleichen Zugangs, Frankreich der Bedarf an Kernbrennstoffen für seine laufenden Programme während einer Übergangszeit garantiert werde. Diesem Wunsch wurde in dem späteren Artikel 223 entsprochen …’.

chapter later on that blurred the picture.[134] In the same vein, several other objections to the reasoning of the Court can be advanced, based on an analysis of other Chapters of the Treaty.[135] In one respect, however, the Court can not be refuted: The judgment here referred to is entirely in line with the longstanding practice of Member States trying to reduce the role of EURATOM in favour of national sovereignty.[136]

A last remark concerning the aforementioned *obiter dictum*: Instead of suggesting the creation of separate radiation protection rules for the 'military sphere' under EC law in order to allow the Member States to rely on Article 296(1) EC Treaty (now Article 346(1) TFEU), it would have been more convincing and coherent for the Court to see that provision as the expression of a general principle that is also applicable under the EURATOM Treaty.[137]

6.5 EURATOM and NPT

The parallel existence of two treaties applying to nuclear activities in Europe prompts the question of the relationship between the two, their similarities and differences. First, it is to be noted that EURATOM is neither a party to the NPT[138]

[134] See Pirotte et al. 1988, pp. 88 et seq.: „La remise en cause des dispositions supranationales", „La mise en sommeil du chapitre VI" and „Le consensus pour un fonctionnement minimaliste de l'Agence".

[135] As regards Chapter 2, the Court fails to see that the security provisions laid down in Articles 24 to 27 seek to afford the same protection of defence interests as Article 296(1) EC Treaty (now Article 346 (1) TFEU). As regards Chapter 3, the Court fails to see that Article 37 is not addressed to the 'military sphere' but to the Member State in its capacity as guarantor having 'to ensure compliance with the basic standards which have been established' (Article 33). Under Article 37 the Member State has to ensure that radioactive emissions originating on its territory do not adversely affect the 'general public' (Article 30) of another Member State by contaminating its water, soil or airspace. All that is required by Article 37 is that the Member State satisfies the Commission that such contamination will not happen. To this end an emission plan has to be provided which the Member State is free to formulate without disclosing any commercial or military secrets upstream. Another ill-considered consequence of the Court's judgment is that it also excludes the 'protection of the health of workers' (Article 30) in the defence industry and the military sector, including military hospitals, from the scope of Chapter 3, a consequence that cannot be remedied by the Court's reliance on EU environmental law (see para 44 quoted above). A lot more could be said about this misguided judgment, but in the present context these few remarks must suffice. See also Grunwald 2010, p. 423 et seq.

[136] A full account of the political erosion of Treaty obligations is given by Pirotte et al. 1988, Trente Ans d'Expérience Euratom.

[137] This was the approach followed by the Court in Case C-115/08 *Land Oberösterreich v CEZ as* (2009) ECR I-10265 in relation to Article 12 EC Treaty: 'It must therefore be recognized that although the principle of prohibition of any discrimination on grounds of nationality within the scope of application of Community law is expressly laid down only in Article 12 EC, it is a general principle which is also applicable under the EAEC Treaty' (para 91).

[138] Treaty on the Non-Proliferation of Nuclear Weapons, United Nations Treaty Series Vol. 729, Nr. 10485, 1970, p. 169.

nor a member of the IAEA, but its Member States are. The relationship between EURATOM and its Member States in internal matters as well as in external relations is governed by the general principle of loyal cooperation (Article 192) according to which the Member States are to enter into and fulfil their international commitments in line with their obligations under EURATOM law (Article 103).

6.5.1 Legal Comparison

Without aiming at completeness, the following five points may illustrate the most important differences between the EURATOM Treaty and the NPT:

First: *Membership and territorial application*. Whereas any State on earth may become a party to the NPT,[139] only European States qualify as members of Euratom.[140] Defining the proper territorial[141] and cultural extension of Europe,[142] however, may be a matter for debate.

Second: *Duration of membership*. Pursuant to Article 208 the EURATOM Treaty 'is concluded for an unlimited period'. In contrast, by virtue of its Article X(2), the duration of the NPT is to be decided by review conferences. Moreover, whereas any party to the NPT may decide to leave its regime at short notice pursuant to Article X(1), Euratom Member States may only withdraw from the Community on terms to be negotiated with the Community (Article 106a(1) EAEC in conjunction with Article 50 TEU), an exit scenario which would also entail the withdrawal from the EU.[143]

Third: *Legal nature*. Whereas the NPT is a multilateral treaty binding on its parties, i.e. States, under international law, the EURATOM Treaty establishes a supranational organisation with legal personality in which far-reaching powers are vested, resulting in obligations which are not only binding on the Member States but also on persons and undertakings under their jurisdiction.

Fourth: *Enforcement of obligations*. Whereas obligations under the NPT can only be enforced politically through the classical means under international law, EURATOM not only possesses the power to impose sanctions on its Member

[139] Article IX(1) NPT.

[140] Article 106a(1) EAEC in conjunction with Article 49 TEU ('Any European State which respects the values referred to in Article 2 and is committed to promoting them may apply to become a member of the Union …').

[141] For the present territorial application of the Treaty see Article 198.

[142] It has been suggested that European cultural identity rests on three pillars: Jewish-Christian Religion, Greek Philosophy and Roman Law.

[143] See Grunwald 2015, p. 553.

States, persons and undertakings, but also to enforce them by judicial measures of constraint in order to ensure compliance.

Fifth: *Scope and objective*. Whereas the principal concern of the NPT is to ward against the dangers of nuclear proliferation, as its title already indicates, EURATOM seeks to create 'the conditions necessary for the speedy establishment and growth of nuclear industries' (Article 1). This, however, does not mean that EURATOM would ignore the dangers of nuclear proliferation. On the contrary, as has been seen above, one of those necessary conditions consists precisely in creating legal mechanisms designed to counter such proliferation. As regards the defence activities of its own Member States the Treaty reflects a liberal attitude.

6.5.2 EURATOM and IAEA

EURATOM, the IAEA and the NEA were established almost at the same time, only CERN is some years older.[144] Pursuant to Article 199 the Commission has 'to ensure the maintenance of all appropriate relations with the organs of the United Nations (and) of its specialised agencies' and here notably with the IAEA. Even before the IAEA was entrusted with its international safeguards mission by the NPT, EURATOM had been entertaining a longstanding cooperation with the IAEA, in line with EURATOM's mandate 'to establish with other countries and international organisations such relations as will foster progress in the peaceful uses of nuclear energy' (Article (2)(h)).

A bilateral Cooperation Agreement between the Community and the IAEA was concluded in 1975.[145] It invites the Community to be represented at the regular annual sessions of the General Conference of the Agency and allows EURATOM participants, without the right to vote, in the deliberations of that body and, where appropriate, of its committees with respect to items on their agenda in which the Community has an interest (Article II). The Agreement also provides for regular consultations on matters of mutual interest (Article I), for the exchange of information and documents (Article III) and for rules on expenditure (Article IV). Regular HLLC and LLLC[146] Meetings are being held in Vienna and Brussels/Luxembourg. In addition, the IAEA provides the venue for the negotiation of international agreements, to be concluded under the auspices of the Agency, in which the Community and its Member States have a special interest.

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[144] CERN in Geneva was established in 1953, the IAEA in 1956, and the Nuclear Energy Agency (NEA) within the OEEC/OECD in 1957.

[145] OJ L 329, 23.12.1975, p. 28.

[146] High Level Liaison Committee and Low Level Liaison Committee.

The most important multilateral agreements concluded with the IAEA are the three Verification Agreements concluded in the 1970s after the entry into force of the NPT. The first of these agreements is between EURATOM, its Non-Nuclear Weapon Member States and the Agency[147] and the two others are voluntary offer agreements concluded between EURATOM, its two Nuclear Weapon Member States and the Agency.[148] In order to avoid parallel or duplicative inspections those agreements were later on supplemented by Additional Protocols which entered into force on 30 April 2004.[149]

In 2008 Dr. ElBaradei, Director General of the IAEA, paid a visit to the Commission, thus confirming the importance of the Agency's relations with the Community.[150] In a Joint Statement on 'Reinforcing Cooperation on Nuclear Energy for Peace and Development' areas of cooperation were identified such as nuclear safety, radiation protection,[151] nuclear safeguards and non-proliferation, nuclear security, as well as technology and research, including research on new reactors (Generation IV) and fusion energy (ITER). Memoranda of understanding on matters of mutual interest[152] and EU measures based on the Union's Common Foreign and Security Policy[153] in support of specific activities carried out by the

[147] Agreement 78/164/Euratom between the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republik of Germany, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the European Atomic Energy Community and the International Atomic Energy Community in implementation of Article III(1) and (4) of the Treaty on the non-proliferation of nuclear weapons, OJ L 51, 22.2.1978, p. 1.

[148] Agreement of 6 September 1976 between the United Kingdom of Great Britain and Northern Ireland, the European Atomic Energy Community and the Agency in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/263, October 1978; Accord conclu le 27 juillet 1978 entre la France, la Communauté européenne de l'Énergie Atomique et l'Agence Internationale de l'Énergie Atomique relatif à l'application de garanties en France, AIEA, INFCIRC/290, Décembre 1981.

[149] See Additional Protocol of 22 September 1998 supplementing Agreement 78/164/Euratom (1999/188/Euratom), OJ L 67, 13.3.1999, p. 1. The Additional Protocols supplementing the Voluntary Offer Agreements with the United Kingdom and France were not published in the OJ.

[150] See Commission Document SEC(2008) 1888 of 13.5.2008.

[151] See also Commission Decision 2010/398/Euratom of 15 July 2010 on the conclusion of a Memorandum of Understanding between the European Commission and the International Atomic Energy Agency concerning EURDEP (EUropean Radiological Data Exchange Platform), OJ L 182, 16.7.2010, p. 15.

[152] See e.g. Commission Decision of 5.9.2013 on the conclusion of a Memorandum of Understanding for a partnership between the European Atomic Energy Community and the International Atomic Energy Agency on nuclear safety cooperation, C(2013) 5641 final of 5.9.2013.

[153] See Articles 23 to 46 TEU.

Agency[154] complete the arsenal of legal instruments governing the relationship between the Agency and the Community.

6.5.3 Measures in Support of the NPT

Both EURATOM and the EEC/EC/EU have a long-standing tradition in supporting the objectives of the NPT. As a renewed restatement of its commitment to non-proliferation the Council adopted its Common Position 2003/805/CFSP of 17 November 2003 on the universalization and reinforcement of multilateral agreements in the field of non-proliferation of weapons of mass destruction and means of delivery[155] which has served as a reference document for specific political action ever since. Pursuant to Article 1 its objective is in particular to promote the universal ratification of, adherence to, and compliance with the NPT and the IAEA Additional Protocols.[156] In 2009 the Commission adopted a comprehensive Communication on nuclear non-proliferation,[157] followed in 2014 by a Communication on a new EU approach to the detection and mitigation of CBRN-E risks.[158] Recent measures include Council Decision 2014/129/CFSP of 10 March 2014 promoting the European network of independent non-proliferation think tanks in support of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction.[159]

6.6 Current Problems and EURATOM Solutions

A rapid survey of the headings listed in the table of contents of this book suffices to identify current problem areas in nuclear law. The contributions on subjects such as Licensing, Nuclear Ethics, Nuclear Safety, Nuclear Waste Management, Protection of the Environment, Emergency Preparedness, Nuclear Accidents, Nuclear Security, and Research, in one way or another, point to legal shortcomings

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[154] See e.g. Council Decision 2013/517/CFSP of 21 October 2013 on the Union support for the activities of the International Atomic Energy Agency in the areas of nuclear security and verification in the framework of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction, OJ L 281, 23.10.2013, p. 6.

[155] OJ L 302, 20.11.2003, p. 34. See also the detailed six-monthly progress reports on the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction, p. ex.: OJ C 41, 5.2.2015, p. 1.

[156] See in particular Articles 4 and 5.

[157] COM(2009) 143 final of 26.3.2009.

[158] COM (2014) 247 final of 5.5.2014 (CBRN-E: Chemical, Biological, Radiological, Nuclear-Explosives).

[159] OJ L 71, 12.3.2014, p. 3.

and propose ways of overcoming them. Although, as seen above, a lot has been achieved already, the potential of EURATOM law to contribute towards solutions is by no means exhausted yet.[160] EURATOM's comprehensive mandate and the fact that the 'Treaty is concluded for an unlimited period' (Article 208), entrust the Community with a permanent responsibility for finding and applying the most effective solutions to problems such as those discussed below.

6.6.1 In and Out Scenarios

While some Member States have decided to phase out nuclear energy,[161] others are about to develop a nuclear industry from scratch.[162] In the first case highly specialised expert knowledge is required in the fields of decommissioning, dismantling, recycling, nuclear waste disposal, etc. In the second case highly specialised expert knowledge will be needed in the fields of nuclear physics, chemistry and engineering, radiation protection, nuclear safety and security, physical protection, nuclear transport and waste management, etc. Such expert knowledge will be necessary at all levels of responsibility in industry, public authorities, supervising agencies, etc. The key to such knowledge, however, is education and training.

The Treaty has been aware of this since the beginning: Articles 4 and 7 call on the Community to complement national efforts by carrying out Community research and training programmes, Article 9(1) mandates the Commission to set up 'schools for the training of specialists', and Article 9(2) requires the Council to establish an 'institution of university status'.[163] Moreover, Article 33 empowers the Commission to make appropriate recommendations for harmonising the national provisions on 'teaching, education and vocational training'. Unfortunately, despite these clear provisions and the manifest need to act,[164] nuclear training has not been

[160] For a full account see Grunwald 2014a, p. 21 et seq.

[161] Such as Germany, the Netherlands, Belgium and Sweden. See on nuclear phase-out the contributions to the fourth working session in Raetzke 2014, pp. 357–387.

[162] Such as Poland. See on nuclear new build the contributions to the second working session in Raetzke 2014, pp. 119–277.

[163] Pursuant to Article 216, the "Commission proposals on the way in which the institution of university status referred to in Article 9 is to function shall be submitted to the Council within one year of the entry into force of this Treaty".

[164] In 2009 the European Economic and Social Committee (EESC), established under Article 106a(1) EAEC in conjunction with Articles 301 to 304 TFEU, expressed the following concerns (OJ C 306, 16.12.2009, p. 56):

"The EESC is particularly interested in the question of building, maintaining and developing skills in the Member States, particularly those which have little or no experience with nuclear energy. These Member States must address this question without delay, in particular by developing the necessary training opportunities. In addition, the EESC suggests that consideration be given to European certification of competence in the field of nuclear power, and that training relates to the technical management as well as to the health aspects of nuclear accidents."

given the attention it deserves. Besides some specific training actions organised by the Joint Research Center, no specialised school has been set up, no university has been established and no detailed harmonisation of national rules on nuclear teaching, education and vocational training has been undertaken.[165]

Another aspect of 'in and out' decisions is their impact on investments and nuclear energy production targets. Here the Commission has an important role to play by providing guidance through illustrative programmes (Article 40). However, since 2008 the Commission has remained silent on these issues, while the Member States have adopted an inward looking attitude, remaining indifferent to the Community dimension of their national decisions. In order to give effect to Article 40 and 'to facilitate coordinated development of … investment in the nuclear field' the Commission should issue a recommendation[166] setting rules for a timely exchange of intentions between industry, Member States and the Commission.

6.6.2 Nuclear Safety

No event has had a stronger impact on the concept of nuclear safety than Chernobyl.[167] Happening at the Community's doorstep, Chernobyl and its aftermath triggered a multitude of internal[168] and external,[169] of autonomous,[170] bilat-

165 The general 'Requirements for Radiation Protection Education and Provision of Information' are set out in Articles 14 to 18 and 59 of Council Directive 2013/59/Euratom, OJ L 13, 17.1.2014, p. 1.

166 See Article 106a(1) EAEC in conjunction with Article 292 TFEU.

167 See Grunwald 1988, p. 33. See also Grunwald 2003, p. 288 et seq.

168 Council Regulation (EURATOM) No 3954/87 of 22 December 1987 laying down maximum permitted levels of contamination of foodstuffs and of feedingstuffs following a nuclear accident or any other case of radiological emergency, OJ L 371, 30.12.1987, p. 11; Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency (87/600/EURATOM), OJ L 371, 30.12.1987, p. 76.

169 In particular financial assistance under the PHARE and TACIS programmes. See for further references Grunwald 2003, p. 289 et seq.

170 See Council Regulation (EURATOM) No 300/2007 of 19 February 2007 establishing an Instrument for Nuclear Safety Cooperation, OJ L 81, 22.3.2007, p. 1, and Commission Decision 2007/530/EURATOM of 17 July 2007 on establishing the European High Level Group on Nuclear Safety and Waste Management, OJ L 195, 27.7.2007, p. 44. See also Communication from the Commission "Nuclear Safety in the European Union", COM(2002) 605 final, 6.11.2002.

eral[171] and multilateral measures,[172] all of them intended to prevent a second Chernobyl from happening or to mitigate the consequences of future nuclear accidents.[173] The collapse of the Soviet Union and the perspective of the Community's enlargement to the East accelerated and intensified the efforts which eventually resulted in the Nuclear Safety Convention.[174] Originally conceived to impose nuclear discipline on the East, the Convention also had to be implemented in the West. When this was done, the issue was reopened by Fukushima.

Fukushima did not only cause the Community to carry out risk and safety assessments of nuclear power plants ('stress tests'),[175] it also led to increased efforts in external financial support[176] and a revision of Council Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations.[177] That Directive imposes obligations on the Member States to establish and maintain *national* frameworks for nuclear

[171] See Agreement in the form of letters exchanged between the European Atomic Energy Community (EURATOM) and Switzerland concerning the inclusion of the latter in the Ecurie arrangements (European Community urgent radiological information exchange), OJ C 335, 13.12.1995, p. 4.

[172] See Nuclear Safety Convention (1994), OJ L 318, 11.12.1999, p. 21; Commission Decision 2005/844/EURATOM of 25 November 2005 concerning the accession of the European Atomic Energy Community to the Convention on Early Notification of a Nuclear Accident (1986), OJ L 314, 30.11.2005, p. 21; Commission Decision 2005/845/EURATOM of 25 November 2005 concerning the accession of the European Atomic Energy Community to the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency, OJ L 314, 30.11.2005, p. 27.

[173] The measures taken under EURATOM radiation protection law and in the field of external relations were complemented under EEC/EC/EU civil protection law (see Article 196 TFEU). The current civil protection programme (2014–2020) is set out in Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism, OJ L 347, 20.12.2013, p. 924. Pursuant to its Article 1(2) that mechanism also applies to radiological disasters (see also recital 28).

[174] See Commission Decision 1999/819/EURATOM of 16 November 1999 concerning the accession to the 1994 Convention on Nuclear Safety by the European Atomic Energy Community (EURATOM), OJ L 318, 11.12.1999, p. 20.

[175] See Communication from the Commission to the Council and the European Parliament on the comprehensive risk and safety assessments ("stress tests") of nuclear power plants in the European Union and related activities, COM(2012) 571 final, 4.10.2012.

[176] See Council Regulation (EURATOM) No 237/2014 of 13 December 2013 establishing an Instrument for Nuclear Safety Cooperation, OJ L 77, 15.3.2014, p. 109. For the period 2014 to 2020 an amount of EUR 225 million is earmarked to 'finance measures to support the promotion of a high level of nuclear safety, radiation protection, and the application of efficient and effective safeguards of nuclear material in third countries…'.

[177] OJ L 172, 2.7.2009, p. 18, as amended by Council Directive 2014/87/EURATOM of 8 July 2014, OJ L 219, 25.7.2014, p. 42.

safety which reflect the provisions of the main international instruments in the field of nuclear safety, namely the Convention on Nuclear Safety and the IAEA Safety Fundamentals.[178] The Directive may well be seen as a step towards a higher level of nuclear safety, but in legal terms it re-assigns the legislative responsibility of the Community back to the Member States, thus atomising into 28 individual particles what Article 2(b) meant to be a *uniform* legislative system.[179] Since no precise substantive technical and engineering standards are fixed for the siting, design, construction, commissioning, operation and decommissioning of nuclear installations,[180] the Directive does not define the concept of nuclear safety in concrete qualitative and quantitative terms and thus does not allow comparative checks against reality on the ground.

Again, it needs to be emphasised that it is not primarily for the Community to carry out such checks, that is the task of the Member States, but it is the task of the Community to define the legislative rules which govern the authorisation procedures designed to 'create the conditions of safety necessary to eliminate hazards to the life and health of the public'.[181] To quote the Court of Justice:

> Even though the EURATOM Treaty does not grant the Community competence to authorise the construction or operation of nuclear installations, under Articles 30 to 32 of the EURATOM Treaty the Community possesses legislative competence to establish, for the purpose of health protection, an authorisation system which must be applied by the Member States. Such a legislative act constitutes a measure supplementing the basic standards referred to in that Article.[182]

In order to fulfil its comprehensive mission in the field of health and safety the Community is therefore not only empowered to, but also, to the extent necessary, called upon to adopt uniform and technically detailed standards governing nuclear safety. While most of the Member States of the IAEA are free and autonomous in accepting international standards and commitments and may thus legitimately prefer the lowest common denominator, such is not the case for the Community and its Member States. They are bound by the obligations set out in the Treaty which are binding internally, irrespective of soft law standards which may have been fixed as reference documents for a wider international community. In short:

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[178] IAEA Safety Fundamentals: Fundamental safety principles, IAEA Safety Standard Series No SF-1 (2006).

[179] Article 2(b) requires the Community to 'establish uniform safety standards to protect the health of workers and of the general public …'.

[180] In its interim-report on the stress tests after the Fukushima accident the Commission stated in November 2011, that 'at present, there are no common safety standards or criteria for nuclear power plants in the EU' (COM(2011) 784 final, 24.11.2011, p. 9). The European Economic and Social Committee, on its part, found in October 2012 that 'there is no common approach to nuclear safety regulation among the Member States "and recommended that the Nuclear Safety Directive" harmonise these aspects' (OJ C 44, 15.2.2013, p. 140).

[181] Fourth recital of the Treaty's preamble.

[182] Case C-29/99 *Commission v Council* (2002) ECR I-11281 para 89.

To the extent that technically precise and binding Community measures prove to be necessary, the Community may not hide behind general and softer terms agreed at international level.

Moreover, as the ultimate guarantor of nuclear safety in the Community, the Commission needs to have access to nuclear installations in order to satisfy itself that the Member States are not failing in their implementing and controlling function under Chapter 3. Not only is the Community bound by Article 2(b) 'to establish uniform safety standards', it is also bound to 'ensure that they are applied'. In order to fulfil this task, the Commission may wish to carry out random checks on the ground to test the viability of national implementing and control systems. To this end the Commission needs a right of access to nuclear installations which the Council may easily confer on it but has not done so far. Article 187 provides:

> The Commission may, within the limits and under the conditions laid down by the Council in accordance with the provisions of this Treaty, collect any information and carry out any checks required for the performance of the tasks entrusted to it.

The Commission's tasks under Chapter 3 culminate, as a last resort, in exercising the powers laid down in Article 38:

> In cases of urgency, the Commission shall issue a directive requiring the Member State concerned to take, within a period laid down by the Commission, all necessary measures to prevent infringement of the basic standards and to ensure compliance with regulations.
>
> Should the State in question fail to comply with the Commission directive within the period laid down, the Commission or any Member State concerned may forthwith, by way of derogation from Articles 258 and 259 of the Treaty on the Functioning of the European Union, bring the matter before the Court of Justice of the European Union.

It is evident that the Commission can only issue a well reasoned and targeted directive and substantiate a case before the Court when it has first hand knowledge of the facts, based on its own findings on the ground. A direct, unhampered right of access to the premises and installations is thus indispensable.[183]

Another cause for concern in matters of nuclear safety is the muddled legal situation created by the Court's ruling according to which the Treaty does not apply to the 'military sphere'. What about mixed installations, i.e. nuclear facilities operated both for civil and defence purposes?

6.6.3 Nuclear Security

To put it simply, it has been said that whereas nuclear safety is about protecting people against nuclear material, nuclear security is about protecting nuclear

[183] Such right of access is already foreseen in Articles 35 and 81 which could serve as a model.

material against people. At the international level the legal instrument seeking to protect nuclear material against people is the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities. The Community has acceded to this Convention which was adopted in 1979, entered into force in 1987 and was amended in 2005.[184] In 1978 the Court had ruled that 'there can be no doubt that the concept of 'safeguards' within the meaning of the Treaty is sufficiently comprehensive to include also measures of physical protection'.[185] This may be so, but there can also be no doubt that the concepts of nuclear security and nuclear safety are to a large extent overlapping in that both of them are intended to give effect to the same objective, namely 'to create the conditions of safety necessary to eliminate hazards to the life and health of the public'.[186] Since Chapter 7 on Safeguards does not empower the Community to legislate on matters of physical protection for lack of an appropriate legal basis,[187] autonomous measures in the field of physical protection can only be based on Articles 30 to 32.[188] It is their ultimate common objective that shows that nuclear safety and nuclear security are, from the Treaty's perspective, in reality 'false opposites' and should therefore be subject to the same rules.[189] This being the case, the Community may legislate in matters of nuclear security by adopting uniform security standards which are binding on the Member States.[190]

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[184] Commission Decision 2008/99/EC (sic!), EURATOM of 19 December 2007 concerning the accession of the European Atomic Energy Community to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, OJ L 34, 8.2.2008, p. 3.

[185] Ruling 1/78 (1978) ECR 2154 para 21.

[186] Fourth recital of the Treaty's preamble. This recital is also the starting point of the Court's reasoning in para 21 of its Ruling quoted above.

[187] Article 79 seems to focus only on traditional safeguards measures. The 'catch all' or 'implied' powers foreseen in Article 203 can only apply when there is no other empowering provision. In this case, however, a legal basis exists in Chapter 3 of the Treaty.

[188] In this context it is to be noted that Article 32 serves the same purpose in Chapter 3 as the simplified amendment procedures set out in Articles 4(2), 41, 76, 85 and 90 do in Chapters 1, 4, 6, 7 and 8 respectively. See for a detailed reasoning on this point Grunwald 2014, p. 25 et seq.

[189] In German it is the same term 'Sicherheit' that applies to both concepts.

[190] As a general legal instrument see also Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection, OJ L 345, 23.12.2008, p. 75, which applies, *inter alia*, to 'Infrastructures and facilities for generation and transmission of electricity in respect of supply electricity' and transport.

6.6.4 Nuclear Waste

There is no nuclear subject in the Community and worldwide which is thornier and more 'contaminated'than the disposal of nuclear waste.[191] The Community seeks to solve this problem through Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste.[192] According to its Article 4, this directive is based on the principle that 'each Member State shall have ultimate responsibility for management of the spent fuel and radioactive waste generated in it' and that therefore 'radioactive waste shall be disposed of in the Member State in which it was generated'. Again, as in the case of nuclear safety, an issue which is of fundamental importance to the Community *as a Community* has been re-nationalised, leaving each Member State to its own devices. And again, as in the case of nuclear safety a Community solution would have offered itself under the Treaty.

As seen above, by virtue of Article 45 undertakings 'which are of fundamental importance to the development of the nuclear industry in the Community may be established as Joint Undertakings'. Both the Treaty and the decay of nuclear waste cover 'an unlimited period' (Article 208) and the fundamental importance of safe and secure disposal of nuclear waste to the nuclear industry is more than evident. Just as Community logic demanded a *common* supply policy managed by

[191] See at the international level: Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management of 5 September 1997, OJ C 51, 26.2.2002, p. E/261.

As autonomous measures see, *inter alia*:

Commission Recommendation 2008/956/EURATOM of 4 December 2008 on criteria for the export of radioactive waste and spent fuel to third countries, OJ L 338, 17.12.2008, p. 69

Commission Decision 2007/530/EURATOM of 17 July 2007 on establishing the European High Level Group on Nuclear Safety and Waste Management, OJ L 195, 27.7.2007, p. 44

Council Directive 2006/117/EURATOM of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel, OJ L 337, 5.12.2006, p. 21

Commission Recommendation 2006/851/EURATOM of 24 October 2006 on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste, OJ L 330, 28.11.2006, p. 31

Commission Recommendation 1999/669/EC(sic!) EURATOM of 15 September 1999 on a classification system for solid radioactive waste, OJ L 265, 13.10.1999, p. 37

Council Resolution of 19 December 1994 on radioactive waste management, OJ C 379, 31.12.1994, p. 1

Council Regulation (EURATOM) No 1493/93 of 8 June 1993 on shipments of radioactive substances between Member States, OJ L 148, 19.6.1993, p. 1

Council Decision 80/237/EURATOM of 18 February 1980 on the setting up of an ‚ad hoc' Advisory Committee on the Reprocessing of Irradiated Fuels, OJ L 52, 26.2.1980, p. 9.

[192] OJ L 199, 2.8.2011, p. 48.

a specialised Agency under Chapter 6, Community logic is pleading for a *common* waste policy managed by a Joint Undertaking under Chapter 3 in conjunction with Chapter 5. Such a Joint Undertaking could benefit from the advantages set out in Annex III, the advantages of economies of scales, and the advantages of a Community-wide exploration area allowing to identify the safest and most suitable geological conditions for a permanent repository for highly radioactive waste, ideally including retrievability. Moreover, such a solution would relieve the Member States of long and agonising searches, delaying tactics, indecision and protracted court proceedings. Again, the powers exist, they only need to be used.

6.7 Conclusion

In a world governed by pictograms, acronyms and abbreviations the name EURATOM may well have become the Treaty's worst enemy. By many it is associated with the dangers of nuclear energy, uncontrollable risks and an out-dated technology, not to mention the long-term burden imposed by the lasting presence of nuclear waste. To those, however, who care to take a closer look, the Treaty shows a totally different face: it is imposing a strict discipline on a sector that would have come into being in any event—with or without the Treaty. Whereas the promotional aspects of the Treaty have almost vanished, the obligations imposed on the nuclear industry in the fields of radiation protection, nuclear safety and security as well as nuclear safeguards have been constantly broadened and intensified. Certainly, more could and should be done, in particular by further developing the Community dimension through common solutions instead of re-nationalising problem areas. On the whole, however, the Community has stood the test of time. Putting the emphasis on its central activities today, it may be more appropriate to rename it 'European Community for Radiation Protection and Nuclear Safeguards'.

It was Fukushima that taught us that not only man and technology can fail, but also an entire State. The EURATOM Treaty had been aware of this from the outset, warding against the potential for failure on the part of Member States. By creating a supranational Community based on legal discipline and common control systems, the Treaty introduced additional levels of redundancy to detect and correct national system failures, thus protecting all Member States, their citizens and neighbouring countries. It all began in a Community of Six, that now is a Community of 28—and perhaps some more in the future, in which this task has become more important than ever. The Treaty is well equipped and up to the task. It is to be hoped that politicians are too.

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Chapter 7
Some Aspects of the Effectiveness of the International Regulatory Framework to Ensure Nuclear Safety

Anguel Anastassov

Abstract This chapter aims at assessing the effectiveness of the current international regulatory framework for nuclear safety and its relationships with the national implementation legislation. The consequences of the major nuclear accidents show an urgent need for assessment of the global and national approach and the role of an appropriate international cooperation to enhance the nuclear safety worldwide. The effectiveness of the nuclear safety regulatory systems could be assessed through the level of independency of the regulatory bodies from the organisations responsible for the promotion of the use of nuclear energy and consistency with international norms. On the other hand, the regulatory bodies should have direct access and reporting line to the respective Government and should not be subordinated to any governmental structures responsible for setting energy policies. The unique role of the International Atomic Energy Agency (IAEA) to develop and update safety standards will progressively increase, especially through the use of international assessment and peer review missions. In addition, the IAEA should promote the harmonization of legal and regulatory regimes for nuclear safety and take measures to ensure synergies between nuclear safety and nuclear security. A conclusion is made that it is realistic to consider the establishment of an international verification of the national safety framework and safeguards inspections that could serve as a model for performing periodic evaluations of Member States' nuclear safety measures, based on their advanced consent. In

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addition, the regulatory requirements for the nuclear safety could be continually enhanced since the need exists to strengthen capabilities to manage risks from beyond-design-basis events.

Keywords Nuclear safety · Regulatory framework · Normative effectiveness · Safety standards · Peer reviews · Safety culture

Contents

7.1 Introduction

The importance of nuclear safety has been recognized since the early phase of nuclear power plant development and is certainly the highest on the list of priorities of the individual States—before production and cost of nuclear energy.

The nuclear industry produces four types of radiation: alpha and beta particles, gamma rays and neutrons. All types of radiation can ionise biological tissue that produces the possibility for a disrupted human cell to become cancerous. Certainly, there are other types of damages, in particular genetic damage, which are outside the scope of this chapter.

A general idea of radiation dose units would help to better understand the basis of nuclear safety. One Joule of energy deposited into a kilogram of tissue gives a dose of one Sievert (Sv), if the radiation is beta or gamma. Alpha particles and neutrons cause ten times the harm for the same amount of energy deposited. The average UK national, for instance, receives 2.7 mSv[1] and most of this comes from background radiation[2] and statistically about a seventh comes from medical X-rays. The upper limit for a radiation worker in the UK is 20 mSv per year, but in practical terms no UK worker has obtained more than half that amount. A dose of 500 mSv or more will lead to radiation sickness. If the dose reaches about 4000 mSv, a significant number of those exposed will die within a few months, although about half will recover. However, should the dose exceed about 8000 mSv, most people exposed will die in a matter of days, weeks or a few months.[3]

Nuclear safety is defined by the IAEA as ‘the achievement of proper operating conditions, prevention, of accidents and mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards’.[4] As a key cross-cutting nuclear law principle, safety could be further divided into the subsidiary principles of prevention, protection and precaution, response, mitigation, and remediation.[5,6]

The general nuclear safety objective has been pursued by the IAEA ‘to protect individuals, society and the environment by establishing and maintaining in nuclear power plants an effective defence against radiological hazard’.[7] The IAEA uses other definitions as well with similar wording. Principally, the same objective has been envisaged in the Article 1 (ii) of the Convention on Nuclear Safety (CNS), as follows: ‘to establish and maintain effective defences in nuclear installations against potential radiological hazards in order to protect individuals, society and environment from harmful effects of ionizing radiation from such installations’.[8]

[1] A Sievert (Sv) is the Système International (SI) unit of dose equivalent (the biological effect of ionizing radiation), equal to an effective dose of a joule of energy per kilogram of recipient mass. See http://www.oxforddictionaries.com/definition/english/sievert. A millisievert (mSv) is a decimal fraction of the SI derived unit of equivalent radiation dose, effective dose, and committed dose. See https://www.translatorscafe.com/cafe/EN/units-converter/radiation-absorbed-dose/7-25/gray-millisievert/.

[2] A background radiation is the radiation that comes from environmental sources including the earth’s crust, the atmosphere, cosmic rays, and radioisotopes. Natural sources of radiation account for the largest amount of radiation exposure received by most people each year with medical and occupational sources accounting for only a fraction of that exposure. See http://www.medicinenet.com/script/main/art.asp?articlekey=24436.

[3] Thomas 2015, p. 5.

[4] This definition is available at http://www-ns.iaea.org/standards/concepts-terms.asp?s=11&l=90#3.

[5] De Pompignan 2005, p. 49.

[6] As stated by the IAEA, there is no precise distinction between the terms safety and security. In the draft safety glossary available on IAEA.org., mitigation is included under safety.

[7] International Atomic Energy Agency 1999a, b, p. 8.

[8] Article 1(ii) of the CNS uses similar text as IAEA 2006a, Fundamental Safety Principles: Safety Fundamentals, IAEA Safety Standards Series, No. SF-1, IAEA, Vienna.

The radiation protection objective has been explained as radiation exposure due to any release of radioactive material from the plant being as low as reasonably achievable.[9] An appropriate radiation protection is ensured by the radiation protection standards[10] based on recommendations by the International Commission on Radiological Protection (ICRP).

The technical safety objective ensures minor radiological consequences for all accidents and the likelihood of severe accidents with serious radiological consequences is extremely small.[11]

'Nuclear security' is defined by the IAEA as the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.[12] The distinction between nuclear safety and security is quite blurry since security is concerned with malicious or negligent actions by humans that could cause harm whereas safety is concerned with the broader issue of harm to humans and the environment from radiation, irrespective of the cause to mitigate its effects. Another common basis of nuclear safety and security is the radiological hazards of acts of sabotage, and in particular the attacks performed by terrorists. Digital systems are being introduced in nuclear safety systems, where malfunction may seriously affect nuclear safety and where design flaws may be exploited by potential attackers. Generally, a cyber attack on a nuclear plant could bring about an uncontrolled release of ionizing radiation.

The present analysis of the effectiveness of the nuclear safety will take into consideration the broader perception of this term notwithstanding that the difference between safety and security issues is of continuing importance. Nuclear safety is applicable to the entire civil nuclear fuel cycle, including uranium mining, uranium conversion, enrichment facilities, fabrication plant and reprocessing facilities. It applies also to nuclear transport and nuclear waste storage facilities.

The nuclear industry is one of the most regulated and safest[13] energy industries in the world. The nuclear safety has improved over the years since designs have progressed from Generation I to Generation III.[14] A comparison of accident data

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[9] International Atomic Energy Agency 1999a, b, p. 9.

[10] International Atomic Energy Agency 2014.

[11] International Atomic Energy Agency 1999, p. 10.

[12] Ibid.

[13] Organization for the Economic Co-operation and Development 2010, p. 35.

[14] Generation I reactors were developed in 1950–60s. Generation II reactors are typified by the present US and French fleets and most in operation elsewhere. So-called Generation III (and III+) are the advanced reactors and they are in operation in Japan and others are under construction or ready to be ordered. Generation IV designs will not be operational before 2020 at the earliest.

containing immediate and latent fatalities from a wide range of energy sources illustrate that nuclear energy risks are much lower than the ones existing in other industries.[15]

The accident in Chernobyl Unit 4 took place on 26 April 1986, and this was the world's worst nuclear accident in comparison to the other two well-known cases in Three Mile Island and Fukushima Daiichi. There were 30 immediate deaths of power station workers.[16] 116 thousand members of the public were relocated in 1986 and a further 220 thousand were relocated post 1990. The radiation released as a result of the Fukushima accident was about a sixth of the Chernobyl release. There were no radiation deaths, but 160,000 were evacuated. This compares with the 267,000 people displaced by the direct effects of the tsunami.

Another dimension of nuclear safety is the economic consequences in the case of a nuclear accident. According to European Commission figures, the Fukushima disaster caused €130bn of damage, which by itself is an important data to be evaluated from the perspective of an individual country's preparedness to develop nuclear industry and its possible side effects.

The effectiveness of the regulatory framework to ensure nuclear safety could be measured by the degree of preventing safety degradation and ensuring that an acceptable level of safety is being maintained by the operating organizations. The regulatory effectiveness encompasses the promotion of safety improvements, the timely and cost-effective performance of regulatory functions in a manner which ensures the confidence of the operating organizations, the general public and the government, and striving for continuous improvements to performance.[17]

Measuring a safety programme's effectiveness is a difficult process, especially its effectiveness for preventing low probability, high-consequence accidents. The Fukushima accident is a clear example of such an event. In order to prevent low-probability, high-consequence accidents, processes with respective key performance indicators should be controlled within allowable limits. A transition is needed from lagging to leading indicators. A specific feature of the nuclear hazard is that it cannot be detected by any of the human senses. No matter what the real damages could be, experts should not wait for an accident to happen in order to find out that certain safety systems do not ensure an acceptable level of safety. Leading indicators are best if they lead to 'actionable' conclusions.

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[15] Ibid.

[16] It was demonstrated by some latest studies that the harm caused by human factor is greater than the negative consequences of a nuclear accident. Mr Jim Smith, professor of environmental science, University of Portsmouth pointed out that 'What we do, our everyday habitation of an area—agriculture, forestry—they've damaged wildlife more than the world's worst nuclear accident', see http://www.theguardian.com/environment/2015/oct/05/wildlife-thriving-around-chernobyl-nuclear-plant-despite-radiation.

[17] IAEA 1999, p. 3.

7.2 Basic Elements of the Regulatory Framework for Nuclear Safety

States have the sovereign right to the peaceful use of nuclear energy, taking into account their various non-proliferation obligations, as set forth for example, in the Treaty on the Non-proliferation of Nuclear Weapons and IAEA safeguards agreements, where relevant. They have set-up respective national standards for nuclear safety. International cooperation in this field however serves as a 'guarantee that internationally agreed standards and good practice' could 'adequately protect against nuclear risks'.[18]

The customary international law obliges States to respect the areas beyond national control. The International Law Commission (ILC) has already referred to the *Trail Smelter* Case in this respect. The ILC Draft Articles on Prevention of Transboundary Harm from Hazardous Activities does not require a certain level of transboundary harm to lead to an international obligation of prevention.

The general normative framework includes norms and standards in conventions, declarations, guidelines, codes of practice and other standard setting instruments at global, regional and national level. The regulations comprise of international legal instruments, national laws, as well as 'soft' law consisting of a number of codes, standards and guides.

The legal instruments for nuclear safety are the following: (1) the Convention on Early Notification of a Nuclear Accident (Notification Convention), (INFCIRC/335)[19] and (2) the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, (Assistance Convention) (INFCIRC/336).[20] Both conventions were adopted by the IAEA General Conference at its Special Session, held from 24 to 26 September 1986, and were both opened for signature at Vienna on 26 September 1986 and at New York on 6 October 1986. They entered into force on 27 October 1986 and 26 February 1987, respectively; (3) the Convention on Nuclear Safety (CNS),[21] (INFCIRC/449) which was adopted on 17 June 1994, opened for signature at Vienna on 20 September 1994 and entered into force on 24 October 1996; and (4) the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention), (INFCIRC/546)[22] which was adopted on 5 September 1997, opened for signature at Vienna on 29 September 1997 and entered into force on 18 June

[18] Pelzer 2013, p. 45.

[19] https://www.iaea.org/sites/default/files/infcirc335.pdf.

[20] https://www.iaea.org/sites/default/files/infcirc336.pdf.

[21] https://www.iaea.org/sites/default/files/infcirc449.pdf.

[22] https://www.iaea.org/sites/default/files/infcirc546.pdf.

2001. A separate place in the legal regime of nuclear safety takes the 1997 Vienna [23] and the Convention on Supplementary Compensation for Nuclear Damage.[24]

In addition, the basic elements of the regulatory framework for nuclear safety include the IAEA safety standards and safety reviews and services. The national nuclear infrastructure deals with the operation of nuclear power plants and research reactors, regulation enforcement and research and education.

The normative framework is not driven by sanctions for non-compliance or mechanisms for enforcement but is rather driven by the states common aim of seeking to achieve and maintain high levels of safety for ensuring the protection of people and the environment.

7.2.1 How Effective Are Notification and Assistance Conventions?

The adoption of the Notification Convention and the Assistance Convention was triggered by the Chernobyl nuclear accident. The accident had unprecedented radiological consequences beyond the territory of former USSR. The accident raises a number of questions relating to the provision of information by States operating nuclear installations to States, which are or may be affected by the operation of such installations.

Both legal instruments were negotiated in a very short space of time in order to address the problems occurred during the accident and its negative consequences on the people and the environment. The two conventions are the primary legal instruments that establish an international framework to facilitate the exchange of information and the prompt provision of assistance in the event of a nuclear or radiological emergency, with the aim of mitigating any consequences.

Both conventions, however, do not impose specific and mandatory requirements on States' parties. These are supplemented by a number of mechanisms and practical arrangements established by the Secretariat, the IAEA's policy making organs and the meetings of competent authorities under the Notification and Assistance Conventions. Together, these instruments establish the IAEA emergency preparedness and response framework for nuclear and radiological incidents and emergencies. This framework is implemented by the IAEA independent of whether or not the Notification and Assistance Conventions are invoked. In the Fukushima accident, the Assistance Convention was not invoked by Japan, while information was provided in accordance with Article 3 of the Notification Convention.

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23 https://www.iaea.org/sites/default/files/infcirc500.pdf.

24 https://www.iaea.org/publications/documents/treaties/convention-supplementary-compensation-nuclear-damage.

The conventions aimed at closing an obvious gap in the international legal framework of nuclear safety. They are however not immune from certain deficiencies. The Notification Convention does not cover nuclear accidents from military operations or sites. This legal instrument would have been more efficient if it covered accidents from whatever source—military or civil since the transboundary effects of radiological safety significance would be equally damaging.

The Notification Convention made a reference in Article 1 (1) to an accident that 'could be of radiological safety significance for another state'. This approach leaves it to the discretion of the State in whose territory or under whose jurisdiction or control the accident has occurred to determine what is or is not of radiological safety significance. Taking into account the harmful effects of radioactivity, it would have been preferable that all radioactive releases be notified to the IAEA. Another problem is that there is no agreed level which would trigger the obligation to provide information. The Notification Convention does not establish any obligation on States providing or receiving information to make it available to members of the general public.

In addition, a number of States have made reservations and declarations restricting the application of the provisions relating to dispute settlement, privileges, immunities, claims and compensation.

7.2.2 *The Normative Effectiveness of the CNS and Joint Convention*

Both Conventions take a central place in the normative framework for nuclear safety, therefore the focus of the present chapter will be on these legal instruments. If we go back to the travaux preparatoires, we should mention the initiative raised by the then Minister for Environment, Nature Conservation and Nuclear Safety of Germany, Mr Klaus Töpfer, at the international conference held in 1991 'Safety of Nuclear Power: Strategy for the Future' to develop a Nuclear Safety Convention. The Final Declaration of the Conference recalled that 'safety should be primarily enforced at national level by continuous application of existing safety principles, standards and good practices at each plant and within each regulatory body, making best use of national legal frameworks and working practices'.[25]

The conceptual debate in the negotiation of the CNS was focused mainly on two basic approaches: a Convention containing general provisions and technical annexes incorporating the IAEA's safety standards; and a framework legal instrument for which a preference was demonstrated. Objections for a conventional approach were based on certain complications related to various types of reactors embedded with process safety. Another point was linked to the fact that industrial competition leads to different technical decisions. In addition, there are country

[25] International Atomic Energy Agency Proceedings 1991, GC (XXXV)/970.

specific considerations which play a role in favour of an 'incentive' type of regulatory framework for nuclear safety.

The 'incentive' concept, which was without precedent in public international law, was generally agreed upon by the majority of the participating States. This concept responded to the emerging consensus reflected in the Final Declaration of 1991 International Conference 'Safety of Nuclear Power: Strategy for the Future', which pointed out that: 'safety should be primarily enforced at national level…'.

In the course of the preparations for the Convention, it was accepted that the 'self-interest of States in matters of nuclear safety would be stronger than any form of outside control devised under international law'.[26] In addition, participating States were reluctant to accept intrusive safety inspections and the respective costs.

An important matter to be clarified and could help to analyse the legal nature of nuclear safety framework is to respond to the question whether the effectiveness means compliance or not. Compliance can be narrowly defined to mean the process by which an entity ensures that it observes and complies with the applicable statutory laws and regulations. A State may comply with the legally binding norms in the nuclear safety area but nevertheless the principle objective to protect individuals, society and environment from radiological hazards of the nuclear energy, may not be achieved.

Both the CNS and the Joint Convention as the basic international legal framework for nuclear safety contain several provisions which could be considered at a first glance not effective enough to ensure nuclear safety. Above all, some important provisions in either convention are heavily qualified and/or subject to substantive reservations. The preamble to the CNS, for instance, while reaffirming 'the necessity of continuing to promote a high level of nuclear safety worldwide', also weakens the normative value of this provision by pointing out that the 'Convention entails a commitment to the application of fundamental safety principles for nuclear installations rather than detailed safety standards'.[27]

In addition, key CNS obligations to ensure the safety of existing nuclear installations are widely qualified as 'reasonably practical' and 'as soon as practically possible'. Furthermore, in case an upgrade of the safety of the nuclear installation cannot be achieved, the stipulation was further compromised by the statement that 'timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact'.[28]

The general safety requirements applicable to spent fuel and radioactive waste management envisaged by the Joint Convention are qualified by such words as 'adequate' and 'minimum practicable', whose meaning could be subject to various interpretations.[29] The qualified language included in the provisions referred to

[26] Jankowitsch-Prevor 2006, p. 160.

[27] Convention on Nuclear Safety, Preamble (viii).

[28] Convention on Nuclear Safety, Article 6.

[29] Joint Convention, Article 4, paras (i) and (ii) and Article 11, paras (i) and (ii).

above does not necessarily affect the effectiveness of the two legal instruments. I do agree with the analysis suggested by Professor Handl who pointed out that for 'prima facie shortcomings of the Safety Conventions' substantive stipulations cannot be separated from but must be seen in the larger normative context'.[30] Above all, both conventions provide guidance to Contracting Parties on how to achieve their fundamental objective, i.e. a high level of nuclear safety, namely by cross-reference to the existing international standards. The CNS for instance, affirms the importance of international cooperation for the enhancement of nuclear safety through existing bilateral and multilateral framework.[31] The Joint Convention specifically refers to the principles contained in the inter-Agency 'International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources' (1996), in the IAEA Safety Fundamentals entitled 'The Principles of Radioactive Waste Management' (1995), and in 'the existing international standards relating to the safety of the transport of radioactive materials.[32]

The IAEA is making efforts to improve peer reviews coordination in cooperation with Member States, in response to their needs and receiving their support through an established experts database and contact points. So-called Country Groups are established (with- and without nuclear programmes). The respective Contracting Party responds to the comments/questions submitted to the secure and restricted database. In accordance with Article 5 of the CNS each Party submits for review, prior to each meeting of the Parties, a report on the measures it has taken to implement the obligations of the CNS. Each Party is obliged to attend the review meetings.[33] Article 5 provides no guidance on form, length or content of reports. In addition, the confidentiality of reports has been a major issue. The role of the peer review process is mainly performed through Guidelines regarding the Review Process under the CNS (INFCIRC/571) and Guidelines regarding National Reports under the CNS (INFCIRC/572). The statistics show however that the participation of Contracting Parties in review meetings is not satisfactory since only between 26 and 37 Contracting Parties took part in the six review meetings conducted so far from 1999 to 2014.[34] One reason for not attending these meetings is the fact that more than 40 Parties have no nuclear power reactors and many have no nuclear facilities at all.

The peer review process helps to enhance nuclear safety transparency by informing the public by suitable means that the nuclear installations are safely regulated. The results of such peer reviews are usually reported in the Countries' National Reports which are prepared in the context of the CNS review meetings. These meetings are hosted once every three years to review the written National

[30] Handl 2003, p. 14.

[31] Convention on Nuclear Safety, Preamble (vii).

[32] Joint Convention, Preamble, (xiv).

[33] Convention on Nuclear Safety, Article 24 (1).

[34] There are 78 Contracting Parties of the Convention on Nuclear Safety as per 23 April 2015. See https://www.iaea.org/Publications/Documents/Conventions/nuclearsafety_status.pdf.

Reports submitted by Member States on the implementation measures and assess with other Member States to evaluate the results achieved.[35] The content of the debates is confidential. The Summary Reports of the meetings contain very general language which should be further 'interpreted' in order to reveal more concrete suggestions for ensuring the safety effectiveness.

The Member States of the CNS are legally bound to sustain a number of principles for a high level of nuclear safety but not specific technical benchmarks such as those written into safety standards published by the IAEA, which are voluntary. In addition, the CNS does not have the means to take measures against its Contracting Parties that do not comply with the Convention's provisions.

7.2.3 The Normative Value of the Vienna Declaration on Nuclear Safety

The Fukushima accident triggered an action to strengthen the CNS, but basically some countries with older nuclear power plants (NPPs) did not accept the proposals initially tabled by Switzerland for mandatory peer reviews and safety standards. In December 2013, Switzerland proposed that Article 18 of the CNS be amended to include specific safety targets that both existing and new reactors would have to meet. This idea was compatible with the Convention's goal to legally commit participating states operating nuclear power plants to maintain a high level of safety by setting international benchmarks.

The Director General of the IAEA convened a Diplomatic Conference to consider the Swiss proposal addressing the design and construction of both existing and new nuclear power plants. Prior to the Diplomatic Conference, a consultation meeting open to all Contracting Parties was organized on 15 October 2014, to exchange views on the Swiss Proposal and to prepare for the adoption of the rules of procedure for the Diplomatic Conference. An informal working group held a series of meetings between July 2014 and February 2015 to facilitate for the preparation of the Conference.

The Conference concluded that it would not be possible to reach consensus on the proposed amendment and in attempt to reach the objective of the proposed amendment, the Contracting Parties recommended the adoption of the Vienna Declaration on Nuclear Safety, which includes principles for the implementation of the objectives of the Convention to prevent accidents and mitigate radiological consequences. European countries considered the implied costs of the Swiss Proposal not prohibitive, because electricity markets were highly regulated and monopolistic. Other countries, in particular the United States, were in favour of less costly measures because of the prohibitive expenses of a new state-of-the art

[35] Convention on Nuclear Safety, Articles 20 and 25.

equipment.[36] Even without the firm opposition of some Contracting Parties, amending the CNS would have been a challenge because it requires a two-thirds majority vote of the Contracting Parties present and voting at the meeting, provided that at least one half of the Contracting Parties are present at the time of voting. In addition, entry into force of the amendment requires approval or ratification by three-fourths of the Contracting Parties. The Convention on the Physical Protection of Nuclear Material is an example to be seen. In 2005, its Parties adopted an amendment which ten years later has still not entered into force because two-thirds of the Parties have not ratified it.

The Vienna Declaration on Nuclear Safety contains three basic safety principles as follows:

1. New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation. In addition, should an accident occur, mitigating possible releases of radionuclides causing long-term off-site contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.
2. Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.
3. National requirements and regulations for addressing this objective throughout the lifetime of NPPs are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified, inter alia, in the Review Meetings of the CNS.

The new principles will be integrated in the CNS review process with immediate effect and reported on at the next Review Conference in 2017. The safety principles are similar to the requirements already established in the European Union and Switzerland. However, they are not legally binding.

7.3 The Legal Nature of the IAEA Safety Standards

One of the reasons for the general acceptance of IAEA standards as legitimate and influential elements of the regulatory framework for nuclear safety is the method of their production. The Agency's safety standards are developed through a transparent process for gathering, integrating and sharing knowledge and experience in ensuring an effective defence against harmful effects of ionizing radiation. Four safety standards committees overseen by the Commission on Safety Standards are

[36] Kilisek 2015.

engaged in the development process of safety standards. These are: Nuclear Safety Standards Committee; Radiation Safety Standards Committee; Radioactive Waste Safety Standards Committee and Safe Transport of Radioactive Material Safety Standards Committee.

Under Article III.A.6 of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property (including such standards for labour conditions), in consultation and, where appropriate, in collaboration with the competent organs of the United Nations (UN) and with the specialized agencies concerned. In application of this Article, Member States, the UN, its specialized agencies concerned, and other intergovernmental and non-governmental organizations are involved in various forms throughout the drafting, review and approval of the IAEA safety standards.

The IAEA develops the following types of safety standards:

- Safety Fundamentals, establishing basic objectives, principles and concepts. They are relatively stable over time;
- Safety Requirements, setting out basic requirements to be followed in the case of particular activities or applications;
- Safety Guides, containing practical recommendations based on international experience that 'should' be followed in fulfilling the Safety Requirements.

Requirements and guides are classified as either generic or specific, depending on whether they apply generically to all classes of facilities and activities or specifically to a given type of facility.

Other IAEA publications, such as Safety Reports and technical documents (TECDOCs)—most of which are issued pursuant to Article VIII of the Agency's Statute—are not safety standards. The TECDOCS generally provide simple sample procedures and 'best practices'. These supporting documents may provide specific information on methods for compliance with a given standard. Some safety standards issued prior to 1997 in the IAEA Safety Series were designated Safety Standards, Codes, Regulations or Rules. Furthermore, some publications issued in the Safety Series were not safety standards, notably those designated Safety Practices or Procedures and Data.

Regulating nuclear safety is a national responsibility, although the IAEA promotes international cooperation in this field. The development of nuclear and radiation safety standards is a statutorily authorized function of the IAEA, which is without precedent in the United Nations system. Certainly the International Civil Aviation Organization, International Maritime Organization, World Customs Organization, World Health Organization and others set nuclear standards within their areas of competence. The IAEA Statute[37] expressly authorizes the Agency 'to establish standards of safety' and 'to provide for the application of these standards'. Over the years, more than 200 safety standards have been published in the

[37] Statute of the International Atomic Energy Agency, 23 October 1956 (entered into force on 29 July 1957).

IAEA's Safety Series of publications: the Nuclear Safety Standards (NUSS); the International Basic Safety Standards for Protection Against Ionising Radiation and for the Safety of Radiation Sources (the Basic Safety Standards), with supporting documents; the Radioactive Waste Safety Standards (RADWASS); and the Regulations for the Safe Transport of Radioactive Material.

7.3.1 *The International Cooperation in Development of the IAEA Safety Standards as a Valuable Criterion for Effectiveness*

The strong need for international cooperation resulted in the creation of the IAEA itself in 1956. Article III of the Statute, defining the IAEA's main functions, includes 'fostering the exchange of scientific and technical information', 'encouraging the exchange and training of scientists and experts', and 'establishing standards of safety for protection of health and minimization of danger to life and property, and providing for the application of these standards to its own operations as well as to operations making use of IAEA materials, services and information'.

During the development or revision of a safety standard all IAEA Member States have the possibility to present their comments on the well-developed draft document and these comments are taken into account in the final draft that is sent to the Nuclear Safety Standard Committee and the Commission of Safety Standards for approval. Final approval to take the safety standard into use is given either by the Director General or Board of Governors, depending on the level of the safety standard.

The level of safety defined by the Convention on Nuclear Safety is quite similar to what is defined by the IAEA Safety Fundamentals. The IAEA safety standards are mandatory for the Agency's operations and for the projects in States supported by the IAEA. Otherwise, the CNS does not oblige States Parties to implement IAEA standards. Any State wishing to enter into an agreement with the IAEA concerning any form of Agency assistance is required to comply with the requirements of the IAEA safety standards that pertain to the activities covered by the agreement. Most countries use IAEA safety standards as a reference for their nuclear legislation or regulations while others use them directly in their regulatory programmes.

Generally the IAEA safety standards are qualitative and performance-based, rather than quantitative and specific. The standards are technology neutral, so they can be widely used by Member States—both as a benchmark for harmonization and as a basis for the review of national regulations or their incorporation into the body of national regulations.

In some countries, the requirement level for certain issues may be higher for various reasons, e.g. because of density of population. Each country defines its own acceptable safety level on the basis of local conditions and governmental practices.

The Agency uses various frameworks to obtain feedback on the quality of the standards, such as safety review missions; technical meetings and conferences; review meetings of the Convention on Nuclear Safety and of the Joint Convention Meetings; networking and interactions.

A question arises whether a comprehensive legal instrument for nuclear safety would be more efficient if it contains a set of legally binding requirements which are the same for all States. As seen by the three biggest nuclear power accidents, most nuclear damage occurs at the local level and damages the local population. Significant damage could also affect distant zones by aerial and water currents. In addition, the geological, climatic, economic and other factors differ in particular countries hence there is no reason to impose the same level of national or international nuclear safety standards. This conclusion applied even for European Union Member States in which a mix between national and international standards is required.[38]

On the issue of possible common nuclear safety standards, the European Nuclear Safety Regulators Group (ENSREG) argues that because of the differences in safety cultures and approaches, agreeing on common rules would be costly, would create problems of transposition and interpretation into national laws and could lead to decisions based on the least common denominator with respect to safety standards for existing reactors.[39]

The Western European Nuclear Regulators' Association (WENRA), which was created in 1999 to provide an independent assessment of the national frameworks for nuclear safety in Eastern European accession countries, serves now as a discussion forum to develop a common approach to nuclear safety in Europe.

Another question arises at what level are the standards drawn? In my view, basic safety standards which provide reference levels should be at the international level. It implies a multinational work among national regulators, not forgetting to take into account the feedback from industry. There is definitively a role for the IAEA as well as for the WENRA and similar regional organizations to play in the elaboration of those basic safety standards. The experience gained already is also very valuable. National regulations could be necessary for one site licensing, control of compliance and safety evaluation of ageing facilities.[40]

The steps for further improvement of the IAEA Safety Standards could be the following: optimization of the process by shortened and streamlined different development and review stages, given the fact that the average time it takes to develop a safety standard is three to five years; common revision of Safety Guides grouped on specific areas of regulation; promotion of continuous improvement of design and operational safety; a cost-efficiency analysis of setting-up of the safety standards. A specific point relates to the fact that practically all nuclear safety standards focus on the protection of people. Certain room for improvement does

[38] Berthélemy and Lévêque 2011, p. 133.

[39] Ibid, p. 133.

[40] IAEA 2006b, Effective nuclear regulatory systems: Facing Safety and Security Challenges, p. 271.

exist in the more comprehensive protection of the environment which is not in the centre of the current safety standards.

7.4 The Role of the IAEA in Ensuring the Effectiveness of the Nuclear Safety Framework

The IAEA provides indispensable advice and assistance to its Member States on nuclear and radiological safety.[41] As shown by the Nuclear Safety Review—2015, more than 70 % of those Member States requesting assistance need additional support to be in full compliance with the Agency's safety standards in radiation, transport and safety. Above all, the Agency issues publications in areas such as nuclear power plants, fuel cycle facilities, research reactors, radioactive waste disposal activities, mining and milling, application of radiation sources and transport of radioactive material. The IAEA has developed a strong system of safety standards covering all fields of peaceful uses of nuclear energy.

The IAEA relies on the work of a number of advisory bodies including the International Nuclear Safety Advisory Group (INSAG). For development of radiological standards the IAEA uses the expertise of the International Commission on Radiological Protection (ICRP) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

The IAEA safety review services provide additional arguments in support of the effectiveness of nuclear safety regime. The peer review process starts with a request by Member State to the IAEA concerning a particular regulatory authority or nuclear power plant. A team of international experts performs an evaluation of regulatory body effectiveness or operational safety of the respectful nuclear installation. The concrete response to the respective recommendations of the team is up to the Member State to decide.

The IAEA performs a number of reviews in the area of nuclear safety, in particular: Operational Safety Review Team (OSART); Design and Safety Assessment Review Service (DSARS); International Probabilistic Safety Assessment Review Team (IPSART); Review of Accident Management Programmes (RAMP); Design Safety (DS)/Generic Reactor Safety (GRS) Reviews; Site and Seismic Safety Review Team (SSRS); Safety Evaluation of Fuel

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[41] In addition to the IAEA several other organizations are involved in ensuring nuclear safety, such as the World Association of Nuclear Operators (WANO); European Nuclear Energy Agency of the Organisation for European Economic Co-operation); EURATOM, though the 1957 EURATOM Treaty does not specifically mandate this organization to regulate nuclear installation safety;; Inter-American Nuclear Energy Commission of the Organization of American States; the Arab Atomic Energy Agency of the League of Arab States;; the Generation IV International Forum (GIF) as a co-operative international endeavour which was set up to carry out the research and development needed to establish the feasibility and performance capabilities of the next generation nuclear energy systems.

Cycle Facilities during Operation (SEDO); Peer Review of Operational Safety Performance Experience Review (PROSPER); Regulator Operating Experience Review (ROpER); Safety Aspects of Long Term Operation of Water Moderated Reactors (SALTO); Research Reactor Safety—Integrated Safety Assessment of Research Reactors (INSARR); Safety Culture—Independent Safety Culture Assessment.

OSART is the best-known peer review service for Member States. Under this programme, international teams of experts conduct in-depth reviews of operational safety performance at a nuclear power plant. They review the factors affecting the management of safety and the performance of personnel. An OSART corporate service has been developed in which a special emphasis is placed on leadership and management for safety. The main portion of the review lasts about three weeks, after which a preliminary report is delivered to the host facility, followed by a final report three months later. These reports are automatically derestricted and available for public view, unless the host country requests otherwise. A three- to five-member team conducts a follow-up visit about 18 months after the review to evaluate progress made.

An IAEA and World Association of Nuclear Operators (WANO) working mechanism is in the process of setting up to communicate and coordinate different international peer review services to ensure an effective method of performance. The IAEA and the WANO missions are complementary rather than competitive. An IAEA/WANO working mechanism to communicate and coordinate different international peer review services is in the process of establishment to ensure an effective method of performance of peer reviews and to allow plants to optimize the use of their resources. In addition, a long-term planning for OSART and WANO missions to minimise duplications and ensure that resources are used to the best interests of all stakeholders.

The IAEA implements safety standards upon States that have agreed to receive these services. But it may decline a request originated from a Member State, subject to any political, economic, military, or other conditions incompatible with the provisions of its Statute.[42]

Apart from the specific assistance in nuclear safety and security, there are some services related to both areas, for instance the Integrated Regulatory Review Service (IRRS). The IRRS deserves a more detailed analysis given its role in ensuring the effectiveness of the regulatory framework of nuclear safety of particular Agency's Member States. The IRRS is designed to enhance the effectiveness of the national regulatory infrastructure of States for nuclear, radiation, radioactive waste and transport safety and security of radioactive sources. This purpose is achieved through consideration of both regulatory technical and policy issues, with comparisons against IAEA safety standards and good practices. The IRRS process consists of the following phases: (a) pre-mission or preparatory (including information meeting, preparatory meeting and self-assessment);

[42] Article III (C) IAEA Statute.

(b) conduct of the peer review mission (including completion and dissemination of the mission report); and (c) follow-up mission.

The review focuses on common aspects of any State's national, legal and governmental framework and regulatory infrastructure for safety. An IRRS mission addresses all relevant areas and activities regulated in the State, with a follow-up IRRS mission no more than four years later to review progress in implementing the recommendations of the initial IRRS mission. Preparation for the IRRS mission includes a self-assessment conducted by the State, in accordance with the IAEA Self-Assessment Methodology.

In response to the Fukushima Daiichi accident, a new module for the IRRS was developed and the analysis by the IAEA Secretariat suggested that no major implications existed for the regulatory regimes of the reviewed countries. The IRRS confirmed the importance of regulatory body independence and a regulatory safety culture for effective regulatory oversight of the safety of nuclear installations. The responsibilities of the operator for safety and the regulator for the oversight of the activities of the operator related to safety are specifically addressed in the IAEA Safety Requirements on the Governmental, Legal and Regulatory Framework for Safety.

The IAEA has developed an adequate set of criteria on measurable performance indicators for effectiveness of the IRRS process. The following indicators have been used in the analysis: the size of the IRRS team; the length of the mission report; a time available for the review of the Advance Reference Material (ARM); a number of advance written comments from the reviewers; feedback from the team members on the quality of the ARM; IRRS' experience of the team members; feedback from the host country representatives; feedback from the team members on the mission; an extension of the pre-mission Action Plan of the host country; coverage of the pre-mission Action Plan by mission findings; a number of issues found beyond those in the Action Plan; a balance of the Recommendations and Good Practices; a balance of Recommendations and Suggestions; the conciseness of the mission report; the completion time of the mission report; and a number of issues remaining open in the follow-up mission.[43]

The IAEA performs certain activities in support of the development of the governmental, legal and regulatory framework for nuclear safety. This includes a training event on drafting safety regulations, namely the School on Drafting Regulations, based on the Agency's Safety Standards. In addition, a number of events have been regularly conducted aimed at improving the national safety infrastructure of Member States expanding or planning to embark on a nuclear power programme, as well as in support of enhancing the regulatory effectiveness of those with established nuclear power programmes. Country specific bilateral assistance is being provided to various Member States, in reviewing and developing national nuclear legislation.

[43] IAEA. Efficiency and Effectiveness of the IRRS Missions. Working Material, 30 October 2014, https://gnssn.iaea.org/regnet/irrs/Documents/E%20and%20E%20of%20IRRS_to%20publish.pdf, p. 2.

The IAEA has developed a self-assessment methodology as a management tool to review a regulatory organization's current status, processes and performances against IAEA Safety Standards, and provides for further planned and programmed development and improvement of the existing regulatory system. The IAEA self-assessment methodology is based on a three-tier model that can be used by the regulators at an early stage of establishing a regulatory infrastructure or a mature stage of implementing a variety of management and quality assurance programmes. The IAEA had used Self-Assessment Tool (SAT) which was replaced by the Self-Assessment of Regulatory Infrastructure for Safety (SARIS).

A number of international meetings to enhance the effectiveness of the regulatory framework to ensure nuclear safety took place after the Fukushima Daiichi accident, in particular, the Diplomatic Conference to consider a Proposal by Switzerland to amend the Convention on Nuclear Safety (9 February 2015), the Sixth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (24 March–4 April 2014), the International Conference on Effective Nuclear Regulatory Systems, (8–12 April 2013), the Integrated Regulatory Review Service (IRRS) missions performed since the accident, the Second Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety (August 2012). Other international meetings include those conducted by the CANDU Regulators Group,[44] the European Nuclear Safety Regulators Group (ENSREG), the Forum of the State Nuclear Safety Authorities of the Countries Operating WWER-type[45] Reactors, the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), and the International Nuclear Regulators Association (INRA).

The Fukushima disaster called for 'expanding' the IAEA's role as an information hub. The IAEA administers several information systems and networks which have direct relevance to prompt actions in cases of a need for assistance and support in the area of nuclear safety.

Examples of IAEA systems for nuclear safety information sharing are the following:

- The Unified System for Information Exchange in Incidents and Emergencies (USIE) as the Agency's web portal for Contact Points of States Parties to the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and of

[44] CANDU stands for CANadian Deuterium Uranium' reactors which supply approximately 50 % of Ontario's electricity and 16 % of Canada's overall electricity requirements. They are also operating in Argentina, China, India, Pakistan, Romania and South Korea. The CANDU Owners Group Inc. (COG) is a not-for-profit organization dedicated to providing programs for cooperation, mutual assistance and exchange of information for the successful support, development, operation, maintenance and economics of CANDU technology.

[45] Water-cooled water-moderated power reactors.

IAEA Member States, and for officially nominated International Nuclear and Radiological Event Scale (INES) National Officers;
- INES provides information on occurrence of nuclear and radiological events using the INES scale. The goal for nuclear safety information sharing is near real-time reporting on incidents, emergencies and operational experiences based on evidence, scientific knowledge and the capabilities of Member States.
- The NEWS—Info on occurrence of nuclear and radiological events using the INES scale; Official access is given to the OECD/NEA and IAEA Secretariat and the WANO Regional Directors.

An open issue exists on the clarification of whether the IAEA itself should determine the rating of a nuclear emergency using INES. This should be done in close consultation with the State (or States) concerned. But it should not be the State or States alone that make the determination. The post-Fukushima Action Plan of the IAEA pointedly calls for the Secretariat to prepare itself to provide Member States, international organizations and the general public with 'timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences, including analysis of available information and prognosis of possible scenarios based on evidence, scientific knowledge and the capabilities of Member States'.

The UN Secretary-General's report on intra-UN coordination during Fukushima called for 'expanding' the IAEA's role in receiving and disseminating information, and better addressing the huge public demand for information through one-voice messages.

The Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) is an essential mechanism for strengthening the coordination between relevant organizations as well as communication with the public.

The IAEA coordinates the Joint Radiation Emergencies Management Plan (JPLAN) to prepare for and respond to 'an actual, potential or perceived radiation incident or emergency independent of whether it arises from an accident, natural disaster, negligence, a nuclear security event or any other cause'.

In order to share information and discuss the progress made in nuclear operational safety since the Fukushima Daiichi nuclear power plant accident, an Operational Safety Conference took place from 23 to 26 June 2015. The conference tried to identify areas where further improvements are needed and international actions that may support the implementation of such improvements.

The cooperation between the IAEA and the European Atomic Energy Community (EURATOM) in nuclear safety can serve as an example of its policy for enhancing the cooperation with regional organizations. The specific areas of cooperation between the two entities include the following:

- Nuclear safety standards, regulatory framework as well as safety-related research;
- Provision of peer reviews of the nuclear safety regulatory framework and the safety of nuclear installations of IAEA Member States, which are Member States of Euratom;

- Assistance to countries for the further development of comprehensive risk and safety assessments;
- Arrangements for the prevention of emergencies with radiological consequences, as well as the mitigation of consequences thereof.[46]

7.5 Basic Principles for the Effectiveness of the International Regulatory Framework to Ensure Nuclear Safety

7.5.1 Effectiveness of Nuclear Regulators

Effective regulators are needed to set the appropriate standards, monitor the performance of the nuclear industry and take action if this industry does not meet the required performance standards. Nuclear regulators, by their very nature, are "law enforcement officers" and hence their effectiveness is not only related to technical competence but also to legal powers. An effective nuclear regulator should possess a number of characteristics on the independency, transparency and collaboration with international partners.[47]

It is widely accepted that a nuclear regulator must be independent. This means that apart from the adequacy of budget and human resources, the regulator should possess the authority to halt an activity, up to the shut down of an NPP, if it identifies a safety or security concern.[48] The importance of regulatory independence is recognized in the Convention on Nuclear Safety and the IAEA Safety Requirements on the legal and governmental infrastructure for safety.[49] Both documents address the establishment of a regulatory body and the need for its separation, or independence, from the operators and promoters of nuclear technology. The primary reason for this separation is to ensure that regulatory judgements can be made without pressure from interests that may conflict with safety. Having said that, it is recognized that a regulatory body cannot be totally independent from the

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[46] Memorandum of Understanding for a partnership between the European Atomic Energy Community and the International Atomic Energy Agency on nuclear safety cooperation, 17 September 2013.

[47] Organization for Economic Cooperation and Development, Nuclear Energy Agency 2014. The Characteristics of an Effective Nuclear Regulator.

[48] It was noted in the case of Fukushima accident the 'too-close-for-comfort' relationships between the regulators and industry. The close links between the regulators and the industry is attributed to what is called "the nuclear power village" which institutionalizes the movement of retiring government officials into private industries they once regulated. Benz 2013, pp. 856–857.

[49] International Atomic Energy Agency 2000 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, Requirements, Safety Series No. GS-R-1, IAEA, Vienna.

rest of a government in all aspects. It must function within a national system of laws and budget constraints, just as other governmental and private organizations do.

An area of paramount importance may be illustrated by the interactions between the regulatory body and the licensee[50] during the various stages of the lifetime of a nuclear installation, which may lead to changes or modifications to improve safety. The regulator needs to possess adequate capabilities and resources to manage its own inspection process and to monitor all safety related activities during the construction, commissioning and operation stages. The licensing process however is not subject to an international verification by actors outside the respective State unless there are bilateral or regional agreements in which this State participates. Therefore, an implementation of a legally binding international standard related to an international supervision of national licensing could supplement the current incentive-based regime.

The regulator should establish an efficient framework to ensure the public access to records of its decisions related to nuclear safety.[51] Since the public will only have confidence in the safe use of nuclear technology if the regulatory process and decisions are transparent, governments should set-up a system to allow independent experts and experts from major stakeholders (for example, the industry and the workforce and the public) to provide their views.

Collaboration on nuclear safety with international partners is another important aspect of effective regulation. The regulatory body shall have the authority to liaise with those of other countries and with international organizations to promote cooperation and exchange of regulatory information.

7.5.2 *Effectiveness of Nuclear Operators*

It goes without saying that every operator and user of nuclear and radiological facilities and materials have the responsibility to conduct these activities in a safe and secure manner. It is equally true that national government regulators bear the responsibility for overseeing these activities in a manner that reinforces those safety and security measures. This is in no way weakened by the separate activities and responsibilities of designers, suppliers, contractors and constructors. From an operator's perspective, regulatory effectiveness results from a clear and stable set of rules, designed and applied rigorously. Regulatory effectiveness is also achieved

[50] A licence is a legal document issued by the regulatory body granting authorization to create a nuclear installation and to perform specified activities. The licensee is the person or organization having overall responsibility for a nuclear installation and its activities and possessing all necessary licences for the installation and its activities. See IAEA. Licensing Process for Nuclear Installations. See Specific Safety Guide, SSG-12, p. 4.

[51] To the extent that these involve nuclear security, there may be aspects that must remain confidential.

when the input of operators can be taken into consideration to achieve stringent safety objectives.

Accountability and communications are the key interrelated elements of an efficient regulation. They should be identified at all interfaces and levels of interaction between regulators, operators and other stakeholders. The requirement for transparency and openness, which is applicable for a regulator, is equally important for operators.

7.5.3 Defence in Depth

Generally, nuclear safety standards are based on the concept of 'defence in depth (DiD)', which incorporates the actions and systems in place to prevent a nuclear accident followed by the release of nuclear substances in the atmosphere and water. The objectives of the DiD are to:

- compensate for potential human and component failures;
- maintain the effectiveness of the barriers by averting damage to the plant and barriers themselves; and
- protect the public and the environment from harm in the event that these barriers are not fully effective.[52]

The independent effectiveness of different levels of defence is a necessary element of DiD.

The first level of defence for nuclear safety relates to site selection, design, construction and operation of a nuclear plant. The next level is the provision of control and detection systems. Accident response provisions should ensure the third level of defence. The fourth level of defence is provided in case of severe accidents and guaranteed by the reactor containment. In comparison to the Three Mile Island, the larger amount of radioactivity that was released as a result of the Chernobyl nuclear power accident was due to the lack of a solid contained building. An off-site emergency plan is the fifth level of defence. The DiD principle is implemented through consecutive and independent levels of protection that all would have to fail before harmful affects could be caused to people or the environment. Should one level of protection fail, the subsequent level is still available to provide protection.

The 'DiD' uses both static and dynamic terms to ensure the effectiveness of the nuclear safety. What is now mainly promoted by nuclear safety experts is to place emphasis on dynamic aspects in which the safety culture would provide a set of appropriate behaviours, including a questioning attitude, alertness, full knowledge as well as good practices to be followed by nuclear operators.

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[52] Defence in Depth in Nuclear Safety. A Report by the International Nuclear Safety Advisory Group, INSAG-10, IAEA, 1996.

7.5.4 Probabilistic Safety Assessment

Probabilistic Safety Assessment (PSA) is sometimes referred to as Probabilistic Risk Assessment (PRA), a systematic logical analysis process. Some of the challenges in the area of civilian nuclear power risk analysis are linked with new trends in the nuclear reactor designs including small modular reactors, as well as next generation light water reactors and advanced metal cooled reactors. The impact of ageing on the safety effectiveness of existing reactor systems is of particular importance. PRA supports Risk Management by investigating thousands of accident scenarios as opposed to Design Basis Accidents which hypothesized accidents that a nuclear facility must be designed and built to withstand without loss to the systems and structures necessary to assure public safety.

7.5.5 As Low as Reasonably Achievable Principle

Generally, the philosophy of continuous safety improvement has been adopted in the nuclear industry. There are certain limits however which are reflected in the principle of 'as low as reasonably achievable' (ALARA).

ALARA is a concept developed by the International Commission on Radiological Protection (ICRP). The basis for this concept is that every radiation dose of any magnitude can produce some level of detrimental affects that may include increased risk of genetic mutations and cancer. With that in mind, ALARA aims to lower doses received by radiation workers using practical, cost-effective measures. Other terms with a similar meaning have been used as well. For instance, the national legal framework of the UK uses terms such as 'ALARP' which is short for 'as low as reasonably practicable'. 'SFAIRP' is short for 'so far as is reasonably practicable'. The two terms mean essentially the same thing and at their core is the concept of 'reasonably practicable'; this involves weighing a risk against the time and money needed to control it. Thus, the three terms describe the level at which it is expected to see workplace risks controlled.

The notion of reasonableness has been used in the modern international law as a concept based on ethical or moral rather than legal considerations.[53] Professor Handl rationally determined this term on the basis of a multiple factor analysis. This includes consideration of the probability and the magnitude of the harm threatened, as well as various parameters which in national legal systems form the framework for determining the ultra hazardous nature of an activity.[54]

An important approach to implement continuous improvement in nuclear safety is to review and implement (taking due consideration of the specificities) already established practices in other areas such as environment, health, aviation

[53] Corten 2009.

[54] Handl 1978, p. 36–37.

and others. The respective industries in these areas use the following incentives: accreditation and certification; financial benefits; and reputational enhancement.

7.5.6 Safety Culture

The quality of an operator's safety culture cannot be measured directly. There are a number of indicators that could be tracked down and compared to get a real story of the performance of the NPP respectively. The main risk associated with the operation of a NPP is a release of radioactivity.

The term 'safety culture' was introduced for the first time in the aftermath of the 1986 Chernobyl accident. The concept of safety culture was referred to by INSAG in the Summary Report on the Post-Accident Meeting on the Chernobyl Accident in 1986.[55] The INSAG clarifies[56] nuclear safety culture as a subset of the culture of the whole organization, whereby the latter comprises the mix of shared values, attitudes and patterns of behaviours that give the organisation its particular character.

The concept of safety culture is defined in INSAG-4 as follows: "Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance." There is widespread consensus that an appropriate balance of both behavioural sciences and quality management systems approaches should be pursued.[57]

The Convention on Nuclear Safety contains a desire "to promote an effective nuclear safety culture". The Preamble provision however is not supported by requirements in the main body of this Convention and other legal instruments.

What might be the criteria for effectiveness of the safety culture? The IAEA International Nuclear Safety Group has pointed out that the regulatory body monitors the effectiveness of the organization's safety management system as part of its scrutiny of safety performance.[58] Measuring the effectiveness of safety culture could be performed through a routine and continuing process of self-assessment conducted by the management in all areas of their responsibility, as well as through independent assessments such as audits or surveillances.

[55] International Nuclear Safety Advisory Group 1986, Summary Report on the Post-Accident Meeting on the Chernobyl Accident, Safety Series No. 75-INSAG-1, IAEA, Vienna.

[56] International Nuclear Safety Advisory Group 1998, Report Series No. 11 "Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress", IAEA, Vienna.

[57] International Atomic Energy Agency 1998, Developing safety culture in nuclear activities: practical suggestions to assist progress, Vienna.

[58] International Nuclear Safety Advisory Group 1999, Management of Operational Safety in Nuclear Power Plants, INSAG-13, IAEA, Vienna, p. 6.

The integration of operational experience and safety research into the work of all major players concerned with nuclear safety is an effective means to strengthen their safety culture and such to enhance nuclear safety.

There are several reasons to develop a concept of a nuclear security culture as distinct from safety culture. Among them are the following:

- Some aspects of security differ from the safety area. For example, controls over access to classified information, or the fact that the threat is purposeful rather than an accidental or caused by equipment failure.
- The concept of safety culture has been widely applied within the nuclear power industry. But it is not generally familiar to the wider range of organizations involved with nuclear materials and radioactive sources.

While objectives or desired outcomes of a nuclear security regime overlap to a substantial degree with those of a nuclear safety regime, they are not identical: it is possible to be safe without being secure.[59]

7.6 Are Ageing Nuclear Plants Safe or not by Today's Standards?

Many plants world-wide are reaching the end of their design life and will be entering long- term operation (LTO). Therefore, the question of safety is high on these plants and on the scale of nuclear industry agenda. On 20 December 1951, at the Experimental Breeder Reactor EBR-I in Arco, Idaho, USA, for the first time electricity-illuminating light bulbs were produced by nuclear energy. EBR-I was not designed to produce electricity but to validate the breeder reactor concept. On 26 June 1954, at Obninsk, Russia, the APS-1 NPP with a net electrical output of 5 MW was connected to the power grid, the world's first nuclear power plant that generated electricity for commercial use.

The design lifetime is the period of time during which a facility or component is expected to perform according to the technical specifications to which it was produced. An increasing number of NPPs are reaching their design lifetimes of 30 or 40 years. With the continuous development of science and technology, new technical solutions become available that may enhance the safety level of nuclear industry, potentially making existing systems outdated until modified. Nuclear power reactors have to meet higher standards as new materials, technologies and design concepts are developed, in particular, as a result of lessons learnt from operational experience and major accidents.

Experts say that significant technical issues related to LTO and plant operation beyond 60 years need to be researched and ageing management solutions

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[59] Khripunov 2005.

identified. Nuclear Regulatory Commission of the USA has been exploring changes to regulatory guidance to address aging issues for up to 80 years of operation which by itself raise a number of technical problems.

The IAEA started to develop guidance on the safety aspects of ageing management in the 1990s. Subsequently, a number of reports on the subject were published, providing general methodological guidance, as well as specific guidance for selected major NPP structures and components, such as reactor vessels, reactor internals, steam generators, containment, etc. An ageing management programme (AMP) is defined by the IAEA as a set of plant activities relating to understanding, prevention, detection, monitoring and mitigation of a specific ageing effect on a structure, or component of an NPP. The AMP should identify: (a) effective and appropriate actions and practices for managing ageing that provide for timely detection and mitigation of ageing effects in the structure or component; and (b) indicators of the effectiveness of the programme. Therefore, the effectiveness of current practices should be confirmed in light of applicable ageing evaluations and condition assessments, and/or improvements to current practices should be recommended, as appropriate.[60]

The IAEA recommends taking 'measures to optimize the life cycle of operational plants' indicating that to achieve the goal of the long-term safe, economic and reliable operation of the respective nuclear plant, plant life management (PLiM) programme is essential. The benefits of PLiM planning are defined to:

- identify components that are critical to plant safety and power generation;
- identify ageing degradation mechanisms that can lead to an unexpected/unplanned functional failure;
- provide opportunities for value creation through consideration of the effects of alternative operation and maintenance practices;
- provide financially optimized, long-term ageing management plans;
- optimize reliability, availability, capacity factor, Operations and Maintenance cost, capital cost and staffing; and
- integrate these to achieve: lowest cost/kWh while maintaining safe operation over the life of the plant.[61]

The international nuclear liability regime does not specifically address the issue of ageing nuclear reactors and this is apparently an open issue in today's regulatory framework of nuclear safety. The ageing reactors represent a higher risk; therefore, the question arises of whether the present liability regime allows for a higher maximum level of liability for such reactors. Article 7(b)(i) of the Paris Convention[62] allows for any Contracting Party to establish by legislation a greater or lesser ceiling of liability, taking into account the opportunities for the operator to obtain insurance or other financial security.

[60] IAEA 2015, p. 12.

[61] https://www.iaea.org/NuclearPower/PLIM-LTO/.

[62] Paris Convention is available at https://www.oecd-nea.org/law/nlparis_conv.html.

A specific feature of the present nuclear liability regime is that all financial security should be covered by insurance. This causes certain problems given the monopolistic situation of the nuclear insurance market and offers an opportunity to explore other alternatives, including risk-sharing, which would better address the issue of ageing nuclear reactors.

7.7 Some Aspects of Synergies Between Nuclear Safety and Nuclear Security—Another Way to Enhance Their Effectiveness

There are certain synergies between safety, security and safeguards integrating where appropriate, relevant factors the national legal and regulatory systems.[63] A mechanism has been established, with an associated Interface Group comprising the Chairs of the Safety Standards Committees and four members of the NSG, the purpose of which is to identify interfaces between safety and security in publications being developed in the IAEA Safety Standards Series and the IAEA Nuclear Security Series, reflecting the common overarching aims of safety and security while recognizing the distinctions between the two areas.[64]

The obligations relating to the regulatory frameworks for nuclear safety and nuclear security could be assessed on the basis of the following common components: (1) the establishment of applicable national requirements and regulations; (2) a system of licensing (or authorisations); (3) a system of regulatory inspections to verify compliance with applicable requirements and conditions of the licence, and (4) the enforcement of applicable requirements and of terms of the licence.[65]

Basically, both nuclear safety and nuclear security serve objectives with significant overlap: namely to protect the workers, public and the environment from unintended releases of radiation. In addition, the security of facilities involves controls on access to nuclear installations and other facilities to prevent the loss of, and the unauthorized removal, possession, transfer and use of radioactive material; protection of sensitive information and cyber security; and material accountancy and control. Some measures that contribute to both safety and security are:

- appropriate provisions in the design and construction of nuclear installations and other facilities;
- appropriate response arrangements and forces;

[63] Nuclear Security Plan 2010–2013—GOV/2009/54-GC (53)18), p. 3. https://www.iaea.org/About/Policy/GC/GC53/GC53Documents/English/gc53-18_en.pdf.

[64] Nuclear Security Plan 2014–20172017, GOV/2013/42-GC(57)/19, 2 August 2013, p. 3. https://www.iaea.org/About/Policy/GC/GC53/GC53Documents/English/gc53-18_en.pdf.

[65] Vasmant 2010, pp. 91–92.

- arrangements for mitigating the consequences of accidents and failures, which also facilitate measures for dealing with breaches in security that give rise to radiation risks; and
- measures for the security of the management of radioactive sources and radioactive material.[66]

There are certain similarities in the approaches to ensure nuclear safety and security, for instance, both place priority in prevention, early detection, and efficient action, and both require extensive emergency planning involving many more organizations than nuclear regulators.

In a number of areas nuclear safety and security differ. Risk assessment in nuclear safety deals with an unintended release as a result of a natural event, equipment failures, or human error. In the area of nuclear security, risk assessment concerns the release of radiation or the loss of nuclear or other radioactive material that result from intentional acts.

It is a simple fact that nuclear material used in a civilian area can also be used in nuclear weapon programmes. Thus there is a risk of diversion and possible misuse. Against this background, safeguards measures are used by the IAEA to prevent the diversion of nuclear material to nuclear weapons purposes. Physical protection of nuclear material also serves to prevent nuclear proliferation and may also reduce the risk of sabotage.

The three 'S' (safety, security and safeguards) have been regulated traditionally in isolation from each other. In fact, measures to address one subject can contribute to addressing another, for instance export controls within the non-proliferation regime can prevent acquisition of materials by terrorists. In addition, the experience by the IAEA in safeguards on inspection mechanisms[67] could be used as a model for performing periodic evaluations of Member States' nuclear safety measures based on their consent. The IAEA safety standard SSR-2/1 'Safety of NPP: Design—2012' explicitly mentions that 'Safety measures, nuclear security measures, and arrangements for the State system of accounting for, and control of, nuclear material for a nuclear power plant shall be designed and implemented in an integrated manner so that they do not compromise one another.' The nuclear safety measures rely on transparency which encourages an open review of the operation of NPPs and their past mistakes, whereas security is based on confidentiality of information that may be used by an adversary.

There are a number of lessons learnt from nuclear safety that could be applicable to nuclear security. Apart from the need for an independent regulatory body, other important requirements discussed in the specialised fora include harmonizing accident reporting requirements and expanding information sharing and the level of transparency.

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[66] International Atomic Energy Agency, Fundamental Safety Principles 2006a, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1273_web.pdf.

[67] Rockwood 2013, p. 13.

A number of elements of the nuclear safety regime embodied in the Convention on Nuclear Safety could be applied to that of the nuclear security. For example: regularised assessments of performance; information sharing; peer review; and reviews of the implementation of relevant international conventions.[68] One practical measure of the interaction between nuclear safety and security could be a closer interrelationship of the nuclear safety standards and nuclear security guidance.

7.8 Conclusions

The effectiveness and sustainability of the current regulatory framework for nuclear safety relies on incentives and not on mandatory requirements. While the prime responsibility for nuclear safety lies with the operators, national regulatory bodies are the organizations through which governments have to assure national compliance with international norms and standards regarding nuclear and radiation safety. Regulatory independence, including the necessary authority and resources is a key prerequisite for performing efficient regulatory functions.

A question arises whether more precise and mandatory international safety standards could be adopted. Carefully introducing some legally binding international standards, in particular related to an international supervision of national licensing and control provisions could supplement the current incentive-based regimes. Safeguards inspections could serve as a model for performing periodic evaluations of Member States' nuclear safety measures based on their advanced consent.

The unique role of the IAEA to develop and update nuclear safety standards will progressively increase especially through the use of international assessment and peer reviews missions. In addition, the IAEA should promote the harmonization of legal and regulatory regimes for nuclear safety and take measures in ensuring synergies between nuclear safety, nuclear security and safeguards.

The Fukushima accident has confirmed that the current regulatory framework could be further strengthened to ensure the safety of nuclear installations. The regulatory requirements for the nuclear safety could be continually enhanced since there is a need to strengthen capabilities in managing risks from beyond-design-basis events. One particular area of interest should be handling the aging processes of nuclear plants. A number of significant technical issues related to the long-term operation need to be researched and ageing management solutions identified.

Can the IAEA be the watchdog for nuclear safety? The present legal regime does not permit the Agency to play a more outstanding role in performing mandatory systemic reviews of NPPs by independent experts. One condition is the vital

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[68] Squassoni 2012.

necessity for any legally binding obligation under public international law, in particular in the nuclear safety, namely an agreement of the participating Contracting Parties. Generally speaking, every intergovernmental organization (and the IAEA is no exception) can only do what its Member States are prepared to accept and finance respectively.

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Chapter 8
A Framework for the Secure Development of Nuclear Energy: Obligations, Challenges and Possible Solutions

Sonia Drobysz

Abstract The right to peaceful uses of nuclear energy as recognized in the Treaty on the Non—Proliferation of Nuclear Weapons shall be exercised in conformity with the obligations not to proliferate nuclear weapons. Since the adoption of the Treaty, additional risks associated with the development of nuclear energy, other than the traditional proliferation by States, have emerged. Those include criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities, such as the illicit trafficking of nuclear material and nuclear terrorism. A number of instruments have been adopted to prevent, detect and respond to such acts. The establishment of a legal framework to ensure the secure development of nuclear energy at the national level is now framed by specific international obligations. At the same time, the consolidation and universalization of the international regime as well as the adoption of national nuclear security legislation give rise to a number of legal and practical challenges. None of them seem impossible to overcome, however, and a few tools and processes can help strengthen nuclear security globally.

Keywords Nuclear security · Nuclear terrorism · Convention on the Physical Protection of Nuclear Material · International Convention for the Suppression of Acts of Nuclear Terrorism · SC Res 1540 (2004) · National implementation · Legislative assistance

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Contents

8.1 Introduction

Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) states that

> Nothing in [the] Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty.

The right to peaceful uses is an inalienable right, but one that has to be exercised in conformity with the obligations not to proliferate nuclear weapons.

Since the adoption of the treaty, additional risks associated with the development of nuclear energy, other than the traditional State proliferation, have emerged. Those risks include criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities, such as the illicit trafficking of nuclear material and nuclear terrorism. The NPT does not directly envisage how to prevent, detect and respond to such acts. As early as 1975, however, discussions during the first NPT Review Conference (RevCon) highlighted the danger of nuclear material being used for 'provocative, terrorist or other malevolent purposes'.[1] The Conference therefore urged that

[1] Mr. Morokhov, Union of Soviet Socialist Republics, Statement during the General Debate, Summary Record of the Second Meeting held on Tuesday, 6 May 1975, at 10.40 a.m, NPT/CONF/SR.2. In Final document of the Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF/35/III.

> action be pursued to elaborate further, within the [International Atomic Energy Agency], concrete recommendations for the physical protection of nuclear material in use, storage and transit, including principles relating to the responsibility of states, with a view to ensuring a uniform, minimum level of effective protection for such material.[2]

International efforts thereafter converged to strengthen what is today commonly defined as 'nuclear security', that is 'the prevention of, detection of, and response to, criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities'.[3]An international framework was progressively developed[4] to cover all the aspects of nuclear security including physical protection, combating illicit trafficking and nuclear terrorism.[5] The first aspect, physical protection of nuclear material, 'can be described as a set of legal, administrative and technical measures, including physical barriers, to physically protect such material'.[6] In simple words, it puts in place 'guard, gates and guns'[7] to protect nuclear material. The second aspect aims to combat illicit trafficking, that is 'incidents involving illegal trade and movement of nuclear or other radioactive material across national borders'; but also 'incidents involving unauthorized acquisition (e.g. through theft), supply, possession, use, transfer or disposal—intentional or unintentional—of nuclear and other radioactive material with or without crossing international borders'.[8] Measures to combat illicit trafficking include physical protection measures but also 'law enforcement, intelligence gathering, procedures for determining the reliability of persons having access to radioactive materials and the like',[9] penal measures, criminal proceedings, etc. The third aspect focuses on the elimination of nuclear terrorism, that is acts involving nuclear and other radioactive material committed

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[2] Final Declaration of the Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, p. 4, Annex I. In Final document of the Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF/35/I, 30 May 1975.

[3] IAEA 2013, p. 1.

[4] See IAEA 2011, pp. 3–8.

[5] Those three aspects are discussed in Stoiber 2010b.

[6] Vez Carmona 2005, p. 31. In this article, physical protection is thus considered to be only one aspect of nuclear security. 'Physical protection' and 'nuclear security' of nuclear material are sometimes used interchangeably: see for instance *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities*, IAEA document INFCIRC/225/Revision 5, footnote 1.

[7] In that sense Findlay 2012, p. 46.

[8] Scope of the IAEA Incident and Trafficking Database http://www-ns.iaea.org/security/itdb.asp. Accessed 5 February 2016.

[9] Stoiber 2010b, p. 225.

with the intent, for example, to cause death or serious bodily injury, substantial damage to property or the environment, to compel a natural or legal person, an international organization or a state to do or refrain from doing an act. Such acts do not necessarily have to be committed with a proper terrorist motivation, that is for a political, ideological or religious motive, to be prohibited. Measures to combat nuclear terrorism are similar to those to combat illicit trafficking.

Nuclear security covers nuclear material, other radioactive materials and their associated facilities. Nuclear material is usually understood as including plutonium except that with isotopic concentration exceeding 80 % in plutonium-238, uranium-233, uranium enriched in the isotope 235 or 233, uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore-residue, and any material containing one or more of the foregoing.[10] These are fissile materials, which can be used in nuclear power plants but also nuclear weapons or other nuclear explosive devices. They are all radioactive as they emit ionizing radiations such as alpha-, beta-, neutron particles and gamma rays. However not all radioactive materials are 'nuclear' or 'fissile' and could be used in nuclear weapons. Such 'other radioactive materials' include cobalt-60, caesium-137, strontium-90, and are commonly used in the form of sealed sources in various applications in medicine, agriculture, industry, etc. Other radioactive materials can also be used to make weapons known as radioactive material dispersal or radiation-emitting device. Thus, both nuclear and other radioactive material can, owing to their fissile or radiological properties, cause death, serious bodily injury or substantial damage to property or to the environment.[11]

The right to peaceful uses is now tied to the responsibility to ensure nuclear security. In its Resolution 1887 (2009), operative paragraph 11, the Security Council in that sense 'encourages efforts to ensure development of peaceful uses of nuclear energy by countries seeking to maintain or develop their capacities in this field in a framework that reduces proliferation risk *and adheres to the highest international standards for […] security.*' A number of international instruments have been adopted, and the establishment of a legal framework to ensure the secure development of nuclear energy at the national level is framed by specific international obligations. At the same time, the consolidation and universalization of the international regime as well as the adoption of national nuclear security legislation give rise to a number of legal and practical challenges. None of them seem impossible to overcome, however, and a few tools and processes can help strengthen nuclear security globally.

[10] See Convention on the Physical Protection of Nuclear Material, Article 1(a).

[11] See in that sense International Convention for the Suppression of Acts of Nuclear Terrorism, Article 1(1). See definitions in VERTIC 2012, pp. 8–10.

8.2 The Obligations: The Secure Development of Nuclear Energy

Most documents and statements related to nuclear security constantly reaffirm that the responsibility for nuclear security in a State rests within that State.[12] The IAEA document 'Objective and Essential Elements of a State's Nuclear Security Regime' underlines that: '[e]ach state aims to achieve nuclear security by creating its own nuclear security regime which is appropriate to that State'.[13] Immediately thereafter, however, the same document emphasizes the importance of international cooperation in the field: 'States also recognize that nuclear security in one State might depend on the effectiveness of the nuclear security regimes in other States. There is an increasing need for appropriate international cooperation to enhance nuclear security worldwide'.[14] States cannot ignore that 'events have clearly demonstrated the international dimension of a nuclear terrorist act';[15] therefore they 'recognize the need to work together to enhance their collective nuclear security. International legal instruments provide a strategic framework and a common platform for such cooperation'.[16]

More than a platform, those instruments provide for international obligations related to nuclear security. The working paper of the President of the 2015 NPT Review Conference recalled in that sense, 'when developing nuclear energy, including nuclear power, the use of nuclear energy must be accompanied by appropriate and effective levels of nuclear security, consistent with States' national legislation and *respective international obligations'*.[17]

8.2.1 The International Instruments for Nuclear Security

The international legal framework for nuclear security comprises a number of instruments, both binding and non-binding. They have largely been introduced,

[12] See for instance: *Nuclear Security,* resolution adopted on 18 September 2015 by the 59th IAEA General Conference, GC(59)/RES/10, para e; Ministerial Declaration adopted at the International Conference on Nuclear Security: Enhancing Global Efforts, July 2013, para 1.

[13] IAEA 2013, para. 1.4.

[14] IAEA 2013, para. 1.5.

[15] *Nuclear Security—Measures to Protect Against Nuclear Terrorism*, Annual Report, Report by the Director General, in GOV/2006/46—GC(50)/13, 16 August 2006, para 20.

[16] Ibid.

[17] NPT/CONF.2015/WP.58, para 39, see also para 69.

explained and compared in great details in many publications[18]; the following section therefore only gives a brief overview of their main provisions.

One of the key treaties that compose the nuclear security framework is the Convention on the Physical Protection of Nuclear Material (CPPNM), adopted on 26 October 1979 and which entered into force on 8 February 1987. The Convention covers three aspects[19]: the physical protection of nuclear material, as defined in the Convention, during international transport; the criminalization of offences involving nuclear material; and international co-operation in connection with criminal proceedings, recovery and protection of stolen material, as well as guidance on the design, maintenance and improvement of systems of physical protection of nuclear material in international transport.

An amendment to the Convention was adopted in 2005,[20] in order to: extend the scope of the Convention to fully apply to nuclear material in domestic use, storage and transport and to nuclear facilities; introduce a commitment to establish, implement and maintain an appropriate physical protection regime applicable to nuclear material and nuclear facilities, applying a series of fundamental principles of physical protection; add new offences including sabotage of nuclear material and facilities; and further strengthen the CPPNM's provisions on international cooperation. The amended Convention, however, is not in force yet.[21]

Regional instruments also include provisions on physical protection, referring to the CPPNM. Article 10 of the Treaty of Pelindaba establishing a nuclear weapons free zone in Africa requires each Party to undertake to maintain the highest standards of security and effective physical protection of nuclear materials, facilities and equipment to prevent theft or unauthorized use and handling, by applying 'measures of physical protection equivalent to those provided for in the Convention on Physical Protection of Nuclear Material and in recommendations and guidelines developed by IAEA for that purpose'. Article 9 of the Semipalatinsk Treaty on a nuclear-weapon-free zone in Central Asia contains a similar requirement. Each Party undertakes 'to apply measures of physical protection to nuclear material in domestic use, transport and storage, to nuclear material in international transport, and to nuclear facilities within its territory at least as effective as those called for by the Convention on Physical Protection of Nuclear Material of 1987 and by the recommendations and guidelines developed by the IAEA for physical protection'.

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[18] See IAEA 2011; Stoiber 2010b; Herbarch 2014; Johnson 2014, pp. 532–538.

[19] See Vez Carmona 2005, pp. 34–35.

[20] On the process leading to the adoption of the amendment and a detailed analysis of its content, see Vez Carmona 2005, pp. 36–48; Johnson 2014, pp. 539–545.

[21] The amendment requires ratification, acceptance or approval by two thirds of the Parties to the CPPNM. As of 1 April 2016, there were 101 contracting States/organization, https://www.iaea.org/Publications/Documents/Conventions/cppnm_amend_status.pdf. See also below, Sect. 8.2.2.

The main instrument on nuclear terrorism is the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), which was adopted on 13 April 2005 and entered into force on 7 July 2007.[22] ICSANT criminalizes a number of activities involving radioactive material—defined as nuclear material and other radioactive substances—nuclear facilities and nuclear explosive devices as well as radioactive material dispersal or radiation-emitting devices. The Convention does not only establish the offences, it also provides for a number of prosecution, extradition and international cooperation measures.

In addition to the CPPNM, its amendment, regional treaties and ICSANT, maritime and civil aviation conventions are also relevant for nuclear security. Even though not exclusively focused on that subject matter, they criminalize acts committed against ships, fixed platforms and aircrafts with nuclear weapons and radioactive material. They are the 1988 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation as amended by the Protocol of 2005 to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA 2005); the 1988 Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf as amended by the Protocol of 2005 to the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (SUA PROT 2005), and the 2010 Convention on the Suppression of Unlawful Acts Relating to International Civil Aviation (Beijing Convention), which is not yet in force.

Finally, nuclear security is addressed in Security Council resolutions, and most notably SC Res 1540 (2004). It aims to curtail the threats of terrorism and the risk that non-state actors may acquire, develop, traffic in or use nuclear, chemical and biological weapons and their means of delivery, as well as the illicit trafficking in nuclear, chemical, or biological weapons and their means of delivery, and related materials. The Resolution contains important decisions that are binding on all UN member States, including the obligations to: refrain from providing any form of support to non-State actors that attempt to develop, acquire, manufacture, possess, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery; adopt and enforce, in accordance with each State's national procedures, appropriate effective laws which prohibit any non-State actor to manufacture, acquire, possess, develop, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery, in particular for terrorist purposes, as well as attempts to engage in any of the foregoing activities, participate in them as an accomplice, assist or finance them; take and enforce effective measures to establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate controls over related materials.

[22] On ICSANT, see Jankowitsch-Prevor 2005.

The aforementioned binding instruments are complemented by a myriad of non-binding codes, guidelines and recommendations, mostly developed by the IAEA. The Agency adopted two important documents concerned exclusively with radioactive sources: the Code of Conduct on the Safety and Security of Radioactive Sources (Code of Conduct), published in January 2004, and the Guidance on the Import and Export of Radioactive Sources (Guidance), first published in March 2005 and revised in 2011. The Code applies to all radioactive sources that may pose a significant risk to individuals, society and the environment, that is the sources referred to in Annex I of the Code; it does not, however, apply to nuclear material as defined in the CPPNM. The objectives of the Code are to achieve and maintain a high level of safety but also security of radioactive sources, as well as to 'prevent unauthorized access or damage to, and loss, theft or unauthorized transfer of, radioactive sources, so as to reduce the likelihood of accidental harmful exposure to such sources or the *malicious use of such sources to cause harm to individuals, society or the environment*' and 'mitigate or minimize the radiological consequences of any accident or *malicious act involving a radioactive source'*.[23] A number of principles for the establishment of an adequate system of regulatory control of radioactive sources are set out, including through the adoption of laws and regulations, the creation of a regulatory body, and measures for the import and export of radioactive sources. The Guidance complements the Code on this later aspect.

As all other IAEA codes and guides, the Code and Guidance are 'addressed to governments with the intention of recommending certain procedures or practices that have international applicability so as to harmonise state practice'.[24] When the IAEA endorsed the objectives and principles set out in the Code, it urged 'each State to write to the Director General that it fully supports and endorses the IAEA's efforts to enhance the safety and security of radioactive sources, is working toward following the guidance contained in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources, and encourages other countries to do the same'.[25] Thus, States do not 'adhere' to the Code and the Guidance but make a political commitment to implement them. Once their principles are incorporated in national law, however, they become legally binding at the domestic level. The Agency also applies the Code and other standards it has developed to its own operations conducted in member states through assistance projects.[26]

[23] Code of Conduct, para 5; emphasis added.

[24] Jankowitsch-Prevor 2010, p. 22.

[25] *Measures to Strengthen International Co-operation in Nuclear, Radiation and Transport Safety and Waste Management*, Resolution adopted on 19 September 2003, GC (47)/RES/7, Part B *Code of Conduct on the Safety and Security of Radioactive Sources,* para 4.

[26] Jankowitsch-Prevor 2010, pp. 22; 23.

In its collection 'Nuclear Security Series' (NSS), the IAEA also regularly publishes fundamentals, recommendations, implementing guides and technical guidance that contain objectives, concepts and principles of nuclear security, best practice and technical specifications. For example, NSS 13 addresses the physical protection of nuclear material and nuclear facilities; NSS 14 gathers nuclear security recommendations on the security of radioactive material and associated facilities; NSS 15 covers nuclear security recommendations on nuclear and other radioactive material out of regulatory control; and NSS 20 sets out the objective and essential elements of a State's nuclear security regime.

During the 2014 Nuclear Security Summit held in The Hague, 35 States committed in a Joint Statement on Strengthening Nuclear Security Implementation to subscribe to the fundamental principles in NSS 20; meet the intent of the recommendations of NSS 13, 14 and 15 through the implementation and enhancement of national regulations; improve the effectiveness of their nuclear security regime by, for example, hosting peer review missions; and ensure that management and personnel with accountability for nuclear security are demonstrably competent. In the letter transmitting the Joint Statement to the IAEA for circulation, the Netherlands—one of the sponsors of the statement—carefully clarified that 'such commitment does not alter the non-binding status of the IAEA NSS documents. States may commit themselves voluntarily to implement the intent of the individual recommendations.'[27] Nevertheless, the joint statement's signatories did commit to reflect the recommendations *in their national legal framework*, thereby making them binding. This contributes to moving 'signatories beyond the voluntary implementation of the IAEA's guidance a significant step forward in building a unified international nuclear security regime'.[28]

8.2.2 The Obligations for Nuclear Security

The international instruments for nuclear security require States to adopt a series of legislative and regulatory measures.[29] Regardless of the 'monist' or 'dualist' systems in place in States parties, the language and content of the international provisions call for the enactment of specific national legislation and cannot be merely implemented through a general constitutional provision recognizing that treaties are automatically incorporated into the domestic legal order.[30] Interestingly, these types of constitutional provisions are sometimes mentioned in

27 Letter reproduced in document INFCIRC/869.

28 Dal et al. 2015, p. 1.

29 See Drobysz 2014, pp. 575–580.

30 See in that sense, about the terrorism conventions (which include ICSANT, SUA 2005, SUA PROT 2005 and the Beijing Convention) UNODC 2008, p. 10.

the criminal-related sections of the 1540 matrices, a method used by the Committee established by SC Res 1540 (2004) to organize information about implementation of the resolution by Member States.[31] To the questions 'does national legislation exist which prohibits persons or entities to engage in one of the following activities' and 'can violators be penalized', the 1540 Committee then responds with a question mark rather than a firm yes,[32] signifying that the constitutional provisions might not be sufficient. The nuclear security instruments are in that sense what is qualified in some legal systems as 'non-self-executing' treaties, especially as they refer 'to the necessity of further implementation by states parties (…)' and because some of their provisions 'cannot be applied directly as [they] (a) [do] not designate the responsible administration, (b) [do] not define a necessary administrative procedure, or (c) [do] not designate the jurisdiction of a specific court',[33] and do not specify specific penalties for relevant offences.[34] These elements as well as others therefore have to be clarified in national legislation.

Firstly, key terms that delineate the scope of the implementing laws and regulations must be defined in line with the international obligations. Such terms include 'nuclear material', 'radioactive material', 'nuclear facilities', 'non-State actors', etc.

Secondly, a set of penal measures should be adopted. As a first step, specific activities involving nuclear explosive and radiological dispersal devices, nuclear material, other radioactive material and their associated facilities—in accordance with the scope of each convention—shall be criminalized. Article 7 of the CPPNM lists a number of acts that 'shall be made punishable offence by each State Party under its national law'[35] with 'appropriate penalties which take into account their grave nature'.[36] Articles 5 of ICSANT, 3 of the Beijing Convention, 5 of SUA 2005—which applies to the offences set forth in SUA PROT 2005—contain similar requirements. Operative para 2 of SC Res 1540 (2004) also provides that 'all States, in accordance with their national procedures, shall adopt and enforce appropriate effective laws which prohibit any non-State actor to manufacture,

31 About the Committee, see p. 20.

32 See for instance Afghanistan's matrix, http://www.un.org/en/sc/1540/docs/matrices/Afghanistan%20revised%20matrix.pdf. The matrix refers to article Article 7 of the Afghan Constitution which provides: 'The State shall observe the United Nations Charter, inter-State agreements, as well as international treaties to which Afghanistan has joined, and the Universal Declaration of Human Rights. The State shall prevent all kinds of terrorist activities, cultivation and smuggling of narcotics, and production and use of intoxicants.'.

33 Crawford 2012, p. 97.

34 Thus 'Even if a country's legal tradition were to allow the theoretical possibility of a criminal charge for committing an offence defined only in an international treaty by which that country was bound, and not in a domestic piece of legislation, that offence would remain a crime without punishment until legislation defined the penalty', UNODC 2008, pp. 10–11. See also UNODC 2014, p. 18.

35 CPPNM, Article 7(1).

36 CPPNM, Article 7(2).

acquire, possess, develop, transport, transfer or use nuclear (…) weapons and their means of delivery, in particular for terrorist purposes (…).'

Further, as a second step, the Resolution and the aforementioned instruments impose to cover all forms of participation in the prohibited activities, including attempts to engage in the offences, participating in them as an accomplice, assisting or financing them, organizing or directing others to commit the offence.[37] The third step is for States to establish their jurisdiction over the offences on a number of bases including territoriality, passive and active personality, and extraterritoriality. As noted in the case of ICSANT, one of the key issues in the conventions is to determine 'clear rules of jurisdiction in order to prevent situations in which states might provide safe havens to alleged offenders and to avoid conflicts of jurisdiction between States Parties'.[38] They therefore specify a number of hypotheses when national courts shall be competent, such as when the offence is committed 'against a state or government facility of that State abroad, including an embassy or other diplomatic or consular premises of that State',[39] 'in an attempt to compel that State to do or abstain from doing any act',[40] 'in cases where the alleged offender is present in its territory and it does not extradite the alleged offender to any of the States Parties which have established their jurisdiction'.[41]

The adoption of measures to enable criminal proceedings is a fourth step. Those are based on the principle 'prosecute or extradite', as shown in, for example, Article 10 of the CPPNM according to which 'the State Party in whose territory the alleged offender is present shall, if it does not extradite him, submit, without exception whatsoever and without undue delay, the case to its competent authorities for the purpose of prosecution, through proceedings in accordance with the laws of that State'.[42] Measures to investigate the offences,[43] ensure the presence of the alleged offender for the purpose of prosecution or extradition,[44] guarantee the alleged offender a fair treatment,[45] and afford other States Parties assistance in connection with investigations or criminal or extradition proceedings[46] shall also be adopted.

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[37] SC Res 1540 (2004), para 2, CPPNM Article 7; ICSANT Article 2(2)(a), (3), (4), SUA 2005 Article *3quater,* SUA PROT 2005 Article *2ter,* Beijing Convention Article 1(3), (4), (5).

[38] Jankowitsch-Prevor 2005, p. 21.

[39] ICSANT, Article 9(2)(b).

[40] ICSANT, Article 9(2)(d), SUA 2005 Article 6(2)(c), SUA PROT Article 3(2)(c).

[41] ICSANT Article 9(4), SUA 2005 Article (6)(4), SUA PROT Article (3)(4), Beijing Convention Article 8(3).

[42] See also ICSANT Article 11, SUA 2005 Article 10(1); Beijing Convention, Article 10.

[43] ICSANT, Article 10(1); SUA 2005, Article 7(2); Beijing Convention Article 9(2).

[44] ICSANT, Article 10(2); CPPNM, Article 9; SUA 2005, Article 7(1); Beijing Convention Article 9(1).

[45] ICSANT, Article 12; CPPNM, Article 12; SUA 2005 Article 10(2); Beijing Convention Article 11.

[46] ICSANT, Article 14; CPPNM, Article 13; SUA 2005 Article 12(1); Beijing Convention, Article 17.

Thirdly, a comprehensive regime to regulate and domestically control nuclear activities shall be established through a legislative and regulatory framework. The latter should particularly provide for the creation or designation of a nuclear regulatory body;[47] a system to grant authorization for any activity involving nuclear material,[48] radioactive sources[49] and their associated facilities; specific physical protection and security measures[50]; and a system to control the transfers—including import, export, re-export, transit and transhipment—of relevant materials, equipment and technology.[51] This comprehensive regime should also include an enforcement mechanism with inspections of relevant facilities,[52] effective border controls,[53] and the adoption of appropriate sanctions in case of non-compliance with legal requirements.[54]

The international instruments for nuclear security thus significantly frame national legislations by requiring the adoption of detailed measures. It is in that respect noteworthy that Article 14 of the CPPNM obliges each State Party to inform the depositary of its laws and regulations which give effect to the convention.

8.2.3 The Relationship Between Nuclear Security and the Right to Peaceful Uses

The development of nuclear security obligations and the fact that the emphasis could be placed on complying with and strengthening them to the detriment of the exercise of the right to peaceful uses seems to have raised concerns amongst some States. During the last NPT review cycle, the Group of Non-Aligned States

> emphasize[d]that measures and initiatives aimed at strengthening (…) nuclear security must not be used as a pretext or leverage to violate, deny or restrict the inalienable right of developing countries to develop research, production and use of nuclear energy for peaceful purposes without discrimination.[55]

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47 Code of Conduct para 19(a), CPPNM as amended Article 2A(3) Fundamental principle D.

48 CPPNM as amended Article 2A(3) Fundamental principle C.

49 Code of Conduct para 19(c).

50 CPPNM as amended Article 2A(1), (2) and (3) Fundamental principle C; Code of Conduct para 19(g); ICSANT Article 8; UNSCR 1540 para 3(b).

51 Guidance on the Import and Export of Radioactive Sources; UNSCR 1540 para 3(d).

52 CPPNM as amended Article 2A(3) Fundamental principle C; Code of Conduct para 20(h).

53 SC Res 1540 (2004), para 3(c).

54 See for instance Code of Conduct, para 22(j).

55 *The inalienable right to develop research, production and uses of nuclear energy for peaceful purposes*, Working paper submitted by the Group of Non-Aligned States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2015/WP.5, para 23.

To address those concerns, it is crucial to note the symbiotic relationship between the right to peaceful uses and the nuclear security obligations.

Firstly, the instruments for nuclear security recognize, and to some extent protect, the right to peaceful uses. In its preamble, ICSANT recognizes ‘the right of all States to develop and apply nuclear energy for peaceful purposes and their legitimate interests in the potential benefits to be derived from the peaceful application of nuclear energy’; this has been viewed as a ‘kind of a general statement in favour of the peaceful use of nuclear energy and technology’.[56] SC Res 1540 (2004) also affirms that the ‘prevention of proliferation of nuclear, chemical and biological weapons should not hamper international cooperation in materials, equipment and technology for peaceful purposes (…)’. Similar statements have been made at international forums such as the NPT Review Conference and the IAEA. In 2015, the RevCon President’s working paper noted that ‘measures and initiatives aimed at strengthening nuclear safety and nuclear security should be in conformity with relevant articles under the Treaty, including the inalienable right of states parties to develop research, production and use of nuclear energy for peaceful purposes’.[57] The resolution on nuclear security adopted by the IAEA General Conference also regularly calls upon ‘all States to ensure that measures to strengthen nuclear security do not hamper international cooperation in the field of peaceful nuclear activities, the production, transfer and use of nuclear and other radioactive material, the exchange of nuclear material for peaceful purposes and the promotion of peaceful uses of nuclear energy (…)’.[58]

Secondly, a comprehensive national legal framework for nuclear security, in line with international obligations, may facilitate bilateral cooperation to develop nuclear energy for peaceful purposes. By becoming a Party to relevant international instruments and implementing them, states send a strong signal to investors and partners that they can secure nuclear material and facilities received through assistance projects. Nuclear suppliers may require that such assurances be given in order to enter into a cooperation agreement. Under the guidelines for nuclear transfers agreed upon by the Nuclear Suppliers Group,[59] ‘all nuclear materials and facilities identified by the agreed [exports] trigger list should be placed under effective physical protection levels to prevent unauthorized use and handling, consistent with the relevant IAEA recommendations (…)’.[60] Similarly, under section 123 of the USA’s 1954 Atomic Energy Act on cooperation with other nations,

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[56] Jankowitsch-Prevor 2005, p. 13.

[57] NPT/CONF.2015/WP.58, para 96.

[58] *Nuclear Security*, Resolution adopted on 18 September 2015, GC (59)/RES/10, para 6; see also *Nuclear Security,* Resolution adopted on 26 September 2014, GC(58)/RES/11, para 5, *Nuclear Security*, Resolution adopted on 20 September 2013, GC(57)/RES/10, para 5, etc.

[59] On the Nuclear Supplier Group, see *The Nuclear Suppliers Group: its Origins, Role and Activities,* in INFCIRC/539/Rev.6, 22 January 2015.

[60] *Guidelines for nuclear transfers*, INFCIRC/254/Rev.12/Part 1, 13 November 2013, para 3(a).

'no cooperation with any nation (…) shall be undertaken until (…) the proposed agreement for cooperation has been submitted to the President, which proposed agreement shall include the terms, conditions, duration, nature, and scope of the cooperation; and shall include (…) a guaranty by the cooperating party that adequate physical security will be maintained with respect to any nuclear material transferred (…)'. Some might view those requirements as additional constraints imposed by Supplier States on countries willing to develop energy for peaceful purposes, even though they do not go beyond the existing international binding and non-binding norms. When accepted and effectively put in place, however, a strong national security regime enables cooperation in the field of nuclear energy. The adoption of nuclear security legislation—and/or general nuclear legislation—may also enable for the allocation of budgets at the national level to develop specific projects related to the peaceful uses of nuclear energy.[61]

8.3 The Challenges: A Comprehensive Framework for Nuclear Security

Maintaining a comprehensive framework for nuclear security at the international and national levels is as challenging as it is important. At least three main aspects raise difficulties: '[t]here is no single, comprehensive legal instrument, like the NPT in the non-proliferation realm, but *several lesser ones*, all of which need to be *adhered to* and *implemented* by states if nuclear security is to be ensured'.[62] The legal imbroglio that characterizes the existing regime makes it arduous to both universalise all the relevant instruments and implement them in the national legal systems of their States Parties.

[61] The case of Jamaica is a good example. Jamaica's parliament passed a Nuclear Safety and Radiation Protection Act in July 2015 (*An Act to make new provisions for the regulation of activities, practices, apparatuses and facilities involving ionizing radiation and nuclear technology for the protection of people, property and the environment from the harmful effects of ionizing radiation; and for connected matters*, No 17-2015, 2015) with the objectives, among others, to 'secure radioactive sources from misuse that may result in harm to people or the environment', while at the same time allowing for 'the beneficial and peaceful uses of nuclear technology' and 'facilitat[ing] Jamaica's compliance with international obligations' arising under a number of conventions including the CPPNM, ICSANT, the maritime conventions, and SC Res 1540 (2004). Shortly after the Act was passed, Jamaica cooperated with the United States to have one kilogram of U.S origin highly enriched uranium removed from the 'Safe Low-Power Critical Experiment' (SLOWPOKE) research reactor and returned to the US. The reactor was converted to run on low enriched uranium, with the assistance of the IAEA, allowing for enhancement of its capacity and additional research related to food safety, food security, and water and air quality. (See news reports of the event at https://www.iaea.org/newscenter/news/international-security-strengthens-caribbean-becomes-free-highly-enriched-uranium, https://www.iaea.org/newscenter/news/iaea-assist-conversion-jamaican-research-reactor-leu-fuel, and http://nnsa.energy.gov/mediaroom/pressreleases/nnsa-removes-u.s.-origin-heu-jamaica-makes-caribbean-heu-free.

[62] Findlay 2012, p. 46. Emphasis added.

8.3.1 Complexity of the International Legal Framework for Nuclear Security

The complexity of the international legal framework for nuclear security[63] resides in the multiplicity of instruments that compose this framework, coupled to the multiplicity of forums where those instruments were negotiated and of the areas of international law they affect. The binding treaties and resolutions, the non binding codes and guidance were developed and fall within the mandate of many international organisations. The IAEA is the depository for the CPPNM and its amendment, and has developed the Code of Conduct, its supplementary guidance and the Nuclear Security Series. The UN General Assembly and the Security Council adopted ICSANT and SC Res 1540 (2004) respectively. The former also assigned specific functions to the IAEA. The International Civil Aviation Organization (ICAO) is the depository for the Beijing Convention, while the International Maritime Organisation is the depository for the maritime conventions. The United Nations Office on Drugs and Crime (UNODC) was encouraged by the UN General Assembly, in its Resolution 60/288 on the United Nations Global Counter-Terrorism Strategy, to 'enhance (…) its provision of technical assistance to States, upon request, to facilitate the implementation of the international conventions and protocols related to the prevention and suppression of terrorism and relevant United Nations resolutions', including ICSANT, the Beijing Convention as well as SUA 2005 and SUA PROT 2005.

Other informal international initiatives also promote nuclear security, in particular the Nuclear Security Summits. The latter have gathered world leaders in 2010 in Washington, 2012 in Seoul and 2014 in The Hague, to agree on general principles and political commitments to strengthen nuclear security. While 'it would be difficult to assess the concrete achievements of the NSS process that must be implemented on a national basis in a large number of states', 'the emphasis on legal instruments and national legislation obviously can contribute to the further development of nuclear security law',[64] as shown for example by the aforementioned Joint Statement on Strengthening Nuclear Security Implementation.[65]

Adding to the complexity of the system, the listed organisations, initiatives and their associated instruments cover many areas of international and national law including nuclear law, criminal law, maritime law, transfer control and customs law, etc.

[63] About the complexity of the international legal framework for nuclear security, see also Drobysz 2014, pp. 582–584.

[64] Stoiber 2014, p. 514.

[65] See p. 8.

The important number of treaties, codes and guidance then raises the issue of the relationship between them, and the risk of overlap and conflict. Most instruments acknowledge the existence of the other ones and do not intend to affect or modify the scope of their obligations. In its preamble, SC Res 1540 (2004)

> [r]ecogniz[es] that most States have undertaken binding legal obligations under treaties to which they are parties, or have made other commitments aimed at preventing the proliferation of nuclear (…) weapons, and have taken effective measures to account for, secure and physically protect sensitive materials, such as those required by the convention on the Physical Protection of Nuclear Materials and those recommended by the IAEA Code of Conduct on the Safety and Security of Radioactive Sources.[66]

ICSANT notes that its States Parties 'bear[…] in mind the Convention on the Physical Protection of Nuclear Material of 1980', and requires States to take into account relevant recommendations and functions of the International Atomic Energy Agency in adopting appropriate measures to ensure the protection of radioactive material.[67] Article 3*ter* of SUA 2005 even criminalizes the act of unlawfully and intentionally transporting another person on board a ship knowing that the person has committed an act that constitutes an offence set forth in a list of treaties including the CPPNM, and intending to assist that person to evade criminal prosecution.

Nevertheless, the nuclear security instruments may sometimes not be considered as forming a fully harmonized, coherent and proper 'legal regime'. One of their significant traits is that they do not adopt the same definitions for the same terms.[68] The CPPNM as amended defines 'nuclear facility' as a 'facility (including associated buildings and equipment) in which nuclear material is produced, processed, used, handled, stored or disposed of, if damage to or interference with such facility could lead to the release of significant amounts of radiation or radioactive material'.[69] It explicitly excludes nuclear facilities containing nuclear material used or retained for military purposes.[70] Under ICSANT, on the other hand, a 'nuclear facility' means '(a) [a]ny nuclear reactor, including reactors installed on vessels, vehicles, aircraft or space objects for use as an energy source in order to propel such vessels, vehicles, aircraft or space objects or for any other purpose' and '(b) [a]ny plant or conveyance being used for the production, storage, processing or transport of radioactive material'.[71] ICSANT thus has a broader scope than

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66 ICSANT preamble.

67 ICSANT, Article 8.

68 It should also be noted that those definitions are not the same in other areas of nuclear law; see for instance the definition for 'nuclear installation' in the Convention on Nuclear Safety, and definition for 'facility' in the comprehensive safeguards agreements concluded pursuant to Article III.1 of the NPT.

69 CPPNM as amended (consolidated text), Article 1(d).

70 CPPNM as amended, Article 2(5).

71 ICSANT, Article 1(3).

the CPPNM, since it does not cover facilities with only nuclear material but also other radioactive material; in addition, it applies to material and facilities used for military purposes. Such differences make it difficult to articulate all the instruments in a harmonized ensemble.

8.3.2 Universalization

The status of the international instruments for nuclear security shows a rather high level of adherence within the international community, highlighting the importance given to nuclear security. As of 15 September 2015, the CPPNM had 153 States Parties, while 100 States were parties to ICSANT. A wide consensus to call for universalization of both instruments is also reflected in the resolutions on nuclear security adopted by the IAEA General Conference. During the 59th session in 2015 for example, all IAEA Member States that had not yet done so were encouraged to become party to the CPPNM and to ICSANT.[72]

As for the Code of Conduct, 127 States have made a political commitment to support and implement it, and 99 States have notified IAEA of their intention to act in accordance with the Guidance on the Import and Export of Radioactive Sources. As previously noted, 35 States participating in the 2014 Nuclear Security Summit committed to subscribe to the fundamental principles in NSS 20 and meet the intent of the recommendations of NSS 13, 14 and 15.

What remains a 'major piece of unfinished business in international efforts to ensure that nuclear material does not fall into the hands of terrorists or other criminals'[73] is the entry into force of the CPPNM amendment. Article 20(2) of the Convention requires two-thirds of its States parties to deposit their instrument of ratification, acceptance or approval for any amendment to enter into force. Paradoxically, while universality of the CPPNM itself is desirable, it may therefore not necessarily bring the amendment closer to entry into force. Unless a State joins both the Convention and the amendment at the same time, or unless one State joins the Convention while another State joins the amendment, the Convention's adherence status may increase only to make the threshold requirement for entry into force of the amendment higher. On 1 April 2016, it counted 101 contracting States and organizations (Euratom). Notably, there was a series of ratifications in 2015, which marked the 10-year anniversary of the adoption of the CPPNM amendment—and of ICSANT–. Italy, Turkey and the United States

[72] *Nuclear Security,* resolution adopted on 18 September 2015, GC(59)/RES/10, paras 8 and 9.

[73] Johnson 2014, p. 568.

ratified the amendment in July, Botswana during the IAEA's Treaty Event on the margins of the 59th General Conference in September, Iceland in October and Morocco in December. Another series of ratifications took place in the first quarter of 2016, bringing the required number of additional ratifications needed for entry into force to two.

However, obstacles to entry into force and then universal acceptance of all binding and non-binding treaties persist.[74] Despite a quite broad consensus on the need to sustain and strengthen the international nuclear security regime, some States still lack the political will to accept additional obligations. Other States might not be opposed to adhere to treaties such as the CPPNM, its amendment and ICSANT, but may have more pressing priorities. This might be coupled to a lack of awareness and/or understanding of the relevant instruments and their obligations. A common perception in States with no nuclear material and no nuclear facilities for instance is that nuclear security instruments are not relevant to them. Even when the instruments and obligations are well understood and considered important, issues of capacity might be an impediment to universalization. There might be no 'national champion' in charge of pushing the adherence process forward, and staff turnover in national governments and administrations might complicate that process. Finally, specific constitutional or legal requirements may slow down ratification. For example, '[s]ome countries will not, either because of domestic law or as a matter of policy, adopt a treaty until legislation is in effect that permits the fulfilment of all of its international obligations'.[75]

8.3.3 National Implementation

Regardless of whether it has to be done before or after adhering to the instruments, adopting implementing legislation is in itself a challenging task and raises a number of issues. Once States have become Parties to the relevant treaties and agreed to commit to the non-binding instruments, they need to adapt their national legislation to their international obligations. They nevertheless face general obstacles similar to those slowing down universalization. A lack of political will, prevalence

[74] For a discussion about obstacles to universalization of the CPPNM amendment, see Johnson 2014, pp. 552–553.

[75] UNODC 2008, p. 10. For example, the United States signed ICSANT in 2005, SUA 2005 and SUA PROT in 2006, but ratified them, together with the CPPNM amendment, only in 2015. One of the reasons behind this long delay was that the implementing legislation had to be passed by Congress before the government could submit their instrument of ratification.

of more pressing legislative priorities, lack of understanding of the implementing obligations, and capacity issues may impede the comprehensive and efficient national implementation of the nuclear security requirements.

In addition, the legislative process to adopt nuclear legal and regulatory provisions presents specific difficulties.[76] As noted by Indonesia at the 2012 Seoul Nuclear Security Summit, 'there are many international legal instruments and frameworks in nuclear security that exist under the aegis of the UN, IAEA and other international organizations. Some of them are internationally legally binding in nature, while the rest are voluntary or non-legally binding. Meanwhile, at the national level, the implementation of instruments and frameworks on nuclear security involve a wide range of national stakeholders'.[77] The complexity of the international framework as described in Section 83.1 makes it particularly challenging to carry out the obligations in the national framework. Firstly, it makes it difficult to identify the relevant instruments and corresponding obligations as well as affected areas of international and national law. Secondly, national lawyers should not only understand the technicalities of the obligations but also harmonize the latter and make sure the scope of the implementing laws is appropriate. States should pay attention to the specifics of each instrument to ensure that each of them is fully applied. A typical example is that of SC Res 1540 (2004). Since the Resolution is an 'umbrella' text often seen as comprehensively covering the non-proliferation of biological, chemical and nuclear weapons and the security of related materials, its implementation could be considered as automatically satisfying the requirements of related treaties. However, even though SC Res 1540 (2004) has certainly complemented certain aspects of the nuclear non-proliferation and security regime, it has also left aside other aspects. For instance, the resolution does not explicitly cover the non-proliferation of radiological dispersal devices and the control of other radioactive material.

Those specificities are also what makes harmonizing the application of all the instruments hardly achievable. With respect to definitions in general nuclear law for instance, the IAEA noted that '[a]lthough consistency in definitions is highly desirable, practical application in some circumstances may warrant the inclusion of separate or special definitions to cover different subjects'.[78] The legislator may choose to adopt several definitions for terms such as 'nuclear material' for instance, specifying that one definition is 'for the purpose of security measures'

[76] See Drobysz 2014, pp. 582–584. About the CPPNM amendment, see Johnson 2014, pp. 555–559.

[77] Non-paper on the National Legislation Implementation Kit on Nuclear Security, presented to the Nuclear Security Summit 2012, http://nuclearsecuritymatters.belfercenter.org/files/nuclearmatters/files/model_legislation_implementation_kit_on_nuclear_security_march_2012.pdf.

[78] Stoiber et al. 2010, p. 18.

while the other is 'for the purpose of safety measures' or liability.[79] The same approach could be followed within nuclear security, adopting several definitions specifying that one is 'for the purpose of implementing physical protection measures in line with the CPPNM' while the other is 'for the purpose of criminalizing offences in line with ICSANT and the CPPNM', etc. A simpler option would be to adopt the broadest definition possible to cover all materials and sources.

As nuclear legislation concerns a number of different legal and technical areas, developing new nuclear security provisions also raises issues related to the number of stakeholders involved in the drafting process and coordination of their participation. They do not necessarily have the same level of understanding of the issues at stake: on the one hand, 'nuclear security legislation can involve complex technical issues unfamiliar to persons typically responsible for drafting laws', while on the other hand, 'other dimensions to nuclear security law […] may not adequately [be] comprehend[ed] [by technical experts], including criminal legal matters or the organisational responsibilities of various security agencies'.[80]

Finally, the national legislative process and national legal systems, regardless of the subject matter, present their own challenges. In particular, there are different approaches to national implementation that can be followed; nuclear security provisions can be incorporated into a single comprehensive weapons of mass destruction law, a nuclear law, a nuclear security law, or through various laws and regulations. The latter would seem an obvious choice since nuclear law is a cross-cutting discipline. However, the fact that States may opt, for various reasons, for a 'diffused' approach to national implementation may complicate the process and add to the problem of harmonization, by increasing the risk of inconsistency, repetition and complicated cross-referencing. The benefits of implementation through a unified and stand-alone nuclear law or nuclear security law are therefore often highlighted, in particular the idea that it will 'help legislative drafters avoid gaps,

[79] In its Nuclear Safety and Radiation Protection Act, Jamaica adopted separated definitions for 'nuclear facility': a general one covering 'any facility where activities or practices utilizing nuclear material are conducted', and a specific one "for purposes of the application of IAEA safeguards",—that is, measures covering 'a facility as defined in the relevant Safeguards Agreement between Jamaica and the IAEA', in line with the requirements of Article III.1 of the NPT. Article III.1 reads: 'Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. Procedures for the safeguards required by this Article shall be followed with respect to source or special fissionable material whether it is being produced, processed or used in any principal nuclear facility or is outside any such facility. The safeguards required by this Article shall be applied on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere.'.

[80] Stoiber 2012, p. 13.

overlaps and inconsistencies in the national legislation as well as unduly complex or poorly drafted and coordinated laws that can create problems of interpretation or application'.[81] However, the legislative and regulatory structure already in place may not be favourable to the adoption of a unified law. Further, following the unified approach does not necessarily prevent from amending existing laws in relevant areas.[82] This can be avoided by including 'a provision in the [stand-alone] nuclear security law stating that its provisions prevail over those in other laws if a conflict occurs',[83] but here again, this solution may not be applicable in some States.

8.4 The Solution: Strengthening the International and National Frameworks for Nuclear Security Through Legal Assistance

As recognized in Resolution 1977 (2011), in which the UN Security Council 'reiterates its decisions in and the requirements of Resolution 1540 (2004), and re-emphasizes the importance for all states to implement fully that resolution',[84] many States continue to require assistance in implementing UNSCR 1540. This holds true with respect to other international instruments for nuclear security. Such assistance includes training on relevant nuclear security matters or the provision of specific equipment. A number of activities can also be conducted under the encompassing concept of legal assistance to facilitate universalization of the international instruments for nuclear security as well as their implementation in national legislation. A report on the nuclear security of material and measures against illicit trafficking in nuclear materials and other radioactive sources submitted to the IAEA Board of Governors and General Conference in 2000 thus explains 'in order to achieve effective transfer of the knowledge and know-how necessary for implementation of the regulatory process, the concept of legislative assistance should involve (…) a transfer of knowledge through a combination of workshops, training, assistance in legislation drafting, and the development of reference material for the drafting and assessment of national nuclear legislation'.[85]

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[81] Johnson 2014, p. 558. See also in that sense Stoiber 2012, pp. 12–13. See also about a unified approach to implementing the maritime and civil aviation conventions, UNODC 2014, p. 106.

[82] In that respect, Johnson 2014 notes: 'In the IAEA's experience of providing legislative assistance to its Member States, which is available to all of them upon request, many countries choose not to just enact a single law (…) They have also amended and/or enacted relevant laws in the other areas mentioned above i.e. related to information security etc.' p. 558.

[83] Stoiber 2012, p. 15.

[84] SC Res 1977 (2011), operative para 1.

[85] *Nuclear verification and security of material—Measures against illicit trafficking in nuclear materials and other radioactive sources,* GOV/2000/40-GC (44)/15, 17 August 2000, para 16.

Awareness-raising, the development of reference material, and drafting assistance can help strengthen the international and national legal frameworks for nuclear security.

8.4.1 Awareness-Raising

A simple way to gain States' support for and commitment to adhere to and implement the international instruments for nuclear security is to raise awareness on the latter and their obligations through international, regional and national seminars, bilateral projects and discussions with states, as well as in publications.

This is all the more important as there is no proper international enforcement mechanism in place to ensure the effective application of the CPPNM, ICSANT, the maritime and civil aviation's conventions and SC Res 1540 (2004). As for most of the instruments and their norms in the field of international nuclear law, they 'lack concrete compliance measures and rely on the actions of states for effective implementation'.[86] None of the conventions provide for a process to periodically review and measure effectiveness of their provisions, let alone to formally assess states' compliance with their obligations. Admittedly, Article 14(1) of the CPPNM requires each State Party to 'inform the depositary of its laws and regulations which give effect to [the] Convention', and 'the depositary shall communicate such information periodically to all States Parties'. However, this obligation 'is quite vague in that it contains no guidance as to the form of the information provided or a process for the communication of the provided information periodically by the depositary'.[87]

SC Res 1540 (2004) created a Committee to report to the Security Council on the implementation of the Resolution, based on national reports submitted by States on steps they have taken or intend to take to give effect to SC Res 1540. A group of experts was later established to assist the Committee in carrying out its mandate and provide relevant expertise.[88] These subsidiary bodies play an important role in monitoring implementation, but cannot be considered as carrying out verification functions.[89] Significantly, the 1540 Committee matrix template notes that it is not a 'tool for measuring compliance of States in their non-proliferation obligations but for facilitating the implementation of Security Council Resolutions 1540 (2004) (…)'.

The absence of proper verification and enforcement systems reflect 'an abiding sense that nuclear security is too sensitive an issue to be subject to global

[86] Stoiber 2010a, p. 103.

[87] Herbach 2015, p. 10.

[88] SC Res 1977 (2011), para 5.

[89] See in that sense Elbahtimy and Drobysz 2015, p. 124.

governance'.[90] The focus of awareness-raising activities should therefore not only be on describing the international framework, but rather on insisting on the benefits to be gained from maintaining a strong national framework, in line with international requirements and guidance.[91]

In addition to sensitizing States with important nuclear industries, outreach efforts should insist on the relevance of nuclear security even for States with no nuclear material and activities.[92] One key aspect to highlight is the importance to avoid safe heaven for criminals that have stolen nuclear material in one country and cross borders to seek refuge in another. With appropriate legislation in place, States can investigate, prosecute and punish such offences involving nuclear and radiological devices and their related material. That may in itself serve as a deterrent against such acts. Another key aspect is the distinction between the targeted material: while there may be no activities involving nuclear material as defined in the CPPNM for instance, a large majority of States use radioactive sources; nuclear security measures as provided for in the Code of Conduct and its Supplementary Guidance for instance are therefore directly relevant. They enable the proper national control over radioactive sources, thereby strengthening national security, public health and safety.

The benefits to be gained at the international level should not be overlooked. Among them is the facilitation of nuclear cooperation by showing a responsible attitude toward nuclear and radioactive material. Buy-in from States might also be won through an active promotion of the international 'prestige' to be gained by adhering to, implementing and complying with the relevant instruments. Joining the CPPNM amendment or ICSANT for instance is a 'response to the calls of various fora such as the IAEA General Conference'.[93] Adopting appropriate laws and regulations also enables to comply effectively with international obligations and prompts the submission of relevant documents to satisfy international reporting requirements.

8.4.2 Reference Materials

The political commitment to adopt a comprehensive framework to secure the development of nuclear energy must then be followed by concrete actions; however, the adhesion and implementation processes may still be viewed as daunting exercises. Attention should therefore be given to providing concrete assistance in those processes. A number of helpful reference materials have therefore been developed.

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[90] Findlay 2012, p. 46.

[91] On specific benefits of adhering to and implementing the CPPNM amendment, see Johnson 2014, pp. 565–567.

[92] On the CPPNM amendment, see Johnson 2014, p. 559–562.

[93] Johnson 2014, p. 567.

In addition to general publications on nuclear security and associated legal requirements, specific tools can in particular assist with national implementation. In that respect, the Hague Communiqué adopted during the 2014 Nuclear Security Summit welcomes 'efforts aimed at developing model legislation on nuclear security, which could provide states with building blocks to develop comprehensive national legislation in accordance with their own legal systems and internal legal processes'.[94] At the same Summit, Indonesia presented the National Legislation Implementation Kit on Nuclear Security, which was developed by the Verification Research, Training and Information Centre (VERTIC), a non-profit organization that promotes the effective verification and implementation of international agreements. The Kit[95] has two objectives: 'to help States develop comprehensive national legislation on nuclear security, in accordance with their own respective legal cultures and internal legal processes' and 'to provide States with references to a wide array of consolidated elements and provisions contained in relevant international legal instruments and guidance documents that together establish the global framework for nuclear security'. It is intended to provide a 'single and friendly reference encompassing all provisions and elements that need to be reflected in national legislation on nuclear security'.[96] The central part of the Kit is a model law to implement binding and non-binding instruments for nuclear security. It covers definitions; the national regulation of nuclear security, including the establishment of a competent authority; the physical protection and security of nuclear and other radioactive material and nuclear facilities, security of radioactive sources and notification of incidents; the transport, import, export and transit of nuclear material and radioactive sources; offences and penalties; jurisdiction; and criminal proceedings and international co-operation. Legislative drafters, taking into consideration their country's legal framework, level of nuclear development, and other national circumstances, can use these model provisions to develop new nuclear security laws or regulations. The Kit also includes a description of the process for developing nuclear security legislation.

Although they do not focus solely on nuclear security and are limited in scope by their respective author's mandates, other useful drafting tools have been published. The IAEA developed two handbooks on nuclear law: volume I endeavours to 'explain the overall character of nuclear law and the process by which it is developed and applied',[97] while volume II focuses on implementing legislation and 'seeks to provide access to a well organized body of resource materials for helping

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[94] The Hague Communiqué, para 11.

[95] IAEA (2014), VERTIC-Indonesia (2014), http://www.vertic.org/media/assets/nim_docs/NIM%20Tools%20(Guides%20Handbooks)/Nuclear%20Security/NLIK-Nuclear%20Security_EN_3mar2014.pdf.

[96] Non-paper on the National Legislation Implementation Kit on Nuclear Security, presented to the Nuclear Security Summit, Seoul 2012. http://nuclearsecuritymatters.belfercenter.org/files/nuclearmatters/files/model_legislation_implementation_kit_on_nuclear_security_march_2012.pdf.

[97] Stoiber et al. 2003, preface.

states in drafting nuclear legislation'.[98] The handbooks cover general principles, the regulatory body, licensing and enforcement systems, safety, transport, waste management, liability, safeguards, exports and imports, and nuclear security. UNODC also developed model legislative provisions against terrorism, and a legislative guide to the universal legal regime against terrorism; both cover the implementation of the CPPNM and its amendment, ICSANT, and the maritime conventions. An additional counter-terrorism legal training curriculum was recently published by UNODC, with the collaboration with ICAO and IMO, to 'assist practitioners and policymakers to identify, understand, and effectively incorporate and implement a set of international legal tools into national legislation'[99] with a focus on transport-related (civil aviation and maritime navigation) terrorist offences. Those include activities prohibited under the Beijing convention, SUA 2005 and SUA PROT 2005.

Useful reference materials also include effective practices shared by States and relevant international and non-governmental organizations: Resolution 1977 (2011) encourages all States to provide information on their implementation of SC Res 1540, including on their effective practices.[100] The National Legislation Implementation Kit on Nuclear Security was for instance submitted by the United Kingdom as part of the 'tools available for all states striving to implement their 1540 obligations'.[101] The Resolution also requests the 1540 Committee, with the support of the group of experts, 'to identify effective practices, templates and guidance, with a view to develop a compilation, as well as to consider preparing a technical reference guide about Resolution 1540 (2004), to be used by States on a voluntary basis in implementing Resolution 1540 (2004)'.

8.4.3 Drafting Assistance

Going beyond simply providing reference materials, drafting assistance to strengthen national legal frameworks involves two steps. The first step consists in conducting an analysis to review the legislative and regulatory measures already in place to identify possible gaps in the implementation of international obligations. Contrary to recent suggestions, this does not only mean creating 'a checklist of questions on implementation of the obligations that requires just a yes or no answer'[102] or developing 'a methodology for self-assessment by states'.[103] On the one hand, States may not have the capacity or time to conduct such a self-assessment. On the other hand, a yes/no approach does not enable a qualitative

[98] Stoiber et al. 2010, p. 2.

[99] UNODC 2014, p. 1.

[100] SC Res 1977 (2011), operative para 7.

[101] See http://www.un.org/en/sc/1540/pdf/UK%20Letter%20effective%20practices%202015.pdf.

[102] Dal et al. 2015, p. 15.

[103] Dal et al. 2015, p. 16.

assessment of whether any one particular measure, for the numerous requirements under international nuclear security law, is accurate or not. VERTIC's National Implementation Measures Programme has therefore developed a template with criteria such as definitions, offences, measures to account for and secure nuclear and other radioactive material, transfer controls and enforcement, to analyse States' nuclear security legislation and assess the extent to which relevant international instruments are being implemented. VERTIC lawyers conduct the analysis themselves, and share them with the interested state.

On the basis of this assessment, the second step consists in providing legislative drafting assistance, to fill in the existing legislative and regulatory gaps. This can be done by organising drafting workshops with relevant national stakeholders, using appropriate reference materials while tailoring the model provisions to the specific needs and particularities of each State. At a later stage, this can also entail reviewing draft bills and regulations.

Legislative assistance in the area of nuclear security is provided by many entities including the IAEA, but also other intergovernmental, non-governmental organisations and initiatives, and through bilateral and regional cooperation. These include UNODC, VERTIC's National Implementation Measures Programme, the European Union Chemical Biological Radiological and Nuclear Risk Mitigation Centres of Excellence Initiative, as well as specific bilateral programmes. Each organisation and programme intervenes within the scope of its particular mandate, which sometimes imposes limitations on which instrument(s) it can or cannot address. It is therefore important to maintain a multiplicity of assistance offers, to cover the entire nuclear security framework but also to give States the option to reach out to the providers of their choice, in order to ensure better tailor-made activities. At the same time, coordination among the various actors is crucial to avoid duplication of efforts and assistance fatigue on the part of the targeted States.

8.5 Conclusion: A Convention on Nuclear Security?

To address 'the weaknesses of the current regime, create a sustainable mechanism through which state parties can assess the effectiveness of nuclear security governance and implementation, and allow for continuous improvements in global nuclear security over time and as new developments warrant action',[104] the Nuclear Security Governance Experts Group (NSGEG)—a multi-sector coalition of experts with diverse nuclear experience that propose recommendations to strengthen nuclear security—has developed a draft International Convention on Nuclear Security (ICNS) to be considered by States.

Per article 1 of the draft Convention, its objective is to 'ensure effective security of nuclear and other radioactive materials by codifying a set of essential elements for national nuclear security regimes and establishing a mechanism for continuous

[104] Bernhard et al. 2015, p. 1.

review and improvement of the international nuclear security regime'. To achieve this objective, Article 4 sets out a number of principles: the responsibility for the implementation and maintenance of the nuclear security regime contained in the convention rests entirely with States; States have a fundamental responsibility to their citizens, other States, and the international community to ensure the security of nuclear and other radioactive materials within their jurisdiction and control; and an effective nuclear security regime shall be based on binding standards, a mechanism for review and continuous improvement, and means for cooperation and providing assistance. Under Article 5, each State Party shall establish a national nuclear security regime, based on the essential elements compiled in the ICNS's annex, which reproduces IAEA NSS No. 20. The draft Convention then requires both the regular assessment of the effectiveness and reporting of the implementation of the national regimes. These aspects are also to be discussed by the Conference of States Parties established to keep under continuous review the implementation of the Convention.

At first glance, the ICNS initiative would seem to offer a simple solution to the challenges raised by the current international framework by facilitating a comprehensive approach to nuclear security. However, a closer look brings into question the ability of the Convention to address the three issues identified in this chapter: complexity, universalization and implementation.

Firstly, according to Article 13, nothing in the convention 'shall affect the rights and obligations of the parties contained in other international agreements'. The ICNS would only add to the existing list of instruments, without integrating all of their provisions in a single comprehensive new treaty. Secondly, as the other instruments, the convention would have to be adopted and adhered to. It is not clear how the obstacles to universalization would be less of an issue in the case of the ICNS. Thirdly, the convention would also need to be implemented through appropriate laws and regulations. Here again, it is not clear how the obstacles to national implementation would be less of an issue in the case of the ICNS. Efforts should therefore focus on universalising and implementing the existing instruments rather than on adopting new ones, through effective activities such as legal assistance.

The ICNS initiative, which was met with scepticism at the 2014 Nuclear Security Summit,[105] could nevertheless help in initiating further reflection on the need to strengthen the existing regime with proper reporting and periodic review mechanisms.

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[105] For instance: Thomas Countryman, Assistant Secretary of State for International Security and Nonproliferation, US, during EU Non-Proliferation and Disarmament Conference 2015 Special Session 5, Prospects for the 2016 Nuclear Security Summit and Beyond: 'There is nothing in a convention on nuclear security that is likely to be agreed that cannot be done today if a country is determined to do it, and I submit to you that the Summit process proved more effective than negotiation of a global convention on nuclear security, no matter how much employment it would have provided for all of us for the five, six, ten years it takes to negotiate. It would not have had the same effect as this Summit process had in mobilising the states that had the most at stake and the greatest responsibility to do it. I am not opposed to a nuclear-security convention. I am concerned that the negotiation of the convention will be a distraction from doing the hard, expensive, physical work of nuclear security.' https://www.iiss.org/en/events/eu%20conference/sections/eu-conference-2015-6aba/special-session-1-a350/special-session-5-0352.

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Chapter 9
Storage and Disposal of Radioactive Waste: The Search for a Global Solution

Kerstin Odendahl

Abstract Questions regarding the safe storage, reprocessing and disposal of radioactive waste continue to occupy scientists, politicians and lawyers alike. Effectively, there are three main types of radioactive waste: low-, intermediate- and high-level radioactive waste. At the end of their useful lifetime, radioactive materials which become radioactive waste are first stored, i.e. secured and shielded for a certain period of time. Afterwards, they have to be disposed of, i.e. indefinitely deposited without the intention of retrieval. The technology for ensuring a safe and secure storage of radioactive waste is well-engineered. Concerning disposal means, satisfactory technologies for low-level and most intermediate-level radioactive waste have been developed. As regards high-level radioactive waste, however, a permanent solution still needs to be found. As it stands today, this third and most dangerous type of radioactive waste is merely stored while the States wait to develop disposal technology to enable more permanent solutions. In order to allow for a solution which takes into account the extreme hazardousness and longevity of high-level radioactive waste, worldwide binding substantial norms on safety and security of both storage and disposal facilities are needed. This chapter analyses whether such international rules currently exist and the extent to which they are precise and sufficiently strict. It seems that the result is rather disillusioning. Therefore, the present chapter ends with some practical and legal proposals.

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Contents

9.1 Introduction

The present chapter presents and evaluates the existing international norms dealing with the so-called 'back end' of the nuclear fuel cycle, i.e. with storage and disposal of radioactive waste. It is divided into five parts: Firstly, a description of radioactive waste management (Sect. 9.2), followed by the presentation of existing global norms for nuclear safety (Sect. 9.3) as well as nuclear security (Sect. 9.4). This discussion is followed by an assessment (Sect. 9.5) of the *status quo* today. The chapter ends with a conclusion (Sect. 9.6) containing some practical and legal proposals. The principal aim of this discussion is to raise the awareness concerning the deficiencies of the existing normative system, as well as to show that there are several ways of improving the current state of play. The chapter deals exclusively with norms of public international law.[1] Regional instruments are important and may be the beginning; but in order to reach a 'global solution' the application of worldwide norms is required.

[1] European law as a regional approach is neither presented nor assessed. A good overview is provided above, Chapter 6 (Grunwald) and by Grunwald 2013. See also Stanič 2010, Sievers 2011, para 16 *et seq.*; Dietze 2012, pp 128–216 (who focuses on the transboundary movement of radioactive waste).

9.2 Radioactive Waste

9.2.1 Types

Normally, a distinction is made between three different types of radioactive waste:[2] low-, intermediate- and high-level radioactive waste. *Low-level* radioactive waste is composed of small objects like paper, rags, laboratory debris, tools, clothing, or filters which are generated from industry, laboratories, hospitals, and nuclear power plants. The amount of radioactivity is small and mostly short-lived. Therefore, low-level radioactive waste is usually not dangerous to handle. That said, it must be disposed of more carefully than other kinds of garbage. Worldwide, it accounts for the highest volume of about 90 % with a relatively small amount of radioactivity (about 1 %). *Intermediate-level* (or medium-level) radioactive waste is more dangerous. It comprises primarily resins, chemical sludges and reactor components. Another type of intermediate-level radioactive waste is contaminated materials coming from the decommissioning of a reactor. Such waste contains higher amounts of radioactivity and may require special shielding. Compared to low-level waste its worldwide volume is smaller (about 7 %) while its percentage of the worldwide radioactivity is marginally higher (4 %). *High-level* radioactive waste, typically generated by nuclear power plants, is either the spent fuel itself, or the principal waste that is left over after reprocessing it. Such a kind of waste contains highly-radioactive fission products and is thermally very hot. Therefore, it requires both special shielding and cooling. While its worldwide volume is rather small (3 %), it is up to 95 % radioactive.

High-level radioactive waste, however, is not only the most hazardous type of waste, it is also extremely long-living. The reason are the heavy elements containing long-lived radioactivity. The half-lives (the time it takes for a given radioactive isotope to lose half of its radioactivity[3]) of each of the isotopes to be found in radioactive waste differ significantly. They range from milliseconds to billions of years. Some figures may serve as an illustration:[4] Plutonium-238 has a half-life of about 88 years, Plutonium-239 a half-life of about 24.000 years. Uranium-238, the most prevalent isotope to be found in spent fuel,[5] has a half-life of almost 4.5 billion years. Therefore, it is obvious that one of the main challenges for humanity is to isolate and contain radioactive waste from the biosphere—not only today, but for thousands, even for billions of years to come.[6]

[2] World Nuclear Association 2012; Sievers 2011, para 6.

[3] World Nuclear Association 2012.

[4] The information was taken from http://www.astro.caltech.edu/~dperley/public/isotopetable.html.

[5] Fox 2014, p 187.

[6] Stoiber et al. 2003, p 97.

9.2.2 Management

How is radioactive waste managed? Here again, a distinction is to be made between the different types of waste.[7] *Low-level* radioactive waste is usually packed in a closed container and buried in shallow landfill sites. Most States have decided to bury low-level radioactive waste in near-surface disposals. They are to be found either at ground level, or in caverns below ground level, i.e. at depths of tens of metres.

For *intermediate-level* radioactive waste, there are different options depending on whether its elements are short-lived or long-lived. In some States, it is solidified in concrete or bitumen for disposal. Short-lived intermediate-level radioactive waste (like resins, chemical sludges and reactor components) is then buried, usually in near-surface disposals. Long-lived intermediate-level radioactive waste (which is often generated from reprocessing nuclear fuel) is dealt with more or less the same way as high-level radioactive waste (see below). Therefore, for low-level and most intermediate-level radioactive waste a satisfactory disposal means has been developed.

This is, however, not the case for *high-level* radioactive disposal. In order to understand the difficulties concerning the handling of high-level radioactive waste, it is essential to have a look at the way this type of waste is managed at the moment.

Today, there are almost 440 nuclear power plants operating in more than 30 States. Over 60 nuclear power plants are under construction, most of them in China, South Korea, the United Arab Emirates and Russia.[8] A nuclear power plant needs nuclear fuel. Nuclear fuel may be used for 3–7 years. Afterwards, its useful life is over. It becomes spent fuel. On average, each nuclear power plant produces about 25 tonnes of spent fuel per year.[9] This makes 11,000 tonnes of spent fuel worldwide every year. According to the IAEA, the total amount of spent fuel, i.e. all spent fuel generated since the initial operation of the first nuclear power plant in 1954, will amount to 445,000 tonnes by the year 2020.[10]

What happens in with the spent fuel? The following short description[11] is based on the fuel used light water reactors. The facts, however, are more or less the same with other types of existing nuclear reactors.

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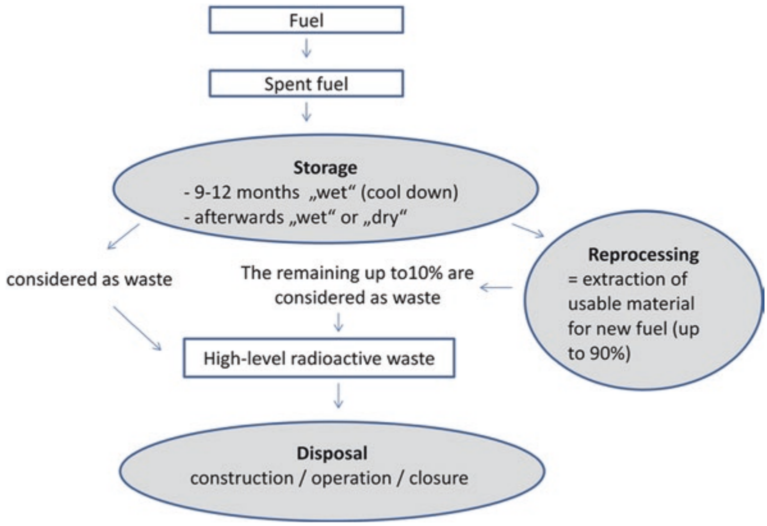
[7] World Nuclear Association 2012, 2016.

[8] World Nuclear Association 2015.

[9] World Nuclear Association 2012.

[10] IAEA 2006, para 11.

[11] The description is based on IAEA 2006; World Nuclear Association 2012; Keegan 2015, p 1267 *et seq.*



Spent fuel is first *stored*. Since it generates great amounts of heat, it has to be cooled which is done by a 'wet' storage process under water which lasts at least for 9–12 months. Afterwards, the spent fuel may be stored either 'wet' or 'dry'. It still has to be cooled. Moreover, it has to be shielded in order to prevent radioactive contamination. Usually, the radioactive waste is kept in the cooling pools for a period of about five years and is then moved to 'dry storage' by placing it in special containers composed of several levels of steel and concrete.

Spent fuel may be considered as *waste*. This is done, for example, by the United States of America,[12] Canada, Finland and Sweden. In this case, the spent fuel is classified as high-level radioactive waste. It consists of 95 % of uranium, 1 % of plutonium and 4 % of other actinides and fission products.

Spent fuel may also be *reprocessed*,[13] as is done, *inter alia*, by France, Russia, Japan, India and China. In this case, the usable uranium and plutonium are extracted in order to use them for the production of new fuel. This way, up to 90 % of the spent fuel may be reprocessed. The remaining 10 % becomes high-level radioactive waste. Most States have not definitely decided whether they opt for reprocessing or not. Therefore, they keep the spent fuel stored, and wait for technology to develop further before taking a final decision. The spent fuel remains stored until it becomes clear which steps will be taken next. Usually, the storage takes place at the site of the nuclear power plant.

[12] This is criticised by Keegan 2015, pp 1285 *et seq.*

[13] Stoiber et al. 2003, p 97. For a description see Fox 2014 p 199 *et seq.*

The last step in the nuclear fuel cycle is the *disposal* of the high-level radioactive waste. Disposal means the emplacement in a facility without the intention of retrieval.[14] Such a facility has to be constructed, operated and—finally—closed. A disposal facility needs to be built in a way to enable long-term safety and security without reliance on active controls or ongoing maintenance.[15] Institutional control, however, has to continue until the threats resulting from radiation have disappeared, i.e. for hundreds, or even billions of years.

Today's technology does not yet enable us to build such disposal facilities for high-level radioactive waste. There are experiments in various States which demonstrate the potential feasibility of geological disposal. The evidence that such a disposal will guarantee safety and security for thousands or billions of years, however, remains to be developed. No geological or other kind of repository for high-level radioactive waste has yet been built. The first disposal facility for radioactive waste is scheduled to be constructed in 2023. It will be situated on the Finnish island of Olkiluoto; the building licence was granted in November 2015.[16] At the moment, all high-level radioactive waste—both spent fuel and the remaining 10 % after reprocessing—are being kept in storage.

9.2.3 The Need for Worldwide Standards

Many scholars feel that the handling of radioactive waste is even 'the most compelling environmental issue facing the world today'.[17] The identification and the construction of suitable storage or disposal sites pose both technological challenges as well as lack general societal acceptance. Most States face *strong political opposition* when identifying a suitable site for building a storage or disposal facility.[18] The main reason for the strong opposition is the fact that the proof that high-level radioactive waste can be stored and deposited safely and securely for an almost indefinite period of time has not been given.

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14 Stoiber et al. 2003, p 100.

15 Stoiber et al. 2003, p 100.

16 For further details see Wiesner 2014, p 6 as well as Funk 2015.

17 Mink 1996.

18 A good example are the political controversies concerning the Yucca Mountain in southern Nevada, see Fox 2014, p 192 *et seq.*; Keegan 2015, pp 1270 *et seq*. A recent example concerns the building of a storage facility in Villar de Cañas (Spain). In July 2015, the regional government blocked the construction of the facility just hours after Spain's Nuclear Security Council decided positively about the site, see https://www.thespainreport.com/articles/36-150728141206-regional-government-blocks-nuclear-waste-dump-hours-after-spain-s-nuclear-council-approves-it. Another example can be found in Australia where the federal government's attempts to build a storage facility for low-level radioactive waste failed again in June 2014, see Nagtzaam 2014.

This situation has led to another significant problem: the *export* and the *dumping* of radioactive waste.[19] The (illegal) export of radioactive waste, mostly to developing countries, as well as illegal dumping has become a matter of grave concern. The extent of these activities has become so large that even the UN General Assembly has called upon States 'to take appropriate measures with a view to preventing any dumping of nuclear or radioactive wastes that would infringe upon the sovereignty of States'.[20] The need to develop a safe and secure radioactive waste management, including a safe and secure 'back end' for all types of radioactive waste, is thus evident.

Concerning *safety* issues (i.e. 'internal threats' resulting from hazards in handling of equipment and material) the States have to decide—at the moment—about the selection of sites, the design, the construction and the operation of storage facilities in order to guarantee the cooling down and the shielding of high-level radioactive waste. In the future, States will have to decide not only on the site, the design and the construction of disposal facilities as well, but also on their closure, their subsequent control and their identification by generations to come. Concerning *security* issues (i.e. 'external threats' ranging from military assault to criminal and terrorist acts), States have to take into account all existing and possible future threats to both storage and disposal facilities.

Some States have developed *domestic practices* in order to guarantee a certain level of safety and security in the radioactive waste management. They differ greatly, however,[21] and therefore, the development of national safety and security standards is only the first step. In the long run, seems that the international level remains the most important. Nuclear accidents or attacks do not affect one State alone. Furthermore, the course of boundaries between States in thousands of years will be different from today. It is, therefore, obvious that common standards are needed on a universal level.

9.3 Worldwide Norms on Nuclear Safety

The predominant role in the field of nuclear safety is played by the IAEA.[22] Some of its activities are also relevant for the management of radioactive waste.

[19] Sievers 2011, paras 1 and 2; Nyman 2002.

[20] A/RES/68/53, 11.12.2013, para 4.

[21] Stoiber et al. 2010, p 91.

[22] A useful website in this respect is https://www.iaea.org/newscenter/focus/radwaste-management.

9.3.1 The IAEA Convention of 1997

In 1997, the Agency adopted the 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management'[23] which entered into force in 2001. Its content is largely based on the IAEA Safety Fundamentals 'The Principles of Radioactive Waste Management' of 1995.[24] The 1997 Convention is the first legally binding treaty to directly address radioactive waste on a global scale, of which some 70 States are parties.

The Joint Convention supplements the 'Convention on Nuclear Safety',[25] adopted under the auspices of the IAEA in 1994. The latter was not drafted to deal with radioactive waste directly. It refers exclusively to 'nuclear installations', defined as 'any land-based civil nuclear power plant (…) including such storage, handling and treatment facilities for radioactive materials as are on the same site and are directly related to the operation of the nuclear power plant'.[26] Therefore, the rules dealing with radioactive waste management are not to be found in the Convention on Nuclear Safety but in the Joint Convention.

The *scope of application* of the Joint Convention is large. It refers—as its name indicates—both to spent fuel[27] and to all types of radioactive waste,[28] i.e. also to the remaining 10 % of radioactive waste after reprocessing. Furthermore, it applies to all stages of the waste management.[29] It does not apply, however, to spent fuel or radioactive waste generated within military or defence programmes.[30] Its main objectives are to 'achieve and maintain a high level of safety worldwide (…), through the enhancement of national measures and international co-operation (…)',[31] as well as to ensure protection 'from harmful effects of ionizing radiation, now and in the future'.[32]

The *obligations* of the States Parties are laid down in two chapters: one relating to spent fuel, the other relating to radioactive waste. The structure of both chapters is the same, stipulating similar duties: As a general safety requirement, the States Parties have to ensure an adequate protection against radiological hazards.[33]

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[23] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 29 September 1997, UNTS Vol. 2153, p 303.

[24] Wirth 2007, p 417. The Principles of Radioactive Waste Management, Safety Series No. 111-F, IAEA, Vienna (1995).

[25] Convention on Nuclear Safety, 17 June 1994, UNTS Vol. 1963, 293.

[26] Article 2(i).

[27] Article 3 para 1.

[28] Article 3 para 2.

[29] Article 1(ii).

[30] Article 3 para 3. The problems resulting from the lack of norms for this type of waste are analysed by Cohen 2013–2014.

[31] Article 1(i).

[32] Article 1(ii).

[33] Article 4; Article 11.

Concerning existing facilities, the States Parties have to review their safety and aim at upgrading it, if necessary.[34] The site of proposed facilities shall be based on the principle that radioactive waste will be disposed of in the State in which it was generated.[35] In doing so, the States Parties have to evaluate, *inter alia*, all relevant site-related factors which may have an impact on the safety of a proposed facility during its operating lifetime.[36] Instead of storing or depositing radioactive waste on the own territory, States still have the possibility of transporting it to another State.[37] Concerning the design and the construction of facilities, the States Parties merely have to ensure the provision of 'suitable measures to limit possible radiological impacts (…)' or that the technologies they use 'are supported by experience, testing or analysis',[38] for example. The main duty of the States Parties relating to the safety of facilities is to provide for a systematic safety assessment before a facility is being constructed.[39] Concerning the operation of a facility, the States Parties shall ensure that, *inter alia*, operational limits, conditions and assessments are defined and revised as necessary, or that engineering and technical support are available throughout the whole operating lifetime of the facility. In case of closure of a facility, the States Parties shall take institutional measures, such as the preservation of records of the location, design and inventory of the facility, or the implementation of institutional controls such as monitoring or access restrictions. Further obligations concern the availability of qualified staff, financial resources, the protection of workers against radiation exposure, the development of emergency plans, and the transboundary movement of radioactive waste.[40]

In order to *comply* with their obligations the States Parties have to 'establish and maintain an adequate legislative and regulatory framework'.[41] This framework has to develop, for example, the national safety requirements, a system of licensing and a system of appropriate institutional control, documentation and reporting.[42] The implementation of the national framework shall be put into the hands of an independent regulatory body to be established or designated by the States Parties.[43] There is no supervisory body, but there is a review process.[44]

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[34] Article 5; Article 12(i).

[35] Preamble, para xi.

[36] Article 6, para 1 (i); Article 13, para 1 (i).

[37] Article 27; for further details see Dietze 2012, pp 60–68.

[38] Article 7(i), (iii); Article 14(i), (iv).

[39] Article 8(i); Article 15(i).

[40] Articles 22–27.

[41] Article 19, para 1.

[42] Article 19, para 2 (i), (ii), (iv).

[43] Article 10.

[44] Article 30 together with the Guidelines regarding the Review Process, 7.12.2012, INFCIRC/603/Rev. 5.

The *overall approach* of the Joint Convention is not to provide at a comprehensive regulation. It denominates itself as an ‘incentive convention’.[45] Furthermore, it only contains procedural obligations, leaving the substantial safety standards to the States Parties. This is not only reflected in the convention itself, but also in the ‘Model Provisions’ based on the convention.[46] The States are thus the ones who will decide about the level of safety they wish to apply. Accordingly, the preamble states that ‘the ultimate responsibility for ensuring the safety of spent fuel and radioactive waste management rests with the State’.[47] The idea (or the hope?) is that the States will have a high interest in ensuring the highest safety standard possible, and that they will strive for such a standard—even without legally binding obligations.

9.3.2 The IAEA Safety Standards

The Joint Convention is supplemented by a large number of *non-legally binding* safety standards adopted by the IAEA under Article III A No. 6 of its Statute.[48] The safety standards may be adopted either in form of Safety Fundamentals, General/Specific Safety Requirements or General/Specific Safety Guides.[49] Their number is very high: The most important ones are the Fundamental Safety Principles of 2006,[50] the General Safety Requirements on Predisposal Management of Radioactive Waste of 2009,[51] on Safety Assessment for Facilities and Activities of 2009,[52] and on Decommissioning of Facilities of 2014,[53] the General Safety Guides on the Predisposal Management of High Level Radioactive Waste,[54] on the Storage of Radioactive Waste of 2006,[55] on the Management

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[45] Preamble, para IX.

[46] The ‘Model Provisions on Radioactive Waste and Spent Fuel’ are to be found in Stoiber et al. 2010, p 93–97.

[47] Preamble, para VI.

[48] For more details see Faßbender 2013, p 113.

[49] The differences between Safety Fundamentals, General/Specific Safety Requirements and General/Specific Safety Guides are to explained in IAEA (2016), p 3.

[50] Fundamental Safety Principles, 7.11.2006, Series No. SF-1.

[51] Predisposal Management of Radioactive Waste, General Safety Requirements Part 5,19.5.2009, Series No. GSR Part 5.

[52] Safety Assessment for Facilities and Activities, General Safety Requirements Part 4, 19.5.2009, Series No. GSR Part 4.

[53] Decommissioning of Facilities, General Safety Requirements Part 6, 8.7.2014, Series No. GSR Part 6.

[54] Predisposal Management of High Level Radioactive Waste, Safety Guide, 30.4.2006, Series No. WS-G-2.6.

[55] Storage of Radioactive Waste, Safety Guide, 28.11.2006, Series No. WS-G-6.1.

System for the Processing, Handling and Storage of Radioactive Waste of 2008,[56] on the Classification of Radioactive Waste of 2009,[57] on the Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste of 2013,[58] the Specific Safety Requirements on the Disposal of Radioactive Waste of 2011,[59] the Specific Safety Guides on the Management System for the Disposal of Radioactive Waste of 2008,[60] on the Geological Disposal Facilities for Radioactive Waste of 2011,[61] or on the Monitoring and Surveillance of Radioactive Waste Disposal Facilities of 2014.[62]

The safety standards are much more detailed than the conventions. However, again, most of them only provide for procedural advice. A lot of desirable guidelines or specific criteria on how to decide, for example, whether a certain place constitutes a geographically suitable site, are missing. To sum up: There are no worldwide legally binding standards for the safety of high-level radioactive waste storage or disposal facilities. The gap left by the Joint Convention (no legally binding substantial safety obligations) is not filled with the help of non legally-binding safety standards.

9.4 Worldwide Norms on Nuclear Security

In the area of nuclear security the IAEA plays an important role, as well. The work of the Agency is, however, supplemented by other international players.

9.4.1 Norms of the IAEA

As a general principle, the *responsibility for nuclear security* rests with the State on whose territory the nuclear material or facility is located.[63] Consequently, the

[56] The Management System for the Processing, Handling and Storage of Radioactive Waste, Safety Guide, 2.7.2008, Series No. GS-G-3.3.

[57] Classification of Radioactive Waste, General Safety Guide, 28.12.2009, Series No. GSG-1.

[58] The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste, 18.4.2013, Series No. GSG-3.

[59] Disposal of Radioactive Waste, Specific Safety Requirements, 5.5.2011, Series No. SSR-5.

[60] The Management System for the Disposal of Radioactive Waste, Safety Guide, 1.7.2008, Series No. GS-G-3.4.

[61] Geological Disposal Facilities for Radioactive Waste, Specific Safety Guide, 21.9.2011, Series No. SSG-14.

[62] Monitoring and Surveillance of Radioactive Waste Disposal Facilities, Specific Safety Guide, 22.5.2014, Series No. SSG-31.

[63] Pomper 2013, p 1.

IAEA has not developed legally binding rules in this field. Its activity, however, has increased.[64] The first steps were taken in the 1970s. The IAEA started providing training in physical protection of nuclear material in order to support States in the establishment and improvement of their national nuclear security regimes. In 1975, the IAEA issued Recommendations for the Physical Protection of Nuclear Material, which have been continuously revised.[65]

After the attacks of 11 September 2001, the IAEA adopted the first *concerted Nuclear Security Plan* in March 2002. It contained a Plan of Activities to Protect against Nuclear Terrorism.[66] The Nuclear Security Plan is renewed and amended every three years. The current Nuclear Security Plan covers the period from 2014 to 2017.[67] Furthermore, the IAEA adopted the Code of Conduct on the Safety and Security of Radioactive Sources in 2004.[68] Finally, the IAEA organizes conferences, such as the International Conference on Security of Radioactive Sources in March 2003, and the International Conference on Nuclear Security 'Enhancing Global Efforts'[69] in July 2013, which generally cover broad areas of nuclear security both at the policy and at the technical level.

Legally binding rules do not exist at least at the moment, however. In 2005, the IAEA Convention on the Physical Protection of Nuclear Material of 1979[70] was amended.[71] The amendment has not entered into force yet.[72] The *amended convention* will oblige States Parties to protect not only nuclear material in use, storage and transport, but also nuclear facilities.[73] The term 'nuclear facility', as defined in the amended Convention, would also include facilities in which nuclear

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[64] The information was gathered from the website of the IAEA.

[65] The latest version was issued 2011: Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/REVISION 5). IAEA Nuclear Security Series No. 13.

[66] GOV/2002/10.

[67] Board of Governors, General Conference, Nuclear Security Plan 2014–2017, GOV/2013/42-GC(57)/19, 2.8.2013.

[68] IAEA, Code of Conduct on the Safety and Security of Radioactive Sources, January 2004. http://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf.

[69] Board of Governors, General Conference, International Conference on Nuclear Security: Enhancing Global Efforts, 1–5 July 2013, GOV/INF/2013/9-GC(57)/INF/6, 5.8.2013.

[70] Convention on the Physical Protection of Nuclear Material, 26.10.1979, UNTS Vol. 1456, p. 125.

[71] Board of Governors, General Conference, Nuclear Security—Measures to Protect Against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, 6.9.2005.

[72] Pursuant to Article 20 of the Amendment it will enter into force after two third of the States Parties have deposited their instruments of ratification, acceptance or approval. As of 16 December 2015, 91 States had become parties to the Amendment. 102 States Parties are needed.

[73] Amendment, para 5.

material is processed, handled, stored or disposed of.[74] This way, the Convention would apply to the safety of storage and disposal facilities, too.

The overview shows that all existing and future activities as well as all documents of the IAEA on nuclear security *do not contain rules specifically drafted for storage or disposal* facilities of radioactive waste. They are based on a larger approach which does not make a difference between the protection of a nuclear power plant, of a storage or of a disposal facility.

9.4.2 International Convention for the Suppression of Acts of Nuclear Terrorism of 2005

Security concerns, especially terrorist threats, affect all areas of life. As a consequence, it is not only the IAEA which has dealt with security issues. There are several other instruments with a wide scope of application which are also applicable to the handling of radioactive waste. One of them is the International Convention for the Suppression of Acts of Nuclear Terrorism, adopted under the auspices of the United Nations in 2005.[75] It entered into force in 2007, and has 100 States Parties. The Convention applies to cross-border acts[76] committed by individuals, and qualifies some of them as 'acts of nuclear terrorism'. They have to be established as criminal offences under the national laws of the States Parties.[77] One of several 'acts of nuclear terrorism' is the use of or damage to a nuclear facility 'in a manner which releases or risks the release of radioactive material'.[78]

The Convention does *not have a direct impact* on security standards concerning radioactive waste management. It forms part of criminal law. However, some of its provisions, like the obligation to cooperate in preventing acts of nuclear terrorism, or to ensure that any nuclear material is held in accordance with IAEA safeguards, are of importance.

9.4.3 Resolutions of the UN Security Council

Also worth noting are resolutions of the UN Security Council, the most significant of which regarding security of radioactive waste are Resolution 1371 (2001) and Resolution 1540 (2004). The first notes the close connection between international

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[74] Amendment, para 3.

[75] International Convention for the Suppression of Acts of Nuclear Terrorism, 13.4.2005, UNTS, Vol. 2445, p 89.

[76] Article 3.

[77] Article 5.

[78] Article 2, para 1 (b).

terrorism and, *inter alia*, illegal movement of nuclear materials.[79] The second affirms that the proliferation of nuclear weapons constitutes a threat to international peace and security.[80] As a consequence, one of the obligations incumbent on States is to develop and maintain measures at the national level to secure nuclear material in production, use, storage and transport.[81] Furthermore, States are called upon to renew and fulfil their commitment to multilateral cooperation, in particular within the framework of the IAEA.[82] The resolutions do not contain specific or technical obligations concerning radioactive waste management, but they reinforce the duties to secure nuclear facilities of any kind against external threats.

9.4.4 Other Forms of International Cooperation

Finally, there are other international forms of cooperation outside the IAEA and the United Nations. Noteworthy are, for example, the Nuclear Security Summits held in Washington, D.C. in 2010, in Seoul in 2012 and in The Hague in 2014 and another in March/April 2016 in Washington, D.C. The aim of the summits, which are usually attended by some 50 States, is the prevention of nuclear terrorism by securing nuclear material. The initiative for the summits was taken by US President Barack Obama in 2009. The most important decisions taken during the summits were the Washington Work Plan of 2010 and additional, voluntary commitments accepted by the States. But here again: No specific requirements concerning the security of facilities for storage or disposal of radioactive waste are to be found.

9.5 Assessment

Some authors characterize the existing system, especially the treaties applicable to radioactive waste, as a successful, pragmatic approach. Their main argument is that the treaties take into account the realities of international law creation and development.[83] Several other authors however, either ring the alarm bells[84] or offer express criticism of the existing conventions.[85]

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79 S/RES/1373 (2001), 28.9.2001, para 4.

80 S/RES/1540 (2004), 28.4.2004, Preamble, para 1.

81 S/RES/1540 (2004), 28.4.2004, para 3 (a).

82 S/RES/1540 (2004), 28.4.2004, para 8 (c).

83 Pelzer 2013, p 149.

84 Mink 1996; Sievers 2011; Keegan 2015.

85 Boustany 1998, p 39; Handl 2004, p 26–27.

An assessment of the existing legal regime should focus on three questions: *Firstly*: Is the distinction between safety and security adequate when dealing with storage and disposal of radioactive waste? The answer is: yes. 'Internal' and 'external' threats are so different from one another that they have to be ensured by different legal and practical means. However, it is true that they are intertwined. Therefore, one must be compatible with the other. *Secondly*: Are the worldwide substantial rules concerning the safety of radioactive waste management sufficiently developed? The answer is: no. Legally binding technical requirements or legally binding best practices for all stages of the waste management are non-existent. There is a need not only for legally-binding, but also for special norms: norms dealing with the storage, with the reprocessing and with the disposal of radioactive waste. *Thirdly*: Are the international substantial rules concerning the security of radioactive waste sufficiently developed? The answer is: in a way yes. 'External' threats to nuclear facilities are more or less the same—no matter whether it is a nuclear power plant, a storage, a reprocessing or a disposal facility. It is, therefore, correct if the security norms are the same for all types of facilities. However, the existing security norms suffer from the same weakness as the ones on safety: They are neither legally binding nor detailed enough. The final decision is left to the States.

9.6 Conclusions

Several practical and legal steps need to be taken in order to improve the existing management of radioactive waste. Concerning the practical steps, there are three actions which should stand in the focus of attention: *Firstly*: Aim at developing nuclear power plants which need less or different nuclear fuel (a fuel composed of isotopes which have a shorter half-time or are less radioactive). This would reduce the amount of spent fuel. *Secondly*: Develop a technology which enables States to reprocess most of the spent fuel, in order to reduce the amount of high-level radioactive waste.[86] *Thirdly*: Develop a technology to build safe and secure facilities not only for the storage and the reprocessing, but especially for the disposal of high-level radioactive waste.

The *best practical step* to take, however, would be to develop a technology able to reprocess all spent fuel. This way, there would be no high-level radioactive waste produced by nuclear power plants any longer. Such a technological success, however, would not be sufficient. We would still need a second one—at the latest when the existing nuclear power plants are decommissioned and dismantled.[87] Large parts of the buildings themselves as well as several employed materials are radioactively contaminated. Most of the materials will fall into the category of

[86] Fox 2014, p 205 *et seq.*

[87] Freytag and Pennekamp 2014, p 19.

either low-level or intermediate-level radioactive waste. Small amounts, however, will still constitute high-level radioactive waste. This type of extremely hazardous waste differs from the one resulting from the employment of nuclear fuel: It is much more voluminous, and the radioactive substances are integrated in other materials like stone or concrete. Therefore, as long as we have not succeeded in developing those new technologies, we have to find ways for achieving a safe and secure storage and disposal of high-level radioactive waste.

Legally speaking, States will have to agree on legally binding rules on a world-wide level. The most important legally binding obligations would be, *firstly*, to use all new technologies described above. It must be mandatory to employ only the most developed technologies. *Secondly*: States will have to agree on a symbol for identifying sites of disposal after closure. This symbol must be understandable and acceptable for all cultures of the world. And it must be so clear and simple that even in several thousands of years human beings will be able to identify an extremely dangerous site and keep out. The existing radiation hazard symbol is definitely not suitable for such purposes.[88] *Thirdly*: States will have to agree on new legally binding norms on liability and compensation for nuclear damage resulting from storage and disposal facilities. The existing treaties focus on nuclear power plants. Storage and disposal facilities which are (going to be) built in order to contain radioactive material which remains hazardous for indefinite periods of time have been left aside so far.[89]

The dangers resulting from high-level radioactive waste are comparable with those resulting from extremely dangerous toxic chemicals, like persistent organic pollutants. The latter are even more difficult to deal with since their hazardousness does not diminish but remains forever. Interesting to note is that some of these substances have been absolutely prohibited.[90] Such a development, however, is unlikely for nuclear power plants.[91] Therefore, a lot of work still has to be done to protect humanity and the environment not only today but also in the next several millenniums.

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[88] Lapidos 2009.

[89] Reiners 2014.

[90] Stockholm Convention on Persistent Organic Pollutants, 22 May 2001. The treaty has got 179 parties.

[91] There are, however, international lawyers who argue that the operation of nuclear power plants violates public international law, inter alia due to the highly-radioactive waste they produce, see Weeramantry 2011, p 15.

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Chapter 10
The Peaceful Use of Nuclear Energy and the Protection of the Environment

Michael Bothe

Abstract The peaceful uses of nuclear energy present a challenge for the law in two totally opposite directions. On the one hand, certain States still want a better chance to use nuclear energy. For them, a major question is the promotion of, and access to, the use of nuclear energy. On the other hand, there are a number of risks involved in the use of nuclear energy. These concerns have triggered national and international legal and non-legal regulations restraining the use of, and access to, nuclear energy. The dangers to be dealt with can be summarized as follows:

- Radioactive materials discharged into the environment in the course of the production process of uranium and plutonium, the relevant raw material;
- Radioactive materials discharged into the environment as a result of accidents or malfunctioning of nuclear installations, or of nuclear propelled vehicles, or as a consequence of transports of nuclear materials;
- Final disposal of radioactive waste;
- Nuclear safety, in particular the risk of diversion of nuclear materials into the hands of criminals ('nuclear terrorism');
- Risk of diversion of nuclear materials or technology for weapons purposes.

The first three concerns present major environmental problems. These environmental concerns coincide with health risks. Although these concerns have international dimensions, international legal answers to those problems have so far been incomplete. The basic answer of customary law relating to the risk of transfrontier nuclear pollution is the so-called no harm rule, recognized by the *Trail Smelter* arbitration. As to nuclear pollution, that rule needs further concretization, preferably by

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treaty law, which still is incomplete. There are treaties dealing with civil liability, obligatory insurance and communications or assistance in case of accidents. IAEA environmental standards for nuclear installations, transportation and waste disposal have so far not reached the status of legally binding norms. As to the content of the regulatory system, three main areas of achievement are highlighted in this Chapter: *First*, there are international norms addressing transboundary harm stemming both from general international (environmental) law and from specific treaties. *Second*, there exists an internationally binding liability regime based on operator liability, which shields the States against claims involving their own responsibility; its adequacy for protecting current victims and future generations is, however, debatable. There are, *finally*, multiple international standard setting procedures leading to a great array of soft law. The environmental and health risks involved in the production and use of nuclear energy are a long-term problem. The risk of radioactive pollution is not banned in a convincing manner. There is also no adequate answer for safe radioactive waste disposal, nowhere on the national level, far less on the international level. These problems affect the fate of future generations, thus prompting an enhanced responsibility for relevant decision-makers. Yet as in other problem areas the international community is slow in living up to the challenge.

Keywords Environmental protection · 'No harm' rule · Nuclear energy · Nuclear pollution · Nuclear and radiation safety · Trail smelter arbitration

Contents

10.1 Environmental Risks of Peaceful Uses of Nuclear Energy—National and International Law

Nuclear energy presents a serious hazard for human health and for the environment, a fact overshadowed by the wish to benefit from its uses for defence and for economic purposes. In the beginning of the military uses of nuclear energy, these hazards were perhaps not realized, but there was no excuse for overlooking them after the consequences of the nuclear bomb attacks on Hiroshima and Nagasaki became clear. Various disaster scenarios of the use of these weapons have been discussed, including a disastrous climate change, the 'nuclear winter'.[1] Despite the security, health and environmental risks involved in the use of nuclear weapons, attempts to achieve a legal regime of nuclear disarmament binding all States have failed. The NPT,[2] concluded in 1968, prohibits the possession of nuclear weapons by all States parties except the five official nuclear-weapon States. In addition, there are another four States, currently not Parties to the Treaty and thus not covered by its prohibitions, who possess nuclear weapons. For these nine States, the use of nuclear weapons continues to be a military option and part of strategic planning, a fact that has triggered a number of waves of political resistance.

For the purpose of maintaining the option of using nuclear weapons, their testing became important from the point of view of national armament policy. Although technology now exists which renders the use of tests unnecessary, testing remains relevant as the five tests conducted by North Korea between 2006 and 2016 show. Because of their negative effects on international security, these tests have repeatedly been condemned by the Security Council who decided sanctions against the DPRK.[3] But international security is not the only problem caused by nuclear testing. Nuclear testing was first conducted by a number of States with complete disregard for the severe health and environmental consequences involved. Yet international legal regimes restraining nuclear testing have developed, induced both by environmental concerns and by the security interest in curbing the nuclear arms race. The 1963 Treaty banning nuclear tests anywhere except underground was, on the one hand, a first result of a process of accommodation between the two antagonistic blocks of the Cold War, it was, on the other hand, a major environmental achievement and now enjoys a widespread adherence.[4] Underground testing has been discontinued by States as a policy matter, but the Comprehensive Test Ban Treaty[5] prohibiting such tests as a matter of treaty law has still not entered into force.

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[1] Robock 2012.

[2] Treaty on the Non-Proliferation of Nuclear Weapons (1 July 1968), 729 UNTS 161, IAEA INFCIRC/1.

[3] The latest resolution, confirming and developing the previous ones, is SC Res 2270 of 2 March 2016. For further reactions of the SC see the agreed press statement of 9 September 2016 (SC/12513-DC/3656).

[4] Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space, and under Water (Partial Nuclear Test Ban Treaty—PTBT), 480 UNTS 43 (5 August 1963). Currently 125 States parties; lacking are in particular France, China, the States of Central Asia, Saudi Arabia, Algeria, Mali. Two treaties concluded roughly at the same time as the PTBT and relating in a general way to the non-militarization of certain spaces also restrain weapons testing, namely the Antarctic Treaty of 1959 (Article I); and the Outer Space Treaty of 1967 (Article IV).

[5] Comprehensive Nuclear-Test-Ban Treaty—CTBT—(10 September 1996), adopted by General Assembly Resolution 50/245 (10 September 1996), 35 ILM 1439. The treaty will only enter into force when all 44 States listed in Annex 2 (which have certain specific nuclear capabilities) have ratified. Currently lacking: China, Egypt, Iran, Israel, U.S., India, North Korea, Pakistan. See Venturini 2014, Bauer and O'Reilly 2015.

As to the peaceful uses of nuclear energy, they present a challenge for the law in two totally opposite directions. On the one hand, many States still want a better chance to use nuclear energy. For them, a major question is the promotion of, and access to, the use of nuclear energy. This interest is recognized by Article IV of the NPT,[6] where it is formulated as an 'inalienable right'. Assistance in satisfying this interest is part of the mandate of the IAEA.[7] The tension between this interest and the security interest in restraining the spread of nuclear weapons was the background for the dispute between Iran and the international community concerning that country's development of nuclear energy knowhow.[8]

The major motive behind the quest for nuclear energy is energy security. A secure supply of energy is a precondition for sustainable economic prosperity. Energy law has become a full-fledged branch of international law.[9] It relates to the peaceful use of nuclear energy to the extent that the latter is considered as an effective tool for ensuring energy security. This aspect is beyond the scope of the present paper.

When the peaceful uses of nuclear energy became more and more important in the 1960s, attempts of legal regulation were mainly inspired by the military origins of the use of nuclear energy. They were concerned about undesirable military uses (proliferation).[10] There are a number of risks involved in the use of nuclear energy beyond the dangers of military uses. These concerns have triggered national and international legal and non-legal regulations restraining the use of, and access to, nuclear energy. The dangers to be dealt with can be summarized as follows:

- Radioactive materials discharged into the environment in the course of the production process of uranium and plutonium, the relevant raw material;
- Radioactive materials discharged into the environment as a result of accidents or malfunctioning of nuclear installations, or of nuclear propelled vehicles, or as a consequence of transports of nuclear materials;
- Final disposal of radioactive waste;
- Risk of diversion of nuclear materials or technology for weapons purposes;
- Nuclear security in the sense of a risk of diversion of nuclear materials into the hands of criminals (an aspect of 'nuclear terrorism');

This chapter concentrates on the first three concerns as they present major environmental problems. These environmental concerns coincide to a large extent with

[6] See Anastassov 2014, see also below, Chap. 16 (Fleck).

[7] Statute of the IAEA, Article II: 'The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world …'; Article III: 'The Agency is authorized … to encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world …'.

[8] Concerning the solution of this conflict, see below, Chap. 13 (Haupt) and 14 (Martellini).

[9] Bruce 2014, MN 1.

[10] Fedchenko, 2009, MN 17 et seq.

health risks, but there are also specific environmental issues. Various papers published in this Volume address a number of issues involved in theses concerns. I will try to draw an overall picture of the international legal toolkit for dealing with them.[11]

The problems addressed here are common to all countries using, or planning to use, nuclear energy for peaceful purposes. This commonality is the first dimension of the internationality of the problem. Yet the risks mentioned also have a transfrontier aspect. Environmental damage due to nuclear activities may occur outside the country where the damage originates. While the commonality of the problems does not necessarily mean that there is a need for international regulation, the transfrontier dimension is by necessity subject to international law, first of all customary international law, which may or may not be concretized or developed by treaty law. It must be emphasized that international environmental law started from the transboundary aspect of the problem, but is nowadays not limited to it. Many aspects of environmental protection or preservation are a matter of 'common concern'.[12] Dealing with common problems through international cooperation, which may or may not be regulated by law, is also a matter of efficiency and well-understood self-interest.

There is a basic problem underlying the various environmental and health problems involved in the peaceful use of nuclear energy: it is the particular long-term effect of the relevant activities. Chernobyl constitutes an environmental and health hazard thirty years after the disaster, and will remain so for further generations. So will Fukushima. Spent nuclear fuels continue their radiation for many thousand years, and the containment of this danger remains an unresolved problem everywhere. This time dimension makes the environmental risks of the peaceful use of nuclear energy a matter of common concern of humankind and of intergenerational equity.

The interests at stake in the peaceful use of nuclear energy result in a complex regulatory picture where national priorities concerning energy production and use face international constraints based on general international law, specific treaty law and, this is of great practical relevance, also on non-legal rule making. An important, but not the only focal point of the development of this regulatory regime is the International Atomic Energy Agency.[13]

[11] For an overview see Nanda 2006.

[12] See Anastassov 2014, at 171. The notion of 'common concern' relating to matters traditionally only subject to national jurisdiction was introduced into international environmental law by UNGA Resolution 43/53, 6 December 1988, on the 'Protection of Global Climate for Present and Future Generations' and then by the Framework Convention on Climate Change as well as the Biodiversity Convention, both of 1992, see Feichtner 2007, MN 19; Biermann 1996.

[13] Fedchenko 2009, MN 22 et seq.

10.2 The Production Process of Raw Materials

The risk for health and the environment involved in uranium mining is nowadays not so much in the limelight. It must be recalled, however, that during the times of the German Democratic Republic, a large part of the uranium needed for Soviet nuclear weapons was mined in Eastern Germany (in the Erzgebirge and Vogtland mountains in Saxony and Thuringia) and that the population had a significantly higher rate of cancer, due to the failure to contain the radon emissions from the mining process. This fact was well known to the authorities, but kept secret. Today, these mines do not operate any more.

A major concern today is the devastation of indigenous lands around uranium mines in the Third World.[14] This is part of the larger problem of environmental and social impact of major development projects. This problem is mainly addressed by soft-law instruments dealing with sustainable development and the fate of indigenous peoples. But it is also an aspect of funding policies of development banks and in particular of the World Bank.[15]

10.3 The Risk of Radioactive Pollution from Nuclear Installations

The three types of risk shall be dealt with separately. First, as to the risk of radioactive pollution from nuclear installations: Different types of dangers may lead to radioactive pollution. First, malfunction of the installation, including failures involved in the transportation of materials, up to an explosion, and second, impact from the outside through natural disasters, sabotage, terrorist acts or armed conflict. These dangers are addressed by rules concerning the installations and transportation, external impact also by rules concerning dangerous behaviour, e.g. the IHL provision prohibiting attacks on certain nuclear installations[16] as well as various treaties concerning terrorism.[17]

As to the rules concerning installations, there are three different types which address this risk: rules concerning siting decisions, rules concerning the construction of installations and rules concerning their operation. These rules are, first of all, contained in national legislation. The acceptability of the risk involved in nuclear installations is a highly political decision, and it is essentially a national

[14] Göcke 2014, in particular at 212 et seq.

[15] Bothe 2005, at p. 463 et seq.

[16] Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts—AP I—(8 June 1977), 1125 UNTS 3, Articles 35, 55 and 56.

[17] In particular the International Convention for the Suppression of Acts of Nuclear Terrorism (Nuclear Terrorism Convention—ICSANT—13 April 2005), UNGA/RES/59/290, 2445 UNTS 89.

decision. This explains why different States pursue different policy options in this respect and why there is only a limited role for international law. While international law so far does not address the basic national choices of energy production, it has to play a role in dealing with various aspects and consequences of this choice.

This is in particular, as already stated, the risk of transborder nuclear contamination and the ensuing questions of liability. The basic answer of international customary law relating to the risk of transfrontier nuclear pollution is the so-called no harm rule,[18] recognized by the *Trail Smelter* arbitration.[19] It prohibits causing significant transborder harm. Although there is controversy about the origin and scope of the rule, its general validity is beyond doubt.[20] It has an impact on all three types of legal rules just mentioned. This rule has been concretized by treaty law, both in the field of general international law and in that of nuclear law. In the field of nuclear law, in particular nuclear safety, non-legal rules provide added concretization.

The duty to avoid transboundary harm is not the only norm which forms the basis of nuclear law, in particular rules of nuclear safety. General rules of international environmental law also enjoin States to reduce and avoid damages to the environment regardless of its location, i.e. also where elements of the environment are located within the territory of the State where the harmful activity occurs. These rules are inspired by human rights concerns, i.e. the duty to ensure the life, health and safety of a population, by an ethical conviction that the environment must be preserved also for its own sake, by the need to preserve the living conditions of future generations reflected in the principle of intergenerational equity. A crucial tool for ensuring intergenerational equity is the precautionary principle. How far these general rules have become customary law is somewhat controversial. It is submitted that the precautionary principle is indeed a norm of customary international law.[21] Yet it certainly needs concretization. This will be described in the following sections.

10.3.1 Siting Decisions

First, siting decisions are subject to the national law on planning (usually special planning procedures for nuclear installations), in particular rules on environmental impact assessment, and public participation in siting decisions.

There are international legal rules on relevant procedures which do not only apply to nuclear installations, but to any installation having a significant

18 Beyerlin and Marauhn 2011, 39 et seq.

19 *U.S. v. Canada,* (1941) 3 RIAA 1907.

20 Beyerlin and Marauhn 2011, at 41.

21 Bothe 2005, at 496 et seq.

transborder impact. Siting in border areas is most often subject to bilateral concertation procedures. Under customary law, the siting State has to give adequate information to any State possibly affected by the installation and to take the interests of the latter State into account when taking a decision, a rule confirmed by the ICJ in the *Pulp Mill* case.[22] A general duty to evaluate the outside (not only transfrontier) effect of a nuclear installation is enshrined in Article 17 of the Nuclear Safety Convention.[23] As to public participation and access to judicial review, it is at least arguable that the right of equal access is now also enshrined in customary law.[24] Among most members of the United Nations Economic Commission for Europe (UNECE), these questions are regulated by two treaties, the conventions on environmental impact assessment (Espoo Convention)[25] and on access to information, public participation and access to justice (Aarhus Convention).[26] This means that in the siting decision-making process, environmental concerns play a significant role, which is strengthened by these procedures. Yet a specific duty to ensure public participation is also contained in Article 17 of the Nuclear Safety Convention.

As to substantive rules on siting, the duty to take the interests of a neighbouring State into account has not only procedural, but also substantive aspects.[27] Specific aspects may impose particular restraints on siting decisions. Taking into account possible effects of armed conflicts may be implied in the duty to take precautions pursuant to Article 58 AP I.[28]

10.3.2 Standards Governing Construction and Operation

As to the construction and operation of nuclear installations, the rules of general international law already mentioned in relation to siting decisions also apply. This is in particular the 'no harm' rule confirmed by international jurisprudence, beginning with the *Trail Smelter* arbitral award and then recognized by the ICJ in the

[22] *Case concerning Pulp Mills on the River Uruguay, Argentina v. Uruguay,* Judgement of 20 April 2010, ICJ Rep. 2010, pp. 14 et seq, para 80 et seq. The reasoning of the Court is, however, treaty based.

[23] Convention on Nuclear Safety—CNS—(20 September 1994), INFCIRC/449, 1963 UNTS 293.

[24] With a cautious conclusion Beyerlin and Marauhn 2011, at 45.

[25] Espoo Convention on Environmental Impact Assessment in a Transboundary Context (25 February 1991), 1989 UNTS 309, amended by the Kiev Protocol of 21 May.

[26] (Århus) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (25 June 1998), http://ec.europa.eu/environment/aarhus/.

[27] Beyerlin/Marauhn, at 41 et seq.

[28] Ibid.

Corfu Channel,[29] *Gabčíkovo Nagymoros*[30] and *Pulp Mill*[31] cases. As to sea areas, the respective provisions of the UNCLOS and of regional treaties on the protection of the maritime environment are also relevant. This was shown in the *MOX Plant*[32] case between Ireland and the UK relating to alleged nuclear pollution of the Irish Sea. The judicial holdings in these cases reflect Principle 21 of the 1972 Stockholm Declaration,[33] repeated in Principle 2 of the 1992 Rio Declaration:

> States have … the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or in areas beyond the limits of national jurisdiction.[34]

Specific international rule-making in this area has followed the traditional experience: international law mainly learns from disaster. In the aftermath of the Chernobyl accident, the Convention on Nuclear Safety was adopted in 1994.[35] Its major objective is 'to achieve and maintain a high level of nuclear safety through the enhancement of national measures and international cooperation including, where appropriate, safety related technical cooperation' (Article 1(i) of the Convention). The goals of measures to be taken are specifically detailed for siting (Article 17), for design and construction (Article 18) and for operation (Article 19). The safety impact on the environment must in particular be evaluated in taking a siting decision (Article 17 (ii)). But the convention does not itself establish relevant standards, it requires States to establish a legislative and regulatory framework in order to achieve the said objective (Article 7). A reporting system is established to monitor the implementation of these goals by the States parties. Currently, 78 States are parties to the Convention, including most States having a significant nuclear industry.

As to concrete safety standards, their elaboration is a statutory function of the IAEA. Numerous safety standards have been adopted in this framework by the IAEA Commission on Safety Standards. In particular the 'Safety Requirements' to be elaborated are those requirements 'that must be met to ensure the protection of people and the environment, both now and in the future'.[36] These Standards are

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[29] *Corfu Channel, United Kingdom v. Albania, Merits,* Judgment of 9 April 1949, ICJ Rep. 1949, p. 4, at p. 22.

[30] *Case concerning the Gabčíkovo-Nagymoros Project, Hungary v. Slovakia,* Judgment of 25 September 1997, ICJ Rep. 1997, p. 7, paras. 97, 111 et seq.

[31] Supra note 22.

[32] See Churchill 2007. The judicial and arbitral history of this case is somewhat confusing as several jurisdictions were involved.

[33] Declaration of the United Nations Conference on the Human Environment (16 July 1972), http://www.unep.org/documents.multilingual/default.asp?documentid=97&articleid=1503.

[34] Rio Declaration on Environment and Development (14 July 1992), http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm.

[35] See supra note 23.

[36] IAEA 2014a, b.

not legally binding, but they carry a significant practical weight due to two factors. They are based on recognized expert knowledge and thus enjoy the legitimacy which results from expertise.[37] Government experts (i.e. officials who afterwards are called upon to implement them) contribute to their elaboration which is important for avoiding later problems of non-observance or non-implementation.[38] Thus, the development of nuclear safety standards is a classical example for international (soft) law making in technical fields. A review process should keep them up to date.[39]

Whether this international regime is sufficient to protect populations and the environment against the dangers involved in the use of nuclear energy is open to doubt.[40] In particular in the aftermath of the Fukushima disaster, it was criticized that not only the Japanese operators and authorities had been careless, but that also the IAEA had not used the influence it had to create a more safety oriented culture in Japan and elsewhere.[41] The political will, including a will to assign sufficient funds to the work of the IAEA in the nuclear safety area was apparently lacking.

10.3.3 Transportation

Among the IAEA Safety Standards, there are (regularly updated) Regulations for the Safe Transport of Radioactive Materials. They require measures to ensure the containment of radioactive content, control of external radiation levels, prevention of criticality and prevention of damage caused by heat.[42] There are also relevant instruments on nuclear security stemming from different sources.[43]

10.3.4 Nuclear Emergencies

An important problem of the operation of nuclear installations is how to deal with emergencies.[44] Specific duties of warning and cooperation are also implied in the

[37] Bothe 2012, at 1409 et seq.

[38] Bothe 2010, MN. 140 et seq.

[39] IAEA 2011.

[40] Nanda 2006, at 66.

[41] For a critical review see Greenpeace 2012.

[42] IAEA, Regulations for the Safe Transport of Radioactive Material, 2012, available at http://www-ns.iaea.org/standards/documents/default.asp?s=11&l=90&sub=70&vw=9.

[43] For an overview see World Nuclear Association, Transport of Radioactive Materials, available at www.world-nuclear.org/info/Nuclear-Fuel_Cycle/Transport/Transport-of-Radioactive-Material.

[44] See below, Chaps. 11 (Handl) and 12 (Pelzer).

rules of general international environmental law relating to transborder harm.[45] In this field, too, the experience of the Chernobyl disaster has very swiftly led to treaty making concretizing these rules. Two new conventions were adopted in September 1986, namely the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency[46] and the Convention on the Early Notification of a Nuclear Accident,[47] both enjoying rather widespread participation. The former Convention provides for a right to request assistance in case of a nuclear emergency regardless of its place of origin (Article 2). The latter convention provides for an obligation of the State where a nuclear accident occurs to notify other States which may be affected and to promptly give relevant information.

10.3.5 Liability

When, despite these rules, nuclear damage occurs, the question of liability arises. This is, first of all, a question of State responsibility. The no harm rule creates a duty of the State where the harmful effects originate to prevent them, i.e. a duty of due diligence.[48] If a State does not fulfill this duty, this is an unlawful act which entails the responsibility of the State for this unlawful act or omission.[49] This is the basis for the *Trail Smelter* Arbitration[50] and for the judgment of the ICJ in the *Corfu Channel* case.[51] It is the traditional rule of State responsibility for unlawful acts based on fault. Yet in the case of hazardous activities, it is now widely accepted that there is a strict (i.e. no-fault) liability also for lawful activities.[52] Be that as it may, the practical application of this rule seems to present difficulties. States are generally reluctant to acknowledge State responsibility for environmental damages in general and for nuclear accidents in particular. After the Chernobyl accident, the USSR adamantly refused to even negotiate about the compensation of alleged damages resulting in other countries from the accident.

Treaty making relating to liability for nuclear accidents has therefore followed another route, namely an ensured liability of the operator.[53] This is a solution of

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45 Anastassov 2014.

46 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (26 September 1986), 1457 UNTS 133, INFCIRC/336, currently (fall 2015) 112 parties.

47 Convention on Early Notification of a Nuclear Accident (26 September 1986), 1439 UNTS 275, INFCIRC/335, currently (fall 2015) 119 parties.

48 See below, Chap. 15 (Black-Branch).

49 Article 12 ARSIWA.

50 See above note 19.

51 See above note 29.

52 Tanzi 2013, MN 18; Douhan 2013, MN 20 et seq.

53 Douhan 2013, MN. 17 et seq.

the damage compensation problem which has also prevailed in other cases of environmental damage, in particular in the field of oil pollution. The scheme is simply this: no fault liability, cap on the amount of compensation, time limits for claims, obligatory insurance. In the case of nuclear accidents, the development was in the beginning complicated by the fragmentation of the regulatory regimes: there was one treaty elaborated in the OECD framework (Paris Convention, 1960, with additional Protocols 1964, 1982, 2004 and the Brussels Supplementary Convention of 1963),[54] another was elaborated by the IAEA (Vienna Convention 1963, amended by the Protocol of 1997, Convention on Supplementary Compensation 1997).[55] Both convention regimes have a different geographical coverage. Under the impression of the Chernobyl accident, a Joint Protocol was adopted in 1988 combining the two conventions into one liability regime with a choice of law clause providing for the exclusive application of one of the conventions. However, the number of parties to the Joint Protocol is quite limited (24). Major industrial States are not among them. Thus, the overall picture of treaty regulation regarding liability for nuclear damages is confused. Although both regimes follow the same principles, just mentioned, there are important differences in detail, for instance concerning the limitation of amounts of compensation. As far as environmental protection is concerned, the damage covered by the older conventions was limited to personal injury and damage to property. Environmental damage was thus only covered if the element of the environment which is damaged is private property. ‘Pure’ environmental damage was not covered. Yet the supplementary conventions cover environmental damage as well as preventive measures.

Important questions remain to be regulated by national law. In the case of the Fukushima disaster, Japan set up elaborate procedures to ensure adequate compensation for victims who had suffered different kinds of damages. Typical sums were fixed for various types of damages, e.g. 100 TJP per person and month in case of mental anguish.[56] According to recent figures provided by the operator, TEPCO, next to 2.6 million applications for compensation were received. The total amount paid by March 2016 was 53 billion USD.[57]

[54] Paris Convention on Third Party Liability in the Field of Nuclear Energy, 956 UNTS 251, amended by the Additional Protocol of 28 January 1964, 956 UNTS 335, the Protocol of 16 November 1982, 1650 UNTS 444, www.oecd-nea.org/law/nlparis_conv.html. A further amendment of 12 February 2004 is not yet in force.

[55] Vienna Convention on Civil Liability for Nuclear Damage (21 May 1963), 1063 UNTS 293, amended by the Protocol of 12 September 1997, 36 ILM 1454, 1462 (1997), INFCIRC/556; see IAEA 2007; see also Šoljan 1998.

[56] Matsuura 2012.

[57] Records of Applications and Payouts for Indemnification of Nuclear Damage, www.tepco.co.jp/en/comp/images/jisseki-e.pdf (last retrieved March 24, 2016).

10.4 Vehicles with Nuclear Propulsion

Nuclear powered ships are the relevant practical case.[58] Important aspects of their use are regulated by a special chapter (VIII) of the International Convention for the Safety of Life at Sea (SOLAS).[59] The innocent passage of foreign nuclear ships through the territorial sea of other States is somewhat restricted.[60] The IMO has adopted a Safety Code for Nuclear Ships.[61] The liability of operators is regulated by a special convention.[62]

10.5 Long-Term Storage of Radioactive Waste

The safe long-term storage of radioactive waste,[63] in particular spent fuel, is probably the most embarrassing environmental problem involved in the peaceful use of nuclear energy. It is a problem which will remain with future generations for centuries, even millennia to come, whatever the national choices of energy policy will be.

Among the safety requirements developed by IAEA, there are rules on safe long-term radioactive waste disposal.[64] An important principle is the need to separate radioactive material from the biosphere. But these are abstract standards only. When it comes to the choice of concrete methods and places, no accepted and implemented solution has so far been found anywhere in the world. In many countries investigations are proceeding, in some countries licensing procedures are under way. Most of the latter have been subject to legal controversy.

Thus, the long term storage of nuclear waste is a question where next to all States have violated and continue to violate the principle of intergenerational equity by presently using a resource (nuclear energy) without taking the

[58] Nakatani and Ishii 2014.

[59] International Convention for the Safety of Life at Sea (1 November 1974), as amended in 1978, 1981, 1983, 1990 and 1991, https://treaties.un.org/doc/Publication/UNTS/Volume%201184/volume-1184-I-18961-English.pdf.

[60] Articles 22 and 23 United Nations Convention on the Law of the Sea (30 April 1982), 1833 UNTS 3.

[61] IMO Res. A/491(XII), 19 November 1981.

[62] Convention on the Liability of Operators of Nuclear Ships (25 May 1962), Vol. 57 (1) American Journal of International Law (January 1963) 268.

[63] See above, Chapter 9 (Odendahl).

[64] IAEA, Near Surface Disposal of Radioactive Waste, Safety Standards Series No. WS-R-1; Safety Principles and Technical Criteria for the Underground Disposal of High Level Radioactive Wastes, Safety Series No. 99; Siting of Geological Disposal Facilities, Safety Series No. 111-G-4.1.

precautionary measures necessary to protect future generations against the dangers resulting from that use.[65]

10.6 Concluding Remarks

Legal rules protecting the environment against the risk involved in the peaceful use of nuclear energy are produced by different policy making bodies and are characterized by a peculiar mix of different legal approaches.

The major policy-making body concerning specific rules on nuclear energy is the IAEA, but it is not the only one. In particular the OECD remains important. Within IAEA, the instruments referred to and in particular different standards are the result of a plurality of expert and regulatory bodies. In this organizational setup, internal coherence and consistency is a difficult postulate.

As to the content of the regulatory system, three main areas of achievement can be highlighted: First, there are international norms addressing transboundary harm stemming both from general international (environmental) law and from specific treaty making. Second, there exists an internationally binding liability regime based on operator liability, which shields the States against claims involving their own responsibility. Its adequacy for protecting current victims and future generations is debatable. There are, finally, multiple international standard setting procedures leading to a great array of soft law.

Whether these restraints imposed on States and operators for the sake of nuclear safety and security are enough is open to question. A particularly glaring hole in world-wide practice and legal regulation exists concerning the question of the safe storage of spent nuclear fuel. This points to the essential problem: the environmental and health risks involved in the production and use of nuclear energy are a long-term problem. They affect the fate of future generations in a very direct and obvious way. This prompts an enhanced responsibility for relevant decision-makers. Yet as in other problem areas the international community is slow in living up to the challenge.

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[65] See Union of Concerned Scientists: 'Safe long-term storage for nuclear waste is a top priority—but it hasn't happened', www.uscusa.org/nuclear-power/nuclear-waste#VvO4YmL2akw; see also Greenpeace International, Nuclear Waste Storage, www.greenpeace.org/international/en/campaigns/nuclear/waste/storage/.

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Chapter 11
Nuclear Off-site Emergency Preparedness and Response: Some International Legal Aspects

Günther Handl

Abstract The accident at the Fukushima-Daiichi nuclear power plant, much like Chernobyl before, is a stark reminder of the critical role of off-site emergency preparedness and response (EPR) in nuclear accident management notwithstanding continuous improvements in nuclear safety worldwide. EPR is a matter of intrinsic international concern, not only between neighboring States, but globally as shortcomings in EPR anywhere tend to undermine confidence in nuclear safety everywhere. Post-Fukushima, EPR therefore has been a focal point of international regulatory attention which this Chapter sets out to describe in the context of nuclear accidents with radiological off-site effects. The Chapter first discusses the international normative setting for EPR, principally the IAEA-centered framework (including relevant conventions, safety standards, operational arrangements and services). It then addresses some of the major international public policy and legal challenges that have presented themselves in the aftermath of Fukushima: The drive to harmonize EPR and the intrinsic difficulties in reaching that goal; transboundary emergency notification/communication arrangements bilaterally, regionally and globally, that are insufficiently anchored to a firm legal basis; enhanced independent peer review and regular testing to ensure quality and reliability of EPR plans; and stronger State support for IAEA's international emergency assistance mechanism. In summarizing how the international community—concerned States, international organizations, the nuclear industry and other stakeholders—has reacted to these issues, the author concludes that while EPR notionally

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remains, of course, a national responsibility, many of its key aspects are increasingly being 'internationalized.'

Keywords Accident assessment and prognosis · Action plan on nuclear safety · Assistance convention · Convention on Nuclear Safety (CNS) · Convention on Early Notification · Emergency assistance · Emergency exercises · Emergency planning zone · Emergency Preparedness and Response Information Management System (EPRIMS) · Fukushima accident · Incident and Emergency Centre (IEC) · International Atomic Energy Agency (IAEA) · Nuclear off-site emergency preparedness and response (EPR) · Nuclear and radiation safety · Peer review · Response and Assistance Network (RANET) · Transboundary emergency notification/communication · Vienna Declaration on Nuclear Safety

Contents

11.1 Introduction

Since the accident at the Fukushima-Daiichi nuclear power plant severe accident[1] management practices at nuclear installations have been the focus of critical attention worldwide.[2] While these safety reviews have aimed at strengthening mitigation capabilities on-site,[3] the prevention of serious, long-term radiological effects

[1] That is an accident beyond the nuclear power plant's design basis. A design basis accident or 'maximum credible accident' involves 'accident conditions against which a facility is designed according to established design criteria, and for which the damage to the fuel and the release of radioactive material are kept within authorized limits.' *See* IAEA 2013a, NEA 2002.

[2] See, e.g., Institute of Nuclear Power Operations 2012; and Western European Nuclear Regulators' Association (WENRA) 2014, 33–35.

[3] Thus the Nuclear Safety Review 2014 concludes that the 'nuclear industry needs to continue focusing resources on improving severe accident management capabilities because this capability is the key to the success of defense in depth level 4—the last line of defense prior to the on-set of significant off-site consequences'. IAEA 2014, 21. *See also* the presentations and discussions at the IAEA Experts' Meeting to Discuss Severe Accident Management after Fukushima, 14 March 2014, at http://www-pub.iaea.org/iaeameetings/cn233Presentations.aspx; and IAEA 2015a.

off-site has become a matter of special concern.[4] In this vein, in 2014, in advance of the Sixth Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS), Switzerland proposed an amendment to Article 18 of the CNS that sought to establish the objective of preventing serious off-site effects as a legal obligation applicable to the design, construction and operation of nuclear power plants, both new and already existing.[5] Although the Swiss proposal did not win approval at the specially convened diplomatic conference of the Contracting Parties to the CNS in February 2015, the meeting did adopt the Vienna Declaration on Nuclear Safety.[6] This statement acknowledges as a key objective in implementing the Convention the mitigation of 'possible releases of radionuclides causing long-term offsite contamination and … [avoidance of] early radioactive releases or radioactive releases large enough to require long-term protective measures and actions'.[7] Avoidance of off-site contamination had already been similarly endorsed in the European Council Directive 2014/87/EURATOM[8] as a new EU-wide safety objective legally binding upon EU member States.

Safety in the design, construction and operation of nuclear fuel cycle facilities is premised on a defence-in-depth philosophy[9] which aims at the prevention or mitigation of the effects of a malfunction or accident involving the release of radioactive materials through multiple independent and redundant layers of protection to compensate for potential human and mechanical failures so that no single layer,

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[4] *See*, e.g., IAEA 2012, para 17: 'The displacement of people and the land contamination after the Fukushima Daiichi accident calls for all national regulators to identify provisions to prevent and mitigate the potential for severe accidents with off-site consequences.'

[5] *See* 6th Review Meeting of the Contracting Parties to the Convention on Nuclear Safety, 24 March–4 April 2014 Vienna, Austria, Doc. CNS/6RM/2014/11 Final, Annex 1: 'Nuclear power plants shall be designed and constructed with the objectives of preventing accidents and, should an accident occur, mitigating its effects and avoiding releases of radionuclides causing long-term off-site contamination. In order to identify and implement appropriate safety improvements, these objectives shall also be applied to existing plants.'

[6] Vienna Declaration on Nuclear Safety on Principles for the Implementation of the Objective of the Convention on Nuclear Safety to Prevent Accidents and Mitigate Radiological Consequences, Doc. CNS/DC/2015/2/Rev.1, Annex 1, February 9, 2015.

[7] Id., para 2.

[8] *See* Article 8(a) of the Council Directive 2014/87/EURATOM of 8 July 2014 amending Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations, [2014] OJ L 219/42.

[9] *See*, e.g., CNS, Article 18(i) which requires installation States to ensure that 'the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defense in depth) against the release of radioactive materials.' Thus '[a] key to a defense-in-depth approach is creating multiple independent and redundant layers of defense to compensate for potential failures and external hazards so that no single layer is exclusively relied on to protect the public and the environment.' *See* U.S. Nuclear Regulatory Commission 2011, 15.

no matter how robust, is exclusively relied upon.[10] Naturally, in this scheme of things prevention of abnormal operational occurrences and system failures will be the primary or first-level objective, whereas mitigation of the radiological consequences of significant external releases through offsite emergency response measures will be a last, albeit still exceedingly important goal.[11] For the simple fact is that for the foreseeable future—perhaps until so-called 'inherently safe nuclear reactors'[12] become a reality—major accidents entailing off-site releases of radioactive materials cannot be ruled out. In short, EPR covering off-site radiological consequences remains an essential underpinning of any nuclear safety regime,[13] a point driven home dramatically by the Fukushima accident,[14] much like the disaster involving the Chernobyl nuclear power plant[15] earlier. At the same time, Fukushima made it all too apparent that there was an urgent need to revisit and improve off-site emergency preparedness and response capabilities globally.[16]

In response, the 2011 IAEA Action Plan on Nuclear Safety called upon member States and other stakeholders to strengthen nuclear safety through a wide range of measures including specific steps regarding EPR.[17] This call was taken up the following year at the 2nd Extraordinary Meeting of the Contracting Parties to the CNS which offered a similarly detailed list of EPR-related measures that warranted special attention.[18] Since then, the need to strengthen efforts to enhance severe accident mitigation capabilities has been raised—and responded to—in numerous other fora as well.[19] Thus today, there is no denying that EPR reviews at national, regional and global levels have deepened awareness of EPR's critical

[10] For further discussion see IAEA (1996).

[11] The last objective of the defense-in-depth approach to nuclear safety 'is mitigation of the radiological consequences of significant external releases through the offsite emergency response'. *See*, e.g., Council Directive, *supra* note 8, preamble, para 17.

[12] Some critics, however, note that 'the use of this term is inappropriate for any nuclear power generating technology'. For even advanced water reactor systems, the PIUS (Process Inherent Ultimate Safety) reactor, or Generation IV—intrinsically safe nuclear high temperature gas-cooled reactor (HTGR) technology, will pose some risk. For a discussion, *see*, e.g., Ragheb 2015.

[13] *See*, e.g., the conclusions of NEA/CNRA/CSNI 2014, 11: 'Recognising that all levels of DiD are important in providing adequate protection to the public and enhancing nuclear safety including Level 4 mitigation and Level 5 protective measures (Off-site emergency response and accident management) set down for offsite release.'

[14] *See*, e.g., IAEA 2015b, 74–93; and NEA 2016, 15.

[15] *See*, e.g., IAEA 2001, 2001, 3–5; and NEA 2012, 121–127.

[16] Thus many the shortcomings of Japan's EPR performance following the accident at Fukushima are not the exception to the rule, but rather symptomatic of deficiencies elsewhere on the part of the industry and regulatory authorities generally. *See* NEA/CNRA/CSNI 2014, at 17; and IAEA 2015b, at 7–15 and 96–99. For further details, see IAEA 2015b, Technical Volume 3/5: Emergency Planning and Response.

[17] IAEA 2011, 3–4.

[18] IAEA 2012a, para 21.

[19] *See* IAEA 2015a, Chairman's Summary.

function in nuclear accident management, generated specific policy or institutional changes[20] and led to notable regulatory action, including the revision of IAEA Safety Requirements governing EPR.[21] Nevertheless, the Agency's 2015 Nuclear Safety Review readily acknowledges that more work still needs to be done 'to ensure and demonstrate …that EPR arrangements, both on- and off-site, are more resilient to severe disruptions of the basic infrastructure'.[22]

It is the purpose of this Chapter to examine evolving EPR policies and practices and to provide a—necessarily—limited assessment of the present state of affairs, namely from the perspective of international law and public policy. Admittedly, EPR, like the regulation of nuclear safety generally, is in principle a national responsibility.[23] Nevertheless, EPR measures and policies can and, more often than not, have intrinsically international implications. This is obviously so whenever an accident in a nuclear installation State might cause serious transboundary radiological effects and thus necessitates EPR measures for the protection of the public and the environment in areas beyond the installation State's jurisdiction and control. Additionally, national EPR measures become a matter of legitimate international concern if they are capable of undermining public confidence in nuclear safety practices of other States, regionally or globally.[24]

The focus of the present review will be restricted moreover to EPR that aims directly at mitigating off-site effects. To be sure, whether and to what extent a nuclear power plant accident will entail significant radiological off-site effects is a function of a huge number of variables associated with both off-site and on-site EPR.[25] However, a discussion of all relevant EPR aspects—directly or indirectly

[20] See, generally, the relevant summary in Progress in the Implementation of the IAEA 2015c, para 47. As regards institutional innovation, note, for example, the emergence of an Emergency Preparedness and Response Standards Committee (EPReSC) within the Agency's Commission on Safety Standards. *See id*. at 2.

[21] *See* IAEA 2015d.

[22] IAEA 2015e, 47. *See also* ENSREG 2015 (noting that although 'improvements in emergency preparedness and response had been made since the previous ENSREG conference … the question of whether enough had been done remained'); and Nuclear Transparency Watch 2015, 8–11.

[23] S*ee*, generally, the IAEA 2011, 1: '[I]t is important to note that …[t]he responsibility for ensuring the application of the highest standards of nuclear safety and for providing a timely, transparent and adequate response to nuclear emergencies … lies with each Member State and operating organization.'

[24] Several scenarios might give rise to such a situation as, for example, when a State's EPR measures are clearly at odds with neighboring countries' EPR approaches or inconsistent with applicable international standards. For further discussion see infra text at notes 128–132. A national EPR program would be similarly problematic if an installation State suffers from what might be called the 'embarking country problem'—worrisome deficiencies in regulatory competences, including in the field of EPR, either on account of insufficient resources for, or inattention to, the requisite regulatory infrastructure. As to the continued existence of this problem, see IAEA 2014, at 43.

[25] The latter includes, notably, the protection of on-site emergency workers.

affecting the nature and extent of off-site radiological effects—would simply be beyond the scope of this chapter. For similar reasons of economy, the chapter addresses only off-site EPR during the early (or emergency) and intermediate phases of a nuclear accident,[26] thus will not specifically examine EPR as it relates to the so-called 'recovery phase.'[27]

11.2 The International Normative Setting for EPR

11.2.1 The IAEA-Centered Regulatory Framework

As noted, whenever a State is forced to adopt protective measures for the sake of its population and environment against the risk of nuclear contamination emanating from a nuclear installation across the border, off-site EPR in respect of that installation is a matter of intrinsic international concern. Such a situation might raise fundamental questions about present-day limitations of the sovereignty of the State over its own territory. However, there is no need here to examine in detail the basic principles and rules of customary international law applicable to such a situation.[28] For insofar as EPR-related aspects of the relationship between the installation State and risk-exposed neighboring State(s) are concerned, generic customary legal rules have largely been subsumed in, refined by, and expanded upon by specific nuclear conventional law as well as other normative elements.[29] It is thus this international legal setting—a mixture of conventional law, formally non-binding

[26] *See* IAEA 2007a, 68–69: 'The period of time from the detection of conditions warranting an *emergency response* until the completion of all the actions taken in anticipation of or in response to the radiological conditions expected in the first few months of the emergency. This phase typically ends when the situation is *under control*, the *off-site* radiological conditions have been characterized sufficiently well to identify where food restrictions and *temporary relocation* are *required*, and all *required* food restrictions and *temporary relocations* have been implemented.' 'During these phases the source and releases from the plant have been brought under control. Also, environmental measurements of radioactivity and dose models are available to project doses to members of the public and base decisions on additional protective actions such as food and water interdictions.' National Research Council 2014, 197.

[27] 'Post-accident recovery includes: the remediation of areas affected by the accident; the stabilization of damaged on-site facilities and preparations for decommissioning; the management of contaminated material and radioactive waste arising from these activities; and community revitalization and stakeholder engagement.' *See* IAEA 2015b, 15.

[28] For a recent analysis see instead Handl 2015, 209–19.

[29] For a summary of EPR-related features of the IAEA-centered international legal framework, see also Rautenbach et al. 2006, 9–13.

safety standards and institutional practices shaping normative expectations regarding EPR—that is the focus of this chapter.[30]

11.2.1.1 Relevant International Treaty Instruments

The two multilateral instruments relevant in the present context—because cornerstones of the international EPR framework—are the Convention on Early Notification of a Nuclear Accident[31] and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency,[32] both adopted in the immediate aftermath of the Chernobyl accident.[33] The Convention on Early Notification applies to nuclear accidents which have the potential for an 'international transboundary release that could be of radiological safety significance for another State'.[34] It requires States parties to notify affected States—directly or through the IAEA, and the IAEA itself—of any nuclear accident involving specifically enumerated facilities and activities.[35] The installation State's report must include data regarding *inter alia* the accident's time, location, radiation releases, other data essential for assessing the situation, as well as information on off-site protective measures taken or planned.[36] Whereas under the Convention on Early Notification the IAEA plays an important, though relatively modest role as an information clearing-house,[37] the Assistance Convention assigns to the Agency a critical central function in the management of nuclear emergency assistance. Against the background of States parties' general obligation to cooperate between themselves and with the Agency to facilitate prompt assistance,[38] the Convention establishes

[30] Some related international normative principles and standards bearing on human rights or procedural entitlements, such as the so-called Waseda Recommendations on human rights and medical management in nuclear disasters, or the UN ECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention), are part of this normative matrix also. *See* Economic Commission for Europe 2013. However, they will not be specifically discussed unless they are of direct and major significance to the issues under review.

[31] IAEA Doc. INFCIRC/335, 18 November 1986.

[32] IAEA Doc. INFCIRC/336, 18 November 1986.

[33] For a discussion, *see* e.g., Moser 2010; Adede 1987.

[34] Article 1, para 1. For further discussion of the notification threshold issue, see *infra* text at notes 177–206.

[35] *See* Article 2.

[36] *See* Article 5.

[37] See Article 4. Note, however, the IAEA's recent launch of an International Radiation Data Monitoring System (IRMIS), a mechanism for reporting these specific measurements from the fixed monitoring stations worldwide.

[38] See ECA, Article 1, para.

the Agency as a channel for communication for requests for assistance[39] and as the repository of individual State-supplied information on national 'experts, equipment and materials which could be made available for the provision of assistance to other States Parties … as well as the terms … under which such assistance could be provided'.[40] Additionally, the Agency is to receive, from each State party, information on national competent authorities and points of contacts,[41] critical 'go-to addresses' in a nuclear emergency. Finally, the Agency is entrusted with the task of promoting, facilitating and supporting cooperation between States.[42] For that purpose, when so requested, it is specifically called upon to collect and disseminate to States EPR–related information,[43] to provide assistance with, *inter alia*, the preparation of emergency plans, the training of emergency personnel, the development of radiation monitoring programs and procedures and the initial assessment of the accident or emergency.[44]

Beyond the Early Notification and Assistance Conventions, special mention must be made of the two nuclear safety conventions, i.e., the Convention on Nuclear Safety[45] and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.[46] Indeed, as will be seen in a moment,[47] these two conventions play an extraordinarily important role as regards off-site EPR. Apart from a generic safety obligation bearing on EPR in Article 1,[48] the CNS specifically addresses emergency preparedness in Article 16. It requires an installation State to ensure that off-site emergency plans are in place and routinely tested and that its own population as well as 'the competent authorities of … [neighboring s]tates in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response'.[49] Conversely, contracting parties which do not have a nuclear installation on their territory but are likely to be affected in the event of a radiological emergency at an installation in a neighboring State, are required to adopt and test

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[39] Article 2, paras 1 and 3.

[40] EAC Article 2, para 4.

[41] Article 4.

[42] Article 1, para 3.

[43] Article 5, para (a).

[44] Article 5, paras (b) and (c).

[45] IAEA Doc. INFCIRC/449, 5 July 1994.

[46] IAEA Doc. INFCIRC/546, 24 December 1997.

[47] *See infra* § 11.2.1.3.

[48] Thus Article 1, para (iii) lists among the objectives of the Convention the prevention of accidents with radiological consequences and to mitigate such consequences should they occur.

[49] CNS, Article 16, paras 1 and 2, respectively.

emergency plans for their own territory.[50] Analogous provisions can be found in the Joint Convention, namely in Articles 1[51] and 25.[52]

11.2.1.2 EPR-Related IAEA Safety Standards, Operational Arrangements and Services

A second category of parameters of global normative significance for EPR are IAEA safety standards (Safety Fundamentals, Safety Requirements and Safety Guides[53]) and technical guidance documents.[54] The IAEA is authorized to establish or adopt 'standards of safety for protection of health, and the minimization of danger to life and property' against ionizing radiation.[55] And in respect of EPR it has done so—jointly with other international organizations and bodies—by publishing a number of safety requirements and safety guides[56]: 'Preparedness and Response for a Nuclear or Radiological Emergency'[57]; 'Arrangements for Preparedness for a Nuclear or Radiological Emergency'[58]; 'Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency'[59]; and 'Radiation Protection and Safety of Radiation Sources: International Basic Safety

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[50] Article 16, para 3.

[51] (iii) lists among the Convention's objectives 'to mitigate their consequences should they occur during any stage of spent fuel or radioactive waste management'.

[52] 1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.
2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

[53] *See* IAEA 2016.: 'The Safety Fundamentals … present the fundamental safety objective and principles of protection and safety and provide the basis for the safety requirements'; 'Safety Requirements establish the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals'; and 'Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures)'.

[54] For a more details, see IAEA 2015b, Technical Volume 3/5, at 123–126.

[55] IAEA Statute, Article III, para 6.

[56] Recognizing the importance of the cross-cutting nature of its EPR work, the Agency recently established a new Emergency Preparedness and Response Standards Committee (EPReSC). *See* Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety, IAEA Doc. GC(59)/RES/9, September 2015, para 31.

[57] IAEA 2015d.

[58] IAEA Safety Guide, No. GS-G-2.1 (2007).

[59] IAEA Safety Guide, No. GSG-2 (2011).

Standards'.[60] EPR safety standards in turn are supported by a series of technical guidance and tools documents covering specific aspects of EPR (examples include generic assessment procedures for determining protective actions during a reactor accident and generic procedures for medical response during a nuclear or radiological emergency).[61]

Given the complexity of EPR-related conventional and Agency safety standards and the resulting challenge for States to implement or abide by them domestically, there is an obvious need for international institutional assistance. As the Agency itself notes, '[t]he practical implementation of the various articles of the … [Early Notification and Assistance] Conventions as well as fulfillment of certain obligations under Article 16 of the … [CNS] and Article 25 of the … [Joint Convention], warrant the establishment of appropriate arrangements for emergency preparedness and response'.[62] In line with this, the Agency issued an Emergency Notification and Assistance Technical Operations Manual (ENATOM)[63]—now Operations Manual for Incident and Emergency Communication[64]—to provide guidance to member States, States parties and relevant international organizations on 'suitable arrangements to interface with each other and the IAEA Secretariat' within the framework of the Early Notification and Assistance Conventions.[65] Further, to provide a common understanding of the respective roles of relevant international organizations during a radiological emergency, the Agency manages the Joint Radiation Emergency Management Plan of the International Organizations (JPLAN).[66] JPLAN is intended 'to support and underpin the efforts of national governments and ensures a coordinated and harmonized international response to radiation incidents and emergencies'.[67] Additionally, in order to strengthen the implementation of the Assistance Convention, the Agency has long sought to facilitate international emergency response through a network of 'teams suitably qualified to respond to nuclear or radiological emergencies rapidly and, in principle, on a regional basis'.[68] The latest incarnation of this effort is the Response and Assistance Network (RANET), a system for providing international assistance, upon request from a State, following a nuclear or radiological incident or emergency.[69]

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[60] IAEA General Safety Requirements Part 3, No. GSR Part 3 (2014).

[61] For further details, see http://www-ns.iaea.org/tech-areas/emergency/technicalproducts.asp?s=1.

[62] IAEA 2015d, preface.

[63] IAEA 2000.

[64] IAEA, 2012b.

[65] Id. at 2.

[66] *See* Joint Radiation Emergency Management Plan of the International Organizations, Doc. EPR–JPLAN (2013). JPLAN has been developed, maintained and sponsored by the IAEA together with the member organizations making up Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE).

[67] Id. at v.

[68] IAEA 2013b, foreword.

[69] *See*, id. at 9. For further discussion, see infra text at notes….

At the global level then, the EPR conventions-based international system for dealing with nuclear or radiological events relies heavily on the central role of the IAEA Secretariat in the coordination of the flow of information and assistance.[70] To better be able to exercise these functions and meet its obligations under the conventions, in 2005 the Agency established an Incident and Emergency Centre (IEC) as 'the global focal point for emergency preparedness and response for nuclear and radiological safety or security related incidents, emergencies, threats or events of media interest.'[71]

The Agency plays an equally significant role as regards the assessment and evaluation of States' EPR capabilities, both prospectively and during an actual nuclear emergency or incident. To begin with, in 2015 the IEC launched the Emergency Preparedness and Response Information Management System (EPRIMS), an interactive, web-based self-assessment tool that allows Member States to share information with other select Member States and discuss national arrangements for emergency preparedness and response to nuclear or radiological emergencies.[72] Significantly, 'EPRIMS … is able to identify where the response arrangements are consistent with IAEA Safety Standards and where further improvement is necessary.'[73] Secondly, the IAEA provides two peer review services which are of special interest here, namely the Emergency Preparedness Review (EPREV) Service, which assesses a country's EPR capabilities against current international safety standards and good practices; and the Integrated Regulatory Review Service (IRRS) which assesses the effectiveness of a State's regulatory framework for the safety of its nuclear installations principally against IAEA safety standards.[74] Thirdly, to test international EPR capabilities the Agency, jointly with the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), prepares and conducts periodic 'convention exercises' (ConvEx exercises)[75] ranging from the testing of emergency communication links with contact points in Member States,[76] of specific parts of the international

[70] IACRNE provides a similar coordinating mechanism for those international organizations whose functions or responsibilities include as well EPR.

[71] IEC functions focus on EPR-related safety standards; appraisal services; EPR capacity building; the inter-agency EPR framework; and emergency assistance. *See* IAEA, Incident and Emergency Center, at http://www-ns.iaea.org/tech-areas/emergency/incident-emergency-centre.asp?s=1.

[72] Report on the Seventh Meeting of Representatives of Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Vienna, Austria, 19–23 May 2014, Doc. CAM/REP/2014, TM-4538610, July 24, 2014.

[73] Meschenmoser, IAEA Launches Self-Assessment Tool for Emergency Preparedness, 17 September 2105, https://www.iaea.org/newscenter/news/iaea-launches-self-assessment-tool-emergency-preparedness.

[74] *See further infra* § 11.3.3.

[75] *See* IAEA 2012b, at 19–24.

[76] So-called Convex1 exercises.

response system,[77] all the way to full-scale exercises over several days covering severe incidents.[78] Finally, following Fukushima the IAEA Secretariat has been assigned an expanded role in 'accident assessment and prognosis',[79] an important responsibility that will be more fully discussed below.[80]

11.2.1.3 The 'Normative Pull' of EPR-Related Safety Standards

Although, generally speaking, IAEA safety standards are not legally binding in a formal sense and instead are merely of a recommendatory nature, they nevertheless exert highly significant normative effects. Firstly, they are binding upon the Agency itself in relation to its own operations and on States in relation to operations assisted by the IAEA, such as the EPREV or IRRS services. Secondly, international organizations that have sponsored a safety standard—in the case of the 2015 EPR safety requirements a total of 13[81]—are expected to apply the standards concerned in their own operations in line with their mandates.[82] Thirdly, given that IAEA safety standards reflect regulatory and industry best practices they carry what might be called 'legitimacy by expertise'.[83] Fourthly, and more importantly, the Agency's safety standards acquire de facto normativity as a result of the way in which obligations under the two safety conventions are to be interpreted and implemented, a fact that continues to be underappreciated by some commentators.[84] As is well known, the safety conventions incorporate by reference internationally formulated or endorsed standards and criteria, as either capable of providing 'guidance on contemporary means of achieving a high level of safety' or of informing the State's obligation to adopt legislation for the effective protection

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77 So-called ConvEx-2 exercises.

78 ConvEx-3 exercises.

79 The 2011 Action Plan on Nuclear Safety calls upon the Secretariat '… to provide Member States, international organizations and the general public with timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences, *including analysis of available information and prognosis* of possible scenarios based on evidence, scientific knowledge and the capabilities of Member States'. IAEA 2011, 6 (emphasis added). Obviously, 'analysis and prognosis' is a function that is antecedent to, thus distinguishable from, the communication of relevant accident information. *See also* IAEA 2015f, 31.

80 *See infra* text at notes 219–226.

81 *See* IAEA 2015d, Preface.

82 Id.

83 See above, Chap. 10 (Bothe), n 37 and accompanying text. Indeed, it is generally agreed that 'IAEA safeguards reflect an international consensus on what constitutes a high level of safety protecting people and the environment from harmful effects of ionizing radiation'.

84 A case in point is, e.g., Durand-Poudret 2015, at 38–39.

of individuals, society and the environment against radiological hazards.[85] It is in the setting of the conventions' periodic peer review meetings that this 'incorporation by reference' bestows upon Agency safety standards a dynamic and normative quality.[86] In no small measure this is due to the adoption of revised guidelines regarding national reports under the two nuclear safety conventions[87]: In consequence, compliance with international standards is now amenable to robust scrutiny as States must provide a detailed article-by-article account in their national reports of how they implement and abide by relevant safety requirements, including those that govern EPR.

On the other hand, the model of 'compliance control' applicable in the context of the Early Notification and Assistance Conventions, the 'EPR Conventions' proper, is clearly less effective. To wit, it was not until 2014, at the Seventh (biannual) Meeting of the Representatives of Competent Authorities (CA) under the Early Notification and Assistance Conventions that national EPR reports were being presented for the first time. These biannual meetings provide more of a public forum for the discussion of EPR generic or topical issues rather than a mechanism for ascertaining individual States' compliance with specific EPR-related obligations under the conventions. On top of it, some States Parties oppose the very idea of national EPR reports on the ground that there are no reporting requirements under the Early Notification or the Assistance Conventions. Others object to such reporting as duplicative given existing reporting requirements under the safety conventions.[88]

Nevertheless, at the end of the day, these obvious differences in the robustness of the review process associated with the conventions directly bearing on EPR should not appreciably affect the ultimate normative effectiveness of the Agency's EPR safety standards. After all, EPR-related obligations under the two safety

[85] CNS, Preamble, para viii; and Joint Convention, Articles 4 and 11, respectively. In other words, they either inform the interpretation of the installation State's conventional obligations because they must be deemed expressly incorporated as such or, alternatively, because they generally reflect the degree of due diligence the installation State will have to apply in a particular situation.

[86] *See*, e.g., Handl 2003.

[87] As to their latest versions, see Guidelines regarding National Reports under the Convention on Nuclear Safety, IAEA Doc. INFCIRC/572/Rev.5, 16 January 2015; and Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management: Guidelines regarding the Form and Structure of National Reports, IAEA Doc. INFCIRC/604/Rev.3, 18 December 2014.

[88] Report of Seventh Meeting of the Representatives of Competent Authorities Identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, IAEA Doc. CAM/REP/2014, TM-45386, July 24, 2014, at 7.

conventions and obligations under the two EPR Conventions proper overlap. The stringency of the review mechanism of the former therefore can and does compensate for the relative weakness of the latter, thereby ensuring that the Agency's EPR standards enjoy de facto normative status. This conclusion stands notwithstanding some criticism that IAEA EPR requirements are too numerous and detailed, thus rendering strict compliance with them virtually impossible.[89] For whether or not they serve as mere "benchmarks" for the identification of broad areas of good practice and opportunities for improvements as alleged,[90] there is no denying that they do create a normative pull which States will not be able to easily disregard or escape from.

11.2.2 *Other International, Regional and Industry-Inspired Nuclear EPR Efforts*

Apart from this global, largely IAEA-based framework, nuclear off-site EPR is being addressed also in various other international, regional and industry-wide fora. These efforts not only reinforce and/or complement the global framework—often by adapting global standards and policies to specific local/regional conditions—but can also result in parallel structures and processes. For example, the OECD Nuclear Energy Agency[91] whose remit specifically identifies assistance with radiological emergency preparedness and management[92] organizes emergency exercises for member and non-member States as well as international organizations.[93] While the NEA ostensibly seeks to minimize any overlap with, and duplication of, IAEA activities,[94] its emergency exercises, such as its most recent INEX 5 exercise,[95] is indeed a service that resembles very closely IAEA's own ConvEx exercises.

[89] ENCO Report 2013a, 11.

[90] *See id.*

[91] NEA's current membership consists of 31 countries in Europe, North America and the Asia-Pacific region.

[92] *See* OECD/NEA, The Strategic of the Nuclear Energy Agency 2011–2016, 21.

[93] Kovan, NEA's role in radiological protection—Keeping things real, in Nuclear News. 31 July 2005: 'The International Nuclear Emergency Exercises (INEX) program was one of the NEA's responses to the Chernobyl accident. … The first exercises dealt with the urgent early phase of an accident, within days of the occurrence of the release, concerned primarily with protecting people through such things as giving iodine, providing shelter, and evacuation.'

[94] Id. at 32.

[95] See OECD/NEA, Working Party on Nuclear Emergency Matters, INEX 5 Exercise on Notification, Communication and Interfaces Related to Catastrophic Events Involving Radiation or Radiological Materials, Doc. NEA/CRPPH/INEX(2014)3, 13 November 2014.

Given the long history of European cooperation on the peaceful use of nuclear energy,[96] it should come as no surprise that EPR has been a topic of considerable regulatory attention at the European level. Following the accident in Fukushima the EU revised its nuclear safety directive.[97] However, while on-site EPR is being addressed in the directive, off-site EPR is not. Nor was the latter a target of the European stress test,[98] although the European Nuclear Safety Regulators' Group (ENSREG) conducting the review did identify a strong demand for a European initiative on off-site emergency preparedness and recognized its importance in the follow-up to the Fukushima disaster.[99] Rather, it is Council Directive 2013/59/EURATOM laying down basic safety standards for protection against ionizing radiation ('BSS Directive')[100] that determines key aspects of off-site EPR throughout EU Member States.[101] The promised gain in European harmonization,[102] however, is far from assured given Member States' wide margin of discretion in matters of nuclear safety. Thus the real challenge in achieving a coherent approach to off-site nuclear EPR in Europe will be, as the Council of the European Union acknowledges, the consistent transposition and implementation of the BSS Directive.[103]

Under the impact of Fukushima the idea of regional cooperation on radiological and nuclear EPR has taken off also in Asia within the framework of the Asian Nuclear Safety Network[104] and among ASEAN Member States.[105] The ASEAN Network of Regulatory Bodies on Atomic Energy's (ASEANTOM) focus on

[96] This cooperation began, of course, in 1957 with the adoption of the Euratom Treaty. For its latest version see the Consolidated version of the Treaty establishing the European Atomic Energy Community, 2012/C 327/01.

[97] Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations.

[98] *See* European Nuclear Safety Regulators Group, Peer review report: Stress tests performed on European nuclear power plants (2012).

[99] Id. at 49.

[100] Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom.

[101] These include basic protective measures, emergency information, environmental monitoring, emergency management systems, response plans and international cooperation. *See* Preambular Articles 41–49, Articles 69–71, 97–98 and Annexes XI and XII.

[102] It will repeal the current Basic Safety Standards Directive 96/29/Euratom by 6 February 2018.

[103] *See* Council Conclusions on Off-site Nuclear Emergency Preparedness and Response, Doc. 14618/15, 15 December 2015, Annex, 4.

[104] *See*, e.g., ANSN Progress Report 2013, 36–40.

[105] *See*, e.g., European Commission-funded study of the feasibility of enhancing regional cooperation within the Association of Southeast Asian Nations (ASEAN) on radiological and nuclear emergency preparedness and response, 16 February 2016.

nuclear EPR[106] includes periodic regional emergency exercises and the establishment of an ASEAN nuclear crisis center.[107] Similar efforts at regional harmonization of EPR have been underway within the ambit of the *Foro Iberiamericano*,[108] the Forum of Nuclear Regulatory Bodies in Africa,[109] the Arab Atomic Energy Agency[110] as well as the Cooperation Council for the Arab States of the Gulf.[111] Building on a long history of cooperative ventures, the Nordic countries[112] too, closely cooperate and coordinate national plans and responses thereby forging a 'Nordic approach'[113] to nuclear EPR.[114] Finally, mention must be made here of industry initiatives, such as the program launched by the World Association of Nuclear Operators (WANO).[115] In 2011, WANO following a recommendation of its 'Post-Fukushima Commission' decided to expand the scope of its peer reviews and other programs so as to 'focus not only on preventing a nuclear event, but also on mitigating the consequences of one if it should occur'.[116] As a result emer-

[106] *See* Summary of 1st Meeting of Asean Network of Regulatory Bodies on Atomic Energy (ASEANTOM), Phuket, Thailand, 3–4 September, 2013; and Economic Research Institute for ASEAN and East Asia, The 2nd WG Meeting on 'Study for Building a Guideline and a Cooperative Framework in East Asian Countries in case of Radioactive Emergency', 17 April 2015, at http://www.eria.org/news/FY2015/04/the-2nd-wg-meeting-on-study-for-building-a-guideline-and-a-cooperative-framework-in-east-asian-count.html; and News Summary, 'EU supports enhancement of regional cooperation on Radiological and Nuclear Emergency Preparedness and Response in South-East Asia', 17 February 2016, at https://ec.europa.eu/europeaid/news-summary-eu-supports-enhancement-regional-cooperation-radiological-and-nuclear-emergency_en.

[107] *See* T. Murakami 2012; Trajano 2015.

[108] *See* Armonización de los criterios reguladores para países de la región iberoamericana en la preparación y respuesta a emergencias radiológicas y nucleares, http://www.foroiberam.org/areas-colaborativas/preparacion-y-respuesta-a-emergencias.

[109] *See* IAEA 2014, para 124.

[110] *See* Mahjoub 2015.

[111] IAEA, Developing a regional emergency response plan in the Gulf region with the IAEA's technical cooperation support, https://www.iaea.org/technicalcooperation/Home/Highlights-Archive/Archive-2013/08302013_GCC_Emergency_Response.html.

[112] These include Scandinavia, Finland and Iceland. For details see The Nordic Manual (NORMAN): Co-operation between the Nordic Authorities in Response to and Preparedness for Nuclear and Radiological Emergencies and Incidents, Revised August 2015.

[113] *See* Holo 2016.

[114] An example of this is the Nordic recommendations on operational intervention levels in a nuclear emergency. *See* The Radiation Protection Authorities in Denmark, Finland, Iceland, Norway and Sweden, Nordic Intervention Criteria for Nuclear or Radiological Emergencies—Recommendations (2001); and Protective Measures in Early and Intermediate Phases of A Nuclear or Radiological Emergency: Nordic Guidelines and Recommendations (2014).

[115] WANO was launched in the wake of the Chernobyl accident for the purpose of maximizing the safety and reliability of commercial nuclear powers plants world-wide.

[116] *See* WANO after Fukushima: Strengthening Global Nuclear Safety, 19 Inside WANO No. 3, 4 (2011).

gency preparedness and severe accident management are now part of WANO's core mission.

Given these diverse efforts the question might well be asked as to the degree to which there is a place for idiosyncratic regional EPR arrangements or standards. A 2013 report prepared for the European Commission,[117] seeks to address this matter in a European context. While acknowledging the utility of existing mechanisms for coordination between the European Commission and the IAEA to 'ensure complementarity of activities, and respecting the principles of subsidiarity and proportionality',[118] the Report nevertheless endorses a Europe-specific approach to at least some aspects of off-site EPR in preference to 'reliance on work done at the international level by the IAEA'.[119] Action at the European level, so it asserts, is 'essential to ensure a consistent approach to compliance with EU [-specific] legislative requirements and a framework that is optimised for European … social and economic conditions'.[120]

Arguably, the greater the socio-economic and legal integration of a region, the stronger might be the argument in favor of a regional approach to nuclear EPR, especially if nuclear safety matters are already subject to region-specific standards. However, there are obvious technical and resource limits to how far any such regionalized approach might go. In this vein, consider, for example, the admission by ENSREG that EU Member States' compliance with the European Safety Directive's requirement to periodically submit to an 'international peer review of relevant segments of their national framework and competent regulatory authorities'[121] was best achieved through cooperation with IAEA's IRRS program.[122] More importantly, regionalization can be at odds with the very objective of harmonizing nuclear EPR measures internationally, a goal whose realization is essential for ensuring the credibility of the global nuclear safety regime.[123] When seen from this perspective, there is no denying that regional EPR standards will ultimately have to dovetail with global standards: 'Broad compliance with…international

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117 ENCO Report 2013a, viii.

118 Id. at v.

119 Id. at viii. The recommended measures include, inter alia, the expansion of EU-wide peer review to cover EPR; greater harmonization across Europe in respect of emergency planning zones and the introduction/removal of protective measures; as well as the development of a guidance document or codes of best practice regarding critical off-site EPR issues, such as cross-border arrangements. Id. at vi.

120 Id.

121 Article 8e.1 of the Directive.

122 ENSREG 2015, 14: 'ENSREG also agreed that self-assessments should be based on IAEA IRRS practices, noting that IRRS missions look beyond the scope of the CNS and the Joint Convention obligations and Full Scope IRRS missions are beyond the scope of the Directive'. *See also* Memorandum of Understanding between ENSREG and the IAEA for International Peer Review Missions to the EU Member States, June 28, 2011.

123 For further discussion, see infra § 11.3.1.

safety standards in EPR [is]…a key step to achieving harmonization'.[124] In this sense IAEA-promulgated EPR-related standards provide foundational normative guidance.[125] This fact has been repeatedly emphasized by the Agency itself, as for example, in 2011 when the IAEA General Conference stressed that EPR mechanisms and mitigation measures at a national level be 'consistent with the Agency's safety standards….'[126] Or, as the 2015 IAEA Safety Review puts it, it 'is essential that Member States make further efforts to utilize, as broadly as possible, the Agency's safety standards in the area of EPR to mitigate major inconsistencies between Member States during an emergency and thereby avoid serious disruptions at the international level'.[127]

11.3 Some Post-Fukushima EPR Challenges and International Regulatory Responses

11.3.1 Towards Greater International Harmonization of EPR

11.3.1.1 Cross-Border Co-ordination of EPR: Shared Understandings and Mutual Trust

The overriding importance of consistency of off-site EPR policies and measures as between neighbouring countries and across different regions was dramatically demonstrated first by the Chernobyl accident when response measures in affected regions of Western Europe inexplicably varied from country to country, at times even within the same country.[128] The issue surfaced with a vengeance also in the

124 International Conference on Global Emergency Preparedness and Response, 19–23 October 2015, Vienna Austria, Conference Report, Annex 2: President's Summary, 43, at 45. They provide more than the basic international framework for EPR, but 'a solid basis for achieving … harmonization'. IAEA 2015e, para 197.

125 For an acknowledgement see, e.g., Memorandum of Understanding ENSREG-IAEA, *supra* note 122, Article 4(1).

126 Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety—Resolution adopted on 22 September 2011 during the seventh plenary meeting, IAEA Doc. GC(55)RES/9, para 83 (2011). Emphasis added. *See also* Measures to strengthen international cooperation in nuclear, radiation, transport and

waste safety, Resolution adopted on 17 September 2015 during the eighth plenary meeting, IAEA Doc. GC(59)/RES/9 (2015), preamble, para (bb).

127 IAEA 2015e, para 197.

128 *See*, e.g., Handl 1988, at 58–59. Consider for example the maximum contamination values set for iodine-131 in milk. The United Kingdom and Sweden adopted a value of 2000 bequerels, whereas in Poland the limit was 1000, in Hungary 500, in Austria 370, and in the State of Hesse, Germany, a mere 20. As to the possibility of different protective standards within one and the same country, see, e.g., McMahon 2011.

wake of the Fukushima accident: While the U.S. government famously recommended that American citizens in Japan evacuate from an area of up to 50 miles from the stricken plant,[129] the Japanese authorities limited evacuation to an area with an initial radius of only 3, then 10, and eventually 20 km.[130] Needless to say, differences in national emergency plans for, perceptions of, and responses to a given major nuclear accident can be highly problematic because inevitably they raise awkward questions about their justifiability. In other words, the lack of a common understanding or approach to the management of off-site effects, certainly as between directly affected States—the accident State and neighbouring risk-exposed State(s)—but also, as Fukushima clearly proves, as between accident State and other distant States,[131] tends to undermine the very credibility of nuclear EPR generally.[132] In this vein, the joint 2014 position paper of the Heads of European Radiological Protection Competent Authorities (HERCA)[133] and the Western European Nuclear Regulators' Association (WENRA)[134] warns that 'differences can potentially have a significant effect, especially if the location of the emergency is close to an international border. Internationally, populations would feel unequally protected, depending on where they live'.[135] The very same point is being made also in the ENCO Report which emphasizes that national differences in implementing EPR principles and objectives 'are a source of misunderstanding, particularly among the public and politicians'.[136]

Both the HERCA-WENRA Approach and the ENCO Report therefore recommend greater harmonization or better cross-border coordination of national protective actions,[137] a position that has long been advocated by the IAEA itself.[138] Of

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[129] See 'U.S. urges Americans within 50 miles of Japanese nuclear plant to evacuate; NRC chief outlines dangerous situation', The Washington Post, 16 March 2011, at http://www.washingtonpost.com/national/us-urges-americans-within-50-miles-of-japanese-nuclear-plant-to-evacuate/2011/03/16/ABwTmha_story.html.

[130] *See* The National Diet of Japan 2012, 38.

[131] *See also* HERCA: Emergency Preparedness and Response, http://www.herca.org/activities.asp?p=3&s=6.

[132] *See*, e.g., French and Agryris 2014, 483; ENCO Report 2013a, xiii.

[133] 'Since its creation, HERCA identified the need for a harmonised approach on Emergency Preparedness and Response (EP&R) in Europe as a top priority.' HERCA, Emergency Preparedness and Response, at http://www.herca.org/activities.asp?p=3&s=6.

[134] WENRA is a non-governmental organization comprised of the heads and senior staff members of all the national nuclear regulatory authorities of European countries with nuclear power plants.

[135] HERCA-WENRA 2014, 7.

[136] ENCO Report 2013a, xii.

[137] HERCA-WENRA 2014, 15; and ENCO Report 2013a, xii–xiii.

[138] *See*, e.g., Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Requirements, No. GS-R-2, 37 (2002); and Measures to Strengthen International Cooperation in Nuclear, Radiation, Transport and Waste Safety, IAEA Doc. GC(55)/RES/9, September 2011, para 82. IAEA 2015e, para 197, reiterates that both practical insights gained from emergency exercises and from discussion in EPR expert group meetings continue to confirm the importance of harmonized EPR arrangements worldwide.

course, such harmonization or coordination is firmly rooted in EPR-related international legal obligations arising under the nuclear safety conventions. Thus, as noted before, Article 16, para 2 of the CNS requires that a nuclear installation state provide 'appropriate information' to other States 'in the vicinity of the nuclear installation' if it is likely to be affected by a radiological emergency. A risk-exposed Contracting Party that does not have a nuclear installation on its own territory, on the other hand, is obliged to 'take the appropriate steps for the preparation and testing of emergency plans' for the protection of its own population and environment.[139] In the final analysis, these obligations clearly imply appropriately harmonized EPR measures as between accident state and risk-exposed neighbouring State(s), as Contracting Parties to the CNS seem to readily acknowledge.[140] Indeed, the IAEA's Safety Requirements deliver a very similar message in that they call, in mandatory language, for 'arrangements for coordination' among States to ensure consistency in assessing the accident situation and its radiological implications, and in the taking of protective or other response actions.[141] More specifically, they mandate 'appropriate coordination across borders' to enable neighbouring states with areas in threat category V[142] to develop 'their own preparedness to respond to a transboundary emergency'.[143]

The ultimate objective of such transboundary coordination/harmonization in respect of off-site EPR cannot be complete cross-border uniformity. After all, emergency planning in general has traditionally been a matter of exclusive domestic jurisdiction; and while today's international (and regional) normative principles and standards do circumscribe States' discretion in devising domestic nuclear EPR policies and measures, they do not eliminate it completely. In short, national

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[139] CNS, Article 16, para 3. Articles 6(iv) and 13(iv) of the Joint Convention contain similar provisions.

[140] For example, at Sixth Review Meeting of the Parties to the CNS in 2014, contracting Parties 'noted the advantage of harmonizing the approach to severe accident analysis and the resulting emergency preparedness and response measures… [as well as] the importance of harmonizing protective measures and trade measures to be taken during an emergency'. Similarly, some contracting parties urged a complete and transparent exchange of information concerning possible transboundary effects of accidents 'as this would facilitate the development of appropriate harmonized emergency preparedness and response measures'. *See* 6th Review Meeting of the Contracting Parties to the Convention on Nuclear Safety, 24 March–4 April 2014, Vienna, Austria, Summary Report IAEA Doc. CNS/6RM/2014/11_Final, paras 28–29.

[141] *See*, e.g., IAEA 2015d, paras 5.39 (requiring transboundary coordination where the emergency planning zone or distance extends across the border); and 6.13–6.14 (requiring that 'governments ensure that arrangements are in place for the coordination of preparedness and response… at the international level', as appropriate).

[142] 'Threat category V area' is an 'area within the food restrictions planning radius, [i.e.,] the distance that could be affected by emergencies at a threat category I or II facility resulting in levels of ground deposition necessitating food restrictions consistent with international standards.' IAEA 2003, 42.

[143] IAEA 2015d, para 6.15.

differences reflecting local political and economic priorities, societal sensitivity to risk, quite apart from regulatory authorities' idiosyncratic understanding and implementation of the EPR normative framework,[144] will persist. Thus, a more realistic goal would be for neighboring states to aim for what has been referred to as cross-border 'shared technical understandings, coordination and mutual trust'.[145]

It goes without saying that, for such a transboundary relationship to materialize, the installation state as well as the neighboring state(s) must, first of all, faithfully and transparently comply with their various obligations arising under general international law,[146] the nuclear safety conventions, regional regimes and IAEA safety standards in respect of the assessment of, and the sharing of information and mutual consultations bearing on, the transboundary nuclear risk involved. More specifically, a transboundary concentration of EPR would have to cover all in-advance determined critical parameters of off-site accident preparedness and response, including reference levels,[147] 'observables' that trigger specific protective action[148] as well as criteria for the adjustment of emergency planning zones in response to evolving accident scenarios.[149]

The end result of this process ought to be a cross-border alignment of national response measures which, importantly, should allow risk-exposed countries' authorities to follow with confidence—at least during the critical early phase of the accident—the accident country's lead with regard to protective measures.[150] It

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[144] *See*, e.g., the ENCO Report 2013a, ix, which addressing the situation in the EU notes that 'Member States often take different approaches to the practical implementation of essentially the same principles and objectives for off-site EP&R'.

[145] HERCA, Guidance for Bilateral Arrangements, November 2015, 5. *See also* International Conference, *supra* note 124, at 12, which refers to cooperation among the NORDIC countries and at the level of the European Union as 'two examples of good regional cooperation in EPR' that promote trust and increase mutual understanding.

[146] For a discussion of such procedural obligations in the context of nuclear power activities, see, e.g., Handl 1992, 74–91.

[147] 'For an emergency exposure situation …, the level of dose, risk or activity concentration above which it is not appropriate to plan to allow exposures to occur and below which optimization of protection and safety would continue to be implemented.' IAEA, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No. GSR Part 3, 415 (2014).

[148] Such as 'operational intervention levels'. OILs are defined as the values of environmental measurements, in particular dose rate measurements, which set the threshold for the initiation of the different parts of the emergency plan and the taking of protective measures. *See* IAEA 2015d, para 4.28.

[149] I.e. in response to changing plant conditions and environmental monitoring results. *See also* Georges Piller, HERCA-WGE's Chairman, Topical Workshop on More Effective Emergency Preparedness & Response Arrangements at the EU level under the BSS Directive, European Commission, Brussels, 3 December 2015, at http://www.riskaudit-int.org/downloads/05_epr-topical-ws-gpiller.pdf.

[150] *See* the HERCA-WENRA 2014, 16.

is for this reason that the EU Council has called upon member states to 'include the alignment of protective measures along borders as a factor in emergency decision-making in accordance with … [an] optimised protection strategy'.[151] By the same token, when EPR policies and measures of the installation state differ appreciably from those of other neighboring states notwithstanding transboundary information exchanges and consultations, the former must be prepared to explain publicly the basis for such divergence.[152]

11.3.1.2 The Nature and Size of the Emergency Planning Zone (EPZ)

One of the principal tools for off-site EPR purposes is the establishment of emergency planning zones (EPZ) and distances around nuclear installations.[153] States are expected to designate two planning zones for 'category I'[154] nuclear facilities: A 'precautionary action zone (PAZ)', an area in the immediate vicinity of the facility in which precautionary protective measures, such as the evacuation, sheltering in place and the administration of stable iodine to the population,[155] would be taken before or immediately after an off-site release of radioactivity to minimize exposure to the radioactive plume[156]; and an adjoining 'urgent protective action planning zone' (UPZ), in which, following an environmental release, measures would be taken to minimize radiation exposure along the expected ingestion pathway.[157] Additionally, the IAEA Safety Requirements call for the establishment of an extended planning distance (EPD) beyond the UPZ to permit timely intervention to reduce the risk of stochastic health effects; and, beyond that, an ingestion and commodities planning distance (ICPD) over which response action

[151] *See* Council Conclusions, *supra* note 103, at 2, 6.

[152] *See* IAEA 2015d, para 6.14.

[153] '[P]lanning areas' nature and size are an important basis for the implementation of protective measures and the development of strategies.' Planning areas for emergency response near nuclear power plants: Recommendation by the German Commission on Radiological Protection 8 (2014).

[154] 'Facilities, such as nuclear power plants, for which on-site events (including very low probability events) are postulated that could give rise to severe deterministic health effects off the site, or for which such events have occurred in similar facilities.' IAEA 2007b, 11.

[155] *See* id., Annex V, 95–103.

[156] The principal goal of measures in the PAZ is to prevent severe deterministic effects, i.e., effects that can be related directly to the radiation dose received. The severity increases as the dose increases. A deterministic effect typically has a threshold below which the effect will not occur. The effect is deemed severe 'if it is fatal or life-threatening or results in a permanent injury that reduces the quality of life.' *See* IAEA 2013c, 129.

[157] IAEA 2015d, 29–31. Measures to be taken in the UPZ after a release of radioactivity, aim at reducing the risk of stochastic effects, i.e., effects that occur on a random basis independent of the size of dose. While the effect has no threshold, the chances of seeing the effect increase with dose.

for the protection of the food chain, water supplies and commodities other than food (and the public potentially affected by such commodities), could be taken following a significant release of radioactivity.[158] Both EPD and ICPD 'are to be established at the preparedness stage for the identification of areas in which actions may need to be taken during the response but for which only limited arrangements are put in place in advance'.[159]

Clearly, the nature and size of emergency planning zones and distances are a matter of international concern. This is self-evidently so whenever the planning zones or distances extend across an international border.[160] This may be the case also—albeit less obviously so—in situations in which emergency planning distances do not reach, let alone cross international boundaries. For, as pointed out before, different national configurations of emergency planning zones/distances irrespective of their proximity to an international border tend to be understood as signaling different protection levels, hence are likely to raise doubts about nuclear EPR in general.[161]

Prior to the accident, a 10 km emergency planning zone was in place around the Fukushima Daiichi nuclear power plant. However, as the IAEA Fukushima Report concludes, 'the extent of [the zone] … did not take into account the potential for a severe accident. In addition, provisions were not in place to extend relevant protective actions beyond the emergency planning zone'.[162] In short, in respect of both the size of the emergency planning zones and corresponding specific protective measures,[163] Japan's nuclear EPR proved to be deficient.[164]

[158] Id. at paras 5.38 (iii)–(iv).

[159] IAEA 2013c, 20.

[160] Luxemburg, Germany, Croatia, Romania, Hong Kong and Canada are among several countries with territory within the EPZ of neighboring countries.

[161] The ENCO Report, while warning against an over-simplistic equation of size of EPZ with level of protection afforded, nevertheless admits that such conclusions are inevitable and therefore will be a source of public and political concern". *See* ENCO Report 2013a, 25. *See also* Planning areas for emergency response near nuclear power plants, *supra* note 153, at 15.

[162] IAEA 2015b, Technical Volume 3/5: Emergency Preparedness and Response, 96.

[163] As is well-known, under deteriorating conditions at the stricken Fukushima-Daiichi plant, Japanese authorities were repeatedly forced to expand the initial evacuation area out to 20 km. Eventually, protective measures were ordered also for residents in an area between 20 and 30 km from the plant: Although at first only ordered to shelter-in-place, these residents were eventually urged to voluntarily evacuate. *See* The National Diet of Japan 2012, 38. However, the accident produced also radioactive hotspots further afield. For example, at Iitate, 40 km from the plant, levels of caesium-137 were as high as 18 MBq/m^2, well above the level at which evacuation would be deemed advisable. *See* 'IAEA says Fukushima fallout warrants more evacuation', New Scientist, 31 March 2011, http://www.newscientist.com/article/dn20324-iaea-says-fukushima-fallout-warrants-more-evacuation.html#.U8BCsbEo4dV.

[164] *See* IAEA 2015b, at 84–90.

Shortly after the accident, a number of countries began to re-evaluate the adequacy of their emergency planning zones.[165] At the same time, an IAEA group of experts concluded that '[a]n internationally agreed calculation methodology … [was] needed for determining the optimal size of emergency planning zones. Emergency planning zones … [were] to be redefined to take into account the experience from the accident at the Fukushima Daiichi nuclear power plant'.[166] As regards the EPR situation in Europe, the authors of the HERCA-WENRA Approach suggest that 'an accident comparable to Fukushima would require protective actions such as evacuation up to 20 km and sheltering up to 100 km. These actions would be combined with the intake of stable iodine'.[167]

International nuclear law does not prescribe a specific size for the planning areas concerned. While the IAEA suggests a mere 3–5 km radius for the PAZ and a 5–30 km radius for the UPZ[168] many nuclear installation states, including the United States,[169] have opted for somewhat larger PAZs covering areas with a 10–16 km radius.[170] The maximum distances for the EPD and ICPD whose establishment the IAEA now recommends are 100 and 300 km, respectively for large nuclear power plants.[171] As regards size, emergency planning areas are likely to vary from country to country. After all, emergency zones/distances will need to be

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165 *See generally* NEA/CNRA/CSNI (2014), at 28. *See further* Office for Nuclear Regulation, Japanese Earthquake and Tsunami: Implications for the UK Nuclear Industry, Final Report, HM Chief Inspector of Nuclear Installations, September 201, pp. 144–145.

166 Main Conclusions from the Workshop on Sharing Lessons Identified from Past Responses and Exercises, 23–27 April 2012, Vienna, in IAEA 2013, Annex A, 40.

167 HERCA-WENRA 2014, 9. More specifically, the study recommends urgent protective actions as well as a minimum common level of preparation for action, namely evacuation up to 5 km around nuclear power plants, and sheltering and iodine thyroid blocking (ITB) up to 20 km; and a general strategy to extend evacuation up to 20 km, and sheltering and ITB up to 100 km.

168 *See* IAEA 2013c, 22.

169 *See* 10CFR § 50.47 (c) 2: 'Generally, the plume exposure pathway EPZ for nuclear power plants shall consist of an area about 10 miles (16 km) in radius and the ingestion pathway EPZ shall consist of an area about 50 miles (80 km) in radius.'

170 *See*, e.g., G. Handl 1992, at 30–35; and J. Kubanyi, et al., Risk Informed Support of Decision Making in Nuclear Power Plant Emergency Zoning: Generic Framework towards Harmonizing NPP Emergency Planning Practices, JRC Scientific and Technical Reports 21–24 (2008).

171 *See* IAEA 2013c, 22. These calculations are for nuclear power plants with a capacity of more than 1 GW (th). The U.S. Nuclear Regulatory Commission rejected a petition for rulemaking which sought an increase in the size of the present plume exposure pathway zone from 10 to 25 miles, establishing a new zone but with less stringent requirements from 25 to 50 miles around reactors, expanding the existing ingestion pathway zone from 50 to 100 miles. See Petition for Rulemaking to Improve Emergency Planning Regulations (10 C.F.R. 50.47), http://www.nirs.org/reactorwatch/emergency/petitionforrulemaking22012.pdf. The Commission maintained that 'the current size of the emergency planning zones … [was] appropriate for existing reactors and that emergency plans … [would] provide an adequate level of protection of the public health and safety in the event of an accident at a nuclear power plant'. See https://www.federalregister.gov/articles/2014/04/09/2014-07981/emergency-planning-zones.

based on site-specific factors, such as topography, population density, infrastructure, etc. Moreover, as the ENCO Report notes, despite common principles underlying their establishment in most countries in Europe, sizes of EPZs in practice differ considerably—reflecting different value judgments about what is reasonable to plan for in a detailed manner.[172] Nevertheless, comparability of national approaches—based on compliance with IAEA's fundamental organizational principles[173]—would be desirable because it would bolster public confidence in EPR programs. This is true even though, admittedly, emergency planning areas' size per se is not necessarily a reliable indicator of the level of protection that could be expected within the areas concerned.

Two general final observations might be offered here. First, the establishment of national emergency planning areas must cover accident scenarios that are highly improbable, rather than merely possible. One of the most significant planning mistakes affecting the way in which the Fukushima accident evolved was the fact that 'a reactor-core damaging event at a nuclear power plant in Japan was considered implausible', hence was not taken seriously.[174] Prompted by the implications of this shortcoming in Japan's emergency preparedness, some countries have since begun to shift the focus of their EPR policies to 'reflect more closely an accident's potential impact rather than its likelihood'.[175] Second, in line with this re-orientation of EPR installation states ought to employ the tool of 'emergency planning distances' as specified in the IAEA Safety Requirements. For while the EPD or ICPD distance parameters are merely recommended, the use of the concepts as such for EPR purposes is mandatory. Unfortunately, today many States' EPR policies and measures have yet to come into compliance with this requirement.[176]

11.3.2 Event Reporting and Information Sharing

An essential precondition for the successful management of potential or actual off-site radiological effects in a transboundary context is the cross-border flow of timely, reliable and accurate information regarding the nature and scope of the accident. As already noted, the installation state is under an international conventional and customary legal obligation to deliver such information to the risk-exposed neighboring state(s) and may well be so obliged also pursuant to regional

[172] ENCO Report 2013a, 25.

[173] Such as its dose-related approach based on representative source-terms. *See* Planning areas for emergency response near nuclear power plants, supra note 153, at 15; and *see generally* IAEA 2007b.

[174] National Research Council 2014, 216.

[175] NEA 2016, 26.

[176] *See*, e.g., ENCO Report 2013b, 88 (noting the absence in most European countries of any planning zones for purposes of food restrictions).

(as in the case of EU Member States)[177] or bilateral legal frameworks bearing on EPR. A corresponding conventional obligation arises also towards the IAEA and the regional authorities concerned. Clearly, several factors determine the ultimate effectiveness of this transboundary communications process,[178] including, for example, the operational integration of regional[179] and global[180] emergency information exchange platforms.[181] It is, however, the degree to which the specific factual circumstances triggering the obligation of transboundary emergency notification are defined exactly and objectively that stands out as being of critical importance. Unsurprisingly, the issue has been the object of much international regulatory attention, hence will also be the focus of inquiry in the present context.

Notoriously, Article 1, para 1 of the Convention on Early Notification establishes a multiple threshold for the obligation to notify by requiring a triple affirmative determination by the installation state regarding the consequences of the emergency: First, that a release of radioactive material occurs or is likely to occur; second that it has resulted or may result in an international transboundary release; lastly, that such a release would be of radiological safety significance for another State.[182] Especially during the first few hours of an incident at a nuclear facility, however, the installation state might simply not be in a position to make these

[177] *See* Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency (87/600/Euratom); and Agreement between the European Atomic Energy Community (Euratom) and non-member States of the European Union on the participation of the latter in the Community arrangements for the early exchange of information in the event of radiological emergency (Ecurie), Official Journal C 102, 29/04/2003.

[178] Of course, the very quality (timeliness, comprehensiveness and accuracy) of the data transmitted and the mode of transboundary communication. However, a detailed analysis of these various factors would far exceed the necessarily limited scope of this paper. For a discussion see instead, IAEA 2012b.

[179] For a discussion of the European system, see infra text at notes 207–215.

[180] Namely, IAEA's Unified System for Information Exchange in Incidents and Emergencies (USIE). The IAEA website at https://iec.iaea.org/usie/actual/LandingPage.aspx. describes USIE as 'an IAEA web portal for Contact Points of States Parties to the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and of IAEA Member States to exchange urgent information during nuclear and radiological incidents and emergencies, and for officially nominated INES National Officers to post information on events rated using the International Nuclear and Radiological Event Scale (INES)." *See further* HERCA, Emergency Preparedness: HERCA-Approach for a better cross-border coordination of protective actions during the response in the early phase of a nuclear accident; development and practical testing 15 (2014), http://www.herca.org/docstats/HERCA_Approach_on_emergencies.pdf.

[181] *See*, e.g., Council of the European Union, Report on the Implementation of the Obligations under the Convention on Nuclear Safety—6th Review Meeting of the Contracting Parties, Doc. 13691/13, 17 September 2013, 42 (discussing the EURDEP's use on a global level by the IAEA).

[182] 'This Convention shall apply in the event of any accident involving facilities or activities … from which and which has resulted or may result in an international transboundary release that could be of radiological safety significance for another State.'

determinations or, equally plausibly, be reluctant to do so for political reasons.[183] It goes without saying that such reliance on the installation state authorities' subjective judgment is unfortunate and potentially represents a serious obstacle to effective emergency communications.[184] Unsurprisingly, at the first post-Fukushima biannual meeting in 2012 of the representatives of competent authorities identified under the Early Notification Convention and the Assistance Convention,[185] two "non-papers" by Japan and Russia called attention to this problem.[186] Specifically, the Japanese delegation urged the establishment of an international system—possibly through a resolution of the IAEA General Conference—which would require the installation state to notify the IAEA in the event of a nuclear accident, even before the state had adjudged that the incident fell within the ambit of the notification-triggering Article 1.1 of the Convention.[187] However, while the desirability of "objectivizing" the Convention's emergency notification threshold is widely recognized, it has not led to a formal adjustment of the global legal regime.[188]

Faced with this issue, many countries have striven for greater objectivity and comprehensiveness in specifying the threshold in bilateral agreements.[189] Consider for example, the case of Austria and neighboring Czechoslovakia/the Czech Republic. Over a period of more than two decades the two sides progressively tightened language in their bilateral agreements defining the obligation of transboundary emergency notification. An original 1982 Agreement concerning Matters of Mutual Interest regarding Nuclear Installations[190] had established dual triggering thresholds, namely the emergence of "a risk of harm to the population of the other contracting party in the vicinity of the border that cannot be excluded with certainty" and, as the default criterion, "the installation state's initiation of protective measures for its own population."[191] In 1989, in the wake of the Chernobyl accident and the entry into force of the Convention on Early

[183] Thus delays in transboundary or international notifications have been a rather more common phenomenon, the most notorious example of which is, of course, the USSR's failure to notify the international community for several days of the accident at the Chernobyl nuclear power plant which in turn prompted the launch of the Convention on Early Notification.

[184] To this effect see already Lang 1988; and Pelzer 2010, at 80.

[185] *See* Report of the Sixth Meeting of the Representatives of Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or a Radiological Emergency, IAEA Doc. CAM/REP/2012, TM-41005.

[186] *See id.* at 42 and 48, respectively.

[187] Id. at 45–46.

[188] *But see* text at notes 217–218 for a discussion of IAEA's recommendations regarding the timeliness of emergency notifications.

[189] For details see G Handl 1992 at 67–73.

[190] Abkommen zwischen der Republic Österreich und der Tschechoslowakischen Sozialistischen Republik zur Regelung von Fragen gemeinsamen Interesses im Zusammenhang mit Kernanlagen, 18 November 1982, BGBl. Nr. 208/1984.

[191] Article 6, paras 1–2. Translation provided.

Notification, the two countries, in a new bilateral agreement, revised the threshold definition by adopting almost verbatim the language of Article 1, para 1 of the Convention on Early Notification as regards unscheduled nuclear events.[192] However, they also retained the 'initiation-of-protective-measures-for-its-own-population' threshold[193] while adding a requirement to provide information to the other side also in respect of any incident which though not representing an unscheduled nuclear event would 'be capable of giving rise to concern among the population of a contracting party'.[194] Moreover, the new agreement expanded the range, and further specified the kind, of data to be provided in order to enable the other party to take appropriate measures for the protection of its own population.[195] Finally, in 2007, a Protocol amending the 1989 Agreement[196] brought about several additional improvements. First, it arguably strengthened the notification requirement in respect of incidents not representing an unscheduled nuclear event by pegging the legal obligation to 'the *informational needs* of the population of a Contracting Party'.[197] Second, it expanded upon the exchange of emergency information while at the same time it de-coupled—at least to some degree—the collection and transmission of relevant data from the installation state's decision-making process. Specific details of these changes were finalized by an exchange of diplomatic notes[198] whereby previous bilateral arrangements for the exchange of information utilizing incident/accident prognosis data from Austrian and Czech systems,[199] environmental gamma-ray dose rates measurements from the two

[192] Abkommen zwischen der Regierung der Republik Österreich und der Regierung der Tschechoslowakischen Sozialistischen Republik zur Regelung von Fragen gemeinsamen Interesses im Zusammenhang mit der nuklearen Sicherheit und dem Strahlenschutz, 25. Oktober 1989, BGBl. III 565/1990., Article 1, para 1.

[193] Id. Article 2, para 1.

[194] Id. Article 2, para 2.

[195] Id. Article 3, para 1.

[196] Protokoll zwischen der der Regierung der Republik Österreich und der Regierung der Tschechischen Republik zur Änderung des Abkommens zwischen der Regierung der Republik Österreich und der Regierung der Tschechoslowakischen Sozialistischen Republik zur Regelung von Fragen gemeinsamen Interesses im Zusammenhang mit der nuklearen Sicherheit und dem Strahlenschutz, December 20, 2007, BGBl. III 71/2008.

[197] Article 2, para 3. Emphasis added. However, this provision is subject to the parties' adoption of specific implementing steps which appear to have yet to be agreed upon.

[198] Notenwechsel zu den Vereinbarungen zur Durchführung des Abkommens zwischen der Regierung der Republik Österreich und der Regierung der Tschechischen Republik zur Regelung von Fragen gemeinsamen Interesses im Zusammenhang mit der nuklearen Sicherheit und dem Strahlenschutz 1), geändert durch das Protokoll vom 20. Dezember 2007, BGBl. III Nr. 68/2010.

[199] Vereinbarung zwischen dem Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Abteilung Strahlenschutz und dem Staatsamt für Nukleare Sicherheit über den Austausch von Daten der Notfallsysteme ESTE und TAMOS vom 10. März 2004. This Agreement was replaced in 2011 with a broader bilateral arrangement for the exchange of information and harmonization of nuclear emergency responses. *See* Vereinbarung betreffend den Datenaustausch von ESTE- und TAMOS-Codes, BGBl. III 148/2011.

countries' early radiation warning systems[200] and—significantly—of radiation monitoring data gathered by an Austrian monitoring station on the territory of the Czech Republic,[201] were formally incorporated into the 2007 Protocol. The Protocol did not, however, replicate all features of a more advanced transboundary notification regime that the two sides had accepted in the so-called 'Melk process of negations'[202] that focused on a single Czech nuclear power station, Temelín, located about 25 miles from the border with Austria.[203] Still, there is no denying that today the legal understandings between Austria and the Czech Republic concerning the cross-border flow of information related to nuclear incidents substantially reduce the installation state's (subjective) margin of appreciation, even though they do not eliminate it.

Ideally, neighboring countries ought to provide each other automatically—i.e., without the need of intercession by installation state authorities—with comprehensive real-time information on critical parameters reflecting the status of the nuclear installation concerned, as well as conditions on-site and off-site. Unfortunately, such sharing of information or complete openness to outside scrutiny by potentially affected neighboring states (or relevant regional bodies or the IAEA) is far from being the rule today. How difficult it might be to secure the legal basis for such cross-border transparency has been underlined again by the recent agreement between the Norwegian Radiation Protection Authority and Rosatom further implementing the 1993 Norway-Russia Agreement on Early Notification on

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[200] Vereinbarung zwischen dem Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft und dem Staatsamt für Nukleare Sicherheit über den Austausch von Gamma-Dosisleistungsdaten aus den Strahlungsfrühwarnsystemen, die von der Regierung der Republik Österreich und der Regierung der Tschechischen Republik betrieben werden, vom 20. November 2001.

[201] Die Vereinbarung zwischen dem Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft und dem Staatsamt für Nukleare Sicherheit über die Errichtung und den Betrieb einer österreichischen automatischen Strahlungsüberwachungsstation in der Tschechischen Republik vom 25. und 27. April 2001.

[202] Protokoll der Verhandlungen zwischen den Regierungen der Tschechischen Republik und der Republik Österreich, geführt von Ministerpräsident Zeman und Bundeskanzler Schüssel im Beisein von EU-Kommissar Verheugen, December 2000. The agreement called for the establishment of an information hotline between the two countries as well as an early warning exchange system, and permitted Austria to set up its own radiation monitoring station in the immediate vicinity of the Temelín power plant. Apart from a daily report on the status of the plant's two reactors, the agreement requires that any INES-1 classified event at Temelín be notified to the Austrian authorities. INES-1 signifies an "anomaly" in the operation of the power plant with no implications for the safety of people and the environment. *See* IAEA 2008, 3.

[203] The Temelín-specific arrangement may well be atypical for transboundary nuclear relations among neighboring States in general given that at that time Austria as a Member State of the European Community may have enjoyed special leverage vis-à-vis the Czech Republic as a then EC candidate country. *See also* Hummer 2008.

Nuclear Accidents and Exchange of Information on Nuclear Facilities.[204] Despite significant improvements upon the existing bilateral arrangement of nuclear emergency information exchange,[205] the transboundary flow of information is not self-activated but continues to require affirmative steps by the installation state which inevitably implies some degree of subjective assessment of the circumstances that trigger the transboundary notification obligation.[206]

At the European regional level, the notification threshold at law itself is relatively high and remains pegged to the decision by the Installation State 'to take measures of a widespread nature to protect the general public'.[207] However, as the ENCO Report concludes, most European countries 'have mechanisms in place to ensure timely notification of emergencies to neighbouring countries over and above obligations under the Convention on Early Notification and the Community's Urgent Radiological Information Exchange System'.[208] For example, of the emergency notification arrangements in place between Switzerland and Germany,[209] it is being claimed that the decision-making bodies of the risk-exposed State 'have almost the same access to information' as the authorities of the installation state.[210] Many neighboring countries cooperate also extensively through bilateral commissions or groups of technical experts whose remit includes EPR.[211] Moreover, specific bilateral notification arrangements, such as they are,

[204] Protokoll mellom Statens strålevern (Konigriket Norge) og Det russiske atomenergibyrået Rosatom (Den Russiske Føderasjon) om gjennomføring av praktiske tiltak i forbindelse med deres forpliktelser som følger av Avtalen av 10. January 1993 mellom regjeringen i Kongeriket Norge og regjeringen i Den Russiske Føderasjon om tidlig varsling ved atomulykker og um utveksling av in formasjon om atomanlegg, September 9, 2015. Text on file with the author.

[205] The new instrument now covers nuclear power plants, nuclear reactors aboard ships, nuclear fuel storage, as well as research and other reactors located in Norway and within the 300 km border with Russia. *See* Article III of the Protocol.

[206] Thus pursuant to Article II, para 2 of the Protocol the parties agree to alert each other immediately about a nuclear accident and provide each other with accessible information about the nuclear accident. While the notification is to be accompanied, if possible, by a categorization of the accident according to the INES scale, the Protocol expressly stipulates that the absence of such classification must not delay the notification.

[207] *See* Article 1 of Council Decision 87/8600/Euratom; and Article 2 of the Agreement between the European Atomic Energy Community (Euratom) and non-member States of the European Union on the participation of the latter in the Community arrangements for the early exchange of information in the event of radiological emergency (Ecurie), Official Journal C 102, 29/04/2003.

[208] ENCO Report 2013b, 106.

[209] *See* Vereinbarung zwischen dem Schweizerischen Bundesrat und der Regierung der Bundesrepublik Deutschland über den radiologischen Notfallschutz, May 31, 1978, AS 1979 312; and Notenaustausch vom 25. Juli 1986 zwischen der Schweiz und der Bundesrepublik Deutschland betreffend die Durchführung der Vereinbarung vom 31. Mai 1978/15. February 1980/25. Juli 1986 über den radiologischen Notfallschutz, AS 1988 781.

[210] *See id*. at 197.

[211] As regards, for example, Germany's cooperation with neighboring States, see, e.g., Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, Bilaterale Zusammenarbeit auf dem Gebiet der kerntechnischen Sicherheit, at www.bmub.bund.de/P297/.

complemented by the European Union Radiological Data Exchange Platform (EURDEP) which makes national radiological monitoring data from most European countries available in near-real time.[212] It is, however, equally true that some of these transboundary arrangements, be they of a bilateral or European regional nature, lack a solid legal foundation. For example, participation in EURDEP is legally required of EU Member States, whereas participation by non-EU countries is voluntary.[213] Similarly, some elements of present-day bilateral transboundary notification and emergency information exchange arrangements rather than being binding in a formal legal sense, represent informal cross-border understandings between regulatory agencies or simply individuals.[214] In the end, they may well prove less resilient than expected, especially during the critical but potentially confusing early hours of a nuclear accident. Clearly, a binding-rules-based approach throughout the wider European region would be preferable. Only such a system or common legal framework, European countries seem to agree, would be capable of ensuring the "instantaneous exchange of information (notifications, alerts, forecasts, summary of measured data, plant parameters, countermeasures)" in a radiological incident.[215]

At the global level, the IAEA's Incident and Emergency System is the lynchpin of the Convention-on-Early-Notification-based international emergency notification framework. A core element is the Unified System for Information Exchange in Incidents (USIE), the Agency's web-based communication platform for global exchanges and sharing of information on nuclear and radiological incidents and emergencies. The Agency recently developed IRIX, the International Radiological Information Exchange, as the preferred standard for emergency information exchanges at national and international levels. IRIX, does or will, enable users—regional systems, such as the EU's Ecurie and national emergency information systems—to automate information exchanges through USIE.[216] Thus, from a technical perspective, the transboundary flow of accident information could be sped up significantly as well as improved in terms of the accuracy of communications.

However, at a political or legal level obstacles remain. As noted, the Convention itself fails in terms of guaranteeing the timeliness of emergency

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212 EURDEP is currently used by 38 European countries—including all 28 EU Member States as well as Norway, Switzerland, Belarus, Russia, Azerbaijan, Turkey, etc.—for the continuous exchange of data from their national radiological monitoring networks. During radiological emergencies the rate of data delivery will be hourly. EUropean Radiological Data Exchange Platform, at https://remon.jrc.ec.europa.eu/. Its main aim, as the EURDEP website explains, "is to notify and inform competent authorities and the general public during the early phase of a large-scale accident with release of radioactivity to the atmosphere as early and extensively as possible.".

213 *See id*.

214 *See also* ENCO Report 2013b, 197.

215 Id.

216 *See* IAEA, International Radiological Information Exchange (IRIX) standard, at http://www-ns.iaea.org/downloads/iec/info-brochures/13-27431-irix.pdf.

notifications. In an attempt to address the problem, the Agency now recommends prompt action of a kind by the installation state that is in line with some of the more advanced bilateral transboundary notification schemes. Thus whenever, because of its closeness to an international border, a facility's emergency planning zone extends into a neighboring country's territory, an emergency notification would be expected to be sent to the neighboring state's authorities (as well as the Agency's IEC) at the same time as it would be sent to the installation state's own off-site authorities.[217] As regards facilities further inland, notifications are expected to be sent 'forthwith (i.e., within less than 2 h) after the declaration' of a nuclear emergency, and follow-up information not later than 4 h after the initial transboundary notification.[218] While these Agency clarifications would obviously go a long way in assuaging concerns about the Convention's notification threshold, they are in the nature of mere recommendations. Against the background of inconsistent and largely unsupportive state practice, it would be difficult to pass off the relevant passages in the Agency's Operations Manual as evidence of controlling normative expectations. In other words, the challenge of securing in legally binding terms the international emergency notification system's adequately prompt activation remains unanswered.

Finally, mention must be made here of, as it were, a reverse flow of emergency information, this time from the IAEA to the Installation (Accident) State (as well as to other states). The Fukushima accident highlighted in dramatic fashion the need for a single institutional voice at the global level capable of characterizing accurately and authoritatively for the world at large the accident and its likely progression.[219] Part of the explanation for the confusing, often contradictory, multiple-sourced flow of information about the status of the Fukushima-Daiichi reactors and the likely progress of the accident,[220] was Japan's difficulty in meeting and managing the demand for information by decision-makers and the public.[221] In recognizing some of these difficulties as symptomatic of the 'fog of accident,' certainly during its early stages, the 2011 Action Plan on Nuclear Safety entrusted the IAEA with an enhanced role in accident assessment and prognosis.[222] Specifically,

[217] IAEA 2012b, at 10.

[218] Id. at 10–11.

[219] *See* IAEA 2015f, 20.

[220] Apart from the difficulty of acquiring real-time accurate data, Japanese authorities also experienced major problems in assessing the information that was available and in offering a global view of the accident, its off-site impact and likely future course of development. For a discussion of these communication failures see, e.g., National Research Council 2014, at 221-22; and IAEA 2015b, Technical Volume 3/5, at 85-9.3.

[221] In other words, to be effective, emergency communications require authoritative interpretation of data, and the presentation of the informational output in a contextually 'proper perspective'. *See* IAEA 2015f, 13.

[222] Actually, at the time of the accident, the Agency's functions did not include 'providing a prognosis of the potential evolution of an accident or an assessment of the possible consequences'. *See* IAEA 2015b, Technical Volume 3/5, at 158.

it called upon the Agency to 'provide Member States, international organizations and the general public with timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences, including analysis of available information and prognosis of possible scenarios based on evidence, scientific knowledge and the capabilities of Member States'.[223] A critical part of the Agency's mandate—which is not to replace or duplicate national responsibilities[224]—is the assessment of accident information with a view to determining 'whether planned or implemented protective measures and other response actions taken' by the installation state are consistent with IAEA safety standards.[225] The conclusions of this assessment by the Agency's team of experts is to be shared with the installation state and, in close coordination with the latter, further refined, and ultimately disseminated to the international community.[226]

11.3.3 Peer Review of EPR and Emergency Exercises

To ensure the ultimate effectiveness of nuclear off-site emergency arrangements, EPR planners must engage in a process of continuous improvement through the sharing of relevant information and experience as well as related consultations with other decision-makers and stakeholders, including the public. Indispensable elements in this process are periodic peer reviews and the testing of EPR arrangements in realistic emergency exercises, both at the local, national and international levels.[227] Indeed, it is by now a commonplace that the importance of independent outside reviews and practical testing of EPR 'cannot be overemphasized.'[228]

Periodic testing and peer reviews of EPR are key proposals of the IAEA Action Plan on Nuclear Safety.[229] Indeed, the nuclear safety conventions themselves establish a clear legal obligation for the installation state to ensure that off-site emergency plans 'are routinely tested' and 'cover the activities to be carried out in an emergency;'[230] or 'are tested at an appropriate frequency.'[231] The IAEA Safety

[223] IAEA 2015c, 6.

[224] *See* IAEA 2015f, 3.

[225] IAEA 2015f, 22.

[226] Id. at 16.

[227] This is clearly one of the many important lessons of the Fukushima accident. For further details see, e.g., Institute of Nuclear Power Operations 2012, 30, 35.

[228] International Conference, *supra* note 124, at 14; and IAEA 2006, 1: 'Emergency response exercises are a key component of a good emergency preparedness program. They can provide unique insight into the state of preparedness of emergency response organizations.'

[229] IAEA 2011, 3.

[230] CNS, Article 16, para 1.

[231] Joint Convention, Article 25, para 1.

Requirements, moreover, call not only for “training, drills and exercises” for EPR,[232] but they stipulate also, as part of a quality management program, that national EPR arrangements undergo ‘periodic and independent appraisals,’ including international appraisals, such as the IAEA-organized EPREV.[233]

Apart from local and national testing of EPR, there is also an obvious, often pressing need[234] for transboundary nuclear emergency exercises.[235] Many of these will be conducted among neighboring countries bilaterally; others multilaterally on a regional[236] or global level. As already noted, these multilateral drills include tests organized by the European Commission,[237] the OCED/NEA (INEX exercises),[238] of course, the IAEA/IACRNE (ConvEx exercises)[239] as well as WANO.[240] They range from table-top exercises to field drills, can run for several hours or days, and are either stand-alone exercises or may represent the combined efforts of several sponsoring organizations.

The importance of periodic peer reviews—overwhelmingly endorsed by the regulatory community and the nuclear industry in respect of the safety of nuclear power plant operations in general[241]—applies with equal force to EPR planning for off-site effects.[242] Thus the Action Plan on Nuclear Safety recognizes the need

232 IAEA 2015d, Requirement 25, 56–57.

233 Id. at 58.

234 Note in this respect the critical findings by Nuclear Transparency Watch 2015, 54–55.

235 Note in this context the EU Council’s call for neighboring Member States to undertake ‘joint training sessions and nuclear emergency exercises representative of real emergency situations…’ See *supra* note 97, at 8.

236 As a case in point is the three-nation exercise simulating an accident at the Cattenom nuclear power plant, involving Luxemburg, France and Germany during 2011–2013. For details, see France, CNS, 6th National Report for the 2014 Review Meeting (June 2013), 132.

237 For example, the October 2015 Ecurie exercise tested the European-wide emergency information system.

238 See *supra* text at notes 91–95; and NEA 2014.

239 The Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), for which the IAEA provides the secretariat functions, coordinates large-scale international emergency exercises with the participation of a host State, of other States and various international governmental organizations concerned with nuclear EPR. For details on ConvEx-1 through 3exercises, see supra text at notes 75–78; For details on the latest Convex-3 exercise postulating a hypothetical major accident with transnational implications at the Laguna Verde nuclear power plant, see IAEA-Incident and Emergency Centre, Report of IAEA Participation: ConvEx-3(2008) International Emergency Response Exercise, Laguna Verde, Mexico, 9 to 11 July 2008 (2009).

240 In 2013 WANO organized a Scandinavian-Baltic region exercise. See WANO Moscow Centre Regional Crisis Centre in Action, http://www.wano.info/en-gb/mediaandevents/pressreleasesandannouncements/Pages/WANO-Moscow-Centre-Regional-Crisis-Centre-in-action.aspx.

241 See Handl 2014, 203–09.

242 On a global level, two types of international peer reviews are of special relevance in the present context, namely IAEA’s dedicated emergency preparedness review (EPREV) and, at least to some extent, its Integrated Regulatory Review Service (IRRS). The latter provides reviews of the effectiveness of national regulatory infrastructure, including EPR organizations, against applicable international guidelines and best practices.

for strengthening IAEA peer reviews of EPR; for enhancing their transparency through the publication of summaries and, with the consent of the state concerned, the full results[243]; and for states to voluntarily and regularly submit to them as well as follow-up reviews.[244] Specifically, the Action Plan calls upon states 'to conduct … regular reviews of their emergency preparedness and response arrangements and capabilities, with the IAEA Secretariat providing support and assistance through Emergency Preparedness Review (EPREV) missions, as requested.'[245]

In contrast to the *periodic testing* of EPR, there exists no equivalent international conventional or other clear legal basis for mandatory international peer reviews of emergency plans, the exception being the European Nuclear Safety Directive which mandates an international peer review of national EPR arrangements, albeit only in the immediate aftermath of an accident with off-site consequences.[246] However, this does not necessarily imply that today states are entirely free to decide whether or not to seek or submit to independent outside appraisals of their emergency plans. For, as noted, a state's international legal obligation to seek periodically an independent international assessment of its EPR plans can be construed to flow from Requirement 26 of IAEA's revised EPR Safety Standards.[247] Admittedly, there has been some push-back against the idea of EPR assessments taking the form of a 'prescriptive appraisal of [States'] emergency arrangements against a standard with no binding nature.'[248] Also, the ENCO Report in recommending that, analogous to the mandatory peer reviews under the European Nuclear Safety Directive,[249] the European Commission propose legislation for periodic EU-wide peer reviews of national off-site EPR arrangements[250] seems to assume the absence of an international legal obligation to this effect. At the same time, it is worth noting that at the 2015 International Conference on Global Emergency Preparedness and Response, the chairman of the international expert meeting recommended that the contracting parties to the CNS use the

[243] Note also the statement of the US delegate at the IAEA Board of Governors Meeting, March 7–11, 2016, at http://vienna.usmission.gov/160307safety.html: "In order to continue to enhance our nuclear and radiation safety programs, as well as emergency preparedness and response readiness, we urge all Member States to request and participate in not only peer review missions, but also in the related follow-up missions, and to publish the results of those missions to promote transparency and openness.".

[244] IAEA 2011, 3.

[245] Id.

[246] Article 8(e), para 4: 'In case of an accident leading to situations that would require off-site emergency measures or protective measures for the general public, the Member State concerned shall ensure that an international peer review is invited without undue delay.'

[247] IAEA 2015d, 57.

[248] Statement by France, Report of the Seventh Meeting of Representatives, supra note 72, at 10, para 53.

[249] See Article 8(e) of the Safety Directive, *supra* note 97. It also requires that the results of the PR be reported to MS and the Commission.

[250] ENCO 2015a, xii.

Convention's peer review process 'to ensure the continuous enhancement of EPR to a nuclear or radiological emergency.'[251]

In sum, as regards the issue of whether today the periodic, routine peer review of national EPR corresponds to an international legal obligation, the picture that emerges is somewhat contradictory. Nevertheless, what can be said with some degree of certainty is that while peer reviews of national EPR within the context of the CNS review meetings are likely to prove unproblematic, the opposite may well be true of similar exercises in different international settings or forums. Moreover, for the time being at least, special in-country, on-site EPR appraisals, such as through IAEA's EPREV missions, are likely to remain grounded in states' decision to voluntary seek out to this service. The independent international peer review, however, is a cornerstone of the global nuclear safety regime in general, and states' emergency planning, in particular. Therefore states' discretion in seeking or accepting to undergo such periodic reviews, to the extent it does exist today, ought to be severely curtailed, if not completely eliminated.

11.3.4 Emergency Assistance

One of the most important factors bearing on the mitigation off-site effects during the early stages of a nuclear accident may be the availability of transboundary emergency assistance. Although not every state's ability to manage the immediate aftermath of an accident will be equally dependent on international support, many countries will undoubtedly not be able to cope well, if at all, without foreign assistance. Certainly, this was a key lesson of the Chernobyl accident which prompted the international community to adopt and bring into force—in record time—the Assistance Convention. In the context of the Fukushima accident, the Convention was not invoked; nor was RANET, the Convention's operational response and assistance network,[252] utilized.[253] Instead, Japan did receive direct assistance from other states, international governmental and industry organizations, and others,[254] which enabled the country to manage an emergency that clearly challenged national response capabilities.[255] The Fukushima experience does not, of course, detract from the crucial importance of the Convention-based international assistance regime for the management of nuclear or radiological emergencies. To the

[251] International Conference, *supra* note 124, at 44.

[252] RANET has been defined as 'a network of States Parties to the Assistance Convention that are capable and willing to provide, upon request, specialized assistance by appropriately trained, equipped and qualified personnel with the ability to respond in a timely and effective manner to nuclear or radiological incidents and emergencies.' *See* IAEA 2013b, 13.

[253] *See* IAEA 2015b, 96.

[254] For details see 2015b, Technical Volume 3/5, at 157–58.

[255] *See* IAEA 2015b, 96.

contrary, the accident provided some valuable lessons[256] and, as noted, has led to an expansion of IAEA's 'assessment and prognosis' mandate,[257] thereby ensuring the Agency an even more prominent role in assisting states in emergency situations in the future.

Although there is substantial treaty practice, overwhelmingly of a bilateral nature,[258] that covers mutual assistance in the event of a nuclear emergency, the centerpiece of the international assistance framework is undoubtedly the Assistance Convention and its mechanisms as discussed above.[259] As noted, states parties to the Convention are expected, within the limits of their capabilities, to identify national assistance capabilities (NAC) consisting of experts, equipment and materials that could be made available to assist another state party.[260] This requirement is being met by registering NAC with RANET.[261] Registration does not, however, imply a legal commitment to assist. Nor does the Convention itself, of course, impose such an obligation. Rather, when a request is directed to the IAEA, it is the Agency's IEC which, upon receiving the request for international assistance, will attempt to coordinate and match registered NAC with the requesting state's specific needs through consultations with the offering state(s). The type of assistance that can be provided in this manner includes nuclear installation assessment and advice; radiation surveying and environmental sampling; dose assessment; decontamination and medical support.[262]

Unfortunately, to date states' compliance with the registration obligation has remained spotty, as only 28 states thus far have registered their capabilities with RANET.[263] Some countries may point to the Assistance Convention's lack of an implementation review process similar to that of the nuclear safety conventions as evidence of the allegedly 'voluntary basis' of the international assistance network, and blame the latter for states parties' lack of motivation to participate in

[256] *See* IAEA 2015b, Technical Volume 3/5, at 157; and infra text at note 266.

[257] See supra text at notes 219–226.

[258] A relatively rare example of a multilateral agreement is the Nordic Mutual Emergency Agreement on Connection with Radiation Accident, IAEA Doc. INFCIRC/49, 8 November 1963. Mention must be made here also, of course, of the all-purpose EU Civil Protection Mechanism, first established in 2001, which covers also nuclear EPR actions. It is available for response assistance intervention throughout the EU as well as outside. See Decision No 1313/2013/EU of the European Parliament and the Council of 17 December 2013 on a Union Civil Protection Mechanism, OJ L 347/924, December 20, 2013.

[259] See text at notes 41–47 and 68–74.

[260] Article 2, para 4 of the Convention.

[261] The European Emergency Response Centre which plays a similar role within the framework of the EU Civil Protection Mechanism could act as the 'single registration point' in Europe for IAEA's RANET system. *See* ENCO Report 2013b, 192.

[262] For details, see IAEA 2013b, at 36–67.

[263] As of February 29, 2016.

RANET.[264] Whatever the real reasons for their reluctance, states' limited participation in RANET remains a matter of concern, especially as there is a growing need for national expertise to assist the Agency with accident assessment and prognosis and for the creation of 'national rapid response teams that could be made available internationally through RANET.'[265] Conversely, the IAEA Fukushima Report draws attention to the fact that a requesting state's failure to make in advance arrangements for receiving emergency assistance may 'prevent the state from being able to accept international assistance in the early stages of the national response.'[266] The revised IAEA General Safety Requirements therefore now expressly call upon governments to 'ensure that adequate arrangements are in place to [allow the country to] benefit from … international assistance for preparedness and response for a nuclear or radiological emergency.'[267]

Finally, one intriguing question regarding emergency assistance is whether the installation state or 'affected state' must be open to offers of emergency assistance from abroad. The issue gained some notoriety at the time of the Chernobyl accident when several commentators, frustrated with the lack of progress on the part of Soviet authorities in getting control of the situation at the accident locale, suggested that the Soviet Union was internationally required to accept good faith offers of foreign assistance.[268] Of course, the Assistance Convention's mechanism itself is premised on there being a call for assistance and permits the requesting state to subject its acceptance of assistance to conditions. The alternative—to impose assistance on an accident-struck country—would prima facie be difficult to square with the affected state's sovereignty or, as Selma Kuş puts it, lead to chaos.[269] And yet, while this may be true considering the legal relationships created by the Convention, the question remains whether *in extremis*, 'elementary considerations of humanity'[270] or the obligation to protect the human rights of its inhabitants, might leave the accident state no choice but to accept an offer of international assistance.

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[264] See Russian Proposal for Strengthening and Implementation of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance with the [sic] Case of Nuclear Accident or Radiological Emergency, Non-Paper, 20 April, 2012, Sixth Meeting of the Representatives of Competent Authorities, supra note 185, at 49.

[265] IAEA 2011, at 3.

[266] IAEA 2015b, at 96.

[267] IAEA 2015d, 45.

[268] This argument could be made in addition to or separate from a claim that such assistance could be imposed on the accident State as a matter of self-defense/self-help on the part of potentially threatened third States.

[269] Kuş 2011, 13.

[270] *Corfu Channel case, (U.K. v. Albania), Judgment, Merits*, [1949] ICJ Rep. 4, at 22.

The issue has been pertinently raised in the course of the International Law Commission's work on the 'Protection of Persons in the Event of Disasters.'[271] In 2014, the Commission adopted draft articles on the topic which cover 'all disasters regardless of transboundary effect.' They would apply to a Fukushima-type nuclear accident, as a 'disaster' which, as a minimum, causes 'large-scale material or environmental damage, thereby seriously disrupting the functioning of society.'[272] While emphasizing states' general duty to cooperate in respect of humanitarian assistance, coordination of relief, etc., as well as disaster reduction,[273] the draft articles acknowledge the primary role of the affected state in managing relief and assistance operations.[274] Specifically, they confirm also the traditional position according to which the affected state's consent is a precondition for the provision of external assistance.[275] However, for a sub-category of disaster, namely one that exceeds the affected state's response capacity, the state is deemed to have an obligation to seek international assistance.[276] This duty, as the ILC's commentary documents, is derived from international human rights instruments and customary international law.[277] But, as the commentary also carefully points out, 'to 'seek' assistance implies … a negotiated approach to the provision of international aid,' thereby preserves the basic notion that the affected state's consent is an indispensable element.[278] On the other hand, the draft Articles also stipulate that 'consent to external assistance cannot be withheld arbitrarily.'[279] In other words, the draft Articles acknowledge that, at the end of the day, the affected state's right of refusal as an expression of its powers as the territorial sovereign is not absolute, but rather must be balanced against its obligations to affirmatively protect the human rights of the population of its territory. In short, they accept the possibility that in certain circumstances when a refusal to accept an offer of assistance amounts to a

[271] *See* Report of the International Law Commission on its Sixty-Sixth Session (5 May–June 6 and July 7–August 8 2014) 84, at 86–89 UN GAOR 99th Session, Supplement No. 10 (A/69/10). In 2014, at its sixty-sixth session, the Commission adopted the draft Articles on first reading and transmitted them to the UN Secretary-General, governments, etc. for comments and observations by January 1, 2016.

[272] The complete definition of 'disaster' in draft Article 3 reads: 'Disaster means a calamitous event or series of events resulting in widespread loss of life, great human suffering and distress, or large-scale material or environmental damage, thereby seriously disrupting the functioning of society.'

[273] *See* draft Articles 9-11.

[274] Draft Article 12.

[275] *See* draft Article 14, para 1.

[276] Draft Article 13.

[277] Commentary to draft Article 13, at 120–122.

[278] Id. at 122. By contrast, a duty to 'request' assistance, so the commentary maintains, 'carries an implication that an affected State's consent is granted upon acceptance of that request by a third State.'

[279] Draft Article 14, para 2. Some the members of the Commission, however, denied that there was a customary international legal basis for the affected State's duty not to arbitrarily withhold consent. See Commentary to draft Article 14, at 124.

violation of the right to life or other fundamental human rights, the affected state's withholding of its consent becomes arbitrary, hence legally untenable.

This finding is of significance also for the provision of nuclear emergency assistance, notwithstanding the 'without prejudice clause' of draft Article 20.[280] Ostensibly, the latter is meant to cover regional and bilateral agreements on mutual assistance.[281] However, it is doubtful whether the relationship between the Assistance Convention and the ILC draft Articles, is truly one calling for the application of the *lex specialis* rule as a result of which the consent provisions of the former would trump those of the latter.[282] For, as the Commission itself underlines, the rationale behind draft Article 20 and the *lex specialis* rule is to protect from among overlapping normative instruments the one whose provisions have 'a higher degree of specificity.'[283] By this measure, the elaborate set of rules governing the issue of the affected/requesting State's consent set out in the draft Articles and expounded in the commentary, rather than being displaced by the Assistance Convention's provisions, would qualify for filling any gaps in the latter as regards the details of an accident state's acceptance and refusal of offers of assistance.[284] Besides, it would be controversial to apply the *lex specialis* rule in a situation of competing normative instruments in a manner that excludes or diminishes the protection of fundamental human rights.[285]

In sum, it seems a reasonable conclusion therefore that in the wake of a catastrophic nuclear accident in which the installation state is clearly unable to take reasonable measures for the protection of its people and the environment, the government should be deemed to have no discretion as to whether or not to accept bona fide international assistance, especially when it is being offered through the IAEA's incident and emergency system.

11.4 Conclusions

While nuclear emergency preparedness and response today is ostensibly still a national responsibility there is no denying the fact that in the wake of the Fukushima accident EPR is increasingly being 'internationalized'. The March

280 Draft Article 20: 'The present draft articles apply without prejudice to special or other rules of international law applicable in the event of disasters.'

281 *See* Commentary, at 136.

282 One cause for such doubts would be the unequal legal standing of the two texts: one a treaty, the other a formally non-binding document or set of normative provisions that represents a mixture of codification of custom and progressive development of international law.

283 Id. at.

284 This is precisely one of the functions that, as the ILC acknowledges, the draft Articles could play, notwithstanding the application of draft Article 20.

285 For one perspective rejecting outright the idea of a *lex specialis* displacement of human rights, especially when the latter have *jus cogens* status or are non-derogable, see Paust 2016, 13.

12, 2011 accident was a wake-up call for the international community. It had become obvious that improvements in the international regulatory regime were urgently needed not only with regard to the operational safety of nuclear power plants worldwide, but also in respect of the management of off-site consequences of accidents through emergency preparedness and response. For Fukushima and its aftermath brought into sharp relief the undeniable fact that effective emergency planning is a critical factor shaping public perceptions of nuclear safety, hence public acceptance of nuclear power generation, not just locally or nationally, but globally. In drawing on the lessons of Fukushima, the IAEA, regional organizations, especially the European Union, the industry and others have been pushing for the harmonization of national EPR measures and policies as a prerequisite for boosting the credibility of nuclear EPR generally. However, it is understood that while regional initiatives are extremely important in fostering necessary cross-border coordination among states, in the final analysis such efforts must be consistent with IAEA's EPR-related safety standards to avoid undermining the very objective of enhancing the credibility of individual states' EPR posture.

Significant efforts have been spent also on enhancing the transboundary flow of relevant emergency information. The result has been some deepening and tightening of bilateral, cross-border information sharing arrangements—an example of which is the 2015 Norway-Russia Agreement,[286]—better integration of regional systems with the IAEA-based global information system, and the expansion within IAEA's IEC of an accident assessment and prognosis function which specifically aims to improve transparency and effectiveness of emergency communications, the lack of which was especially problematic in the context of Fukushima. Still, the goal of putting on a firm legal basis, as between installation state and risk-exposed neighboring state(s), largely automated sharing of real-time, comprehensive and accurate emergency information continues to prove elusive.

As is true of the aftermath of most catastrophic events, Fukushima, much as Chernobyl before, has triggered a reform process as a result of which today the global nuclear safety regime appears to be significantly stronger and more resilient. This is true also of nuclear emergency preparedness and response, generally speaking. Still, several major challenges remain to be tackled. Foremost among these is the need for international acceptance of mandatory, periodic in-country and on-site peer reviews of national emergency plans. Present reviews of national EPR during regularly scheduled review meetings of the parties to the nuclear safety conventions is useful, but not sufficient. Additionally, States will need to support more strongly the Agency's incident and emergency system, by signing up in greater numbers to RANET and registering more of the requisite specific assets in support of the Agency's expanded 'assessment and prognosis' mandate.

[286] See *supra* note 204.

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Chapter 12
Nuclear Accidents: Models for Reparation

Norbert Pelzer

Abstract The accidents of Chernobyl and of Fukushima-Daiichi teach the lesson that nuclear accidents may have large-scale catastrophic detrimental and trans-boundary effects causing nuclear damage of an extraordinary magnitude and of an 'exceptional character'. In order to cope with those occurrences, a risk-adequate regime of damage reparation has to be available. Reparation for nuclear damage may be provided by different tools (remediation or compensation). In the nuclear field, the civil law 'compensation approach' prevails and has been adopted by the international nuclear liability conventions and by national legislations. States refrained from establishing instruments on State liability under public international law. International conventions on civil compensation of nuclear damage have been developed and adopted since the late 1950s: The 1960/2004 [Paris] Conventions on Third Party Liability in the Field of Nuclear Energy, the 1963/2004 [Brussels] Conventions Supplementary to Paris Conventions, the 1963/1997 Vienna Conventions on Civil Liability for Nuclear Damage, the 1988 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention and the 1997 Convention on Supplementary Compensation for Nuclear Damage. These conventions establish a severe civil liability regime which is particularly tailored for the specifics of compensating nuclear damage. Main

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elements of this regime are: Liability without fault (strict liability) of the operator of a nuclear installation—exclusive liability of the operator (legal channelling)—limitation of liability in amount and in time—mandatory financial security to cover liability—exclusive competent court—recognition and enforcement of judgements—equal treatment of all victims. While the liability rules are simple there are yet elements which complicate compensation or which are disputable. The nature of the effects of ionizing compensation entails that it is in some cases difficult if not impossible to prove the causal link between incident and damage. This problem cannot finally be solved by lawyers. The amount of money to cover nuclear damage may be insufficient, particularly if States limit liability in amount. There may be reasons for limited liability but nevertheless unlimited liability appears to be the only form of liability which is adequate to the nuclear risk. Legal channelling of liability onto the operator of a nuclear installation is a most disputable concept because it is unjust. But at the same time it facilitates the bringing of claims for victims. Only a minority of States adhere to the international nuclear liability conventions. As a consequence, in cases of transboundary nuclear damage which affects non-Contracting States to the conventions claiming compensation is governed by the uncertainties of the general laws of conflict. A global nuclear liability regime based on worldwide treaty relations is requested. But this request misjudges reality and is disputable. Aiming at regional harmonisation based on treaty relations is a more realistic goal and is more helpful for victims.

Keywords Brussels Supplementary Conventions · Channelling of liability · Compensation amounts · Convention on Supplementary Compensation for Nuclear Damage (CSC) · Joint Protocol · Nuclear damage reparation · Paris Conventions · Nuclear liability regime · Strict liability · Vienna Conventions on Civil Liability for Nuclear Damage

Contents

12.1 Basic Questions of Nuclear Damage Reparation

12.1.1 Nuclear Accident Scenario

The peaceful use of nuclear energy is a potentially hazardous activity. It may cause damage of a catastrophic nature including long-distance transboundary effects. The Chernobyl and the Fukushima Daiichi nuclear accidents give evidence of this statement. It does not even need an accident to cause damage: Ionizing radiation emitted within the limits of the respective licence, *i.e.*, as a consequence of normal operation of the nuclear activity, may also entail detrimental effects.

This scenario quite obviously needs to be governed by a strong and robust regulatory national and preferably also international regime consisting of both a preventive legal framework aimed at excluding or at least acceptably minimizing the nuclear risk and a framework to ensure reparation in case nuclear damage occurs. A special regime of damage reparation 'is necessary since the ordinary common law is not well suited to deal with the particular problems in this field.'[1] This applies to the possible magnitude of nuclear damage and its potential to widespread effects also on the territories of States other than the installation State. It applies likewise to the particular nature of the effects of ionizing radiation on cells. Nuclear damage to cells often cannot easily be identified: a cancer does not show whether it is caused by radiation or by any other cause, there is no typical radiation cancer. Radiation damage may be latent for a long period of time (late damage). Radiation has a cumulative effect. Therefore the establishing of the causal link between the damaging occurrence and the damage suffered may be difficult if not even impossible in certain cases.

Against this background it does not require further explanation that nuclear damage does not only impact on the individual victims of a nuclear incident but it may also have broad detrimental impact on the environment and on the economic, social and organisational structure of human societies, which mainly means on the States involved. Alone the number of victims of Chernobyl and Fukushima Daiichi confirms this conclusion.[2] That background does not only require severe national liability legislations but at the same time it necessarily requires a far-reaching and

[1] No. 2 Exposé des Motifs [to the Paris Convention] approved by the OECD Council on 16th November 1982, http://www.oecd-nea.org/law/nlparis_motif.html.

[2] In Germany alone approximately 300,000 people claimed compensation for nuclear damage suffered by the 1986 Chernobyl accident. The claims were based on Section 38 German Atomic Energy Act which grants a right for compensation ('Ausgleich') against the Federal State in case the foreign operator or its installation State does not pay compensation. See Eich 2003, pp. 89–97.—As for the 2011 Fukushima-Daiichi accident, the status of claims made per 5 February 2016 is: 872,000 individual claims, 1307 millions claims made by individuals regarding losses due to voluntary evacuation, 390,000 claims made by corporations and sole proprietors; the total amount paid out accounts to Yen 5877.4 billion (= approximately EUR 46.3 billion) (see Table at http://www.tepco.co.jp/en/comp/images/jisseki-e.pdf).

comprehensive international harmonisation of the reparation regimes. International treaty relations on nuclear liability have to be established to facilitate compensation of transboundary nuclear damage. This situation has consequences and relevance for the concept, the role and the content of any model for the reparation of nuclear damage. It has in fact to be a guiding line for lawmakers at both the national and the international level.[3]

12.1.2 Strict Liability

It is not self-explanatory that a damage suffered has to be compensated by another person. Under ancient Roman law damage has to be borne by the damaged person: *casum sentit dominus* or *res perit suo domino*. In order to involve another person in damage reparation it needs the prerequisite that the damage can be attributed to another person. Attribution of damage ('Schadenszurechnung' under German law) is the legal basis for shifting damage reparation from the *dominus* to another person. It may be based either on the conduct of that person or on a source of risk under the responsibility of that person. The first alternative leads on to liability based on fault while the second alternative justifies liability without fault (strict or objective liability) ('Haftung ohne Verschulden' or 'Gefährdungshaftung', in French 'responsabilité sans faute' or 'responsabilité objective'). Since the use of nuclear energy is a potentially hazardous activity, is 'a source of risk', it follows that any regime on reparation of nuclear damage has to be based on strict liability principles.

Strict liability is the modern reaction of the law to the specific risks of industrialized societies. A person who performs potentially hazardous activities which are permitted by law shall be held liable for damage even if there is no fault on his part. He thus shall be liable for damage caused by misfortune, mishap and any other incidental damage, in German 'Unglücksschaden' or 'Zufallschaden'. The mere causation of a damage triggers liability.

Since nuclear damage may have widespread consequences and since nevertheless nuclear activities may be admitted by law, a question has to be raised: Shall damage caused by that type of activity indeed be entirely attributed to the person who caused it by performing an activity which is permitted by the State and is in compliance with its legal order, or should it not rather, at least partly, be attributed also to other persons including the person who suffered the damage because they all may have benefited from the permitted activity which eventually caused damage? The concept of strict liability establishes responsibility to pay compensation for an activity which was also performed in the interest of the general public, namely to contribute to energy supply.

[3] On the following part of this Chapter see also: Pelzer 2010a, pp. 13–21 (16 *et seq.*).

The German scholar Josef Esser in 1941 recognized that compensation of ‘Unglücksschaden’ is a task rather of ‘*iustitia distributiva*’ (distributive justice) than a task of ‘*iustitia commutativa*’, *i.e.*, of retributive justice.[4] That is a correct conclusion. If there is misfortune damage there is no valid reason for retribution between the two persons directly involved. There can only be just distributing of the damage between both.

Esser’s conclusion is confirmed and strengthened by recent new developments in general liability law. Liability law is seen as an instrument to create social peace. That means that not only the situation of the victim has to be taken into account but also that of the tortfeasor. Achieving social peace requires balancing the interests of all persons. ‘Was der Geschädigte erhält, muss dem Schädiger genommen werden.’,[5] what the victim receives, has to be taken away from the tortfeasor. Social peace can therefore only be gained if the person who pays compensation is in a position to carry that burden more easily than the other person. If we, however, require a balance between the burdens of the victim and the tortfeasor we make the first step to collectivise the originally crystal-clear bipolar relationship and expand it to a possible multipolar risk community. Liability does not only touch upon the victim and the tortfeasor, also others may be affected and involved. This applies in particular to insurers and possible additional financial guarantors. In case of catastrophic damage the State is obliged to step in if necessary.

The existence of various circles which are affected by the damaging occurrence makes evident a conflict. George P. Fletcher, in his often referred to Article ‘Fairness and Utility in Tort Theory’,[6] describes that there is a ‘confrontation’ between the ‘paradigm of reciprocity’ and the ‘paradigm of reasonableness’. While the first paradigm addresses the individual interests, the second one covers general welfare.[7] The paradigm of reasonableness presents ‘a commitment to the community’s welfare’.[8]

If lawmakers face nuclear liability scenarios they have to deal with multi-facet risk communities. Their diverging interests need to be balanced. Moreover, liability schemes also have general economic effects. This is an additional element which has to be taken into account. ‘The primary function of law, in an economic perspective, is to alter incentives.’[9] National and international legislators have to set the right incentives when establishing a regime of reparation of nuclear damage. Whether this is the case in regard to the existing nuclear liability rules will be more closely looked at later in this Chapter.

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[4] Esser 1941/1969, p. 73. See also Rinck 1959, p. 23.

[5] Medicus 2006, margin number 582.

[6] Fletcher 1972, pp. 537–573.

[7] Fletcher 1972, pp. 539 *et seq*. See critical comments on Fletcher’s approach made by: Watts 2011, particularly pp. 599–612.

[8] Fletcher 1972, p. 543.

[9] Posner 2002, p. 288.

12.1.3 Remediation and Compensation

Legal instruments to achieve reparation of damage are remediation and compensation. Black's Law Dictionary defines remediation as follows: 'Environmental law. The restoration of polluted land, water, or air to its former state, or as nearly so as is practical'.[10] This definition describes a scope which is limited to environmental restoration. It mainly deals with the restoration of goods which are in nobody's property ownership but are common goods. An eminent example of a remediation regime is so the so-called Superfund of the USA, namely the Comprehensive Environmental Response, Compensation, and Liability Act of 11 December 1980 (CERCLA). The full title of this Act reads: 'An act to provide for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites'.[11] Typical elements of remediation measures are that they are required by authorities and not by individual victims. Remediation is similar to risk prevention and may be called a sibling to prevention. It is of a public law nature rather than of civil tort law nature.[12]

Of course, remediation may be used to repair nuclear damage, too. This applies to CERCLA which also covers pollution of the environment caused by nuclear pollutants,[13] and a closer look into other national legislations will most probably confirm that there are more examples. However, at the international level there are no instruments which establish remediation measures to repair nuclear damage to the environment.

The only instrument of a transnational character which could be referred to here is the EU Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on Environmental Liability with regard to the Prevention and Remedying of Environmental Damage.[14] Although Article 4 (4) of the Directives explicitly excludes the nuclear risk or environmental damage or the imminent threat of such damage which may be caused by activities covered by the EURATOM Treaty[15] from the application of the Directive, Article 18 reserves a right to review this exclusion by 2013. This problem is still under review at the EU Commission but there are no indications that the exclusion under Article 4 (4) will be deleted and nuclear damage will be covered by the Directive.

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10 Black's 2004, p. 1407.

11 Public Law 96–510; 94 Stat. 2767. Codification: 42 U.S.C. § 9601.

12 See on compensation and remediation Pelzer 2010b, pp. 49–57.

13 See the definitions in CERCLA Section 101 no. 22 (C): 'release of source, byproduct, or special nuclear material from a nuclear incident…'

14 EU O. J. 2004 No. L 143 p. 56.

15 See consolidated version of the Euratom Treaty per March 2010 at http://europa.eu/eu-law/decision-making/treaties/pdf/consolidated_version_of_the_treaty_establishing_the_european_atomic_energy_community/consolidated_version_of_the_treaty_establishing_the_european_atomic_energy_community_en.pdf.

In summary, remediation as a means to provide reparation for nuclear damage does not play a major role internationally. There may be different pictures regarding national legislations. But this issue cannot be explored more in-depth in this Chapter.

As a matter of fact, in the nuclear field most of the existing national legislations and all of the current international instruments establish regimes of civil law compensation to balance nuclear damage suffered. The concept of compensation is defined by Black's Law Dictionary as follows: 'Payment of damages, or any other act that a court orders to be done by a person who has caused injury to another. In theory, compensation makes the injured person whole.'[16] Compensation of nuclear damage is construed as a specialized part of civil tort law. This applies to national nuclear liability legislations and also to the international nuclear liability conventions, which albeit being public international law instruments, establish civil law nuclear liability regimes. The principles and the content of those conventions will be dealt with in more detail later on.

Having in mind the long-distance transboundary nuclear risk and having in mind the possible magnitude of nuclear damage which may extend beyond the financial limits of private nuclear operators, one may ask why States did not embark on negotiating and adopting conventions on State liability for nuclear damage under public international law. This issue was discussed by the States in the 1990s during the negotiations on improving the international nuclear liability conventions in the aftermath of Chernobyl. The States clearly confirmed the existing civil law approach and expressly decided against a State liability instrument.[17] However, the liability conventions now contain amended Articles which explicitly stipulate that the conventions do not affect the rights and obligations of the Parties under the general rules of public international law. That means rights to compensation under public international law obligations remain untouched by the civil nuclear liability conventions. Here we will have mainly to resort to international custom, and it is well known that this is not necessarily a solid and secure basis for compensation of individual damage. It was a prudent decision that the States decided to build the special international nuclear liability regime on civil law rather than on public international law.

[16] Black's 2004, p. 322.

[17] See with references to the relevant IAEA Documents and to the work of the UN International Law Commission: Explanatory Texts 2007, pp. 18–19, 24–25; Lamm 1998, pp. 7–24 (10); Kiss 2006, pp. 67–83 (82); Van Dyke 2006, pp 13–46.

12.2 The International Nuclear Liability Regime

12.2.1 International Nuclear Liability Conventions

12.2.1.1 The Paris Convention

National civilian nuclear programmes commenced to be launched as a consequence of US President Eisenhower's 1953 Atoms-for-Peace Speech[18] in the mid of the 1950s. At the same time talks and negotiations started within the OEEC to develop an international instrument on third party liability for nuclear damage. The efforts resulted in the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, the so-called Paris Convention (PC) (entry into force: 1 April 1968). The Paris Convention was amended by an Additional Protocol of 28 January 1964 (entry into force: 1 April 1968), by a Protocol of 16 November 1982 (entry into force: 7 October 1988) and by a Protocol of 12 February 2004 (not yet in force).[19] The Paris Convention currently has 16 European Parties including Turkey.[20] The Convention contains in 24 Articles the main elements of a civil liability scheme to compensate nuclear damage. It is embedded in the national law of the Contracting Parties, *i.e.*, the Convention only offers provisions where national law is 'not well suited to deal with the particular problems'.[21] Pursuant to Article 7 PC, the liability is limited to a maximum amount of 15 million Special Drawing Rights (SDRs);[22] after the entry into force of the 2004 Protocol this ceiling will be replaced by a minimum amount of EUR 700 million.

Usually law and in particular international law react to certain events which make evident that a legal framework is needed. It is noteworthy that the public international law instrument Paris Convention was already available before the majority of States embarked on nuclear programmes and prior to most of the national nuclear liability legislations.

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[18] See the text of the speech at https://www.iaea.org/about/history/atoms-for-peace-speech.

[19] See unofficial consolidated version of the 2004 Paris Convention at http://www.oecd-nea.org/law/Unofficial%20consolidated%20Paris%20Convention.pdf.

[20] Latest status at: http://www.oecd-nea.org/law/paris-convention-ratification.html.

[21] See n. 1.

[22] There is, however, a Steering Committee recommendation of 20 April 1990 which recommends that Parties raise their liability amounts to not less than SDRs 150 million (OECD/NEA Doc NE/M(90)1, http://www.oecd-nea.org/law/paris-convention-dec-rec-int.pdf p. 13 no. 15). Most Parties followed that recommendation, see OECD/NEA, Nuclear Operator Liability Amounts and Financial Security Limits (last updated: July 2015), http://www.oecd-nea.org/law/2015-table-liability-coverage-limits.pdf.

12.2.1.2 The Brussels Supplementary Convention

Since the Paris Convention limits liability at a very low level, States recognized that the liability amount was already in 1960 inadequate to cope with the nuclear risk. In supplement to the Paris Convention they adopted the Convention of 31 January 1963 Supplementary to the Paris Convention of 29 July 1960, the so-called Brussels Supplementary Convention (BSC) (entry into force: 4 December 1974). The Brussels Supplementary Convention was amended by an Additional Protocol of 28 January 1964 (entry into force: 4 December 1974), by a Protocol of 16 November 1982 (entry into force: 1 August 1991) and by a Protocol of 12 February 2004 (not yet in force).[23] The Convention currently has 12 European Parties and is open only to Parties to the Paris Convention.[24] It contains 25 Articles plus an Annex on non-peaceful nuclear installations and establishes a three tier compensation system as follows (Article 3 BSC):

- 1st tier: compensation to be provided by the operator of a nuclear installation liable under the Paris Convention, currently not less than SDRs 15 million, after the entry into force of the 2004 Protocol not less than EUR 700 million;
- 2nd tier: compensation to be provided out of public funds of the Installation State between the amount of the first tier and—currently—SDRs 175 million, after the entry into force of the 2004 Protocol EUR 1200 million;
- 3rd tier: compensation to be provided out of public funds of all Contracting Parties according to a formula set out in the Convention between the amount of the 2nd tier and—currently—SDRs 300 million, after the entry into force of the 2004 Protocol EUR 1500 million.

Victims of nuclear incidents of Contracting Parties to both the Paris Convention and the Brussels Supplementary Convention thus enjoy a guaranty of a total amount of currently at least 300 million SDRs of compensation; this amount will be increased to a total amount of not less than 1500 million Euro once the 2004 Protocols are in force.

12.2.1.3 The Vienna Convention

The Paris Convention is open to Member States of the OECD and to Associate Countries as well as to States which are accepted by unanimous assent of the Contracting Parties to the convention. So it is not a worldwide convention. The

[23] See unofficial consolidated version of the 2004 Brussels Supplementary Convention at http://www.oecd-nea.org/law/Unofficial%20consolidated%20Brussels%20Supplementary%20Convention.pdf.

[24] Latest status at http://www.oecd-nea.org/law/brussels-convention-ratification.html.

obvious need for an instrument the participation to which is not limited was met by the Vienna Convention on Civil Liability for Nuclear Damage of 21 May 1963.[25] The Vienna Convention (VC) is adopted under the auspices of the IAEA and is open to all States Members of the UN, its specialized agencies and the IAEA. It entered into force on 12 November 1977 and was amended by a 'Protocol to Amend the Vienna Convention on Civil Liability for Nuclear damage of 29 September 1997' (1997 Vienna Convention, 1997 VC) (entry into force on 4 October 2003).[26] The Vienna Convention has 40 Contracting Parties and the 1997 VC has 13.[27] The Conventions contain 29 Articles each and, like the Paris Convention, establish a civil nuclear liability scheme. The Paris and the Vienna schemes in substance are more or less identical. However, the Vienna Conventions do not limit the liability in amount. The liability is unlimited but Parties have the option to limit it under the Vienna Convention to an amount of not less than US-Gold-$ 5 million, under the 1997 Vienna Convention to not less than SDRs 300 million. All Contracting Parties used the option to limit liability in amount which resulted in a great variety of liability amounts.[28]

12.2.1.4 The Joint Protocol

The Paris and the Vienna Conventions in their original versions limited their geographical scopes of application to their Contracting Parties.[29] This limitation entailed that a nuclear incident occurring in a Paris State and causing damage in a Vienna State could neither be compensated under the Paris Convention nor under the Vienna Convention and *vice versa*. Since the conventions are *leges speciales*, victims could not even have recourse to general tort law. Damages remained uncompensated.[30] It needed the 1986 Chernobyl accident to create momentum and do away with this unacceptable situation: States adopted the 'Joint Protocol

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[25] IAEA Doc. INFCIRC/500 = 1063 UNTS 265, https://www.iaea.org/publications/documents/infcircs/vienna-convention-civil-liability-nuclear-damage.

[26] IAEA Doc. INFCIRC/566. A The Protocol and a consolidated Text of the VC and the 1997 VC are published in IAEA Doc. INFCIRC/566 Annex at http://ola.iaea.org/ola/treaties/documents/infcirc566.pdf.

[27] Status see at IAEA Docs. Registration Nos. 1277, 1759 (http://www.iaea.org/Publications/Documents/Conventions/liability_status.pdf; http://www.iaea.org/Publications/Documents/Conventions/protamend_status.pdf).

[28] See OECD/NEA Operator Liability (n. 22).

[29] Article 2 1960/1982 PC. The Vienna Convention does not contain a territorial scope provision but the Contracting Parties recommended already in 1964 that the Convention should be applied as if there were such provision (IAEA Standing Committee on Civil Liability for Nuclear Damage, Vienna 13–17 April 1964, IAEA Doc. CN-12/SC/9). This recommendation was never disputed. See also OECD/NEA 1970, pp. 22–23. The 2004 PC and the 1997 VC explicitly extend their geographical scope if certain conditions are met, Article 2 2004 PC, Article I A 1997 VC.

[30] This problem was first described by Nordenson 1970, pp. 427–442.

Relating to the Application of the Vienna Convention and the Paris Convention of 21 September 1988' (Joint Protocol, JP)[31] The Joint Protocol entered into force on 27 April 1992 and currently has 28 Parties.[32]

The Joint Protocol 'bridges' both conventions in 11 Articles: An operator of a nuclear installation in a Vienna State shall be liable in accordance with the Vienna Convention for nuclear damage suffered in a Paris State, and an operator in a Paris State shall be liable in accordance with the Paris Convention for nuclear damage caused in a Vienna State (Article II JP). Either the Vienna Convention or the Paris Convention shall apply to the exclusion of the other. In case of a nuclear incident occurring inside a nuclear installation, the applicable Convention shall be that to which the State is a Party within whose territory the installation is situated. In the case of an incident outside an installation, especially during the carriage of nuclear material, the applicable Convention shall be that to which the State is Party within whose territory the installation is situated whose operator is liable according to the transport provisions of the Vienna Convention or of the Paris Convention (Article III JP).[33] The operative parts of both Conventions shall be applied in the same manner as between the Parties of the respective Convention (Article IV JP).

12.2.1.5 The Convention on Supplementary Compensation for Nuclear Damage

The Convention on Supplementary Compensation for Nuclear Damage of 29 September 1997 (CSC)[34] in its Preamble recital no. 2 in combination with recital no. 1 states that its Contracting Parties are 'desirous of establishing a worldwide liability regime to supplement and enhance … [the Vienna Convention, the Paris Convention and complying national legislation on compensation for nuclear damage] … with a view to increasing the amount of compensation for nuclear damage'. This describes the goal of the Convention *in nuce*: The Convention is designed to be the basis for a global nuclear liability regime based on the Paris and the Vienna Conventions and on national liability legislation which is consistent with the principles of those Conventions. At the same time it aims at increasing the compensation amount. The new element of this Convention is that it also directly refers to defined national legislation. States are not to adhere to the Conventions if they have complying legislation ('free-standing convention'). The principles of the national legislation have to be consistent with provisions which are set out in an Annex (so-called Annex States).

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[31] IAEA Doc. INFCIRC/402 = 1672 UNTS 302, http://ola.iaea.org/ola/treaties/documents/infcirc402.pdf.

[32] IAEA Doc. Registration No. 1623, http://www.iaea.org/Publications/Documents/Conventions/jointprot_status.pdf.

[33] On the history and on details of the Joint Protocol see in particular von Busekist 2006, pp. 129–153.

[34] IAEA Doc. INFCIRC/567, http://ola.iaea.org/ola/treaties/documents/infcirc567.pdf.

The Supplementary Convention establishes a civil liability regime for nuclear damage and a mechanism to increase the amount of compensation beyond the operator's liability. It consists of 27 Articles plus an Annex of 11 Articles. The Convention requests an operator liability of not less SDRs 300 million and beyond this amount 'the Contracting Parties shall make available public funds according to the formula specified in Article IV' of the Convention (Article III CSC). This second tier of compensation shall mainly be provided by nuclear States Parties; it is open-ended dependent on the number of Parties and currently will procure roughly SDRs 330 million. The second tier shall be distributed as follows: 50 % shall be provided to compensate nuclear damage suffered in or outside the Installation State and 50 % to compensate nuclear damage outside the Installation State to the extent it remains uncompensated under the first 50 % of the compensation (Articles V, XI CSC). If, however, a Contracting Party has ensured the availability without discrimination of at least SDRs 600 million, the funds of both tiers shall be made available to compensate nuclear damage suffered in and outside the Installation State (Article XI (2) CSC). The Convention does, unlike the Brussels Supplementary Convention, not contain a special Installation State tier.[35]

The Supplementary Compensation Convention entered into force on 15 April 2015 and has 8 Parties.[36] Among the Parties is the USA which claims that this Convention is the only nuclear liability convention it could adhere to. The USA adopted the Convention as 'Annex State' based on the so-called Grandfather Clause in Article 2 CSC Annex which allows the USA to leave its national nuclear liability law unchanged although it is partly not consistent with the requirements of the Annex.[37]

12.2.1.6 The Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material

The Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material of 17 December 1971 (CMC)[38] shall ensure that the exclusive liability of the operator of a nuclear installation ('legal channelling of liability onto

[35] On the Convention, *inter alia*, see: Explanatory Texts 2007, pp. 18–20, 61–99; US Dept. of State, Convention on Supplemental Compensation for Nuclear Damage: Article by Article Analysis, http://www.state.gov/t/isn/trty/5951.htm; Boulanenko 2000, pp. 161–170; McRae 2000, pp 171–183; McRae 2006, pp. 187–200; McRae 2015, pp. 7–25; Pelzer 2015, pp. 394–397; Touïtou-Durand 2010, pp. 257–274.

[36] IAEA Doc. Registration No. 1914.

[37] See on this issue in particular Pelzer 2015, p. 396.

[38] 974 UNTS 255, https://treaties.un.org/doc/Publication/UNTS/Volume%20974/v974.pdf.

the operator'[39]) under the Paris and the Vienna Conventions will also apply to the maritime carriage of nuclear material. Persons who by virtue of an international convention or national law in the field of maritime transport might be held liable for nuclear damage[40] shall be exonerated from this liability if the operator of a nuclear installation is liable for that damage pursuant to the provisions of the Paris Convention or the Vienna Convention (Article 1 CMC). Thus the Convention re-establishes the principle of legal channelling for the field of maritime nuclear transport.[41]

The Convention contains 12 Articles. It entered into force on 15 July 1975 and has 14 Contracting Parties.[42]

12.2.1.7 The Convention on the Liability of Operators of Nuclear Ships

Only for historical reasons mention has to be made to the Convention on the Liability of Operators of Nuclear Ships of 25 May 1962, the so-called 1962 Brussels Nuclear Ship Convention.[43] This Convention more or less transfers the Paris/Vienna civil nuclear liability scheme to nuclear powered ships. The liability of the operator of the nuclear ship is limited to 1500 million Belgian Gold-Francs per ship and per nuclear incident (Article III).[44] If a court of the licensing State on request by the operator, a claimant or the licensing State certifies that there is likelihood that the nuclear damage exceeds that amount the operator or the licensing State has to make available that amount to the court to pay any claims. The amount shall be regarded as constituting the limitation fund in respect of this particular incident. After the fund has been constituted that court is exclusively competent to apportion and to distribute the fund (Article XI).[45]

[39] See below Sect. 12.2.2.3.

[40] See Articles 6 (b) PC and II (5) VC which stipulate that liability under defined transport conventions shall remain untouched.

[41] See, *e.g.*, IAEA, Maritime Carriage of Nuclear Materials, https://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull14-1/14104502427.pdf.

[42] See https://treaties.un.org/pages/showDetails.aspx?objid=0800000280107d4b.

[43] Royaume de Belgique 1963, p. 707. The text is also reproduced in: American Journal of International Law vol. 57 (1963) p. 268. Since Germany is among the few States that ratified the Convention it is published in the German Official Gazette: Bundesgesetzblatt 1975 part II p. 977.

[44] The Franc mentioned in Article III is a unit of account constituted by sixty-five and one half milligrams of gold of millesimal fineness nine hundred [Article III (4)].

[45] For an overview of the Convention see: Könz 1963, pp. 100–111.

The Convention contains 28 Articles. Because of the inclusion of nuclear warships it never entered into force. With the exception of six Russian nuclear-powered icebreakers (plus two under construction) there are currently no civil nuclear ships.[46]

12.2.2 International Nuclear Liability Principles

12.2.2.1 General

The regime of damage reparation to cope with the specifics of the nuclear risk combines legal concepts familiar from general tort law with additional concepts which are new, unexpected and disputed, and one will see only in the future whether they might become innovative for tort law in general. The international nuclear liability regime was developed prior to the occurrence of major nuclear incidents which could have taught lessons. The concepts of the nuclear liability conventions were the result of theoretic deliberations, an academic exercise performed by government lawyers, insurance experts and diplomats. All of them, however, had in mind that the beginning of the use of nuclear energy was the atomic bomb. They knew that nuclear energy has a Janus face. Early studies confirmed this concern and predicted that major nuclear accidents in the civilian use may cause damage of many billion US Dollars.[47]

The result of the negotiations on the nuclear liability conventions had decisive impact upon national legislations. That does not only apply to the Contracting Parties to the conventions but also to non-contracting States' legislations. The liability principles of the conventions today are broadly accepted concepts and are recognized as a guaranty for a liability law adequate to the nuclear risk. Regarding the liability principles there is international harmonisation among the approximately 70 States that are Parties to the liability conventions or that enacted national nuclear liability laws without being a party to the conventions. Only few States adopted special nuclear liability legislation which does not fully conform to

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[46] The German Atomic Energy Act contains a provision on the liability for nuclear powered ships. The Act refers to the Brussels Nuclear Ship Convention which thus is made applicable as national German law (Section 25a Atomic Energy Act, for an English translation of the German Atomic Energy Act see http://faolex.fao.org/docs/pdf/ger50913E.pdf.

[47] Reference has particularly to be made to the so-called Brookhaven Report 1957; for a facsimile of the report see http://www.dissident-media.org/infonucleaire/wash740.pdf. With regard to a major nuclear incident the Brookhaven Report estimated 3400 deaths, 43,000 injuries and property damage of US $7 billion. If the $ 7 billion property damage is adjusted for inflation 2015 the figure will probably be increased tenfold; this figure is close to the Fukushima figures, see n. 2.

these principles, namely the USA,[48] Austria[49] and India.[50] Nuclear liability law seems to be open for international input and formal harmonisation. On the other hand, this small statistics also shows that only roughly one third of the States of the world have established special nuclear liability rules. The great majority rely on the existing national general tort law; some of them deem conventional tort law even better equipped to guarantee compensation for nuclear damage than the nuclear liability conventions and their principles.[51]

The basic liability scheme of all nuclear liability conventions is simple, clear and transparent like a silhouette: The operator of a nuclear installation shall be liable for nuclear damage upon proof that such damage has been caused by a nuclear incident in that installation or involving nuclear material coming from or originating in that installation. The constituents of this liability rule are 'operator', 'nuclear installation', 'nuclear incident', 'nuclear damage', 'nuclear material'. All of these terms are defined in the conventions: Articles 1 1960 and 2004 PCs, I 1963 and 1997 VCs, I CSC and 1 CSC Annex. This scheme applies likewise to most of the national nuclear liability laws irrespective of whether the States are Party to the conventions or not. It would go beyond the limits of this Chapter to elaborate on the elements of the scheme in detail. The definitions as drafted in the conventions provide sufficient first-glance insight. This includes the concept of nuclear damage but it has to be admitted that nuclear damage is probably the most complex concept.

In order to better understand the system of nuclear reparation, it is, however, necessary to introduce its main principles. They shall be described and commented upon in the following Sections.[52]

[48] An Act to amend the Atomic Energy Act of 1954, as amended, and for other purposes of 2 September 1957 ('Price-Anderson Act') (Public Law 85-256 = 71 Stat. 576 = 42.U.S.C. ch.23).

[49] Bundesgesetz über die zivilrechtliche Haftung für Schäden durch Radioaktivität (Atomhaftungsgesetz 1999–AtomHG 1999) (Bundesgesetzblatt Österreich I 1998/170; 2001/98; 2003/33). An English translation of the Act is available at: Hinteregger and Kissich 2004, p. 151.

[50] An Act to provide for civil liability for nuclear damage and prompt compensation to the victims of a nuclear incident through a no-fault regime channeling liability to the operator, appointment of Claims Commissioner, establishing a Nuclear Damage Claims Commission and for matters connected therewith or incidental thereto (The Civil Liability for Nuclear Damage Act 2010) (No. 38 of 2010, The Gazette of India, Extraordinary, Part II Section 1 No 47, September 22, 2010).

[51] See, *e.g.,* O'Higgins and McGrath 2002, pp. 7–21; Carroll 2005, pp. 229–238. See also Ludbrook 2004, pp. 239–247.

[52] For a quick overview of the liability regime, among others, see Schwartz 2010, pp. 307–354; Cook 2013, pp. 64–88.

12.2.2.2 Liability Without Fault; Exonerations

Articles 3 1960 and 2004 PCs, II (1), IV (1) 1963 and 1997 VCs establish liability without fault of the operator of a nuclear installation (strict liability[53]). Pursuant to Article 3 (1) and (3) CSC Annex, the legislation of Annex States is only in conformity with the Convention if it provides for liability without fault.[54] The mere causation of a nuclear damage triggers the liability as provided for under the terms of the convention applicable.

Exoneration from this liability is limited to exclusive cases of *force majeure*: the nuclear incident has to be directly due to an act of armed conflict, hostilities, civil war or insurrection (Articles 9 PCs, IV (3) VCs, 3 (5) CSC).[55] The list of exonerating events is exhaustive, which entails that events not listed do not exonerate the operator from liability. This applies, *e.g.*, to nuclear incidents which are directly due to a terrorist act. While in the cases of the listed events the operator is not in a position to provide effective protection against actions resulting in nuclear incidents, there is a different situation regarding accidents caused by terrorism. Protection against terrorism is possible and reasonable. Therefore the operator, under the respective law applicable, is responsible to take preventive measures against acts of terrorism. The operator has to ensure adequate protection against terrorist acts of both the nuclear installation and any nuclear material coming from or originating in his installation. During carriage of nuclear materials the operator who, in accordance with the relevant provisions, is liable for nuclear incidents in the course of transport is also responsible for adopting adequate precautionary measures against terrorists' interference. Strict liability for damage is a justified consequence if the precautionary measures fail to prevent a nuclear incident.

12.2.2.3 Exclusive Liability

'The right to compensation for nuclear damage caused by a nuclear incident may be exercised only against an operator liable for nuclear damage in accordance with this Convention…' (Article 6 (a) 1960 and 2004 PCs). 'Except as otherwise

[53] The Vienna Conventions and the Convention on Supplementary Compensation talk about 'absolute liability'. This term is also used in No. 14 of the Exposé des Motifs to the 1960 Paris Convention (n. 1). However, this marking may be misleading because sometimes absolute liability is understood as liability without any exoneration. This does not apply to nuclear liability law which allows exonerations.

[54] The relevant provision of the 1962 Brussels Nuclear Ship Convention is Article II (1): 'The operator of a nuclear ship shall be absolutely liable for any nuclear damage upon proof…'

[55] The 1960 Paris Convention, the 1963 Vienna Convention and the Convention on Supplementary Funding list as a further reason for exoneration a 'grave natural disaster of an exceptional character'. This exoneration was deleted in the 2004 Paris Convention and the 1997 Vienna Convention because it is expected that the operator is in a position to take precautionary measures against such events.

provided in this Article, no other person shall be liable for nuclear damage caused by a nuclear incident…' (Article 6 (b) 1960 and 2004 PCs). 'The operator shall incur no liability outside this Convention for nuclear damage caused by a nuclear incident.' (Article 6 (c) (ii) 1960 and 2004 PCs).—'Except as otherwise provided in this Convention, no person other than the operator shall be liable for nuclear damage.' (Article II (5) 1963 and 1997 VCs).—'The right of compensation for nuclear damage may be exercised only against the operator liable…' (Article 3 (9) CSC Annex). 'The operator shall incur no liability for damage caused by a nuclear incident outside the provisions of national law in accordance with this Convention.' (Article 3 (10) CSC Annex).

These quotations from provisions of the conventions form the core of the conventions' liability concept: Only and exclusively the operator of a nuclear installation shall be liable for nuclear damage. The liability of all other persons, as for instance suppliers, licence authorities or other third persons who may contribute to a nuclear incident, are excluded from liability. The liability is concentrated on the operator, and the operator shall be the only person liable under the convention with the exclusion of any possible other legal grounds of liability. The liability is 'legally channelled onto the operator'. Channelling is supported by the structure of the liability: The operator is not only liable for nuclear damage caused by nuclear substances in his installation but also by nuclear substances which originate from the installation.[56] This covers material used outside the installation and in particular the carriage of nuclear material. In case of transport, either the sending or the receiving operator shall be liable for damage caused by nuclear incidents occurring in the course of the transport.[57]

The reason for channelling liability onto the operator is spelt out in the Exposé des Motifs to the Paris Convention as follows:[58]

> 'Two primary factors have motivated in favour of this channelling of all liability onto the operator as distinct from the position under ordinary law of torts. Firstly, it is desirable to avoid difficult and lengthy questions of complicated legal cross-actions to establish in individual cases who is legally liable. Secondly, such channelling obviates the necessity for all those who might be associated with the construction or operation of a nuclear installation other than the operator himself to take out insurance also, and thus allows a concentration of the insurance capacity available.'

If nuclear damage is caused by an incident that results from an act or omission done with intent to cause damage, the operator has a right of recourse against the individual[59] acting or omitting to act with such intent. Establishing a right of recourse only against individuals may be qualified as economically irrelevant.

[56] Articles 3 (a) 1960 and 2004 PCs, II (1) 1963 and 1997 VCs, 3 (1) CSC Annex.

[57] Articles 4 1960 and 2004 PCs, II (1) 1963 and 1997 VCs, 3 (1) CSC Annex.

[58] No. 15 para 2 *op. cit.* (n. 1). See also Explanatory Texts 2007, pp. 10–12. See furthermore: Fiore 2009, pp. 423–425.

[59] The principle *respondeat superior* does not apply.

Individuals normally do not have the financial means to reimburse the operator. With exception of terrorists there will probably be only few cases where people act with intent to cause nuclear damage. However, there is likewise a right of recourse if and to the extent it is so provided expressly by contract.[60] Such contractual right of recourse has more economic relevance because it is not limited to individuals.

Legal channelling is a unique concept which cannot be found in other fields of tort law.[61] Its justification provided in the Exposé des Motifs is convincing but, on the other hand, it has to be admitted that the concentration of liability to one single liable person and the exoneration of all other persons who may, even with fault, have contributed to causing the damage is unjust. Legal channelling is therefore the most disputed principle of nuclear liability law.[62]

12.2.2.4 Limitation of Liability in Amount

The 1960 Paris Convention clearly provides for a limitation of liability in amount in form of a binding ceiling (SDRs 15 million but in no event less than SDRs 5 million, Article 7). The other Conventions, including the 2004 Paris Convention, do not establish ceilings but only minimum amounts.[63]

Compensation for damage suffered in principle aims at full compensation which *per se* is not guaranteed if the liability is legally fixed at a certain amount. This applies to both liability based on fault and strict liability. Regarding strict liability, it is sometimes claimed that the severe liability principle has to be balanced against a limitation of the liability in amount. Apparently as a consequence of this view, all nuclear liability legislations, with only few exceptions, provide for a limitation of the operator's liability in amount. These liability amounts of the various national legislations, even if based on the conventions, vary greatly: extremely low

[60] Articles 6 (f) 1960 and 2004 PCs, X 1963 and 1997 VCs, 10 CSC Annex.

[61] There are other examples of liability channelling, though. But in those examples the exoneration from liability of other persons is limited to a certain circle of persons while nuclear channelling is comprehensive and excludes all other persons. See Article 7 (5) 1996/2010 HNS Convention, http://hnsconvention.org/Documents/Consolidated_Text.pdf. A short overview of the different types of channelling is provided by Boyle 2006, pp. 572–573.

[62] See, *e.g.*, Ameye 2010, pp. 339–379, pp. 33–58; Handrlica 2011, pp. 69–82. Legal channelling was particularly discussed in Germany prior to its ratification of the Paris Convention in 1975. Germany had made a reservation regarding channelling which was not used after all. The discussion of the channelling concept delayed the ratification considerably. On German literature see Weitnauer 1964, pp. 146–149; Pelzer 1966, pp. 1010–1014; Kanno 1967.

[63] Articles 7 2004 PC (not less than EUR 700 million), V 1963 VC (not less than Gold-USD 5 million) and 1997 VC (not less than SDRs 300 million), 4 CSC Annex (not less than SDRs 300 million).

figures and rather high figures are available.[64] Only Austria,[65] Germany,[66] Japan[67] and Switzerland[68] enacted nuclear liability legislation with unlimited liability.[69]

The claim that strict liability has necessarily to be limited liability is not a convincing justification of the limitation. The history of law and comparative studies show that strict liability may be limited or unlimited; both approaches are being used. There is no compelling link between strict liability and limitation in amount of compensation, and limited liability may likewise be combined with liability based on fault.[70] The limitation of liability is an instrument which is used to support and promote defined industrial developments. It is a form of a subsidy. But it has broader importance than promotion of industry. Limitation of liability amounts may also be a tool to distribute the burden among the parties involved in order to achieve the balance as described in Sect. 12.1.2. Adequate burden-sharing facilitates gaining social peace. This point will be discussed later in some more detail.

On the other hand, it cannot be denied that establishing an exclusive and final amount to cover all damages is an arbitrary decision in any case, and the lower the amount the more arbitrary is the ceiling. That holds also true if the legislator,

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[64] See OECD/NEA, Nuclear operator liability amounts *op. cit.* n. 22.

[65] See n. 49.

[66] Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren (Atomgesetz) of 23 December 1959/15 July 1985 as amended (Bundesgesetzblatt 1985 I p. 1565; 2015 I p. 2053).

[67] 1961 Act on Compensation for Nuclear Damage as amended (Act No. 147 of 1961, Act No. 19 of 2009).

[68] Kernhaftpflichtgesetz (KHG) of 18 March 1983 as amended (SR 732.44; AS 1983, 1886; 2010, 1739).

[69] After the entry into force of the 2004 Protocol to Amend the Paris Convention, unlimited liability will also be introduced in Finland and Sweden.—Parties to the Vienna Convention that do not expressly limit the liability in amount are deemed to also apply unlimited liability to the operator liable. Insofar the legislation of the 1963 Vienna Party Russia gives rise to doubts. The Russian 'Federal Law on the Use of Atomic Energy of 21 November 1995' (No. 170-FZ) as last amended on 2 July 2013 (No. 159-FZ) seems to establish unlimited liability, see Articles 53–60 and in particular Article 55(2): 'The maximum limit of liability for losses and damage caused by radiation exposure in regard to any incident cannot exceed the amount established by the international agreements of the Russian Federation.' The Vienna Convention does not fix an amount but leaves limitation to the implementing legislation of the Contracting Parties. Article V (1) 1963 VC stipulates 'The liability of the operator may be limited by the Installation State to not less than US $5 million for any one nuclear incident.' The Russian Law does not take a decision of its own on a limitation of liability but refers back to Article V (1) VC. This can either mean that there is no limitation under the Russian law which entails that unlimited liability applies or it may be interpreted as limitation of liability to the minimum amount of US $5 million which corresponds to 5 million US Gold-Dollars (Article V (3) 1963 VC). Since 1996 (sic!) Russia has been working on a new nuclear liability act but there is no result of these efforts yet. See the report by Lebedeva 2014, pp. 105–111.

[70] See Pelzer 1982, pp. 33 *et seq.* with references. In great detail on this issue see Fischinger 2015, pp. 42 *et seq.*

including the constitutional legislator, decides on the limitation. Therefore, a limitation of liability in amount can only be accepted if the national legal order ensures that the arbitrary limitation will be corrected by additional payments if necessary in order to achieve the envisaged social peace. The US Price-Anderson Act[71] limits liability in amount at a very high level.[72] In a judgement of 26 June 1978 the US Supreme Court acknowledged that the fixing of liability limits is arbitrary and in conflict with constitutional rules (equal protection component of Due Process of the Fifth Amendment). The Court ruled that the limitation of liability under the Price-Anderson Act only for that reason is not violating constitutional rights because Congress, in case of nuclear damage in excess of the statutory limit, will 'take whatever action is deemed necessary and appropriate to protect the public from the consequences'.[73] This judgement is groundbreaking and precedent-setting also for other States with liability limitation. It confirms that liability limits in principle are arbitrary and may be in conflict with individual constitutional rights but can be accepted if the State ensures compensation if the damage exceeds the limit. States under the rule of law will most probably stand this test even if there is no express language to this extent in the written statutes.

Since the function of liability limitation to contribute to burden-sharing with a view to achieving social peace obviously conflicts with high-level individual rights protected by the constitution, the confrontation described by Fletcher between the paradigm of reasonableness and the paradigm of reciprocity[74] again prevails. This confrontation seems to be inevitable and immutable because the limitation of liability in amount is a legal means which is impropriate to align one paradigm with

[71] See n. 48.

[72] The current amount is US $ 13.6 billion (Section 170 (b) Atomic Energy Act 1954, as amended, Public Law 83–703, 68 Stat. 919). A brief description of the US system is available at World Nuclear Association, Liability for Nuclear Damage—US Framework (updated February 2016), http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/liability-for-nuclear-damage.aspx.

[73] U. S. Supreme Court, Duke Power Co. v. Carolina Environmental Study Group, No. 77–222, argued: March 20, 1978, decided: June 26, 1978, (438 U. S. 59 (1978) = JUSTIA US Supreme Court, https://supreme.justia.com/cases/federal/us/438/59/case.html. The Court ruled at p. 86: 'Given our conclusion that, in general, limiting liability is an acceptable method for Congress to utilize in encouraging the private development of electric energy by atomic power, candor requires acknowledgment that whatever ceiling figure is selected will, of necessity, be arbitrary in the sense that any choice of a figure based on imponderables like those at issue here can always be so characterized'. This is not, however, the kind of arbitrariness which flaws otherwise constitutional action. When appraised in terms of both the extremely remote possibility of an accident where liability would exceed the limitation and Congress' now statutory commitment to 'take whatever action is deemed necessary and appropriate to protect the public from the consequences' of any such disaster, 42 U.S.C. § 2210(e) (1970 ed., Supp. V), we hold the congressional decision to fix a $560 million ceiling, at this stage in the private development and production of electric energy by nuclear power, to be within permissible limits, and not violative of due process.' Today the ceiling is adjusted for inflation to $ 13.6 billion, see n. 72.

[74] See nn. 6, 7, 8.

the other one. Insofar liability which is not limited in amount is superior. By establishing minimum liability amounts, the revised Paris and Vienna Conventions and the CSC now offer unlimited liability as an option. However, unlimited liability can end the confrontation between the paradigms neither. It continues to exist but it will be shifted from the level of the extent of liability to the level of coverage of liability.

12.2.2.5 Mandatory Coverage of Liability

All of the nuclear liability conventions require the operator of a nuclear installation to have and maintain insurance or other financial security to cover liability.[75] The Contracting Parties have to implement those obligations at the national level. States not Party to any of the conventions provide similar obligations for the operator liable in their respective laws.

Liability which is limited in amount has to be covered in full (principle of congruence). Unlimited liability cannot be covered in full because unlimited assets for full coverage do not exist. The conventions provide that the amount of financial security to cover unlimited liability shall be not lower than the minimum liability amount established under the convention if there were limited liability, *i.e.*, EUR 700 million under the 2004 Paris Convention and SDRs 300 million under the 1997 Vienna Convention and the Convention on Supplementary Compensation.[76]

The public means which are provided under the second and the third tiers of the Brussels Supplementary Convention[77] or under the second tier of the Convention on Supplementary Compensation[78] are meant to increase the amount of compensation. Where the liability of the operator is not limited in amount, the public tiers to be provided by the Installation State or by all of the Contracting Parties in substance serve as additional financial security of the operator. Where the liability is limited in amount, the public money forms a fund in excess of the operator's liability and thus is independent of the operator's financial security.

Mandatory coverage of the operator's liability ensures that compensation money is available. This means a guarantee for both the operator and the victim: The operator is protected against bankruptcy while the victim has assurance of compensation payment.

This describes one side, the positive side of the coin. But there is a second side which is negative rather than positive. Mandatory financial security, and particularly the congruence principle in cases of limited liability, makes the operator dependent on the financial guarantor, that is, as a rule, the insurer. If insurers

[75] Articles 10 1960 and 2004 PCs, VII 1963 and 1997 VCs, 5 CSC Annex.

[76] Articles 10 (b) 2004 PC, VII (1) (a) sentence 3 1997 VC, 5 (1) (a) sentence 3 CSC Annex.

[77] See above Sect. 12.2.1.2.

[78] See above Sect. 12.2.1.5.

refuse to insure the nuclear risk in total or with regard to certain heads of damage or if they do not have sufficient capacity, the operator cannot provide financial security. Here we arrive at a most crucial point of the development of nuclear liability law.

The insurance industry originally was most reluctant vis-à-vis the nuclear risk. This applies to both the possible magnitude of damage and the nature of certain types of damage.[79] In particular the magnitude of damage and the lack of capacity of the insurance industry played a role. European insurers at the end of the 1950s/ beginning of the 1960s held the view that third party damage in excess of 5 million units of account of the European Monetary Agreement (= the minimum liability amount according to Article 7 (b) 1960 PC) is a catastrophe which under the Paris Convention should not be covered by insurance and that the consequences of a catastrophe should be borne by the general public.[80] In order to increase the insurance capacity the insurance industry established insurance pools and used the instrument of international re-insurance (risk-sharing).[81] This may entail a closed market and a restriction of competition.[82]

The difficulty to get insurance to cover the nuclear risk entailed that the mandatory requirement to ensure coverage of nuclear liability was put upside down to read: Where there is no coverage there cannot be liability. Consequently, lawmakers limited liability to that amount which is insurable. This is the main reason for the limitation of liability in most States. Until today, the insurability of the risk to be covered is a decisive impediment on the way to improving the liability law. Increased liability amounts and an expanded concept of damage under the revised conventions caused concern on the part of the insurance industry.[83] The still ongoing delay of the ratification of the 2004 Paris Protocol is to a large extent due to the fact that in some member States it seems to be difficult to get insurance to cover EUR 700 million and some of the new heads of damage.

The conventions allow coverage by financial security other than insurance, and there are alternatives to insurance coverage. They may either complement or replace insurance. Operators' pooling to provide coverage is an approach which is successfully implemented in the USA based on legislation and in Germany based

[79] There is ample literature available. See, *e.g.*, the concise introduction by Reitsma and Tetley 2010, pp. 387–416, and the comprehensive article by Quéré 2014. EURATOM in 1965 organised a colloquium on the insurance of nuclear risks. The papers presented by high-rank experts at that colloquium provide excellent insight into the insurance issues relevant at the time of developing nuclear industry: Europäische Atomgemeinschaft—EURATOM 1966. Special attention should be paid to the presentation by Dr. W. E. Belser from Switzerland (*op. cit.* pp. 39–54). Belser is one of the fathers of the Paris Convention.

[80] See Belser *op. cit.* (n. 79) p. 43.

[81] See Reitsma and Tetley 2010, pp. 390 *et. seq.*; Tetley 2014, pp. 709–726; Harbrücker 2014, pp. 281–286.

[82] See Ameye and Igartua Arregui 2012, pp. 265–300; Rimšaitė 2013, pp. 16–26.

[83] See Tetley 2006, pp. 27–39.

on an agreement of the leading energy suppliers.[84] The US scheme provides coverage for the limited liability of the operator through insurance plus operators' funds and covers the liability amount of currently US $ 13.6 billion.[85] The German scheme provides coverage for the unlimited liability of the operator through insurance plus operators' funds of EUR 2.5 billion (both tiers backed by State money) plus the other assets of the operator which includes the assets of the parent company and thus the final amount available is open-ended.[86]

There are other additional options for coverage such as self-insurance or a bank guarantee, which, however, will probably be more expensive. Finally, there is State money to provide coverage. This option is expressly foreseen by the conventions which stipulate that the Installation State has to ensure payment of claims by providing the necessary funds to the extent that the mandatory financial security of the operator is not available or insufficient.[87]

12.2.2.6 Limitation of Liability in Time

Ordinary tort law limits the bringing of claims in time. It is an element which shall ensure that after the elapse of a certain time span no claims can any longer be made. This applies to nuclear liability law, too. But nuclear liability law does not simply refer to the periods established under ordinary tort law. Nuclear liability prescription or extinction periods are determined by their insurability. Insurance industry limits its protection to ten years because after that period the risk is not any longer calculable.[88] As a consequence, the 1960 Paris Convention, the 1963 Vienna Convention and the Convention on Supplementary Compensation limited the bringing of claims to ten years, but Contracting Parties could establish longer periods provided financial coverage is available for the entire period. The conventions left it to the national legislation to introduce the so-called discovery rule which means to establish a period of not less than three years from the date at which the victim had knowledge or ought reasonably to have known of both the nuclear damage and the operator liable.[89]

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[84] For details, including descriptions of the U. S. and of the German pooling systems, see Pelzer 2007, pp. 37–55; Carroll 2008, pp. 75–97.

[85] Section 170 (b) (c) US Atomic Energy Act (n. 72).

[86] Sections 13 (3), 25, 31, 34 German Atomic Energy Act (n. 66), Section 302 Stock Corporation Act (Aktiengesetz, Bundesgesetzblatt 1965 I p. 1089; 2015 I p. 1245). For an unofficial English translation see http://www.nortonrosefulbright.com/files/german-stock-corporation-act-2010-english-translation-pdf-59656.pdf.

[87] Articles 10 (c) 2004 PC, VII (1) 1963 VC, VII (1) (a) 1997 VC, 5 (19 (a) CSC Annex.

[88] Reitsma and Tetley 2010 pp. 398–399.

[89] Articles 8 1960 PC, VI 1963 VC, 9 CSC Annex. The discovery-rule period under the 1960 Paris Convention is two years.

In view of the fact that radiation injury may be latent for a long time, the ten-year period was deemed insufficient from the beginning. But only as part of the revision exercises after the Chernobyl accident, States agreed to amend the figures. Now the 2004 Paris Convention and the 1997 Vienna Convention fix a thirty year period in respect of personal injury or loss of life and a ten year period in respect of all other nuclear damage. The discovery-rule period remained unchanged.[90] The insurance industry continues limiting insurance contracts to ten years only. With regards to the uncovered period of twenty years remaining the State has to provide coverage. From the point of view of the victims this amendment is an improvement. But in many cases it may be an improvement without consequences: the longer the interval between the occurrence of the nuclear incident and the bringing of an action the more difficult it is to prove the causal link between the incident and the damage.

12.2.2.7 Exclusive Jurisdiction

In case of a major nuclear incident with widespread nuclear damage the processing of a large number of actions will be difficult. At national level probably numerous courts will be competent to deal with the very same nuclear incident. If there is transboundary nuclear damage, the situation will be even more complex: Which court is competent and which law is applicable? Quite obviously, a provision on the competent court and on the law applicable is among the most important parts of any international nuclear liability regime.

The conventions grant exclusive jurisdiction to the courts of one State to the exclusion of others: Except as otherwise provided in the conventions, a court of that Contracting Party is exclusively competent in whose territory the nuclear incident occurred.[91] This general rule points at the jurisdiction of the installation State if the nuclear incident occurs in the installation. If the incident occurs in the course of carriage of nuclear substances in the territory of a Party other than the installation State, the courts of that other Party are competent.

Where the nuclear incident occurs outside the territory of a Contracting Party, or where the place of the incident cannot be determined with certainty, the courts of that Party have jurisdiction in whose territory the installation of the operator liable is located.[92]

In order to meet the concern of coastal States regarding the risk of nuclear transports which are passing by their coasts the revised conventions and the Convention on Supplementary Compensation grant exclusive jurisdiction to the

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[90] Articles 8 (c) and (d) 2004 PC, VI (1) (a) and (3) 1997 Vienna Convention. The discovery-rule period under the 2004 Paris Convention is now also three years.

[91] Articles 13 (a) 1960 and 2004 PCs, XI (1) 1963 and 1997 VCs, XIII (1) CSC.

[92] Articles 13 (b) 1960 PC, 13 (c) 2004 PC, XI (2) 1963 and 1997 VCs, XIII (3) CSC.

courts of that Contracting Party in whose exclusive economic zone the nuclear incident occurs.[93]

The revised conventions stipulate that the Contracting Parties whose courts have jurisdiction shall ensure that only one single court shall be competent to hear claims for compensation.[94] There is no corresponding provision in the Convention on Supplementary Compensation.[95]

Enforceable judgements entered by the court competent under the conventions become enforceable in the territory of any of the other contracting Parties. If an action is brought against a Contracting Party under the conventions such Party may not invoke jurisdictional immunities with the exception regarding measures of execution.[96]

The concentration of lawsuits to one single competent court is often called 'procedural channelling' and it is indeed a supporting means to simplify legal procedures by channelling both the claims for compensation and the related lawsuits to one person and to one court. As compared to the general rules of private international law and international procedural law respectively, the special regime of the nuclear liability conventions is a useful improvement for the victims and the person liable. The material and procedural concentration likewise facilitates the work of courts. But there might also be conflicts with other specialized regimes of jurisdiction. This applies to Member States of the EU particularly in relation to the regime established under the Brussels I Regulation.[97] If a nuclear incident occurs in Germany (EU Member State, Paris Party) or in the Czech Republic (EU Member State, Vienna Party) which causes nuclear damage in Austria (EU Member State, not a Party to any of the liability conventions), it is unclear which jurisdiction regime is applicable.[98]

12.2.2.8 Equal Treatment

A compelling prerequisite for an appropriate international nuclear liability regime is the assurance that victims in the case of a nuclear incident with transboundary

[93] Articles 13 (b) 2004 PC, XI (1*bis*) 1997 VC, XIII (2) CSC.

[94] Articles 13 (h) 2004 PC, XI (4) 1997 VC.

[95] See on this Explanatory Texts 2007 pp. 91–93.

[96] Articles 13 (d, e) 1960 PC, 13 (i, j) 2004 PC, XII, XIV 1963 and 1997 VCs, XIII (6, 7) CSC.

[97] Council Regulation (EC) No. 44/2001 of 22 December 2000 on jurisdiction and the recognition and enforcement of judgments in civil and commercial matters (O. J. EU 2001 No. L 12 p. 1). This Regulation was, as of 2015, replaced by the so-called 'recast' Brussels I Regulation (Regulation (EU) No. 1215/2012 of 12 December 2012, O. J. EU 2012 No. L 351 p. 1, see Articles 80 and 81).

[98] See, *e.g.*, Magnus 2010, pp. 105–121.

effects are equally treated in the territories of all States who the regime applies to. As a matter of fact, non-discrimination has to be among the main principles of a nuclear liability regime. The nuclear liability conventions meet this requirement.

The conventions shall be applied 'without any discrimination based upon nationality, domicile or residence'. The same applies to the 'national law' and to the 'national legislation' which the conventions refer to. This is clearly spelt out in the Paris and in the Vienna Conventions.[99] Since the Convention on Supplementary Compensation provides for a second tier of compensation to be provided by public means of all of the Contracting Parties, the non-discrimination clause is split into two variations. The first tier of compensation to be provided by the operator liable has to be distributed equitably without discrimination on the basis of nationality, domicile or residence.[100] Insofar the provision is identical to those under other conventions. The international State tier, however, shall, although it also has to be provided without discrimination, be distributed as follows: 50 % of the funds shall be available to compensate nuclear damage inside and outside the Installation State, the other 50 % shall be available to compensate nuclear damage outside the Installation State to the extent that such damage remains uncompensated under the first 50 % of the fund.[101] This rule does not apply if the Contracting Party has ensured the availability without discrimination of an amount not less than 600 million SDRs which has to be specified to the depositary prior to the nuclear incident.[102] It is the purpose of this provision to make sure that the international money provided under this tier to a considerable part may be used to compensate international victims.

The Brussels Supplementary Convention does not contain a similar provision but the supplemental compensation will be paid without discrimination if and to the extent the operator is liable under the Paris Convention, the nuclear installation is used for peaceful purposes,[103] appears on the list required under Article 13 BSC and the victim's State is also Party to the Brussels Supplementary Convention.[104]

The principle of non-discrimination ought to be applicable without any problems if nuclear damage is limited to the territory of the installation State: Within the domestic area equal treatment of all victims is, as a rule, ensured. The principle therefore has its main importance for nuclear incidents with transboundary impact. Also victims of other States shall enjoy equal treatment. In order to gain this effect, the principle of non-discrimination needs to be flanked and supported

[99] Articles 14 1960 and 2004 PCs, XIII 1963 and 1997 VCs.

[100] Article III (2) (a) CSC.

[101] Articles III (2) (b), XI (1) (b) CSC.

[102] Article XI (2) CSC.

[103] Regarding installations which do not serve peaceful purposes see the Annexes to both the 1963 and the 2004 Brussels Supplementary Conventions.

[104] Article 2 1963 and 2004 BSC.

by other elements of the liability regime, particularly by the provision on the geographical scope of the regime. The application of the principle is linked to the geographical scope of application of the conventions. The treaty relations among the Contracting Parties bindingly extend the non-discrimination principles to the territories of all Parties. The convention law is insofar superior to national legislation which does not have this effect.

While the 1960 Paris Convention and the 1963 Vienna Convention limited their applicability to the territories of Parties only,[105] the 2004 Paris Convention and the 1997 Vienna Convention extend their geographical scope of application to nuclear damage wherever suffered.[106] The Convention on Supplementary Compensation does not have express language on the geographical scope of application but it insofar depends on the Paris Convention, the Vienna Convention or the national Annex legislation as applicable. Due to the fact that the Convention provides for two-tier compensation the legal situation is more complex. But one may summarize that the non-discrimination principle will also be applied with regard to transboundary damage.[107]

12.3 Nuclear Damage Reparation—a Risk Adequate Regime?

12.3.1 Starting Point of the Assessment

> The international nuclear liability regime is extremely patchy, complicated and features sparse participation.[108]
>
> Although the underlying customary international law principles (the no-harm principle and the polluter-pays principle) are clear, the actual treaties that have been drafted are inadequate and they have not been widely ratified. Victims of damage from nuclear activities would have difficulty finding a neutral tribunal in which to bring their claims and would face procedural obstacles including caps on liabilities and inappropriate statutes of limitations as well as difficulties regarding proof of damages. The failure to develop a proper regime that would ensure full restitution and compensation for harm resulting from nuclear facilities constitutes a continuing subsidy to the nuclear industry and distorts decisions regarding energy choices. The effort to update international nuclear law must, therefore, continue until a proper liability and compensation regime is established.[109]

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[105] See Sect. 12.2.1.4. above and in particular n. 29.

[106] Article 2 2004 PC, I A 1997 VC. The Paris and Vienna Conventions use different legal approaches but they eventually have identical results. While the Vienna Conventions opens the scope of application to nuclear damage 'wherever suffered' and permits Parties to exclude defined territories, the Paris Convention organises the scope provision the other way round: it lists defined territories to which the PC is applicable and gives Parties discretion to provide for a broader scope of application.

[107] See in detail Explanatory Texts 2007, pp. 73–75, 80–82 with references.

[108] Currie 2006, p. 85.

[109] Van Dyke 2006, p. 46.

The views expressed in those two observations are like most firm statements correct and at the same time simplifying and therefore misleading or even incorrect. The international nuclear liability regime is ‘patchy, and it features sparse participation’. But are other liability regimes to cover hazardous activities less patchy? There is sparse participation in the international regime but are other hazardous activities covered by international liability regimes which are adopted by all or nearly all States? Is the nuclear liability regime complicated or is rather the activity complicated which shall be regulated? And finally, does the regime constitute a continuing subsidy to the nuclear industry? The justification for those apodictic assessments is the opinion that the use of nuclear energy carries a risk which can not at all be compared to other industrial risks. This starting point evades discussion and the review will therefore inevitably result in a negative assessment of the existing nuclear liability regime. Actually, describing and summarizing the existing international nuclear liability regulations by catchwords as used in both quotations do not contribute to achieving a well balanced appraisal of the regime.

Of course, any review of the nuclear liability regime has to start with the nuclear risk, and without further in-depth discussion, and as already said at the beginning of this Chapter, it can be stated the nuclear risk is extraordinary and lacks twin siblings. It is ‘of an exceptional character’.[110] Systems of damage reparation need to be commensurate. It follows that we have to look more closely at the object and purpose of liability law in order to be enabled to recognize which elements have to prevail in a liability regime appropriate to the nuclear risk. The paradigms of reciprocity and reasonableness[111] may provide guidance: The liability regime has to ensure, firstly, individual justice between the tortfeasor (= operator of the nuclear installation) and the victim and, secondly, social peace among all stakeholders or for the entire society.

12.3.2 Compensation of the Victim

The consequences of nuclear accidents, including such of a catastrophic nature, are suffered by individual victims. This holds true also for damage caused to the environment because environmental damage is eventually likewise suffered by individuals. Damage reparation therefore means compensation of individual

[110] No. 7 of the Exposé des Motifs to the Paris Convention (n. 1).

[111] See above Sect. 12.1.2, in particular nn. 6, 7, 8.

losses: the tortfeasor 'must restore the position that would exist if the circumstance obliging him to pay damages had not occurred.'[112] It follows that reparation schemes have to be drafted and equipped to ensure this requirement. It was stated earlier in this Chapter that the basic nuclear liability rule is of a simple structure consisting of only few and well-defined constituents: 'operator', 'nuclear installation', 'nuclear incident', 'nuclear damage', 'nuclear material (or substances)'.[113] 'The operator of a nuclear installation shall be liable, in accordance with this Convention, for nuclear damage … upon proof that such damage was caused by a nuclear incident in such installation or involving nuclear substances coming from (or originating in) such installation.'[114] As the elements of this rule are clearly defined in the conventions,[115] it is, in principle and subject to the specifics and difficulties of the individual case, a simple exercise to justify or to dismiss a claim for compensation. It is most favourable for the victim that the operator is held strictly liable which means the victim does not need to prove fault of the operator, and that the operator is exclusively liable which means the victim does not need to try and find the right defendant among possible various other alternatives.

It may be provisionally summarized: the basic nuclear liability rule is appropriate to establish individual justice. Yet there exist two major stumbling blocks in the way to compensation: Firstly: The victim has to prove the causal link between the nuclear incident and the nuclear damage suffered. Secondly: In case of a major nuclear incident with high compensation amounts, there may be doubts as to whether the limited compensation money available is sufficient to cover all claims in full.

As already mentioned above in the description of the nuclear accident scenario,[116] the causal link between incident and damage is in particular difficult to prove if living cells are exposed to ionizing radiation. The same applies if nuclear damage only becomes evident a long time after the radiation exposure. The necessary proof of causality will be most difficult and sometimes even impossible. But tort law and also nuclear liability law cannot refrain from requiring a proof of causality. Otherwise tort law would be transmuted to a general insurance against mishap.[117]

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[112] English translation of Section 249 paragraph 1 German Civil Code (Bürgerliches Gesetzbuch—BGB); for a translation by the German Federal Minister for Justice in cooperation with others see http://www.gesetze-im-internet.de/englisch_bgb/german_civil_code.pdf).

[113] See above Sect. 12.2.2.1.

[114] Articles 3 1960 and 2004 PCs, II (1) 1963 and 1997 VCs, 3 (1) CSC Annex.

[115] Articles 1 1960 and 2004 PCs, I 1963 and 1997 VCs, I CSC and 1 CSC Annex. The revised Conventions and the CSC have an enlarged and more detailed list of definitions than the unrevised PC and VC, particularly regarding the concept of nuclear damage.

[116] See Sect. 12.1.1 above.

[117] Whether such transmutation is perhaps desirable depends on the social conception and the politics of the respective State.

As long as science is not in a position to enable us to trace the path of radiation from the exposure to the damage with certainty or at least with the highest degree of certainty possible, the missing causal link cannot be established by legal means. Law can provide approximate solutions only. The nuclear liability conventions do not provide rules on causality but refer to the national law of the contracting Parties (Articles 11 PCs, VIII VCs, 11 CSC Annex). National law offers options. In defined cases an assumption of causality may be appropriate. This solution is used in some States in the social security and workmen compensation law.[118] There is also the *prima-facie* evidence or the *res-ipsa-loquitur* doctrine.[119]Another possibility is to require a lower standard of proof, *e.g.*, by applying the more-probable-than-not rule.[120] All in all, the burden of proof of the causal link in radiation injuries may face obstacles difficult to remove. There is not a legally clear solution and thus the proof of the causal link remains an open problem. Irrespective of the appropriate drafting of the nuclear liability rule, claimants have to face the risk that actions will be dismissed because they do not succeed in proving causality.[121]

The second stumbling block is the amount of money available for compensation. In case the national legislator limits the liability in amount, there is always the risk that the money will be exhausted before all claims are satisfied. However, even if liability is not limited, mandatory financial security plus all other assets of the operator liable may not suffice to guarantee satisfying all claims.

Insolvency of debtors is not a rare occurrence in everyday life. But it gains eminent importance when an activity licensed by the competent State authority causes damage of a magnitude and of an extent which has detrimental effects which are of relevance for the entire State and possibly neighbouring States as well and which the debtor cannot compensate by means of his own. Here we reach the point where the bipolar relation tortfeasor/victim is extending to a multipolar relationship. The paradigm of reasonableness comes into play.

12.3.3 Social Impact

'The function of both of these paradigms [= of reciprocity and of reasonableness] is to distinguish between those risks that represent a violation of individual

[118] For example: Article L 411-1 French Code de la Sécurité sociale.

[119] Judge Pollock in: Byrne v. Boadle [2 Hurlstone & Coltman's Exchequer Reports 722, 159 English Reports 299 (Exch. 1863)].

[120] Judge Denning in: Miller v. Minister of Pensions [1947] (2 All England Law Reports 372): 'It must carry a reasonable degree of probability, not so high as is required in a criminal case. If the evidence is such high that the tribunal can say: 'we think it more probable than not', the burden is discharged, but if the probabilities are equal it is not.'

[121] See on the issue of causality in nuclear liability law in more detail: Pelzer 1968, pp. 41–63; Moser 1986, pp. 70–93; StåhlbergSthlberg 1994, pp. 22–29. Special literature is rather rare because there is no progress in this field.

interests and those that are the background risks that must be born as part of group living.'[122] From the point of view of 'risks as part of group living', the regime of nuclear liability has more closely to be looked at. Of course, this aspect must not too strongly interfere with the object of individual justice. A co-existence of both paradigms has to be aimed at. So the struggle between both paradigms is 'a struggle between two strategies for justifying the distribution of burdens in a legal system.'[123]

When Van Dyke[124] recognizes a 'failure' of the existing nuclear liability regime because it, according to his view, constitutes a 'continuing subsidy to nuclear industry' which does not ensure full compensation of nuclear damage, he mainly has in mind the limitation of liability in amount. Limited liability indeed is a subsidy for industry as was already said earlier. But perhaps this conclusion does not cover all aspects. It is also possible to understand limited liability as a means to facilitate establishing a bridge between the paradigms of reciprocity and of reasonableness. The limitation would then be the result of a proper weighing of interests made by the legislator.[125]

Strict liability mainly covers activities which State and society have a special interest in. In order to cope with the risk for third parties involved with those activities it is appropriate to facilitate the bringing of claims for damage reparation by establishing strict liability. On the other hand, this type of liability may be too favourable for the victim and perhaps prohibitive for nuclear industry, the potential tortfeasor; the paradigm of reciprocity would prevail. This situation could be balanced by a limitation of the liability which is in favour of the tortfeasor. Limited liability would so be a contribution to a fair compensation which is balanced in both directions. Fair compensation through limited liability is even more convincing if it is supplemented by mandatory financial security, which is easier to be achieved if liability is limited and which protects against bankruptcy of the person liable.[126]

The balance between the two paradigms so achieved is, however, of a fragile nature. If the amount of liability is fixed at a very low level social peace cannot be achieved: The low amount is prejudicial for the victim and supports the paradigm of reasonableness.[127] The question has to be asked: Which amount of liability is adequate to re-establish the balance between the two paradigms? Of course, if

[122] Fletcher 1972, p. 544.

[123] Fletcher 1972, p. 570.

[124] Van Dyke 2006, p. 46.

[125] Fischinger 2015, p. 46: '…kann man die Normierung von der Höhe nach begrenzten, verschuldensunabhängigen Haftungstatbeständen auch als das sachgerechte Ergebnis einer vom Gesetzgeber vorgenommenen Interessensabwägung ansehen.'

[126] In detail Fischinger 2015, pp. 46–51.

[127] Fischinger 2015 *op. cit.* (n. 126).

there is only minor damage a small liability amount is sufficient. But which amount is needed to cover major or catastrophic nuclear damage?

This question can certainly not be answered with a simple figure. The entire nuclear liability scheme has to be taken into account and be counterbalanced against the nuclear risk. 'When is a risk so excessive that it counts as a nonreciprocal risk?',[128] *i.e.*, that the bipolar relation tortfeasor victim has less relevance. The nuclear risk without any doubt is an excessive one. As a consequence the number of individual victims of a major nuclear incident is very high.[129] This has an impact on the entire community. Reciprocal risks that require individual just compensation and general community's welfare approximate. There is no longer a controversy between the two paradigms. They are congruent. This balance could only be disturbed if the other liability principles as listed in Sect. 12.2.2. above shift the weights into the direction of one of the paradigms. But that is not knowable.

On the basis of this result it has to be concluded that the limitation of liability in amount lost its justification as a means to contribute to balancing the two paradigms. The magnitude and the extent of the nuclear risk balance the two controversial paradigms: In case of a major nuclear incident the interests of the individual victim and of the general public more or less coincide. In this situation it is extremely difficult to warrant limited liability amounts.

The limitation of liability in amount is permitted under the nuclear liability conventions and introduced in the majority of national nuclear legislations. Nevertheless it is not a means to unify the controversial paradigms. Moreover, all limits fixed are arbitrary and are insufficient if we want to prepare for a major nuclear accident. Limited liability can only be accepted if, as the US Supreme Court ruled,[130] there are flanking binding commitments of the installation State to provide additional compensation if the liability amount of the operator is exhausted. Limited liability to cover nuclear damage does not fit into a liability regime the scope of which is designed to cope with 'risks of an exceptional character'.[131] Actually it is only and exclusively a subsidy for industry.

Liability without limitation in amount appears to be the only appropriate tool to cope with the nuclear risk. It has to be admitted that unlimited liability can only guarantee compensation if there is coverage. Liability is as good as its coverage.

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[128] Fletcher 1972, p. 573.

[129] See the references in n. 2. Furthermore see on the Chernobyl accident: UNSCEAR, The Chernobyl accident, at http://www.unscear.org/unscear/en/chernobyl.html; World Nuclear Association, Chernobyl Accident 1986, at http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/Chernobyl-Accident/; Environmental Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience, Report of the UN Chernobyl Forum, Expert Group Environment (EGE), August 2005, at http://www-ns.iaea.org/downloads/rw/meetings/environ-consequences-report-wm-08.05.pdf.

[130] See n. 73.

[131] No. 7 Exposé des Motifs (n. 1).

That means the situation of the victim is not improved as compared to limited liability. However, in addition to the mandatory financial security to be provided by the person liable unlimited liability allows access to any other assets of the person liable. That is not the case if the liability is limited. In cases of unlimited liability victims may claim until all sources of the person liable are exhausted. This result may and probably will again disturb the balance between the two paradigms. At this point at the latest the State has to step in. If it is not desirable that a nuclear operator and perhaps also its parent company go bankrupt or if the magnitude of damage forms a national catastrophe it is a genuine duty of the installation State to provide additional compensation.[132] Insofar the situation is identical to that of limited liability but in cases of unlimited liability the State has to intervene at a later stage. In terms of public money needed for compensation this may form a significant difference. The restriction of State intervention to catastrophic damage may also have advantages for EU Member States. Under EU law the intervention of the State could be seen as an infringement of the EU competition rules.[133] Such claim is more difficult to defend if State intervention is restricted to catastrophic nuclear damage.

12.3.4 Procedural Issues

Major or catastrophic nuclear accidents entail mass litigations. According to the nuclear liability principles they are all channelled to one single competent court.[134] There probably will be many hundreds of thousand claimants.[135] Courts are not prepared for this situation. At short notice, it requests organisational arrangements including an increase in qualified staff.

Mass litigations are well known from environmental and other disasters of human or natural origin, in particular the insurance industry is familiar with them (*e.g.* 2005 Hurricane Katrina[136]). So there should be experience how to organize mass tort lawsuits.[137] Nuclear mass tort procedures are not regulated by international instruments; the nuclear liability conventions only cover the material

[132] In more detail on the compensation of catastrophic nuclear damage see: Pelzer 2010c, pp. 341–357.

[133] Articles 101 *et seq.* consolidated version of the Treaty on the Functioning of the European Union (EU O. J. 2008 No. C 115 p. 47) (= former Articles 81 *et seq.* EC Treaty).

[134] See above Sect. 12.2.2.7.

[135] See n. 2.

[136] Abraham 2007, pp. 173–180.

[137] See with references Pelzer 2010c, pp. 351–353. For a comparative overview see: van Boom and Wagner 2014; for the German law see von Bar 1998; for the US law see Weinstein 1995; Nagareda 2007.

liability law. So the organisation of mass litigations is a matter of national law which entails that there are differences in approach and substance. Key words are 'consolidation of procedures', 'class actions' and 'model or test case procedures'. All those approaches seem to be adequate to deal with the issue of handling mass torts. But it has to be mentioned that they run the risk of conflicting with the right of individuals of a 'fair and public hearing' by a court.[138] There is no need to go into further detail here.[139] It is, however, worthwhile briefly discussing those national nuclear liability legislations which contain procedural provisions to cope with major nuclear damage and in particular with damage in excess of the compensation amount available. Reference has to be made to the legislations of Canada,[140] the Netherlands,[141] the United States[142] and India.[143] All these States limit nuclear liability in amount and they developed regulations on distributing money for compensation in excess of the operator's liability amount. Common to all national solutions is that they establish commissions or committees other than courts to handle the cases. The committees act in supplement to, or in support of, the competent courts, and in certain cases they even replace them. It can be summarized that in principle all those approaches have merits even if they may not be ideal in every regard. But they form efforts to deal with extraordinary situations. Regarding details, it can be referred to earlier publications of the author.[144]

Among the States which entrust damage compensation at least partly to special committees other than a court is also Japan. Highest attention has therefore to be paid to the way how Japan handled and is still handling the catastrophic consequences of the 2011 Fukushima Daiichi nuclear accident. It would be beyond the limits of this Chapter to elaborate in detail on the Japanese nuclear damage reparation. Moreover, it is probably any way too early for a final appraisal. But already now the Japanese way of settlement of the Fukushima nuclear damages deserves tribute.[145]

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[138] Cf. Article 6 (1) of the 1950 European Convention for the Protection of Human Rights and Fundamental Freedoms (*Bundesgesetzblatt* 2002 II p. 1054).

[139] See Pelzer 2010c, p. 353 with references.

[140] Nuclear Liability Act (Revised Statutes 1985, c. N-28).

[141] Wet van 17 maart 1979, houdende regelen inzake aansprakelijkheid voor schade door kernongevallen as amended (Staatsblad 1979/225, 1979/374, 2014/129).

[142] See n. 48.

[143] See n. 50.

[144] Pelzer 2010c pp. 353–356. On India see Pelzer 2011a, p. 12. See also Mohan 2015, pp. 53–69.

[145] A most comprehensive report (= 1254 pages) on the Fukushima Daichi nuclear accident was published by the IAEA in September 2015: IAEA (ed.) 2015, http://www-pub.iaea.org/books/IAEABooks/10962/The-Fukushima-Daiichi-Accident. The Report consists of a Report by the IAEA Director General (208 pp.) and 5 Technical Volumes. Technical Volume 5/5 provides at pp. 149–152 a brief description of the Japanese compensation framework. See for the relevant legal texts: The 21st Century Public Policy Institute (ed.), Genshi-ryoku songai baisho seido shiryo-shu, Tokyo June 2015, http://www.21ppi.org/pdf/thesis/150622.pdf.

The main characteristic of the Japanese approach is that the great majority of compensation procedures are settled outside courts. Pursuant to Section 18 (1) of the 1961 Act on Compensation for Nuclear Damage[146] a 'Dispute Reconciliation Committee for Nuclear Damage Compensation' was established which is entrusted with mediating reconciliation of any dispute arising from compensation of nuclear damage and with preparing general instructions to help operators reach a voluntary settlement of such disputes. The Reconciliation Committee, in accordance with Section 18 (2) of the Compensation Act, issued a number of Guidelines which form the backbone of compensation payments.[147] These comprehensive materials and their implementation need to be studied carefully with a view to finding out if and to which extent the Japanese experience could inspire improving the international and national nuclear liability regimes.[148]

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[146] Act on Compensation for Nuclear Damage (Act No. 147 of 1961 as amended by Act No. 19 of 2009). Complementing legislation: Act on Indemnity Agreements for Compensation of Nuclear Damage (Act No. 148 of 1961 as amended by Act No. 19 of 2009); Order for the Execution of the Act on Compensation for Nuclear Damage (Cabinet Order No. 44 of 1962 as amended by Cabinet Order No. 201 of 2009); Order for the Execution of the Act on Indemnity Agreements for Compensation of Nuclear Damage (Cabinet Order No. 45 of 1962 as amended by Cabinet Order No. 201 of 2009); Nuclear Damage Compensation Facilitation Corporation Act (Act No. 94 of 2011); Act on Emergency Measures Related to Damage Caused by the 2011 Nuclear Accident (Act No. 91 of 2011). The Acts and Orders are reproduced at: OECD/NEA (ed.) 2012, pp. 61 *et seq.*

[147] See: Preliminary Guidelines on Determination of the Scope of Nuclear Damage resulting from the Accident at the Tokyo Electric Power Company Fukushima Daiishi and Daini Nuclear Power Plants of 28 April 2011; Secondary Guidelines on Determination of the Scope of Nuclear Damage resulting from the Accident at the Tokyo Electric Power Company Fukushima Daiishi and Daini Nuclear Power Plants of 31 May 2011; Interim Guidelines on Determination of the Scope of Nuclear Damage resulting from the Accident at the Tokyo Electric Power Company Fukushima Daiishi and Daini Nuclear Power Plants of 5 August 2011. The Guidelines, together with Supplementing Guidelines of 6 December 2011 and 16 March 2012, are reproduced at OECD/NEA (ed.) 2012, pp. 89 *et seq.* Third Supplement to Interim Guidelines on Determination of the Scope of Nuclear Damage resulting from the Accident at the Tokyo Electric Power Company Fukushima Daiishi and Daini Nuclear Power Plants (concerning Damages related to Rumour Related Damage in the Agriculture, Forestry, Fishery and Food Industries) of 30 January 2013 (2013 Nuclear Law Bulletin 92:197).

[148] Selected literature on the Fukushima Daiichi accident damage reparation: A comprehensive description and assessment including proposals for amendments of the Japanese nuclear liability law is presented in a report edited by the 21st Century Public Society Institute, Towards the Establishment of a New Compensation System for Nuclear Damage, Supervision: Akahiro Sawa, Tokyo November 2013, 243 pp., http://www.21ppi.org/pdf/thesis/141215.pdf. See also: Genshiryoku songai baisho seido ni kansuru kongo no kento kadai Tokyo Denryoku Fukushima Daiichi genshiryoku hatsudensyo jiko o chushin to Shite-Heisei 23–24 nendo genshiryoku songai baisho ni kansuru kokunaigai no housei kento han houkokusho- (JELI-R-No.129) (March 2014), Tokyo: Japan Energy Law Institute 2014, www.jeli.gr.jp/; Nomura 2012; Nomura et al 2012, pp. 15–27; Matsuura 2012, pp. 29–39; Takahashi 2012, pp. 41–59; Faure and Liu 2013, pp. 129–218; Feldman 2014, pp. 130–147; Weitzdörfer 2011, pp. 61–115; Pelzer 2011b, pp. 97–122; Vásques Maignan 2012, pp. 9–14.

12.3.5 Nuclear Liability Regime Reviewed

Special national and international nuclear liability regimes exist since the late 1950s. As of that period a number of nuclear and radiation accidents occurred. Only two them, namely the 1986 Chernobyl accident and the 2011 Fukushima Daiishi accident caused catastrophic nuclear damage. The nuclear liability regime could not be applied to Chernobyl because the installation State Soviet Union was neither nationally nor internationally part of the regime and because it, moreover, evaded any compensation payments for transborder nuclear damage. Fukushima damages are compensated under national law which implements the international principles. Due to the geographical position of Japan, transboundary nuclear damage is of negligible nature. "However, because the accident occurred on the eastern side of Japan, bordering the Pacific Ocean, the transboundary impact on other countries has been insubstantial."[149] Therefore it is irrelevant that Japan at the time of the accident was not a party to any of the liability conventions, their beneficial qualities were not required.[150] It follows that, fortunately, until today the advantages of an international treaty regime could not be tested. Appraisals of the system cannot refer to practical experience.[151]

In general, the nuclear liability law based on the internationally recognized principles appears to be appropriate to the risk to be covered. It adequately reacts to the liability challenges of the use of nuclear energy. It also contributed effectively to large range international harmonisation of the nuclear liability rules. It has mainly three major elements, which mark weak points or are disputable: Causality, limitation of liability in amount and legal channelling of liability. The problem of causality cannot finally and satisfactorily be solved by lawyers and will remain an open issue.[152] Limitation of liability in amount was already discussed in some detail.[153] On the one hand, it is a subsidy for industry which may be a nuisance for victims, and its contribution to gaining social peace is limited as discussed above in Sect. 12.2.2.4. On the other hand, one should be aware that civil liability law is not designed for national catastrophes not to mention international catastrophes. Its scope is restricted to damages below the catastrophic level. It is up to the State to compensate the consequences of a catastrophe irrespective of whether it is a natural or a man-made catastrophe. Therefore it is a matter of

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149 Abraham 2014, p. 18.

150 Japan ratified on 15 January 2015 the Convention on Supplementary Compensation for Nuclear Damage which entered into force on 15 April 2015 (IAEA Doc. Reg. No. 1914).

151 On the advantages of adhering to the international conventions see the IAEA INLEX Document 'Civil Liability for Nuclear Damage: Advantages and Disadvantages of Joining the International Nuclear Liability Regime', http://ola.iaea.org/ola/treaties/documents/liability_regime.pdf.

152 See above Sect. 12.3.2.

153 See above Sects. 12.3.3 and 12.3.4.

national politics whether the State steps in at an earlier or at a later stage. However, there must be available legally relevant assurance that the State will intervene as the US Supreme Court ruled.[154]

Regarding legal channelling of liability solely onto the operator of a nuclear installation, opinions tend to differ sharply. Channelling was 'invented' 1959 by scholars of the Harvard Law School in cooperation with the US Atomic Industrial Forum in order to facilitate US nuclear export: Suppliers should be excluded from third party actions.[155] Legal channelling started a worldwide triumph and is today one of the cornerstones of international harmonisation of nuclear liability law, while the US maintained its so-called economic channelling which leaves the liability of all potential tortfeasors untouched and only obliges the operator of the nuclear installation to provide coverage for that liability.[156] Legal channelling today is one of the main goals for objections by nuclear opponents, and it is difficult to confute their arguments.[157]

Legal channelling cannot finally be assessed in this Chapter. It is an unjust concept but at the same time it facilitates the bringing of claims in a most complex field and is a basic element of international harmonisation. So there are relevant merits. Perhaps the objections against channelling could be mitigated if the right of recourse of the operator liable was strengthened. The right of recourse could be extended to cases of gross negligence and the principle *respondeat superior* could be re-enacted. In order to make this amendment better acceptable for suppliers, the amount of recourse could be limited to the amount of the value of the individual supply. This amendment would have more economic relevance than the current recourse only against the individual who caused the nuclear damage with intent. It would not too strongly infringe upon the principle of legal channelling and ought to be agreeable to industry.[158] The Indian Civil Liability for Nuclear Damage Act, 2010[159] follows a similar avenue by enlarging the options of recourse actions.[160] It should in particular be noted that the Indian law in Rule 24 (1) of the Civil Liability for Nuclear Damage Rules, 2011[161] refers to 'the extent of the operator's

[154] See n. 73.

[155] Harvard Study 1959, p. 56: 'This exposure of suppliers to liability is the source of danger to the manufacturing industry in the nuclear field.' and p. 59: 'Abolishing any cause of action in tort against suppliers presents the advantage of greatest simplicity and effectiveness on an international level.'

[156] Section 170 (b) (c) US Atomic Energy Act of 1954 as amended (Public Law 83-703). The Austrian legislation provides for economic channelling, too, see Section 16 (2) No. 3 of the Atomhaftpflichtgesetz 1999, n. 49).

[157] See among recent authors, *e.g.*, Ameye 2010.

[158] This proposal was already made by the author at the 1999 Budapest Symposium: Pelzer 2000, p. 429.

[159] See n. 50.

[160] See Sections 17 and 46 of the Indian Act (n. 50).

[161] The Gazette of India, Extraordinary, Part-II, Section-I, Sub-Section (i) No. 2112 of November 11, 2011.

liability under sub-section (2) of section 6 of the Act *or the value of the contract itself,* whichever is less' (emphasis by the author) regarding the extent of contractual rights of recourse of the operator.

Deviations from the principles of the international nuclear liability conventions, especially from the principle of legal channelling, cannot easily be made and implemented, if at all. It would be a long way to amend international conventions and national legislations correspondingly. But it is even more important that there will be a lack of political momentum. In particular the USA insists of establishing a worldwide international regime a main element of which is legal channelling. This became again evident after the enactment of the Indian Nuclear Liability Act which seemed to deform legal channelling being one of the leading principles of a possible worldwide regime.[162]

Not only has the USA aimed at establishing a global nuclear liability regime.[163] The USA and France in August 2013 issued a 'Joint Statement on Liability for Nuclear Damage' and declared that they 'promote efforts to achieve a global nuclear liability regime based on treaty relations among France, the United States and other countries that might be affected by a nuclear accident.'[164] Likewise the

[162] See: Ministry of External Affairs, Government of India, Media Center, 'Frequently Asked Questions and Answers on Civil Liability for Nuclear Damage Act 2010 and related issues, February 08, 2015', in particular questions 8–13, at http://www.mea.gov.in/press-releases.htm?dtl/24766/Frequently+Asked+Questions+and+Answers+on+Civil+Liability+for+Nuclear+Damage+Act+2010+and+related+issues. Furthermore see: G. Balachandran, Some issues in respect of India's nuclear liability law—II India and the Convention on Supplementary Compensation, at: http://www.idsa.in/issuebrief/IndiaandtheConventiononSupplementary_gbalachandran_190215.html.—Despite those obvious incompatibilities, India ratified the CSC on 4 February 2016, which means entering into force for India on 4 May 2016 (http://www.mea.gov.in/press-releases.htm?dtl/26324/India+submits+the+Instrument+of+Ratification+of+the+Convention+on+Supplementary+Compensation+for+Nuclear+Damage+CSC+1997).

[163] See among other sources especially: US Government Accountability Office. Report to the Committee on Foreign Affairs, House of Representatives. Nuclear Commerce. Governmentwide Strategy could Help Increase Commercial Benefits from U. S. Nuclear Cooperation Agreements with Other States, November 2010 (GAO-11-36), *passim* and particularly at pp. 24 *et seq.* See also McRae 2015.

[164] Joint Statement on Liability for Nuclear Damage, August 2013, http://energy.gov/sites/prod/files/2013/08/f2/Joint%20Statement%20Signed_0.pdf.—Recently French authors expressed the view that the 'grands États nucléaires', 'les cinq grandes puissances nucléaires' bear responsibility for establishing a global liability regime. They should provide guidance to all other States by adopting the Paris and the Vienna Conventions and the Joint Protocol. See Mignard et al. 2012, pp. 227–230.

See: Progress towards a Global Nuclear Liability Regime, Nuclear Law Bulletin 93 (2014/1) 9–23.

IAEA and the OECD Nuclear Energy Agency[165] strongly support a global nuclear liability regime only to name the most important international players. The IAEA 'Action Plan on Nuclear Safety'[166] requests:

> Member States to work towards establishing a global nuclear liability regime that addresses the concerns of all States that might be affected by a nuclear accident with a view to providing appropriate compensation for nuclear damage. The IAEA International Expert Group on Nuclear Liability (INLEX) to recommend actions to facilitate achievement of such a global regime. Member States to give due consideration to the possibility of joining the international nuclear liability instruments as a step toward achieving such a global regime.

12.3.6 Global or Regional Regime?

Establishing a global nuclear liability regime based on worldwide treaty relations is on the agenda. This object appears to be eligible for everybody's support: it ensures an equal level of guaranteed compensation without discrimination worldwide, seems to do away with the uncertainties of the general rules of private international law in the event of transboundary nuclear damage, and facilitates nuclear trade by unifying the competition rules. Global harmonisation is superior to the current patchwork situation. Nevertheless, a closer look at this goal will help to better see the pros and cons.

A truly global regime would require that all 193 UN Member States plus 2 Observer States are party to the global treaty regime.[167] That is surely not a realistic prospect for the foreseeable future, and its possible establishment would last decades. One may only expect a step-by-step approximation which means that we still have to face a patchwork situation for a long period of time. The global regime will not be global.

It is only partly correct that a global treaty regime would do away with the problems of the laws of conflict if transboundary nuclear damage occurs. The regime would in particular provide a single competent court, binding rules on the

165 See: Progress towards a Global Nuclear Liability Regime, Nuclear Law Bulletin 93 (2014/1) 9–23. See also Burns 2012.

166 Approved by the IAEA Board of Governors on 13 September 2011 and endorsed by the IAEA General Conference at its 55th Session on 22 September 2011, see https://www.iaea.org/sites/default/files/actionplanns.pdf. Quotation under the heading 'International Legal Framework' dot 3 p. 5. On the implementation of the Action Plan see the INLEX Recommendation 'Recommendations on how to facilitate achievement of a global nuclear liability regime, as requested by the IAEA Action Plan on Nuclear Safety', at: https://ola.iaea.org/ola/documents/ActionPlan.pdf.

167 There are more countries in the world, see http://www.polgeonow.com/2011/04/how-many-countries-are-there-in-world.html.

law applicable and provisions on recognition and enforcement of judgements. The law applicable is the law of the international nuclear liability conventions and of those parts of the respective national law, which are not regulated by the conventions. The conventions do not provide a comprehensive civil liability law but are restricted to those parts of liability law 'for which common law rules and practice are not suitable. Whenever risks, even those associated with nuclear activities, can properly be dealt with through existing legal processes, they are left outside of the Convention'.[168] The conventions are embedded in national law. Consequently they expressly, for defined areas, grant national legislators competence, for example, to fix the compensation amount within a certain frame or, subject to the provisions of the conventions, to decide on 'the nature, form and extent of compensation'.[169] There are also silent or implicit competences of the national law (*e.g.* operator is the person who is designed by the competent authority). Finally there are the so-called preliminary questions to be determined by national law (*e.g.* who is the property owner?). It follows that also within a convention regime differing national laws remain applicable. In order to determine the national law applicable to the individual case the general rules of the laws of conflict are to be applied.[170] Even a global regime will therefore continue exposing stakeholders to the uncertainties of the general rules of private international law. The conflict of laws problems are not done away with but only reduced, perhaps mitigated and not necessarily less complicated.

Finally, a global regime will facilitate worldwide nuclear trade. Indeed, the winner of a global regime would be the exporting nuclear industry. Legal channelling and the competent court at the place of the nuclear incident protect suppliers against compensation claims and lawsuits in domestic courts which might be unfavourable for them.[171] This is clearly expressed in the message by US President George W. Bush to the US Senate to introduce the Convention on Supplementary Compensation for Nuclear Damage:[172]

> Second, U. S. participation in a global liability regime will allow U. S. exporters of nuclear technology and equipment to compete more effectively in foreign markets generally. Today, as noted above, these firms are exposed to potentially unlimited liability in their foreign businesses and to suit in U.S. courts. Even if the suits are baseless, expenses to defend such cases can be substantial. When the United States and the state whose

[168] No. 7 Exposé des Motifs (n. 1).

[169] Articles 11 1960 and 2004 PC, VIII 1963 and 1997 VC, 11 CSC Annex.

[170] See in detail on this question: Pelzer 2009, pp. 819–842.

[171] See also: Nuclear Power Plant and Reactor Exporters' Principles of Conduct, October 22, 2014, http://nuclearprinciples.org/the-principles/.

[172] 107th Congress, 2nd Session, Senate, Treaty Doc. 107-21, Message from the President of the United States'submitting Convention on Supplementary Compensation…, etc., November 15, 2002, Washington, DC 2002, p. IX, https://www.congress.gov/107/cdoc/tdoc21/CDOC-107tdoc21.pdf.

nationals are involved are both parties of the CSC, however, liability exposure will be channeled to the operator of the 'installation state', thus substantially limiting the nuclear liability risk of the U.S. suppliers.'

Nuclear liability law, however, is not mainly designed to protect exporting industry but it is above all meant to compensate those who suffer damage caused by nuclear activities. Do they as well benefit from a global regime? Again we have to refer to the nuclear risk. Is there a nuclear risk of a global dimension? Only if there is risk which has a worldwide considerable detrimental impact on man and environment can we talk about a global nuclear risk. If that should be the case a global nuclear liability regime would be beneficial for potential victims, too.

Chernobyl, Fukushima and all of the other nuclear accidents which ever occurred[173] show that the significant nuclear risk consequential to a major nuclear incident is limited to a restricted region neighboured to the place of the incident. There may be widespread radioactive air or water pollution. But there are doubts as to whether that pollution will be able to cause considerable nuclear damage in regions of the world far away from the place of the incident. A nuclear incident in Europe will most probably not cause nuclear damage in the Americas or in the Far East. The radioactive pollution of the sea close to the shores of California originating from Fukushima seems to be of a negligible extent.[174] Far-distance pollution does not warrant worldwide treaty relations. If such pollution still causes compensable nuclear damage the case could be settled through the general rules of the law of conflicts. Moreover, the 2004 Paris Convention and the 1997 Vienna Convention extend their geographical scope of application also to non-Contracting States if certain conditions are met and thus may be applicable.[175]

A nuclear risk with a possibly worldwide impact is caused by the international carriage of nuclear materials,[176] and particularly coastal States have respective concern.[177] Of course, the effect of a transport accident is also concentrated to the

[173] See Wikipedia 'List of civilian nuclear accidents', https://en.wikipedia.org/wiki/List_of_civilian_nuclear_accidents. See also Wikipedia 'Lists of nuclear disasters and radioactive incidents', https://en.wikipedia.org/wiki/Lists_of_nuclear_disasters_and_radioactive_incidents.

[174] See Kim Martini, True Facts about Ocean Radiation and the Fukushima Disaster, Deep Sea News, November 28, 2013, http://www.deepseanews.com/2013/11/true-facts-about-ocean-radiation-and-the-fukushima-disaster/; Reynard Loki, How worried should we be about nuclear fallout from Fukushima?, Alternet, August 22, 2015, http://www.alternet.org/environment/fukushima-fallout-should-you-be-worried.

[175] See n. 106.

[176] See on the risk and the frequency of the carriage of nuclear materials: World Nuclear Association, Transport of Radioactive Materials (updated January 2016), http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Transport/Transport-of-Radioactive-Materials/; World Nuclear Transport Institute, Nuclear Transport Facts, http://www.wnti.co.uk/nuclear-transport-facts/faqs.aspx; IAEA (ed.) 2001; Wilkinson 2001.

[177] See Ludbrook 2004.

place of the incident and its direct environment. The difference to an accident in an installation is that the operator liable will probably be located far away in a State that is not party to the convention which the victim State is a party to, if at all. Also here it can be referred to the revised geographical scope of the 2004 Paris Convention and the 1997 Vienna Convention to solve the problem. But it has to be admitted that a global regime would improve the situation. This applies the more so since under the revised conventions and the Convention for Supplementary Compensation the competent court lies with the coastal State who a transport passes by and in whose exclusive economic zone the nuclear incident occurs.[178]

From the point of view of the victim a global nuclear liability regime would only be advantageous in order to more reliably cover nuclear damage caused by the rare possibility of worldwide-distance radioactive air or water pollution or caused in the course of international carriage of nuclear material. This is not a totally convincing justification for embarking on the long lasting and open-ended exercise of establishing a global regime. Victims do not necessarily need such regime.

Focus should instead be steered to the region in the neighbourhood of a nuclear installation with a view to ensuring that the States of that region are party to the very same nuclear liability convention. Such concrete risk community could also and exclusively provide compelling justification for adhering to a convention on supplemental compensation to be provided by public means of all contracting Parties. This applies to the Brussels Supplementary Convention which is meant to cover a risk community in a certain region, namely Europe. It is, however, questionable if it also applies to the second tier of compensation under the Convention on Supplementary Compensation to be provided by all Parties.[179] This Convention is designed as worldwide treaty, and it is difficult to explain that tax money from all Parties shall be used to compensate nuclear damage worldwide. There is no global risk community.

As a consequence a change of goal should be envisaged: Not a global nuclear liability regime shall be aimed at but several regional nuclear liability regimes. 'Regional convention clusters'[180] are needed to ensure that the risk communities in the neighbourhood of nuclear power plants are adequately protected. They may be established, as the case may be, in all continents. They may build on either the Paris Convention or the Vienna Convention or the Convention on Supplementary Compensation or a combination of them.

A regional approach seems to be also envisaged by recent publications of Asian authors. Mohit Abraham,[181] after a careful description of the liability situation and the potential nuclear risks evolving in Asian regions, concludes that a clear liability mechanism is required to meet that challenge and summarizes: 'Considering

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178 Articles 13 (b) 2004 PC, XI (1*bis*) 1997 VC, XIII (2) CSC.

179 Article III (1) (b) CSC.

180 Pelzer 2012, p. 4. See furthermore: Pelzer 2014, p. 343.

181 Abraham 2014.

the difficulties that the world has already seen in developing a global nuclear liability regime, the focus on regional cooperation and arrangements in the area of international nuclear liability should consider the EU's initiative for a European nuclear liability law.'[182] He also suggests recommending to the IAEA to entrust the INLEX Group to re-examine the existing principles of nuclear liability 'including those in relation to regional arrangements.'[183] M. P. Ram Mohan[184] examines the conditions for achieving overarching global nuclear liability architecture in South Asia. His book, which is also based on interviews with politicians and experts, comes to the result that the South Asian Association for Regional Cooperation (SAARC) would be the appropriate forum to deal with establishing a nuclear liability regime for the region which covers roughly 1.9 billion people. He has in mind to establish a mandated SAARC Nuclear Energy Risk Community competent for a South Asian nuclear liability regime.[185]

Summary

The international nuclear liability regime, which is based on several international conventions and on national legislations, provides appropriate concepts and tools to ensure full or at least adequate reparation of nuclear damage. More comprehensive international harmonisation is still desirable with a view to further facilitating the bringing of claims for compensation of transboundary nuclear damage within a system of treaty relations. However, the current efforts to establish one single global nuclear liability regime may aim at an ideal, if at all, but they are the result of misjudging the reality and thus are leading astray. The nuclear risk is not of such a nature that it compellingly requires a global treaty regime of damage reparation. Only regional approaches to international nuclear liability regimes have a realistic chance to be accepted and implemented. Regions are directly exposed to the risks of nuclear activities performed in that region. They form risk communities which provide momentum for States to adhere jointly to liability conventions including instruments on supplemental compensation to be provided by public money of all Contracting Parties.

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[182] Abraham 2014, p. 36.

[183] Abraham 2014, p. 37.

[184] M. P. Ram Mohan 2015. See also: Mohan et al. 2013, 4:46–62.

[185] Mohan 2015, pp. 121 *et seq.*; Mohan et al. 2013, 4:54–59.

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Chapter 13
Legal Aspects of the Nuclear Accord with Iran and Its Implementation: International Law Analysis of Security Council Resolution 2231 (2015)

Dirk Roland Haupt

Abstract This chapter aims to analyze United Nations Security Council Resolution 2231 (2015), endorsing the comprehensive solution to the Iranian nuclear issue reached in Vienna on 14 July 2015, between China, France, Germany, the Russian Federation, the United Kingdom, the United States of America, with the support of the High Representative of the European Union for Foreign Affairs and Security Policy ('E3/EU+3') on the one side and Iran on the other side, from the perspective of international law. Taking into account the interim Joint Plan of Action concluded by these sides on 24 November 2013, this Chapter applies the method of a legal commentary in order to explain and dissect the complex and unprecedented structure of this arrangement. The ambition is to analyze the arrangement in the multilateral context of the 1968 Treaty on Non-proliferation of Nuclear Weapons (NPT). The author argues that the implementation of this comprehensive solution is decisive for a strengthening, or weakening, of the NPT regime in the long term, and submits that certain arguments of concern raised in the international discourse on the outcome of the negotiations commenced in Geneva, streamlined in Lausanne and finalized in

Licentiate of Law (jur. lic.), University of Lund, Sweden. Member of the Swedish Branch of the International Law Association, Alternate Member of the ILA Committee on Nuclear Weapons, Non-Proliferation and Contemporary International Law.—The author wishes to acknowledge, with sincere gratitude, the most helpful and valuable comments and reflections received by Professor Per Cramér, Dean of the School of Business, Economics and Law, University of Göteborg, Sweden, and by Advocate Keren Shakar, Director Treaties' Department, Legal Advisor's Office, and legal counselor for international strategic affairs, Ministry of Foreign Affairs, Jerusalem, Israel. This article is dedicated to Professor Hans-Heinrich Vogel, University of Lund, Sweden, who has been the author's mentor for many years and to whom the author owes the major part of what he could achieve in his academic education.

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Vienna are not unfounded from a mere point of view of the international law. As the nuclear accord with Iran first and foremost is a diplomatic solution, it is advisable for international lawyers involved in this process to pursue a contextualized expectation management with regard to the role and effectiveness of international law.

Keywords Civil nuclear cooperation · IAEA verification · Implementation plan · International Atomic Energy Agency (IAEA) · Joint Comprehensive Plan of Action (JCPOA) · Missile Technology Control Regime (MTCR) · Nuclear Non-Proliferation Treaty (NPT) · Procurement channel · Nuclear accord · Sanctions · SC Res 1929 (2010) · SC Res 2231 (2015) · Snap-back mechanism

Contents

13.1 Introduction

For over a decade, Iran's activities related to the sensitive nuclear fuel-cycle have been at the center of international concerns about the further spread of nuclear weapons.[1] After years of accelerations and slowdowns in international diplomatic efforts, a comprehensive arrangement was reached on 14 July 2015 between China, France, Germany, Russia, the United Kingdom and the United States, with the High Representative of the European Union for Foreign Affairs and Security Policy—the so-called 'E3/EU+3'[2] participants[3]—and Iran. The core of this solution is the Joint Comprehensive Plan of Action (JCPOA)[4] that is designed to block, for at least 15 years and in a verifiable manner, Iran's potential pathways to nuclear military capacity using highly enriched uranium and plutonium and to prevent a covert nuclear weapons program in exchange for terminating the existing nuclear-related sanctions and allowing to pursue a limited civilian nuclear energy program under nuclear restrictions, intrusive monitoring and permanent additional transparency measures.[5] The accord was endorsed on 20 July 2015 by the United Nations Security Council (SC) in its Resolution 2231 (2015) and adopted on 18 October 2015 after the provision by Iran, on 15 August 2015, to the International Atomic Energy Agency (IAEA) of its explanations clarifying past and present outstanding issues regarding former military dimensions of Iran's nuclear program.[6] Implementation commenced on 16 January 2016 upon the submission, by the IAEA Director General on the same day, of a report to the IAEA Board of Governors and the SC, confirming that Iran has completed the necessary preparatory steps to start the implementation of the JCPOA,[7] inter alia by removing and

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[1] Bernstein 2014, pp. 177–183; Cordesman et al. 2014, pp. 35–73; Davenport et al. 2015, p. 1; Sofaer 2013, pp. 20 et seq., 73–76, 89 and 97 et seq.

[2] Especially sources in the United States almost exclusively use the designation 'P5+1' States, i.e., the five permanent members of the SC plus Germany. See e.g. Davenport et al. 2015, pp. 1 et seq., or Samore 2015, pp. 1 et seq. As this language not only overlooks the role assigned to the EU High Representative in this process, but does not occur in SC Res 2231 (2015) or its Annexes and Attachments either, it is not used in this contribution. For the definition of the term 'E3/EU+3' see first paragraph in the Preface to Annex A (JCPOA) to SC Res 2231 (2015) and § (i) in the JCPOA section entitled 'Preamble and General Provisions' (UNSC 2015d, pp. 8–9).

[3] As will be analyzed in greater detail in Sect. 13.7.1 *infra*, the nuclear accord with Iran reached in Vienna—hereinafter also referred to as the 'Vienna Accord'—is no legally binding international agreement; in particular, it is not a treaty under international law. In the negotiations and in the consolidation of the relevant texts, treaty terminology was consequently avoided in the JCPOA as well as in the Statement in Annex B to SC Res 2231 (2015). An indication in this respect is the usage of the term 'participants' instead of the term 'parties' as defined in Article 2(1)(g) of the 1969 Vienna Convention on the Law of Treaties.

[4] UNSC 2015d, conforming with UNSC 2015b.

[5] Davenport et al. 2015, p. 2.

[6] IAEA 2015b.

[7] IAEA 2016a.

rendering inoperable existing calandria for the heavy-water reactor at Arak.[8] For the authority and integrity of the NPT and for a rule-based behavior in the field of nuclear arms control the Iran case remains a crucial yardstick.

Quite predictably very different political interpretations have emerged around the nuclear accord with Iran. In his 'Remarks on the Iran Nuclear Deal', made on 5 August 2015 at the American University in Washington, DC, U. S. President Barack Obama emphasized that '[…] while Iran, like any party to the Nuclear Nonproliferation Treaty, is allowed to access peaceful nuclear energy, the agreement strictly defines the manner in which its nuclear program can proceed, ensuring that all pathways to a bomb are cut off'.[9] In his statement made on 14 July 2015, the Prime Minister of Israel, Benjamin Netanyahu, counter-argued that the Islamic Republic perceived itself to having secured access to nuclear weapons in that the international community is removing the sanctions while Iran is keeping its nuclear program[10] and noted that '[b]y not dismantling Iran's nuclear program, in a decade this deal will give an unreformed, unrepentant and far richer terrorist regime the capacity to produce many nuclear bombs, in fact an entire nuclear arsenal with the means to deliver it. What a stunning historic mistake!'[11]—a statement which in substance received some support from Saudi Arabia and certain other Gulf States.

This Chapter aims to analyze the Vienna Accord on Iran's nuclear program from an international law point of view. After a brief overview of the developments leading to this arrangement and a review of its highly complex, convoluted and in some parts unprecedented structure, in Sects. 13.2 and 13.3, core substantive elements of the nuclear deal will be examined in greater detail in Sects. 13.4–13.6. The subsequent commentary on SC Res 2231 (2015), in Sect. 13.7, will depart from these findings when it will address the following nine aspects: (i) the legal qualification and the binding effect of the accord; (ii) the scope and limitations of the powers of the SC; (iii) the consequences for nonperformance of commitments under the JCPOA—and the lack thereof; (iv) the snap-back mechanism and its limited effect; (v) the exemptions granted with immediate effect; (vi) the role of the IAEA; (vii) the ratification of the Additional Protocol; (viii) possible implications of changes in the composition of the JCPOA participants; and—as a short digression—(ix) the relationship between the Vienna Accord and Iran's ballistic missile program. In Sect. 13.8, three issues will be evaluated which are not only of particular importance for the authority and feasibility of the nuclear

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[8] Operative paragraph (OP) 5 of SC Res 2231 (2015) [UNSC 2015a, p. 3] in conjunction with § 15.1 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 94] and § 3 of JCPOA Annex I (Nuclear-related Measures) [UNSC 2015d, p. 21].

[9] Obama 2015.

[10] Netanyahu 2015b, quoting Iran's President Rouhani.

[11] Netanyahu 2015a.—For a detailed analysis of Iran's nuclear program from the perspective of Israel, which is not a State party to the NPT, see Katz and Hendel 2011, as well as Gold 2009, pp. 179–232.

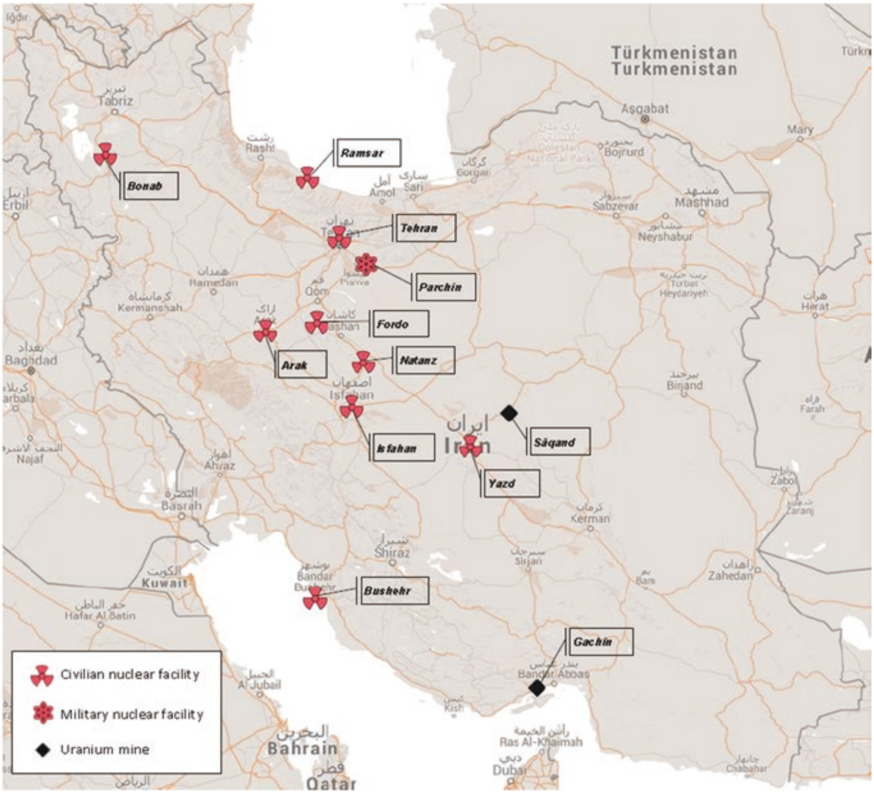

Fig. 13.1 Nuclear facilities in Iran

accord, but in addition act as links between international law on the one hand and security policy on the other hand: (i) the military dimension of Iran's nuclear program; (ii) Iran's ability to be able to detach itself again from the NPT after having implemented the JCPOA by means of a 'breakout' or a 'sneakout'; and (iii) the significance of Iran's long record of breach[12] of international obligations regarding nuclear nonproliferation. Finally, preliminary conclusions will be presented in Sect. 13.8.

In order to facilitate a geographical orientation, Fig. 13.1 points out the locations of nuclear facilities in Iran.

[12] There are voices which, with varying arguments, hold the view that Iran, in a strictly legal meaning, made a justifiable interpretation of Article IV of the NPT when it stated that the country's uranium enrichment activities were compatible with its obligations under international law. Cf., on the one hand, the confident assessment by Joyner 2009, p. 53, and, on the other hand, the more reticent view expressed by Ogilvie-White 2007, pp. 469 et seq., as well as Sofaer 2015, p. 2, who is critical of these views.

13.2 Anamnesis of the Vienna Accord

The Vienna Accord is not the first arrangement which came into operation between Iran and foreign powers on the former's nuclear program. It was preceded by the 2003 Tehran Agreed Statement,[13] the 2004 Paris Understanding,[14] the 2007 'Understandings of the Islamic Republic of Iran and the IAEA on the Modalities of Resolution of the Outstanding Issues' (usually referred to as the '2007 Work Plan'),[15] the 2010 'Joint Declaration by Iran, Turkey, and Brazil' on nuclear fuel exchange,[16] and not least by the Joint Plan of Action (JPA),[17] which the E3/EU+3 and Iran approved on November 24, 2013 in Geneva—an arrangement aiming at the short-term freezing of key parts of Iran's nuclear program in exchange for a decrease in sanctions, as both sides would work towards a long-term solution—as well as the 'Parameters of a Joint Comprehensive Plan of Action (JCPOA) regarding the Islamic Republic of Iran's nuclear program', as decided by the JPA participants in Lausanne on 2 April 2015.[18]

From the perspective of international nuclear diplomacy, the 2015 JCPOA is thus no singular event. Reaching a consensual solution has engaged the governments involved, regardless of their internal—sometimes altering—compositions. Modules for a comprehensive arrangement have been developed in earlier stages and carried forward on a bumpy road. The JCPOA is a result of negotiations which could build on previous achievements and proposals, although its endorsed version differs significantly from them. In particular, the 2013 Joint Plan of Action, which ceased to be effective on 16 January 2016, can be traced in numerous parts of the JCPOA.[19]

When Article IV(1) of the NPT determines that '[n]othing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty', it establishes, although expressed in a negative form, that the States parties are entitled to develop a civil nuclear program without discrimination and without restrictions other than those that may result from obligations of nonproliferation under the NPT.[20] The 2013 JPA strove for a treatment of Iran's nuclear program according to the rules which apply for nuclear programs of any other Non-Nuclear Weapon State which is party to the NPT.

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[13] Kerr 2012, p. 6. The text of the agreed statement of October 21, 2003 is reproduced in FCO 2005, pp. 40 et seq.

[14] IAEA 2004.

[15] IAEA 2007b. See also Perthes 2008, pp. 89–120.

[16] The Guardian Online 2010.

[17] IAEA 2013d.—For a detailed analysis see Cordesman et al. 2014.

[18] U. S. Department of State 2015.

[19] According to the last clause in § (viii) of the JCPOA's section 'Preamble and General Provision' [UNSC 2015d, p. 9], '[t]his JCPOA builds on the implementation of the Joint Plan of Action […] agreed in Geneva on 24 November 2013'.

[20] See Shaker 1980, pp. 293–337; 2007, pp. 120–127, and Joyner 2009, pp. 43–50.

Since early on, the issue whether Iran has a right to enrich uranium or plutonium is controversial. There has been a lack of acceptance, on the part of the United States, for the idea that Iran should be allowed to control enrichment capability.[21] The implementation of the 2013 JPA was characterized by the appearance of diverging vectors, the first one being official statements in support of a restrictive interpretation of this interim agreement,[22] while the other is defined by the fact that the United States Government under President Obama was willing to accept that Iran possesses its own enrichment capacity.[23] However, the United States consistently rejects the opinion held by international legal commentators[24] that the NPT, and in particular its Article IV(1), would give a right to enrich uranium; it merely conceded the fact that there were cases in which States in practice had enrichment program in place.[25]

13.3 Structure of the Vienna Accord

The Vienna Accord is based on two separate structural components, which complement each other functionally without being formally intertwined by more than individual references:

(i) SC Res 2231 (2015) which can be likened to an umbrella spanning over a complex system that connects numerous elements, of diverse qualification under international law and of varying regulatory scope; and
(ii) the bilateral relationship between the IAEA and Iran with regard to legally binding safeguards and nonbinding verification commitments or policy understandings.

Figure 13.2 conveys an overview of the constitutive modules of the Vienna Nuclear Accord.[26]

13.3.1 The First Pillar

In light of its elaborated structure, it is reasonable to perceive SC Res 2231 (2015) as the centerpiece of the nuclear accord with Iran. Being standard within the

[21] Congress of the United States of America 2006, p. 1 et seq [Chairman Edward R. Royce]; Joyner 2013, pp. 79–87 and 94 et seq.

[22] White House Office of the Press Secretary 2013.

[23] U. S. Department of State 2013.

[24] Joyner 2013, pp. 42 et seq, 66–68.

[25] Katzman and Kerr 2016, p. 7.

[26] Cf. Haupt 2016, p. 119.

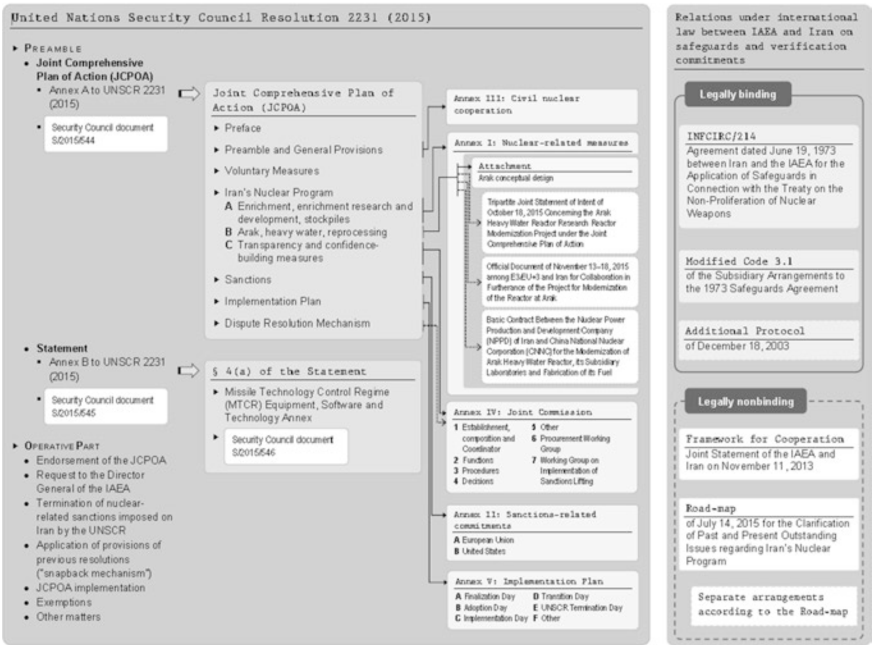

Fig. 13.2 Structure of the Vienna nuclear accord

typology of decision-making by the SC, a resolution—according to established practice subdivided into a preamble and an operative part—is instrumental both in communicating and operationalizing a decision adopted by the members of the SC for the purpose of maintaining international peace and security and in qualifying the implications of this decision under international law. In anticipation of this decision, § (xiv) of the JCPOA's section 'Preamble and General Provisions'[27] is reflective of a delineating approach[28] chosen by the participants in that the E3/EU+3 committed themselves to submit a draft resolution to the SC endorsing this JCPOA, affirming that the conclusion of this JCPOA marks a fundamental shift in its consideration of this issue and expressing its desire to build a new relationship with Iran. The provision assigns to the SC Res to be adopted also to provide for the termination, on Implementation Day,[29] of provisions imposed under previous resolutions, the establishment of specific restrictions, and the conclusion of consideration of the Iran nuclear issue by the SC ten years after the Adoption Day.[30]

On the timeline, the historicity of the modules gathered in SC Res 2231 (2015) must be taken into account. When, on 14 July 2015, the JCPOA was approved and

27 UNSC 2015d, p. 10.

28 This regulatory technique will be analyzed in Sect. 13.7.2 *infra*.

29 On the concept and meaning of 'Implementation Day' see Sect. 13.4.3 *infra*.

30 On the concept and meaning of 'Adoption Day' see Sect. 13.4.2 *infra*.

the Statement made by the E3/EU+3 they constituted historical, legally relevant facts for the SC Resolution which was adopted on 20 July 2015. The modular technique employed in the case of SC Res 2231 (2015) and the substantive abundance of each of its parts suggest that each element—the resolution *strictu* sensu,[31] the JCPOA as Annex A to the resolution,[32] and the Statement attached to it as Annex B[33]—be considered separately in a first analytical step.

13.3.1.1 SC Res 2231 (2015) *Strictu* Sensu

Already the preamble outlines the structure of the Vienna Accord: In its PP 4,[34] the JCPOA is referred to as Annex A to the resolution and quoted as Security Council document S/2015/544;[35] in PP 6, the Statement is noted as Appendix B to the resolution and referenced as Security Council document S/2015/545.[36] The reason is partially the wish to reflect the historicity of these sources, but more importantly the fact that, while the resolution will terminate at a certain point in time, the 'UN Security Council resolution Termination Day' according to § 34(v) of the JCPOA, which will be 18 October 2025 at the latest, a UN document does not have a definite expiration date, unless it is repealed by the State which introduced it to the SC. As will become apparent from the subsequent analysis, there are several commitments in the Vienna Accord, which are conceived to apply well beyond Termination Day. To the extent those commitments do not constitute provisions regulated in the second pillar, the termination of SC Res 2231 (2015) entails that also its annexes—the JCPOA and the Statement—will cease to be applicable. To circulate them as SC documents cannot prevent that their quality in terms of international law will alter on Termination Day. However, this technique implies that they will continue to exist as reference sources and thus be subject to the JCPOA participants' continued political will to implement long-term commitments without needing to take into account a predetermined ultimate validity date of the JCPOA having turned into an ordinary SC document.

The operative part is opened, in OP 1, by the SC's endorsement of the JCPOA and request directed to the Director General of the IAEA, in OP 3, to undertake the necessary verification and monitoring of Iran's nuclear-related commitments for the full duration of those commitments under the JCPOA. It reaffirms that Iran shall cooperate fully as the IAEA requests to be able to resolve all outstanding issues, as identified in IAEA reports. The central provisions of the operative part

31 UNSC 2015a.

32 UNSC 2015d.

33 UNSC 2015e.

34 In the diplomatic and legal practice the unnumbered preambulary paragraphs are often cited as 'PP', followed by a cardinal number, the numbering of which starts with the paragraph next after the introductory line 'The Security Council,—'.

35 UNSC 2015b.

36 UNSC 2015c.

concern, on the one hand, the terminations of SC Res 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010), and 2224 (2015) as foreseen in OP 7(a) and, on the other hand, the section covering OPs 10–15 on the application of provisions of previous resolutions. This title denominates the specific, and quite unique, so-called snap-back mechanism, which in the event of an issue attributable to Iran that a JCPOA participant State believes constitutes significant non-performance of commitments under the JCPOA shall enable a quick return to the sanction status prevailing prior to the lifting of sanctions against Iran's nuclear program. Further, OPs 16–20 address specific aspects of JCPOA implementation, notably in light of the sphere of competence and procedures of the Joint Committee foreseen in the Vienna Accord with respect to proposals by the States to participate in or allow nuclear-related activities specified in § 2 of the Statement in Annex B. A section on immediate exemptions, covering OPs 21–24, precedes a final section on other matters (OPs 25–30).

It is important to note that the operative part encompasses selected aspects which are regulated in greater detail in the JCPOA and the statement by the E3/EU+3, but that it does not fully replicate the contents of Annexes A and B. The reason for this is that the Security Council intended to give regulatory elements of the Vienna Accord, which are expressly mentioned in SC Res 2231 (2015) *strictu sensu*, legally binding effect.[37]

In PP 14, SC Res 2231 (2015) underscores that Member States are obligated under Article 25 of the Charter of the United Nations to accept and carry out the Security Council's decisions. As this topic is an aspect of the legal qualification and the binding effect of the accord, it will be commented on in Sect. 13.7.1 *infra*.

13.3.1.2 Joint Comprehensive Plan of Action (JCPOA)

The JCPOA,[38] the centerpiece of the nuclear accord with Iran, is an arrangement, or a memorandum of understanding—i.e. a single document using non-treaty terms—,[39] between China, France, Germany, Russia, the United Kingdom and the United States with the support of the EU's High Representative (the 'E3/EU+3') on the one side and Iran on the other side. The commitments approved by the sides in the JCPOA do only apply among them. This is a major difference from the Statement in Annex B, which contains provisions addressing all States without exception.[40]

Five detailed annexes; on nuclear-related matters, sanctions-related commitments, civil nuclear cooperation, the Joint Commission, and the implementation plan, two of which are complemented by attachments, constitute integral elements

[37] Haupt 2016, p. 118.

[38] The JCPOA has not only been promulgated in the manner indicated by PP 4 of SC Res 2231 (2015), but also as IAEA document INFCIRC/887 (IAEA 2015e).

[39] FCO 2014, p. 26.

[40] OP 7(b) of SC Res 2231 (2015) [UNSC 2015a, p. 3] in conjunction with § 1 of Annex B (Statement) of SC Res 2231 (2015) [UNSC 2015e, p. 98].

of this memorandum of understanding and are essential for its implementation. Furthermore, it is implied that Iran and the so-called 'Working Group', i.e. JCPOA's other participants, on the one hand and competent bodies and legal persons on the other hand approve further arrangements, the purpose of which shall be to regulate aspects in greater detail, primarily because the JCPOA was considered by the involved sides not be the right place for these solutions. Examples in this respect are (i) the 'Tripartite Joint Statement of Intent of 18 October 2015 Concerning the Arak Heavy Water Reactor Research Reactor Modernization Project under the Joint Comprehensive Plan of Action' made by the Iranian, Chinese and American nuclear authorities,[41] (ii) the 'Official Document among E3/EU+3 and Iran for Collaboration in Furtherance of the Project for Modernization of the Reactor at Arak', which was signed in the capitals of the JCPOA participants between 13 and 18 November 2015,[42] and (iii) the so-called 'Basic Contract Between the Nuclear Power Production and Development Company (NPPD) of Iran and China National Nuclear Corporation (CNNC) for the Modernization of Arak Heavy Water Reactor, its Subsidiary Laboratories and Fabrication of its Fuel' with statements of support by the JCPOA participants.[43]

The JCPOA, introduced by a preface, is divided into six main parts: (i) the preamble and general provisions; (ii) the guiding provision that all commitments made in the JCPOA are voluntary measures; (iii) a detailed part on Iran's nuclear program; (iv) provisions on sanctions; (v) the implementation plan; and (vi) provisions on a dispute resolution mechanism.

In the preface, the participants emphasize that the JCPOA envisions restoring the international community's confidence in the exclusively peaceful nature of Iran's program, while Iran reaffirms that under no circumstances will Iran ever seek, develop or acquire any nuclear weapons. It is, however, not possible to determine by means of ordinary methods of interpretation whether this reaffirmation constitutes a waiver, on the part of Iran, to avail itself of the right of withdrawal from the NPT under Article X(1) of the said treaty, according to which '[e]ach Party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other Parties to the Treaty and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests'.[44]

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41 U. S. Department of Energy 2015.

42 EEAS 2015.—Cf. § 4 of JCPOA Annex I (Nuclear-related Measures) in conjunction with § 5.2 of JCPOA Annex III (Civil Nuclear Cooperation) and § 12 of JCPOA Annex V (Implementation Plan).

43 Haupt 2016, p. 136 note 21.—At the time of the editorial deadline, the Basic Contract was still not published. It is in the files of the author.

44 See Shaker 2007, pp. 93–101, and Fleck 2012, pp. 250–269.

At the same time, the JCPOA will leverage the comprehensive lifting of all SC sanctions as well as multilateral and national—i.e., EU and U. S.—sanctions related to Iran's nuclear program, including steps on access in areas of trade, technology, finance, and energy.

As provided for in para. (i) of the of the JCPOA's section 'Preamble and General Provisions',[45] the JCPOA and the annexes hereto include reciprocal commitments. In their capacity as voluntary measures,[46] they are, however, not mutually conditional upon each other, as this arrangement does not found a system of rights and obligations under treaty law. The successful implementation of JCPOA will facilitate for Iran to fully enjoy its right to use of nuclear energy for peaceful purposes in accordance with the relevant articles of the NPT, and the Iranian nuclear program will be treated under the same rules and conditions which apply to all other Non-Nuclear Weapon States that are party to the NPT.[47] Simultaneously the E3/EU+3 and Iran acknowledge that the NPT remains the cornerstone of the nuclear nonproliferation regime and the essential foundation for the pursuit of nuclear disarmament and for the peaceful uses of nuclear energy.[48] Within the framework of JCPOA, the EU,[49] the E3+3 States, and Iran will cooperate, as appropriate, in the field of peaceful uses of nuclear energy and engage in mutually determined civil nuclear cooperation projects as detailed in JCPOA Annex III (Civil Nuclear Cooperation), including through IAEA involvement.[50]

At the intersection between the JCPOA's 'Preamble and General Provisions' and its subsequent four parts on Iran's nuclear program, sanctions, the implementation plan and the dispute resolution mechanism, the 'voluntary measures clause' provides that the commitments made in these parts to take action within the time schedule specified in JCPOA as well as in its annexes and attachments are voluntary measures. This means that §§ 1–37 of the JCPOA are not legally binding as long as they are only considered in the context of the JCPOA.[51] As will be analyzed in greater detail in Sect. 13.7.1 *infra*, individual provisions of the JCPOA

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45 UNSC 2015d, p. 9.

46 UNSC 2015d, p. 11.

47 Paragraph (iv) of the of the JCPOA's section 'Preamble and General Provisions' [UNSC 2015d, p. 9].

48 Paragraph (vii) of the of the JCPOA's section 'Preamble and General Provisions' [UNSC 2015d, p. 9].

49 The reason for the circumstance that the EU is specifically mentioned in this paragraph, and not just as part of the nomenclature 'E3/EU+3' as customarily used throughout the JCPOA, is the fact the legal personality under international law vested in the European Atomic Energy Community (Euratom) is a distinct one when it comes to civil nuclear cooperation, as Euratom—although integrated into EU structures and represented by the Union—remains an international organization under international law alongside the EU.

50 Paragraph (xiii) of the of the JCPOA's section 'Preamble and General Provisions' [UNSC 2015d, p. 10].

51 The Vienna Accord itself encompasses an interpretive clarification in this regard, albeit in a somewhat concealed reference in footnote 3 to § 18.1 of JCPOA Annex V (Implementation Plan).

may have legally binding effect as a consequence of the fact that they are subject to legally binding decisions taken in SC Res 2231 (2015). While this regulating technique does not alter the character of the nuclear accord with Iran as a not legally binding arrangement, it gives rise to the question, whether the JCPOA's 'Preface' and 'Preamble and General Provisions' may be of legally binding content due to the circumstance that they are not covered by the voluntary measures clause. However, it has to be answered in the negative: The terminology 'reciprocal commitments' used in para. (i) of the JCPOA's 'Preamble and General Provisions' indicates the deliberate intention of the drafters not to provide for anything more than merely politically binding commitments. Further, the meticulous avoidance of any treaty language in these two sections of the JCPOA preceding the voluntary measures clause is further proof of the finding that the participants did not want the JCPOA to comprehend a complex two-tier system of legally binding obligations and merely politically binding commitments. Rather, they unequivocally opted for a regulatory scheme based on legally nonbinding commitments only.

The part on Iran's nuclear program covering §§ 1–17 of the JCPOA is divided into three sections: (i) Section A on enrichment, enrichment-related research and development, and nuclear stockpiles; (ii) section B on the heavy water reactor in Arak, heavy water and its reprocessing; and (iii) section C on transparency and confidence-building measures. Each of these three sections contain references to technical annexes: Section A is interrelated with JCPOA Annex I on nuclear-related measures;[52] Section B refers to the Arak conceptual design, which is an attachment to JCPOA Annex I;[53] and Section C points to the important JCPOA Annex IV on the Joint Commission.[54] The latter, as well as the Procurement Working Group (PWG) established pursuant to § 6 of JCPOA Annex IV (Joint Commission), will play a crucial role in the administration of the procurement channel, the use of which is mandatory.[55] The concept of the procurement channel refers to a licensing procedure for dual-use nuclear-related exports to Iran which will be in place for no less than ten years, i.e., until 16 January 2026 at a minimum;[56] PWG decisions will be made by consensus, meaning that any participant can veto a proposed transfer. After an item is approved for sale or transfer, the

[52] UNSC 2015d, pp. 21–34.

[53] UNSC 2015d, pp. 35 et seq.

[54] UNSC 2015d, pp. 87–92.—JCPOA Annex IV (Joint Commission) contains provisions on, inter alia, the establishment, composition and Coordinator of the Joint Commission, functions, procedures and decisions, the PWG and the Working Group on Implementation of Sanctions Lifting.

[55] § 2 of the Statement in Annex B to SC Res 2231 (2015) [UNSC 2015e, pp. 98 et seq.] and § 6 of JCPOA Annex IV (Joint Commission) [UNSC 2015d, pp. 87–92] in conjunction with OP 8 of SC Res 2231 (2015) [UNSC 2015a, p. 3].

[56] At least one aspect of the Procurement Channel extends beyond the ten-year time limit: According to the Verification Assessment Report submitted by the U. S. Department of State to Congress, procurement of hot-cell-related equipment will be handled through the Procurement Channel for 15 years. See Samore 2015, p. 14 note 11.

exporting State is required to inform the UNSC within ten days of the supply. After shipment, Iran is required to provide access to the IAEA to verify the end-use and locations of items listed in Sect. 1—the 'Guidelines for Nuclear Transfers (Trigger List)'[57]—adopted by the Nuclear Suppliers Group (NSG),[58] as well as access to the exporting State to verify the end-use of items on the nuclear-related dual-use list.[59] Section C further establishes a linkage between the first pillar and the second pillar on the issue of clarification of past and present outstanding issues by referring, in § 14, to the Roadmap approved on 14 July 2015 between Iran and the IAEA.

Sanctions-related commitments are contained in §§ 18–33 of the JCPOA. These include (i) the sanctions adopted by the UNSC, (ii) the nuclear-related sanctions adopted by the EU on the legal basis of its jurisdiction autonomously to take so-called restrictive measures—sometimes referred to as 'multilateral sanctions'—,[60] and (iii) the extraterritorially applicable sanctions adopted by the United States, which at different places in the Vienna Accord are referred to as 'national sanctions'. As China and Russia do not have introduced any national sanctions targeting Iran in addition to those already decided by the UNSC, there is, of course, no need for any placeholder in the JCPOA for specific sanction commitments made by these two JCPOA participants. The same method applies in the correlating JCPOA Annex II on sanctions-related commitments.[61]

The drive line of the Vienna Accord is a detailed timetable—the 'Implementation Plan'—pursuant to §§ 34 and 35 of the JCPOA in conjunction with JCPOA Annex V.[62] § 34 of the JCPOA provides for five temporal parameters, which will be discussed further in Sect. 13.4 *infra*—Finalization Day, Adoption Day, Implementation Day, Transition Day, and UN Security Council Resolution Termination Day. While all measures relevant for the nuclear accord and approved in the JCPOA and in the Statement in Annex B to SC Res 2231 (2015) are interfaced with one or more of these temporal parameters, which—with the exception of Implementation Day—occur automatically, the sequence and milestones set forth § 34 of the JCPOA and in JCPOA Annex V (Implementation Plan) are without prejudice to the duration of JCPOA commitments stated in the JCPOA; § 35 of the JCPOA. The meaning of this proviso is further explained in footnote 1 to JCPOA Annex V (Implementation Plan), stating that the implementation plan does not restrict or expand the scope of these commitments.

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57 IAEA 2013a.

58 §§ 6.7 and 6.8 of JCPOA Annex IV (Joint Commission) which refer to IAEA 2013a, b.

59 Samore 2015, p. 49.

60 Article 215 of the Treaty on the Functioning of the European Union provides the legal basis for the EU to impose restrictive measures (sanctions) on third countries as well as natural and legal persons and groups or non-State entities responsible for or supporting a specific objectionable behavior ('targeted sanctions' or 'smart sanctions').

61 UNSC 2015d, pp. 37–80.

62 UNSC 2015d, pp. 93–97.

The JCPOA is concluded by the provision in §§ 36–37 of JCPOA on a dispute resolution mechanism to be dealt with in greater detail in Sect. 13.5 *infra*.

13.3.1.3 Statement in Annex B to SC Res 2231 (2015)

China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union, acting in their capacities as subjects of international law, made a statement on 14 July 2015, which is attached to SC Res 2231 (2015) as Annex B and in which they set forth certain provisions for the benefit of the implementation of the nuclear accord, the implications of which either fall beyond the material ambit of the JCPOA or were not acceptable to Iran within the framework of the JCPOA. The Statement is subdivided in four unnumbered parts: (i) an introduction; (ii) detailed provisions on issues of export control, activities related to ballistic missiles, conduct of trade, and inspections of the implementation of the nuclear accord, altogether structured in seven numbered paragraphs; (iii) a reference to the effect that the UNSC would make the practical arrangements to undertake directly the tasks specified in this Statement; and (iv) a final provision on the review of the duration of this Statement.

Distinctive from the JCPOA, which is formally separated from SC Res 2231 (2015), the Statement in Annex B to the said resolution is functionally dependent on the assumption that the SC will adopt certain of its provisions as legally binding obligations.[63] The Statement has been carefully drafted, and nowhere it invokes terminology which clearly goes beyond standard formulations for memoranda of understanding or legally nonbinding arrangements, with the phrasing in the first introductory paragraph of the Statement that the E3+3 and the EU ‘require States to comply with the provisions in this statement for their respective durations’ being a borderline issue of interpretation. Certain provisions of the Statement are addressing ‘all States without exception’[64]—thus also States not member of the UN as well as the JCPOA participants themselves including Iran who is not included among the sponsors of the Statement. Hence, the Statement’s provisions in §§ 2, 4–7 relating to issues of export control, conduct of trade, inspections of the implementation of the nuclear accord and other specific

[63] The third sentence in the introductory part of the Statement provides that the participation of China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union in the JCPOA ‘[…] is contingent upon the United Nations Security Council adopting a new resolution that would, acting under Article 41 of the U. N. Charter: terminate resolutions 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010), and 2224 (2015); require States to comply with the provisions in this statement for their respective durations; and facilitate, in cooperation with the Joint Commission established in the JCPOA, implementation of the JCPOA as provided in paras 2 and 6(a) below’.

[64] OP 7(b) of SC Res 2231 (2015) [UNSC 2015a, p. 3] in conjunction with § 1 of Annex B (Statement) of SC Res 2231 (2015) [UNSC 2015e, p. 98].

restrictions are thus directed towards all States since Implementation Day on 16 January 2016. Practical arrangements and procedures for the UNSC for carrying out tasks related to the implementation of SC Res 2231 (2015), particularly with respect to the provisions specified in §§ 2–7 of Annex B to that resolution, were set forth in a note by the President of the SC dated 16 January 2016 and entitled 'Security Council Tasks under Security Council Resolution 2231 (2015)'.[65]

In comparison, § 3 of the Statement on the specific restriction concerning ballistic missile-related activities is exceptional in calling upon Iran not to undertake any activity related to ballistic missiles designed to be capable[66] of delivering nuclear weapons, including launches using such ballistic missile technology, until the date eight years after Adoption Day, i.e., until 18 October 2023, or until the date on which the IAEA submits a report confirming the broader conclusion, whichever is earlier.[67] As no consensus could be reached that the issue of Iran's capabilities in terms of ballistic missiles and related launching technology was to be considered a subject which belonged to the core of the nuclear accord or of SC Res 2231 (2015), but the strength of its interconnectedness with central provisions of the nuclear deal advised to regulate it within the framework of the Vienna accord, both sides accepted late in the negotiations to capture it in the Statement.

The advantage of this solution is that it has come to be closely associated with § 4, particularly its subparagraph (a), which comprises the important reference to SC document S/2015/546.[68] Unlike the references to SC documents in PPs 4 and 6 in SC Res 2231 (2015), the quoted nomenclature is not deciphered. It refers to the letter dated 16 July 2015 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security

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65 UNSC 2016a.

66 While OP 9 of SC Res 1929 (2010), a resolution adopted by the SC acting under Article 41 of Chapter VII of the Charter of the United Nations, sets forth the decision that 'Iran shall not undertake any activity related to ballistic missiles *capable of* delivering nuclear weapons, including launches using ballistic missile technology' [emphasis inserted], Iran insisted in the negotiations on the nuclear accord that this language should not be repeated, but be replaced by the wording in § 3 of the Statement in Annex B to UNSCR 2231 (2015), which adds the element of '*designed to be* [capable]'. The impact of this rephrasing of the capability element, introduced in the last stage of the negotiations on the nuclear accord upon request of the Iranian side, is analyzed in greater detail in Sect. 13.7.9 *infra*.

67 It cannot be ruled out that ballistic missile-related activities, attributable to Iran, could pose a burden on the implementation of the JCPOA, although they do not represent a nuclear-related issue and JCPOA Annex II on sanctions-related commitments only copes with delistings of persons, entities and bodies related to these activities. Under a general reference to the JCPOA, the U. S. Department of the Treasury's Office of Foreign Assets Control (OFAC) introduced national sanctions on 17 January 2016, thus a day after Implementation Day on 16 January 2016, targeting 11 entities and individuals involved in procurement on behalf of Iran's ballistic missile program; see U. S. Department of the Treasury 2016.

68 UNSC 2015f.

Council, submitting the MTCR Equipment, Software and Technology Annex[69] as it stood at that date. In the negotiations, Iran, who is not participating in the MTCR, tried intensively to avert to be indirectly bound to the MTCR Equipment, Software and Technology Annex, and the failure in this regard provoked criticism at home.[70] To encode the plain text of this reference constitutes a concession in order to meet Iran's concern at the editorial, but not at the substantial level.

Simultaneously, this solution gives rise to a new issue, which puts the question to the forefront whether the technique of submitting the MTCR Equipment, Software and Technology Annex as it stood on 16 July 2015 bars the latter's dynamic application. This is not a theoretical reflection, as this annex was updated on 8 October 2015 and, subsequent to Implementation Day, on 17 March 2016, and thus the question arises, if these and later updates are and will be reflected under § 4(a) of the Statement. As the Procurement Channel does not apply to the transfers and activities set forth, inter alia, in § 4 of the Statement in Annex B on ballistic missile-related transfers and activities, national jurisdictions might be prompted to treat this matter by means of legal interpretation. While this problem has to be left open here, it is noteworthy that China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union did not condition the reference to the MTCR Equipment, Software and Technology Annex as it stood on 16 July 2015 upon a dynamic modification rule. An aspect closely related to this issue, albeit from a different angle, involves China, who is not participating in the MTCR either. The People's Republic has agreed to follow the regime's initial 1987 Guidelines and Annex, but not the subsequent revisions and updates of these documents. Solely in the context of the Vienna Accord, however, China consented to apply the MTCR Equipment, Software and Technology Annex in its 16 July 2015 version. This creates a complicated situation, both in practical terms for the administration of Chinese export controls and in terms of their effectiveness as a factor of credibility to be secured on the side of the

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[69] The provision in § 4 of the Statement in Annex B reserves the SC the right to decide in advance on a case-by-case basis to permit activities by all States implying

(a) the supply, sale or transfer directly or indirectly from their territories, or by their nationals or using their flag vessels or aircraft to or from Iran, or for the use in or benefit of Iran, and whether or not originating in their territories, of all items, materials, equipment, goods and technology set out in the MTCR Equipment, Software and Technology Annex and of any items, materials, equipment, goods and technology that the State determines could contribute to the development of nuclear weapon delivery systems; as well as

(b) the provision to Iran of any technology or technical assistance or training, financial assistance, investment, brokering or other services, and the transfer of financial resources or services, or Iran's acquisition of an interest in any commercial activity in another State, related to the supply, sale, transfer, manufacture or use of the items, materials, equipment, goods and technology described in (a) *supra* or to activities concerning ballistic missiles, provided that in the event of an approval by the Security Council: (i) the contract for delivery of such items or assistance include appropriate end-user guarantees, e.g. in the form of the 'Optional End-use Certification' pursuant to Enclosure 3 of UNSC 2016c; and (ii) Iran commit not to use such items for development of nuclear weapon delivery systems.

[70] Haupt 2016, pp. 138 et seq. note 36.

co-participants in the Statement. As it is not excluded that this situation might allow for undercuts, lacunae or circumventions in the field of ballistic missile technology, China would appear to be under a responsibility to assure that its export control practice is in full and strict compliance with the Vienna Accord.

According to § 6(c) of the Statement in Annex B, all States are, for eight years after Adoption Day on 18 October 2015 or until the date on which the IAEA submits a report confirming the broader conclusion, whichever is earlier, to continue to freeze the funds, other financial assets and economic resources which are on their territories at the date of adoption of the JCPOA, and freeze the funds, other financial assets and economic resources which are on their territories at any time thereafter, that are owned or controlled by the individuals and entities that were specified on the list established and maintained by the Committee pursuant to SC Res 1737 (2006)[71] as of 20 July 2015, with the exception of those individuals and entities specified in the Attachment to the Statement in Annex B, or that may be de-listed by the SC, and freeze those of additional individuals and entities that may be designated by the latter.

Before the termination of the SC Resolutions quoted in OP 7(a) of SC Res 2231 (2015), the issue how States shall deal with items the supply, sale, transfer, or export of which was prohibited by SC Resolutions, when they were identified in inspections, in particular of vessels on the high seas and of cargo aircraft at airports, was clearly regulated: Under the so-called 'seize and dispose' rule, States were authorized and obligated to seize and dispose of them, e.g. through destruction, rendering inoperable, storage or transferring to a State other than the originating or destination States for disposal. The main purpose of the legally nonbinding provision in § 6(f) of the Statement in Annex B, according to which '[a]ll States are to … [t]ake the required actions, in accordance with the resolution and guidance provided by the Security Council, with respect to items the supply, sale, transfer, or export of which is being undertaken contrary to the provisions contained in the JCPOA or this statement, and cooperate in such efforts', is to address the situation previously covered by the 'seize and dispose' rule. This may lead to the intriguing question whether specific provisions in the SC Resolutions terminated under OP 7(a) of SC Res 2231 (2015) could arguably be reinstated in the shape of guidance provided by the SC, most notably the standard 'seize and dispose' rule, terminated per Implementation Day, under OP 16 of SC Res 1929 (2010).[72] While the SC decided in OP 7(b), acting under Article 41 of the UN

[71] UNSC 2006b.

[72] According to OP 16 of SC Res 1929 (2010), the Security Council '[d]ecide[d] to authorize all States to, and that all States shall, seize and dispose of (such as through destruction, rendering inoperable, storage or transferring to a State other than the originating or destination States for disposal) items the supply, sale, transfer, or export of which is prohibited by paras 3, 4 or 7 of resolution 1737 (2006), para 5 of resolution 1747 (2007), para 8 of resolution 1803 (2008) or paras 8 or 9 of this resolution that are identified in inspections pursuant to paras 14 or 15 of this resolution, in a manner that is not inconsistent with their obligations under applicable Security Council resolutions, including resolution 1540 (2004), as well as any obligations of parties to the NPT, and decides further that all States shall cooperate in such efforts'. SC Res 1929 (2010) was in its entirety adopted under Article 41 of Chapter VII of the UN Charter.

Charter, that all States shall comply with, inter alia, § 6(f) of the Statement in Annex B, it is not clear beyond reasonable doubt that this regulatory structure entails that a legally binding obligation under Chapter VII of the UN Charter has been founded. But even if it was assumed that compliance with § 6(f) amounts to a legally binding obligation, it would be difficult to argue—as has been proposed in the early phase of the implementation of the nuclear accord after 16 January 2016—that specific provisions in the Resolutions terminated according to OP 7(a) of SC Res 2231 (2015) can be fully retrieved in their previous legal quality, should the SC avail itself of the possibility to provide guidance, for instance by adopting and issuing a guidance document or guidance notes which affirm the content of the 'seize and dispose' rule. Instruments of this kind are indeed in the 'tool box' of the nuclear accord, but they can only accomplish a substitute for this rule; and as potential seizure and disposal measures by States are, as such, not expressly mandated in the nuclear accord by the SC acting under Chapter VII, States taking action in this regard with mere reference to a SC guidance document or guidance notes would be doing so under the full legal responsibility for their conduct and without possibility to have recourse to a line of argument holding that action has been taken in fulfillment of an express SC decision adopted under Chapter VII. Conceivably, legal authority might be deduced from SC Res 1540 (2004), a resolution adopted under Chapter VII of the UN Charter; however, this resolution lacks an express provision mandating all States to take seizure and disposal measures.

Under § 7 of the Statement in Annex B, China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union call upon all States to facilitate full implementation of the JCPOA by inspecting, in accordance with their national authorities and legislation and consistent with international law, in particular the law of the sea and relevant international civil aviation agreements, all cargo to and from Iran, in their territory, including seaports and airports, if the State concerned has information that provides reasonable grounds to believe that the cargo contains items the supply, sale, transfer, or export of which is being undertaken contrary to the provisions contained in the JCPOA or the Statement in Annex B. They further call upon all States also to cooperate in inspections on the high seas with the consent of the flag State, if there is information that provides reasonable grounds to believe the vessel is carrying items the supply, sale, transfer or export of which is being undertaken contrary to the provisions contained in the JCPOA or this statement. In OP 7(b) of SC Res 2231 (2015), the SC decided, acting under Article 41 in Chapter VII of the UN Charter, that all States are called upon to comply with § 7 of the Statement in Annex B. One case of application of this plea of conduct, for which the SC Res employs the low-intrusive agentive theme of calling upon—an agentive theme indicating that no direct binding effect under international law has been intended—, are interdictions in the framework of the Proliferation Security Initiative (PSI).

PSI is a global effort that aims to stop trafficking of weapons of mass destruction, their delivery systems, and related materials to and from States and non-state actors of proliferation concern. Launched on 31 May 2003, the strategy recognizes the need for more robust tools to stop proliferation of weapons of mass destruction around the world; it specifically identifies interdiction as an area, on which greater focus would need to be placed. The States endorsing PSI chiefly perceive it as an enduring international counter-proliferation effort. Endorsement entails adherence by States to the legally nonbinding 'PSI Statement of Interdiction Principles',[73] which commit participants to establish a more coordinated and effective basis through which to impede and stop weapons of mass destruction, their delivery systems, and related items. The countries commit, inter alia, to (i) interdict transfers to and from States and non-state actors of proliferation concern to the extent of their capabilities and legal authorities, (ii) develop procedures to facilitate exchange of information with other countries, (iii) strengthen national legal authorities to facilitate interdiction, and (iv) take specific actions in support of interdiction efforts.

While the wording of §§ 6(f) and 7 of the Statement in Annex B does not contradict a continued application of the Interdiction Principles, the question arises whether the application of the Vienna Accord in due course will necessitate an adjustment of the practice to apply these principles. Iran, who is not a PSI participant, might argue that it has justified expectations—despite OP 7(b)of SC Res 2231 (2015) in conjunction with §§ 6(f) and 7 of the Statement in Annex B—to the effect that PSI interceptions would ultimately cease with respect to deliveries to and from Iran that might be covered by the Vienna Accord. This contradiction of evaluation would be of a political nature, as China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union have taken adequate precaution in the drafting of § 7 of the Statement in Annex B in order to allow the application of the PSI Interdiction Principles and established practice to continue. As potential issue of compliance it could not be referred by JCPOA participants to the dispute resolution mechanism under §§ 36 and 37 of the JCPOA[74] for the reason that it falls outside the scope of the JCPOA. After the termination, on Implementation Day,[75] of provisions imposed under the previous SC Res 1737 (2006), 1747 (2007), 1835 (2008), and in particular 1929 (2010), the legal authority for interdiction activities based on the 'PSI Statement of Interdiction Principles' would—in analogy to what has been said on § 6(f) supra—need to be deduced primarily from SC Res 1540 (2004).[76]

13.3.2 The Second Pillar

In order for the Vienna Accord to be fully implemented, the functioning of the complex regulatory pattern of the first pillar is to a considerable extent depending

[73] For a detailed analysis of the international law aspects of these principles see Ahlström 2005. See also Jacobsson 2009, pp. 62 et seq.

[74] On the JCPOA dispute resolution mechanism see Sect. 13.6 *infra*.

[75] On the concept and meaning of 'Implementation Day' see Sect. 13.4.3 *infra*.

[76] Cf. Ahlström 2005, pp. 763 et seq.

on the ability of the second pillar—the bilateral relationship between the IAEA and Iran with regard to legally binding safeguards and nonbinding verification commitments or policy understandings—to fulfill its mission to ensure compliance with the NPT safeguard standards in the intricate case concerning the Non-Nuclear Weapon State Iran.[77] SC Res 2231 (2015) emphasizes that the efficiency of this relationship is of great significance to the credible implementation of the first pillar, inter alia by requesting the Director General of the IAEA to undertake the necessary verification and monitoring of Iran's nuclear-related commitments for the full duration of those commitments under the JCPOA[78] and by reporting to the IAEA Board of Governors and in parallel to the SC that the IAEA has reached the broader conclusion that all nuclear material in Iran remains in peaceful activities.[79]

As illustrated in Fig. 13.2, the IAEA is responsible for a system of safeguards in relation to Iran that mainly responds to the international community's desire to strengthen measures which, on the one hand, prevent nuclear proliferation prohibited under international law and, on the other hand, can be adapted and developed further in an appropriate and flexible manner. The IAEA is admittedly an independent international organization,[80] not a UN agency—which the Vienna Accord takes into account in its methodical choice of keeping the scope of responsibility of the SC strictly apart from that of the IAEA. Pursuant to Article III(1)(b) of the Agreement Governing the Relationship between the United Nations and the International Atomic Energy Agency dated 19 June 1959, and 19 August 1959,[81] the IAEA shall submit reports, when appropriate, to the SC and notify it whenever, in connection with the activities of the IAEA, questions within the competence of the SC arise. The IAEA therefore acts independently and is not subject to supervision by the SC, which, to a certain extent, makes it more difficult to assess the performance capacity of the second pillar, especially with respect to the bilateral relations between the IAEA and Iran which are surrounded by a considerable degree of confidentiality.

The second pillar is constituted by the following components:

- Agreement dated 19 June 1973 between the Iran and the International Atomic Energy Agency for the Application of Safeguards in Connection with the of the Treaty on the Non-Proliferation of Nuclear Weapons,[82] which is legally binding under treaty law;

[77] PPs 9 and 10 of SC Res 2231 (2015) [UNSC 2015a, p. 2].

[78] OP 3 of SC Res 2231 (2015) [UNSC 2015a, p. 3].

[79] OP 6 of SC Res 2231 (2015) [UNSC 2015a, p. 3].

[80] Rautenbach 2012, pp. 349 et seq (§§ 1 och 4).

[81] IAEA 1959, pp. 2–9. See also Szasz 1970, pp. 257–283, and Lohmann 1993, pp. 48 et seq.

[82] IAEA 1974. The agreement—hereinafter referred to as the '1973 Safeguards Agreement'—entered into force on 15 May 1974.

- the equally binding Modified Code 3.1 of the General Part of the Subsidiary Arrangements[83] of the 1973 Safeguards Agreement, which deals with information about existing as well as planned facilities and nuclear material outside facilities;[84]
- the Additional Protocol dated 18 December 2003 to the 1973 Safeguards Agreement,[85] a treaty that is to be effectively applied provisionally from the Implementation Day on 16 January 2016, but which as of the time of writing[86] has not been ratified by Iran and therefore has not yet entered in force under treaty law. The Additional Protocol as a new legal instrument is designed to strengthen the effectiveness and improve the efficiency of the IAEA safeguards system. The 2003 Iran–IAEA Additional Protocol was concluded after regular inspections under the NPT and the 1973 Safeguards Agreement had proved unable to detect Iran's attempts to develop nuclear weapons. It was applied provisionally from December 2003 to February 2006, at which time Iran announced that it would suspend the provisional application of the Additional Protocol. This is a treaty relevant manifestation of intent, the international law assessment of which—not least with regard to Article 18 of the 1969 Vienna Convention on the Law of Treaties (VCLT), which obliges the State to refrain from acts which would defeat the object and purpose of a treaty when it has signed the treaty subject to ratification, until it has made its intention clear not to become party to the treaty—must be deferred until the exact wording of the 2003 Additional Protocol will be known, which is not the case at this stage. In principle, an Additional Protocol has to be negotiated individually by each Non-Nuclear Weapon State which has concluded a comprehensive safeguards agreement with the IAEA. The Additional Protocols between the IAEA and the Non-Nuclear Weapon States are confidential; variations between finally agreed texts may occur. On 15 May 1997, the IAEA adopted a 'Model Protocol Additional to the Agreement[s] Between State[s] and the International Atomic Energy Agency for the Application of Safeguards',[87] which, inter alia, requires the State to provide certain nuclear-related information under Articles 2 and 3 and allow complementary access to certain locations under the conditions laid down in Articles 4 and 5. In view of the fact that the IAEA closely followed the Model Safeguards

[83] For an analysis of the ancillary instruments to Comprehensive Safeguards Agreements, inter alia of Subsidiary Arrangements, see Rainer and Szasz 1973, pp. 336–341, particularly p. 337.

[84] The disagreement on the legal character of Iran's obligations in relation to the Modified Code 3.1 and the failure on the part of Iran to fulfill them as a consequence of its subsequent rejection of the modification of Code 3.1 initially accepted by Iran are one core element which built up the Iranian nuclear defiance case. See also König 2010, pp. 25–36.

[85] IAEA 2007a, p. 2 § 6; IAEA 2015a, p. 13 note 75.

[86] On 10 September 2016.

[87] IAEA 1998.

Agreement[88] at any individual event of the conclusion of safeguards agreements with States, it may be assumed that the 2003 Iran–IAEA Additional Protocol displays significant similarities to the Model Additional Protocol.[89] In OP 6 of SC Res 1696 (2006), the Security Council called upon Iran to implement the Additional Protocol and to implement without delay all transparency measures as the IAEA may request in support of its ongoing investigations, an obligation which appears in Article 2(c) of the Model Additional Protocol, which stipulates that 'at the request of the Agency, the State shall provide amplifications or clarifications of any information it has provided under this Article, in so far as relevant for the purpose of safeguards'.[90] Such an obligation was not incumbent upon Iran before, because it had not ratified the Additional Protocol and the IAEA Statute does not provide the IAEA with such far-reaching powers that the Agency would be able to request this type of information;

- the 'Framework for Cooperation' as agreed between IAEA and Iran on November 11, 2013, a joint statement without legally binding effect;[91]
- the 'Road-map of 14 July 2015 for the Clarification of Past and Present Outstanding Issues regarding Iran's Nuclear Program',[92] a legally nonbinding document, which is referred to both in PP 9 of SC Res 2231 (2015) and in § 14 of JCPOA, as well as confidential Separate Arrangements approved on the basis of § 1 of the Road-map[93] addressing still unresolved questions about the possible military dimension of Iran's nuclear program, of § 4 of the Road-map on completions and clarifications requested by the IAEA, and of § 5 of the Road-map regarding activities of the military-industrial complex in Parchin.

The role of the IAEA in these relationships is not always easy to assess, not least taking into consideration that the documents which could support a solid assessment are confidential. This holds true, for example, for the contents of Separate Arrangement II pursuant to § 5 of the Road-map regarding the issue of Parchin and the regulated access of IAEA to entities and locations in this complex.[94]

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88 IAEA 1972.—For a detailed analysis of the IAEA Model Safeguards Agreement see Rainer and Szasz 1993, pp. 289–306, and den Dekker 2001, pp. 274–297.

89 For a detailed analysis of the relationship between the NPT and the IAEA Additional Protocol see Asada 2016.

90 UNSC 2006a.

91 IAEA 2013c. Cf. the reference to the 'Framework for Cooperation' in PP 9 of SC Res 2231 (2015) [UNSC 2015a, p. 2].

92 IAEA 2015c, d.

93 For the report of the Secretary General of the IAEA entitled 'Implementation of the NPT Safeguards Agreement and relevant Provisions of Security Council resolutions in the Islamic Republic of Iran', as referred to in § 1 of the Road-map, see IAEA 2011.

94 What has become known of the contents of Separate Arrangement II, however, is apt to cause questions, provided the leaked source proves to be reliable. See Jahn 2015 and Tobin 2016.

13.4 Temporal Parameters of the Vienna Accord

The nuclear accord with Iran is not only a structurally complex, but also in large parts necessarily a highly technical solution. Still it remains a negotiated one, in which the will to reach a compromise is reflected in formulations and terminological usage which are open for interpretation.[95] In order to enhance a common understanding and to clarify key parameters of the accord, specific definitions are employed consistently throughout SC Res 2231 (2015), the JCPOA and the Statement, and this knowledge is material for the analysis and operationalization of the accord. This is particularly relevant for the temporal parameters[96] 'Finalization Day', 'Adoption Day', 'Implementation Day', 'Transition Day', and 'UN Security Council Resolution Termination Day'.

13.4.1 Finalization Day

According to § 34(i) of the JCPOA, Finalization Day was the date—not conditioned by any other prerequisite—on which negotiations of this JCPOA were concluded among the E3/EU+3 and Iran, i.e. 14 July 2015. In close proximity to Finalization Day a draft resolution suggesting endorsement of the JCPOA had to be submitted to the SC for adoption without delay. SC Res 2231 (2015) was adopted on 20 July 2015. Finalization Day was the starting point for the EU to promptly endorse SC Res 2231 (2015) through Council Conclusions.[97] At the same time Iran and the IAEA started developing necessary arrangements to implement all transparency measures provided for in the JCPOA so that such arrangements were completed, in place, and ready for implementation on Implementation Day.[98]

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[95] The unclear use of the term 'sabotage' in § 10.2 of JCPOA Annex III (Civil Nuclear Cooperation) [UNSC 2015d, p. 85], inserted upon the request of the Iranian side, is but one example of wordings which found their way into the accord as the result of a general give and take in international negotiations. It is not difficult to subsume under this concept, for instance, potentially lawful cyber operations which are carried out as nuclear counter-proliferation measures.

[96] § 34 of the JCPOA in conjunction with JCPOA Annex V (Implementation Plan) [UNSC 2015d, pp. 19 and 93–97].

[97] EU 2015.

[98] § 5 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 93].—See also Sect. 13.3.2 *supra*.

13.4.2 Adoption Day

Within 90 days after the endorsement of this JCPOA by the SC, i.e. at the latest by 19 October 2015, or such earlier date as may have been determined by mutual consent of the JCPOA participants, the JCPOA and the commitments in the JCPOA had to come into effect;[99] this date—not conditioned by any other prerequisite—is denominated in § 34(ii) of the JCPOA as 'Adoption Day'.[100] The EU and its Member States had approved to adopt an EU Regulation, taking effect as of Implementation Day, terminating all provisions of the EU Regulation implementing all nuclear-related economic and financial EU sanctions,[101] simultaneously with the IAEA-verified implementation by Iran of agreed nuclear-related measures. Adoption Day was set at 18 October 2015, upon which JCPOA participants made necessary arrangements and preparations, including legal and administrative preparations, for the implementation of their JCPOA commitments. It was at this point in time Iran notified IAEA that it will return to a provisional application of the Additional Protocol and fully implement the Modified Code 3.1, effective on Implementation Day,[102] and began to prepare nuclear-related commitments by tak-

[99] In accordance with Articles 77 and 125 of the Constitution of the Islamic Republic of Iran, international agreements shall be confirmed by the Parliament (Majlis), before they can be ratified by the President or his designated deputy. On 23 June 2015, the Majlis adopted a bill, according to which the agreement is submitted for the knowledge of the members of the House, while the National Security Council was to deliver its opinion. On 21 July 2015, Foreign Minister Javad Zarif submitted the JCPOA to Majlis. In August 2015, the Majlis set up a 15-person committee to review the JCPOA. The committee issued its findings on 4 October 2015, finding the agreement partially flawed, but stopping well short of saying it should not be adopted. Acting just before the deadline for Adoption Day, the Majlis formally voted to approve the agreement, and the law doing so was subsequently accepted in review by the Council of Guardians. On 21 October 2015, Supreme Leader Khamene'i issued a letter to President Rouhani formally accepting the decisions taken by the Majlis and the Council of Guardians, while stressing stipulations, reservations, and distrust of the U.S. intent to fully implement U.S. commitments under the JCPOA. See Meier and Zamirirad 2015, p. 2, as well as Katzman and Kerr 2016, pp. 26 et seq.—In the United States, legislation providing for congressional review was enacted as the 'Iran Nuclear Agreement Review Act of 2015', which means that a section 135 was inserted in the 'Atomic Energy Act of 1954'; see U. S. Congress 2015. For greater detail on the congressional review process and all the provisions of that law, see Daugirdas and Mortenson 2015, pp. 649–658, as well as Katzman 2016, pp. 59–67.

[100] § 34(ii) of the JCPOA in conjunction with §§ 6–13 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, pp. 19 and 93 et seq.].

[101] Per Adoption Day on 18 October 2015, the EU had accepted to adopt the legal acts in the form of decisions and regulations needed to implement the commitment under the JCPOA to lift the nuclear-related sanctions. This was done by the Council Decision (CFSP) 2015/1336 of July 31, 2015 amending Decision 2010/413/CFSP concerning restrictive measures against Iran, in: OJ L 206, 2015-08-01, p. 66. As of Implementation Day on 16 January 2016, the EU adopted Council Decision (CFSP) 2016/37 of 16 January 2016 on the application date of the Decision (CFSP) 2015/1863 amending Decision 2010/413/CFSP concerning restrictive measures against Iran, in: OJ L 11 I, 2016-01-16 p. 1.

[102] § 8 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 93].

ing technical measures of mitigation and limitation, such as the reduction of the number of centrifuges or the conversion of the heavy water reactor at Arak.[103]

13.4.3 Implementation Day

The lifting of the economic, commercial and financial sanctions was contingent on the fulfillment by Iran of nuclear commitments and measures, on the one hand, and the confirmation of this fulfillment in a report by the Director General of the IAEA, on the other hand. In § 34(iii) of the JCPOA, this date—conditioned by the prerequisites (i) that the IAEA certified that Iran has taken the key steps to restrict its nuclear program and put in place increased monitoring,[104] (ii) upon which the U. S., EU, and UN implemented sanctions relief takes effect,[105] the latter subject, however, to reimposition under the JCPOA 'snap-back' mechanism—is referred to as 'Implementation Day';[106] it occurred on 16 January 2016. On that date, the nuclear restrictions and the few and very limited alleviations under the 2013 JPA as well as the existing sanctions including, where applicable, criminal or administrative law provisions on violations of the sanctions regime, ceased to apply.

13.4.4 Transition Day

According to § 34(iv) of the JCPOA, 'Transition Day' is the date eight years after 'Adoption Day' or the date on which the Director General of the IAEA submits a report stating that the IAEA has reached the broader conclusion that all nuclear material in Iran remains in peaceful activities, whichever is earlier, i.e. at the latest on 18 October 2023. On this date—not conditioned by any other prerequisite—, the EU should terminate[107] and the United States should seek such legislative action as may be appropriate to terminate, or modify to effectuate the termination of,[108] their respective sanctions, while Iran should have made efforts to ratify the Additional Protocol consistent with the President's and the Parliament's constitutional roles.[109]

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[103] Second sentence in § 1 of JCPOA Annex I (Nuclear-related Measures) [UNSC 2015d, p. 21].

[104] §§ 15.1–15.11 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 94].

[105] §§ 16 [concerning the EU], 17 [concerning the United States] and 18 [concerning the UNSC] of JCPOA Annex V (Implementation Plan) [UNSC 2015d, pp. 95 et seq.].

[106] § 34(iii) of the JCPOA in conjunction with §§ 14–18 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, pp. 19 and 94–96].

[107] §§ 20 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 96].

[108] §§ 21 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 96].

[109] §§ 22.1 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 96].

13.4.5 UN Security Council Resolution Termination Day

Under § 34(v) of the JCPOA, ‘UN Security Council Resolution Termination Day’ is the date ten years from ‘Adoption Day’ on which SC Res 2231 (2015) terminates, i.e. 18 October 2025, provided, however, that the snap-back mechanism has not been activated before and the provisions of previous resolutions have not been reinstated.[110] On that date, the provisions and measures imposed in SC Res 2231 (2015) would terminate and the SC would no longer be seized of the Iran nuclear issue,[111] while the EU will terminate all remaining provisions of Council Regulation (EU) No 267/2012 of 23 March 2012[112] concerning restrictive measures against Iran and repealing Regulation (EU) No 961/2010 and of Council Decision 2010/413/CFSP of 26 July 2010[113] concerning restrictive measures against Iran and repealing Common Position 2007/140/CFSP.[114]

13.5 The Implementation Plan

Characteristic of the Vienna Accord—and in this regard fundamentally distinguishing it from the 2013 JPA—is the Implementation Plan pursuant to JCPOA Annex V which contains a detailed sequence order, in which the nuclear-related measures shall be taken and the sanction-related commitments be fulfilled. Since the JCPOA set one temporal parameter which was conditioned by other prerequisites—Implementation Day—, it is plausible to adopt a perspective that focuses on this point as benchmark for actions which had to be fully implemented in the antecedent implementation phase, and another that starts from this point in order to make clear the differentiation in the subsequent implementation phase between timed commitments on the one hand and measures, the duration of which is unlimited, on the other hand.

Figure 13.3[115] summarizes nuclear-related commitments under the Vienna Accord until Implementation Day on 16 January 2016.[116]

[110] §§ 23 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, pp. 96 et seq.].

[111] §§ 24 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 97].

[112] OJ L 88, 2012-03-24, p. 1.

[113] OJ L 195, 2010-07-27, p. 39.

[114] §§ 25 of JCPOA Annex V (Implementation Plan) [UNSC 2015d, p. 97].

[115] This figure is based on the figure in Davenport et al. 2015, p. 24, slightly modified and updated. Reproduced with kind permission by Dr Kelsey Davenport on behalf of the Arms Control Association.

[116] Haupt 2016, p. 122.

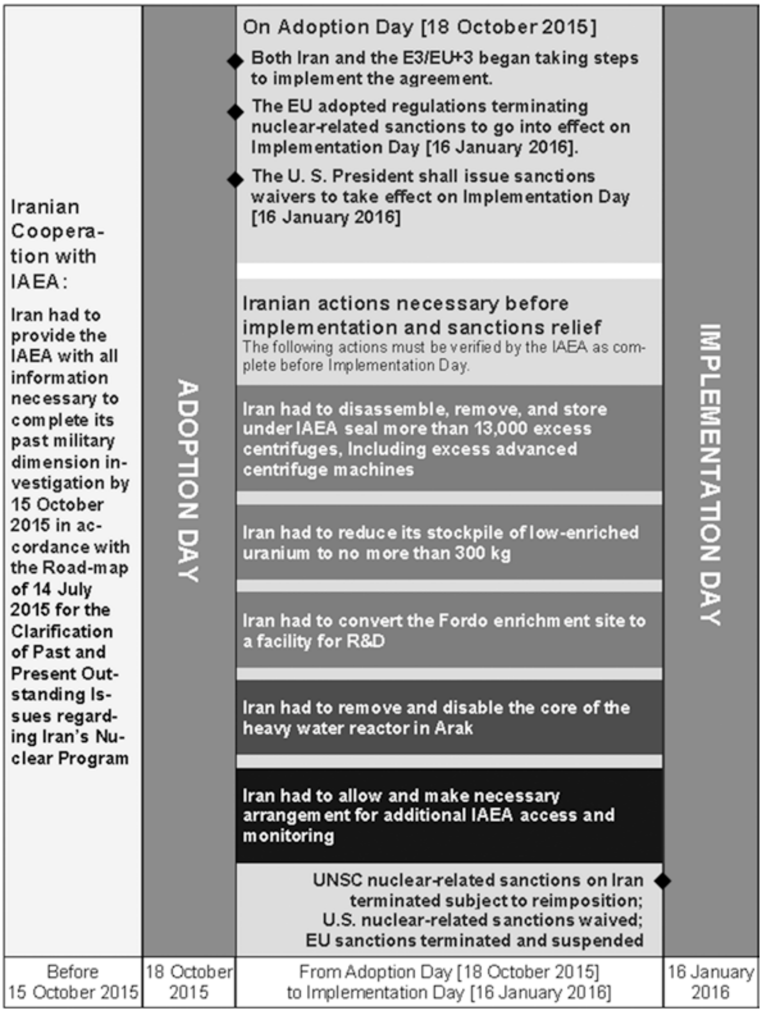

Fig. 13.3 Nuclear-related commitments under the Vienna accord until Implementation Day on 16 January 2016

The timetable of the subsequent implementation phase, taking Implementation Day as its starting point, is illustrated in Fig. 13.4.[117]

[117] This figure is based on the figure in Davenport et al. 2015, p. 25, slightly modified and updated. Reproduced with kind permission by Dr Kelsey Davenport on behalf of the Arms Control Association.

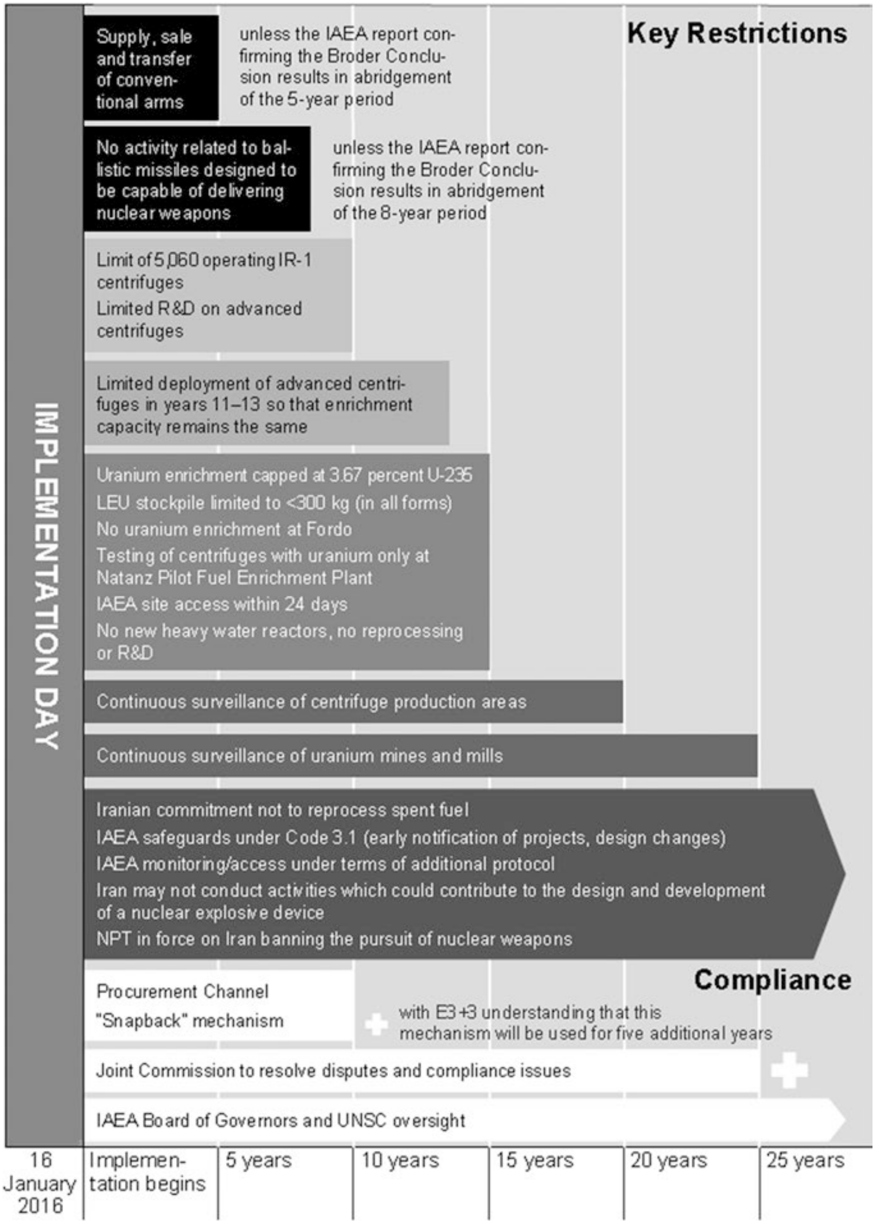

Fig. 13.4 Nuclear-related commitments under the Vienna accord from Implementation Day on 16 January 2016

13.6 Dispute Resolution Mechanism

SC Res 2231 (2015) treats the dispute resolution mechanism together with the so-called 'snap-back mechanism' as part of a sequence, the function of which is to resolve complaints by JCPOA participants about significant non-performance by another JCPOA participant. This sequence has two phases:

- Pursuant to OP 10 of SC Res 2231 (2015), JCPOA participants are encouraged in the first phase to resolve any issues arising with respect to implementation of JCPOA commitments through the procedures specified in § 36 of the JCPOA in conjunction with JCPOA Annex IV (Joint Commission). It is not mandatory for the JCPOA participants to have recourse to the dispute resolution mechanism in this phase. The SC only encourages them to make use of this procedure, an appeal of conduct which is not legally binding. In Fig. 13.5, this phase is indicated by the gray timelines spanning over the first 35 days.
- The second sequential phase, which is defined by the 'snap-back mechanism', is initiated by a notification by a JCPOA participant State to the SC of an issue that the JCPOA participant State believes constitutes significant non-performance of commitments under the JCPOA—with or without having had recourse to the dispute resolution process in the first phase—, the SC shall vote, within 30 days of receiving the notification, on a draft resolution to continue in effect the terminations of the provisions of SC Res 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010) and 2224 (2015).[118] A draft of this resolution, which hereinafter is termed 'sanctions lifting maintenance resolution', shall be submitted by any member of the SC for a vote within 10 days of the notification or, if no member of the SC submits such a draft, by the President of the SC within 30 days of the notification. If the SC does not adopt a 'sanctions lifting maintenance resolution', then effective midnight Greenwich Mean Time after the thirtieth day after the notification to the SC, all of the provisions of resolutions that have been terminated pursuant to OP 7(a) of SC Res 2231 (2015) shall apply in the same manner as they applied before the adoption of the latter resolution, and the measures contained in OP 7, 8 and 16 to 20 of SC Res 2231 (2015) shall be terminated, unless the SC decides otherwise. This second sequential phase is almost entirely based on SC decisions under Article 41 in Chapter VII of the UN Charter and thus legally binding.[119] In Fig. 13.5, this phase is indicated by the black timeline.

[118] OP 11 in conjunction with OP 7(a) of SC Res 2231 (2015) and § 37 of the JCPOA.

[119] OPs 12 and 13 of SC Res 2231 (2015) in conjunction with § 37 of the JCPOA. The only SC decision in the second sequential phase which is not taken under Article 41 is the decision that a draft 'sanctions lifting maintenance resolution' shall be submitted by any member of the SC for a vote within 10 days of the notification or, if no member of the SC submits such a draft, by the President of the SC within 30 days of the notification.

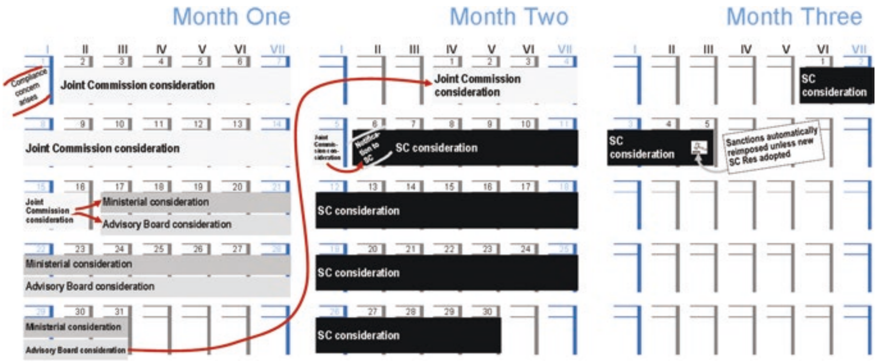

Fig. 13.5 JCPOA schedule for the dispute resolution mechanism

According to § 36 of the JCPOA, the mechanism for the settlement of disputes is led by a Joint Commission[120] established pursuant to JCPOA Annex IV (Joint Commission) and composed of one representative each from China, the EU, France, Germany, Iran, Russia, the United Kingdom, and the United States. The decision to arrange for this mechanism entails a recognition of the need to address inevitable challenges that will arise during implementation of the accord; these challenges will stem from political opposition to the arrangement in both Iran and the United States, and from common temptations to test the boundaries of arrangements such as this nuclear accord.[121]

Neither SC Res 2231 (2015) nor the JCPOA provide for the duration of existence of the Joint Commission. In particular, there is no established deadline for its institutional winding up, nor is there any agreed automatics for its liquidation. The legal character of the Joint Commission is, however, functionally dependent on alterations of the applicability of the JCPOA. Its continued operation after UN Security Council Resolution Termination Day, after which time the JCPOA is merely a SC document, is then subject to JCPOA participants' political will. The participants of the nuclear accord are free to avail themselves of the possibility of dispute resolution in the forum of the Joint Commission, but they are under no commitment to resolve disputes with the Joint Commission's help.

120 The Joint Commission gathered for the first time on 19 October 2015.

121 Perkovich et al. 2015.

Only participants to the JCPOA could refer an issue of compliance to the Joint Commission. Aside from voting on access to suspect sites,[122] decisions of the Joint Commission require consensus, and any member of the Commission is able to block any procurement proposals or plans that it believes could pose a proliferation risk.[123]

If the Commission were unable to resolve the issue in 15 days, any participant could refer the matter to the Foreign Ministers of the States on the Commission—thus not to the High Representative of the European Union for Foreign Affairs and Security Policy—, who would have another 15 days to resolve it. In the meantime, either the complaining participant or the participant whose performance is in question could request that an Advisory Board composed of three members (one appointed by each of the two disputing participants and a third independent member) provide a nonbinding opinion on the compliance issue. If none of these modalities satisfies the complaining participant, that participant could treat the issue as grounds to cease performing its commitments and/or notify the SC that it believes the issue constitutes significant nonperformance. Upon receipt of such a notification—the submission of which by Iran is, for reasons underlying the functionality of the dispute resolution mechanism having reached this stage, highly unlikely despite the fact that § 37 of the JCPOA maintains the formal semblance that the entirety of the procedural decisions available within the mechanism could be employed equitably—, UN sanctions would automatically be reimposed 30 days later unless the UNSC passed a resolution to continue the lifting of sanctions called for under the JCPOA.[124] As follows from Fig. 13.5, the total time for this dispute resolution mechanism—i.e., between the time of the complaint of Iranian noncompliance and the reimposition of UN sanctions—is 65 days.[125]

Perkovich et al.[126] assess that the dispute resolution mechanism combines reasonableness with sensitivity to the need for timely action and that it also provides significant leverage by invoking the SC in a way that would make the reimposition of sanctions likely if Iran were found to be in significant noncompliance. Quite rightly, they point out that, realistically, the willingness of participants to hold other participants to account for implementation and to take envisioned steps to enforce it will depend on the circumstances obtaining at the time.[127] These circumstances will include performance of the specific terms of the JCPOA as well as broader political, economic, and security dynamics, even though the JCPOA is confined to nuclear-related matters.[128]

123 Samore 2015, p. 54.

124 This reimposition process—also known as 'snap-back mechanism'—will be analyzed in greater detail in Sects. 13.7.3 and 13.7.4 *infra*.

125 Katzman and Kerr 2016, p. 21.

126 Perkovich et al. 2015.

127 Perkovich et al. 2015.

128 The adequacy of this argument will be further developed in the considerations in Sect. 13.7.9 *infra*.

122 See Sect. 13.8.1 *infra*.

13.7 Commentary on SC Res 2231 (2015)

13.7.1 Legal Qualification and Question of the Binding Effect of the Vienna Accord

The legal nature of the JCPOA raises the question whether—and in the affirmative: to what extent—it is legally binding upon the participants of the JCPOA, on the one hand, and upon third States, on the other hand.

For the JCPOA's participants it was very important to avoid all treaty terminology in the JCPOA, its Annexes and the Statement; any potential remnants in the finalized texts were carefully reedited. Therefore, terms such as 'party' or 'parties' are not used for denominating the actors of this arrangement, mindful of the fact that a 'party' is defined in Article 2(1)(g) of the 1969 VCLT as 'a State which has consented to be bound by the treaty and for which the treaty has entered into force'. Instead, the Vienna Accord employs the term 'participant(s)' as reflective of a usage not established in treaty law. In addition, the wording in para. (i) of the JCPOA's section 'Preamble and General Provisions'—'The Islamic Republic of Iran and the E3/EU+3 (China, France, Germany, the Russian Federation, the United Kingdom and the United States, with the High Representative of the European Union for Foreign Affairs and Security Policy)'—and in the unnumbered first part of the Statement in Annex B—'China, France, Germany, the Russian Federation, the United Kingdom, the United States, and the European Union have concluded with Iran'—clarifies that the participants themselves consider the accord to be concluded by two sides. This is further underlined by the memorandum of understanding establishing the so-called Working Group, consisting of the JCPOA participants except Iran.

The JCPOA is not a treaty pursuant to Article 2(1)(a) of the1969 VCLT, and it has also not been the intention of the participants to conclude a binding international agreement between subjects of international law.[129] Treaties lay the foundations for rights and obligations applicable between the parties to them; they epitomize the consensus reached on the legal consequences which the concluding sides consented to be bound by. By contrast, there are no legally binding rights and obligations in the JCPOA, the reciprocity of which would have been agreed on by its participants. This is clearly illustrated by the guiding provision qualifying all commitments made in the JCPOA as voluntary measures,[130] which the participants are taking within the timeframe as scheduled in the JCPOA and its Annexes, most notably in the Implementation Plan. The JCPOA thus contains a collection of

[129] Klingler 2015, p. 2; Haupt 2016, p. 123.

[130] After JCPOA's section 'Preamble and General Provisions', the subsequent §§ 1–37 are preceded by the major premise 'Iran and the E3/EU+3 will take the following voluntary measures within the timeframe as detailed in this JCPOA and its Annexes' [UNSC 2015d, p. 11].

manifestations of unilateral intentions, not conditioned upon connectivity, mutuality or reciprocity; it therefore amounts to a legally nonbinding arrangement, to a memorandum of understanding deliberately calibrated in a manner to remain below the threshold of a binding international agreement. The JCPOA participants hereby express that they will voluntarily take those measures assigned to them in the JCPOA without recognition of any legal obligation to do so.

A crosscheck analysis leads to no other conclusion: A legally binding effect cannot be inferred from the ‘Guiding Principles applicable to unilateral declarations of States capable of creating legal obligations’ adopted by the International Law Commission (ILC) in 2006,[131] either. According to the Guiding Principles 3[132] and 7,[133] States’ unilateral declarations can only be considered to create legal obligations, if (i) this follows from an overall assessment taking account of the declarations’ content, of all the factual circumstances in which they were made, and of the reactions to which they gave rise to, and (ii) it is stated in clear and specific terms that the declaring States had the intention to create legal obligations. The provision expressing that ‘Iran and the E3/EU+3 will take the following voluntary measures within the timeframe as detailed in this JCPOA and its Annexes’[134] leaves no doubt that the JCPOA participants are guided solely by voluntary self-commitments and not by an intention to create obligations under international law or precedents.[135] During the negotiations, Iran has been unambiguous about its position that the JCPOA were not be given any legally binding effect,[136] and in editing the drafts the participants endeavored to consistently eradicate the last remnants of language that could be interpreted as linguistic indications to the effect that the JCPOA could be qualified as a binding international agreement.

In light of this finding, the question arises, what kind of international legal consequences, if any, this nonbinding manifestation of intentions may have for States and international organizations other than those participating in the accord. This is particularly relevant because of the interconnectedness of the legally nonbinding arrangement embodied by the JCPOA on the one side and those parts of SC Res 2231 (2015), which have legally binding effect such as the decisions taken by the SC acting under Article 41 in Chapter VII of the UN Charter, on the other side. Initially, attention should be paid to the provision in § 18 of the JCPOA, according to which ‘[t]he UN Security Council resolution endorsing this JCPOA will terminate all provisions of previous UN Security Council resolutions on the Iranian nuclear issue – 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010) and 2224 (2015) – simultaneously with the IAEA-verified

131 ILC 2006a, b.

132 ILC 2006b, p. 3.

133 ILC 2006b, p. 4.

134 UNSC 2015d, p. 11.

135 This is emphasized in OP 27 of SC Res 2231 (2015) [UNSC 2015a, p. 6] as well as in the OP 2 in IAEA 2015g, p. 2.

136 Haupt 2016, p. 123.

implementation of agreed nuclear-related measures by Iran and will establish specific restrictions'; a footnote accompanying this provision clarifies that '[t]he provisions of this Resolution do not constitute provisions of this JCPOA'.[137] This provision cannot be construed as entailing legally binding effect, already for the reason that the SC is not a participant in the accord. Nor can the JCPOA participants decide, with legally binding effect, that the SC should be imposed such action.

SC Res 2231 (2015) explicitly underscores Article 25 of the UN Charter, pursuant to which UN members agree to accept and carry out decisions of the SC in accordance with the UN Charter. As the International Court of Justice rules in its Advisory Opinion of 21 June 1971 on 'Legal Consequences for States of the Continued Presence in Namibia (South West Africa) notwithstanding Security Council Resolution 296 (1970)', decisions by the SC under Article 25 can be legally binding upon UN member States in those parts that comprise duties addressed to them. Against this background, the language of a SC resolution is to be carefully analyzed before a conclusion can be drawn about its binding effect. The question, whether the powers conferred by Article 25 in fact have been exercised, must be answered in each individual case, 'having regard to the terms of the resolution to be interpreted, the discussions leading to it, the Charter provisions invoked and, in general, all circumstances that might assist in determining the legal consequences of the resolution of the Security Council'.[138] The SC has developed a practice to label such decisions in resolutions—adopted under Article 25 or under any relevant provision in Chapter VII of the UN Charter—by availing itself of the agentive theme 'decides' in italics.[139] Often this decisional indicator is placed between the preambular and operative paragraphs of a resolution, but SC Res 2231 (2015) is an example of a deviating practice, in which it is spread over several operative paragraphs, including in a manner in which one and the same operational paragraph may encompass both nonbinding recommendations for action and legally binding decisions.

In OP 2 of this resolution, the SC calls upon all Member States, regional and international organizations both to take appropriate actions to support the implementation of JCPOA in accordance with the timeframe set out therein, and to refrain from actions that would undermine the implementation of commitments under the JCPOA. Although the low-intrusive theme 'calls upon' does not in itself imply a legally binding effect, the phrasing of OP 2 creates, however, a not insignificant indistinctness consisting in a solicitation of implementing action or of refrainment from undermining action, as if the JCPOA had legally binding effect on the subjects addressed in this operative paragraph, while it has not. This problem is further amplified in OP 7(b) by the fact that the SC, acting under Article 41

[137] UNSC 2015d, p. 14.

[138] ICJ 1971, pp. 17 and 52–53 §§ 113–114.

[139] Delbrück 2002, pp. 454 et seq. § 4 and p. 457 § 12; Wood 1998, pp. 79 and 95.

of the UN Charter,[140] decided that 'upon receipt by the Security Council of the report from the IAEA described in para 5: [… a]ll States shall comply with paras 1, 2, 4, and 5 and the provisions in subparagraphs (a)–(f) of para 6 of Annex B for the duration specified in each paragraph or subparagraph, and are called upon to comply with paras 3 and 7 of Annex B'. The invocation of Article 41 results in a requalification of the JCPOA as legally binding—even if it were only to be the case for the purposes of the first clause in OP 7(b)—also for States that have not participated in its conclusion or who, if they had participated in the negotiating process, would have opposed the conclusion of the accord. Whether this hybrid legal nature which inheres to the JCPOA and the SC Resolution is compatible with the principle of sovereignty of States, should at least be described as questionable. In any case, it evinces a possible line of argument of those States who did not participate in the negotiations on the Vienna Accord and who remain reluctant to lift or ease national sanctions against Iran or to refrain from lawful passive encumbrances targeting relevant subjects there. It therefore remains for those States to make their own assessments as to the extent of lifting or upholding national restrictive measures against Iran, a duty imposed on them as a consequence of binding elements in SC Res 2231 (2015).

13.7.2 Scope and Limitations of the Powers of the Security Council

In Resolution 2231 (2015), the SC in ten out of the 30 operative paragraphs takes its decision on the basis of Article 41, a provision in Chapter VII of the UN Charter on action with respect to threat to the peace, breaches of the peace and act of aggression. In accordance with this provision the SC may both decide on sanctions, i.e. on restrictive measures not involving the use of armed force, which are to be employed to give effect to its decisions, and call upon UN members to take such measures. Although this is not expressly provided for in Article 41, it can be assumed on reasonable grounds that this encompasses or implies an annex competence of the SC to also terminate, suspend or ease such measures which have been decided under this provision. It is questionable, however, if the SC with reference to this competence is entitled to adopt binding decisions, as is done in OP 7(b) of Resolution 2231 (2015), which obligates all States to rescind national sanctions and to participate in the implementation of the JCPOA, i.e., of an arrangement that has been concluded without their participation.

[140] According to Article 41 in Chapter VII of the UN Charter, the Security Council may 'decide what measures not involving the use of armed force are to be employed to give effect to its decisions, and it may call upon the members of the United Nations to apply such measures'.

According to OP 7, the provisions of the Security Council resolutions listed in subparagraph (a),[141] which have hitherto been used as the legal basis for sanctions against the Iranian nuclear program, shall be terminated when the Security Council receives the IAEA report provided for in OP 5. The wording of this operational step is not unambiguous and can be understood in different ways. On the one hand, it can be interpreted in such a way that SC Res 2231 (2015) in its OP 7(a) prescribes a legal consequence, which is conditional on an event that has suspensive effect: In this perception, the legal consequence follows already upon receipt of the IAEA report. The suspensive event would in this option consist of the registration of the report submitted by the IAEA, after receipt of which the listed resolutions would end automatically, i.e., without being subject any longer to additional conditions. This, however, excludes a prior examination of the IAEA report by the UNSC.[142] On the other hand, OP 7 could also be interpreted in such a way that the UN Security Council undertakes with binding effect in the future to adopt a resolution that terminates the resolutions mentioned in OP 7(a) as soon as the IAEA report is received and reviewed. This raises the question of whether it would be compatible with the UN Charter that the Security Council in such a way binds itself for the future. Not least because of the freedom of vote and of decision-making of the non-permanent members in the Security Council, such a binding self-commitment for the future must be assessed critically.

In determining Implementation Day and hence in terminating the resolutions cited in OP 7(a) of SC Res 2231 (2015), the SC did not proceed in the way described in the latter alternative. It rather chose the first option with a certain modification: Upon receipt of the report by the Director General of the IAEA dated 16 January 2016,[143] pursuant to OP 5 of SC Res 2231 (2015), the President of the SC, on 19 January 2016, circulated this report among the members of the Security Council.[144] The report confirmed that ‘the […] IAEA has verified that, as of January 16, 2016, the Islamic Republic of Iran has taken the actions specified in paras 15.1–15.11 of annex V of the Joint Comprehensive Plan of Action’ and stated that ‘[t]he report […] is submitted to the IAEA Board of Governors and in parallel to the Security Council’.[145] On the basis of the ‘as of’ clause in the report of the Director General of the IAEA, the termination of the resolutions cited in

141 The resolutions in question are SC Res 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010) and 2224 (2015).

142 This option not only excludes a prior examination of the IAEA report by the UNSC, but—seen in an extended perspective from each member State in the UNSC—also parliamentary advice and consent in each UNSC member State, including the Congress of the United States. See Sofaer 2015, pp. 2–4, for comments on these options from the point of view of U. S. constitutional law.

143 IAEA 2016b.

144 UNSC 2016b.

145 UNSC 2016b, p. 2.

OP 7(a) of SC Res 2231 (2015) occurred as an automatic legal consequence effective 16 January 2016, the Implementation Day.[146]

On the same day, the President of the SC issued a note entitled 'Security Council Tasks under Security Council Resolution 2231 (2015)', in which practical arrangements and procedures for the Security Council are set forth for carrying out tasks related to the implementation of Resolution 2231 (2015), particularly with respect to the provisions specified in §§ 2–7 of the Statement in Annex B to that resolution.[147]

13.7.3 Consequences for Nonperformance of Commitments Under the JCPOA—and the Lack Thereof

Because of the lack of connectivity, mutuality and reciprocity of legal obligations, the areas for action under the JCPOA—on the one hand the regulation of the Iranian nuclear program, on the other hand the lifting of UN, EU and U. S. nuclear-related sanctions—are, in principle, not related to each other, except in the overarching political conception of a comprehensive accord in which the functionality of one major element presupposes the functionality of corresponding elements. Both areas of action are, however, combined indirectly in the Implementation Plan and in the so-called snap-back mechanism under OP 12 of SC Res 2231 (2005). Pursuant to OP 11, the application of the latter requires a JCPOA participant to notify the SC that it believes a disputed issue constitutes significant nonperformance of commitments under the JCPOA.

The Resolution as well as the JCPOA are devoid of definitions and criteria of what could constitute such a serious fulfillment deficiency; it would seem that they rather allow practice to evolve by means of the specifics of each individual case. But indefiniteness of what can be considered as a significant nonperformance of commitments under the JCPOA admittedly faces concerns from an international law point of view, especially considering that the activation of the snap-back

[146] The presentation on the website of the SC at http://www.un.org/en/sc/2231/ is supportive of this view. It states:

'Implementation Day occurred on 16 January 2016 when the Security Council received the report from the International Atomic Energy Agency (IAEA) confirming that Iran has taken a series of nuclear-related actions specified in paras 15.1–15.11 of JCPOA Annex V. Accordingly:

The provisions of Security Council resolutions 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010) and 2224 (2015) have been terminated subject to reimposition in the event of significant non-performance of JCPOA commitments […]; and

All States shall comply with the specific restrictions established by Annex B of resolution 2231 (2015) for the duration specified in each paragraph or subparagraph'.

[147] UNSC 2016a.

mechanism as well the continued application and operability of the Vienna Accord are causally dependent on a distinct idea of when such deficiency should be deemed to have occurred.[148] As the resolution and the JCPOA refrain from giving any guidance to determine which acts or omissions that qualify as significant nonperformance of the commitments under the JCPOA, and no indication of which kind of intensity threshold or frequency that must be overstepped to reach this conclusion can be derived from these sources either, compliance practice gained and developed on a case-by-case basis will contribute to the emergence of guidance in this regard.

However, it is important to keep in mind that this formulation of the term 'significant nonperformance of commitments under the JCPOA' implies that there must be performance deficiencies that are not of a serious nature and which therefore are not qualified enough to activate the reimposition mechanism. The JCPOA participants can be assumed to having considered that repeated deficiencies of JCPOA compliance, which do not reach the threshold of significant nonperformance could be disregarded, as they do not compromise the operability of the accord. To prevent a targeted undermining of the JCPOA by a series of acts of noncompliance, it therefore appears crucial—as a fulfillment of a task incumbent upon the SC—to concretize criteria of significant nonperformance at an early stage;[149] § 2(e) of the SC document entitled 'Security Council Tasks under Security Council Resolution 2231 (2015)' at least points to the right direction, stating that '[t]he Security Council shall take any necessary action to support and improve the implementation of Resolution 2231 (2015), including […] [u]ndertaking outreach activities to promote proper implementation of the resolution, including the provision of practical guidance.'[150]

Due to the fact that the sides involved in the JCPOA have no legal obligation to resolve disputes by means of the Joint Commission, a failure to turn to it should therefore not per se be qualified as an act of nonperformance of the JCPOA, just as would be the case if a dispute on the interpretation of provisions of JCPOA—despite best attempts to the contrary—cannot be resolved. It follows from this that the assessment of whether a significant nonperformance according to OP 11 of SC Res 2231 (2015) exists or not, does not necessarily have to be submitted to the Joint Commission's consideration.

13.7.4 The 'Snap-Back Mechanism' and Its Limited Effect

SC Res 2231 (2015) contains a mechanism for reimposition of UN sanctions if Iran does not satisfactorily resolve a compliance dispute; OP 12. As has been

[148] Haupt 2016, p. 126.

[149] Haupt 2016, p. 127.

[150] UNSC 2016a, p. 1.

elaborated on in Sect. 13.6 *supra*, the SC shall vote on a 'sanctions lifting maintenance resolution' upon receipt of the notification from the complaining participant, including a description of the good-faith efforts the participant made to exhaust the dispute resolution process specified in the JCPOA. As the procedural rules of the SC apply on this decision to continue the sanctions lifting,[151] any participant in the JCPOA who is a permanent member of the SC would be able to veto a 'sanctions lifting maintenance resolution' despite Iran's refusal to resolve this dispute.[152] (Obviously this does not include the JCPOA participant Germany, who is not a permanent member of the SC.) In that case, '[t]he provisions of the old UN Security Council resolutions would be reimposed, unless the UN Security Council decides otherwise'. The wording implies that the SC has the option to reimpose some, but not all, sanctions that existed prior to the JCPOA.[153] The possibility of a reimposition of the sanctions listed in OP 7(a) enables a reinstatement of the sanctions status that existed prior to Implementation Day, but also to a status at variation hereof, as long as the reimposition is based on any of the SC resolutions enumerated in OP 7(a). The snap-back mechanism serves primarily as a latent means of exerting a deterring pressure on Iran.[154] On closer examination, however, it is doubtful whether this mechanism actually has the ability to achieve the intended effect.

The first impediment is the limited scope of the mechanism which applies only to SC sanctions. Neither in SC Res 2231 (2015) nor in the JCPOA mention is made of reinstating EU or U. S. nuclear-related sanctions. These national and regional sanctions form, however, much broader and more intrusive regimes which are targeting many more natural or legal persons, entities and bodies. For both Iran's nuclear program and its economy these sanctions regimes represent a significantly higher burden than the UN sanctions in a stand-alone perspective. A reinstatement of the EU sanctions would require a renewed Council decision which cannot be reliably expected as a consequence of the unanimity requirement. To exclude EU and U. S. sanctions from the scope of the reimposition mechanism is therefore likely to greatly limit the deterrent pressure that this instrument is conceived to exert on Iran.

The second impediment is the limitation of the mechanism on the time axis. According to OP 14 of SC Res 2231 (2015) and § 37 of the JCPOA the mechanism does not apply retroactively; contracts concluded by natural or legal persons in Iran since 16 January 2016 until the day of reimposition of sanctions will not be

[151] Rule 40 of the Provisional Rules of Procedure of the Security Council (S/96/Rev.7) in conjunction with Article 27 of the UN Charter.

[152] § 37 of the JCPOA. See Perkovich et al. 2015 and Dubowitz 2015, p. 17.

[153] Katzman and Kerr 2016, p. 21.

[154] Haupt 2016, p. 127.

affected by reintroduced sanctions.[155] The exclusion of the retroactive applicability of the snap-back mechanism is not limited in time and entails that all contracts concluded during the entire period until the date of reinstatement of the SC Resolutions (including 2231) cannot be reached by sanctions provisions.[156] In this manner OP 13 significantly reduces the effect of the economic pressure of the snap-back mechanism under OP 12. Save the fact that Iran has declared that, if the snap-back mechanism was applied in accordance with OP 12 in its entirety or in part, it will treat this as a reason to cease to perform its commitments under the JCPOA,[157] Iran is put in a rather favorable position of being able to retain all the economic advantages acquired as a consequence of the country's economic opening and still to require fulfillment of contracts with foreign investors and companies even in the event of a reinstatement of UN sanctions under OP 12.[158]

13.7.5 Exemptions Granted with Immediate Effect

The Vienna Accord includes a three-phase lifting of sanctions meant to retain leverage on Iran for ten years; some sanctions will be lifted at the outset of implementation, and the remainder eight years and ten years later provided Iran is deemed to have complied with the arrangement.[159] The separate embargo on conventional arms sales to Iran will end in five years.

As illustrated in Fig. 13.6, SC Res 2231 (2015) provided for a 'zero-phase' lifting of sanctions ahead of the first phase easing: From the adoption of SC Res 2231

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[155] A complicated issue in that respect is the transfer into EU law of reimposed nuclear-related sanctions pursuant to the snap-back mechanism, the only exception for an EU regime of nuclear-related sanctions reserved pursuant to § 26 of the JCPOA ('The EU will refrain from reintroducing or reimposing the sanctions that it has terminated implementing under this JCPOA, without prejudice to the dispute resolution process provided for under this JCPOA.'). Furthermore, it poses a challenge for Union law to adequately map the principle of non-retroactive applicability of the snap-back mechanism in OP 14 of SC Res 2231 (2015) and § 37 of the JCPOA. The principle entails that contracts concluded with natural or legal persons in Iran since 16 January 2016 to the date of the reintroduction of sanctions are not affected by the restrictive measures. Most notably, the exclusion of the snap-back mechanism having retroactive effect—which in itself is not limited in time—could lead to intricate situations for interpretation and application. The same applies to secondary contracts, such as, for example, export credit insurances, whose contractual object are contracts which may or may not be affected by the application of the snap-back mechanism. It is, however, not the purpose of this contribution to elaborate on this specific aspect.

[156] Haupt 2016, p. 127.

[157] See the last sentence of § 37 of the JCPOA: 'Iran has stated that if sanctions are reinstated in whole or in part, Iran will treat that as grounds to cease performing its commitments under this JCPOA in whole or in part'.

[158] Haupt 2016, p. 128.

[159] Perkovich et al. 2015.

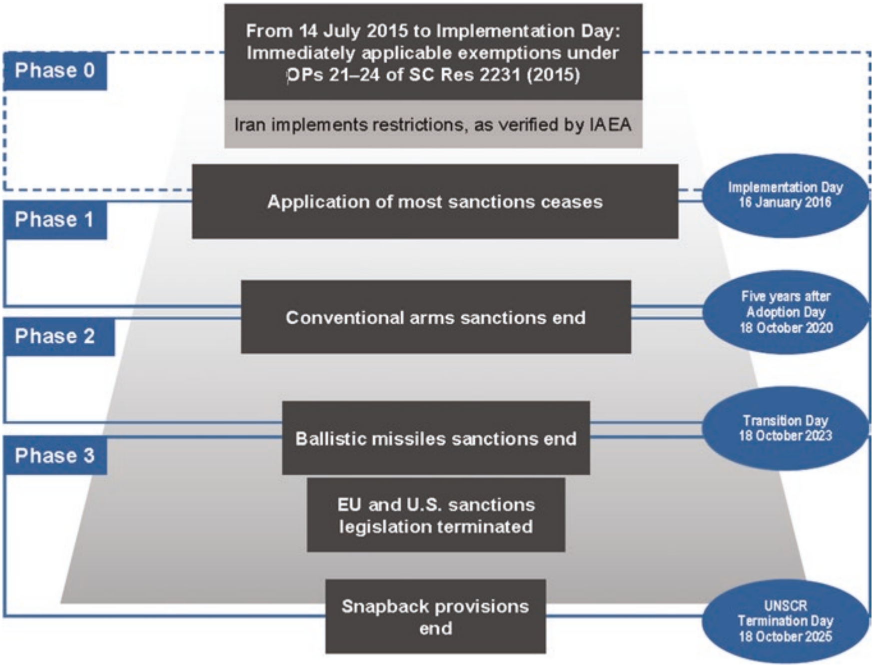

Fig. 13.6 The phases of sanctions-lifting pursuant to the Vienna accord

(2015) to Implementation Day, the provisions in OPs 21–23 of SC Res 2231 (2015) played a prominent role as the UN Security Council had decided, acting under Article 41 of the UN Charter, with immediate effect to ease sanctions for certain activities that were directly linked to the three measures under the JCPOA which should be taken by Iran:[160] (i) the modification of two cascades at the Fordo facility for stable isotope production; (ii) the export of enriched uranium from Iran in excess of 300 kg in return for natural uranium; and (iii) the modernization of Arak reactor, based on the conceptual design and, subsequently, on the agreed final design of such reactor. The easing referred to a variety of financial and economic activities: the supply, sale or transfer of items, materials, equipment, goods and technology, or the provision of any related technical assistance or training, financial assistance, investment, brokering or other services. Remarkably enough, OP 24 of the resolution forecloses the exemptions in OPs 21–23 altogether from the snap-back mechanism. These above mentioned exemptions, which were

[160] The exemptions have been implemented in EU law by (i) Article 1 of Council Regulation (EU) 2015/1327 of 31 July 2015 amending Regulation (EU) No 267/2012 concerning restrictive measures against Iran (OJ L 206, 2015-08-01, p. 18), and (ii) Article 1 of Council Decision (CFSP) 2015/1336 of 31 July 2015 amending Decision 2010/413/CFSP concerning restrictive measures against Iran (OJ L 206, 2015-08-01, p. 66).

immediately applicable pursuant to OP 21, would thus not be affected at all even if UN sanctions were reinstated at a later stage. After Implementation Day, these exemptions have partially lost their prominence other than that the immediate immunity they enjoyed from being pulled back to the ambit of reimposed sanctions continues to apply.

The lack of clarification of how these three exemptions relate to other Iran-related sanctions which are still in force after Implementation Day appears as problematic. In particular, it is unclear whether the exceptionally allowed actions may be carried out in relation to the persons, entities or bodies that remain under sanctions. If this question were to be answered in the affirmative, the exemptions provided for in the OP 21 would give ample opportunity to evade individualized sanctions and, in addition, remain in force even after the snap-back mechanism has been activated.

13.7.6 The Role of the IAEA

The Vienna Accord attributes the IAEA a vital role in verifying Iran's compliance with the JCPOA and its safeguards obligations. The report by the Director General of the IAEA under OP 5 of SC Res 2231 (2015) caused the lifting of the nuclear-related sanctions as from 16 January 2016. The IAEA is thus in the crucial position of a neutral expert between, on the one side, Iran, against which the sanctions are oriented, and, on the other side, the States and international organizations, which imposed the sanctions.

Pursuant to the JCPOA the IAEA is commissioned to monitor certain Iranian facilities. In contrast, both the resolution and the JCPOA are reticent on specifying the standards, according to which inspections shall be carried out, and on what grounds the IAEA can confirm that Iran actually complies with the accord. The question of the objective control standards to be applied by the IAEA arises mainly at the following two dates connected to the fulfillment of reporting tasks by the Director General of the IAEA: (i) under OP 5 of SC Res 2231 (2015), when the submission of the report was crucial for the concretization of Implementation Day, and (ii) pursuant to OP 6 with respect to the IAEA's so-called broader conclusion that all nuclear material in Iran remains in peaceful activities, as the delivery of a report containing this specific finding is crucial for determining Transition Day, if it shall be earlier than the date eight years after Adoption Day, and for confirming that the conditions are in place to lift the sanctions altogether.

Under OP 3 of SC Res 2231 (2015) the SC requests the Director General of the IAEA to undertake the necessary verification and monitoring of Iran's nuclear-related commitments for their full duration under the JCPOA. However, the SC Res remains largely silent on how this should happen. According to § 15 of the JCPOA, Iran commits itself to allow the IAEA to monitor the implementation of the voluntary measures for their respective durations, as well as to implement transparency measures, including a long-term IAEA presence in Iran, IAEA monitoring of uranium ore concentrate produced by Iran from all uranium ore concentrate plants for 25 years, containment and surveillance of centrifuge rotors and bellows for 20 years, use of IAEA approved and certified modern technologies including on-line enrichment measurement and electronic seals, and a reliable mechanism to ensure speedy resolution of IAEA access concerns for 15 years. Thus the IAEA is, in principle, free to apply its internal assessment criteria and procedures, and to evaluate the Iranian measures at its discretion. The lack of transparency and control in this respect manifests itself as a problem, which is especially visible in the case of the so-called broader conclusion. According to OP 6, the IAEA's declaration that all nuclear material in Iran remains in peaceful activities allows for a determination of Transition Day earlier than the end of the eight-year period in accordance with § 34(iv) of the JCPOA. At the same time, it embodies a confirmation that the conditions are present to lift the sanctions entirely.

It is not unproblematic that the conditions for the concept of the broader conclusion as a conventional method in the organizational practice of the IAEA are not laid down in a legally binding document. It therefore remains an internal decision by the IAEA to issue the confirmation associated with the broader conclusion that all Iranian nuclear material is used exclusively for peaceful purposes. The JCPOA participants or the SC as the principals have no access to a generally regulated verification procedure and are constricted to rely on the decision by the IAEA in this regard. It is obvious that this situation reinforces the significance of strict compliance with the 1973 Safeguards Agreement between Iran and the IAEA and the 2003 Additional Protocol thereto[161] as well as the exigency to bring about an alteration of the latter's treaty law status from provisional application to full ratification and entry into force.

Judging by the importance attributed to the IAEA as a neutral expert body in the context of implementation of the nuclear accord, the position of the IAEA of having free hands might comprehend a conflict potential. If one of the JCPOA participants considers the IAEA inspection performance as insufficient or too rigid, it is at liberty to turn to the Joint Commission. Participation in this dispute resolution mechanism is, as explained *supra*, not mandatory and cannot therefore be enforced by the other participants. The absence of objective assessment criteria substantiates the conflict potential with respect to both the material assessment made by the IAEA as well as to the latter's methodological approach.

13.7.7 Ratification of the 2003 Additional Protocol to the 1973 Safeguards Agreement Between Iran and the IAEA

The verification and monitoring of the Iranian nuclear facilities by the IAEA is directly connected to Iran's commitment under § 64 of JCPOA Annex I (Nuclear-related

[161] Cf. Fry 2013, p. 159 f.

Measures) to seek ratification and entry into force of the 2003 Additional Protocol to the 1973 Safeguards Agreement between the IAEA and Iran. The Additional Protocol provides the necessary legal basis for expanded inspections by the Agency,[162] which in turn is the precondition enabling the IAEA to reach the 'broader conclusion'. In anticipation of the ratification and in the interest of allowing expanded inspections without delay, Iran committed itself pursuant to § 13 of the JCPOA to resume the provisional application of the 2003 Additional Protocol, to proceed with its ratification process and to fully implement the Modified Code 3.1 of the Subsidiary Arrangements to the 1973 Safeguards Agreement.[163]

During the negotiations on the Vienna Accord, there has never been a consistent view that the provisions of § 13 of the JCPOA and § 64 of JCPOA Annex I (Nuclear-related Measures) would be binding under international law; instead they remained political commitments. If the Iranian government can show that it has endeavored to achieve ratification, but unfortunately not been successful in its efforts, it has, to a sufficiently high degree, complied with what it has politically committed itself to do. The cited provisions lay the foundation for a commitment to behave in a certain way, not for an obligation to achieve a certain result, and they are further relativized by the condition that ratification must be consistent with the respective roles of the president and of Majlis, the Iranian parliament. Consequently, it is fully conceivable that ratification of the Additional Protocol fails because of alleged or factual constitutional obstacles, without that Iran could be said to be in breach of the fulfillment of its voluntary commitments in accordance with the JCPOA. Moreover, the provisions do not define when ratification of the Additional Protocol ultimately has to accomplished. A provision on an ultimate date for ratification was rejected by Iran as interference in its sovereignty.[164] Thus, there are no other incentives for ratification before the end of the eight years preceding Transition Day in accordance with § 34(iv) of the JCPOA than the realization that a protracted provisional application of the Additional Protocol may have an impact on the content of IAEA's 'broader conclusion'—a finding that allows the EU to lift, and the U.S. to make the legislative changes required to bring about the lifting, of the last group of the sanctions still in force. If ratification of the Additional Protocol is not achieved, this does not affect Iran's commitment to continue applying the Additional Protocol provisionally and to fully implement the Modified Code 3.1 of the Subsidiary Arrangements to the 1973 Safeguards Agreement.

In light of the fact of the automatic and non-conditional scheduling of Transition Day it should also be noted that the provisional application of a treaty terminates in accordance with Article 25(2) of the 1969 VCLT, if the State which until now applied the treaty provisionally, notifies the other States, between which the treaty is being applied provisionally, of its intention not to become a party to

[162] Myjer and Herbach 2012, p. 127.

[163] Davenport et al. 2015, p. 21.

[164] Haupt 2016, p. 130.

the treaty. Based on this treaty law principle Iran may at any time declare that it no longer applies the 2003 Additional Protocol provisionally. Even such a course of events would *per se* be without consequences for the validity of the JCPOA and would not prejudice the scheduling of Transition Day, which would occur at the latest after eight years. If Iran decided to no longer apply the 2003 Additional Protocol—i.e., to take a legal action which is not ab initio unlawful under treaty law—, this would not in itself represent a significant nonperformance of the commitments under the JCPOA, unless JCPOA participants would arrive at a conclusion to the effect that the invocation of the dispute resolution mechanism in accordance with §§ 36 and 37 of the JCPOA is necessary. If the IAEA decided not to take up such a development in its 'broader conclusion' or if the reimposition mechanism was not activated by JCPOA participants at this particular time, both a provisional application of the 2003 Additional Protocol ad infinitum and the suspension of the provisional application of the Additional Protocol could reasonably no longer be relied upon by JCPOA participants as a ground to terminate, to withdraw from or to suspend the catalog of measures, whose implementation the JCPOA has scheduled in the time period between Transition Day and Termination Day. They would in fact not inhibit the Termination Day and the legal consequences, which this event encompasses. These scenarios were discussed during the negotiations, and all involved sides were fully aware of that they could emerge.[165]

The importance of the effectiveness of the safeguards agreements and of the verification and monitoring arrangements for ensuring the quality of the implementation of the nuclear accord cannot be overrated. They underline the role of the second pillar. The assessment of how it performs is, however, a delicate task given that the bilateral relations between the IAEA and Iran are surrounded by a considerable degree of confidentiality. Just as little as the 2003 Additional Protocol to the 1973 Safeguards Agreement, the 'Separate Arrangements' mentioned in the 14 July 2015 Road-map have been made public. So far, Tehran admittedly denies any military nuclear research, but if it in the assessment were to admit that such operations have taken place, or are taking place, it would be easier for Iran's public diplomacy to handle such findings in the prevailing protective environment than in the focus of the searchlight of global interest. The international community—especially that part of it that does not have its own adequate intelligence capacity—is therefore largely remitted to trust the fairness, sustainability and veracity of the IAEA's assessment of possible military dimensions of Iran's nuclear program. The Agency's reports are important contributing factors in the decision-making by JCPOA participants to gradually suspend the sanctions against Iran with the aim of finally repealing them. The assessment by the Director General of the IAEA should therefore provide as comprehensive an answer as possible to the remaining issues of potential military objectives of the Iranian nuclear program.

Should the Director General of the IAEA settle for a statement to the effect that Iran has, in the eyes of the IAEA, responded adequately without describing

[165] Haupt 2016, p. 130.

whether and to what extent Iran has conducted research into the development of nuclear weapons, this will cause the public diplomacy of the IAEA no relief: First, doubt will remain whether Iran really has ceased any ambition to develop nuclear weapons, and, second, the critics of the accord will see a reason to stress that Iran continues to secretly pursue nuclear research for military applications even though the results of the investigations by the IAEA suggest otherwise. The balancing act between the requirement to comply with obligations of confidentiality and to facilitate for the international community, which does not have its own intelligence capacity, to get an independent opinion on possible violations of the NPT committed by Iran might prove to be an intricate one.

13.7.8 Possible Implications of Changes in the Composition of the JCPOA Participants

The JCPOA contains no provision for early termination of the arrangement or for withdrawal from it, a scenario that cannot be completely ruled out with respect to possible political changes impacting on JCPOA's participants, which could cause one of them to decide to terminate, or withdraw from, the nuclear accord. In view of the fact that the JCPOA is no binding international agreement under treaty law, it is unclear if the regulatory principle in Article 56(1) of the 1969 VCLT would give suitable guidance in such a situation. This provision stipulates that '[a] treaty which contains no provision regarding its termination and which does not provide for denunciation or withdrawal is not subject to denunciation or withdrawal unless (a) it is established that the parties intended to admit the possibility of denunciation or withdrawal; or (b) a right of denunciation or withdrawal may be implied on the basis of the nature of the treaty'. While nothing contradicts the arguments that the nature of the JCPOA may permit withdrawal and that the nuclear accord could continue to have, though adapted, effect, if an E3/EU+3 participant was to decide to withdraw—the same obviously cannot be concluded, if Iran should decide to withdraw—, in the case of the JCPOA it seems most reasonable, however, to refer such a state of affairs to the SC, owing to the circumstances after the remaining participants of the JCPOA having reached an endorsable solution.[166] Before Termination Day, OP 30 of SC Res 2231 (2015) entitles the Security Council to remain seized of the matter. After that date, the JCPOA must be considered as formally terminated. As the continued valence of a Security Council document completely depends on the political will of the participating sides to continue cooperation, lack of willingness thereto is not in itself a legal basis under the UN Charter to call upon the SC's attention.[167]

166 Haupt 2016, p. 131.

167 Haupt 2016, p. 131.

13.7.9 *The Relationship Between the Vienna Accord and Iran's Ballistic Missile Program*

One issue that arose during final negotiations on the JCPOA was the suspension of UN sanctions on Iran's development of nuclear-capable ballistic missiles and on Iran's importation or exportation of conventional weaponry.[168] The 'Parameters for a Joint Comprehensive Plan of Action Regarding the Islamic Republic of Iran's Nuclear Program', agreed on 2 April 2015 in Lausanne,[169] indicated in the last sentence of the fifth indent under the subheading 'Sanctions' that these sanctions would remain in place.[170] But the finalized Vienna Accord provided for the ban on Iran's development of nuclear-capable ballistic missiles to be lifted within eight years[171] and the ban on conventional arms sales to Iran and on Iran's exportation of arms to be lifted within five years.[172]

Upon order given on 2 February 2016 by the Chief of the General Staff, the Islamic Republic of Iran conducted a series of short-range and medium-range ballistic missile launches of at least six ballistic missiles during the 'Eqteda-e-Velayat' military exercises, between 7 and 9 March 2016, encompassing two Shahab-3, two Qiam-1 and two Shahab-1 type missiles.[173] According to Iranian media, also two Qadr H ballistic missiles were launched.[174] Iran also previously, on 10 October 2015, carried out a flight test involving its Emad warhead, based on the Shahab-3 series. The October 2015 test was condemned by the UN Iran Sanctions Committee Panel of Experts as a breach of SC Res 1929 (2010)[175] and brought to the attention of the Sanctions Committee in November 2015. A further test was carried out on 21 November 2015. All missile types used in these

168 Katzman and Kerr 2016, p. 20.

169 U. S. Department of State 2015.

170 U. S. Department of State 2015.—This indent reads as follows: 'However, core provisions in the UN Security Council resolutions—those that deal with transfers of sensitive technologies and activities—will be re-established by a new UN Security Council resolution that will endorse the JCPOA and urge its full implementation. It will also create the procurement channel mentioned above, which will serve as a key transparency measure. Important restrictions on conventional arms and ballistic missiles, as well as provisions that allow for related cargo inspections and asset freezes, will also be incorporated by this new resolution.'

171 § 3 of the Statement in SC Res 2231 (2015) [UNSC 2015e, p. 99].

172 § 5 of the Statement in SC Res 2231 (2015) [UNSC 2015e, p. 100].

173 Iranian military leaders have reportedly claimed that these missiles are designed to be a direct threat to Israel, with reports that at least one missile had the words 'Israel should be wiped off the Earth' written in Hebrew on them; FARS News Agency 2016.

174 FARS News Agency 2016. See also Daugirdas and Mortenson 2016, 353–356.

175 This resolution was terminated on Implementation Day on 16 January 2016.

launches are MTCR Category I[176] Item 1 § 1.A.1 systems: the medium-range ballistic missile Shahab-3 is capable of delivering a payload[177] of around 700 kg to 2000 km, the short-range ballistic missile Shahab-1 of 1000 kg to 300 km—both being Scud-based systems—and the short-range ballistic missile Qiam-1 of around 650 kg to 750 km. The question is whether the launches of such systems carried out by Iran after 16 January 2016—i.e., Implementation Day—are compatible with SC Res 2231 (2015).

It should be noted at the outset that Iran's ballistic activities cannot be qualified as a breach of the JCPOA, as Iran has not committed itself under this arrangement not to carry out launches of the kind it conducted subsequently.

While SC Res 1929 (2010), a resolution which in its entirety was adopted by the SC acting under Article 41 on Chapter VII of the UN Charter, still applied when the October 2015 missiles tests were conducted, this was not the case anymore concerning the March 2016 launches. The legal evaluation of the October 2015 tests was governed by OP 9 of the said resolution, which provided that 'Iran shall not undertake any activity related to ballistic missiles capable of delivering nuclear weapons, including launches using ballistic missile technology'. As the constituent element 'capable of delivering nuclear weapons' aims at the establishment of facticity, the UN Iran Sanctions Committee Panel of Experts was tasked to establish that the missiles used had objectively this technical capacity. By definition,[178] MTCR Category I systems are designed to be capable of delivering nuclear weapons and other weapons of mass destruction. Using the MTCR Category I threshold as a generally applicable guideline is considered to be consistent with established SC practice, even if in an individual case—like in the case of Iran—the UN member State concerned does not directly participate in this control regime. In particular, the list of missile-related items, the transfer of which to Iran is restricted under SC Res 2231 (2015), is based on the MTCR Equipment, Software and Technology Annex as a consequence of the reference, in § 4(a) of the Statement in Annex B to SC Res 2231 (2015), to SC document S/2015/546 submitting this Annex as it stood[179] on 16 July 2015. In subsuming, the Panel of Experts held that it was justified to classify the actions by Iran as a breach of SC Res 1929 (2010).

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[176] MTCR Category I systems comprehend, inter alia, as complete delivery systems ('Item 1'), complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and complete unmanned aerial vehicle systems (including cruise missile systems, target drones and reconnaissance drones)—in both cases capable of delivering at least a 500 kg payload to a range of at least 300 km—, and, as complete subsystems usable for of complete delivery systems ('Item 2'), individual rocket stages, re-entry vehicles, rocket propulsion subsystems, so-called 'guidance sets', and thrust vector control subsystems. MTCR 2015, pp. 17–22.

[177] For the definition of 'payload' under the MTCR see MTCR 2015, pp. 11–13.

[178] MTCR Guidelines 1 and 3 in conjunction with 'Category I' and the definitions 'payload' and 'range' in MTCR 2015, pp. 11–14 and 17–22. See also Ahlström 1999, pp. 376–395.

[179] See Sect. 13.3.1.3 *supra* for a discussion whether the submitted document containing MTCR Equipment, Software and Technology Annex is subject to dynamic adaptation.

The same pattern of argumentation is, however, not available concerning the March 2016 launches. OP 9 of SC Res 1929 (2010) was replaced by OP 7(b) of SC Res 2231 (2015), according to which all States 'are called upon to comply with paragraph[] 3 […] of Annex B', which, for its part, calls upon Iran 'not to undertake any activity related to ballistic missiles designed to be capable of delivering nuclear weapons, including launches using such ballistic missile technology'. Not only has the agentive theme 'decides' employed in SC Res 1929 (2010) been replaced by 'calls upon', an agentive theme of lesser intrusiveness—albeit under the major premise of OP 7 referring to a decision by the UNSC acting under Article 41 in Chapter VII of the UN Charter—, but, not less importantly, has the element 'capable of delivering nuclear weapons' been substituted by 'designed to be capable of delivering nuclear weapons'.

The new language was agreed in the framework of the negotiations on the nuclear accord in bilateral talks between Iran and the United States at the highest level and upon Iranian initiative; preparatory drafts were still modelled after the usage in OP 9 of SC Res 1929 (2010). It is unclear which reasons Iran stated for the change in formulation and whether this was meant to establish a material understanding to be distinguished from the one which was governing the application of OP 9 of SC Res 1929 (2010), and it is also ultimately unclear whether the United States—besides its preparedness to accept the new language in the spirit of compromise—perceived the wish for an amended formulation as a solicitation, from the Iranian side, to agree on a modified ground for application.

This lack of clarity can thus not be eliminated by a mere reference to a common understanding which might be guiding the interpretation of the provision in § 3 of the Statement in Annex B. Instead, it rather encourages different interpretive approaches:

(i) It has been argued that an equal sign was to be placed between 'capable of delivering nuclear weapons' and 'designed to be capable of delivering nuclear weapons', i.e., that the meaning of § 3 of the Statement in Annex B is not meant to be any different from the one in OP 9 of SC Res 1929 (2010). Following this approach, the March 2016 launches do not lead to a conclusion different from the one drawn by UN Iran Sanctions Committee Panel of Experts under factual aspects of the October 2015 tests. Under aspects of legal consequences, the normative modification from the unambiguous prohibition under SC Res 1929 (2010) to the appeal phrased 'are called upon' under SC Res 2231 (2015)—admittedly decided on the basis of Article 41 in Chapter VII of the UN Charter—has to be taken into account. While it was well-founded in international law to denominate the breach of SC Res 1929 (2010) a violation of this resolution, the same would not be sustainable for a breach of § 3 of the Statement in Annex B, referentially embedded in OP 7(b) of SC Res 2231 (2015). In violating SC Res 1929 (2010), State responsibility resulted on the part of Iran. In the March 2016 situation, Iran ignored the call emanating from OP 7(b); in doing so, its activity is certainly inconsistent with SC Res 2231 (2015), but it is doubtful whether this activity amounts to a violation of the said resolution and, consequently, whether State responsibility results on the part of Iran.

(ii) The point of departure in an alternative line of argumentation is the basic assumption that differences in wordings indicate differences in substance, i.e., that 'capable of delivering nuclear weapons' and 'designed to be capable of delivering nuclear weapons' do mean different things. The fact that the modified phrasing was proposed by Tehran would advise an endeavor by Iran to obtain a stronger claim to legitimacy for its continuing launches of space rockets and conventionally-tipped ballistic missiles.[180] The MTCR Equipment, Software and Technology Annex does not offer a stand-alone definition for the term 'designed to', but holds ready the terminology 'designed or modified' to describe 'equipment, parts or components which, as a result of "development", or modification, have specified properties that make them fit for a particular application'.[181] The term 'development' used in this explanatory note is itself defined as 'relat[ing] to all phases prior to "production" such as: design; design research; design analysis; design concepts; assembly and testing of prototypes; pilot production schemes; design data; process of transforming design data into a product; configuration design; integration design; layouts'. Apart from the argumentative shortcoming of a slight circular reasoning leading from 'designed or modified' via 'development' to certain aspects in conjunction with 'design', the MTCR terminology clarifies to a sufficient degree that 'designed to' implies specified properties in the pre-production phase which are functionally liaised with capabilities. This leads to the question whether the modified language implies that a nuclear weapons intent must now be established in assessing the design of any missile launched by Iran or whether other standards might be applicable. The establishment of intent addresses a subjective element, the proof of which can be extremely laborious, in particular with respect to regimes with a pronounced predisposition for covert activities. After singularization of the element 'designed' in the MTCR definition 'designed or modified' to phenomena in the pre-production phase of Category I items, a recourse to establishing intent is, however, not necessitated; on the contrary, despite the fact that the onus of establishing breach (and, as the case may be, responsibility) lies in principle on the claimant States, is suffices for them to argue conclusively that the identified activities engaged equipment having specified properties that make them fit for delivering nuclear weapons in accordance with the standard evidentiary threshold in international law, which, as a rule, amounts to plausibility or reasonableness.[182] It would, therefore, be fully possible to make plausible that the ballistic missiles launched by Iran in March 2016 were designed to be

[180] Thielmann 2016.

[181] § 3(b) of the section 'Introduction, Definitions, Terminology' in the MTCR Equipment, Software and Technology Annex [MTCR 2015, p. 16].

[182] This does not contradict the fact that in specific areas of international law, such as in international criminal law, in the law of the sea, in international environmental law, or in the law of territorial sovereignty with respect to border disputes, evidence rules of a more elaborate stringency apply.

> capable of delivering nuclear weapons by referring to their inherent capabilities in a way similar to the line of argumentation which the UN Iran Sanctions Committee Panel of Experts relied upon previously—and it would be upon Iran to disproof these conclusions. While ostracizing the assertion of fabricated circumstances and contexts, the standard of plausibility or reasonableness confines the importance to have recourse to subjective elements. In order to determine legal consequences under this approach, the decisive moment is whether the Security Council's '2231 Format', the structure established to facilitate monitoring that resolution's implementation,[183] concurs with the view that the claims of inconsistency of Iran's ballistic missile activity with SC Res 2231 (2015) pass the plausibility test or not.

Furthermore, the SC must continue to insist on full implementation of the binding measures in SC Res 2231 (2015) that restrict outside support to Iran's ballistic missile program. All States have an obligation under that resolution[184] not to sell, supply, or transfer to Iran ballistic missile-related items, materials, equipment, goods and technology, and not to provide Iran with any technology or technical assistance or training, financial assistance, investment, brokering or other services, or the transfer of financial resources or services, related to ballistic missiles designed to be capable of delivering nuclear weapons, including launches using such ballistic missile technology, or to the supply, sale, transfer, manufacture or use of such items, materials, equipment, goods and technology absent Security Council approval.

13.8 Perspectives and Conclusions

At the conclusion of the negotiations in Vienna on 14 July 2015, the foreign ministers declared that the political significance of the nuclear accord goes far beyond verification and monitoring of Iran's nuclear program: It aims at ensuring the exclusively peaceful nature of this program and should therefore be a strategy for reaching a long-term comprehensive solution of the Iranian nuclear issue. According to them, the reaching for the Vienna Accord has shown that it is possible to find a solution even in deeply rooted, historically complex conflicts which are further aggravated by suspicion and hostility. The result could contribute to developing a comprehensive security architecture for the region.

[183] § 2(e) and §§ 3–13 in UNSC 2016a.

[184] OP 7(b) of SC Res 2231 (2015) [UNSC 2015a, p. 3] in conjunction with §§ 4 and 5 of the Statement in Annex B to this resolution [UNSC 2015e, p. 100]. It follows from § 5 that the meaning of the term 'missiles and missile systems' is based on the definition of this category for the purpose of the UN Register of Conventional Arms, which does not comprise ground-to-air missiles.

The accord is seen by governments as lever to intensify their bilateral relations with Iran, not least in the interest of promoting what is considered to be an ongoing reform process in the Iranian society.[185] This requires a sense of proportion and realism, knowing that the situation in Iran will not change overnight, which makes it important to evaluate the shortcomings and comparative advantages of the Vienna Accord.

13.8.1 Breakout or Sneakout

In the event that the Non-Nuclear Weapon State Iran—despite its reaffirmation in the first paragraph of the preface to the JCPOA that it under no circumstances ever will seek, develop or acquire any nuclear weapons—would opt for seeking to acquire nuclear weapon capability in violation of Article II of the NPT, it would have mainly two options:[186]

- It could break out with the help of its declared facilities. After having implemented the JCPOA and been reintegrated as Non-Nuclear Weapon State in the NPT's nonproliferation regime, the ability to breakout describes the period of time needed for Iran to regain the capability to accumulate uranium hexafluoride in such quantity needed for one single nuclear weapon. For the ability to be able to break out from the NPT, it is, however, not decisive whether the nuclear weapon actually has been designed or manufactured or if there is an initial operating capability.[187]
- Iran could sneak out with the aid of a covert program. If Iran really chose to seek nuclear weapon capability, it appears more likely that it would tend towards this option, given the intrusive monitoring of Iran's declared nuclear facilities.[188]

Experts generally agree that there is the possibility of a covert program which causes most concern. Iran has long experience both in building nuclear facilities secretly and in admitting sensitive nuclear activities only when the evidence provided against it is totally overwhelming.[189] In a fundamental way, it is extremely difficult to prove the absence of something, especially in a country as large as

[185] For a detailed analysis see Zamirirad 2015, pp. 4–7.

[186] Davenport et al. 2015, p. 18.

[187] As Davenport et al. 2015, p. 43 et seq., explain, breakout time as a function of the time required to produce enough fissile material to build one single nuclear weapon is expected during the first decade of the application of the Vienna Accord to extend over at least a year and during a multi-year transitional period thereafter over at least about six months or longer, while it is currently estimated to equal 2–3 months.

[188] Davenport et al. 2015, p. 18.

[189] Pabian 2010, pp. 234–238.

Iran.[190] Deliberate evasion from monitoring and transparency measures—something that any covert program would imply—obviously makes such a verification task even more difficult.[191] The subtle effectiveness of the nuclear accord can prove to be most pronounced in the provisions addressing covert activities.[192] Critics have focused on the question of how long it would take for the IAEA inspectors to gain access to undeclared sites, but this view is based on the thinking that was prevailing in the 1990s' Iraq conflict, namely on the—erroneous—assumption that the inspections 'anytime, anywhere' could be achieved under conditions that do not resemble a postwar environment.[193]

Theoretically, Iran could try to provide itself with uranium via unauthorized channels, bypassing the JCPOA's procurement channel. Pursuant to §§ 17 and 21 of the JCPOA in conjunction with § 6.5 of JCPOA Annex IV (Joint Commission), a transfer that has not been approved by the procurement working group is unlawful. The procurement procedure prescribed in the JCPOA will govern the transfer to Iran of goods and materials in NSG Part 1 (Trigger List) and Part 2, the 'Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology',[194] as well as—according to the 'catch all' provisions in OP 19 of SC Res 2231 (2015) in conjunction with § 6.8 of JCPOA Annex IV (Joint Commission)—of any further items which, according to an exporting State's view, would contribute to an illegal nuclear program in Iran. The 'catch all' controls only cover items that a State determines could contribute to reprocessing, enrichment-related, or heavy-water-related activities. By their nature, catch all controls apply to items that have many legitimate non-nuclear uses.[195] In its procurement activity, Iran has learned to target such items, that can be useful for nuclear purposes, but are not on the international control lists.[196] Interdictions of shipments to Iran's nuclear program were based on catch all controls that stopped transfers to specific end-users in Iran because they were associated with Iran's nuclear program. The removal of most of Iran's nuclear-related entities and individuals from designation lists will complicate the ability of export control authorities to apply catch all controls.[197]

Assuming that Iran would be able to procure uranium in amounts needed to begin a covert program, it must have the capability to reprocess the uranium so that it can be used for nuclear weapons purposes. This basically means that Iran

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[190] Nephew 2015, p. 8.

[191] Nephew 2015, p. 8.

[192] Nephew 2015, p. 8.

[193] Nephew 2015, p. 8.—See also den Dekker 2001, pp. 52 et seq., as well as Edelman and Ross 2015, p. 11.

[194] IAEA 2013b.

[195] Samore 2015, p. 51.

[196] Samore 2015, p. 51.

[197] Samore 2015, p. 51.

would need to convert raw uranium into material suitable for enrichment or reactor fuel.[198] In order to reach this step, Iran would be required to construct a new, covert uranium conversion facility. Before solving the problem of gaining access to equipment and technologies to transform nuclear material to weapons-grade uranium, a technical landmark decision has to be taken. It is considered to be the most likely scenario that Iran would try to utilize centrifuge-based uranium enrichment.[199] This premise is based on Iran's experience in uranium enrichment with centrifuges and in the covert construction of enrichment plants, although these facilities had been exposed long before they ever became operational.[200] Centrifuge plans have the advantage that they leave fewer detectable signatures than nuclear reactors and reprocessing plants for spent nuclear fuel.[201] Covert uranium enrichment would require the construction of a new clandestine enrichment facility, which is not allowed under the JCPOA, and to equip it with centrifuges. The logistically easiest way to meet this demand would be to regain access to the stockpile of centrifuges removed pursuant to the nuclear accord.[202] However, pursuant to §§ 46.1, 62 and 70 of JCPOA Annex I (Nuclear-related Measures) the stockpiles, the stored centrifuges and related components and infrastructure will remain under constant supervision for a period of 15 years as from Implementation Day. Against this background, IAEA should have reasonably good preconditions for a timely detection of any attempts to divert these centrifuges before a plant could be built.

Instead of removing centrifuges from the declared centrifuge stockpile, Iran could conceivably decide to build new centrifuges. To proceed on this path, it would have to develop, inter alia, new rotors and bellows for the centrifuges.[203] As the Vienna Accord in § 15 of the JCPOA in conjunction with §§ 79–80 of JCPOA Annex I (Nuclear-related Measures) requires containment and surveillance of the existing inventory of both rotors and bellows for 20 years, Iran would be required to develop new centrifuge components using specialized equipment.[204] However, § 1 of the JCPOA in conjunction with § 52 of JCPOA Annex I (Nuclear-related Measures) prevent this option by requiring that Iran submits a declaration of all locations, where the production of centrifuge components can take place, and allows access to these locations in order to verify that no unauthorized production is in progress. In addition, under §§ 29.2, 41, 47.1 and 48.1 of JCPOA Annex I (Nuclear-related Measures) Iran must provide access to flow-forming machines, filament-winding machines and mandrels used for the manufacture of centrifuge rotor tubes and bellows. As follows from § 80.2 of JCPOA Annex I

198 Nephew 2015, p. 10.

199 Nephew 2015, p. 10.

200 Nephew 2015, p. 10.

201 Nephew 2015, p. 10.

202 Nephew 2015, p. 10.

203 Nephew 2015, p. 10.

204 Nephew 2015, p. 10.

(Nuclear-related Measures) also this equipment is subject to continuous monitoring under the JCPOA for 20 years. If the existing equipment were to be diverted or misused, the IAEA would gain knowledge of interferences of this kind. In order to embark on a path leading to a covert enrichment capability, Iran would, in sum, have to secure a clandestine channel for the supply of uranium, a covert uranium conversion plant, a secret method to manufacture centrifuges and secluded locations to install and operate them.[205] This would essentially require a replication of the current enrichment program,[206] i.e., the management and operation of a complicated and detection-prone process.

Regarding the option to build a covert reactor, there are conceptual designs of reactors which would allow Iran to maximize the production of plutonium for use in nuclear weapons.[207] One conception of design is the heavy water reactor in Arak, which, however, according to § 2 of JCPOA Annex I (Nuclear-related Measures) will be modified in such a way that its annual production is reduced to only one-eighth of the current performance. Reactors require specially designed parts and materials.[208] At least some of these Iran would probably have to procure from foreign sources. In addition, reactors have unique construction signatures that can be detected by intelligence satellites.[209] The North Korean-built reactor in Al Kibar, Syria, which was destroyed on 6 September 2007 by Israel,[210] exemplifies that it is not entirely impossible to start building a reactor clandestinely, at least until a certain stage, but that it remains a very difficult task.[211] Israel's ability to identify and destroy the reactor before it went into operation supports the idea that it is possible to prevent even a carefully concealed reactor facility from being put into operation.[212] This in turn points to the importance of the time factor: For each day an unauthorized facility is operative, the possibility increases that intelligence services succeed in cultivating a source, that a successful tapping operation can be carried out or that satellite imagery captures proliferation activities in the very act.

[205] Nephew 2015, p. 10.

[206] Nephew 2015, p. 10.

[207] Nephew 2015, p. 10.

[208] Nephew 2015, p. 10.

[209] Pabian 2010, p. 237.

[210] Katz and Hendel 2011, pp. 118–128.

[211] Nephew 2015, p. 10.

[212] The lawfulness of this measure of individual self-defense is not generally accepted. At the 2015 NPT Review Conference, the States of the Non-Aligned Movement under the leadership of Iran contended that measures of this kind were generally in contravention of international law. Germany, the United States, the United Kingdom and Canada opposed this view with good reasons and argued that an assessment can only be made on a case-by-case basis. As the Review Conference could not agree on adopting a final document by consensus, this issue has not been challenged as an explicit expression of *opinio juris* of the parties to the NPT. The approach to a concrete case-by-case examination of self-defense measures targeting construction projects intended for nuclear reactors is further analyzed by McCormack 1996, p. 302.

On 2 December 2015, the Director General of the IAEA submitted a report[213] to the Board of Governors in accordance with the 14 July 2015 Road-map for the Clarification of Past and Present Outstanding Issues Regarding Iran's Nuclear Program. The report contains the final assessment of all past and currently unresolved issues set out in the Director General's report of 8 November 2011.[214] In accordance with § 14 of the JCPOA, the IAEA Board of Governors adopted a resolution on 15 December 2015 approving this assessment,[215] which is based on all the information available to the Agency relating to nuclear material acquisition,[216] including from the particular verification activities specified under the Framework for Cooperation[217] and the 2013 JPA.[218] The Agency had not found indications of an undeclared nuclear fuel cycle in Iran and concluded that all the activities covered by the road-map were implemented in accordance with the agreed timetable. Iran is said to have given explanations, in written form and by reference to related documents, on past and current outstanding issues, after which the IAEA had to get back with questions about ambiguities regarding Iran's explanations and meetings of technical experts were held. The IAEA took safeguards measures at special places of interest, including in the facility of Parchin.[219]

The IAEA assesses that the range of activities relevant to the development of a nuclear explosive device were conducted prior to the end of 2003 as a coordinated effort, and that some activities took place even after 2003. The agency also estimates that these activities did not advance beyond the stage of feasibility and scientific studies and that some relevant technical competences and capabilities were acquired. The IAEA has, however, no credible indications of either activities in Iran that would be relevant for the development of a nuclear explosive device after 2009 or of the diversion of nuclear material in connection with the possible military dimensions of Iran's nuclear program.[220]

According to § 77 of JCPOA Annex I (Nuclear-related Measures), Iran has committed itself to give access to undeclared facilities, if the IAEA so requests and if appropriate alternative arrangements cannot be identified. This requirement is based on the implementation of the Additional Protocol with the IAEA, which Iran applies provisionally effective 16 January 2016. The JCPOA regulates the procedure which is activated by the IAEA's request as soon as the Agency has been notified of a potentially hidden location or of undeclared nuclear-related activities. This procedure, laid down in § 78 of JCPOA Annex I (Nuclear-related Measures), includes the provision of information by the IAEA to Iran on the kind

213 IAEA 2015f.

214 IAEA 2011.

215 IAEA 2015g.

216 IAEA 2015f, p. 13 [§ 77].

217 IAEA 2013c.

218 IAEA 2013d.

219 IAEA 2015f, pp. 14 et seq. [§ 86].

220 IAEA 2015f, pp. 14 et seq. [§§ 86–88].

of suspicion that prompted the request for access with such a request, and of the commencement of a countdown of up to 24 days, within which period of time Iran will grant the requested access or refer the matter to the JCPOA's dispute resolution mechanism. Iran could avert a request for access only if four out of the eight participants in the JCPOA—Iran, the EU, China, France, Germany, Russia, the United Kingdom and the United States—opposed its granting. Even then, the complainant state is still entitled to raise the issue in the dispute resolution procedure. The final result of this procedure could be a reimposition of the UN as well as of U. S. sanctions, and, theoretically, of EU sanctions[221] as well as a revitalization of the crisis surrounding Iran's nuclear program.

Sneakout scenarios predicting a covert Iranian program assume that there must be a high risk preparedness, if Iran would be willing—after having worked hard and successfully to achieve the Vienna Accord—to jeopardize that its actions nullify the results obtained and to cause consequences that may include a reimposition of sanctions, but, ultimately, also military action.

Without the Vienna Accord, Iran's nuclear program would be unlawful as a legal consequence of the continued applicability of the resolutions cited in OP 7(a) of SC Res 2231 (2015). Given that Iran has not fulfilled its obligations under those resolutions since 2006, it could be argued that the prohibitions under international law in practice did not have such great importance when it comes to avert Iran from pursuing a covert program. The nuclear accord, at least, contributes to significantly hamper such clandestine efforts. In important parts, it achieves an improvement compared to the preceding and long-lasting situation. In the least optimal scenario, it offers an enhanced opportunity to detect when Iran is taking covert action to acquire nuclear weapons capabilities. In this sense, the Vienna Accord could even be said to strengthen the preconditions for a renewed deterrence policy.[222]

This contention requires a brief explanation, as it addresses, indirectly though, the question whether deterrence policy, which necessarily includes a significant element of threat of military force, is consistent with international law or the UN Charter. States advocating that the UN Charter, under certain circumstances, permits the threat of violence primarily rely on the deterrence model. They argue that deterrence indirectly promotes the Charter's peace purposes and therefore is outside the scope of interpretation of Article 2(4). Further arguments invoked in favor of the compatibility of military threat with international law in certain circumstances are overriding security concerns and criteria of self-help and necessity.[223] In this context it is important to take into account that the UN Charter—mainly in Article 42 of Chapter VII—partly is based on deterrence to dissuade States from resorting to violence, in the context of which it supports the threat of military action to reinstate obedience with international law. In this concept, deterrence is

[221] See EEAS 2016, p. 8, as well as Katzman and Kerr 2015, p. 13.

[222] Cf. Sofaer 2015.

[223] Sadurska 1988, pp. 250 et seq. See also den Dekker 2001, pp. 31 et seq.

intended to be derived from the SC, whose initiation of collective action as a whole was meant to counter behavior in contravention of international law.[224] The right to resort to deterrence should in this sense be asserted by States when they exercise their inherent right of individual or collective self-defense.[225] Except when international law imposes a duty on States, they are free to choose a policy of action to exercise their rights or not. If a State decides to act, its actions are necessarily significant in terms of its view of what international law permits or dictates. In his separate opinion in the Advisory Opinion of the International Court of Justice on the 'Legality of the threat or use of nuclear weapons', issued on July 8, 1996, Judge Carl-August Fleischhauer drew attention to the fact that the practice expressed by a policy of deterrence is based specifically on the rights to individual or collective self-defense—of which he concludes that the practice as reflected in the policy of deterrence is considered as State practice in the legal sense.[226]

Deterring Iran's acquisition of nuclear weapons by advising to prevent it with strength,[227] if necessary, is justified under international law to protect vital security interests. To be effective, a policy of deterrence will require clarity and credibility, with the Iranian regime knowing just what acts will trigger retaliation and having good reason to believe that JCPOA participants will follow through on their threats.[228] The purpose of deterrence should be specific and limited, namely to prevent Iran from acquiring nuclear weapons capability. However, deterrence policy would have to face two challenges:[229]

- The first one is the likelihood of an Iranian policy of international law moral hazard, i.e., of repeated well-dosed, though less significant nonperformance of its commitments under the JCPOA, which gradually will bring the Islamic Republic closer to a nuclear weapon without a single nonperformance to be considered significant enough to trigger a reaction under the Vienna Accord, under SC Res 2231 (2015) or under general principles of international law.[230]
- The other one is the potential difficulty in detecting such nonperformance. Despite the provisions in the Vienna Accord regarding inspection, verification and monitoring, it will be extremely difficult to keep track of all activities in Iran related to the acquisition of nuclear weapons capability.

224 Stürchler 2009, p. 47.

225 Franck 2004, p. 45.

226 ICJ 1996, p. 309.

227 See Conway and Wald 2016, pp. 5 and 16–18.

228 Mandelbaum 2015, p. 23, and Sofaer 2015.

229 Mandelbaum 2015, p. 23.

230 See Sect. 13.7.2 *supra*.—This contribution has to bypass the issue whether the international law of nonproliferation and the specific obligations and institutional mechanisms founded by its fundamental treaties restrict or modify the right to countermeasures pursuant to customary international law, in particular in the context of violations of these treaties. For a detailed analysis of this aspect see Singh 2012, pp. 196–249.

The first challenge is real and has been highlighted *supra* in the commentary on the SC Res 2231 (2015).[231] The second challenge is precarious for the reason that the safeguards regime in force between the IAEA and Iran to a considerable extent is confidential, so that the international community outside the IAEA's sphere will understand its shortcomings only when violations have already occurred.[232] The Vienna Accord has created a scope of action for a policy of deterrence which sees its aim in helping to address some of the shortcomings of the JCPOA without sacrificing or undermining its useful elements.[233] President Obama has repeatedly argued that the alternative to the Vienna Accord was war,[234] which reasonably would entail, from the perspective of Tehran, that the prospect of U. S. military operations should be avoided at all costs. This suggests, in other words, that the JCPOA would benefit from being complemented by a resonating element of deterrence in the ultimate interest of preventing Iran from acquiring nuclear weapons capability.[235]

It is undisputed that a covert way for Iran to establish control over nuclear weapons before Termination Day would be a huge security challenge for both the members of the Working Group and the countries in the region. Such a program would undermine the Vienna Accord and thus lead, if not to military action, so with a certain degree of probability to the reimposition of UN sanctions, which would be detrimental—and even might be fatal—for the JCPOA. In addition, a covert program spurs further nuclear proliferation in the region and beyond. Iran would need to anticipate these risks and develop a strategy against them before it decides to execute a covert option.

13.8.2 Evaluation

The nuclear accord's unique structure allows a balancing of participants' diverse interests, albeit on the basis of a negotiated result which is very beneficial for Iran.[236] The manner in which the Vienna Accord will be implemented is crucial for the legitimacy of the SC in the foreseeable future, if necessary, to decide on nuclear-related sanctions against States of the magnitude and disposition of Iran. In the end, it will be crucial for answering the question whether the NPT regime is strengthened in the long term.

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[231] See Sect. 13.7.3 *supra*.

[232] Meier 2015.

[233] Mandelbaum 2015, p. 24.

[234] Obama 2015.—See Rubin 2015 and also Sofaer 2015, pp. 1 et seq. and 6, who criticizes the bipolarity of this alternative, as he argues that there are more options in between these far-end points.

[235] Cf. Mandelbaum 2015, p. 24.

[236] Brzoska and Neuneck 2015.

In its report entitled ‘Weapons of Terror: Freeing the World of Nuclear, Biological and Chemical Arms’, the Weapons of Mass Destruction Commission chaired by the former IAEA Director General Hans Blix held that ‘[a] key premise of discussions with Iran and the resolutions passed by the Board of the IAEA has been that Iran, as all other parties to the NPT, has the right—in keeping with Articles II and IV of the treaty—to engage in peaceful nuclear energy production. While some have sought to suggest that this right does not extend to the right to domestically enrich uranium, but only to have a secure supply of fuel for power reactors, it would seem to be not only legally correct but also wise to recognize that there is a right for NPT States, acting in full conformity with Article II and IV of the treaty, to participate in all stages of fuel-cycle activity. Trying to reinterpret the NPT and assert a new division of the world into “nuclear fuel-cycle-haves” and “have-nots” would hardly get broad support’.[237] The Vienna Accord rests on the acquiescence of Iran’s right to have a full-fledged nuclear fuel cycle without foreclosing the exercise of this right once confidence has been built, at the latest by UN Security Council Resolution Termination Day on 18 October 2025, with regard to the peaceful orientation of the Iranian nuclear program.[238]

As the nuclear accord with Iran first and foremost is a diplomatic solution, it is advisable for international lawyers involved in this process to pursue a contextualized expectation management with regard to the role and effectiveness of international law. However, it would be too narrow a view to perceive the Vienna Accord merely as a comprehensive solution to the Iranian nuclear issue; it is a novel contribution to the international conflict and security law with thematic links beyond nuclear nonproliferation.

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Chapter 14
The Iranian Nuclear Agreement: A Scientifically Reliable, Transactional and Verifiable Joint Comprehensive Plan of Action

Maurizio Martellini and Massimo Zucchetti

Abstract In the international question of non-proliferation, Iran occupies a peculiar position among the Parties (i.e., the Ratifiers of the Non-Proliferation Treaty). Even before the first revelations of the existence of a suspected clandestine nuclear program (in 2002), and the Report of IAEA in 2003, the international relations between Iran and Western countries were quite intense and contradictory. After many years of difficult negotiations and slow construction of trust, the reach of a Nuclear Agreement in July 2015 (called JCPOA, Joint Comprehensive Plan of Action), between Iran and the P5+1, or the E3/EU+3 (i.e., China, France, Germany, Russia, the UK, the USA, with the High Representative of the European Union for Foreign Affairs and Security Policy) represents a relevant step in the fight against the proliferation of Weapons of Mass Destruction (WMD). This Chapter aims, firstly, at summarizing the historical background of the relations between Iran, the EU and the USA; then, describing the main features of the Agreement; and finally evaluating the relevance of the agreement, in the belief that the lessons learned from this question could be useful for future cases.

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Keywords Iran · European Union · United States of America · International Atomic Energy Agency · Joint Comprehensive Plan of Action (JCPOA) · Safeguards · Sanctions

Contents

14.1 Introduction: Iran as an Emblematic Case in the Non-proliferation Question

Since many decades, international and multilateral commitments have been formulated and reiterated at different levels for both fighting against the proliferation of weapons of mass destruction (WMD) and for achieving a 'world without nuclear weapons'. The drafting and entry into force of the Treaty of Non-proliferation (NPT) in 1970 has given a significant boost to these issues. A 'multiple silos approach' has been adopted: many actors have been involved in the course of time; strategies, official documents, and academic literature, as well as multilateral *fora* have focused on the matter and strongly committed to placing the non-proliferation concern at the core of the international debate.[1] Notwithstanding these efforts, there are still some 'States of concern', which continue to constitute a concern in the control of proliferation:

[1] See, for instance, multilateral instruments like the Global Partnership against WMD; the Nuclear Security Summits process; the bilateral dialogues among Nuclear Weapons States and Non Nuclear Weapons States; the discussions about the New START Treaty between Russia and the USA, or the conclusion of the Comprehensive Ban Treaty (negotiated in 1996, but not yet into force); the involvement of civil society through the 'Humanitarian Initiative'. In literature see, among the many: Dunn 2009, Graham 2012, Mearsheimer 1984/1985, Kmentt 2013, Nielsen and Hanson 2014, Renard 2013, Smith 1987, Ruzick and Wheeler 2010.

The European Union 2003 WMD Strategy[2] states that

> States of concern are those States that are non-compliant with the main multilateral legally binding treaties on non-proliferation (the NPT, the 1972 Biological and Toxin Weapons Convention and the 1993 Chemical Weapons Convention), whether or not the State in question is a party to the relevant treaty.[3]

Therefore, the problem is represented by both non-Parties[4] of the NPT possessing nuclear weapons, and the Parties of the NPT that are challenging the norms through non-compliance or are not fully complying with the International Atomic Energy Agency (IAEA) safeguards agreements. Among the latter group, there is Iran. The IAEA Comprehensive Safeguards Agreement (CSA) for Iran entered into force in 1974, when the country was led by the Shah. However, Iran has attracted international attention since August 2002, when the existence of a suspected clandestine nuclear program was revealed through the complaint from an Iranian opposition group, stating that 'the clandestine construction in Iran of a large uranium enrichment facility at Natanz and a heavy-water reactor in Arak'[5] was a reality. In reality, Iran has been treated as a 'deeply enigmatic country'[6] and 'special case'[7] quite before 2002, actually since the regime change in the country that took place in 1979.

Indeed, Iranian nuclear activities date back to the 1950s: until 1979, in fact, the country had friendly relationships with Western States,[8] and certain countries in that period supported Iran in building its nuclear energy programme[9]: for instance, the construction of the Bushehr Nuclear Power Plant was started in 1975 by German companies, however the work was stopped in 1979 after the regime change in Iran. Western countries in 2002 started condemning Iran for violating the international non-proliferation norms signed in the NPT. This fact is part of the explanation why it was so difficult to reach an agreement on the Iranian nuclear programme between the Western and international community, on the one hand, and Iran, on the other. A 'mutual history of cultural and political misperceptions and high levels of tension and distrust'[10] has accompanied the international relationships among these countries.

The application of IAEA safeguards in Iran, ensuring the peaceful use of all nuclear material, has gone through a 13-year-long process, since the IAEA—in

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[2] Council of the European Union, EU Strategy against Proliferation of Weapons of Mass Destruction, 15708/03, Brussels, 10 December 2003. About the EU WMD Strategy, see Quille 2004 and Van Ham 2011.

[3] Grip 2014, p. 7.

[4] Namely India, North Korea, Pakistan, and Israel, a State which is assumed to possess nuclear weapons.

[5] Meier 2013, p. 3.

[6] Adebahr 2014, p. 3.

[7] Meier 2013, p. 18.

[8] Tarock 2006, p. 651.

[9] Ibid, p. 652.

[10] Parsi 2012, p. 4.

2003—reported on Iran's failure to declare nuclear material and activities in accordance with the CSA. Iran voluntarily signed the IAEA Additional Protocol (AP). The AP is a legal document that supplements States' IAEA safeguards agreements: it grants the IAEA complementary legal authority to verify a State's safeguards obligations, and it is designed for all States having any of the three types of safeguards agreement with the IAEA.[11] As Iran did not ratify the AP, this pathway, however important in the IAEA action for implementing safeguards in Iran, had a temporary interruption when Iran stopped to implement the AP in 2006. After years of negotiations carried out by IAEA, as it will be reported in detail in the next Section, a new important step was taken in 2013, when a Framework for Cooperation was signed by the IAEA and Iran.[12] The same year 2013, a Joint Plan of Action (JPOA) was agreed on 24 November 2013 in Geneva by the so-called E3+3 countries (France, UK, Germany, China, US, and Russia) and Iran,[13] after long negotiations. The goal was to reach a mutually-agreed long-term comprehensive solution that would ensure that Iran's nuclear programme would be exclusively peaceful. Following this, in the frame of a Road Map for the clarification of all outstanding issues signed in 2015 by IAEA and Iran, the solution of the crisis was at hand. The IAEA finally reported in 2015 on the final assessment of all outstanding issues, and in the same year the Joint Comprehensive Plan of Action (JCPOA) was agreed by the E3/EU+3 (the former six States including the High Representative of the European Union for Foreign Affairs and Security Policy) and Iran. So, after many years of negotiations and difficult dialogues, a definitive Agreement has finally been concluded on 14 July 2015 in Vienna, involving the E3/EU+3[14] and Iran. The JCPOA represents a relevant step for the solution of the Iranian crisis, and, more generally, in the fight against the proliferation of Weapons of Mass Destruction. Furthermore, on 20 July 2015, the United Nations Security Council unanimously adopted Resolution 2231.[15]

Concerning the very recent activities, the Road-map set up in the JPCOA for the period to 15 October 2015 has been completed on schedule, as it is reported in the IAEA Report of the Director General[16] of 18 November 2015. On 18 October

[11] States with a Comprehensive Safeguards Agreement (CSA), such as Iran, which decide to conclude and bring into force the Additional Protocol must accept all provisions of the Model Additional Protocol (see https://www.iaea.org/sites/default/files/infcirc540c.pdf).

[12] For this and the other steps that brought to the applications of IAEA Safeguards in Iran, see for instance a comprehensive summary in: https://www.iaea.org/newscenter/focus/iran where reports, statements and media coverage in relation to the question are available.

[13] See full text of the JPA in: http://eeas.europa.eu/statements/docs/2013/131124_03_en.pdf.

[14] The full text of the JCPOA and its five Annexes may be founded for instance at the site of the US Department of State: http://www.state.gov/e/eb/tfs/spi/iran/jcpoa, or: http://eeas.europa.eu/statements-eeas/docs/iran_agreement/iran_joint-comprehensive-plan-of-action_en.pdf.

[15] See full text of SC Res 2231 (2015) at: www.un.org/en/sc/2231.

[16] IAEA, Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran, Report by the Director General, GOV/2015/65 Date: 18 November 2015.

2015, Iran informed the IAEA that, effective on JCPOA Implementation Day, Iran will provisionally apply the Additional Protocol to its Safeguards Agreement and fully implement the modified Code 3.1. On 18 October 2015, being the Adoption Day of the JCPOA reached, IAEA has begun conducting preparatory activities related to the verification and monitoring of Iran's nuclear-related commitments under the JCPOA, including verification and monitoring of the steps Iran has begun taking towards the implementation of those commitments. On 16 January 2016, IAEA released a report[17] confirming that Iran has completed the necessary preparatory steps to start the implementation of the Joint Comprehensive Plan of Action. The report was submitted to the IAEA Board of Governors and to the United Nations Security Council.

The purpose of this contribution is to describe the innovative features of this JCPOA Agreement and how it may be considered as a significant example of 'scientific diplomacy' to be taken into account for future cases.

14.2 Main Steps of the EU and the US International Relations with Iran

In order to understand how the recent JCPOA could be reached, it is important to briefly delineate the background of the relations between Iran and the Western countries.

While in the 1990s Europe was in dialogue with the Islamic Republic of Iran and both of them were interested in a fruitful exchange of energy commodities,[18] after the 9/11 terroristic attack the policy changed: the USA, which aimed at a 'dual containment' of Iran and Iraq, invaded Iraq while the relationships with Iran kept becoming worser; the EU 'iced' its contacts with Iran as a consequence,[19] with the worry that Iran possessed nuclear weapon capability at first place in the reasons claimed for worsening of the relationships.[20] The Bush 'Axis of Evil' statements,[21] where Iran was included, contributed to condition the relationship with Iran, creating an anti-Western attitude that—actually—went far beyond the nuclear issue. Even if at the EU level, negotiations concerning a possible TCA

[17] IAEA Director General Yukiya Amano, 'Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)' (16 January 2016), https://www.iaea.org/newscenter/news/iaea-director-general%E2%80%99s-statement-iran.

[18] Parsi 2011, p. 31.

[19] Posch 2006, p. 99.

[20] Commission of the European Communities, Communication from the Commission to the European Parliament and the Council: EU Relations with the Islamic Republic of Iran, COM (2001) 71 final, Brussels, 7 Feb. 2001, p. 8, http://eurlex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52001DC0071&from=EN.

[21] Yongtao 2010.

(Trade Cooperation Agreement) with Iran continued and the EU tried to assume a softer position than the US (for instance, the EU firmly stated in several occasions that it was necessary for Iran to sign the above mentioned IAEA Additional Protocol),[22] in reality the EU had a somehow contradictory behaviour.

Although Iran had formally accepted—in public statements—what they called 'the IAEA's control' (actually, nothing more than the correct implementation of the CSA and the AP provisions) and had agreed to suspend uranium-enrichment programs, the 2005 presidential election of Mr. Ahmadinejad changed the scenario, and Iran stopped its diplomatic ties with the EU and its commitment to the IAEA Additional Protocol.[23] The IAEA could do nothing but refer the Iranian case to the United Nations Security Council (SC), which decided for the imposition of sanctions,[24] due to Iran's non-compliance with the relevant SC Resolutions. More precisely, the SC demanded that Iran suspended all enrichment- and reprocessing-related activities, including research and development, and requested that the fact-finding verification was implemented by the IAEA. Sanctions on Iranian imports of nuclear-related materials and technology, and assets' freeze of individuals involved with nuclear activities, as well as travel bans, were decided, too. In 2007, the EU also published an expanded list of Iranian individuals deemed as *persona non grata* in the Union,[25] and the US enacted new unilateral sanctions that cut more than 20 organizations associated to Iran's Islamic Revolution Guard Corps (i.e., Praetorian guards of the Supreme Leader Khameini,[26] which were considered as the main operators in oil industry and the leaders of nuclear programme) from the US financial system.[27]

With the advent of the Obama administration in 2009, and the adoption of the Lisbon Treaty, followed by the appointment of Catherine Ashton as the new EU High Representative of Common Foreign and Security Policy, the climate started changing, as a politics of rapprochement to Iran was adopted. The US and EU offered Iran a 'freeze-for-freeze' Agreement, which stipulated that no additional sanctions would be imposed on Iran if the latter agreed to freeze uranium

[22] See Posch 2006, p. 104. The negotiations between EU countries and Iran resulted in the signing of the Tehran Declaration (2003) and the Paris Agreement (2004), which were useful in leading Iran to sign the AP.

[23] Bertram 2008, p. 31.

[24] SC Resolutions 1696 and 1737 (31 July and 27 December 2006); Resolution 1747 (24 March 2007); Resolution 1803 (3 March 2008); and Resolution 1929 (9 June 2010).

[25] See Council Decision 2012/35/CFSP amending Decision 2010/413/CFSP concerning restrictive measures against Iran, 23 January 2012; Council Regulation 267/2012 concerning restrictive measures against Iran, 23 March 2012; Council Decision 2012/635/CFSP amending Decision 2010/413/CFSP concerning restrictive measures against Iran, 15 October 2012.

[26] Ali Khameini is the Supreme Leader of the Islamic Republic of Iran since 1989 after the death of Ayatollah Khomeini. To deepen this issue, see Katzman 2014, p. 3.

[27] See US 2010 Comprehensive Iran Sanctions, Accountability and Divestment Act, Public Law, 111–195, July 1, 2010. Iran Sanctions Act; National Defense Authorization Act for 2012; Iran Freedom and Counter-Proliferation Act; and Iran Threat Reduction Act.

enrichment. However, the EU and US sanctions continued, even if their effectiveness remained uncertain.[28]

In 2012—as summarized in the previous Section–under the constant effort and technological advice of IAEA, negotiations were improving, in order to reach an agreement with Iran that could allow it to develop nuclear energy for peaceful purposes, respecting its right in conformity with Article IV of the NPT, but prevent it from developing a nuclear payload. However, in practice, improvements were small and the pace of the negotiations was quite slow.

In 2013, the political change with the election of President Rouhani and his approach based on 'prudence and hope'[29] opened new streams of collaboration and a desire of openness towards the international community. The meetings between the foreign ministers John Kerry (US) and Javad Zarif (Iran), the exchange of letters and phone calls between Obama and Rouhanire presented a new era for bilateral contacts.

All this led to an Interim agreement (the JPOA, see previous Section) between Iran and the E3+3, drafted on 24 November 2013 in Geneva, in which Iran accepted to limit its program and allowed IAEA's controls, while the E3+3 accepted to reduce sanctions. It can be noted that—as mentioned above—indeed just before the JPOA, Iran and the IAEA signed a Framework for Cooperation. Its basic objective was to resolve all outstanding issues, past and present, through strengthened cooperation and a step-by-step approach.[30]

On 18 February 2014, the discussions for the definitive agreement started, and the deadline was fixed on 24 November 2014. On 2 April 2015, a framework plan was adopted in Lausanne, and the final date for the agreement was postponed to 30 June 2015, and finally to 14 July 2015, when the Iranian JCPOA Agreement was reached.

The steps forward have included the adoption of Security Council Resolution 2231 (2015), which has endorsed the JCPOA: it has been adopted on 20 July 2015 with unanimity, and has postponed its official implementation for 90 days, to allow for the U.S. Congress' consideration. On the same 20 July 2015, the EU has discussed and agreed on the JCPOA via a vote of the EU Foreign Affairs Council (i.e., the group of EU foreign ministers), while in the US—after the sixty-day review in the United States Congress—the JCPOA has been endorsed on 10 and 11 September. On 13 October 2015, the Iran's Majlis (Parliament) has also agreed on the Agreement.[31]

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[28] Portela affirms that, instead of stopping the nuclear program, sanctions upon Iran have just slowed down its process. Portela 2014. About sanctions to Iran, see Esfandiary 2013 and Katzman 2015.

[29] Adebahr 2014, p. 19.

[30] See Amano 2015a.

[31] There were 161 votes in favour of the bill, 59 votes against and 13 abstentions, according to the Islamic Republic News Agency (see http://www.irna.ir/en/News/81797383/).

14.3 The Iranian Agreement (JCPOA)

The JCPOA is transactional and non-transformational, since it does not aim to reach a complete transformation of Iran from the political viewpoint, but deals only with the non-proliferation aspects and—stemming from about two years of nuclear negotiations with Iran (since the JPOA of November 2013)—puts the ‘burden of proof’ on Iran, and insists on a strengthened regime of verification and monitoring by the International Atomic Energy Agency (IAEA).

14.3.1 Dispute Resolution Mechanisms, Safeguards and Additional Transparency Measures

The Agreement includes:

(a) nuclear arms control thinking, for instance in calling up a disputes’ resolution mechanism
(b) enhanced strengthened nuclear non proliferation Safeguards, which go beyond the Additional Protocol of the Safeguards itself through additional transparency measures.

Indeed, the Agreement has fixed a specific Dispute Resolution Mechanism (DRM), centered on a specific body, namely the ad hoc Joint Commission, which will comprise representatives of each party to the JCPOA. It is called upon to solve potential inconsistencies and IAEA’s concerns about undeclared nuclear materials and activities.

The DRM is triggered when any participant in the JCPOA ‘believes’ that another ‘is not meeting commitments’ under the JCPOA. It can then refer the issue to the Joint Commission, which has 15 days to resolve the issue. If it cannot solve the matter, either party may request that the issue is considered by an Advisory Board consisting of three members (one appointed by each party and one independent member) who will provide a non-binding opinion within 15 days, or by the Ministers of Foreign Affairs.

So, the case can be dealt with by the Advisory Board in parallel with, or in lieu of, the review by the Ministers of Foreign Affairs.

After the analysis conducted by the Advisory Board or the Ministers, the Joint Commission has five days to consider the case. If this process does not resolve the issue, the complaining party may notify the SC, which could decide, within 30 days, to vote on a resolution to continue the sanctions lifting (that is to say, the continuation of the JCPOA), or not to vote any resolution, and this means that the provisions of the old UNSC resolutions will be re-imposed unless decided otherwise. It is the so-called ‘snapback’ mechanism, which re-imposes sanctions in case of non compliance with the JCPOA.

As regards the additional transparency measures, the JCPOA includes measures of 'enhanced access to uranium mines and mills, and continuous surveillance of centrifuge manufacturing plants'[32] that go beyond the Additional Protocol(AP) to the Comprehensive Safeguards Agreement (CSA): so IAEA is granted further complementary legal authority to verify Iran safeguards obligations. In this sense, the Agreement is really innovative, as it enhances and strengthens the CSA and the AP, which Iran will implement under the JCPOA on a provisional basis until its ratification by the Iranian Parliament, by complementing them with a sort of 'challenge inspections'. In the JCPOA language, these inspections consist of 'special access' to any nuclear and nuclear-related facility in Iran, including military ones, aimed at verifying Iran's compliance with its nuclear obligations under the JCPOA.

It is of utmost importance that, through the JCPOA, the IAEA has expanded its mandate: indeed, it is called to implement the Additional Protocol, to monitor and verify additional transparency measures and to implement also the so-called modified Code 3.1 to declare the future activities in nuclear related plants well in advance. Even if the expansion of powers for the IAEA and in particular the provision of additional transparency measures is an exception in the 'normal' activities conducted by the IAEA, as provided by the JCPOA and authorized by the IAEA Board of Governors, it is in our opinion that this type of 'smart integrated safeguards' system—comprising the CSA, the AP and the unique JCPOA's special access and transparency provisions—could provide in principle[33] a solution model for future cases, dealing with Parties of the NPT that are not fully complying with their IAEA Safeguards Agreement.

14.3.2 Iranian Obligations and Rights, and Different Timing Phases

The main duties upon Iran, according to the JCPOA Agreement, are:

- the reduction of the number of its operational centrifuges;
- the conversion of the uranium enrichment facility at Fordow into a civilian R&D centre;
- the redesign of Arak heavy water reactor in order to drastically reduce the production of plutonium in the spent fuel;
- the permanent renounce to construct a reprocessing facility;

[32] See IAEA Board of Governors' authorization for the verification and monitoring in Iran in light of Security Council resolution (25 August 2015, https://www.iaea.org/newscenter/news/IAEA-Board-of-Governors-authorizes-verification-and-monitoring-in-Iran-in-light-of-Security-Council-resolution).

[33] The IAEA Director General Yukiya Amano has stated that the JCPOA innovative, non-proliferation agreement applies only to the Iran case in the context of an E3/EU+3 negotiation table. See Amano (Amano 2015b).

- the removal out of the country of almost all its current stockpiles of enriched uranium;
- the implementation of the Additional Protocol; and
- the acceptance of enhanced levels of IAEA monitoring and confidence-building measures.

Moreover, the JCPOA poses physical restrictions on Iran's ability to produce, at its declared nuclear facilities, the two-types of fissile materials (separated plutonium and highly enriched uranium—HEU—), which are necessary to manufacture nuclear weapons. Under these caps, the HEU weapon 'break-out time (BOT)' (i.e., the time it would take for Iran to produce enough fissile material to build a single bomb core by employing its declared facilities) would be extended at the only existing enrichment facility at Natanz to roughly a year, from the current estimated 2–3 months.

It should be kept in mind, however, that the BOT is not in itself a necessary and sufficient parameter to conclude that a 'State of concern' has crossed the nuclear threshold. Indeed, to manufacture an operative nuclear payload there are other relevant BOTs to consider, such as, for instance, the ability to assemble the 'non-physical package' (neutron initiator, high-voltage switchers, neutron tampers, etc.) of the nuclear weapon, the 'miniaturization' of the nuclear weapon itself to fit a missile warhead, different kind of tests, etc. As a 'bargain', the Iran has obtained the recognition of its right to continue its peaceful research and development activities, provided that the facilities do not accumulate enriched uranium besides 300 kgs limit allowed by the JCPOA. Moreover, concerning the JCPOA civil nuclear cooperation, it is of particular relevance the agreement on the establishment of an Iranian Nuclear Safety Center (NSaC), since Iran is running a nuclear power plant at Bushehr, and having capabilities in the manufacture of fuel assemblies for nuclear power and research reactors.

A peculiar aspect of the Agreement is the subdivision of timing periods, as it shows the preference for a'step-by-step' approach in solving the nuclear issue in Iran. These are the different phases:

- *Finalization Day*: 14 July 2015—it is the day of the finalization of JCPOA and the concurrent proposal of a resolution to the UNSC;
- *Adoption Day*: 18 October 2015. During this period the JCPOA participants have made the necessary arrangements and preparations for implementation of the JCPOA[34];
- *Implementation Day*:16 January 2016. This period starts with the IAEA's report stating that Iran has completed the key nuclear steps agreed in the JCPOA, and thus all nuclear material in Iran remains in peaceful activities. With the Implementation Day, there is the beginning of the lifting of other EU, US and UN sanctions (sanctions mentioned in Annex II of JCPOA);

[34] See in particular Annex I, section M, para 66.

- *Transition Day*: 8 years from Adoption Day (or 8 years after the IAEA's report)—presumably October 2023. Iran ratifies Additional Protocol; the EU will terminate all non-proliferation-related sanctions, and the USA will suspend the remaining sanctions[35];
- *Termination Day*: 10 years from Adoption Day (or 10 years after the IAEA's report). The EU will terminate further sanctions, while the UN Security Council resolution will expire, and so Iranian nuclear issue will be removed from the UN agenda.

14.3.3 Sanctions Lifting

On the Adoption Day, the USA provides the cessation of the application of the majority of secondary (extraterritorial) sanctions (as embedded in the Iran Sanctions Act; the National Defense Authorization Act; the Iran Freedom and Counter Proliferation Act; the Iran Threat Reduction Act).

On the Implementation Day, the Security Council resolution endorsing this JCPOA will terminate all provisions of previous Security Council Resolutions on the Iranian nuclear issue, i.e., SC Res 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010) and 2224 (2015). Some specific restrictions, as stated in Annex V of the JCPOA in relation to the transfer of proliferation-sensitive goods, remain active.[36]

The EU will terminate all provisions of the EU Regulation 267/2012, implementing all nuclear-related economic and financial sanctions to Iran; the EU will also remove asset freeze and visa ban all individuals and entities listed; it will not introduce any new nuclear-related sanctions. Three restrictive measures remain: restrictions on nuclear and ballistic missile-related activities; certain assets freezes and visa bans; restrictions on financial messaging services.

The USA suspend the sanctions mentioned in Annex II, among which there are: the ban of financial and banking transactions with Iranian banks and financial institutions, including the Central Bank of Iran and specified individuals and entities (Specially Designated Nationals and Blocked Persons List—SDN List—); the ban to transfer US banknotes to the Government of Iran; the blocks of import, export, purchase, acquisition, sale, transportation or marketing of petroleum, petrochemical products and natural gas from Iran; the ban of transactions with Iranian energy sector, automotive, shipping and shipbuilding sectors; the restrictions for trade in gold and other precious metals; the block to sale of commercial passenger aircraft and related parts and services to Iran. Moreover, the USA confirm that non

[35] Paras 18 to 33 and Annexes II and V of the JCPOA Agreement with sanctions and timing of sanctions relief.

[36] In addition, it can be noted that SCRes 2231 (2015) envisages a 'procurement channel' and a 'catch-all' provision to reduce the risks deriving from the transfer to Iran of items, materials, equipment, goods and technology inconsistent with the JCPOA.

US companies could engage in most types of trade with Iran without the threat of penalty by the US (suspension of secondary sanctions), but they keep the ban upon individuals qualified as 'United States person' to import goods from Iran in the USA, and to supply, transfer, export, directly or indirectly, goods to Iran (except with a specific authorization ad hoc from the Office of Foreign Assets Control, OFAC).

With the Transition day, the rest of US sanctions will terminate, while in the EU there will be the end of all provisions of the EU Regulation 267/2012, implementing all EU proliferation-related sanctions against a number of Iranian companies, individuals and institutions (e.g.: sanctions upon Iran Revolutionary Guard Corps). It is provided the termination of the provisions relating to weapons and ballistic missiles, financial messaging services and remaining sanctions on metals and software too. Instead, the restrictive measures upon individuals and entities related to Iran's abuse in human rights and general export controls on dual-use items are not addressed by JCPOA and remain in place. In other words, sanctions related to proliferationsensitive nuclear related goods and technology, investment and training will be amended rather than terminated.

14.3.4 Political Dialogue and Technical Assessment: The 'Roadmap for Clarification of Past and Present Outstanding Issues'

An important point of the Agreement is its distinction between the 'political framework' pursued by the E3/EU+3 (France, the UK, Germany, the US, China and Russia) and the 'technical work' to be conducted by the IAEA. It is relevant the combination of these two approaches (political dialogue and technical verification), as the nuclear issue is not only a technical problem, and the technical aspects should be coupled with the political debate.

Therefore, the Iranian Agreement is the result of a political-technical solution which allows thinking that the Iranian 'recipe' could be used in future to solve other similar geopolitical and strategic issues.

In this regard, from the technical viewpoint, it is worth mentioning the '*Roadmap for Clarification of Past and Present Outstanding issues*',[37] agreed in a separate document between Iran and the IAEA and signed prior to the JCPOA. The Roadmap is not a public document, even if the general terms are known. It describes all the steps in the relationship between Iran and the IAEA. In particular, it establishes that Iran should provide, as it has done, by 15 August 2015, its

[37] IAEA Director General's Statement and Road Map for the Clarification of Past & Present Outstanding Issues regarding Iran's Nuclear Programme, 14 July 2015, https://www.iaea.org/newscenter/pressreleases/iaea-director-generals-statement-and-road-map-clarification-past-present-outstanding-issues-regarding-irans-nuclear-program.

explanations on 12 nuclear activities of Possible Military Dimensions (PMD) and on its past and possibly present nuclear-weapons-related research. In particular, with reference to the PMD, it should be noted that the substance of any nuclear agreement is to ensure, with sufficient confidence, that the alleged PMD issues and items of concern should not come up in the next 10–15 years or even longer. In other words, the clarification of the PMD should avoid secondary details and, instead, it must concentrate on the aspects that are essential for the finalization of the main architecture of the future IAEA verification and monitoring system in Iran. Then, after receiving Iran's written explanations and related documents, the IAEA has reviewed this information by 15 September 2015, and submitted to Iran questions on any possible ambiguities found.

Pursuant to the submission to Iran of those questions, technical-expert meetings, technical measures and discussions have been organized in Tehran to remove such ambiguities. All activities, as set out above, have been completed by 15 October 2015, while on 2 December 2015, the Director General has provided, for action by the Board of Governors, the final Report entitled 'Final Assessment on Past and Present Outstanding Issues Regarding Iran's Nuclear Programme'. In the Director General introductory statement to the Board of Governors, the Director General has stated that

> The Agency assesses that a range of activities relevant to the development of a nuclear explosive device were conducted in Iran prior to the end of 2003 as a coordinated effort, and some activities took place after 2003. The Agency also assesses that these activities did not advance beyond feasibility and scientific studies, and the acquisition of certain relevant technical competences and capabilities. The Agency has no credible indications of activities in Iran relevant to the development of a nuclear explosive device after 2009. Nor has the Agency found any credible indications of the diversion of nuclear material in connection with the possible military dimensions to Iran's nuclear programme.[38]

On 15 December 2015, the IAEA Board of Governors considered the Director General's Final Assessment on Past and Present Outstanding Issues Regarding Iran's Nuclear Programme and adopted a resolution, in which the IAEA Board agreed to close the file on Iran's past nuclear activities.[39]

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[38] International Atomic Energy Agency (IAEA) Director General's Introductory Statement to the Board of Governors, 15 December 2015: https://www.iaea.org/newscenter/statements/introductory-statement-board-governors-67.

[39] International Atomic Energy Agency (IAEA) Board of Governors Resolution (GOV/2015/72) entitled 'Joint Comprehensive Plan of Action implementation and verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)', 15 December 2015: https://www.iaea.org/sites/default/files/gov-2015-72-derestricted.pdf.

14.4 Some Ideas About Civilian Nuclear Cooperation Between the EU and Iran

The JCPOA correctly envisages some forms of civilian nuclear cooperation between the international community and Iran. It is worth to notice that Iran has developed a strong capability in nuclear energy and in its peaceful applications beyond the fuel cycle activities. Indeed, the country has a long expertise in several technological areas, a high level of education and training, and the Atomic Energy Organization of Iran (AEOI) also has a long experience in coordinating different technological branches attaining to the civilian nuclear area. In this context, in the following two specific areas of civilian nuclear cooperation, which are of particular concern for Iran, are pointed out.

14.4.1 Nuclear Medicine

Cancer is one of the most devastating mankind diseases which cause increasing morbidity and mortality every year over the world. Cancer is the third cause of death in Iran, following coronary heart disease and accidents. Iranian research institutes, Universities, Hospitals and medical firms have high level of competence and innovative programs in promising new applications of nanomedicine for:

- synthesizing targeted theranostic—i.e., thérapeutiques and/or diagnostic—molécules allowing imaging and therapeutic effect;
- laboratory testing of the new molecules in vitro and in vivo;
- irradiation innovative facilities;
- clinical trials on human subjects.

Here follows some proposed actions:

- design, synthesis, testing of new theranostic molecules
- design, commissioning and operation of innovative irradiation devices (compact particle accelerators and plasma neutron sources) and related theranostic irradiation rooms,
- testing of the processes in laboratory and on small animals
- clinical trials on human subjects

As Europe face a shortage of irradiation facilities and there are increasing costs and non technical obstacles in performing irradiation testing, this initiative will be beneficial as well as to European institutes willing to develop innovative cancer treatments based on alpha-emitting radionuclides or neutron-capture.

Iranian nuclear scientist have already found original innovative solutions on the way to develop theranostic agents based on nanopharmaceutical as well as to irradiation devices that in next years will replace reactors and large cyclotrons, with the potential for sitting within every hospital with a Department of Radiotherapy.

A sort of advanced Irradiation Room combined with a customized nano-drug facility could be set in the main Iranian hospitals dealing with the therapy and diagnostic of tumors.

14.4.2 Nuclear Safety Centre of Excellence

In November 2013, the establishment of a Nuclear Safety Centre of Excellence in Iran has been proposed,[40] modelled on the Nuclear Support Security Centre of the IAEA, as well as the Chemical Biological Radiological and Nuclear Risk Mitigation (CBRN) Centre of Excellence of the EU.

Nuclear power plant safety and management is of utmost importance. Iran is the only Middle East State operating today, in synergy with the Russian Rosatom, a Nuclear Power Plant (the Bushehr NPP) of big size. It is important, to avoid future lack of know-how in the field, which is actually one of the main causes of risk, to maintain technical capabilities by means of a Nuclear Safety Centre of Excellence (NSaCoE). This experience should be part of a Master and modular courses education system, open to students and specialists. This NSaCoE might become a concrete way to boost trust, confidence and be a tool of 'science for diplomacy' in Iran. Concrete actions could envisage a short time scale for the establishment of the Iranian NSaCoE under the cooperative assistance of EURATOM and IAEA, built up on running worldwide the so-called Nuclear Security and Training Support Centres. A medium term perspective could envisage the settlement of an Academic and Professional Master in nuclear safety tailored to the effective capabilities and needs on nuclear safety best practices, regulations and laws, and specific topics to advance the civilian nuclear energy generation and technologies in the region; a long term objective could comply the implementation of a Virtual Nuclear Power Plant Simulator to make simulation games and scenarios, including crisis management and response to major nuclear accidents, with the purpose to improve awareness and capacity building to prevent, mitigate and respond to major nuclear accidents in the region.

The NSaCoE in Iran should emphasize training and formation objectives, by launching, for instance a dedicated Master open also to other Persian Gulf Region scholars. Operating in this way, this Centre could contribute to promote trust and confidence in the nuclear energy and its peaceful applications, building-up on the expertise and capacity building developed by Iran in running the Bushehr NPP.

40 Martellini 2013.

14.5 Conclusion

The JCPOA Agreement, reached after long negotiations in July 2015, represents a relevant step in the fight against the proliferation of Weapons of Mass Destruction. In our opinion, it represents a scientifically reliable, transactional, and verifiable agreement, as it shows a proportional 'balance' of obligations and concessions, insists on the importance of mechanisms of verification of the activities conducted and on the compliance with the agreement itself, and it combines the technical/scientific part with diplomatic and political instances. It aims to be a long-lasting solution to the Iranian nuclear issue. Some peculiarities and relevant points can be stressed:

First of all, the Agreement has avoided labelling Iran as a 'pariah State' or as a State in a 'nuclear apartheid'[41] through deprivation of the 'inalienable right' (embedded in Art. IV NPT), to pursue peaceful nuclear energy activities. In this regard, the changes in the US foreign policy and the active involvement of the EU High Representative have been crucial.

The key shift of the President Obama Administration, with respect to the previous ones, is having placed the 'red line' not on the nature of Iran as a de facto 'threshold nuclear State', which could have implied the risk to fall into pre-emptive military actions aimed at the destruction of all Iranian critical nuclear infrastructures, but instead on preventing Iran from becoming a next 'nuclear armed State' thanks to agreed mutual nuclear negotiations in the E3/EU+3 format.

Another element to underline has been the proactive involvement of the US Department of Energy (DoE), in the person of Dr Ernest Moniz, and the Atomic Energy Organization of Iran (AEOI), represented by Dr Ali Akbar Salehi, during the later stage of the nuclear talks: indeed, since February 2015, turning President Reagan's old adage 'trust, but verify' about the Soviet Union, the US has called upon the DoE to provide the necessary technical advice, 'table-top' and 'red-team' exercises, in order to verify the effectiveness, completeness and integrity of a strengthened IAEA monitoring and verification system, so as to allow the quick detection of prohibited Iranian nuclear weapons-related activities and researches. Such joint work of the DoE and the AEOI is an excellent concrete example of the so-called 'non proliferation science for diplomacy'.[42]

Some suggestions for the future can be drawn, too. For instance, as regards the role of the IAEA, we think that, in case that the IAEA's 'broader conclusion' leads to the declaration that all of Iran nuclear material is in peaceful uses or it will be after eight years from now (with the Transition Day), the underlying 'State-Level Concept (SLC)' approach of the Agency should be developed. Then, once achieved this SLC phase, it would be desirable the promotion, in the country and in the Persian Gulf region, of non sensitive peaceful nuclear activities related, for

[41] Tarock 2006, p. 656. Jaswant 1998.

[42] Moniz 2015, http://www.energy.gov/articles/science-based-nuclear-security-and-iran-agreement.

instance, to nuclear medicine, nuclear energy powered water desalination, use of radioisotopes for industrial purposes, etc.

Furthermore, part of the AEOI personnel not engaged in the nuclear fuel cycle activities as a consequence of the JCPOA might be re-oriented to training and education initiatives in the country, to develop future peaceful nuclear energy activities. Under this vision, the outstanding experience and human capabilities developed in Iran for its nuclear program could become an essential driving factor for promoting a sound scientific and technological cooperation. Considering the role played by the IAEA and the European Union, it would be worth setting up a dedicated forum to deal with the lessons learnt from the Iranian Agreement that might be applicable to other geopolitical cases.

In conclusion, the essential role of IAEA in the application of safeguards, ensuring the peaceful use of all nuclear material, has been not only confirmed, but increased by the JCPOA Agreement. The Agreement could lead to the normalisation of international relations with Iran, also opening up new channels of cooperation between Iran, the EU and the USA, as well as among the Middle East countries.

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Chapter 15
Due Diligence as a Legal Concept to Ensure Security and Safety of Peaceful Uses of Nuclear Energy as well as Non-proliferation and Disarmament Obligations

Jonathan Black-Branch

Abstract International law has seen the emergence and development of primary obligations requiring States to exercise due diligence regarding certain international obligations. It is not so much the failure to achieve the desired end result in question, but rather failing to take adequate and appropriate steps towards meeting the intended obligation that falls under scrutiny, that is failing to exercise due diligence, *per se*, in addressing the issue in a necessary and proportionate manner. The Non-Proliferation Treaty recognizes the 'inalienable right' to develop research, production and use of nuclear energy for peaceful purposes, requiring unimpeded access to fissile material. But with this 'right' come obligations. The purpose of this chapter is to explore the concept of due diligence in relation to obligations to ensure security and safety of peaceful uses of nuclear energy as well as nuclear non-proliferation and disarmament, examining the development of this legal concept under various areas of international law, exploring how it may apply as an emerging obligation pursuant to nuclear law.

Keywords Due diligence · Nuclear obligations · Nuclear law · Non-proliferation · Disarmament · Nuclear energy · Nuclear Non-Proliferation Treaty (NPT)

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15.1 Introduction

15.1.1 The Nuclear Paradox: Friend or Foe

Today, we see the world in what this author would label *the Nuclear Paradox*. The development of nuclear capacity has transformed the world providing unimaginable opportunities relating to friendly uses of nuclear capacity for human progress in terms of energy as well as medical and technological advancement, on the one hand, whilst also posing challenges for nuclear safety and security as well as military challenges to international peace and human security, on the other.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT)[1] is at the heart of the nuclear non-proliferation regime intending to prevent the spread of nuclear weapons and weapons technology, as well to promote cooperation in the peaceful uses of nuclear energy whilst ultimately calling for complete disarmament by nuclear-weapon States. Today, non-State actors create new challenges regarding the applicability and enforcement of nuclear obligations within a contemporary global setting. Despite strenuous efforts by governments, lawyers and diplomats

[1] Treaty on the Non-Proliferation of Nuclear Weapons (1 July 1968) 729 UNTS 161.

alike across the political divide, some seventy years after the discovery of nuclear fission*, the Nuclear Paradox* remains whereby the breakthrough that could feasibly address growing energy needs as well as aid medical technology as populations increase and emerging economies grow, also creates arguably the greatest threat to human security within a modern world. United Nations Secretary-General Ban Ki-moon highlighted the enormity and significance of this challenge at the 2010 Non-Proliferation Review Conference stating: 'Let us remember that you are here not simply to avoid a nuclear nightmare, but to build a safer world for all.'[2]

Perhaps the immediate focus should be on the actual process of working towards the desired goals and not focus too obsessively on the final outcomes themselves. There is an international legal requirement under due diligence to take adequate, appropriate and necessary steps towards achieving nuclear obligations whereby individual States must demonstrate their actually working towards compliance.[3] This chapter explores due diligence as a legal concept in relation to international nuclear obligations to ensure security and safety of peaceful uses of nuclear energy and technology as well as taking steps towards nuclear disarmament and non-proliferation. It examines these as separate and intimately interconnected obligations that cannot be examined in isolation and must be interpreted and legally enforced as a complete system, concluding that due diligence is both a process that must be adhered to in meeting international objectives regarding safety and security as well as non-proliferation and disarmament.

15.1.2 Due Diligence: A Duty and a Constraint

International law has seen the emergence and development of primary obligations requiring States to exercise due diligence regarding certain international obligations. Notably, due diligence is a flexible concept, the content of which varies depending on the area of law and the specific circumstances of the case. Indeed, it continues to emerge as a general principle of international law, increasingly gaining traction in numerous areas, perhaps most notably in the sphere of international environmental law, especially as regards preventing transboundary harm.

In the *Alabama* Claims Arbitration,[4] the Tribunal set out an international, due diligence, standard for neutral States in meeting their obligation of neutrality.[5]

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[2] United Nations Secretary-General Ban Ki-moon, addressing the 2010 High-level Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) General Debate, 3 May 2010, http://www.un.org/en/conf/npt/2015/.

[3] It may be compared to elementary mathematics, the teacher is seeking a correct answer but students score more points for demonstrating competence in showing their work.

[4] *Alabama* Claims Arbitration (*United States v. Great Britain*) (1872) 29 RIAA 125, p. 129.

[5] Bin Cheng 2006, 221–222.

Here the Tribunal adopted the position[6] that a due diligence standard requires a neutral government to act in exact proportion to the risks to which belligerents may be exposed from any failure to fulfil obligations of neutrality.[7] Due diligence is therefore a flexible concept, whereby the content of which varied depending on the circumstances of the case. With this in mind one can see how it may be examined from a unique position regarding nuclear issues. The *Alabama* Claims Arbitration is seen as 'highly significant in ascribing State responsibility over private acts occurring within its territory, and conditioning that responsibility by reference to an internationally defined due diligence standard'.[8] A more recent and indeed significant case regarding due diligence was the International Court's dictum in *Corfu Channel*[9] wherein it was stated: 'every State's obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States' which will be discussed in greater detail later in this chapter.

Due diligence is best described as an obligation of conduct on the part of a subject of law, including subjects of international law. The criterion applied in assessing whether such an obligation has met by a subject is that of 'the responsible citizen or responsible government'. 'Failure on a subject's part to comply with the standard—often termed negligence—describes the blameworthiness of the subject as one element of ascribing legal responsibility to it'.[10] Although the concept of due diligence remains a general principle of international law, it seems that State practice has developed more precise rules and standards in certain areas of international relations, witnessing the emergence of primary obligations that require States to exercise due diligence. Drawing on these developments it seems that such standards also apply within the domain of nuclear law.

15.1.3 Distinguishing Between State Responsibility and Due Diligence

There is a distinction to be made between primary and secondary rules as it relates to State Responsibility under international law. Suffice it to say for the purposes of this current discussion, that *primary rules* are the rules regarding what States 'may' and 'may not do', whilst *secondary rules* effectively refer to the consequences emanating from a breach of those primary rules.[11] The term itself is not

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[6] Argued by the United States.

[7] *Alabama* Claims Arbitration (*United States vs. Great Britain*) (1872) 29 RIAA 125, p. 129.

[8] First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014 at: http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045, at page 3.

[9] ICJ, *Corfu Channel (United Kingdom of Great Britain and Northern Ireland v. Albania)*, Merits, Judgment of 9 April 1949, I.C.J. Reports 1949, p. 4.

[10] Koivurova 2010.

[11] See: Articles on Responsibility of States for Internationally Wrongful Acts, with commentaries 2001, in the Yearbook of the International Law Commission, 2001, vol. II, Part Two.

included in the ILC's Articles as 'the articles take an agnostic approach to the question of fault'.[12] Hence, it was excluded from Article 2 of ARSIWA, simply requiring that a wrongful act be attributable to a State and to also constitute a breach of an international obligation of that State. The Articles remain neutral in apportioning 'some degree of fault, culpability, negligence or want of due diligence'.[13] Although their work did not advance the codification of due diligence, *per se*, it is well noted that this failure was not due to a lack of acknowledgement of the significance of the concept of due diligence. Moreover, it has not hindered the development of due diligence obligations, which have evolved over centuries. Although the codification of State Responsibility did not distinguish between obligations of conduct and obligations of result, this was not due to the classification itself. Due diligence obligations are primary obligations of conduct that require States to work toward in aiming at the result set out in the obligation, taking steps and measures not to harm another State. Due diligence is a primary obligation whereas state responsibility is a secondary obligation. So there may be a breach of State responsibility but not necessarily a breach of due diligence obligations, as such. Moreover, a breach of due diligence that does not require harm or damage.

15.2 Due Diligence Obligations of Nuclear-Weapon and Non-nuclear Weapon States

The NPT comprises three central pillars: (1) non-proliferation, (2) peaceful uses of nuclear energy and (3) disarmament. The *first* pillar requires non-proliferation of nuclear weapons, whereby non-nuclear-weapon States agree not to import, manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices.[14] Nuclear-weapon States (the United States, Russia, the United Kingdom, France and China), are obliged not to transfer nuclear weapons to non-nuclear-weapon States. The NPT imposes strict obligations not to transfer nuclear weapons or other nuclear devices or control over such weapons or devices to any recipient whatsoever to non-weapons States under any circumstances.[15] There are several

[12] In the codification of State Responsibility (ARSIWA), the International Law Commission (ILC) took a strategic decision to focus on Secondary Rules, partly to avoid contentious areas where consensus was not easily attained. See First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014, http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045, at pages 4–5.

[13] James Crawford, The International Law Commission's Articles on State Responsibility (2002), p. 82 as quoted from: First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014 at: http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045, at page 5.

[14] Article IX(3) stipulates that, 'a nuclear weapon State is one which has manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January, 1967'.

[15] All remaining States.

obvious stipulations in terms of specific outcomes, all having due diligence requirements, including procedural and process-driven steps that must be adhered to in order to ensure these obligations are being met. There must be proper infrastructure in place that act diligently. Taking no measures, or inadequate attempts could be interpreted as non-compliance, or at least fail to meet due diligence requirements, as will be discussed throughout this chapter.

Obligations Regarding Nuclear Energy for Peaceful Purposes

The *second* pillar of the NPT ensures the inalienable right of all Parties to develop research, production and use of nuclear energy for peaceful purposes, and that each non-nuclear-weapon State Party must accept and comply with International Atomic Energy Agency (IAEA) safeguards. General standards for the implementation of the NPT requirements of developing and using nuclear energy for peaceful purposes are provided in INFCIRC/153 and the IAEA has developed a Model Protocol additional to the comprehensive safeguards agreements that non-nuclear-weapon States are obliged to conclude.[16] That said, the number of States using the Model Additional Protocol remains unsatisfactory and there is no agreement on its mandatory adoption.[17]

At the 2015 NPT Review Conference many States convincingly underlined that the Treaty fosters the development of the peaceful uses of nuclear energy by providing a framework of confidence and co-operation within which those uses can take place. As sovereign States, they must ensure that all legal entities, citizens, subjects and corporations are abiding by such measures and safeguards not to place subjects or the environment at undue risk or harm. Details of the international legal framework for nuclear security are set out in the Nuclear Security Plans[18] and Nuclear Security Reports. The framework includes legally binding and non-binding instruments adopted under Agency and other auspices. Among its nuclear security activities, the Agency facilitates adherence to and implementation of the international legal framework by assisting States, upon request, in effectively meeting their obligations under the relevant international instruments.

The Amendment to the Convention on the Physical Protection of Nuclear Material[19] will have a major impact on reducing the vulnerability of States Parties to nuclear terrorism. In particular, it extends the scope of the physical protection measures required by the Convention to include nuclear facilities and nuclear material in peaceful domestic use, storage and transport as well as sabotage. It also

[16] INFCIRC/540 Corr.

[17] Indeed, this was a major sticking point in the recent Iran deal whereby Iran has finally agreed to ratify the Additional Protocol, but must still undergo political ratification process according to its national constitution.

[18] For a detailed analysis see IAEA International Law Series No 4.

[19] Convention on the Physical Protection of Nuclear Material (CPPNM, 1 November 1979), 1456 UNTS 125, entered into force on 8 February 1987, amended on 8 July 2005, INFCIRC/274/Rev 1 http://www.iaea.org/Publications/Documents/Conventions/cppnm.html, (amendment not yet in force), http://www.iaea.org/About/Policy/GC/GC49/Documents/gc49inf-6.pdf.

provides for expanded cooperation between and amongst States regarding rapid measures to locate and recover stolen or smuggled nuclear material, mitigate any radiological consequences of sabotage and prevent and combat related offences.[20] It also confers a number of additional functions on the IAEA.[21]

Obligations Regarding Disarmament

The *third* pillar of the NPT requires disarmament in that all Parties undertake 'to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control'. To date 190 Parties have joined this multilateral treaty imposing due diligence requirements and making States individually liable for breaches and non-compliance with such requirements. At the 2010 NPT Review Conference it was resolved that States should commit to pursue policies that are fully compatible with the Treaty and the objective of achieving a world without nuclear weapons,[22] applying the principles of irreversibility, verifiability and transparency in the implementation of their respective treaty obligations.[23]

Today, the concept of due diligence seems to have acquired a robust character in the fields of international environmental law and the law of the sea. It continues to gain traction in areas including, international humanitarian law, international human rights law, and international criminal law. Despite an emerging body of work on the relevance of due diligence as a developing obligation in international law, there appears to be little work, if any, relating to nuclear law.[24] This chapter seeks to address this deficiency, exploring the emerging concept generally as well as applying it more specifically to the nuclear obligations both in regard to a nations' relations with other States but also within its own jurisdiction, focusing primarily on the relevance of due diligence for obligations under nuclear energy law.

15.2.1 Application of Due Diligence Obligations from International Humanitarian Law

International humanitarian law prohibits all means and methods of warfare which 'cause superfluous injury or unnecessary suffering'.[25] This would invariably apply to the use of nuclear weapons or the detonation of a nuclear device by state or

[20] http://www-ns.iaea.org/downloads/security/nuclear-security-plan2014-2017.pdf.

[21] See IAEA GOV/2005/51.

[22] Action 1 (NPT/CONF.2010/50 (Vol. I) at page 20.

[23] Action 2 (NPT/CONF.2010/50 (Vol. I) at page 20.

[24] The literature contains works including: Barnidge 2006; Heathcote 2012; Hoffmann 2012; Koivurova 2003.

[25] See https://www.icrc.org/eng/assets/files/other/what_is_ihl.pdf at page 2.

non-state actors during times of conflict of an international nature. Also prohibited is all means and methods that 'fail to discriminate between those taking part in the fighting and those, such as civilians, who are not, the purpose being to protect the civilian population, individual civilians and civilian property'.[26] The use of nuclear weapons or devices by states or non-state actors during armed conflict would come under serious scrutiny in this regard. Interconnected with humanitarian obligations are those relating to due diligence requirements in this regard.

The ILA Study Group concludes that due diligence plays a considerable role, albeit often covert, in international humanitarian law (IHL) stating

> [t]he engagement of a State's forces against belligerent forces (both State and non-state) as well as the interaction with civilian bodies within the purview of IHL requires a high level of state control of the activities of all actors under (or that ought to be under) their control. The standard of due diligence expected of States during peace, including the legal and material resources to ensure fulfilment of its obligations, may become more difficult to meet during conflict, especially during internal armed conflict. Nonetheless, the due diligence requirements of IHL, and in a residual manner international human rights law, continue to apply.[27]

The Report notes that the concept of due diligence would primarily pertain to the areas of targeting, the protection of civilians, the protection of prisoners of war, but also the prevention and prosecution of grave breaches of IHL.[28] The use of nuclear devices would invariably be a violation of these due diligence requirements but States also have process-driven requirements to oversee that all actors within their jurisdiction including those actually under State control or that ought to be under its control.

IHL treaty law contains specific due diligence obligations, such as under the Hague Convention 1907 which imposes liability of States if they fail to exercise due diligence to prevent war crimes.[29] States must be vigilant where there is a perceived or actual nuclear dimension in this regard. The four Geneva Conventions require Parties to respect and ensure respect for the Convention in all circumstances (Article 1),[30] which it concludes is an obligation that requires a minimum duty of due diligence. Additional Protocol I provides that a party to the conflict shall be responsible for all acts committed by persons forming part of its armed forces.[31] There is a requirement to take extra caution that members of the forces do not take matters into their own hands and assist with nuclear terrorism.

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[26] See https://www.icrc.org/eng/assets/files/other/what_is_ihl.pdf at page 2.

[27] First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014, http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045, at pages 11–12.

[28] Id.

[29] Hague Regulations, Regulations concerning the Laws and Customs of War on Land, annexed to Convention (IV) respecting the Laws and Customs of War on Land, The Hague, 1907, Article 3.

[30] 1949 Geneva Conventions (I-IV) 75 UNTS 287, Article 1.

[31] 1977 Additional Protocol II, 1125 UNTS 3, Article 91.

Of particular relevance for the purposes of this discussion is the role of private entities and non-State actors undertaking the activities that may normally be attributable to States. The First Report notes that the most controversial point relates to the degree to which remoteness of the duty of due diligence actually extends in relation to actors engaged in the activity that are not direct State actors.[32] Koivurova notes that in the commitment to 'ensure respect', the parties may in some cases be responsible for the actions of private parties, whose actions cannot be attributed to the State. Moreover, a State's failure to take diligent efforts to prevent and punish private entities or individuals for breaches of humanitarian law treaties triggers a legal responsibility on its part for those breaches.[33]

The standard of due diligence expected for international humanitarian law is measured in proportion to the magnitude of the object, dignity and strength of the power which is to exercise it.[34] Arguably, nuclear issues heighten the matter as it relates to legal necessity to take action and to have procedural protections in place balanced with proportionality as to the perceived nuclear threat and potential harm as an outcome of an attack. 'States, too, are increasingly obligated through a variety of international instruments to take diligent action in many ways, for example, to suppress terrorism in their territories.'[35] States have an obligation to take all effective measures to ensure that no harm comes to other States in or from their territory.[36] So planning a nuclear attack, e.g., the detonation of a dirty bomb in one country, to execute the attack in another, would fall under due diligence obligations to have procedures in place to deter, prevent and prosecute for such developments, particularly from a general international law perspective. In armed conflicts neutral States are 100 % protected under law, whereas enemy civilians have to suffer collateral damage and are thus only protected against disproportionate and direct attacks.

The recent Paris attacks sent fear throughout nation States as an attack with relatively little sophistication in its planning and execution caused irreparable harm, including the loss of human life.[37] The planning apparently took place in Belgium and the crimes were executed in France. Had the perpetrators arranged a dirty bomb to be detonated, in central Paris or at the crowded football stadium Stade de France, the level of injury as well as fear and psychological damage would have moved these tragic attacks to a different level. Strictly speaking, this does not fall under

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[32] First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014 at: http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045. At page 12.

[33] Koivurova 2010, at para 32.

[34] *Alabama* Claims Arbitration (*United States v Great Britain*) (1872) 29 RIAA 125.

[35] Koivurova 2010, at para 46.

[36] *Alabama* Claims Arbitration (*United States s Great Britain*) (1872) 29 RIAA 125, see also *Military and Paramilitary Activities in and against Nicaragua* (*Nicaragua v United States*) 1986 ICJ Rep 14, p. 126.

[37] Under the European Convention on Human Rights, the State has a positive duty to protect the right to live under Article 2.

international humanitarian law for obvious reasons; however, it does cover 'restrictions on the means of warfare—in particular weapons—and the methods of warfare, such as military tactics'.[38] Within today's climate of terrorism, many States question the nature of this new war on terrorism and whether new norms are evolving governing this area of international and domestic law. In relation to the Paris attacks, they involved planning in one State against targets in another triggering an international dimension to the attacks and indeed they were claimed as an attack under a war waged by the 'Islamic State'. Whether due diligence to have processes and procedures in place would seem obvious, without getting too bogged down in the discussion under which category or classification of law the responsibility falls. In essence, if there were to be conflict of an international nature occurring within a State's jurisdiction there are clear responsibilities. Additionally, this discussion clearly overlaps with international human rights law as well as issues of safety and security of nuclear materials in general which will be examined in further depth below.

In relation to the nuclear element of this discussion and the duty of States regarding State and non-State actors, whilst the vast majority of nuclear arms, are held by the United States and Russia,[39] other States, namely: Israel, India, Pakistan and the Democratic People's Republic of Korea, are known or believed to have nuclear weapons. North Korea,[40] in particular, has withdrawn from the NPT and the United Nations Security Council has requested it to retract its withdrawal and to abandon all nuclear weapons and their nuclear programs in a complete, verifiable and irreversible manner.[41] Their recent satellite launches clearly demonstrate they are not heeding this call thus making new sanctions necessary.[42]

The International Atomic Energy Agency has determined that Iran, as a State party to the NPT, in the past has not been compliant with applicable safeguards[43] and has disregarded relevant Security Council Resolutions.[44] The recent agreement[45] provides the blueprint of a comprehensive solution which is in the process of being implemented.[46] First and foremost, it is an accord reached by sovereign States and is thus their respective responsibilities to take action.

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[38] See https://www.icrc.org/eng/assets/files/other/what_is_ihl.pdf, at page 2.

[39] An estimated 95 percent.

[40] Article X(1) provide States a withdrawal clause from the Treaty.

[41] See SC Res. 1718 (2006), 1874 (2009), 2050 (2012), 2087 (2013), and 2094 (2013).

[42] See SC Res. 2270 (2016).

[43] See IAEA Report GOV/2013/40 of 28 August 2013, http://www.iaea.org/Publications/Documents/Board/2013/gov2013-40.pdf. The Committee will focus on legal aspects of verification in its forthcoming Third Report.

[44] See SC Res. 1696 (2006), 1737 (2006), 1747 (2007), 1803 (2008), 1835 (2008), 1929 (2010), and 1984 (2011). It should be noted that many Security Council Resolutions have been challenged by a practice of non-compliance. See also Kile (ed) 2005.

[45] Joint Plan of Action adopted by the 'EU3+3' and Iran (24 November 2013), http://eeas.europa.eu/statements/docs/2013/131124_03_en.pdf; SC Res. 2231 (2015).

[46] See https://www.iaea.org/newscenter/statements/iaea-director-general%E2%80%99s-statement-iran.

India, Pakistan, North Korea are not party to the NPT. Notably, the Hague and Geneva Conventions invariably form part of customary international law thus binding on all States and at all times requiring due diligence in this regard. NPT member States should react to these by taking proactive steps to condemn States that fail to heed to NPT requirements relating to the proliferation concerns. They should condemn or be seen as complicit in allowing States to pursue a program that is clearly contrary to the spirit and intent of the NPT. They should take diligent steps towards renouncing the actions of non-compliant States.

In addition, the Treaty's authority over non-State parties and indeed the extend of its reach governing non-State actors, if at all, as well as private individuals within respective jurisdictions raise significant concerns. Whilst it may be assumed that genuine production of nuclear weapons is still in the realm of States, whereby sufficient control of fissile material, technical knowledge and adequate infrastructure is not used for illicit purposes or indeed available to non-State actors with terrorist intensions, neither of these points are guaranteed or should be taken for granted. It appears plausible that terrorist groups could potentially gain access to nuclear material and radioactive sources, transfer or acquire them through the black market or by criminal means. Non-State actors raise concerns, as highlighted by UN Secretary-General Ban Ki-moon, stating in 2008: 'There are also concerns that a "nuclear renaissance" could soon take place. … The main worry is that this will lead to the production and use of more nuclear materials that must be protected against proliferation and terrorist threats'.[47] URENCO'S Head of Security and Safeguards stated, '[i]t is physically possible to misuse enrichment plants, and it is important that they're properly safeguarded, to ensure that weapons-grade HEU is not produced illicitly'.[48]

Security Council Resolution 1887 (2009) calls on States to raise standards regarding nuclear security in order to reduce the risk of nuclear terrorism. In particular, it seeks to secure all vulnerable nuclear material from such risks within four years,[49] noting that State Parties could only enjoy the benefits of the Non-Proliferation Treaty by full compliance with its obligations.[50] It encouraged States 'to provide the IAEA with the cooperation necessary for it to verify whether a state is in compliance with its safeguards obligations',[51] calling for 'universal

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[47] Secretary-General Ban Ki-moon, Address to the East-West Institute: 'The United Nations and Security in a Nuclear-Weapon-Free World' (24 October 2008), http://www.un.org/apps/news/infocus/sgspeeches/search_full.asp?statID=351.

[48] Paper entitled: URENCO'S Views on International Safeguards Inspection by Peter Friend, Head of Security and Safeguards, Urenco Ltd, presented at the 8th International Conference on Facility Operations—Safeguards Interface, March 30–April 4, 2008, Portland, OR; on CD-ROM, Danielle Peterson, Pacific Northwest National Laboratory, P. O. Box 999, K8-16, Richland, WA, 99352 (2008) and available at: http://web.mit.edu/stgs/pdfs/Friend%20-%20Urenco%27s%20Views%20on%20International%20Safeguards%20Inspection.pdf at page 9.

[49] Paragraph 24.

[50] Paragraph 3.

[51] Paragraph 16.

adherence' to the Convention on Physical Protection of Nuclear Materials (including its 2005 Amendment) and to the Convention for the Suppression of Acts of Nuclear Terrorism.[52] The Resolution asked States to improve their national capabilities to detect, deter, and disrupt illicit trafficking in nuclear materials throughout their territories, through enhanced partnerships and capacity building,[53] and taking all appropriate national measures aimed at preventing proliferation financing and shipments, whilst strengthening export controls, and securing sensitive materials, and controlling access to intangible transfers of technology.[54] These concerns invariably highlight the need for vigilance, particularly in a contemporary context where not only States but non-State actors, too, pose a growing threat to international peace and security. Such fears have not abated with the advent of ISIS and fear over a terrorist cells seek acquiring nuclear capacity to detonate a 'dirty bomb'. This highlights a major dilemma in the international community regarding the regulation of nuclear technology for energy, on the one hand, balanced with disarmament and non-proliferation on the other,[55] whereby an appropriate response to any nuclear terrorists threat by non-State actors cannot be limited to self-defence alone but requires pro-active preventative measures.

In discussing due diligence obligations in relation to cyber context, Michael Schmitt defines due diligence as, 'the obligation of states to take measures to ensure their territories are not used to the detriment of other states.'[56] Schmitt makes reference to the Tallinn Manual on the International Law of Cyber Warfare,[57] a restatement of international law pertaining to cyber activities within the context of the unique characteristics of cyberspace. The particular rule provides that '[a] State shall not knowingly allow the cyber infrastructure located in its territory or under its exclusive governmental control to be used for acts that adversely and unlawfully affect other States'.[58] Schmitt points out that 'the experts unanimously agreed that states shoulder a due diligence obligation with respect to both government and private cyber infrastructure on, and cyber activities emanating from, their territory'.[59] Furthermore, they agreed that, 'if a state fails to meet its due diligence obligation, a victim state may resort, when appropriate, to legal remedies such as countermeasures or self-defense'.[60]

Such concerns have led to a number of legal developments regarding nuclear safety and security, including both process and outcome. Indeed, this author would

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52 Paragraph 21.

53 Paragraph 26.

54 Paragraph 27.

55 ILA Committee on Arms Control and Disarmament Law, Final Report, in *International Law Association, Report of the Seventy-First Conference,* Berlin 2004 (London 2004) pp. 488–526.

56 Schmitt 2015.

57 Schmitt 2013, 45–52.

58 Schmitt 2013, at 27 (Rule 5).

59 Schmitt 2015.

60 Schmitt 2015.

argue that a due diligence obligation has evolved as a norm in the international community as it relates to the production and use of nuclear energy and nuclear technology. Specifically, international due diligence obligations to State parties to the NPT as well as to subjects and citizens within the jurisdiction of the State itself is emerging and continues to develop. States have a two-fold obligation, both between and amongst themselves, i.e., State actors within the international community, to ensure due diligence relating to safety and security issues regarding the production and use of nuclear energy and technology, disarmament and non-proliferation as per the three pillars of the Treaty, as well as a duty of care towards citizens and subjects within their respective jurisdictions to ensure a safe and secure environment in both civilian and military aspects. These requirements are emerging as international obligations, separate and apart, but intertwined with existing national obligations.

International humanitarian law prohibits all means and methods of which 'cause severe or long-term damage to the environment,'[61] separately but linked to international environmental obligations. In relation to nuclear issues, one can begin to see how the issue takes a multi-facetted dimension in that detonating a nuclear device during armed conflict could cause cross-boarded harm invariably triggering a wide range of international concerns. Also, aside from detonating, *per se*, the issue of procedural due diligence requires under IHL requires procedural protections to be in place to 'prohibit' such activities from occurring in the first place.

With the above points in mind regarding superfluous injury or unnecessary suffering, the need to protect civilian populations, and property as well as severe or long-term damage to the environment, international humanitarian law prohibits all means and methods of warfare, acknowledging that private entities and non-State actors or individuals may violate IHL even if their conduct is not necessarily attributed to the State itself. 'States may incur responsibility if they are not diligent in pursuing and preventing acts contrary to international law by prosecuting and punishing the private perpetrators. The emergence of private military contractors (not characterized as mercenaries) has added to the complexities of understanding due diligence in such circumstances.'[62]

Koivurova[63] notes that the concepts of due diligence and negligence have figured in many International Court of Justice cases, albeit mainly in dissenting or separate opinions wherein due diligence featured strongly in deciding the case in two judgments, in particular, the *United States of America vs Iran*[64] Case and the

[61] See https://www.icrc.org/eng/assets/files/other/what_is_ihl.pdf, at page 2.

[62] First Report of the ILA Study Group on Due Diligence in International Law, Duncan French (Chair) and Tim Stephens (Rapporteur) 7 March 2014, http://www.ila-hq.org/en/study-groups/index.cfm/cid/1045, at page 13.

[63] Koivurova 2010, at para 36.

[64] *United States Diplomatic and Consular Staff in Tehran* Case, http://www.icj-cij.org/docket/files/64/6283.pdf.

Nicaragua Case.[65] In the former case the Iranian authorities failed to protect the US embassy from an attack by private persons, and this negligence triggered responsibility on the part of the Iranian government. In *Nicaragua* the Court considered whether Nicaragua had breached its due diligence obligations, as it had not been able to prevent the arms traffic taking place through its territory to El Salvador, stating: ‘it would clearly be unreasonable to demand of the Government of Nicaragua a higher degree of diligence than is achieved by even the combined efforts of the other three States’.[66] In relation to non-State actors fulfilling State roles during conflict, the ILA Report notes the case of *Yeager v Iran*[67] before the Iran-United States Claims Tribunal where it was found that the actions of private actors carrying out State functions, in the absence of regular State authorities, could be attributable to the State. This does not automatically mean that States are required to exercise due diligence no matter what the connection is to an armed group, for example. It notes that the degree of attribution to the State sets the requirement for due diligence. Such distinctions invariably apply regarding nuclear obligations.

15.2.2 Application of Due Diligence Obligations from International Human Rights Law

International human rights law (IHRL) differs greatly from most other fields of international law in that it focuses primarily on the internal affairs of States whereas in other fields the principle of sovereignty leaves internal affairs largely unexamined, focusing on transboundary injuries of a moral or material nature. The ILA Project on Due Diligence highlights that the concept of due diligence is in varying degrees applicable to all of the nine core United Nations human rights treaties, most commonly associated with economic, social and cultural rights for which States Parties must take ‘all appropriate measures’ to ‘achieve progressively’ the rights concerned but noting due diligence obligations in respect of civil and political rights as well, albeit to a lesser extent.[68] Overall, due diligence obligations have been addressed, explicitly and implicitly, by relevant international and regional monitoring bodies.

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[65] *Military and Paramilitary Activities in and against Nicaragua* (*Nicaragua v United States of America*) (Merits) 1986 ICJ Rep 14.

[66] Id, at para 157. Koivurova 2010, para 40, points out that, ‘[a]lso figuring prominently in the ICJ’s assessment that Nicaragua had not failed to act diligently was the traditional criterion of due diligence whereby developing States with their less developed economy and human and material resources cannot be expected to uphold the same degree of diligence as their developed counterparts’.

[67] *Kenneth P. Yeager v. The Islamic Republic of Iran*, Iran-U.S. (1987) 17 C.T.R. 92, pp. 101–104.

[68] International Covenant on Civil and Political Rights 1966, 999 UNTS 171 (ICCPR), Articles 2(1) and (3).

The obligation is primarily targeted at State and its internal procedural mechanisms for protecting rights and ensure that all individuals within its jurisdiction are protected. In other words, 'a violation of a human right by a non-State entity may also trigger a State's legal responsibility where it has failed to act with due diligence in preventing and punishing the non-State actor.'[69] The ILA Group summarizes the United Nations tripartite approach under the human rights treaty system, consisting of the duties to: (1) respect, (2) protect and (3) fulfil whereby State actors must refrain from infringing, that is respect human rights, consisting of some due diligence requirements. They must also take preventative measures to protect, imposing positive obligations to take preventive measures to reduce or eliminate violations by non-state actors. And, they must fulfil their responsibility by acting appropriately, including duties to facilitate, as well as to provide and to promote. The above discussion regarding the Paris tragedy, to name only one of several suicide bombings and explosive attacks occurring almost weekly around the world, demonstrate the need for states to protect their citizens and various subjects operation within their jurisdictions, particularly against a potentially dirty bomb attack. In particular, the State must maintain certain institutions to protect human rights, including, (a) ensure legal protection of human rights; (b) have preventive apparatus, such as a police force; (c) have investigative machinery; (d) have a forum under which remedies can be sought; and (e) have a system to facilitate reparation for violations. These are result-based obligations requiring immediate action whereby the State will be in violation if it does not posses these specific institutions. The due diligence requirement relates to how these institutions actually function, that is they must function diligently.[70]

The duty to fulfil requires the progressive realisation of the treaty, meaning that States need not immediately guarantee the final specific outcome of the right in question to all persons from the outset but it must take incremental steps and move towards achieving the desired end result. Obligations of progressive realisation may be divided *firstly* into institutional requirements, which do in fact impose immediate results to have the required mechanisms and infrastructure in place. *Secondly*, they must take incremental efforts towards realising the right itself to achieve the final outcome. Note that both aspects entail obligations of due diligence requiring on-going efforts from the outset both in relation to the institutional aspect as well as the process of successively realizing the right in question. One could argue that a similar approach should apply for the realization of the goal of disarmament and more particularly towards achieving a binding treaty to that effect. From the outset there is a need to have an institutional framework in place that would entail due diligence obligations, and the institution should be working towards a final treaty and its full implementation. Whether the NPT Review process could provide adequate institutional assistance generally remains

[69] Koivurova 2010, at para 33.

[70] As in European Court of Human Rights, Application no. 30054/96, *Kelly and Others vs United Kingdom* (May 4 2001), para 96.

questionable. What seems clear is that the current arrangement does not conform fully to due diligence standards in this regard. It is deficient in that from an international human rights perspective, the reliance is on each individual state and not an overall international system or institution. The link to human rights is that pertaining to the right to life, protected under international human rights treaties and most home constitutions in varying degrees, as well as due process clauses.

Most notably, the ICJ has highlighted that Article VI NPT recognized 'an obligation to negotiate in good faith a nuclear disarmament' that goes beyond 'a mere obligation of conduct' (*pactum de negotiando, pactum de contrahendo*), and includes 'an obligation to achieve a precise result'.[71] The Court apparently did not see this obligation as being created by the NPT, as it used the term 'recognition by Article VI', to describe it correctly, arguably an expression of customary international law.

It would seem that this phrase imposes a three-fold due diligence obligation: (1) to *negotiate*, (2) to do so *in good faith*, and (3) *at an early date*. Specifically, the need to negotiate in good faith a treaty invariably imposes not just an outcome, *per se*, but working towards achieving an end result. This entails an express procedural, outcome-driven process of negotiation requiring both procedural requirements as well as working towards the set goal of disarmament. Whilst related to achieving a final result, from a due diligence perspective, it is distinct from the final goal itself. In addition, the negotiations must be conducted in good faith. That is to say, the parties are earnest in their commitment to both participating in the process and the end results regarding 'effective measures relating to cessation of the nuclear arms race'. Article VI also requires the process to be done at an early date, i.e., in a timely fashion. In sum, the Treaty imposes due diligence in terms of the process, i.e., moving entering into negotiations; due diligence to pursue them in good faith, i.e., with good intentions; and, to do so at an early date, i.e., in a timely fashion. Again, separate from the final results, disarmament due diligence obligations requires participation, process and procedures. Active participation, not passive and waiting for every other State to talk the lead. Each sovereign State is duty-bound in this regard.

At present one may question the efforts on the part of member States to accomplish or achieve or ever work towards such an objective. Whether they are making earnest efforts towards negotiating or accomplishing the desired outcome.

They may be in breach of all three due diligence requirements (1) to negotiate, (2) to do so in good faith, and (3) at an early date. It is important to recall that member States, each one separately and individually, are responsible as sovereign entities to uphold the objectives of the Treaty. The fact that no centralized authority or power is achieving this end, in no justification for the failing, as is incumbent on all to work both individually and collectively. They must exercise their due diligence in this respect and not ignore one of the main pillars of the Treaty and arguably one of the two most important pillars. It is the obligation of each and

[71] *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, 1996 I.C.J. Reports 226, para 99 (July 8).

every party to the NPT to take action individually in that regard. In the absence of leadership, every member state party to the Treaty has the responsibility.

At the NPT Review Conference 1995,[72] the Treaty was extended indefinitely, at which the Conference issued 'Principles and objectives for nuclear non-proliferation and disarmament'. In 2000[73] the State Parties agreed on '13 practical steps' to meet their disarmament commitments, followed by the 2010[74] Review Conference adopting an 'action plan on nuclear disarmament which includes concrete steps for the total elimination of nuclear weapons'.[75] Arguably, there are due diligence requirements built into these practical steps towards meeting disarmament commitments. The question remains as to whether these steps are strictly results based whereby the final result is what counts or are there also due diligence obligations requiring States to begin immediately taking positive action towards their final accomplishment. The development of primary obligations requiring States to exercise due diligence obligations requires action which means that the failure to achieve the desired end result is not the primary focus but rather failing to take adequate and appropriate steps towards meeting the intended obligation, *per se*.

These steps are results-based but also require process-driven procedures and immediate positive action towards their accomplishment. The Review conference announced these 13 practical steps with the results in mind but one cannot loose sight of their title: '13 practical Steps'. The words say it all, 'practical steps' which requires, attention, care and vigilance; i.e., diligence in achieving the end results. This entails working on processes and procedures and developing infrastructure. The 2015 Review conference examined the implementation of the Treaty's provisions since 2010, but despite intensive consultations, were not able to reach agreement on the substantive part of the draft Final Document,[76] reaffirming the continued validity of the practical steps agreed in 2000.

Human rights obligations contain, *inter alia*, strict obligations of conduct (not subject to due diligence); immediate obligations of result, usually of an institutional nature or to have certain laws in place (not subject to due diligence); obligations of conduct subject to due diligence (e.g., that institutions function diligently); and obligations of progressive realisation, i.e., duties to aim to achieve, over time, certain results which might be conceivable as due diligence obligations.

States have a considerable degree of discretion regarding which measures they employ to protect individuals from non-state actors and to fulfil human rights, but there is a clear preference for 'legislative measures' (e.g. ICESCR, article 2(1)).[77]

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[72] The Treaty has a built-in review process with conferences held every five years to assure that its purposes and provisions are being implemented (Article VIII.3). For the 25 anniversary (1995) Article X.2 stipulated that a conference be held to review the future of the Treaty.

[73] NPT/CONF.2000/28 (Parts I and II), pp 14–15.

[74] NPT/CONF.2010/50 (Vol. I), pp. 19–24.

[75] See http://www.un.org/disarmament/WMD/Nuclear/2000-NPT/pdf/FD-Part1and2.pdf.

[76] See http://www.un.org/en/conf/npt/2015/.

[77] See also, Committee on Economic, Social and Cultural Rights, General Comment No. 9 (1998) 'The domestic application of the Covenant', para 3.

This is obviously an area requiring attention, particularly as it relates to protecting citizens and subjects within the jurisdiction from terrorist attacks planned at home or cross-frontier such as in the Paris attacks. Despite several futile attempts to have treaty bodies apply international human rights obligations on non-state actors directly, human rights law remains largely the domain of States, with the noted exceptions of international criminal law and international humanitarian law. Nuclear facilities often fall under the domain of the private sector or within a hybrid system involving public-private partnerships or special status arrangements.[78] A question arises as to the extent to which private nuclear enterprises must adhere to human rights standards. A quick answer is that it depends on the operation itself and whether it is a publicly owned and operated company, a completely private enterprise, or a hybrid operation. The next factor relates to the country in question. Each State has, or should have, in place its own human rights protections wherein human rights jurisprudence may be applied and enforced differently. That said, there are moves afoot to ensure that private enterprises more accountable to international human rights standards which would invariably apply to nuclear facilities and research operations. Recent developments regarding corporations see movement in this area including due diligence considerations. It is the duty of States to govern their respective corporate conduct, in keeping with UN Guiding Principles on Business and Human Rights.[79] Depending on the nature of nuclear power stations, they could be classified as purely private business.

The Guiding Principles create a Three Pillar Framework affirming the duty of a state to protect human rights, a corporate responsibility to respect human rights, and to have access to a remedy, highlighting that all business enterprises, i.e., corporations, regardless of their size, nature, or location, should be subject to the Framework and Guiding Principles, clearly recognizing that business enterprises can abuse human rights of any ilk including, economic, social, cultural, civil, political, and collective.[80] The second pillar, in particular, makes specific reference to due diligence with Guiding Principle 15, where as Principles 17 to 21 list practical steps that business enterprises should undertake to discharge this responsibility.

The ILA Report notes that the requirement appears to be an integration of the international human rights legal obligation of due diligence in relation to the actions of non-state actors, and the general voluntary business practice of due diligence. The term in Guiding Principles seems to be used in the business-practice sense of the term, being about the subjective means of conduct. There is no question that such principles apply to the nuclear industry like that on any other sector.

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[78] See, Owners of Nuclear Power Plants. R. L. Reid, V. S. White (February 2000) NUREG/CR-6500, Rev. 1 ORNL/TM-13297/R1, at p. 1, http://web.ornl.gov/~webworks/cpr/rpt/105875.pdf.

[79] Report of John Ruggie as Special Representative of the Secretary-General on the Issue of Human Rights and Transnational Corporations and Other Business Enterprises, entitled: Guiding Principles on Business and Human Rights: Implementing the United Nations ‘Protect, Respect and Remedy’ Framework, UN Human Rights Council, UN Doc. A/HRC/17/31 (Mar. 21, 2011).

[80] See McCorquodale 2014.

Given the nature of nuclear power or scientific research and development generally, due diligence obligations would have a heightened focus and awareness on rights such as the right to life, and the right to an effective remedy within national settings.[81]

Providing redress, including an effective remedy regarding human rights violations is an essential component of due diligence, encompassing both having the required national institutions as well as the determination of the case. Failing to provide such would be a breach of the requirement to act diligently. In acting diligently the state must have the relevant infrastructure in place whereby legal institutions and law enforcement organs work to an adequate standard. The standard requirement focuses on processes, procedures and functioning of mechanisms in place and not the end results, *per se*. As regards the issue of remedy, punishment of the wrongdoers formulates an essential element of providing reparation for serious violations, whether it relates to a State or not.

15.2.3 Application of Due Diligence Obligations from National and International Criminal Law

The financing or terrorism has raised serious concerns globally with heightened vigilance regarding the movement, ownership and sources of money. Security Council Resolution 1887 (2009) calls on States to assist in combating the risk of nuclear terrorism whereby they should take all appropriate national measures aimed at preventing proliferation financing.[82] Security Clouncil Resolution 1373 (2001), obliges all States to criminalize assistance for terrorist activities, deny financial support and safe haven to terrorists and exchange information for the prevention and prosecution of criminal acts.[83] Specifically, all States are to prevent and suppress the financing of terrorist acts[84] and to criminalize the wilful provision or collection, directly or indirectly, of funds by their nationals or in their territories for terrorist acts.[85] They are to freeze funds and other financial assets or economic resources of individuals or entities who participate or facilitate terrorist acts,[86] as well as prohibit funds, financial assets or economic resources or financial or other services intended to commit or facilitate terrorist acts.[87] The Resolution requires States to become parties to the relevant international conventions and

[81] Arguably, it includes the right to adequate health care in the event of injury caused.

[82] Paragraph 27.

[83] See SC Res. 1373 (2001).

[84] Id., para 1(a).

[85] Id., para 1(b).

[86] Id., para 1(c).

[87] Id., para 1(d).

protocols relating to terrorism, including the International Convention for the Suppression of the Financing of Terrorism.[88]

The development of criminal law and other measures on crime prevention on a range of issues, such as drug trafficking and human trafficking, has been driven by a need to be more effective in addressing transnational criminal activities by non-State actors. Needless to say, customer protection is a prime motivation whereby due diligence plays an important role. Under treaties aimed at crime control, States impose regulations on noncriminal non-State actors, such as businesses working in the financial sector, to carry out 'due diligence' checks against potentially criminal non-state actors so as to reduce risk and not facilitate criminal activities by non-state actors, effectively focusing on third parties, i.e., private individuals under State authority.[89] Note that State actors may also come under scrutiny if thought to be in breach of their commitments in this same regard. The banking system in particular has a list of due-diligence requirements in relation to anti-money laundering and identity of both individuals as well as the source of funds so as to play a preventive role in crime and terrorist activities, including the illegal purchasing of nuclear materials or financing nuclear terrorists activities.

15.2.4 Application of Due Diligence Obligations from International Environmental Law

International environmental law has seen the steady and progressive development of due diligence requirements relevant to international nuclear obligations. Although established under the guise of international environmental law, many aspects of these apply to nuclear obligations, having directly and indirect implications, particularly as it relates to safety and security matters of both States and non-State actors. The ILA First Report highlights that the concept of due diligence is a key component of the obligation to prevent harm in international environmental law. Needless to say few areas raise such acute environmental concern as that relating to the production and use of nuclear materials as well as their storage, transport and disposal.

A cornerstone of international environmental law is that States are obliged to not cause harm to the environment of other States, or areas beyond their national jurisdiction. Under the no-harm rule or the prohibition of transboundary environmental harm, States must not conduct or permit activities within their territories, or common spaces, without having regard to other States. Brunée highlights that the obligation was originally grounded in Roman Law, whereby States are obliged not to inflict damage on, or violate the rights of other States, under the principle

[88] International Convention for the Suppression of the Financing of Terrorism of 9 December 1999. See also SC Res. 1373 (2001), para 3(d).

[89] See Gilmore 2014.

sic utere tuo ut alienum non laedas.[90] At the municipal level the rule under *Ryland vs Fletcher*[91] has been well accepted and well-entrenched within both in common and civil law municipal jurisdictions: persons who allow a dangerous element onto their land, which, if it escapes and damages a neighbour, are liable on a strict liability basis. It is not necessary to prove negligence on the part of the landowner from which the dangerous substance has escaped.[92]

International jurisprudence has been instrumental in assisting with establishing and reinforcing the principle regarding no transboundary harm. The *Trail Smelter* Case[93] involving a dispute between Canada and the United States in the 1930s was a significant development in the no harm rule relating to transboundary harm.[94] Here, the tribunal found that Canada was responsible for the damage caused by the smelter and granted compensation to the US, also prescribing a regime for control of emissions to prevent future transboundary pollution from the smelter.[95] The Tribunal stated that,

> under the principles of international law … no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.[96]

It is the responsibility of the State to protect other States against harmful acts by individuals from within its jurisdiction. This invariably applies to nuclear damage, on various levels, such as nuclear fallout from the testing nuclear or from the spillage of nuclear waste. Companies also have obligations in relation to safety and security of nuclear power plants, including those operated privately, e.g., such as the recent British deal with China.[97]

The subjective component of the principle of prevention of environmental damage was developed further by the ICJ in its 1949 *Corfu Channel* Case.[98] In this

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[90] Use your own property in such a way that you do not injure other people's. Brunée 2010.

[91] *Rylands vs Fletcher*, [1868], L.R. 3 H.L. 330 (UKHL).

[92] In *Rylands*, Justice Blackburn held: 'We think that the true rule of law is, that the person who for his own purposes brings on his land and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril, and, if he does not do so, is *prima facie* answerable for all damage which is the natural consequence of its escape.'

[93] Arbitral Trib., 3 U.N. Rep. Int'l Arb. Awards 1905 (1941) http://legal.un.org/riaa/cases/vol_III/1905-1982.pdf.

[94] The United States sought damages from Canada regarding atmospheric emissions from a private owned smelter operating on Canadian territory which was alleged to have caused damage to crops and lands in Washington state.

[95] *Trail Smelter*, p. 1908.

[96] *Trail Smelter*, p. 1965.

[97] In June 2015 the UK and China signed two agreements enabling Chinese companies to invest in nuclear power plant projects as well as to build Chinese-design nuclear reactors in the UK, http://www.world-nuclear-news.org/NP-UK-government-paves-way-for-Chinese-nuclear-plant-18061401.html.

[98] The *Corfu Channel* Case, (*United Kingdom v. Albania*), ICJ Rep. I.C.J. Reports 1949, p. 4.

case the ICJ stated that every State is under an obligation 'not to allow knowingly its territory to be used for acts contrary to the rights of other States'.[99] British warships passing through the North Corfu Strait, which was part of Albanian territorial waters, struck mines, causing explosions leading to severe material damage and 44 deaths. In deciding the case the Court,[100] made reference to 'certain general and well-recognized principles'[90] effectively recognizing 'the existence of a general principle of law prohibiting states from violating the rights of or inflicting damage on other states'.[101]

Most notably under the no-harm principle, States are prohibited from causing significant pollution damage to the environment of another State or to the environment of areas beyond national jurisdiction, from an objective standpoint. This principle of no-harm is breached only when the State causing the harm has not acted diligently with regard to its own activities, over state-owned enterprises, or private activities. In assessing what is required of States towards the activities under its jurisdiction and control, the ILA Study Group on due Diligence notes that both the material content and the procedural content of due diligence are relevance.

There are emerging imperatives regarding the material content of due diligence under international environmental law whereby in order for a State to demonstrate that it has acted diligently, it is expected to prevent foreseeable significant damage, or at least to minimize the risk of such harm whereby the State of origin is expected to prevent foreseeable significant damage, or at least minimize the risk of such harm.[102] This is outlined in the *Pulp Mills* case which will be discussed later in this chapter, where it was stated that, 'the principle of prevention, as a customary rule, has its origins in the due diligence that is required of a State in its territory'.[103]

15.2.5 Due Diligence in the International Law of the Sea

In addition to the no harm principle, international environmental law now contains various primary treaty norms that do not expect achievement of a specific result but requires States to make their best efforts to conserve the environment. Koivurova cites the example of such a norm listed in the Law of the Sea Convention (UNCLOS).[104] Moreover, a 'due regard' rule is also included in Articles 60(3), 234,

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[99] Id., p. 22.

[100] It did not rely on treaty law, *per se*.

[101] See Jervin, at page 23.

[102] ILA Report at page 26.

[103] *Pulp Mills on the River Uruguay (Argentina v Uruguay),* [2010] ICJ Rep 14, para 101.

[104] United Nations Convention on the Law of the Sea of 1982 (UNCLOS), 1833 UNTS 397, Article 194(2): 'States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment…'.

236 UNCLOS. These articles effectively require States to act with due diligence when permitting and monitoring activities under their jurisdiction or control in order to prevent or minimize damage by pollution to the marine environment of other States. A State does not breach the article merely by causing damage but by demonstrating a lack of diligent efforts on the part of the home State. That invariably applies to nuclear waste or shipping of nuclear substances. Again, the material rules demonstrate that due diligence applies to both private activities as well as those of the State in regard to transboundary harm. It is safe to say that, due diligence also applies in the case of illegal conduct by non-State entities when the act in question cannot be attributed to a State. Koivurova highlights the relevance of due diligence especially in diplomatic law and the laws of war in examining a State's legal responsibility for illegal private conduct. 'In most of these instances, it is not the State that has breached the international law norm in question but a private entity or individual, whose act cannot be attributed to the State. Yet, the State has breached its own due diligence obligations of prevention and punishment with regard to the private activity.'[105]

In this regard, due diligence holds a special relevance to the obligations upon States to protect the marine environment. In its *Seabed Mining* Advisory Opinion,[106] the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea found that parties to the 1982 United Nations Convention on the Law of the Sea must exercise due diligence to ensure that contractors engaged in seabed mining activities in the area comply with their obligations to protect the marine environment.[107] Examining the nature of the obligation 'to ensure' that contractors mining the seabed protect the marine environment,[108] the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea in the Seabed Mining Advisory Opinion (2012), noted that an obligation is not one of achieving the end result in every case. It is an obligation of due diligence, 'an obligation to deploy adequate means, to exercise best possible efforts, to do the utmost, to obtain this result.'[109]

Providing guidance, firstly, the Chamber affirmed that due diligence is an elastic and flexible concept, with the specific content of the obligation depending on the particular circumstances of the case. In relation to the law of the sea, the content of the obligation may change proportionate to the risk, with a high standards expected for activities that carry higher risk.[110] The criteria for assessing risk will evolve with scientific and technological advances.[111] This seems to reiterate an

[105] Koivurova 2010, at para 31.

[106] *Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area* (Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Case No 17, 1 February 2011).

[107] ILA Study Group Report at page 29.

[108] UNCLOS, Article 139(1).

[109] *Seabed Mining* Advisory Opinion, para 110.

[110] *Seabed Mining* Advisory Opinion, para 117.

[111] *Seabed Mining* Advisory Opinion, para 117.

emerging theme regarding the general application of the principle of due diligence, specifically that which is sufficiently diligent in a certain context, and at one period, may become insufficiently so over time. Standards and expectations are forever emerging. This could have significant relevance in regard to scientific advances regarding nuclear issues. Moreover, the ILA Report notes there appear to be increasing numbers of various 'direct duties' that may be relevant factors in meeting a due diligence obligation. In relation to seabed mining, for example, one such direct duty is the duty to comply with the precautionary principle listed in Principle 15 of the Rio Declaration. 'The Chamber noted that in situations where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks, a sponsoring State would not meet its obligations of due diligence if it disregarded those risks.'[112] States are also required to apply best environmental practices and to administer an environmental impact assessment prior to commencing activities. Finally, the Chamber considered the issue of differing levels of capacity among States. In its request for an advisory opinion, Nauru had noted that as a developing country it was dependent on the private sector to participate in deep seabed mining.[113] Significantly, the Chamber held that the general provisions relating to the responsibilities and liability apply equally to all States, whether developed or developing.[114]

Due diligence is also of relevance to a range of other obligations in the law of the sea, including those which require States to have 'due regard' to the interests of others, such as the obligation upon coastal States in exercising rights and performing duties concerning their exclusive economic zone to have 'due regard' to the rights and duties of other States.[115]

15.3 Special Due Diligence Obligations Concerning Nuclear Safety

A State must demonstrate that it has acted diligently and is expected to prevent foreseeable significant damage, or at least to minimize the risk of such harm. The State is expected to prevent foreseeable significant damage, or at least minimize the risk of such harm as outlined in the *Pulp Mills* case[116] involving a dispute between Uruguay and Argentina regarding actual and potential environmental

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[112] Quoted from the ILA Report, *Seabed Mining* Advisory Opinion, para 131.

[113] It expressed concern that exposure to liability or costs arising from its sponsorship of private actors could far exceed its national financial resources and thus preclude its participation in the activities.

[114] *Seabed Mining* Advisory Opinion, para 158.

[115] UNCLOS, Article 56(2).

[116] *Pulp Mills on the River Uruguay (Argentina vs Uruguay),* 2010 ICJ Reports 14, para 101.

harm caused by the construction and operation of pulp mills located near their mutual border river. In this case the ICJ in 2010 made relevant statements over the requirements of due diligence in general international law.[117] Here, the Court clearly stated that the principle of prevention is a customary rule, and as such has its origins in the due diligence required of a State in its territory. Consequently, the ICJ held that a State is obligated to use all the means at its disposal in order to avoid activities which take place in its territory, or in any area under its jurisdiction, causing significant damage to the environment of another State. In so doing, the ICJ, stipulated procedural requirements under general international law in cases of breach of the no harm principle.[118]

Whilst in early case law the obligation not to cause transboundary harm was based solely on the concept of territorial integrity, and was only applicable to harm to the territory of other States, more recently case law recognizes, that the scope of the obligation is expanded to also include harm to areas beyond national control, thus weakening the rule's link to territorial integrity. The no-harm rule, indeed, consists of opposing objectives in that States have sovereign rights over their natural resources, but they must refrain from causing environmental harm. Such environmental harm would include harm caused by nuclear-related activities, including uranium mining, the development, storage and shipment of nuclear material as well as the disposal of nuclear waste. Moreover, this would include nuclear experimentation and testing. Again, placing due diligence requirements relating to nuclear activities and limiting sovereignty. Such places an explicit due diligence requirement not to cause harm as well as to act diligently in striving towards that aim, effectively restricting their sovereignty in this regard. Given the potency of the materials in question and the potential harm that may transpire, there is a firm due diligence requirement to not harm their own territory as well as that of others, or to place its own population at unnecessary risk. Governments have a duty to act in a proportionate manner to the risk at hand and to protect their subjects and citizens for undue harm or risk, locally or trans-border. Obviously, this applies to the nuclear industry whereby States must insure requisite environmental impact assessments are conducted and perhaps consultations are in order when nuclear sites are near boarder areas.[119]

The ILA Study Group on Due Diligence referred to the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea,[120] which in its Seabed Mining Advisory Opinion, emphasised that precaution is, in effect, part of

[117] Even though it eventually resolved the dispute by applying a governing Statute.

[118] Procedural requirements will be discussed below (Part 17.4).

[119] Example of nuclear plants near international boarders, include Point Lepreau Nuclear Generating Station based on the Bay of Fundy in the Province of New Brunswick, Canada with relative proximity to the United States, and Pickering on Lake Ontario, across from New York State.

[120] *Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area* (Seabed Dispute Chamber of the International Tribunal of the Law of the Sea, Case No 17, 1 February 2011).

due diligence. It highlighted that traditionally due diligence required States to take preventive action in relation to foreseeable harm, i.e., when they possess scientific evidence that significant transboundary damage is likely. It seems the Advisory Opinion, may require that States are expected to act when there is insufficient evidence but where the consequences may be perceived to be severe and irreversible. The ILA Report notes that this approach would be in keeping with Article 10(c) of the Draft Articles on Prevention of Transboundary Harm from Hazardous Activities,[121] which suggests that the precautionary approach is relevant to an evaluation of the risk of the significance of harm to the environment and the availability of means to prevent or minimize it. Proof must be made not of the existence of a risk, *per se*, but that the State has not put in place the legislative and regulatory framework that would have enabled it to become aware of the risk, to measure its probability and gravity, and to take measures aimed at preventing the harm. In the case of nuclear safety issues this could be seen as placing requirements on states, not only to not cause harm but to insure that their domestic legislative and regulatory systems are in order according all due diligence in that regard.

Most notably, due diligence is a standard that varies according to context, as confirmed in the *Seabed Mining* Advisory Opinion where the Chamber stated, due diligence 'may not easily be described in precise terms' because it is 'variable' and it may change 'over time' and 'in relation to the risks involved in the activity'.[122] Even if the subjective requirements may change in relation to the risks involved in the activity, it seems clear that a State is not in breach of due diligence if it has taken all the precautions but damage still occurs. In that respect, inherently risky activities, such as operating nuclear generating plants, may cause significant transboundary damage, but escape legal responsibility under such scrutiny if due diligence has been exercised and legislative and regulatory infrastructure are in place and procedures and systems observed. Safety concerns have arisen on occasion raising serious questions regarding procedures at both the national and international level in incidents such as those at Three Mile Island (1979),[123] the Cosmos 954 incident (1978)·[124] Chernobyl (1986),[125] and Fukushima Daiichi (2011)[126]

[121] International Law Commission, Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, UN GAOR 56th Sess., Supp. No. 10, U.N. Doc. A/56/10 (2001).

[122] Paragraph 117.

[123] A minor malfunction in the secondary cooling circuit triggered the reactor to shut down and a relief valve failed to close, with the core suffering severe damage. The accident marked the need for a national and international plans to handle nuclear emergencies of this sort during peacetime.

[124] A Soviet nuclear-powered surveillance satellite, crashed in the Northwest Territories, scattering a large amount of radioactivity debris over a 124,000 square kilometre area in northern Canada.

[125] A flawed reactor design that was operated with inadequately trained personnel, resulted in a steam explosion and fires released at least 5 % of the radioactive reactor core into the atmosphere where 2 workers died on the night and 28 died within a few weeks as a result of acute radiation poisoning.

[126] An earthquake and tsunami disabled the power supply and cooling of three Fukushima reactors, causing all 3 cores to melt within the first three days. The accident was rated 7 on the INES scale, due to high radioactive releases over days and 4 reactors non-functional as a result of damage in the accident.

which attracted world attention regarding nuclear safety and due diligence obligations on states to insure their nuclear programs are adequate and what infrastructure is in place to prevent, monitor and contain such incidents.

It is incumbent on the nation States to ensure they are complying with adequate and appropriate measures and safeguards enshrined in law and they are to be monitored and enforced with appropriate sanctions for all breaches with clear criminal repercussions. Normally, due diligence standards may vary on the basis of common but differentiated responsibilities according to a States level of development and capacities. Specifically, developing States may not be able to control the activities in their territory in a similar manner to that of developed States, consequently, the due diligence standard is the same and common to all but they may have different thresholds of what is expected.

This raises questions in relation to nuclear issues. Given that a State decides freely to establish a nuclear program, making a conscious effort to do so, requiring planning and relevant resources, that State should only do so if it is able to fully implement all necessary standards and protocols required of delivering, monitoring and maintaining a nuclear program. In particular, nuclear issues involve ultra-hazardous waste and materials consequently requiring the highest level of diligence in this regard. There should not be varying standards based on development; they should be common and equal responsibilities. Indeed the Commentaries to article 3 of the Prevention Articles, state that the standard of due diligence by which the conduct of a State of origin should be measured is that which is 'generally considered to be appropriate and proportional to the degree of risk of transboundary harm in the particular instance.' Moreover, 'ultra-hazardous activities require a much higher standard of care in designing policies and a much higher degree of vigour on the part of the State to enforce them. Issues such as the size of operation, its location, special climate conditions, materials used in the activity, and whether the conclusions drawn from the application of these factors in a specific case are reasonable, are among the factors to be considered…'.[127]

The ILA Study Group Report notes that while the *Seabed Mining* Advisory Opinion observes that precautionary measures must be applied by States 'according to their capabilities',[128] it is noteworthy that the ITLOS Chamber did not agree with the Republic of Nauru's position that a contractual approach rather than a regulatory approach would be sufficient for developing countries to meet their due diligence obligations with regard to contractors engaging in mining of the international deep seabed.[129] Moreover, the ITLOS Chamber noted that while rules 'setting out direct obligations of the sponsoring State could provide for different treatment for developed and developing sponsoring States,'[130] it would 'jeopardize

127 Commentary to Article 3, Prevention Articles, at para 11, p. 394.

128 *Seabed Mining* Advisory Opinion, para 161.

129 Id., para 223: 'a sponsoring State could not be considered as complying with its obligations only by entering into a contractual arrangement, such as a sponsoring agreement, with the contractor.'

130 Id., para 160.

uniform application of the highest standards of protection of the marine environment' if 'sponsoring States "of convenience"' became prevalent.[131] The Chamber also noted that such equality of treatment addresses concern that prevent commercial enterprises based in developed States may establish companies in developing States, in order to acquire their nationality and obtain their sponsorship 'in the hope of being subjected to less burdensome regulations and controls'.[132] In the case of nuclear safety this is doubly amplified due to the ultra-hazardous materials in use and the breath and depth of the potential harm and risk.

15.4 The Procedural Content of Due Diligence for the Use of Nuclear Energy

In the Uruguay and Argentina *Pulp Mills* case[133] the ICJ stipulated procedural requirements under general international law regarding actual and potential environmental harm caused by the construction and operation of pulp mills near their mutual border river. In cases of breach of the no harm principle, the ICJ stated that due diligence cannot be considered to have been exercised, if the party planning the works liable to affect the quality of the border river did not undertake an environmental impact assessment on the potential effects of such undertakings, confirming that general international law requires the State of origin to undertake such assessments in cases where there is a risk of the proposed industrial activity having a significant adverse transboundary impact. Notably, the Court stated:

> [I]t is the view of the Court that it is for each State to determine in its domestic legislation or in the authorization process for the project, the specific content of the environmental impact assessment required in each case, having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment. The Court also considers that an environmental impact assessment must be conducted prior to the implementation of a project. Moreover, once operations have started and, where necessary, throughout the life of the project, continuous monitoring of its effects on the environment shall be undertaken.[134]

Under this ruling, States must establish various domestic and transboundary procedures to prevent significant transboundary damage in order to meet their due diligence obligations, including impact assessments and permit procedures; notification and consultation with a potentially affected State; there may be consultation with the public likely to be affected in another State; an obligation to monitor the implementation; and, of course states can agree more specifically due diligence measures required.

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131 Id., para 159.

132 Id., para 159.

133 *Pulp Mills on the River Uruguay (Argentina v Uruguay)* (Judgment) (20 April 2010) ICJ Doc 2010 General List No 135.

134 Id., at para 205.

15.4.1 Impact Assessments and Permit Procedures

The requirement of impact assessments and permit procedures for all activities that may reasonably be thought of as raising the risk of environmental damage is aimed at minimising the risk of significant transboundary damage to the environment of States and/or areas beyond the home state's national jurisdiction.[135] There is no set protocol to implement and it is a matter for each individual States themselves to determine the specific nature of the environmental impact assessment to conduct and the permit procedures they introduce. They main requirement is that they conform to due diligence standards prior to implementing the project in question.[136] The actual degree and depth will depend on the nature of the project in question, e.g. the building and development of nuclear facilities would certainly warrant more in depth and comprehensive environmental impact assessment than some other industries.

15.4.2 Notification and Consultation

There also needs to be a notification and consultation process with a potentially affected State. In order that the environmental impact assessments is conducted properly, the home State is required to notify and consult with the any states that may be potentially affected by transboundary effects. The potentially affected State must an opportunity to participate in the process by commenting on possible transboundary consequences and offering its views.[137] Developing a nuclear program invariably raises concerns regarding safety and security. There could be worries of a neighbouring state regarding potential contamination due to accidents or malfunctions.

15.4.3 Consultation with the Public

According to the Prevention Articles, it may also be that the home State will consult the public of another State. Article 13 stipulates that all States concerned shall provide the 'public likely to be affected' with the relevant information relating to the activity in question, including the risk involved, and the potential harm which might result. Moreover, the State shall ascertain their views.[138] It seems that this

[135] Prevention Articles, Article 5, 6 and 7, pp. 398–406.

[136] As per the *Pulp Mills* case, para 205.

[137] Prevention Articles, Articles 8–10, pp. 406–418.

[138] Prevention Articles, Article 13, p. 422.

obligation applies regardless of whether the public is the State's own public, or the public of another State, according the Commentary.[139] That said, the Court in the Pulp Mills case was not explicit as to whether the public of the potentially affected State needs to be consulted, therefore strictly speaking, it seems that it is not currently part of the due diligence obligation of States.[140] Nevertheless, the Prevention Articles, might be signalling an evolving change of practice or at least highlighting what may be perceived as 'best practice'. This distinction aside, it is unlikely that any state would contemplate developing nuclear energy without wide-scale consultation with the public at large. As for consultations with populations in neighbouring countries, this seems somewhat optimistic and at the very least down to the government of a potentially affected State itself to conduct or to grant permission.

15.4.4 Obligation to Monitor the Implementation

A comprehensive monitoring requirement also exists under due diligence requirements, consisting of an obligation to monitor the implementation of the activity in question. This must be done throughout its duration. Also, all parties concerned must exchange information with each other during the entirety of the activity and the full duration of any potential or actual harm or risk. In the Case of *Gabčíkovo-Nagymaros*[141] references were also made to 'required precautionary measures' and 'the recognition that environmental risks have to be assessed on a continuing basis'. This would require providing appropriate infrastructure to oversee the monitoring and full implementation of the required standards. It would require a legislative framework to ensure a legally binding and enforceable regime under which standards would be set and implemented along with clear processes and sanctions for violations.

15.4.5 Specific Due Diligence Measures

Along with the above requirements, states can agree to undertake more specific due diligence measures in addition to those already required when undertaking a project. It would be prudent and indeed advisable for a State to take pro-active measures prior to engaging in a project that could potentially cause international environmental nuclear harm or damage such as form nuclear fallout, emission or radiation. Prior to commencing a project, they should open dialogue and conclude

[139] Prevention Articles, Commentary to Article 13, pp. 422–425.

[140] *Pulp Mills*, paras 215–219.

[141] *Gabčikovo-Nagymaros* Project (*Hungary vs Slovakia*) [1997] ICJ Rep 7, para 53.

specifically agreed due diligence measures required on both sides. As a matter of good practice, States should agree to the nature and scope of measures to be taken relating to due diligence standards and requirements in order to establish and clarify respective expectations regarding due diligence.

15.4.6 Due Diligence as an Evolving Standard

The concept of due diligence played an important role in the 1970s in two ILC projects International Liability for Injurious Consequences Arising Out of Acts Not Prohibited by International Law and The Law of the Non-Navigational Uses of International Watercourses, both dealing with situations of transboundary physical harm[142] and placing the concept of due diligence at the center of international environmental protection law within a contemporary context. Koivurova concludes that the Liability Project was central to defining due diligence within a contemporary context, progressively developing the concept and applying it in situations where there is risk of transboundary harm from hazardous activities.[143]

The dynamic character of due diligence requires the state to aim to reach the result set out in the obligation. In essence, the test is one of endeavour. The criteria for reaching such an aim is, of course, based on the outcome sought and the circumstances of the case, which will evolve over time as technology improves, etc. Effectively, it would be on a case-by-case basis, examining the context in its entirety. A breach of these obligations consists not of failing to achieve the desired result but failing to take the necessary, diligent steps towards that end.

The Commentary to the Preventive Draft Articles points out the dynamic character of due diligence.[144] Specifically, that which would be considered a reasonable standard of care or due diligence may invariably change with time. Additionally, what might be considered an appropriate and reasonable procedure, standard or rule at one point in time may not be considered as such at some point in the future. As a result, due diligence in ensuring safety, for example, requires a State to keep abreast of technological changes and scientific developments,[145] whereby nuclear obligations invariably fall under such scrutiny of due diligence.

Koivurova notes that important developments in customary law have made it possible for the Preventive Draft Articles to specify the procedural obligations of due diligence, distinguishing two sets of norms, those requiring States to establish specific institutional capacity to fulfil their due diligence requirements and obligations to co-operate in cases of specific transboundary harm situations, with which

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[142] Despite being excluded from the codification efforts of the State Responsibility.

[143] At page 4. See also Tanzi 2013.

[144] At 394.

[145] See *Gabčíkovo-Nagymaros* Case *(Hungary/Slovakia)* where the ICJ highlighted the dynamic nature of all international environmental law.

the failure to comply may be deemed a breach of due diligence. Drawing on these developments in customary law, in particular the Preventive Draft Articles, States must take legislative and administrative steps including establishing suitable monitoring mechanisms, and on a continual, on-going basis.[146] States are obligated to establish prior authorization procedures domestically for proposed hazardous activities and any major changes to them; they are also obligated to base the authorization decision on an environmental impact assessment, which includes an assessment of transboundary harm, as discussed above. Again, nuclear programs will invariably require action on this front or face charges of breaching due diligence.

Koivurova notes that the ILC Draft Articles on the Law of the Non-Navigational Uses of International Watercourses attempted to incorporate due diligence obligations in relation to the no harm principle regarding to transboundary watercourses, but this was removed from the final text of the Convention on the Law of the Non-Navigational Uses of International Watercourses. Although not in the final treaty the fact that it was almost included highlights the status and importance of this area. Two notable developments in relation to international environmental protection that have a direct bearing on nuclear protection are the Rio Declaration[147] and the Stockholm Declaration.[148] The commentary to the Preamble of the Preventive Draft Articles, notes from the outset that the instrument has a firm legal basis, which was affirmed to have entered the corpus of international law in the Legality of the Threat or Use of Nuclear Weapons Advisory Opinion of the International Court of Justice.

The *Nuclear Tests* Case[149] involved New Zealand and Australia opposing France, concerning the legality of atmospheric nuclear tests conducted in the South Pacific by the French Government from 1966 to 1972. In Legality of the Threat or Use of Nuclear Weapons (Advisory Opinion),[150] New Zealand requested the Court to declare that the nuclear tests conducted in the region giving rise to radio-active fall-out, constituted a violation of its rights under international law and 'that these will be violated by any further such tests'. Australia asked the Court to decide whether carrying out further atmospheric nuclear tests in the South Pacific was inconsistent with rules of international law. In essence, New Zealand focused on the illegality of nuclear testing, regardless of method whilst Australia emphasized the illegal nature of atmospheric tests. The Court decided that the objective of the court proceedings was to stop France from conducting atmospheric nuclear tests in

[146] See Commentary to Article 5 Preventive Draft Articles.

[147] Rio Declaration on Environment and Development (1992). http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=78&ArticleID=1163.

[148] Declaration of the United Nations Conference on the Human Environment (1972). http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=97&ArticleID=1503.

[149] *Nuclear Tests* Case, *Australia v. France*, ICJ Rep. (1974) and *New Zealand v. France*, ICJ Rep. (1974) p. 457; and Legality of the Thret or Use of Nuclear Weapons (Advisory Opinion), [1996] ICJ Rep.

[150] *Legality of the Threat or Use of Nuclear Weapons* (Advisory Opinion), [1996] ICJ Rep.

the South Pacific. Since France had already announced it intention to cease atmospheric testing, the objective was achieved and there was no longer a dispute to settle, deciding not to consider the merits of the cases presented by Australia and New Zealand as the dispute no longer existed. In the *Legality of Nuclear Weapons* advisory opinion, the majority of the Court, did, however, acknowledge a general obligation of States to 'ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control is now part of the corpus of international law relating to the environment'.

Again the Rio Declaration[151] (Principle 2) and the Stockholm Declaration[152] (Principle 21) require that 'States have … the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond national jurisdiction'. The preamble of the Rio Declaration explicitly reaffirms the Stockholm Declaration, 'seeking to build upon it'. In addition, Principle 13 provides that, 'States shall develop national law regarding liability and compensation … [regarding] activities within their jurisdiction or control to areas beyond their jurisdiction'. Moreover, in direct relation to nuclear concerns, Principle 26 of the Stockholm Declaration states that '[m]an and his environment must be spared the effects of nuclear weapons …. [and] must strive to reach prompt agreement, in the relevant international organs, on the elimination and complete destruction of such weapons'. This invariably places a due diligence imperative at the centre of state obligations in this regard. These various clauses taken together provide a multiple set of binding obligations. Not only are there environmental concerns that could be caused by nuclear programs but Principle 26 clearly places obligations relating to 'the elimination and complete destruction of such weapons'. Moreover, 'man' i.e., people and 'his' i.e., their environment 'must be spared the effects of nuclear weapons'. Aside from the nuclear environmental aspects, the principle also poses an obligation that States must strive to reach prompt agreement. The use of the word 'strive', arguably imposes a due diligence requirement to work towards an agreement which is an immediate requirement towards a achieving an end result. Again, in keeping with the tenants of due diligence it is a process-driven exercise to act immediately and not simply the final result itself under scrutiny. The inclusion of the word 'prompt' reiterates the need for immediacy.

The no harm principle has been included in wide range of multilateral treaties and declarations in which the long debate on whether the principle has entered the body of international law and whether it is based on the causing of damage alone or requires additional proof of lack of diligence. But, consensus has taken shape on these issues when the International Court of Justice in the *Nuclear Weapons* Advisory Opinion recognized the existence of the general obligation of States as now part of the corpus of international law relating to the environment to ensure

[151] Rio Declaration on Environment and Development (1992). http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=78&ArticleID=1163.

[152] Stockholm Declaration of the United Nations Conference on the Human Environment (1972). http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=97&ArticleID=1503.

that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control.[153] Koivurova notes that the ICJ has confirmed the no harm principle as *lex lata* and that consensus is building that breach by a State of its due diligence obligations, and the consequent significant damage caused to the environment of other States or of areas beyond national jurisdiction, engages the origin State's legal responsibility.[154] Indeed these seem codified in the Preventive Draft Articles, which in some respect appear to go beyond *lex lata*.[155] He notes the commentary to the Draft Articles, that 'due diligence is manifested in reasonable efforts by a State to inform itself of factual or legal components that relate foreseeably to a contemplated procedure and to take appropriate measures in timely fashion, to address them'.[156] Due diligence is to take preventive or measures to minimize harm.

15.5 A Call for Due Diligence in the Nuclear Paradox: A Duty and a Constraint

The concept of due diligence continues to emerge as a general principle of international law, acquiring a robust character in various fields and gaining traction in nuclear law. Whilst progressive growth into codified form was not achieved, as a result of what seems pragmatic decisions on the part of the International Law Commission, its successive development has neither been arrested nor hindered. As a concept it is advancing with steadily emerging norms invariably having important implications within the nuclear law context. These primary obligations directly and indirectly apply to non-proliferation, the peaceful uses of nuclear energy, and disarmament requirements whereby States have a two-fold obligation, both between and amongst themselves, i.e., State actors within the international community, as well as within their respective jurisdictions, i.e., duties regarding subjects and citizens.

Due diligence obligations apply to nuclear safety in its own right as well as being inextricably linked with obligations from other branches of international law, including international humanitarian law, international human rights law, international environmental law in particular. The range of progressive developments in these areas of law have progressively developing due diligence nuclear requirements, expressly advancing this emerging area. Though this patch-work quilt of international legal obligations one sees the broader fabric of a set of due

[153] *Nuclear Weapons* Advisory Opinion para 29.

[154] Koivurova 2010, at para 15.

[155] Stephens highlights that '[t]he obligation to take preventative measures is one of due diligence, not an absolute guarantee against the occurrence of harm.' See ILA First Report: Tim Stephens, International Courts and Environmental Protection (2009), p. 158.

[156] As quoted from the ILA First Report: Report of the International Law Commission, 53rd Session, UN Doc. A/56/10 (2001), p. 154.

diligence obligations individually embedded within their respective fields and cumulatively forming an intricate set of international obligations directly and indirectly applicable to international nuclear law imposing due diligence obligations that are legally binding on States, *sine qua non,*[157] and *inter pares*.[158] Due diligence obligations may best be described in their duality of simultaneously being both a duty and a constraint. A duty to fulfil specific actions regarding nuclear obligations and a restraint on absolute sovereignty and unbridled State behaviour.

Recommendations

(1) States have due diligence obligations to comply with the Nuclear Non-Proliferation Treaty as well as all other relevant nuclear legal obligations.
(2) Due diligence obligations have evolved as legal norms as it relates to the Nuclear Non-Proliferation Treaty as well as to other relevant nuclear obligations.
(3) States must establish various domestic and transboundary procedures to prevent significant damage relating to nuclear power, including impact assessments and permit procedures.
(4) States must notify and consult with a potentially affected States including the public likely to be affected in another State.
(5) States must establish various domestic procedures and processes to monitor the implementation of nuclear safety, both immediate and on a continual and on-going basis.
(6) States must establish various domestic and transboundary impact assessments and permit procedures pertaining to the risk of environmental damage.
(7) States must act in a pro-active manner to ensure compliance with due diligence measures regarding international environmental nuclear harm or damage such as form nuclear fallout, emission or radiation.
(8) States must agree to the nature and scope of measures to be taken relating to due diligence standards and requirements in order to establish and clarify expectations regarding due diligence and establish good practice in this area.
(9) All States should cooperate in ensuring compliance with those obligations.
(10) States should consider options regarding States not complying with the non-proliferation, safety and disarmament due diligence obligations.

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[157] 'An essential condition or requirement.' (http://www.thefreedictionary.com/sine+qua+non).

[158] The term *Inter Pares* effectively means between peers, or between those who stand on a level of equality, as respects diligence, opportunity, responsibility, etc. (http://thelawdictionary.org/inter-pares).

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Chapter 16
The Right to Develop Research, Production and Use of Nuclear Energy for Peaceful Purposes: Shortcomings and Loopholes in Legal Regulation

Dieter Fleck

> *The security and economic benefits of adherence to the Non-Proliferation Treaty by the non-nuclear-weapon States parties to the Treaty need to be greatly enhanced. Among other measures, there deserve to be provided unconditional positive and negative security assurances against the use or threat of use of nuclear weapons, and against military aggression in general. Also, the promise of peaceful nuclear cooperation contained in the Non-Proliferation Treaty must be fulfilled.*
>
> Maleeha Lodhi (2001)

Abstract The right to develop research, production and use of nuclear energy for peaceful purposes without discrimination is addressed in the Nuclear Non-Proliferation Treaty (NPT) in but general terms (preambular paras 6–7, Articles IV–V NPT). It is characterized as an inalienable right of all Parties, to be used in conformity with the nuclear non-proliferation obligations under the Treaty. The author examines the character and contents of this right in context with corresponding obligations of States Parties. The relevant rights and obligations are assessed in view of their development over time, considering changes in global security, safety and environmental protection during the last decades. Some shortcomings and loopholes in legal regulation are identified that need to be solved in

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international cooperation. The tension between the interest of States in keeping civilian nuclear options open as much as possible on the one side, and the interest in preventing acquisition or manufacture of nuclear weapons and ensuring nuclear safety and security on the other is not fully balanced out by the provisions of the NPT; it rather requires cooperative and sustainable implementation efforts. What is needed is a joint effort in identifying common interests and evolving new potentials for nuclear cooperation. To be successful, such efforts must go beyond the divide between nuclear-weapon States and non-nuclear-weapon States and the even more challenging divide between Parties and Non-Parties to the NPT. At the same time, the role of the IAEA in peer-reviewing and monitoring compliance with safety standards needs to be strengthened.

Keywords Access to fissile material · Inalienable right · Incentives for compliance · Nuclear cooperation · Nuclear Non-Proliferation Treaty (NPT) · Peaceful uses of nuclear energy

Contents

16.1 Introduction

The right to peaceful uses of the Atom was used in the negotiations on the Nuclear Non-Proliferation Treaty[1] as one of the 'bargains' and, indeed, in no lesser degree than the obligations on disarmament, as a *quid pro quo* to facilitate commitments on nuclear non-proliferation.[2] Thus it is fair to state that the declared goal of the

[1] Treaty on the Non-Proliferation of Nuclear Weapons—NPT—(1 July 1968), 729 UNTS 161.

[2] As noted by Shaker 1980, Vol. I, 76, this was apparent from the beginning of negotiations in the conference of the Eighteen-Nation Committee on Disarmament (ENDC) when the US and Soviet Co-Chairmen presented their identical treaty drafts of 27 August 1967: trying to convince other members of the validity of their draft proposals they were 'at one point going to insinuating in a vehement tone the unfavourable implications in the field of peaceful uses of nuclear energy for those who refuse to become parties to the treaty'.

Treaty—to ensure nuclear non-proliferation—would hardly have been reached without addressing and seeking to regulate two further goals: disarmament and peaceful nuclear cooperation. The latter goal shall be examined here. Described in the Treaty in but general terms (preambular paras 6–7 and Articles IV-V NPT), the right to develop research, production and use of nuclear energy for peaceful purposes is referred to as an 'inalienable' right, to be carried out in conformity with the non-proliferation obligations under Articles I and II.

For an assessment of the contents of this right and its relevance for the effective functioning of the Treaty several questions arise: It deserves some discussion, whether and to what extent there may be a tension between the characterization of this right as 'inalienable' and the requirement of using it in conformity with certain rules. The 'inalienable' character of the right to develop research, production and use of nuclear energy for peaceful purposes is rooted in the sovereignty of States. This may suggest that States might use this right independently from any outside help and free from any outside interference. But as stated in Article IV.1 NPT, the development, production and use of nuclear energy is to be carried out in conformity with the non-proliferation obligations under Articles I and II. Recent NPT Review Conferences have added further considerations, confirming that States Parties using this right have to act not only in conformity with Articles I and II of the Treaty, but also in conformity with Articles III and IV.[3] While the legal foundation of such wider restrictions may be a matter of some discussion, their importance for ensuring non-proliferation goals needs to be contemplated. Furthermore, best-practice procedures for the use of nuclear energy should be examined with a view to identify existing shortcomings and requirements for further regulation. Another provision of the Treaty may be neglected here: Article V NPT provides regulation on 'potential benefits from any peaceful applications of nuclear explosions'; but this Article has become redundant, as no State Party has an active program for such activities, neither has the IAEA received any requests for services related to its development.[4]

A detailed reflection of the obligations under Article IV.2 NPT should help to better understand the character and contents of the right that is confirmed in Article IV.1 NPT. Article IV.2 NPT provides that all Parties (i.e. not only the nuclear-weapon States, but also non-nuclear-weapon States in a position to do so) are obliged to contribute to the further development of the applications of nuclear energy for peaceful purposes: They undertake

[3] See Final Document 2010, NPT/CONF.2010/50 (Vol. I), para 31.

[4] As recorded by the 1995 NPT Review Conference, such benefits had not been demonstrated and serious concerns had been expressed as to the environmental consequences that could result from the release of radioactivity from such applications and on the risk of possible proliferation of nuclear weapons, NPT/CONF.1995/MC.III/1, http://www.un.org/Depts/ddar/nptconf/21d6.htm, V 2. The 2010 Review Conference affirmed that the provisions of Article V are to be interpreted in the light of the Comprehensive Nuclear-Test-Ban Treaty, NPT/CONF.2010/50 (Vol. I), http://www.un.org/ga/search/view_doc.asp?symbol=NPT/CONF.2010/50%20(VOL.I), para 78.

> to facilitate … the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy.

Are they free to decide what may or may not be done in the performance of this obligation? Are there international standards on the issue, defining this obligation or offering at least certain guidance for best practice in this respect? Are States under a legal obligation to provide access to fissile material? May they establish conditions for nuclear cooperation other than those included in the NPT? How may such conditions be defined? Should the same or similar standards apply to nuclear cooperation among all Parties or would it be acceptable to establish priorities for exchange, subject to specific abilities and needs?

In this context it should also be considered that, in addition to non-proliferation law proper, there are further obligations relevant to the use of nuclear energy. These may be seen e.g. in environmental law with its principles of concern for the common heritage of mankind, sustainable development, equity, precaution and prevention, and common but differentiated responsibilities.[5] While these obligations are more relevant for one particular use of nuclear energy, i.e. the production of electricity from nuclear reactors and its particular requirements for nuclear safety and safe radioactive waste disposal,[6] other uses of nuclear radiation in medicine, biology, agriculture, industry and marine environment may be affected as well.

This Chapter examines, in a first step, in which way and to what extent the 'inalienable' right on peaceful uses is informed, and in fact limited under the Treaty (Part 16.2). It then undertakes to clarify the contents of the obligations of States Parties to facilitate peaceful uses of nuclear energy by other States Parties (Part 16.3). To find out whether this regulation is static or rather subject to progressive development, all relevant rights and obligations have to be assessed in view of their application over time, considering that over the last decades main parameters of global security, safety and environmental protection have changed, while at the same time the technological threshold for accessing sensitive nuclear technology has become much lower.[7] In this context the role of non-State actors, i.e. nuclear industry and non-governmental organizations, deserves particular attention. It is also to be considered that safety risks (in particular after the severe nuclear accidents in Three Mile Island, Chernobyl and Fukushima),[8] illicit trafficking and terrorist threats[9] have increased the risks of nuclear energy use and this has changed significantly the way in which States (industrial and developing States alike) view nuclear energy and the appropriate controls on nuclear material. Benefits and disadvantages of nuclear energy require a new unbiased assessment today. As a result of these deliberations, some conclusions shall be submitted, drawing consequences from existing legal regulation and implementing practice, and developing proposals for improving international cooperation in this field (Part 16.4).

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[5] See Anastassov 2014, at 164–172; Nanda 2008, at 49–64; and above, Chap. 10 (Bothe).

[6] See Anastassov 2014, at 160.

[7] Zhang 2009, at 65.

[8] See above, Chap. 1, Part 1.1.

[9] See above, Chap. 8 (Drobysz).

16.2 The Right on Peaceful Uses and Its Limitations

The regulation concerning the use of nuclear energy for peaceful purposes (Article IV.1 NPT), which mirrors President Eisenhower's vision of 'Atoms for Peace'[10] and prominently forms the second pillar of the Treaty, was not part of the original U.S. and USSR proposals, but has been included at a later stage of the negotiations in August 1967, following a proposal made by Mexico in March 1967.[11] It is important to note that the right to develop research, production and use of nuclear energy for peaceful purposes is rooted in general international law. Thus it existed even before the NPT was adopted. The Treaty underlines its significance. States may and do refer to it as a pre-existing right, irrespective of whether or not they are Parties to the NPT. Yet the Treaty regulates the use of this right by its Parties, setting certain limitations to such use. These limitations may not only affect States Parties; consequences for non-Parties and non-State actors including exporters of nuclear technology have to be considered in this context as well. Furthermore, there are corresponding obligations under the Treaty (Article IV.2), obligations to which I will revert later (Part 16.3).

16.2.1 Legal Basis

In a very general sense, the legal basis of the right on peaceful uses of nuclear energy derives from general principles of law. This was discussed and confirmed during the NPT negotiations. As well put by a delegate attending the Conference of Non-Nuclear-Weapon States in 1967,

> the right of every State to use nuclear energy for peaceful purposes was inherent in its sovereign right to independent economic development, and was an essential attribute of national sovereignty and independence.[12]

In the final Treaty text the negotiating Parties went even further, referring to that right not only as 'inherent', a term used in relation to the right of self-defence in Article 51 of the UN Charter, but as 'inalienable', thus insinuating that nothing in the Treaty may be seen as affecting it. There is not much discussion in literature on the meaning of this provision. An interpretation as expression of 'a strong intention of the dominant negotiating States to advocate ambiguity'[13] does not

[10] GAOR, 8th Session, 470th Plenary Meeting, 8 December 1953, paras 79–126, http://voicesofdemocracy.umd.edu/eisenhower-atoms-for-peace-speech-text/.

[11] ENDC/PV.325, para 17; ENDC/PV.331, para 7. See Shaker 1980 Vol. I, 276–277; Joyner 2009, at 44.

[12] Shaker 1980 Vol. I at 294, quoting the Romanian statement in A/CONF. 35/C.2/SR.9 (17 September 1968), p. 98.

[13] Zhang 2006, at 647, 655–657, 662.

seem to be convincing. The right to peaceful uses was included in the NPT at the request of developing States.[14] Its solemn affirmation as 'inalienable', a term coined in the American Declaration of Independence,[15] reminds of the struggle of these years on the unalienable right of peoples to self-determination.[16] The Treaty text that was finally agreed upon may be explained as a reference to this development so important to the Third World and also as a means to settle diverging interests of negotiating States by revoking principles commonly shared. But it is clear that for the Parties to the NPT this inalienable right is to be used not only 'without discrimination', but also 'in conformity with Articles I and II of this Treaty'. A contradiction between these two clauses cannot be construed in a convincing manner. The former clause ensures that the inalienable right may be used by all States on an equal basis, while the latter provides that this right is to be implemented in a manner meeting the non-proliferation goals of the Treaty: States Parties have this right, but they undertake to ensure that non-proliferation obligations are accepted and safeguards are applied in its execution.

It may also be recalled that the IAEA Statute[17] provides that the Agency 'shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity' (Article II), and that it is authorized to 'encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world' (Article III A 1), thus recognizing the rights of Member States to develop research, production and use of atomic energy for peaceful purposes.

The relevance of the right of every State to use nuclear energy for peaceful purposes is an important argument in deliberations how best to secure adherence to, and compliance with, the NPT.[18] It has been reiterated by Member States of the Non-Aligned Movement (NAM) at NPT Review Conferences:

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[14] ENDC/PV.325, para 17; ENDC/PV.331, para 7.

[15] American Declaration of Independence (4 July 1776): 'We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable rights, that among these are Life, Liberty and the pursuit of Happiness.'

[16] See ICJ, *Legal Consequences for States of the Continued Presence of South Africa in Namibia (South West Africa) Notwithstanding Security Council Resolution 276 (1970)*, Advisory Opinion (21 June 1971), ICJ Reports 16; Separate Opinion of Judge Ammoun, id. at 80, quoting Jacques Maritain, *Autour de la Déclaration universelle des droits de l'homme*, Unesco, *1948*, p. 16, on the binding character of human rights: '… à l'origine de l'incitation secrète qui pousse sans cesse à la transformation des sociétés, il y a le fait que l'homme possède des droits inaliénables, et que cependant la possibilité de revendiquer justement l'exercice de tels ou tels d'entre eux lui est ôtée par ce qui subsiste d'inhumain à chaque époque dans les structures sociales' ['… underlying the stealthy, perpetual urge to transform societies is the fact that man possesses inalienable rights while the possibility of claiming actually to exercise now this one, now that, is yet denied him by those vestiges of inhumanity which remain embedded in the social structures of every era'].

[17] Statute of the International Atomic Energy Agency—IAEA Statute—(26 October 1956), 276 UNTS 4, amended 1963, 1973, 1989, and 1999), http://www.nuclearfiles.org/menu/library/treaties/atomic-energy-act/trty_atomic-energy-statute.htm.

[18] See Lodhi 2001, para 17.

> The Group of Non-Aligned States Parties to the Treaty is of the firm belief that the full, effective and non-discriminatory implementation of article IV of the Treaty plays a crucial role in achieving the object and purpose of the Treaty. In this regard, the Group also firmly believes that, any measure aiming at hampering, fully or partly, the fullest exercise of these inalienable rights, would seriously jeopardize the delicate balance between rights and obligations of States parties in contravention with the Treaty's object and purpose and widens the gap between developed and developing countries in this field.[19]

What is expressed in this demand for full application of Article IV NPT is a plea for fair cooperation in the use of the right to develop research, production and use of nuclear energy for peaceful purposes, to be interpreted and applied to all State Parties 'without discrimination' (Article IV.1 NPT). As will be discussed in the following Section, this is not to be misunderstood as neglecting the legal limitations of peaceful uses, stemming from non-proliferation obligations and responsibilities for nuclear safety and security. Full acceptance and correct implementation of the right to use nuclear energy for peaceful purposes as one of the three essential pillars of the NPT is of no lesser importance than the other two: non-proliferation and disarmament. As all three pillars are important elements of the Treaty, their faithful maintenance remains essential for the good functioning of the Treaty regime as such. This should be accepted not only as a global policy imperative, but also as a legal obligation stemming from general principles of treaty law.

16.2.2 Limitations

Important limitations of the right on peaceful uses of nuclear energy are clearly addressed in the Treaty text. This is definitely true for the non-proliferation obligations under Articles I and II which are expressly referred to in Article IV.1 NPT. In line with these obligations, and as long as nuclear material is involved, all activities in research, development and production of nuclear energy for peaceful purposes need to be conducted under the IAEA safeguards system. A 'literal interpretation which would tolerate sensitive activities'[20] would raise severe issues of compliance with Treaty obligations and cannot make a convincing case. While it may still be an open question,[21] whether or not such activities would come close to weapons manufacture and are—in the final assessment—breaching Treaty obligations under Article II, their performance as part of peaceful uses under Article IV requires States to accept safeguards to be applied 'on all source or special fissionable material in all peaceful nuclear activities within the territory of such

[19] 'The inalienable right to develop research, production and uses of nuclear energy for peaceful purposes' Working paper submitted by the Group of Non-Aligned States Parties to the NPT (24 April 2012), NPT/CONF.2015/PC.I/WP.24, para 3.

[20] Spector 1995, 23–24.

[21] Zhang 2009, at 48.

State, under its jurisdiction, or carried out under its control anywhere' (Article III). Hence it is justified that NPT Review Conferences have confirmed that States Parties must use their right to peaceful uses in conformity with Articles I, II, III and IV.[22]

This interpretation is in conformity with the text of the Treaty as well as its object and purpose. Enrichment and reprocessing plants belong to the most proliferation-sensitive parts of the nuclear fuel cycle. Verification is of utmost importance and it serves the interest of the international community as a whole. It is essential to put the IAEA in a position to confirm that all nuclear material had been placed under safeguards and remained in peaceful nuclear activities. The absence in Article IV.1 of an explicit reference to Article III is not important, as Article III only specifies obligations under Article II. Strictly implementing these obligations serves the interests of all Parties without discrimination. To qualify this understanding of Article IV as an auto-interpretation by some States[23] appears to neglect that it has been accepted and approved by all State Parties, as confirmed at NPT review conferences. Objective verification of compliance with non-proliferation obligations on non-nuclear-weapon States is guaranteed under the IAEA safeguards system. Relevant policy decisions of the Agency are scrutinised and confirmed by the Board of Governors, in a spirit providing adequate statutory opportunities for all Member States to participate in this process. Hence the question *quis custodiet ipsos custodies* which has been considered relevant in the present context[24] has found a comprehensive institutional answer here. The inalienable right of a State Party to peaceful nuclear energy under Article IV.1 NPT is to be understood and needs to be implemented in accordance with that Party's non-proliferation obligations under the Treaty. It is important to underline that these obligations require that all nuclear material in all peaceful nuclear activities must be effectively safeguarded by the IAEA.[25]

Limitations of the right on peaceful uses of nuclear energy have been used to suggest a hierarchy of norms under the Treaty, yet without fully considering comparable limitations in the legal regulation of non-proliferation and nuclear disarmament. Thus the argument was made that 'Articles IV and VI are significantly qualified and contain substantial ambiguity unlike Articles I and II',[26] an argument that seems understandable from the viewpoint of nuclear-weapon States, but does not reflect a global assessment, neither of the history of negotiations nor of the text as finally adopted. The right to nuclear energy for peaceful purposes is to be taken serious by all State Parties and should not be put aside because of existing or pretended uncertainties. Clear interpretation of this right and its relevance for the

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[22] See above, Footnote 3.

[23] Zhang 2009, passim.

[24] Zhang 2009, at 65.

[25] Zarate 2010, at 222.

[26] Wulf 2011.

obligations on nuclear non-proliferation and disarmament is necessary. It may be difficult to develop consensus on this issue, yet this is what is necessary and, indeed, warrants joint efforts.

For this purpose the Treaty text as well as subsequent practice, which may be different and may affect Treaty implementation, need to be re-examined. It should be considered in this context that significant limitations and ambiguities do exist in respect of the other two pillars of the Treaty as well: The treaty obligations concerning nuclear non-proliferation are not without disputes as to their reach and application, as demonstrated by the controversies on the State-level concept to ensure verification, a matter that should not obscure the quality of legal regulation.[27] Similar conclusions may be drawn on the obligations concerning nuclear disarmament, as demonstrated by attempts to downplay the legal obligations under Article VI.[28] While no full agreement on these issues has been reached so far, it should be clear that all three pillars of the NPT are of like relevance not only for the adoption of the Treaty, but also for its implementation.

There are also other legal limitations on the use of nuclear energy that are important, however not expressly mentioned in the NPT: The *safety* of nuclear and other radioactive material that can create enormous damage must be adequately ensured as a matter of State responsibility. It may be noted that many of the contemporary nuclear technologies were originally developed for military purposes, without constraints that are normal in civilian enterprise, as to costs, efficiency, and profitability, let alone environmental considerations.[29] A wealth of professional expertise and, indeed, recommendations for best practice and soft law has been developed by now, yet ensuring compliance with, international monitoring and enforcement of nuclear safety standards remains a challenge. While significant treaty improvements have been achieved during the last years,[30] a comprehensive treaty regime on nuclear safety is still beyond realistic expectations. Gaps in existing treaty regulation may be acceptable to a certain degree, as any vendor of nuclear energy has a remarkably strong incentive to ensure the safety of its product and provide considerable assistance to recipients in safe use through the development of human resources and capacity building. Yet an active role of the IAEA appears essential nevertheless, to keep nuclear safety standards up to date, to

[27] See Black-Branch and Fleck 2015, Nuclear Non-Proliferation in International Law, Vol II, in particular Chapter 3 (Dupont), *contra*: Chapters 4 (Rockwood and Johnson), 5 (Asada) and 11 (Kellman).

[28] See Legal Aspects of Nuclear Disarmament, Report of the ILA Committee on Nuclear Weapons, Non-Proliferation and Contemporary International Law (Washington DC, 2014, http://www.ila-hq.org/en/committees/index.cfm/cid/1025), paras 3–5.

[29] Fedchenko 2009, MN 17.

[30] Convention on Nuclear Safety (20 September 1994), INFCIRC/449, 1963 UNTS 293; Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, INFCIRC/546 (29 September 1997); Convention on Early Notification of a Nuclear Accident (26 September 1986), 1439 UNTS 275, INFCIRC/335; Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (26 September 1986), 1457 UNTS 133, INFCIRC/336.

monitor technological risks of nuclear energy production, and to offer professional assistance to enhance nuclear safety and security in cooperation with the various stakeholders. Subject to agreement with States the IAEA could and should do more to assist in preventing nuclear accidents, a matter that has convincingly been addressed by experts,[31] but, unlike the widely accepted practice of the Agency in the field of nuclear non-proliferation under comprehensive safeguards agreements, there is no regular verification of compliance with nuclear safety standards as part of compulsory daily activities. It may be noted that similar deficits exist even in the European regional cooperation, where supranational structures of the European Atomic Energy Community (EAEC or EURATOM) are yet to be used to ensure that common solutions will be developed and fully implemented.[32]

The Agency's role in the maintenance of nuclear *security* is even more limited. To cope with nuclear security risks it is essential that the relevant conventions[33] are implemented by all States Parties and that all States comply with their obligations under Security Council Resolution 1540 (2004), obligations imposed on them not only to reduce the risk of nuclear proliferation, but to enhance nuclear security in a broader sense. The restricted scope of existing treaty obligations and the fact that States consider nuclear security as a sovereign, i.e. exclusively national domain has led to important gaps in international regulation that need to be closed in international cooperation.[34] It is encouraging to see that all Heads of State or Government, including NAM Member States, have underlined in the Nuclear Security Summit process that more must be done to ensure nuclear safety and security. They have recognized that 'highly enriched uranium (HEU) and separated plutonium require special precautions and that it is of great importance that they are appropriately secured, consolidated and accounted for'. They also encouraged States 'to continue to minimise the use of HEU through the conversion of reactor fuel from HEU to LEU, where technically and economically feasible', and

[31] For similar proposals see Findlay 2011; Gioia 2012; and Anastassov, above (Chap. 7). On a strengthened role of the IAEA in the field of nuclear security see also Vassalli di Dachenhausen 2015, Drobysz and Persbo 2015.

[32] See above, Chap. 6 (Grunwald).

[33] See e.g. Convention on the Physical Protection of Nuclear Material (1 November 1979—CPPNM), 1456 UNTS 125, entered into force on 8 February 1987, amended on 8 July 2005, INFCIRC/274/Rev 1 (amendment not yet in force); International Convention for the Suppression of Acts of Nuclear Terrorism (Nuclear Terrorism Convention (13 April 2005—ICSANT—), 2445 UNTS 89; International Convention for the Suppression of Terrorist Bombings (15 December 1997, http://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XVIII-9&chapter=18&lang=en); Protocol to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (14 October 2005, 1678 UNTS 2014); Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (14 October 2005, 1678 UNTS 304); Beijing Convention on the Suppression of Unlawful Acts Relating to International Civil Aviation (10 September 2010, http://www.icao.int/secretariat/legal/Pages/TreatyCollection.aspx).

[34] See Herbach 2016, at 65.

in this regard welcomed 'cooperation on technologies facilitating such conversion'.[35]

Liability for nuclear damage is still in a problematic state: Exclusive liability of the operator is a principle that in practice has to be supplemented by State guarantees. This causes additional burdens for civil society,[36] a situation that may encourage investors and insurance companies to support nuclear energy, thus serving economic development; but it violates the 'polluter pays' principle and may negatively affect the operator's compliance with safety standards, even considering that the potential loss of a multibillion investment is a good reason for strict attention to quality control and safety. Nuclear risk assessment is too complex and too important to be left to investors alone. Accidents are unforeseen events and national regulatory authorities deciding on additional safety obligations should act in full reliance on international advice and review. Further problems may arise from the continuing lack of a global nuclear liability regime[37]: the Paris Convention[38] is limited to OECD Member States, and the global Vienna Convention[39] has only 40 States Parties so far.[40] Both treaty systems remain distinct and they do not cover nuclear damage suffered in the territory of non-contracting States.[41] After the Chernobyl accident the Joint Protocol was concluded, to establish treaty relations between the Parties to the Paris Convention and the Parties to the Vienna Convention, but this Protocol, too, is still not widely adopted.[42] The more ambitious Convention on Supplementary Compensation for Nuclear Damage, which provides for a minimum compensation amount of 300 million Special Drawing Rights (SDR) defined by the International Monetary

[35] See the 2014 Nuclear Security Summit Communiqué, http://www.state.gov/documents/organization/237002.pdf, paras 21 and 22.

[36] See Findlay 2011, at 124.

[37] See Gioia 2012, at 99–100; see also above, Chap. 12 (Pelzer).

[38] Paris Convention on Third Party Liability in the Field of Nuclear Energy (29 July 196), 956 UNTS 251, amended by the Additional Protocol of 28 January 1964, 956 UNTS 335, the Protocol of 16 November 1982, 1650 UNTS 444, and by the Protocol of 12 February 2004.

[39] Vienna Convention on Civil Liability for Nuclear Damage (21 May 1963), 1063 UNTS 293, amended by the Protocol of 12 September 1997, 36 ILM 1454, 1462 (1997), INFCIRC/556.

[40] As of 27 January 2014, https://www.iaea.org/Publications/Documents/Conventions/liability_status.pdf.

[41] This important gap is closed in principle by the Vienna Protocol of 12 September 1997, but only 13 States have become Parties to the Protocol so far, see https://www.iaea.org/Publications/Documents/Conventions/protamend_status.pdf. They may exclude damage suffered in non-contracting States that do not provide reciprocal benefits.

[42] Joint Protocol relating to the Application of the Vienna Convention and the Paris Convention (21 September 1988), 1672 UNTS 302; 28 State Parties (as of 30 April 2014), https://www.iaea.org/Publications/Documents/Conventions/jointprot_status.pdf.

Fund and is open for all States, has so far entered into force only for 7 States including the USA.[43]

It may be open for discussion, whether technological and economic developments will make the use of nuclear energy less desirable for certain States. The use of energy from other sources, such as wind, sun, tides, and geothermic sources may become preferable at larger scale.[44] To assume, however, that such developments would make the inalienable right to peaceful nuclear technology 'inoperative',[45] is still less than realistic. Such assumption fails to acknowledge the role of nuclear energy in many parts of the world for many years to come. States may find the use of nuclear energy uneconomical under certain circumstances, as compared to other energy sources; but why should this judgment stand forever, as economic conditions may change? Even as long as nuclear energy is not an economic option, why should a State exclude access to nuclear technology for other purposes, such as cancer therapy and sterile insect techniques to support agricultural and cattle production and the standard of living for local populations? Proliferation risks will hardly be connected with such uses, so that the same safeguards as for nuclear energy may not be required, but international support and monitoring would still be essential to ensure compliance with safety standards.

A strengthened role of the IAEA may be seen as a prerequisite for any revival of peaceful uses of the atom in today's State practice. Nuclear safety and security, technical cooperation for new nuclear electricity programmes, and international support can hardly be ensured without closer cooperation with and assistance by the Agency including the exercise of regularised monitoring and control functions.[46] This might require a new balance in the work of the IAEA between nonproliferation safeguards and technical assistance functions, which was a matter of critical debates at all times[47] but appears to be more vital today than ever before. It should be made mandatory that safety and security of nuclear installations are regularly assessed by the IAEA.

16.2.3 Consequences for Non-state Actors

While the right to use nuclear energy for peaceful purposes is regulated by international law and national laws and regulations adopted by States, application of that law is to a large extent a matter of nuclear industry, both national and

[43] Convention on Supplementary Compensation for Nuclear Damage—CSC—(12 September 1997), 36 ILM 1454 (1997), INFCIRC/567; 7 State Parties (as of 17 April 2015), https://www.iaea.org/Publications/Documents/Conventions/supcomp_status.pdf.

[44] See International Renewable Energy Agency (IRENA), www.irena.org.

[45] This opinion was expressed by Slater 2008, at 62.

[46] See Findlay 2011, at 213.

[47] See Scheinman 1987, 246–256; Fischer 1997, in particular at 146, 189, 196, 210, 226, 343.

multinational. Civilian enterprise and investment would benefit from clear and reliable regulation,[48] but this goal is not yet fully met by the realities of international cooperation between nation States. A strengthened role of the IAEA could offer considerable support both to suppliers and recipients. It could also lead to improvements in communication of relevant safety and security standards.

There is of course nothing like full reliability in this complex field in which progressive technological development is desirable, while remaining uncertainties cannot be excluded and gaps in regulation often need to be filled by best practices. Private companies operate within the framework provided by international and national norms and policies. Governments already extensively regulate their activities. To ask for more regulation may miss technological uncertainties and sometimes be counter-productive.

Effective controls of nuclear technology and its export remain necessary. Security Council Resolution 1540 (2004) obligates States to control exports, transit, trans-shipment and re-export and also control providing funds and services where this would contribute to proliferation of nuclear weapons or other nuclear explosive devices. There are also helpful support services resulting from this situation. The advisory practice by private enterprise organizations, such as the World Association of Nuclear Operators (WANO)[49] or groups representing nuclear power plant exporters is instrumental for technological development. Cooperation with States and competent international organizations can be both facilitated and influenced by private enterprise, as was demonstrated by the Principles of Conduct[50] signed by exporters of nuclear reactors in conformity with the guidelines of the IAEA and the Nuclear Suppliers Group.[51] The IAEA's Technical Cooperation Programme itself is a significant facilitator for the use of nuclear technology for peaceful purposes. At the 2010 NPT Review Conference it was recognized as 'one of the main vehicles for the transfer of nuclear technology for

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[48] For an Indian plea for a comprehensive legal framework see Hariharan 2012, at 120 ('The only requirement is to abandon all the domestic legislations and have a single nuclear law framework so that the whole process is streamlined.').

[49] World Association of Nuclear Operators (WANO), http://www.wano.info/en-gb.

[50] See 2010 Nuclear Power Plant and Reactor Exporters' Principles of Conduct (NuPoC), http://nuclearprinciples.org/about/history/.

[51] See revised text of the document entitled 'The Nuclear Suppliers Group: Its origins, role and activities', INFCIRC/539/Rev.6 (2015), http://www.iaea.org/sites/default/files/infcirc539r6.pdf; revised Guidelines for Nuclear Transfers, INFCIRC 254, Part 1, http://www.nuclearsuppliersgroup.org/images/Files/Updated_control_lists/Prague_2013/NSG_Part_1_Rev.12_clean.pdf (June 2013); revised Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology, INFCIRC 254, Part 2, http://www.nuclearsuppliersgroup.org/images/Files/Updated_control_lists/Prague_2013/NSG_Part_2_Rev._9_clean.pdf.

peaceful purposes'.[52] Likewise, the Agency's Peaceful Uses Initiative (PUI), initially launched in 2010, has become an important incentive for raising extra-budgetary contributions in support of Agency activities in the use of nuclear technology in areas such as food security, water resource management, human health and nuclear power infrastructure development.[53]

But further efforts remain necessary to ensure international monitoring and control. Cooperation with the IAEA in nuclear energy production should be made mandatory and it will need to be intensified in that the Agency should be given like verification and review powers in the fields of nuclear safety and security as currently exist in the field of nuclear non-proliferation. Professional cooperation, which comprises many actors in States, industry, and international organizations, appears necessary to secure effective implementation of applicable norms and policies. It will not fully replace existing deficits in verification and control of nuclear safety standards by the IAEA, yet it may serve transparency for and confidence of the public at large.

While the plea for an international legal instrument covering both civil and international liabilities[54] still depends from an objective stocktaking of problems to be solved, the remaining limits of any such regulation should not be neglected.[55] Such an international legal instrument may facilitate control by States and international organizations, but it cannot replace an efficient implementation of existing norms and policies.

16.3 The Nature and Limits of the Obligation to Facilitate Peaceful Uses

The obligations to facilitate and regulate research, production and use of nuclear energy for peaceful purposes are addressed in the NPT in less than detailed manner. Their description underwent considerable developments in the course of the negotiations, and the result achieved might not fully reflect President Eisenhower's vision of 'Atoms for Peace', which had been expressed more than a decade earlier.[56] Yet the Treaty affirmed the principle

> that the benefits of peaceful applications of nuclear technology, including any technological by-products which may be derived by nuclear-weapon States from the development of

[52] 2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons Final Document, NPT/CONF.2010/50 (Vol. I), para 41. It seems, however, debatable, to what extent this support effect applies to cooperation in the field of nuclear energy. The funds allocated for civilian projects are relatively modest and more than half of this money goes to health, food, water, and industrial applications.

[53] See Quevenco (2012).

[54] Anastassov (2014), at 192, 195.

[55] See above, Chap. 12 (Pelzer).

[56] See above (Footnote 8).

> nuclear explosive devices, should be available for peaceful purposes to all Parties to the Treaty, whether nuclear-weapon or non-nuclear-weapon States,[57]

a principle that requires positive action by all States Parties to make such by-products from military development available for peaceful purposes and to enhance nuclear cooperation between nuclear-weapon States and non-nuclear-weapon States to this effect. It is confirmed as a Treaty obligation in the following terms:

> All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world.[58]

Yet this Treaty obligation is qualified in a distinct form ('fullest possible exchange', 'in a position to do so'), and there is nothing in this text to imply that recipients be given a *droit de regard* if potential suppliers declare themselves as being not in a position to cooperate or decide that a certain exchange would not be possible. Security considerations may limit the range of possibilities existing here. But also economic considerations and the financial reliability of the recipient will be essential aspects of the calculation of any supplier.

Article IV.2 NPT is thus not really ensuring that the 'Atoms for Peace' idea will be fulfilled and subsequent developments so far with negative safety experience and growing concerns on security issues have resulted in more reserved attitudes as far as nuclear cooperation is concerned. Incentives for providing extensive information, offering exchange, and supporting investments in nuclear programmes are required if this vision is to be fulfilled. The silence of the Treaty on this important issue may be considered as a severe shortcoming, comparable to the lack of Treaty rules to ensure nuclear safety.[59]

It should be recognized that the NPT encourages nuclear cooperation not just as a general principle, but also in some concrete way. The obligations under Article IV.2 apply 'especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world'. The distinction between nuclear 'haves' and 'have-nots', which characterises the Treaty as a whole and entails quite different non-proliferation obligations for non-nuclear-weapon States on the one hand (Articles II and III.1 NPT) and nuclear-weapon States on the other (Article I NPT), is thus partly balanced out by special obligations of nuclear-weapon States to ensure international cooperation for the 'further development of the application of nuclear energy for peaceful purposes'. In fact, many non-nuclear-weapon States, too, have highly developed capacities

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[57] Preamble, para 6.

[58] Article IV.2 NPT.

[59] As to the latter, see above, Sect. 16.2.2.

in nuclear research, development, and industrial production. Consequently, they may assist even nuclear-weapon States in the use of nuclear energy for peaceful purposes. Not only technological by-products from the development of nuclear explosive devices, but also a wider field of cooperation providing opportunities for mutual give-and-take situations and joint ventures should be considered here. Many other States are not in a position to use nuclear energy without external support. These States, in particular, should benefit from a fulfilment of obligations by transferor States under Article IV.2 NPT.

It seems fair to summarize here that the NPT underlines the need for international nuclear cooperation, and even encourages such cooperation, but it refrains from making it mandatory or regulating it in any detail.

16.3.1 Existing Treaty Obligations and Their Limits

In order to achieve 'the fullest possible exchange of equipment, materials and scientific and technological information', the NPT provides that all Parties 'undertake to facilitate, and have the right to participate in' such exchange. These carefully crafted[60] words describe a commitment of all States in a position to contribute to, and a right of all States to benefit from such exchange. It is difficult, however, to compare the legal obligations resulting from this commitment with those resulting from the commitments in respect of nuclear non-proliferation (Articles I–III) or nuclear disarmament (Article VI).[61] As explained above, any legal obligation would be mitigated by what is 'possible' (Article IV.2) and the fact that States in a position to contribute may decide themselves on whether or not this condition is met, further limits the corresponding right of States to participate in the exchange. This is exactly how the commitments under Article IV differ from those under Articles I–III, and VI. Hence participation remains dependent from the willingness of Supplier States; yet the interest of all States in receiving the benefits of the exchange may (and should) offer certain incentives for facilitating the implementation of that obligation to the 'fullest possible' extent.

The NPT sets strict limits to such cooperation by requiring nuclear-weapon States

> not in any way to assist, encourage or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices[62]

and non-nuclear-weapon States

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60 Shaker 1980, Vol. I, 300 ff.

61 Joyner 2009, 46–50; and again Joyner 2011, 94–95, stipulates a broad interpretation of obligations under Article IV.2 NPT which is, however, neither in line with the Treaty text nor supported by subsequent State practice.

62 Article I NPT.

> not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices; and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices.[63]

These obligations neither prohibit nor regulate activities conducted as part of the nuclear fuel cycle, but they are nevertheless significant here.

It is also to be considered in this context that suppliers make cooperation conditional on the recipient's willingness to accept a wide range of conditions. The Members of the Nuclear Suppliers Group (NSG), for example, require physical protection, retransfer controls, and full scope safeguards, developed as best-practice standards and strict export control guidelines, published by the IAEA as Information Circulars (INFCIRCs).[64] All of these measures are neither regulated by the NPT nor excluded by its text; they evolved as a result of externalities not present when the Treaty was negotiated and they were accepted by recipient States as serving safety, security and non-proliferation interests commonly shared.

Yet these regulations do not exclude or inadequately restrict nuclear cooperation for peaceful purposes. On the contrary: all Parties are even required to facilitate such cooperation, as provided in Article IV.2. Cooperation in sensitive areas may, however, be problematic, as this could lead to supporting activities that are prohibited under the Treaty. There may be cases of cheating in breach of Article II and also situations where a recipient who lawfully sought cooperation for peaceful purposes and misused the technology so received at a later stage for clandestine nuclear-explosive-related activities.

Controversies on exports of nuclear technology to Brazil, India, Pakistan and South Korea have revealed the sensitivity of cooperation under Article IV.2 soon after the NPT's entry into force. They arose in context with concerns about nuclear weapon programs which, in the case of India and Pakistan, proved to be valid in retrospect:

- India's nuclear test on 18 May 1974 was condemned as a violation of peaceful-use agreements underlying U.S. and Canadian-supplied nuclear technology and material transfers.[65] The test was a major contributing factor to the formation of

[63] Article II NPT.

[64] Nuclear Suppliers Group (NSG), http://www.nuclearsuppliersgroup.org/en/; Guidelines for Nuclear Transfers (INFCIRC/254, Part 1), and Guidelines for transfers of nuclear-related dual-use equipment, materials, software, and related technology (INFCIRC/254, Part 2), reprinted in Elbaradei et al. 1993, 1517 *et seq*; Good practices for corporate standards to support the efforts of the international community in the non- proliferation of weapons of mass destruction, http://www.nuclearsuppliersgroup.org/images/Files/National_Practices/NSG_Measures_for_industry_update_revised_v3.0.pdf. See the IAEA website where the NSG guidelines, which have changed many times since 1993, are published in the most up-to-date versions as INFCIRC's.

[65] Agreement for Cooperation between the Government of the United States of America and the Government of India Concerning the Civil Uses of Atomic Energy (8 August1963), reproduced in Chellaney 1993, at 318–327; see http://www.nti.org/country-profiles/india/nuclear/.

the Nuclear Suppliers Group (NSG). After decades of irritation, conditions on U.S.-Indian nuclear cooperation were re-negotiated under Article 123 of the Atomic Energy Act of 1954.[66]

- Exports of enrichment and reprocessing technology by the German company Kraftwerk Union to Brazil had been permitted by the Bonn Government in 1975, considering that Brazil, at that time not yet Party to the NPT, had a safeguards agreement with the IAEA in accordance with INFCIRC/66. This export was severely criticized at its time.[67] Yet after years of construction delays and cost overruns Brazil drastically limited the number of reactors originally planned and in 1985 the country indefinitely postponed the construction of any uranium enrichment plant. Together with Argentina, Brazil created the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC),[68] an organization participating in cooperation with the IAEA, the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL),[69] EURATOM, and with States.[70]
- France had authorized similar exports to Pakistan and to the Republic of Korea.[71] As a consequence, the Nuclear Suppliers Group (NSG) developed best-practice standards and introduced its strict export guidelines.[72]

While these controversies have taken place decades ago out of fears that nuclear cooperation with States not Parties to the NPT could be abused for clandestine nuclear weapon programs, they are not altogether irrelevant today. All fears evolved in the context of cooperation under Article IV. Similar controversies continue today with respect to States Parties, as seen e.g. by events in Iran. Like decades ago, the question is what obligations of Supplier States exist under the NPT and other norms of international law.

Access to nuclear material is not fully regulated. It appears that the rights and obligations laid down in the NPT are not sufficient to allow for a solution that would be satisfactory for all participants. Hence additional conditions had been developed each time to secure compliance with the NPT and national interests of the Supplier State. Efforts taken at a larger scale between 1977 and 1980 by the International Nuclear Fuel Cycle Evaluation (INFCE) were designed to provide

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[66] Agreement Between the Government of the United States of America and the Government of India Concerning the Peaceful Uses of Nuclear Energy. With Agreed Minute (8 October 2008), http://www.state.gov/documents/organization/122068.pdf; see Di Lieto 2015, at 168–172.

[67] Lowrance 1976, at 154; Krause 2005, at 3.

[68] Agência Brasileiro-Argentina de Contabilidade e Controle de Materiais Nucleares/Agencia Brasileño-Argentina de Contabilidad y Control de Materiales Nucleares (ABACC).

[69] Created as a specialized regional body for articulating common positions and joint actions on nuclear disarmament to implement the Treaty of Tlatelolco.

[70] Kroenig 2010, 198; Nuclear Threat Initiative, Country Profiles, http://www.nti.org/country-profiles/brazil/.

[71] Zhang 2009, at 40.

[72] See above (Footnote 64).

objective parameters for decision-making. Such parameters may have contributed to a better understanding of the underlying attitudes on all sides. But they did not succeed in allaying 'fears that trade in the nuclear sector would continue to being distorted or even disrupted by the unilateral action of certain governments'.[73] Such controversies may still occur in future and the question remains open, whether and to what extent they may be avoided by establishing general principles.

The 2010 NPT Review Conference has urged that

> in all activities designed to promote the peaceful uses of nuclear energy, preferential treatment be given to the non-nuclear-weapon States parties to the Treaty, taking the needs of developing countries, in particular, into account.[74]

It still remains to be seen, how this principle will be implemented in the practice of Supplier States under the guidelines and policies of the NSG. There is a continuing tension between the interest of States in keeping civilian nuclear options open as much as possible on the one side, and the interest in preventing acquisition or manufacture of nuclear weapons on the other. This tension has increased due to attempts by some States, including NPT parties, to illicitly acquire nuclear technology, and by some non-State actors to market nuclear technology without any controls. The problem is not fully balanced out by the Treaty provisions themselves; it rather requires cooperative and sustainable implementation efforts. For this continuing task a clear understanding of the contents of the relevant treaty regulation and its object and purpose remains essential. It should include not only the substance of and procedures for cooperation, but also its limits.

An early effort undertaken by Donald Greig to this end convincingly considered that certain loops in regulation that might have been foreseen by the negotiating Parties, were dealt with in general clauses maintaining (or pretending) the character of a legal obligation:

> Given the fact that the NPT deals with an area in which the vital interests of contracting States are of paramount importance, it would hardly be surprising to discover that the Treaty as a whole, as well as many of its provisions, gloss over potential areas of conflict in forms of wording which create the impression that agreement has been achieved and translated into legal prescriptions. Thus, in approaching the problem of interpreting the Treaty's provisions, it is necessary to bear in mind that 'the intention of the parties' might well include a deliberate choice in favor of accepting a text that gives an illusion, rather than a reality, of agreement. The reasons for adopting such a policy would include the belief that any treaty which establishes certain minimum undertakings is better than no treaty.[75]

This approach, indeed, included the introduction of progressive elements as part of continuing interpretive efforts to clarify such obligations, thus responding to factual developments:

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[73] See Report from the Commission of European Communities COM(80) 316 (11 June 1980), http://aei.pitt.edu/34085/1/COM_(80)_316_final.pdf, para 14.

[74] NPT Review Conference 2010, Final Document 2010, NPT/CONF.2010/50 (Vol. I), para 33.

[75] Greig 1975, at 82.

> As far as Article IV.2 is concerned, textual analysis provides a useful starting point, but would provide a totally inadequate assessment by itself of the balance that will need to be struck between the non-proliferation of nuclear explosive devices on the one hand and access to peaceful technology on the other. Consideration of the activities of the London Suppliers' Club [the NSG] and of INFCE is essential to any political assessment of the future of Article lV, and it would be legal pedantry to disregard those activities in seeking an interpretation of that Article within the framework of the NPT regime as a whole.[76]

Still today, there is no general legal regulation of the prerequisites and procedures for cooperation under Article IV.2 NPT. What may be considered as a gap in firm treaty regulation, may well present a challenge for current and future interpretive efforts, leading to shared understandings of legal obligations under the circumstances then existing with respect to the relevant Parties at the relevant time. In this way State practice may inform *opinio juris*, not necessarily in the sense of confirming a customary rule, but of progressively developing common understandings and best practice. While the NSG may help to ensure consistent practice among its participating States, NPT review conferences do provide a forum for cooperation at a larger scale, which might lead to more widely accepted interpretations. Any expectation that review conferences could provide an 'authoritative interpretation'[77] of the NPT is, however, hardly justified, as diplomatic consensus-building processes remain distinct from treaty negotiations and the final documents of such conferences are not legally binding.

16.3.2 Current and Future Challenges

A continuing assessment of shortcomings in compliance with the NPT is a necessary consequence of the Treaty's indefinite extension in 1995. It must go beyond formal breaches of Treaty provisions and include new potentials in research and development. In a critical evaluation Lawrence Scheinman concluded in 2004:

> While heretofore civil nuclear programs have not been the vehicle of choice for states seeking to acquire nuclear weapons that appears to be changing. Diversion of material from safeguarded facilities is not the problem, although development of clandestine programs in parallel with open and safeguarded activities has occurred as in the case of North Korea, Iraq, Libya and Iran. Rather, the problem is increasing concern over the past decade of states using the NPT to openly acquire the enrichment and reprocessing capabilities that provide the means to acquire materials that could be used to develop nuclear weapons, and having done so, to possibly withdraw from the treaty on 90 days notice and develop nuclear weapons without violating the NPT. Iran is the focal point of this concern at present. The dilemma is how to interpret the inalienable right specified in Article IV with the nonproliferation obligations specified in Articles I and II of the NPT.[78]

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76 Id, at 118.

77 Zhang 2009, at 65.

78 Scheinman 2004, at 5.

Still today experts are uncertain whether precautions in negotiated treaty obligations will effectively avoid this continuously feared consequence. To address this issue, practical measures including some incentives for non-nuclear-weapon States have been considered, e.g. by creating fuel banks consisting of low enriched uranium resulting from blending down of highly enriched uranium drawn from existing nuclear weapon stockpiles, thus facilitating access to fissile material if supply was disrupted.[79] While such proposals have been unsuccessful in the past, the situation might change in future. In 2015 a fuel bank has been agreed with fuel stored in Kazakhstan and managed by IAEA.[80] The Model Supply Agreement between the IAEA and a recipient State ensures non-discrimination and compliance with Agency safeguards in accordance with Article XII A of the IAEA Statute. International fuel banks may be suited to combine reductions of military stockpiles with benefits for civilian usages, measures that could result in incentives for accepting further verification measures.

The risk of terrorist attacks and illicit trafficking are even more challenging than horizontal proliferation to States. Non-State actors increase the risks of nuclear energy use today. This was not contemplated in the 1960s when the NPT was negotiated.

Serious challenges for the safety and security of peaceful uses of nuclear energy will continue in future. The tragedies in Chernobyl[81] and Fukushima Daiichi[82] have revealed risks that were unexpected and had remained unaddressed, despite the fact that such risks may have been reduced by international monitoring and control activities. The deplorable conclusion remains that this situation has led to losses and severe damage to health of innumerable people over several generations. Those responsible are unable to provide full reparation to the victims. It remains a challenging question, how this inability is balanced out by a clear advantage for mankind, which may make it worthwhile and could justify compensating the damage at the expense of others, even in future generations. Measures adopted at global[83] as well as at regional scale[84] still need to be implemented by States and supplemented in order to fully meet their national responsibility for nuclear safety and security.

Even day-to-day tasks of nuclear waste disposal are far from being settled. Radioactive waste management still requires enormous activities to effectively

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[79] Ibid, at 6–7.

[80] Host State Agreement (HSA) governing the establishment and operation of a low-enriched uranium (LEU) fuel bank in Oskemen, Kazakhstan (27 August 2015), https://www.iaea.org/our-work/leubank; Rauf 2015.

[81] The Chernobyl Forum 2005.

[82] IAEA, Fukushima Daiichi Report 2015.

[83] See Vienna Declaration on Nuclear Safety (9 February 2015), published as INFCIRC/872 of 18 February 2015, https://www.iaea.org/sites/default/files/cns_viennadeclaration090215.pdf, https://www.iaea.org/newscenter/news/vienna-declaration-nuclear-safety-adopted-diplomatic-conference.

[84] See European Nuclear Safety Regulators Group (ENSREG), http://www.ensreg.eu.

isolate contaminated material from the biosphere over hundreds or thousands of years and ensure the success of these activities to coming generations.[85]

An effective treaty regulation to solve these problems is not in sight. It seems that even decades after the first electricity has been generated by nuclear power plants the physical, economical, environmental and ethical problems involved are not fully tackled and that new efforts will be necessary to do this in a manner convincing also the following generations. Meaningful solutions must be inter-disciplinary in nature. They should mainly focus on nuclear electricity, but other uses of nuclear radiation in medicine, biology, agriculture and industry should not be excluded, as an objective assessment may reveal different problems in these different areas and lead to different solutions.

16.3.3 Consequences for States Parties

Existing difficulties in reaching a more effective balance between the various interests involved can hardly be achieved by promoting one-sided interpretations of treaty provisions that have proven to be debatable, as their lack of precision may even be considered as the price for final adoption of the treaty at the end of controversial negotiations. What is needed here is a joint effort in identifying common interests and evolving new potentials for cooperation. To be successful, such efforts must go beyond the divide between nuclear-weapon States and non-nuclear-weapon States and the even more challenging divide between Parties and Non-Parties to the NPT. The values expressed in the three pillars—nuclear non-proliferation, the use of nuclear energy for peaceful purposes, and disarmament—are far from representing group interests only. They stand for an interest of mankind as a whole. Ambiguities in the right to develop research, production and use of nuclear energy cannot be fully solved, except by cooperation. The matter is not so much, what interpretation might be right or wrong; but which steps are to be taken to reach the goals expressed in the three pillars of the NPT.

16.3.4 Countermeasures in Case of Non-compliance

Compliance with nuclear safety and security obligations is too important to be left without sanctions for wilful breaches and even for negligence. As a matter of proportionality, countermeasures to be taken by the IAEA in accordance with the Draft Articles on Responsibility of International Organizations (DARIO)[86] and the

[85] See above, Chap. 9 (Odendahl).

[86] Draft Articles on the Responsibility of International Organizations (DARIO), UN Doc. A/66/10 (2011).

IAEA Statute should be considered here before measures to be taken by third States or the Security Council.

Article XII B of the IAEA Statute provides that

> [t]he Agency shall, as necessary, establish a staff of inspectors. The Staff of inspectors shall have the responsibility of examining all operations conducted by the Agency itself to determine whether the Agency is complying with the health and safety measures prescribed by it for application to projects subject to its approval, supervision or control, and whether the Agency is taking adequate measures to prevent the source and special fissionable materials in its custody or used or produced in its own operations from being used in furtherance of any military purpose. The Agency shall take remedial action forthwith to correct any non-compliance or failure to take adequate measures.

As spelled out in this provision, such 'remedial action' of the Agency is foreseen for 'projects subject to its approval, supervision or control'. As discussed above (Sect. 16.2.2), this condition will not be fulfilled in most cases with the result that reminders could be sent as part of a peer review process, but 'remedial action' cannot be taken.

Under Article XII A of the IAEA Statute the Agency has the right and responsibility 'with respect to any Agency project, or other arrangement where the Agency is requested by the parties concerned to apply safeguards',

> 7. In the event of non-compliance and failure by the recipient State or States to take requested corrective steps within a reasonable time, to suspend or terminate assistance and withdraw any materials and equipment made available by the Agency or a member in furtherance of the project.

This provision, again, is subject to conditions that very often may not be fulfilled, as it applies to projects under Agency safeguards, not to situations which are presently the normal case.

As a last resort Article XII C of the IAEA Statute provides that

> … The inspectors shall report any non-compliance to the Director General who shall thereupon transmit the report to the Board of Governors. The Board shall call upon the recipient State or States to remedy forthwith any non-compliance which it finds to have occurred. The Board shall report the non-compliance to all members and to the Security Council and General Assembly of the United Nations. In the event of failure of the recipient State or States to take fully corrective action within a reasonable time, the Board may take one or both of the following measures: direct curtailment or suspension of assistance being provided by the Agency or by a member, and call for the return of materials and equipment made available to the recipient member or group of members. The Agency may also, in accordance with article XIX, suspend any non-complying member from the exercise of the privileges and rights of membership.

While reporting to the Board of Governors and to States, the Security Council and the General Assembly will be possible in any case, the precise measures to be taken by the Agency in accordance with the last two sentences are, however, only applicable to projects subject to an 'agreement between the Agency and the State or States concerned'. This follows from the preceding sentence of this paragraph and is a result from the sovereignty of States to take appropriate measures to ensure safety and security within their national competence, unless agreed otherwise. It may also be left open here, whether or not ‘curtailment or suspension of assistance’ could be counter-productive in cases where nuclear safety and security is at stake.

While this account of possible countermeasures of the Agency and their limits provides in itself an argument for strengthening the monitoring and control role of the IAEA in nuclear safety and security affairs, it also shows that under the present practice States would be the first to decide on countermeasures in accordance with the Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA).[87] As all States have standing to take appropriate action against breaches of important non-proliferation obligations,[88] the same should be accepted for breaches of important safety and security obligations, considering the *erga omnes* character of these obligations and the potential detrimental effects of even the slightest negligence. This puts a distinct burden on States, which should seek to find cooperative solutions in the first case. As a last resort, Security Council action cannot be excluded.

16.4 Conclusions

The right to develop research, production and use of nuclear energy for peaceful purposes is an inalienable right of States, which is regulated by the NPT. Peaceful uses of nuclear energy focus on nuclear fuel-making activities, medical treatment and agricultural applications. In neither case are peaceful nuclear explosions an option for modern State practice. As shown above, there is a tension between the interest of States in keeping civilian nuclear options open as much as possible on the one side, and the interest in preventing acquisition or manufacture of nuclear weapons and ensuring nuclear safety and security on the other. This tension is not fully balanced out by the provisions of the NPT. There are shortcomings and loopholes in legal regulation that need to be solved in international cooperation. To do this successfully, sustainable efforts remain necessary. It is a continuing concern that States do not enter into negotiations about explicit safety (or security) regulations for fear that this will necessarily lead to a lowest common denominator. Informal cooperation and peer review may be more realistic in this situation. While they are partly more effective than strict legal regulation, they cannot replace legal regulation altogether. The following principles may be suggested as relevant for further cooperation:

1. The inalienable right to peaceful nuclear energy, which is confirmed in Article IV.1 NPT, is to be understood and implemented in accordance with existing

[87] Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA), UN DOC A/56/10 (2001).

[88] Black-Branch 2015, 370–382, 385; Singh 2012, 204–219, 248–249.

obligations under international law, most particularly with existing non-proliferation obligations. The latter obligations require that all nuclear activities will be effectively safeguarded by the IAEA. States Parties must comply with Comprehensive Safeguards Agreements and the Additional Protocol. All States must also strictly implement their obligations under UN Security Council Resolution 1540 (2004). If done effectively, this will help to create an environment that may facilitate nuclear cooperation by reducing the risks of proliferation and terrorist use of nuclear material.
2. Incentives for cooperation in the use of nuclear energy could increase mutual confidence, thus strengthening the balance between peaceful uses and activities by States and non-State actors alike to ensure non-proliferation of nuclear weapons or other nuclear explosive devices.
3. An increased international cooperation on peaceful uses of nuclear energy would also serves the confidence in effective measures on disarmament and strengthen the NPT regime as a whole.
4. Safety and security of the use of nuclear energy widely depends on international cooperation and peer review by the IAEA. Regular reporting obligations by States and monitoring and control functions of the IAEA should be introduced to strengthen the Agency's role in this field.
5. International cooperation should include activities to ensure verification of compliance with nuclear safety and security standards.
6. Challenges for the safety and security of peaceful uses of nuclear energy must be assessed in a realistic manner. In doing so, physical, economical and ethical problems need to be addressed in context, including the threat posed by terrorist groups or other non-State actors.
7. An international nuclear liability regime, which should provide for mandatory coverage of damage wherever suffered, is yet to be developed.
8. Countermeasures must be considered not only in cases of non-compliance with nuclear non-proliferation obligations, but also in cases of non-compliance with nuclear safety and security obligations.
9. The role of the IAEA, States and the Security Council in taking countermeasures and supporting international cooperation should be reconsidered in this context.

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