Chapter 1
Nuclear Law: The Global Debate

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Abstract The International Atomic Energy Agency (IAEA) plays a unique role in the development and implementation of international nuclear law. This chapter contains a short examination of the regime of nuclear law and its four pillars, namely safety, security, safeguards and civil liability for nuclear damage. It examines how we got to where we are and where we can take the global debate, taking into account current and emerging peaceful applications of nuclear science and technology such as advanced reactors and nuclear fusion. The chapter also contains an invitation to all stakeholders in the global community, including international organizations, non-governmental organizations, industry, academia and civil society, as well as all those that will be responsible for shaping nuclear law in the future, to let the debate and dialogue on nuclear law begin.

Keywords International Atomic Energy Agency (IAEA) · International nuclear law · Nuclear safety · Nuclear security · Safeguards · Civil liability for nuclear damage · Peaceful applications (of nuclear science and technology) · Advanced reactors · Nuclear fusion

International instruments, standards and norms make up the framework of nuclear law on which we build the trust that nuclear will benefit us and our planet. At its heart stands the International Atomic Energy Agency (IAEA), which ensures this vital asset remains robust and agile in the ever-changing landscape of technology, opportunity and challenge.

Just as IAEA inspections make sure nuclear material is not misused to make weapons, or its scientists support Member States in using nuclear science and technology in medicine, agriculture, and the fight against plastic pollution and

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zoonotic diseases like COVID-19, nuclear law and those who shape it provide the indispensable normative framework to sustain the whole effort.

This critical framework on which we rely today was largely built through a series of reactions to major world events, beginning with the founding of the IAEA by those emerging from World War II with the realization of nuclear energy's awesome power to both save lives and destroy them. The IAEA's verification activities enable us to provide assurances that States adhere to their non-proliferation undertakings to use nuclear material and technology exclusively for peaceful purposes. This builds shared confidence that nuclear material is not being diverted to nuclear weapons and forms the bedrock of the international non-proliferation regime.

Beyond ensuring the IAEA is a tireless, firm, unbiased, fair and transparent watch-keeper of the world's safeguards system, there are three important tasks within the legal arena that I have set myself as Director General: to work actively towards making the legal and normative framework we have today as robust as possible; to help States adhere to the laws, standards and norms that keep us all safe and allow us to enjoy the many benefits of nuclear technology; and to make it possible for all those who, together with the IAEA, shape the international nuclear legal instruments of tomorrow to be as proactive as possible.

This book includes the thoughts and ideas of some of the most distinguished people in their field, many of them lawyers. This chapter will be informed by my own experience as a student of history, an Argentine diplomat and an international civil servant. As Edmund Burke said: "In history, a great volume is unrolled for our instruction, drawing the materials of future wisdom." A short examination of the regime of nuclear law, how we got to where we are and where we can take this global debate is a good way to start. Making the global debate in nuclear law accessible to a wider audience will ensure that informed decisions are made by States considering the views and contributions of the stakeholders in the global community including international organizations, non-governmental organizations, industry, academia and civil society.

Nuclear law has four main 'pillars': safety, security, safeguards and liability. These permeate the entire nuclear sector. They cover how we handle nuclear and other radioactive material, whether it is in the laboratory of a university in Paris or on a container ship travelling to a research reactor in Nigeria. Nuclear law is essential in realizing the benefits of the safe, secure and peaceful use of nuclear technology and its applications in our daily life.

The sharpest focus is understandably on nuclear power, which is essential as it becomes an ever more critical part of the low-carbon energy mix of countries looking to avoid the worst effects of climate change while providing the sustainable and reliable fuel for their economic growth, and as advances such as small modular reactors (SMRs) require special attention. But nuclear law does much more than address questions of safety, security, safeguards and liability related to nuclear power plants (NPPs). Other major challenges continue to face humanity today and can be expected to persist in the future, including food security, health care and management of water resources, together with the need for a cleaner and safer environment. Legal frameworks enable the use of nuclear technology to address these critical issues.

As participants in the nuclear community, we therefore need to ensure nuclear law remains fit for purpose.

The nuclear sector and the laws and norms that govern it are ever-evolving and so is the IAEA. In this chapter, I endeavour to describe how we are helping our Member States to embed the lessons of the past in order to anticipate the needs of the future.

A certain rigour is required to continually evaluate the legal frameworks in which nuclear activities take place. As the Director General of the IAEA, I am keenly aware of the years it takes to master the complexity of this area where scientists, engineers, lawyers, politicians and diplomats must speak a common language. To do this, we must understand the nuclear field and its attendant laws. For us to speak a common language in the global debate, we start our journey with a basic understanding of the origins, content and evolution of this field.

On Tuesday, 8 December 1953, against the backdrop of a developing nuclear arms race between the United States of America and the Soviet Union, diplomats gathered at the United Nations (UN) headquarters in New York to hear US President Dwight Eisenhower address the UN General Assembly. In what has since become one of the most famous speeches in history, he pledged that the US would help solve the "fearful atomic dilemma" and devote itself to "finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life." In his so-called 'Atoms for Peace' speech, President Eisenhower gave an outline of what would become the IAEA and set the stage for the future Treaty on the Non-Proliferation of Nuclear Weapons (NPT),[1] two cornerstones that still govern the world's approach to ensuring that its most powerful energy source is used only for peaceful purposes.[2]

Like a coin, the IAEA's mandate has two sides. It is the world's international nuclear watchdog and it is the central intergovernmental forum for scientific and technical cooperation in the nuclear field. In this regard, it works to ensure that the safe, secure and peaceful uses of nuclear science and technology help Member States advance towards meeting their Sustainable Development Goals.

In the more than six decades of its existence, the IAEA has faced many challenges in continually renewing its role as the preeminent independent science and technology based intergovernmental organization in the UN system, and has always been agile in responding to crises. The development of robust nuclear legal frameworks has evolved since the mid-1940s at the national, regional and international levels.

As described in this chapter, past events such as the Chernobyl accident in 1986, the discovery of a clandestine nuclear weapons programme in Iraq in 1991, and the terrorist attacks of 11 September 2001 led to the development of new and the strengthening of existing international legal instruments on nuclear and radiation safety, nuclear security, safeguards, and civil liability for nuclear damage. They were also significant catalysts for change within the IAEA, resulting in the strengthening of the organization's verification, safety and nuclear security roles.

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[1] Treaty on the Non-Proliferation of Nuclear Weapons, opened for signature 1 July 1968, entered into force 5 March 1970 (NPT).

[2] Eisenhower 1953.

A basic feature of nuclear law is its focus on weighing the benefits of nuclear technology while minimizing risks. Its objective is to furnish a legal framework for conducting activities related to nuclear energy and ionizing radiation in a manner that adequately protects individuals, property and the environment in order that the public may obtain the benefits of this technology. This is done through complementary regimes dealing with safety, security, safeguards and liability.

The accident at the Chernobyl nuclear power plant (NPP) on 26 April 1986 was a wake-up call to the international community and resulted in the introduction of higher standards of nuclear safety at the international and national levels. Operators pored over their reactors and forged channels of communications that spanned even the Cold War's deeply divided political lines, creating a global safety-first culture we still benefit from today. Chernobyl led to the creation of an international legal framework in this field which today consists of four treaties adopted under the Agency's auspices. It was also a significant catalyst for the strengthening of the IAEA's role in nuclear safety.

Two conventions were adopted in September 1986 immediately after the Chernobyl accident, namely, the Convention on Early Notification of a Nuclear Accident (Early Notification Convention)[3] and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Convention on Assistance).[4] The purpose of the Conventions is to minimize the consequences of accidents or emergencies, by providing for the notification of accidents, the exchange of information and the prompt provision of assistance in the event of a nuclear accident or radiological emergency. The Early Notification Convention currently has 130 Parties and the Convention on Assistance, 124 Parties (as of September 2021).

While the status of adherence to both post-Chernobyl safety conventions is relatively high, there are still close to 50 IAEA Member States that are not yet party to these fundamental instruments. Our work is to continue to raise awareness about why all States should be party to these instruments. Significantly, the Conventions form the legal basis for the international Emergency Preparedness and Response (EPR) framework and are supported by operational arrangements which are the practical means by which the IAEA, its Member States and other international organizations maintain emergency preparedness and effectively respond to any nuclear or radiological incident or emergency.[5]

The cornerstone of the international legal framework for nuclear safety, the Convention on Nuclear Safety (CNS)[6] adopted in 1994, addresses the important subject of the safety of land-based NPPs (including storage, handling and treatment

[3]Convention on Early Notification of a Nuclear Accident, opened for signature 26 September 1986 (Vienna) and 6 October 1986 (New York), entered into force 27 October 1986 (Early Notification Convention).

[4]Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, opened for signature 26 September 1986 (Vienna) 6 October 1986 (New York), entered into force 26 February 1987 (Convention on Assistance).

[5]See IAEA 2017; IAEA 2018a; IAEA 2020a; IAEA 2020b.

[6]Convention on Nuclear Safety, opened for signature 20 September 1994, entered into force 24 October 1996 (CNS).

facilities directly related to the operation of the NPP). The CNS has 91 Parties and with limited exception all countries operating NPPs are party (as of March 2021).

As its name denotes, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management adopted in 1997 (Joint Convention)[7] addresses the back end of the nuclear fuel cycle and other radioactive waste, subjects that were not addressed earlier in the CNS. Although the Joint Convention entered into force two decades ago, it currently only has 86 Parties and more than half of all IAEA Member States are still not yet a Party to it (as of September 2021). This situation can be partly explained by the Convention's technical aspects and the need for increased awareness among decision makers of its relevance for countries with no nuclear fuel cycle-related activities. For example, nearly all countries generate radioactive waste, either from the production of nuclear electricity or from the use of radioisotopes in medical diagnosis and treatment, in industrial or agricultural applications, or in research. As such, the Joint Convention is relevant for all States.

The main innovative element of the CNS and the Joint Convention is the peer review process. At triennial meetings, officials, including regulators, subject their country's national safety practices as reflected in their national reports to a challenging but constructive peer review. Through this mechanism, they not only demonstrate commitment to applying stringent safety measures and to achieving high levels of safety but also have a unique opportunity for sharing experience and collective learning.

When we speak of nuclear law, we are referring to a body of law that includes not only legally binding international treaties, but legally non-binding instruments and standards of conduct which have a powerful norm-creating effect. Where consensus for a treaty is absent, such legally non-binding instruments can serve as a useful option with the possibility to be adopted and updated more quickly, offering simplicity and flexibility to respond to current needs. In particular, two Codes of Conduct adopted by the IAEA during the past two decades address the safety and security of radioactive sources and the safety of civil research reactors, respectively.[8] As a counterbalance to the legally non-binding nature of the Code of Conduct on the Safety and Security of Radioactive Sources of 2003[9] (and its two supplementary Guidance documents),[10] States have an opportunity to provide political support for the Code of Conduct pursuant to the relevant resolutions of the General Conference, the policy making organ of the IAEA on which each Member State sits and annually adopts resolutions that guide the work of the Agency.[11] Since 2006, a formalized process of information

[7] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, opened for signature 29 September 1997, entered into force 18 June 2001 (Joint Convention).

[8] IAEA 2004; IAEA 2006a.

[9] IAEA 2004.

[10] IAEA 2012a; IAEA 2018b.

[11] To date (September 2021), 140 States have made a political commitment to implement the Code of Conduct and 123 States have made a political commitment to the supplementary Guidance on

exchange, within the context of the Code of Conduct, on national approaches to controlling radioactive sources has been in operation.

Establishing high level principles, objectives and requirements, the conventions and codes of conduct are respectively underpinned by a comprehensive suite of detailed legally non-binding technical standards of safety, adopted on the basis of the IAEA Statute, which reflect an international consensus on what constitutes a high level of safety for protecting people and the environment. The standards, which apply to a broad range of facilities and activities, from nuclear installations to the use of radiation and radioactive sources in medicine, industry and agriculture, are developed in an open and transparent process led by the Commission on Safety Standards (CSS) with experts from Member States, in consultation with the UN and its specialized agencies.[12]

Most countries apply the Agency's Safety Standards on a voluntary basis. To facilitate national implementation, the instruments and standards are supported by voluntary practical implementation mechanisms such as the IAEA safety peer reviews and advisory services, which are carried out as an IAEA statutory function.[13] In addition, there are various other assistance activities, including the IAEA Legislative Assistance Programme, which help States to adhere to relevant international legal instruments and effectively implement them in comprehensive national nuclear legal frameworks.

The accident at the Tokyo Electric Power Company's Fukushima Daiichi NPP in Japan on 11 March 2011 was the second most impactful accident in nuclear energy's history even though leading international scientists have detected no radiation-induced health effects as a result of it.[14] Shortly after the accident, IAEA Member States unanimously endorsed an Action Plan on Nuclear Safety.[15] Further to the

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Import and Export of Radioactive Sources and 44 States to the 2017 supplementary Guidance on the Management of Disused Radioactive sources.

[12]There are four Committees supporting the IAEA Safety Standards programme: in the area of nuclear safety, the Nuclear Safety Standards Committee (NUSSC); in radiation safety, the Radiation Safety Standards Committee (RASSC); in the safety of radioactive waste, the Waste Safety Standards Committee (WASSC); and in the safe transport of radioactive material, the Transport Safety Standards Committee (TRANSSC).

[13]IAEA safety peer review and advisory services include the Integrated Regulatory Review Service (IRRS), the Operational Safety Review Team (OSART), the Emergency Preparedness Review (EPREV) missions, the Site and External Events Design (SEED) review missions, the Technical Safety Review (TSR) services, the Occupational Radiation Protection Appraisal Service (ORPAS) missions, the Safety Aspects of Long Term Operation (SALTO) missions, the Peer Review of Operational Safety Performance Experience (PROSPER) missions, the Integrated Safety Assessment of Research Reactors (INSARR) missions, the Independent Safety Culture Assessment (ISCA) missions, the Advisory Missions on Regulatory Infrastructure for Radiation Safety (AMRAS), (which can also address security as the Advisory Mission on Regulatory Infrastructure for Radiation Safety and Security of Radioactive Material (RISS)), and the Education and Training Appraisal (EduTA) missions. In 2014, the IAEA launched the Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS).

[14]IAEA 2015a.

[15]IAEA 2011a. The Action Plan was approved by the IAEA Board of Governors on 13 September 2011 and endorsed by the IAEA General Conference during its 55th regular session in 2011.

Action Plan, several actions were taken aimed at improving the effectiveness of the international legal framework on nuclear safety and strengthening IAEA peer reviews and safety standards. The Parties to the CNS[16] also adopted the Vienna Declaration on Nuclear Safety in 2015[17] which is now an integral part of the CNS review process. The Declaration enhances the implementation of the objective of the CNS to prevent accidents with radiological consequences and to mitigate such consequences should they occur. Parties to both the CNS and the Joint Convention[18] also strengthened the Conventions' peer review processes. Further, utilization on a regular basis by Member States of IAEA safety peer reviews and advisory services was encouraged. The increased usage that followed, as well as the sharing of results, experiences and lessons learned, are positive steps that should continue. Additionally, the IAEA Secretariat was called upon to perform assessment and prognosis during a nuclear or radiological emergency.[19]

The Fukushima Daiichi NPP accident reminded the international community of the need for a common understanding among countries and, whenever possible, a common approach to EPR, even for those NPP accidents happening at great distance on the other side of the globe. Broad compliance with IAEA Safety Standards is acknowledged as a key step to achieving harmonization in EPR. The need for cross-border coordination and harmonization of EPR arrangements is established in the relevant international legal instruments and standards.[20] As more countries worldwide seek to launch new nuclear power programmes and construct NPPs, discussions to harmonize EPR strategies at bilateral and regional levels are important. A harmonized response across countries in the event of a nuclear accident is vital.

Since the 1970s, there has been a growing recognition that the operation of NPPs and management of radioactive sources requires high levels of both safety and security. At its root, nuclear security aims to ensure that nuclear and other radioactive material do not fall into the hands of non-State actors who could use it for malicious purposes. This requires, for example, making borders more secure by installing radiation monitors at ports and border crossings and ensuring that police, border guards and other officials are capable of detecting and preventing the smuggling of nuclear and other radioactive material. It requires improving physical protection at nuclear installations and hospitals, including guards and cameras, so that radioactive material is not stolen.

The interface between nuclear security and nuclear safety is an area of synergy in the global nuclear law debate. Both share the same goal: to protect individuals, the public and the environment from harmful effects of ionizing radiation. However, the

[16] CNS, above n.6.

[17] IAEA 2015b.

[18] Joint Convention, above n.7.

[19] Further to the Action Plan, the IAEA General Conference during its 57th regular session in 2013 subsequently emphasized that the Secretariat's response role was to cover all nuclear and radiological emergencies. See IAEA 2013a, para 103.

[20] In particular, see the CNS and Joint Convention, as well relevant IAEA Safety Standards such as IAEA 2015c and other IAEA recommendations and guidance on EPR.

activities that address nuclear safety and nuclear security are different, and actions taken to strengthen one may affect the other positively or negatively. For example, controls to limit access to vital areas of an NPP not only serve a safety function by preventing or limiting exposures of workers and controlling access for maintenance to qualified personnel, but also serve a security purpose by inhibiting unauthorized access by intruders. There is therefore a continuing need to ensure that safety measures and security measures are designed and implemented in an integrated manner.

For 50 years, the Agency has been developing important nuclear security guidance, originally with a focus on recommendations for the physical protection of nuclear material.[21] The Agency's recommendations helped inform the discussions and negotiations of the Convention on the Physical Protection of Nuclear Material (CPPNM),[22] which was adopted in 1979 under IAEA auspices. But it was the terrorist attacks of 11 September 2001 in the United States of America that propelled a rapid and dramatic re-evaluation of the risks of terrorism in all its forms—including the threat of nuclear and radiological terrorism. This atrocity reinforced the urgent need to strengthen nuclear security without waiting for a watershed nuclear security event to provide the impetus for security upgrades and expanded international cooperation.

Following the terrorist attacks of 11 September 2001, States agreed to enhance existing international legal instruments, establish new ones to enhance nuclear security worldwide and reinforce the role of the IAEA. Specifically, agreement was reached in 2005 to adopt an Amendment to strengthen the CPPNM.[23] At the same time, the UN's International Convention for the Suppression of Acts of Nuclear Terrorism was adopted (ICSANT).[24]

Today, the legal framework for nuclear security comprises several complementary treaties, relevant resolutions of the UN Security Council and a number of legally non-binding instruments.[25] The instruments have not only been adopted by and under IAEA auspices but also by and under the auspices of the UN and its specialized agencies, notably the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO).[26] The framework includes two important resolutions of the UN Security Council adopted after the terrorist attacks of 11 September 2001 under Chapter VII of the UN Charter concerning Action with Respect to Threats

[21] IAEA 2011b.

[22] Convention on the Physical Protection of Nuclear Material, opened for signature 3 March 1980, entered into force 8 February 1987 (CPPNM).

[23] Amendment to the Convention on the Physical Protection of Nuclear Material, entered into force 8 May 2016 (Amendment to the CPPNM).

[24] International Convention for the Suppression of Acts of Nuclear Terrorism, opened for signature 14 September 2005, entered into force 7 July 2007 (ICSANT).

[25] IAEA 2011c.

[26] A primary focus of most of the relevant treaties adopted outside of IAEA auspices is on criminalization of certain acts involving nuclear or other radioactive material, as well as related aspects, whereas the instruments adopted under IAEA auspices also cover legislative, administrative and technical measures to ensure the physical protection of materials and facilities, in addition to criminalization and international cooperation.

to the Peace, Breaches of the Peace and Acts of Aggression (Resolution 1540 (2004) and Resolution 1373 (2001)).[27] Both resolutions are binding on all (currently 193) UN Member States. The entry into force of the Amendment to the CPPNM in 2016 marked an important milestone for international efforts to strengthen nuclear security worldwide. Importantly, the CPPNM[28] and its Amendment remain the only internationally legally binding undertakings in the area of physical protection of nuclear material and of nuclear facilities used for peaceful purposes.

In order to support States, the IAEA produces guidance on nuclear security, which much like IAEA Safety Standards, aims at helping States develop, implement and maintain national nuclear regimes. This IAEA Nuclear Security Series includes the important guidance on physical protection which today also addresses nuclear facilities.[29] The Nuclear Security Guidance Committee (NSGC), which oversees the publication and review of all publications in the series, is composed of representatives from IAEA Member States and includes observers such as the World Institute of Nuclear Security (WINS). Through becoming mainstreamed norms, IAEA nuclear security guidance will enjoy the same status as IAEA Safety Standards. Similar to nuclear safety, the Agency's voluntary nuclear security advisory services, such as the International Physical Protection Advisory Service (IPPAS) and the International Nuclear Security Advisory Service (INSServ), play an important role in supporting States in establishing, sustaining and enhancing their nuclear security regimes.

Our work to maintain and enhance robust legal frameworks for nuclear security must continue. We live in a world in which the number of nuclear and other facilities and activities, including NPPs, laboratories and other locations concerned with this material, is increasing. Individuals and groups with malicious intent could attempt to exploit weak links in the global nuclear security regime to create fear and panic. Not only would this cause distress, but it would also undermine the public confidence critical to the continued use of nuclear science and technology for all kinds of important, life-saving applications.

Nuclear security, like nuclear safety, is the responsibility of individual countries. However, it is universally recognized that international cooperation is key in guarding against nuclear terrorism and that the IAEA serves as the inclusive global platform for this purpose. In addition to the technical guidance and recommendations that the IAEA establishes and supports Member States in the application thereof, another part of its work relates to the provision of radiation detection equipment, including personal detectors and radiation portal monitors for scanning vehicles and containers at seaports and border posts, and training of personnel. The IAEA also provides practical nuclear security support at major public events. In addition, the Agency's unique position allows it to bring together and integrate the many valuable efforts being made throughout the world, not just by governments, but also by think tanks, non-governmental organizations and others.

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[27] United Nations 2004; United Nations 2001.

[28] CPPNM, above n.22.

[29] IAEA 2011b.

In order to eliminate weak links in the global nuclear security regime, it is essential for the relevant instruments to be universally adhered to and fully implemented.[30] We continue to promote the universalization of the Amendment to the CPPNM,[31] including through engaging with all relevant stakeholders at national, regional and international levels. We advise on the legal aspects to ensure understanding and awareness, as well as the benefits of becoming a Party to it. We also assist on technical aspects through practical assistance, expert advice, equipment and training.[32] Having a strengthened global international framework for combatting nuclear terrorism, a basis for ensuring that those involved in terrorist and other criminal acts involving nuclear material are brought to justice and denied safe haven, and stronger mechanisms for international and regional cooperation enhances the security of all States, whether they possess nuclear material or not.

In accordance with the CPPNM as amended, a Conference of the Parties to the Amendment to the CPPNM is being convened to review its implementation and adequacy in light of the situation prevailing at the time of the Conference. This Conference provides an excellent opportunity to consider the applicability of the amended Convention to contemporary challenges, including emerging issues, to discuss lessons learned in the implementation of the amended Convention, and to ensure the continued viability of the amended Convention as a living instrument going forward.

Emerging technologies, such as unmanned aerial systems and artificial intelligence, are an issue receiving ever greater attention and likely to remain a focus going forward. Such technologies and their applications present opportunities and challenges. On the one hand, emerging technologies are essential to improving operations and can be valuable for improving nuclear security. For example, technologies in areas such as artificial intelligence and big data have applications in detection, delay and response to a nuclear security event. On the other hand, there is a need to be mindful of the additional potential security risks that may accompany such technologies, especially those associated with information and computer security.

Attention to computer security has intensified in the last decade as clear and recurring proof of the vulnerabilities of computer systems has come to light. As more reliance is placed on artificial intelligence and digital control and safety systems, including those used to detect faults and shut down plants, recent events have reinforced the importance of heightened computer security. The IAEA plays an important role in supporting consideration of new technologies for nuclear security applications.[33] Adapting nuclear security to address emerging technologies means ensuring

[30] The CPPNM has 164 Parties and the Amendment 127 Parties (as of September 2021).

[31] Amendment to the CPPNM, above n.23.

[32] See IAEA 2021a.

[33] See IAEA 2021a. The IAEA Nuclear Security Plan for 2022–2025 identifies that the Agency has a recognized a role in assisting States, upon request, to strengthen protection of computer-based systems, recognizing the threats to nuclear security and from cyberattacks at nuclear related facilities, as well as their associated activities.

that they meet security requirements and fall within legal and regulatory frameworks. This requires enhanced cooperation between the public and private sectors. Emerging technologies can be expected to continue to play an important role in the global debate, whether in the context of the Conference to review the CPPNM as amended, in the context of further developing the IAEA Nuclear Security Series guidance or in connection with important ministerial level conferences on nuclear security, which the Agency has been organizing since 2013.[34]

The Agency plays a recognized central role in strengthening the nuclear security framework globally and in coordinating international activities in this field, including cooperation with other international organizations and the various initiatives on nuclear security. It is vital that we all remain ahead of the curve in guarding against nuclear terrorism. The Agency's Nuclear Security Training and Demonstration Centre, soon to be operational, will reinforce the central role the Agency plays in this area of international importance by providing training at a state of the art facility.

The need for effective safeguards is a critical component of nuclear law, in addition to the high levels of safety and security discussed earlier. The evolution of the IAEA safeguards system started at a time of great fear that nuclear weapons would dominate the arsenals of many countries across the world. That this did not come to pass is a testament to the importance of the third major pillar of nuclear law, one that lies at the core of the Agency's mission and history, namely the task of safeguarding nuclear material and related technology for peaceful purposes. As a result, the establishment and administration of safeguards became a core function of the IAEA under its Statute.[35] The IAEA, through its safeguards work, has been recognized over the last 60 years as the international authority responsible for verifying and assuring that States are not developing nuclear weapons.

The IAEA's safeguards responsibilities and workload have increased steadily since the conclusion of the first safeguards agreement in 1959. From one nuclear facility under IAEA safeguards at that time, by 1971 there were 156 nuclear facilities under safeguards in 32 States. Fast forward five decades from 1970 when the NPT entered into force, and during the year 2020 the IAEA conducted 2034 inspections at more

[34]Such conferences are forums for ministers, policy makers, senior officials and nuclear security experts to formulate and exchange views on experiences and achievements, current approaches, future directions and priorities for nuclear security, including the legal framework.

[35]IAEA 1989, Article III.A.5; in 1957, it was also anticipated that the IAEA would play a major role as an intermediary for the purposes of securing the performance of services or the supplying of materials, equipment or facilities by one Member State of the IAEA for another. This did not happen on the scale that was originally anticipated, but instead through IAEA projects and the conclusion of so-called 'project and supply agreements', which require that IAEA safeguards be applied to the supplied items (see Ibid., Article XI). It should also be noted in this context that multilateral approaches to the nuclear fuel cycle have been developed with IAEA involvement. These have addressed the front end of the nuclear fuel cycle. The first, for example, is the International Uranium Enrichment Centre formally established by the IAEA and the Russian Government in March 2010, and which is owned and operated by the Russian Federation. The second is the IAEA Low Enriched Uranium (LEU) Bank, which is owned by the Agency and hosted by Kazakhstan, and which became operational in October 2019.

than 1300 facilities and locations outside facilities under safeguards in 183 States. Even in the most challenging of times, such as during the COVID-19 pandemic, the verification work of the IAEA does not stop for a single minute. An effective and robust legal framework is essential to ensuring a credible safeguards system on a global scale.

The IAEA safeguards journey started soon after its establishment, with the first safeguards agreement concluded with Canada and Japan in 1959. Under this agreement, the IAEA safeguarded a single small research reactor and its fuel. Between 1959 and 1971, 32 States concluded with the IAEA so-called 'item-specific'[36] safeguards agreements, under which the IAEA applied safeguards only to items specified in those agreements (i.e. nuclear material, facilities or equipment). While item-specific safeguards were the norm for about 15 years prior to 1971, today the Agency only implements safeguards pursuant to item-specific agreements for three States which are not party to the NPT or nuclear-weapon-free zone treaties: India, Israel and Pakistan.

The IAEA's safeguards work changed dramatically after the entry into force of the NPT[37] in 1970. Under the NPT,[38] non-nuclear-weapon States (NNWSs) Party must conclude so-called 'comprehensive' or 'full-scope' safeguards agreements (CSAs) with the IAEA, which apply to "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." These safeguards agreements enable the IAEA to verify the fulfilment of the NNWS's obligations under Article III of the NPT with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. CSAs are based on The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, which was approved by the Board of Governors in April 1971 (INFCIRC/153).[39] As of September 2021, CSAs were in force for 178 NNWSs Party to the NPT[40] and eight NNWSs Party to the NPT

[36] Item-specific safeguards agreements were an early type of safeguards agreement which was typically required by bilateral cooperation agreements between States. The safeguards agreement itself was concluded between the IAEA and the recipient State (and occasionally with the supplier State as well). Item-specific safeguards agreements have been concluded based on the safeguards procedures specified in a succession of documents: the first safeguards system, INFCIRC/26 (covering research reactors up to 100 MW thermal) and INFCIRC/26/Add.1 (covering all reactors); and the revised system, issued first as INFCIRC/66 (based on INFCIRC/26/Add.1) and expanded in INFCIRC/66/Rev.1 (adding reprocessing plants) and INFCIRC/66/Rev.2 (adding conversion and fuel fabrication plants) (IAEA 1961, 1964, 1965, 1967, 1968, respectively).

[37] Reproduced in IAEA 1970.

[38] NPT, above n.1.

[39] IAEA 1972.

[40] For 33 States, the CSAs are also in connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco Treaty)—and for one State the CSA is also in connection with the Treaty of Bangkok. Two CSAs (reproduced in IAEA documents INFCIRC/193 (IAEA 1973) and INFCIRC/435 (IAEA 1994) include two or more States Parties and their regional safeguards organizations—the Brazilian–Argentine Agency for Accounting

had yet to bring into force CSAs required by that Treaty. CSAs are also required by regional treaties establishing nuclear-weapon-free zones.[41]

The five nuclear weapon States Parties to the NPT—China, France, Russian Federation, United Kingdom and the United States of America—have concluded 'voluntary offer safeguards agreements' (VOAs) with the IAEA. These VOAs were entered into for the purpose of encouraging widespread adherence to the NPT by demonstrating to NNWSs that they would not be placed at a commercial disadvantage by reason of the application of CSAs pursuant to the Treaty. The VOAs are also based on the document approved by the Board of Governors in 1971[42] and include the same safeguards procedures as a CSA, albeit with a different scope of application.[43] Large amounts of plutonium produced through the processing of spent fuel are safeguarded by the IAEA under VOAs in nuclear weapon States.

Several challenges have arisen in the implementation of safeguards over the course of the IAEA's existence. For the first 20 years of safeguards implementation in States with CSAs, the safeguards activities were primarily focused on verification of nuclear material and facilities declared by a State (i.e. on verifying the correctness of States' declarations and providing assurances that there is no diversion of declared nuclear material from peaceful nuclear activities in the State). Implementation of so-called 'traditional safeguards' during this period with respect to nuclear material and facilities declared by States under their CSAs was based on safeguards approaches and safeguards criteria which specify the scope, frequency and extent of the verification activities required to achieve the IAEA's inspection goals.

In the early 1990s, the discovery of Iraq's undeclared nuclear material and activities, including its clandestine nuclear weapons programme, underscored the need for the IAEA's safeguards activities to give greater consideration to a CSA State as a whole (i.e. to verify also the completeness of the State's declarations so that the IAEA could provide credible assurance that there was no undeclared nuclear material and activities in the State as a whole). That discovery coupled with the IAEA's detection of possible undeclared plutonium in the Democratic People's Republic of Korea (DPRK) in 1992, and experience from the IAEA's verification of the completeness of South Africa's declarations under its CSA in 1993, triggered efforts to strengthen the IAEA's capability to ensure that safeguards are applied as required by CSAs on all nuclear material in States with CSAs. The nearly simultaneous experiences in Iraq, the DPRK and South Africa played important formative roles in the subsequent work by the IAEA to strengthen the safeguards system.

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and Control of Nuclear Materials (ABACC) and the European Atomic Energy Community (EURATOM).

[41] Nuclear-weapon-free zones have already been established in Latin America and the Caribbean, the South Pacific, Southeast Asia, Africa and Central Asia.

[42] IAEA 1972.

[43] Under a VOA, the Agency applies safeguards to nuclear material in those facilities or parts thereof which have been offered by the State for the application of Agency safeguards and selected by the Agency from the State's list of eligible facilities in order to verify that such material is not withdrawn from safeguards except as provided for in the VOA.

The experiences in Iraq, DPRK and South Africa led directly to the launch in 1993 of 'Programme 93+2'. Historically, this was the most notable effort to further strengthen the effectiveness and improve the efficiency of IAEA safeguards, including the legal framework. The measures identified in this programme were designed to improve the IAEA's ability to detect undeclared nuclear material and activities in States with CSAs. Some of these measures (e.g. early provision of design information for new facilities, environmental sampling and the use of satellite imagery) could be implemented under the existing legal authority provided for in CSAs while others[44] required complementary legal authority. In May 1997, the Board of Governors approved the Model Additional Protocol,[45] which included the recommended measures and was the culmination of efforts to "strengthen the effectiveness and improve the efficiency of the safeguards system as a contribution to global nuclear non-proliferation objectives."

The Model Additional Protocol has significantly strengthened IAEA safeguards. Without it, what inspectors can do is limited. It gives inspectors the authority to search thoroughly, enabling the IAEA to more confidently reassure the world that no nuclear material remains unaccounted for, and none has been diverted. The additional information and broader access for the IAEA provided for in the Model Additional Protocol are designed to fill the gaps in information and access required under CSAs. The Model Additional Protocol is therefore essential for the Agency to obtain a more complete picture of the existing and planned nuclear programmes, nuclear fuel cycle related activities and nuclear material holdings of States with CSAs. Thus, the entry into force and implementation of an additional protocol (AP) in a State with a CSA is of vital importance for the IAEA to provide assurances about the exclusively peaceful nature of that State's nuclear programme.

For a State with both a CSA and an AP in force, the IAEA can provide credible assurance not only of the non-diversion of declared nuclear material from declared nuclear activities, but also of the absence of undeclared nuclear material and activities in the State as a whole and thereby draw a so-called broader conclusion for the State that all nuclear material remains in peaceful activities. As of September 2021, APs were in force for 138 States: 132 States with CSAs in force, five States with VOAs in force, and one State with an item-specific safeguards agreement in force. Forty-seven States have yet to bring into force APs to their safeguards agreements.

Changing requirements, assumptions and boundary conditions, as well as continuously improving technical capabilities and safeguards approaches, have all featured in the evolution of IAEA safeguards. The changing requirements for IAEA safeguards, along with corresponding modifications in the legal framework, have reflected the changing security needs of States over time. These security needs continue to evolve, and the IAEA continues to adapt to them.

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[44] Such measures include provision of information by the State regarding research and development activities related to nuclear fuel cycle not involving nuclear material, uranium mines, uranium and thorium concentration plants, manufacturing of nuclear related equipment, processing of intermediate or high level waste, exports of specified equipment and non-nuclear material, and broader access to locations in the State.

[45] IAEA 1997.

A prominent example of the need to adapt to the times is the continuing evolution of safeguards involving small quantities of nuclear material, which may also pose a proliferation risk as technological capabilities to produce or process nuclear material increase. The original small quantities protocol (SQP) to a CSA was introduced by the IAEA in 1974 as a means to minimize the burden of safeguards implementation for those CSA States with minimal or no nuclear activities. However, the original SQP has long been considered a weakness in the IAEA safeguards system. Under the original SQP, the IAEA does not receive facility design information at an early stage of construction of a nuclear facility or an initial report on all nuclear material, nor can it conduct any in-field verification activities in the State. As a result, in 2005, the IAEA Board of Governors modified the SQP and called on all States with SQPs to amend or rescind their protocols, as appropriate, as soon as possible through exchange of letters. Under a modified SQP, the State is required to submit an initial report on all nuclear material and early design information, and the IAEA can conduct in-field verification activities in the State.[46]

The IAEA's ability to draw a credible and soundly based annual safeguards conclusion for States that have not yet amended or rescinded SQPs based on the original standard text has become increasingly difficult to sustain. The IAEA has therefore in 2020–2021 reinvigorated its efforts to strongly and actively call upon States that have not yet done so to amend or rescind their SQPs by exchange of letters. As of 24 September 2021, 96 States had operational SQPs in force to their CSAs, of which 69 were based on the revised standard text. Ten States had also rescinded their SQPs. There were 27 States that had yet to amend their operational SQPs based on the original text.

The IAEA must keep up with advances in nuclear technology for safeguards purposes. Currently, newly produced equipment and materials are used in nuclear fuel cycle-related activities but not subject to reporting to the IAEA. In order to keep pace with the evolution of nuclear technology, consideration might be given by Member States to updating the lists of nuclear equipment and non-nuclear material relevant for the nuclear fuel cycle[47] of the Model Additional Protocol. This would enable the IAEA to obtain a more complete picture of advances in technology and verify additional activities and items relevant to the nuclear fuel cycle and safeguards.[48]

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[46] IAEA 2006b.

[47] See IAEA 1997, Annexes I and II.

[48] Regarding Annex II of IAEA 1997, it is well known that since May 1997, when the Board approved the Model Additional Protocol, the members of the Nuclear Suppliers Group (NSG) have updated the NSG's Part I, or Trigger List, six times to reflect advances in nuclear equipment including with respect to reactors and components, non-nuclear material for reactors, and plants for reprocessing, fuel fabrication, the production of heavy water and the conversion of uranium and plutonium for use in the fabrication of fuel and the separation of uranium isotopes. The IAEA already noted more than 15 years ago that updating the lists would "ensure that the Agency's safeguards system keeps pace with developments in nuclear technology, and the information acquired as a result thereof would contribute to the transparency of a State's nuclear activities and the Agency's understanding of these activities. Such an update would contribute to increasing confidence that the additional activities identified in Annex I, and the additional specified equipment and non-nuclear material identified in Annex II, are being used only for peaceful purposes." See IAEA 2006c.

At the national level, ensuring that safeguards remain effective is largely a function of having a robust system of laws and regulations in place that reflects international safeguards obligations. The IAEA has been very active in providing legislative and regulatory assistance to States, including in this area of nuclear safeguards. The IAEA can complement this work by providing further assistance in strengthening State authorities in their regulatory functions, including through providing support on the development of safeguards-related regulations. The new COMPASS initiative contributes to the strengthening of national legal frameworks. Launched at the IAEA General Conference in 2020, the initiative involves partnering with States to help strengthen the effectiveness of their State authorities responsible for safeguards (SRAs) and systems of accounting for and control of nuclear material (SSACs).

The IAEA has developed important safeguards legal instruments which are in force for many States. However, not all States have adhered to these instruments. In the area of safeguards, the main obstacle to comprehensive safeguards reaching full effectiveness is the lack of universality. From the IAEA's point of view, universality will be achieved when all NNWSs Party to the NPT[49] have met their obligation under Article III.1 of the NPT to bring into force a CSA with the IAEA (eight NNWSs Parties have yet to do so); all States with a CSA in force have brought into force an AP to their agreements (47 States have yet to do so); and all States with CSAs and original SQPs have agreed to either amend or rescind their SQPs (27 States have yet to do so). The IAEA is increasing awareness of the importance of these instruments, assisting States to adhere to them and cooperating at the highest levels in their implementation. By continuing this work, I am confident that the IAEA will ensure that the credibility of its safeguards will be an enduring feature of the nuclear landscape.

An important final point on the IAEA's safeguards authority relates to compliance with safeguards agreements and to additional verification and monitoring activities. On several occasions, the Director General has reported to the Board of Governors safeguards implementation issues encountered in States with CSAs. In some of those cases, the Board found those States to be in non-compliance with their safeguards obligations, which was reported to the UN Security Council.[50] International agreement on confidence-building measures was reached in some instances, resulting in requests for the IAEA to perform enhanced verification and monitoring of a nuclear programme. Such activities were additional to those provided for in a safeguards agreement or related protocol.

The IAEA Statute has provided the basis for the IAEA to undertake 'other verification activities' to build confidence that nuclear activities remain peaceful, including in Iraq from 1991 to 2009 pursuant to relevant UN Security Council resolutions, verification of the 'freeze' of nuclear facilities in the DPRK under the US–DPRK Agreed Framework between 1994 and 2002, monitoring and verification activities in the DPRK between 2007 and 2009 in connection with the Six Party Talks, and

[49] NPT, above n.1.

[50] See IAEA 1972, para 19.

verification and monitoring of the Islamic Republic of Iran's nuclear-related commitments under the Joint Comprehensive Plan of Action. Consistent with its statutory authority, the IAEA performed a broad range of verification activities at the request of States and when approved by the Board of Governors, thereby contributing to the maintenance of international peace and security. As nuclear activities continue to expand worldwide, IAEA verification will continue to play a key role to ensure a peaceful nuclear future.

In addition to ensuring high levels of safety, security and safeguards, nuclear law also provides for mechanisms for adequate and prompt compensation in the rare event of a nuclear incident. This is the important area of civil liability for nuclear damage, the fourth pillar of nuclear law. This pillar was first developed in the 1960s as a recognition of the potential magnitude of nuclear damage, its cross-border effects, and the resulting need for a special liability regime to facilitate the compensation of victims and to address the economic concerns of the nuclear and insurance industries. The result was the Paris Convention[51] adopted in 1960 under the auspices of the then Organisation for European Economic Co-operation (OEEC) (now the Organisation for Economic Co-operation and Development (OECD))[52] and the Vienna Convention[53] adopted in 1963 under the auspices of the IAEA.

The conventions lay down uniform rules and are designed to facilitate compensation for transboundary damage. They are based on several general principles, including that of the exclusive liability of the operator of a nuclear installation, and that this operator is strictly liable for a minimum amount of liability, which in turn is guaranteed through mandatory financial coverage, typically in the form of insurance.

The 1986 Chernobyl accident also had an impact on the international nuclear liability regime, in addition to its impact on nuclear safety discussed earlier. States responded by modernizing the existing nuclear liability instruments of the 1960s, adopting new ones and linking them together.[54] Under the IAEA's auspices, the

[51] Paris Convention on Third Party Liability in the Field of Nuclear Energy, opened for signature 29 July 1960, entered into force 1 April 1968 (Paris Convention).

[52] The so-called Paris regime consists of the Paris Convention, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982, concluded under the auspices of the OECD, open to OECD Member States and to other States if all Parties give their consent. The Paris Convention is supplemented by the 1963 Brussels Convention Supplementary to the Paris Convention, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982, that raises the level of monetary compensation for nuclear damage based on national and international public funds. Both conventions have been amended by Protocols adopted in 1964 and 1982, respectively.

[53] Vienna Convention on Civil Liability for Nuclear Damage, opened for signature 21 May 1963, entered into force 12 November 1977 (Vienna Convention).

[54] Under the IAEA's auspices States adopted: Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, opened for signature 21 September 1988, entered into force 27 April 1992 (Joint Protocol), (see also IAEA 2013b); the Vienna Convention; the Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage, opened for signature 29 September 1997, entered into force 4 October 2003 (1997 Vienna Protocol); and the Convention on Supplementary Compensation for Nuclear Damage, opened for signature 29 September 1997,

adoption of the 1997 Protocol to Amend the Vienna Convention and the 1997 CSC represented a major milestone in the development of an international nuclear liability regime. Both instruments contain important improvements in the amount of compensation available, the scope of damage covered and the allocation of jurisdiction.

More recently the 2011 Fukushima Daiichi NPP accident made evident the need for liability mechanisms to be in place before an accident occurs and the need for more States to be in treaty relations, thereby establishing a truly global nuclear liability regime. Further to the call in the 2011 IAEA Action Plan on Nuclear Safety, the International Expert Group on Nuclear Liability (INLEX), an advisory body of experts which reports to the IAEA Director General, adopted in 2012 recommendations on how to facilitate achievement of a global nuclear liability regime and how to provide better protection to victims of nuclear damage.[55] More than a decade on since the Fukushima Daiichi NPP accident and the adoption of the Action Plan, the IAEA's efforts remain focused on pursuing the establishment of such a regime.

The annual IAEA General Conference continues to encourage Member States to give due consideration to the possibility of joining the nuclear liability instruments, and to work towards establishing such a regime based on the principles of nuclear liability. With the entry into force in April 2015 of the 1997 CSC, the international community came one step closer. The 1997 CSC provides a framework for establishing a global regime with widespread adherence by nuclear and non-nuclear countries. It is now the single instrument covering the greatest number of nuclear power reactors worldwide. A regime that addresses the concerns of all States that might be affected by a nuclear incident is within our grasp and we therefore continue to promote greater adherence to the nuclear liability instruments adopted under IAEA auspices.[56]

Nuclear power is a 'cross-cutting' area of nuclear law of paramount importance, requiring the sharpest focus as it becomes an evermore critical part of the low-carbon energy mix. The operation of NPPs requires careful attention to safety, security and safeguards. Worldwide, more than 440 power reactors are in operation, accounting for about 10% of total global electricity generation and more than a quarter of the world's low-carbon electricity production. Out of more than 50 reactors currently under construction, nine are in countries building their first NPP. Some

entered into force 15 April 2015 (CSC) (see also IAEA 2020c). Under the auspices of the OECD, the Paris and Brussels Conventions will be further amended by Protocols adopted on 12 February 2004, which are expected to enter into force in early 2022: Protocol to Amend the Paris Convention on Nuclear Third Party Liability, opened for signature 12 February 2004, not yet in force (2004 Paris Protocol); Protocol to Amend the Brussels Supplementary Convention on Third Party Liability in the Field of Nuclear Energy, opened for signature 12 February 2004, not yet in force (2004 Protocol to the BSC).

[55] IAEA 2012b.

[56] The Vienna Convention, above n.53, only has 43 Parties; the 1997 Vienna Protocol, above n.54, 15 Parties; the CSC, above n.54, which finally entered into force in 2015, 11 Parties (but covering some 177 reactors) and the Joint Protocol, above n.7, 31 Parties. Most of the Paris Convention States are also party to the Joint Protocol but none of them are party to the CSC. Further, there are also a handful of countries with NPPs that are still not yet party to the instruments.

28 countries have expressed interest in nuclear power and are considering, planning or actively working to include it in their energy mix. Another 24 Member States participate in the IAEA's nuclear infrastructure related activities or are involved in energy planning projects through the technical cooperation programme.[57] To further encourage nuclear development, innovative approaches to financing and support policies, including from development finance institutions, are important to support the transition to a low-carbon economy.

A new nuclear power programme is a major undertaking requiring careful planning, preparation and investment in time, institutions and human resources. A decision to start a nuclear power programme should be based on a commitment to use nuclear power safely, securely and peacefully. The commitment includes joining all the relevant international legal instruments; this being a normative expectation of IAEA Member States. The international legal frameworks establish minimum obligations and provide a means of assurance of safety and security. Current new-build experience shows the importance of developing a sound national nuclear infrastructure, including a comprehensive and effective legislative and regulatory framework. It is important that the legal frameworks be robust to ensure that levels of safety or security remain high.[58]

The choice of an NPP site can be politically contentious, especially where the site is close to a border or shared waterway. It can give rise to specific legal and policy issues of concern, especially from neighbouring countries. As more countries worldwide seek to launch new nuclear power programmes and construct NPPs, enhanced discussions on effective and harmonized mechanisms addressing transboundary concerns, including environmental impacts, are needed. Such mechanisms can help to avoid or minimize disputes which can undermine the important role of nuclear energy.

Related to this issue are the topics of the rights of access to environmental information, public participation in the environmental decision making process and access to justice in environmental matters. A recent regional development in this context is the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement).[59] Significantly, it is the first international treaty in Latin America and the Caribbean concerning the environment.[60]

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[57] IAEA 2021b.

[58] The IAEA Milestones Approach is the leading publication for use by Member States in the development of new and expanding nuclear power programmes, IAEA 2015d. The Milestones Approach is supported by Integrated Nuclear Infrastructure Review (INIR) missions, which provide expert and peer-based evaluations, in helping requesting Member States to determine their nuclear infrastructure development status and needs.

[59] Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, opened for signature 27 September 2018, entered into force 22 April 2021 (Escazú Agreement).

[60] This agreement was adopted by representatives of 24 countries of the Economic Commission for Latin America and the Caribbean (ECLAC) at the 9th meeting of the negotiating committee on 4 March 2018 in Escazú, Costa Rica. The agreement is open to 33 countries in Latin America

New technologies represent another important cross-cutting area of nuclear law, specifically with the introduction of advanced reactors including SMRs and transportable nuclear power plants (TNPPs). Across the world, several Member States continue to research, develop or deploy advanced fission reactors which consist of both evolutionary reactor technologies and innovative reactor technologies that may not use water as a coolant and moderator but rather use gas, molten salt or liquid metals.[61] These newer generation reactors are designed to generate typically up to 300 MW of electric power, and consist of components and systems that can be shop fabricated and then transported as modules to the sites for installation as demand arises. More than 70 SMR designs are currently in various stages of design and development and a few concepts are close to deployment.

Like large nuclear reactors, SMRs provide low-carbon energy, but they are smaller, more flexible and more affordable. They are an option to fulfil the need for flexible power generation for a wider range of users and applications and to replace ageing fossil fuel-fired power plants. They can be used on smaller power grids notably in developing countries and be built in hard-to-reach places like remote communities with less developed infrastructures where large reactors would not be practical. The driving forces in the development of SMRs are their specific characteristics: smaller size, use of novel technologies, modular design and more flexible deployment approaches. The novel approaches in the design and deployment of SMRs, as well as differences from traditional land-based NPP new-build projects such as factory manufacturing and testing, and new construction and commissioning methods, provide an opportunity to consider the need for tailor-made approaches, including for licensing. Although the IAEA Safety Standards can generally be applied to SMRs, global experts from the SMR Regulators' Forum are working on a tailor-made solution to help national authorities regulate this new class of reactor. To facilitate deployment of SMRs there are also calls in some fora for the harmonization of safety requirements, recommendations and guidance globally.

The IAEA supports its Member States through cooperation in SMR design, development and deployment and by serving as a hub for sharing SMR regulatory knowledge and experience. Recognizing the increasing global interest in SMRs, the IAEA recently established an Agency-wide SMR Platform to provide integrated support to Member States on all aspects of their development, deployment and oversight.

The IAEA is keenly aware of the challenges that SMRs and TNPPs pose for the implementation of safeguards and is working with stakeholders to consider how effective safeguards measures could be applied when such reactors are constructed,

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and the Caribbean. Of the 24 signatories, it has been ratified by 12. Following the accession of Argentina and Mexico on 22 January 2021, the Agreement entered into force on 22 April 2021. The objective of the agreement is to guarantee the full and effective implementation in Latin America and the Caribbean of the rights of access to environmental information, public participation in the environmental decision making process and access to justice in environmental matters, and the creation and strengthening of capacities and cooperation, contributing to the protection of the right of every person of present and future generations to live in a healthy environment and to sustainable development.

[61] IAEA 2020d.

exported, deployed or operated. Such reactors could present the appropriate solution for countries with energy needs on islands, in remotely located areas without interconnected electricity grids, or for countries with immediate needs for energy but without the full infrastructure required for stationary NPPs. Depending on the user requirements, such a plant can be operated by the supplier or by an entity from the receiving country.

For the effective and efficient implementation of safeguards at new facility types, safeguards measures need to be considered from the initial design planning stages. The IAEA has been working to support States and the nuclear industry in this area by providing 'safeguards by design' guidance in order to help implement safeguards effectively and efficiently. For facilities at the design stage or under construction, the IAEA has been working closely with the relevant State and/or regional authority, and facility operators, to incorporate safeguards features into the design of new facilities. For example, the IAEA has continued to cooperate closely with Finland, Sweden and the European Commission in the planning of safeguards implementation at encapsulation plants and geological repositories; with the Republic of Korea on planning for safeguards implementation at future pyroprocessing plants; with China to develop safeguards approaches for the high temperature gas-cooled pebble-bed reactor; and with Japan on the safeguards approach for the mixed oxide fuel fabrication plant at the Rokkasho site.

As new technologies and reactor types are deployed, nuclear law does not lose sight of the older models which they may replace. More than half of the reactors currently operating around the world are older than 30 years. Long term operation or lifetime extension of NPPs is a growing trend. Also, decommissioning of nuclear installations is gaining importance as an increasing number of reactors and related facilities are being permanently shut down or will be soon. Legal requirements form the basis to ensure that financial resources are sufficient and available to cover all decommissioning costs. The international legal framework contains important general principles in this regard.

The vision of decommissioning is evolving, reflecting new trends and concepts such as sustainable development and circular economy principles. Thus, the end-state definition is going beyond purely radiological criteria and more and more often covering wider environmental and even culturological context. That poses new challenges for decision making and stakeholders' involvement processes. National legal frameworks need to evolve to adopt emerging practices such as the transfer of the site from a previous owner to a decommissioning operator. Potential implications of such approaches relate, for example, to nuclear liability issues and the adequacy of funding collected and transferred, which could affect the achievement of the decommissioning goals.

Few issues play as central a role in the public acceptance of nuclear technologies as the management and disposal of spent fuel and high level radioactive waste. At the opposite side of the scale, finding suitable endpoints is often also a concern in many States having responsibility for a comparatively small national radioactive waste inventory resulting from a more limited use of nuclear technologies, such as in medical, food or research applications.

In recent years, there has been significant progress in the development of national deep geological repositories for high level radioactive waste.[62] The most advanced programmes are nearing the formal recommendation for the disposal site, and a few are preparing approaches for the construction and operation of their deep geological disposal facility or are preparing the licence application for spent fuel emplacement in a facility under construction. Looking to the future, an increasing focus not only on the scientific and technical issues, but also on societal, political, legal and economic aspects that influence public perceptions of the safety and feasibility of implementing the geological disposal concept, will be critical.

No shared multinational, regional or international repository currently exists. However, national developments may spark a renewed interest in such repositories which could make technical and economic sense and offer safety, security and non-proliferation advantages. It can also be advantageous from an environmental viewpoint to have a small number of large repositories rather than many small ones. Further consideration of these concepts can be expected.

Remaining nimble and prepared to respond to emerging challenges in nuclear law requires us to be prepared for the advent of other game-changing technologies which lie within our grasp, such as nuclear fusion. It holds the promise of endless low-carbon energy and could be a game-changer in the fight against climate change. Fusion is now progressing from the academic ambit to a much more technological approach, and the quantities of radioactive substances generated by more advanced facilities will be much higher than those currently generated by existing experimental facilities. There are currently multiple projects in multiple countries developing multiple designs of fusion facilities. Lately, there have been some breakthroughs but fusion is not expected to contribute to power generation before 2050.

As investments and efforts expand in the area of nuclear fusion, there is a need to consider what legal frameworks are required to support the commercialization of safe fusion energy facilities, whether existing legal frameworks for fission reactors should apply or be adapted to apply to fusion technology, or whether there is a need for new fusion-specific legal frameworks and regulatory approaches.

It is generally acknowledged that the legal framework for the protection of the environment from the impact of nuclear activities has two distinct bodies of law: nuclear law, which mostly covers aspects related to radioactivity; and environmental law, which covers all types of hazard but may also include requirements for the protection of the environment against the harmful effects of ionizing radiation. Synergies between nuclear and environmental law, which share the common goal of protecting the environment, are essential for this purpose.

Some fundamental international legal principles and environmental law instruments addressing both substantive and procedural aspects are pertinent to nuclear activities. In particular, there is the 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters

[62] IAEA 2021b, paras 49–50.

(Aarhus Convention)[63] of the United Nations Economic Commission for Europe (UNECE), the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)[64] and the 2003 Protocol on Strategic Environmental Assessment (Kiev Protocol),[65] adopted under the auspices of the UNECE.

Over the last few decades, international nuclear law has also focused more actively on protecting the environment and granting a specific status to the environment. Looking forward, a continuing focus on the protection of the environment in the nuclear sector can be expected, not least in areas such as strengthening of the IAEA Safety Standards and stakeholder access to nuclear information and participation in nuclear decision making, as well as the prevention of and compensation for environmental damage caused by nuclear incidents.

The IAEA serves as a hub for experts and representatives of Member States to share experiences and discuss topical issues in this field. In contributing to shaping nuclear law for the future, the IAEA and its Member States continue to be vigilant in assessing whether the legal frameworks for and related to the safe, secure and peaceful uses of nuclear technology and its applications are adequate to address future challenges. The IAEA works actively towards making the legal and normative framework we have today as robust as possible. There are opportunities to perform outreach to regional organizations such as the Association of Southeast Asian Nations (ASEAN), the African Commission on Nuclear Energy (AFCONE), the Forum of Nuclear Regulatory Bodies in Africa (FNRBA) and the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), as well as to parliamentarians at the national and international levels through collaborating with organizations such as the Inter-Parliamentary Union (IPU). There are also opportunities to promote universalization with like-minded Parties to the relevant international legal instruments that wish to demonstrate leadership in supporting outreach to those States which are not yet party.

Owing to the complexity of nuclear technology, policies, laws and regulations, knowledgeable and skilled legislative drafters are required. IAEA training has traditionally focused on helping officials in Member States develop the skills needed for drafting nuclear legislation. Importantly, through the Legislative Assistance Programme we help States to adhere to all the international legal instruments and assess, review and develop nuclear legislation, to gain a better understanding of the international legal instruments, and to implement their international obligations. In addition, our legislative support includes scientific visits and fellowship opportunities in the IAEA Office of Legal Affairs and in national regulatory bodies.

Effective and comprehensive national and international legal frameworks for the safe, secure and peaceful use of nuclear science and technology underpin the lives and

[63] Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, opened for signature 25 June 1998, entered into force 30 October 2001 (Aarhus Convention).

[64] Convention on Environmental Impact Assessment in a Transboundary Context, opened for signature 25 February 1991, entered into force 10 September 1997 (Espoo Convention).

[65] Protocol on Strategic Environmental Assessment to the Espoo Convention, opened for signature 21 May 2003, entered into force 11 July 2010 (Kiev Protocol).

livelihoods of billions of people, allowing all of us to strive to live better today and in the future. Such frameworks build the public trust necessary so that nuclear science and technology can benefit everyone. With the increasing utilization of nuclear technologies and the significant number of Member States involved in drafting or revising nuclear legislation, or planning to do so, the demand for reviewing draft and enacted legislation and for the training of drafters remains high. This demand will continue to be addressed through the annual IAEA Nuclear Law Institute (NLI) and its interactive programme, complemented where needed and requested through tailored national activities. Since the launch of the NLI in 2011, some 550 professionals from all regions of the world have graduated, nearly half of them women.

Governments are continuing to call upon the IAEA to raise the awareness of policy makers, decision makers and senior officials about the importance and benefits of the instruments and about the importance of putting in place and maintaining an adequate national nuclear legal framework. They are also increasingly calling upon us to assist in raising the awareness of parliamentarians in these areas.

In the coming years, regional training approaches on nuclear law will likely play an increasingly important role, in line with regional needs, interests and priorities. These approaches could be facilitated through collaborative arrangements with regional or national training or education centres, and some Member States have expressed interest in becoming centres for training in nuclear law at the regional level.

As the IAEA's membership grows and as Member States expand their uses of nuclear technology, the IAEA is likely to be increasingly called upon to provide legislative assistance. To further ensure that robust nuclear law frameworks are able to meet this moment, the IAEA's Secretariat remains at the ready to provide services for meetings held in conjunction with the conventions and codes of conduct. The IAEA will also maintain a spotlight on its unique function to establish safety standards and play a central role in developing comprehensive nuclear security guidance publications, according to the priorities set by Member States. Finally, the IAEA will be relied on to optimize its ability to conduct, upon request, peer reviews and advisory services as a feedback mechanism to facilitate the implementation of safety standards and nuclear security guidance. Remaining proactive in delivering such services, the IAEA will support the continued contribution of nuclear technology to human progress.

Making the global debate in nuclear law accessible is an essential prerequisite to ensure that informed decisions can be made by States. The Agency has an important role to play in this context. As with all technical conferences hosted by the IAEA, the 2022 International Conference on Nuclear Law provides a unique forum for leading global experts from governments, international and non-governmental organizations, industry and its advisers, academia and civil society to share experiences and discuss topical issues. But the discussions that take place today and the decisions arising therefrom will either directly or indirectly affect the interests of the generations to come.

The evolution of nuclear technology and its benefits has and will continue to span multiple generations. To optimally address global needs, therefore, we have a responsibility to take into account the views of not only our generation of nuclear

lawyers, policy makers and scientists but also the next. It falls to each generation to re-envision the role of nuclear in improving the world. Our debate therefore needs to involve those who will be responsible for shaping nuclear law in the future.

The promise of the future well-being of humanity can be achieved through the deployment of technologies to support clean energy, clean air, clean water, resilient agriculture and the highest level of medical care. Nuclear technology can propel us forward on a sustainable path in each of these areas. Effective implementation of nuclear law frameworks is key to ensuring that we forge this path in a safe, secure and peaceful manner.

Nuclear law will continue to provide a foundation to achieve the goal of harnessing the power of nuclear technology to fulfil the dream envisioned in the Atoms for Peace speech, namely to devise methods whereby this technology would be allocated to serve the peaceful pursuits of mankind and experts are mobilized to apply it to the needs of agriculture, medicine and other peaceful activities, and provide electrical energy for sustainable development. Through this debate, we can shape the world we want to live in 50 years from now—the world we wish to leave for future generations.

The IAEA is the world's centre for cooperation in the nuclear field and will remain a pivotal force in ensuring that nuclear technology contributes to this future in partnership with our Member States and other organizations. Nuclear legal frameworks are an integral part of the global nuclear architecture and critical to its future. As the principal forum for the global debate on nuclear law issues, the IAEA, together with all those who wish to join us, will continue its efforts to shape a brighter nuclear future.

Let the Global Debate begin.

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