Chapter 12

Nuclear Liability and Post-Fukushima Developments

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Abstract The international community has developed a series of conventions on civil liability for nuclear damage, which aim to ensure compensation is available for damage, including transboundary damage, caused by a nuclear incident. Those conventions have struggled to gain universal adherence, and the “global regime” called for in 2011 is at best a patchwork quilt, with a number of treaties with differing memberships, and many States (including States with large and growing nuclear

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sectors) not party to any convention. However, the principles of the conventions are reflected in national laws in most States which operate nuclear power reactors and associated facilities. This chapter assesses the current global nuclear liability regime and discusses a series of recommendations made by the International Expert Group on Nuclear Liability (INLEX) to allow the international community to respond to the continued evolution of the nuclear industry.

Keywords Nuclear liability · Civil liability for nuclear damage · Global nuclear liability regime · International Expert Group on Nuclear Liability (INLEX) · Fukushima · Convention on Supplementary Compensation (CSC) · Paris convention · Vienna convention · Joint protocol · Nuclear incident · Radioactive sources · Transportable nuclear power plants (TNPPs) · Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency · Decommissioning · Waste disposal · Nuclear fusion · Small modular reactors (SMRs) · Nuclear-powered ships

12.1 Introduction

The issue of nuclear liability may appear somewhat arcane, but it is vital to the future of the nuclear industry. Unless there is public confidence that innocent victims will be properly compensated in the unlikely event of a nuclear incident, the nuclear industry will struggle to gain the social licence it needs—both at the national level and internationally. The international community has developed a series of conventions which reflect common principles in relation to strict liability, the liable entity, the court in which claims would be heard, the amount of money which must be available, and the protection of victims located in a country different from the one in which the liable entity is located. Although those conventions have struggled to gain universal adherence, their principles are reflected in national laws in most States which operate nuclear power reactors and associated facilities. The International Expert Group on Nuclear Liability (INLEX) provides advice to the Director General of the International Atomic Energy Agency (IAEA) on the implementation of the conventions and on their application to the evolving nuclear landscape.

12.2 International Expert Group on Nuclear Liability

The Director General of the IAEA established INLEX in 2003. INLEX serves three major functions:

- (a) Creating a forum of expertise to explore and advise on issues related to nuclear liability;
- (b) Enhancing global adherence to an effective nuclear liability regime; and

- (c) Assisting in the development and strengthening of the national nuclear liability legal frameworks in IAEA Member States.¹

Since its establishment, the Group has held regular annual meetings where it has explored and advised on issues regarding the existing international liability regime for nuclear damage. In this context, INLEX finalized explanatory texts on the nuclear liability instruments adopted under Agency auspices in 1997² and on the Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention of 1988.³

12.3 Actions Taken in Direct Response to the Accident

In September 2011, six months after the accident at the Fukushima Daiichi nuclear power plant, the IAEA Board of Governors approved an Action Plan on Nuclear Safety, which was also endorsed by the IAEA General Conference.⁴ In respect of nuclear liability, the plan called on:

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.⁵

In response to the second sentence of that action, INLEX reviewed the actions taken by Japan under its national nuclear liability law to provide compensation to those affected by the accident in order to identify whether there were any instances where victims were not properly compensated because of a gap in that law. Whilst Japan was not party to any of the international conventions at the time of the accident, its national law generally reflected their content; the detail, amendments to and operation of that law after that accident have been expounded in great detail elsewhere,⁶ and I will not attempt to summarize them here.

That review found no such gaps. What was obvious, however, was that the lack of treaty relations would have been the cause of significant disputes between States

¹<https://www.iaea.org/about/organizational-structure/offices-reporting-to-the-director-general/office-of-legal-affairs/international-expert-group-on-nuclear-liability-inlex>. Accessed 13 July 2021.

²IAEA 2017.

³Joint 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); IAEA 2013.

⁴<https://www.iaea.org/topics/nuclear-safety-action-plan>. Accessed 13 July 2021; see IAEA 2011a.

⁵IAEA 2011b.

⁶OECD/NEA 2012.

had damage spread beyond Japan,⁷ and that the amount of damage caused by the Fukushima Daiichi accident had demonstrated the inadequacy of the minimum amounts specified in the conventions (the 1960s conventions, the amending protocols adopted in 1997 and 2004, and the Convention on Supplementary Compensation (CSC))⁸ in the event of a major nuclear incident.⁹ Consequently, INLEX made a number of recommendations¹⁰ directed at developing a global nuclear liability regime and at increasing the amounts of compensation available at the national level.

12.3.1 Strengthening the Global Nuclear Liability Regime

The recommendations directed at strengthening the regime were, as is always the case with nuclear liability, a political compromise:

1. All Member States with nuclear installations should adhere to one or more of the relevant international nuclear liability instruments that contain commonly shared international principles reflecting the enhancements developed under the auspices of the IAEA during the 1990s. In addition, all Member States with nuclear installations should adopt national laws that are consistent with the principles in those instruments and that incorporate the best practices identified below.
2. All Member States with nuclear installations should strive to establish treaty relations with as many States as practical with a view to ultimately achieving universal participation in a global nuclear liability regime that establishes treaty relations among all States. The INLEX experts note that the CSC establishes treaty relations among States that belong to the Paris Convention, the Vienna Convention¹¹ or neither, while leaving intact the Joint Protocol¹² that establishes treaty relations among States that belong to the Paris Convention or the Vienna Convention. In addition to providing treaty relations, the CSC mandates the adoption of the enhancements developed under the auspices of the IAEA and contains features to promote appropriate compensation, including an international fund to supplement the amount of compensation available for nuclear damage.
3. Member States with no nuclear installations should give serious consideration to adhering to a global regime, taking into account the benefits which such a regime can offer for victims once it achieves adherence by a significant number of States with nuclear installations.

⁷Even though damage was confined to Japan, that did not prevent multiple court cases being brought in the United States of America; see later discussion.

⁸Convention on Supplementary Compensation for Nuclear Damage, opened for signature 29 September 1997, entered into force 15 April 2015 (CSC).

⁹Noting that Japan's domestic law did not have a cap on liability and that the Japanese government had put in place a legislated scheme to ensure that all claims were paid in full.

¹⁰IAEA 2012.

¹¹Paris 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); Vienna Convention on Civil Liability for Nuclear Damage, opened for signature 21 May 1963, entered into force 12 November 1977 (Vienna Convention); additional protocols amending both conventions have come into force since their original adoption.

¹²Joint Protocol, above n. 3.

Unfortunately, these recommendations have largely been ignored by the international community. In the decade since 2011, the number of States Parties to the 1997 Vienna Convention¹³ has only increased from six to fifteen; of those nine additional States Parties, only the United Arab Emirates has nuclear power reactors in operation.¹⁴ The CSC¹⁵ has fared only slightly better: prior to March 2011, only four States¹⁶ had ratified the convention; since then, another seven have, including nuclear power States Canada, India, Japan and the United Arab Emirates. The CSC now covers around 40% of the world's operable power reactors.

One promising recent event has been the announcement that the 2004 protocols to the Paris Convention¹⁷ and to the Brussels Supplementary Convention to the Paris Convention (BSC)¹⁸ will enter into force on 1 January 2022. The delay in entry into force was largely attributable to a stipulation from the European Commission that all European Union (EU) Member States party to the Paris Convention¹⁹ could only ratify the protocols simultaneously, which meant in practice that their entry into force was held hostage to the Member State with the slowest legislative process.²⁰ Fortunately, there have been no nuclear incidents in the territory of any of the parties to the Paris Convention in the intervening years. Whilst the entry into force of the protocols is certainly welcome, the States Parties to that convention represent only 23% of the world's operable power reactors, a share that will continue to decline as a result of political decisions to phase out nuclear power in some EU Member States and increasing new build in developing countries.

What all this means is that there is not a global nuclear liability regime at present. Instead, we have:

- The 1960 Paris Convention as amended by the Additional Protocol of 28 January 1964, by the Protocol of 16 November 1982 and by the Protocol of 12 February 2004,²¹ which after 1 January 2022 will provide for significantly higher minimum limits of liability (and thus greater amounts of compensation)²² than any other

¹³Vienna Convention on Civil Liability for Nuclear Damage of 21 May 1963, as amended by the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage of 29 September 1997, entered into force 4 October 2003 (1997 Vienna Convention).

¹⁴Noting that of the pre-March 2011 parties Argentina, Belarus and Romania have power reactors.

¹⁵CSC, above n. 8.

¹⁶Including Argentina, Romania and the United States of America.

¹⁷Protocol to Amend the Paris Convention on Nuclear Third Party Liability, opened for signature 12 February 2004, not yet in force (2004 Paris Protocol).

¹⁸Protocol to Amend the Brussels Supplementary Convention to the Paris Convention, opened for signature 12 February 2004, not yet in force (2004 BSC Protocol).

¹⁹Paris Convention, above n. 11.

²⁰Which turned out to be Italy.

²¹2004 BSC Protocol, above n. 18.

²²Particularly when backed up by the 2004 BSC Protocol, above n. 18.

convention. However, the geographical scope of the Paris Convention is restricted to a region with a declining nuclear power industry.²³

- The 1963 Vienna Convention,²⁴ which covers a number of States operating nuclear power reactors in eastern Europe and elsewhere, but was implicitly found in the 1990s to offer inadequate protection to victims.
- The 1997 Vienna Convention,²⁵ which has few States Parties (and very few with nuclear power reactors).
- The Joint Protocol,²⁶ which creates treaty relations between most States party to the Paris Convention and a number of States party to the 1963 Vienna Convention and the 1997 Vienna Convention. However, the disparity in the minimum limits of liability between the parties to the Paris Convention²⁷ and the parties to the 1963 Vienna Convention has caused some disquiet among the parties to the Paris Convention; when approving the Joint Protocol in 2014, France made a reservation effectively imposing a reciprocity requirement on parties to the Vienna Convention.²⁸
- The CSC,²⁹ which only has a small number of States Parties (albeit including some important nuclear States), none of which are party to the Paris Convention.

All this means that the “global regime” called for in 2011 is at best a patchwork quilt, with a number of treaties with differing memberships, and many States (including States with large and growing nuclear sectors) not party to any convention. Whilst the consequences of most nuclear incidents will be restricted to the territory of the incident State,³⁰ and most nuclear power States have domestic legislation that reflects the principles of the conventions, the five Fukushima-related lawsuits brought in US federal courts in California, the District of Columbia and Massachusetts following the Fukushima Daiichi accident illustrate the perils of a lack of treaty relations.³¹

²³Noting that Turkey is an exception to that general statement, being both a party to the Paris Convention and a State with an active new build programme; however, as of the date of writing this paper, Turkey had yet to ratify the 2004 Paris Protocol.

²⁴Vienna Convention, above n. 11.

²⁵1997 Vienna Convention, above n. 13.

²⁶Joint Protocol, above n. 3.

²⁷Particularly as amended by the 2004 Paris Protocol, above n. 17.

²⁸“France makes a reservation regarding subpara 2 of Article IV, specifying that, for States which limit the amount of the liability of the operator and which are Parties to the Vienna Convention and the Joint Protocol, France reserves the right to provide, in case of nuclear accident in its territory, that the operator responsible shall be liable for the nuclear damage caused in the territory of one or several of these States up to the amount provided for by the national law of these States at the time of the accident for reparation of nuclear damage caused in French territory.”

²⁹CSC, above n. 8.

³⁰The Chernobyl accident appears to be an outlier in many ways.

³¹For the discussion following, I am indebted to Omer Brown for access to his unpublished presentation to the OECD NEA Nuclear Law Committee in June 2021.

Plaintiffs favour US courts, especially given the lower nuclear liability limits of many other countries, the more generous attitudes of US juries, the potential availability of punitive damages, liberal discovery, contingency fees and large damage awards. Additionally, non-governmental entities typically make attractive targets for plaintiffs' lawyers, because, for example, they are more likely subject to jury trials, have fewer defences against executions of judgements and lack sovereign immunity.

Because there were no treaty relations in respect of nuclear liability between the United States of America and Japan at the time of the accident, US courts were under no obligation to defer to the jurisdiction of Japanese courts and were not bound by rules regarding the channelling of liability exclusively to the operator. Consequently, the defendants in the US cases included not only the operator of the Fukushima Daiichi plant, the Tokyo Electric Power Company (TEPCO), but also a number of suppliers. The plaintiffs included not only US citizens but also Japanese citizens with no connection to the United States of America.

Even though Japan's nuclear liability law channels liability for nuclear damage exclusively to nuclear operators, and provides for unlimited liability (with the Japanese Government committing more than US\$76 billion to resolve Fukushima-related claims as of February 2021), the last two of the five US lawsuits were not dismissed until 20 May 2021, following consideration of the cases by three US district courts, two US courts of appeals, and the US Supreme Court. There appears little doubt that a critical factor in the eventual decisions to dismiss the various cases was the absence of any cap on liability in Japanese law, which meant that the defendants were ultimately able to successfully argue that Japanese courts offered the most convenient venue in which claims could be heard.

12.3.2 Increasing the Amounts of Compensation

In making recommendations to increase available amounts of compensation at the national level, INLEX implicitly recognized the impracticality of either amending the conventions to increase the minimum liability limits prescribed therein, or of utilizing the complex mechanisms set out in the conventions to increase those limits.³² Those recommendations are:

All IAEA Member States with nuclear installations should ensure that there are adequate funds available to compensate all victims of a nuclear incident, without discrimination. Therefore, such Member States should in particular:

- a. Establish compensation and financial security amounts significantly higher than the minimum amounts envisaged under the existing instruments;
- b. Undertake regular reviews of the adequacy of compensation amounts in order to ensure that their value is maintained and that they reflect developments in the understanding of the possible impact of incidents involving the installations on their territory, noting that there is a trend towards establishing unlimited liability of the operator;

³²1997 Vienna Convention, above n. 13, Article V D; CSC, above n. 8, Article XXV.

- c. Undertake regular reviews of the adequacy of financial security amounts in order to ensure that those amounts reflect available capacity in insurance markets, as well as other sources of financial security;
- d. Be prepared to set up appropriate funding mechanisms in cases where the amount of damage to be compensated exceeds the available compensation and financial security amounts;
- e. Provide compensation for latent injuries, noting that the revised Vienna and Paris Conventions set a 30 year time limit for filing claims for personal injury; and
- f. Ensure that compensation is available in the case of an incident directly due to a grave natural disaster of an exceptional character.”

It would be valuable to survey IAEA Member States (not just parties to the conventions) to measure the extent to which those recommendations have been actioned.³³ The author is aware that:

- (a) Canada increased its national nuclear liability limit to 1 billion Canadian dollars³⁴ as part of the legislative package adopted to allow for ratification of the CSC.³⁵ In 2021, the Canadian Government undertook a review of the 1 billion Canadian dollar limit, pursuant to a requirement in the national law that requires the responsible minister to review the liability limit at least once every five years.³⁶
- (b) The United States of America has continued, in accordance with the legislative scheme known as the Price–Anderson Act, to index the amount payable by each operator in the United States of America³⁷ in the event of a grave nuclear disaster, thereby increasing the total amount of the pool that would be used to compensate victims in such an event. The amount for which each plant has to be insured has also been increased. As a result of both these steps, the total amount of money available to pay compensation in the event of a grave nuclear disaster³⁸ is now US \$13,522,836,000.³⁹
- (c) The amount of money available in the global nuclear insurance market has continued to increase over the years and is now well in excess of the amounts set out in the conventions.

³³Noting that in the case of Japan a number of those recommendations had been actioned either prior to the accident or in the immediate aftermath.

³⁴Approximately 560 million Special Drawing Rights (as of 7 September 2021).

³⁵CSC, above n. 8.

³⁶The review was ongoing at the time of writing this paper.

³⁷Noting that when a plant is permanently shut down, the former operator of the plant is no longer bound to pay a deferred premium following a nuclear incident, meaning that the total compensation amount available shrinks.

³⁸Leaving aside both moneys payable by other States Parties under the CSC and the possibility foreseen under the Price–Anderson Act that Congress could vote for additional moneys to be provided by government.

³⁹Approximately 9.5 billion Special Drawing Rights (as of 9 September 2021).

12.3.3 Other Recommendations

The remaining recommendations from INLEX were that:

All Member States should:

- a. Ensure that all claims arising from a nuclear accident are dealt with in a single forum in a prompt, equitable and non-discriminatory manner with minimal litigation, which could include a claims handling system (which may be set up in close cooperation with insurers or other financial guarantors) in order to deal equitably and expeditiously with all claims;
- b. Use the model legislation developed by the IAEA as a guide, as appropriate, when drafting or revising national nuclear liability legislation.

The experience of Japan in using a claims handling system to address the great majority of compensation claims has encouraged a number of other States to make provision for the rapid creation of a similar system in the event of a major nuclear incident.

12.4 Other Issues Considered by INLEX Since 2012, Largely Responding to Developments and Innovations in the Global Nuclear Industry

The global nuclear industry is not static, but rather in constant change. In particular, the recent changes in the broader energy generation landscape driven by climate change concerns have caused the industry to question whether the long-standing model of very large water cooled reactors constructed on-site is the only viable model for nuclear power, or whether advanced designs, transportable reactors and/or smaller reactors might be more flexible⁴⁰ and more predictable in build cost. Just as international and national safety standards have to be updated to address these developments, consideration also needs to be given to whether the existing nuclear liability regime adequately addresses any new risks which arise, or any changes in expert assessment of the magnitude of existing risks. In addition, radiological risks which fall outside the scope of the existing conventions should be taken account of by INLEX.

In considering these issues, INLEX needs to be conscious that the nuclear liability principles are detailed in international treaties, which are very difficult to change. This is in contrast to the safety landscape, where the conventions are written in general terms and the detailed safety rules are contained in non-binding safety standards which are subject to regular review and update. For that reason, INLEX has developed a practice of making recommendations to States that sometimes go beyond the letter

⁴⁰Both in terms of where they can be sited and in terms of their ability to operate alongside intermittent renewable energy sources.

of the conventions. Those recommendations are made from a perspective that the nuclear liability principles generally offer superior protection and greater certainty to victims than does normal tort law.

12.4.1 The Establishment of Maximum Limits for the Exclusion of Small Quantities of Nuclear Material from the Application of the Vienna Conventions on Nuclear Liability

In 2013, INLEX decided that a recent revision of the IAEA transport regulations, specifically as it related to fissile materials, required a minor consequential change in the 2007 decision of the Board of Governors regarding the Exclusion of Small Quantities of Nuclear Material from the Application of the Vienna Conventions on Nuclear Liability.⁴¹ A draft decision amending that earlier Board decision was approved by INLEX in 2014, and, following approval by the relevant safety standards committees, adopted by the Board of Governors in November 2014.⁴²

12.4.2 Radioactive Sources

Radioactive sources—whether sealed or unsealed—are excluded from the scope of all the liability conventions (see, for example, Article I(g) of the 1997 Vienna Convention),⁴³ given that they are generally under the control of persons who are not operators of nuclear facilities.⁴⁴ Implicitly, materials that have reached such stage of fabrication are covered by general tort law, including any applicable environmental law. To quote the IAEA:

Radioactive sources are used extensively throughout the world for a wide range of beneficial purposes, particularly in medicine, general industry, agricultural research and educational applications. The need to ensure the safety and security of these sources has been recognized for many years, and many Member States established regulatory infrastructures for that purpose. Even so, the occurrence of a number of serious accidents in the 1980s and 1990s

⁴¹Replacing the words “paragraph 672 of the 2005 Edition of the Agency’s Transport Regulations” with “paragraphs 417, 674 and 675 of the 2012 Edition of the Agency’s Transport Regulations”.

⁴²IAEA 2014.

⁴³“‘Radioactive products or waste’ means any radioactive material produced in, or any material made radioactive by exposure to the radiation incidental to, the production or utilization of nuclear fuel, *but does not include radioisotopes which have reached the final stage of fabrication so as to be usable for any scientific, medical, agricultural, commercial or industrial purpose*” (emphasis added), 1997 Vienna Convention, above n. 13.

⁴⁴Where a radioactive source is used in a nuclear installation, damage arising may be compensable under the liability conventions; see 1997 Vienna Convention, above n. 13, Article IV(4) and similar provisions in the other conventions.

led the international community to question the effectiveness of these controls. ... [There was a] growing realization that inadequate controls over radioactive sources had led to some significant radiological accidents, some of which had caused serious injuries, even death, and/or severe economic disruption. These accidents had their origins in a breakdown or absence of proper regulatory control and were not a result of malicious intent. After 2001, concerns regarding the possible use of radioactive sources for malicious purposes led the international community to broaden the focus of discussions to consider also the need to strengthen controls over the security of radioactive sources.⁴⁵

In recognition of those hazards, in the early 2000s the IAEA adopted a Code of Conduct on the Safety and Security of Radioactive Sources.⁴⁶ That Code contains comprehensive advice to States as to the regulatory structures they should put in place to ensure the safety and security of the sealed sources under their jurisdiction, whether in use or in storage. However, it does not contain any provisions concerning third party liability. In 2013, a major international conference suggested that INLEX might consider the issue.⁴⁷

When INLEX considered the issue, the general view was that the possible scope of damage—particularly transboundary damage—was not so great as to demand a special international regime. However, it recommended that States should require, as a condition for the licensing of an activity involving a high activity radioactive source, that the licensee take out a specified amount of insurance⁴⁸ to cover its potential third party liability. Some States already have such a requirement in place, and the advice from the insurers was that such insurance is readily available.⁴⁹ Consequently, the group encouraged the IAEA Secretariat to convey the importance of insurance provision covering radioactive sources to Member States in the context of its legislative assistance activities.

INLEX noted that facilities where bulk material irradiated in a reactor is processed into its final form, and the transport of such bulk material, do not fall within the exception. For example, rods of cobalt-60 are generally transported in bulk form from a nuclear installation to a manufacturer of radioactive sources. Another example is the case of molybdenum-99, a form of nuclear medicine, which is created in reactors and then often shipped in bulk to another site where it is dispensed into ‘generators’ for the use of hospitals and medical clinics. In those circumstances, the exclusion would not apply because the material being transported would not qualify as radioisotopes “which have reached the final stage of fabrication”. Facilities where the materials are transformed into their final form are “nuclear installations” under the conventions.⁵⁰

⁴⁵IAEA 2015, pp. 707–708.

⁴⁶IAEA 2004.

⁴⁷IAEA 2015, p. 720.

⁴⁸That amount might be specified in the regulations or in the licence associated with a particular source.

⁴⁹For facilities such as hospitals, their general insurance policies would generally cover the relatively minor risks arising from radioactive sources they might hold.

⁵⁰Noting that “the Installation State may determine that several nuclear installations of one operator which are located at the same site shall be considered as a single nuclear installation”, 1997 Vienna

12.4.3 *Transportable Nuclear Power Plants*

The issue of whether transportable nuclear power plants (TNPPs) are covered by the conventions was the subject of discussions by INLEX spread over many years. The issue turns around the definition of “nuclear installation” in the convention, in particular the exclusion of a nuclear reactor “with which a means of sea or air transport is equipped for use as a source of power, whether for propulsion thereof or for any other purpose”.⁵¹ There was broad agreement that, although the nuclear liability regime does not apply to reactors with which a means of sea or air transport (or, in the case of the Paris Convention,⁵² any means of transport) is equipped for its own operational purposes, TNPPs to be used only for the external production of nuclear energy would be covered by the regime when in operation. INLEX considered that the term “as a source of power” necessarily implied that the power was used in connection with the operation of the means of sea or air transport.⁵³ This conclusion is consistent with the clear intention of the original drafters of the Vienna Convention⁵⁴ to include in the definition of “nuclear installation” “low and medium power mobile power plants” transported by truck or railroad (while excluding reactors used to propel means of transport by sea or air or in outer space) while the mobile reactors were in a stationary position and operation.⁵⁵

Once it is determined that TNPPs are, in principle, within the scope of the definition of “nuclear installation”, the question turns to which State would be the Installation State for the purpose of the conventions. All current proposals for TNPPs envisage that the reactors would only be operable when in a fixed position, very likely within the territory⁵⁶ of a State (which would be the Installation State). In the unlikely event that a TNPP would be operated outside the territory or territorial sea of any State, from artificial islands, installations or other structures in the exclusive economic zone or the continental shelf, jurisdictional rules under the Law of the Sea relating to the exclusive economic zone and the continental shelf could be used, in principle, to identify the Installation State. Uncertainties arise if that State is not party to the international conventions, but those uncertainties are no different in principle to those that arise in the case of land-based reactors located in such States.

Convention, above n. 13, Article I(1)(j); CSC, above n. 8, Annex, Article 1(1)(b); the definition in the Paris Convention is worded differently but ultimately means the same.

⁵¹ 1997 Vienna Convention, above n. 13, Article I(1)(j)(i); CSC, above n. 8, Annex, Article 1(1)(b)(i); the definition in the Paris Convention is worded differently but ultimately means the same.

⁵² Paris Convention, above n. 11.

⁵³ This conclusion cannot apply in circumstances where the reactor is used for the propulsion of the vessel. During the movement of such a vessel, it would fall outside the definition of “nuclear installation” contained in all conventions.

⁵⁴ Vienna Convention, above n. 11.

⁵⁵ IAEA 1964.

⁵⁶ “Territory” includes territorial sea.

Whilst the determination of the Installation State is therefore straightforward for TNPPs when in operation, the mobile nature of TNPPs means that liability for a nuclear incident in the course of transport of the reactor also needs to be considered. While in transport from the site of manufacture to the deployment site, the TNPP might contain fresh fuel, or it might not. In the former case, it would be treated as a transport of nuclear material for liability purposes. In the latter case, the liability conventions would not apply. While in return transport from the deployment site to the site of manufacture, the TNPP might contain spent fuel, or the spent fuel might have been unloaded (although the TNPP would inevitably still be radioactive, given activation of structural materials). In either case, it would again be a transport of nuclear material for liability purposes.

However, if the host State is not a party to the same convention as the sending State, or is not party to any convention, there may not be a “receiving operator” as envisaged under the conventions. If the conventions are interpreted literally, the “sending operator” might remain as the liable operator for the entire duration of the deployment; under that interpretation, the State of origin would remain as the Installation State. In particular, where the sending operator is in a Contracting Party to, for example, the Vienna Convention and the reactor is being sent to a person in a non-Contracting State, Article II.1(b)(iv) of the Vienna Convention⁵⁷ provides that the sending operator is liable for damage caused by a nuclear incident occurring before the nuclear material “has been unloaded from the means of transport by which it has arrived in the territory of that non-Contracting State”. Similar language occurs in all the conventions. This language was considered ill-suited to the case of a TNPP because it would entail that, there being no unloading of nuclear material from the means of transport by which the TNPP had reached the State of destination, the sending operator would remain liable indefinitely, irrespective of whether the TNPP would thereafter be operated by another operator, and regulated by a regulatory body, in the State of destination. Following a broad discussion, the group considered that the Vienna Convention and the CSC⁵⁸ should be interpreted to mean that, in the particular case of the transportation of a floating nuclear power plant when no unloading of fuel from the vessel occurs before its operation, the sending operator would cease to be liable when the TNPP is taken charge of by the authorized person in the State of destination. At some future point of time when the original sending operator took responsibility for the TNPP in order to return it to the sending State, that operator would again assume liability. Although this appears complex, in reality it is inevitable that the deployment and operation of any TNPP in a State other than the State of origin will be the subject of an intergovernmental agreement between the two States involved. Such an agreement would determine, *inter alia*, regulatory responsibility for the facility and, in the absence of any existing liability convention to which both States are party, the liability rules which would apply.⁵⁹

⁵⁷Vienna Convention, above n. 11 and 1997 Vienna Convention, above n. 13.

⁵⁸CSC, above n. 8.

⁵⁹However, such an agreement could not derogate from the rights of other States under any applicable liability convention.

12.4.4 The Interaction, If Any, Between the Liability Conventions and the Assistance Convention

In 2014, INLEX considered the interaction, if any, between the liability conventions and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention),⁶⁰ in particular Article 10 thereof. Article 10 provides that the State requesting assistance shall, in respect of death or injury to persons, damage to or loss of property, or damage to the environment caused within its territory or other area under its jurisdiction or control in the course of providing the assistance requested: (a) refrain from bringing legal proceedings against the assisting party or persons and entities acting on its behalf; (b) assume responsibility for dealing with such legal proceedings that may be brought by third parties; (c) hold the assisting party or persons and entities acting on its behalf harmless in respect of any such legal proceedings; and (d) compensate the assisting party or persons and entities acting on its behalf for damage suffered as a result of providing assistance.

INLEX noted that Article 10 of the Assistance Convention⁶¹ could only apply if the convention applied, and that in each case it should be clear whether it had been invoked. INLEX also noted that a significant number of States Parties to the Assistance Convention had made reservations to Article 10, and that the existence of such a reservation might impact on the willingness of other States Parties to provide assistance. The group observed that, if there were treaty relations under one of the international liability conventions, Article 10 would be of little practical relevance to incidents falling within the scope of the applicable liability convention, given that the channelling of liability to the operator would effectively exempt the assisting party or persons and entities acting on its behalf from liability in any case. However, the scope of the Assistance Convention is much wider than that of the liability conventions, in that it extends to all radiological incidents, including those involving radioactive sources, and Article 10 also applies to damage other than nuclear damage. Article 10 of the Assistance Convention may also be relevant where claims are made in a State other than the State requesting assistance in circumstances where there are no treaty relations under one of the nuclear liability conventions between those two States.

12.4.5 Installations Undergoing Decommissioning

In principle, there is no difficulty in deciding whether reactors or other nuclear facilities undergoing decommissioning are subject to the conventions. Whilst they may no longer “contain nuclear fuel in such an arrangement that a self-sustaining chain process of nuclear fission can occur therein without an additional source of

⁶⁰Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, opened for 26 September 1986 (Vienna) and 6 October 1986 (New York), entered into force 26 February 1987 (Assistance Convention).

⁶¹Assistance Convention, above n. 60.

neutrons”, they are nevertheless facilities “where nuclear material (radioactive waste) is stored”. Only when the site is fully released from regulatory control as a nuclear facility will it fall outside the conventions.

The difficulty is that when a reactor, for example, is in operation it is subject to very high liability limits and particularly insurance amounts. At what stage in the decommissioning process is the hazard of that reactor reduced so much that it no longer needs to be insured for that amount—or indeed at all? This issue is particularly acute under the 2004 Paris Convention, given that the minimum amount of liability and insurance for lower-risk installations is €70 million.⁶² If there is a wish on the part of government to further reduce the burden on the ‘operator’ of an installation in the late stages of decommissioning, the only option is for the installation to be excluded from the scope of the convention altogether, pursuant to Article 1(b) of the Convention.⁶³ The OECD Steering Committee on Nuclear Energy has set criteria for the exclusion of certain installations under that provision. Similar considerations apply to installations used for the disposal of certain types of low level radioactive waste.

In 2017, INLEX considered whether there was a need for similar action to be taken by the IAEA Board of Governors.⁶⁴ However, it was noted that both the 1997 Vienna Convention (Article V(2)) and the CSC (Article 4(2) of the Convention on Supplementary Compensation Annex) allow the Installation State to establish a lower amount of liability (5 million Special Drawing Rights) of the operator having regard to the nature of the nuclear installation or the nuclear substances involved and to the likely consequences of an incident originating from such installations. Taking this into account, and also noting the view that the exclusion of some installations from the scope of the Vienna Convention and the CSC may act as a disincentive for companies considering involvement in decommissioning activities, INLEX concluded that there was no need to exclude any installations being decommissioned or low level waste disposal facilities from the scope of the 1997 Vienna Convention and the CSC.

12.4.6 Waste Disposal Facilities

In 2016–2018, INLEX considered the application of the conventions to facilities for the disposal of radioactive waste. The conventions adopted under the auspices of the IAEA only expressly include facilities for the “storage” of nuclear material, which includes radioactive waste.⁶⁵ INLEX considered three distinct periods during the lifetime of such a facility:

⁶²2004 Paris Protocol, above n. 17, Articles 7(b) and 10(a).

⁶³Paris Convention, above n. 11.

⁶⁴Vienna Convention, above n. 11 and 1997 Vienna Convention, above n. 13, Article I(2); CSC, above n. 8, Annex, Article 1(2).

⁶⁵The 2004 Paris Protocol, above n. 17, expressly includes “installations for the disposal of nuclear substances” in the definition of “nuclear installation”.

- (a) The period when the facility is being actively utilized, with wastes being emplaced by a licensed operator;
- (b) The period immediately following closure of the facility,⁶⁶ when institutional controls will remain active and the facility will continue to be under regulatory control with a licensed operator;
- (c) The period after the end of institutional control,⁶⁷ when the operating licence will be surrendered or otherwise cease.

INLEX noted there would be an interest to maintain these installations within the scope of the conventions as much as possible, as it would otherwise mean that other legislation or general tort law would be applicable in case of an incident at such an installation. This would in particular be a concern in situations where the radioactive waste remains the property of the waste producer.

For periods (a) and (b), INLEX concluded that during the period where institutional controls remain active (the duration of which will differ from country to country and with different classes of waste), there will still be an operator and the waste can be regarded as being in storage. Therefore, the nuclear liability conventions would continue to apply during the period of institutional control.

Following the cessation of institutional control over the site (period (c)), the group noted that in the absence of an operator, the nuclear liability conventions cannot be applied, and therefore the State which has agreed to the cessation of institutional control would implicitly be expected to assume the responsibility in case of any nuclear incident. In such a case, the State would compensate for any nuclear damage caused by the nuclear incident, implicitly assuming the nuclear liability.

12.5 Current and Future Areas of Discussion

As will be apparent, INLEX is observing the current wave of innovation in the nuclear industry with interest, and is considering the implications for nuclear liability. We have commenced consideration of nuclear fusion and will soon turn our attention to small modular reactors (SMRs) and to marine reactors.

12.5.1 Nuclear Fusion Installations

Although the most well known fusion reactor project is the ITER project in France, there are currently multiple projects in multiple countries developing multiple designs of fusion facilities. Most of the new concepts are much smaller than ITER, but their

⁶⁶Such a period could last for up to 300 years.

⁶⁷Although the risks involved in this period would probably be very limited and would most probably not trigger transboundary damage, the conventions also act to harmonise national law on liability issues.

developers are looking at much shorter timelines to commercial deployment. 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. Moreover, private entities are entering as a new player in the development of future fusion facilities and, as a result, a stronger regulatory framework may be needed and is in fact already being considered, in the United States of America, the United Kingdom⁶⁸ and elsewhere.

The technical consensus is that a catastrophic accident scenario is not credible, and the radioactive inventory of fusion reactors (primarily tritium) is much smaller than that of commercial fission-based facilities. However, the future operation of fusion facilities will result in the generation of significant amounts of low-intermediate level radioactive waste, both in terms of tritium and in terms of material activated by the operation of the reactor.

Nuclear fusion facilities fall outside the definition of “nuclear installation” in all of the conventions,⁶⁹ and any radioactive materials generated during their operation similarly fall outside the definition of “nuclear material”. Liability arrangements for such facilities are therefore currently covered only by national law.

INLEX has discussed whether it would be desirable to include nuclear fusion installations within the scope of the 1997 Vienna Convention⁷⁰ or to adopt a specific regime, either at the international or at the national level, to deal with liability for damage caused by nuclear fusion facilities and related activities. That discussion has not yet come to a finalized position. On the one hand, the hazard posed by fusion facilities is of a different magnitude than that posed by large fission reactors, more akin to that posed by a large chemical plant or uranium mining and milling operations, which fall outside the scope of the conventions. On that view, the inclusion of fusion facilities within the scope of the existing nuclear liability conventions might lead the public to believe that they posed hazards of a similar nature to large fission reactors. On the other hand, the existing conventions capture facilities of a similar level of hazard, in the shape of research reactors and radioactive waste storage facilities, and the nuclear liability system offers greater protection to victims than does normal tort law. Discussion will continue at the 22nd session of INLEX in 2022.

⁶⁸Department for Business, Energy & Industrial Strategy (2021) Towards Fusion Energy. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1022286/towards-fusion-energy-uk-government-proposals-regulatory-framework-fusion-energy.pdf. Accessed 12 October 2021. The paper includes specific discussion of third party liability on pp 50–54.

⁶⁹The definitions of “nuclear reactor” and “nuclear fuel” explicitly refer to fission.

⁷⁰1997 Vienna Convention, above n. 13, by way of a decision by the Board of Governors under Article I(1)(j)(iv) thereof. Such a decision could have no effect under the 1963 Vienna Convention, above n. 11, or the CSC, above n. 8, given that they lack a corresponding provision.

12.5.2 *Small Modular Reactors*

At its 2021 meeting, INLEX decided to discuss liability issues concerning small modular reactors (SMRs) in 2022. In principle, SMRs raise no new issues for the nuclear liability regime; whilst they may well pose a lesser hazard than large power reactors because of their smaller radioactive inventory,⁷¹ so do research reactors, which have been covered by the regime since its inception. What may be worthy of discussion is whether INLEX has a view on the advisability of States reducing the liability limit and/or the financial security amount of the operator as foreseen in Articles V and VII of the 1997 Vienna Convention⁷² and similar provisions in the other conventions. It will be instructive to hear from experts in government, industry and the insurers as to their experience of situations where States have taken advantage of these provisions in respect of other low hazard facilities and activities.

12.5.3 *Nuclear-Powered Ships*

INLEX will probably also commence consideration of liability issues around nuclear-powered vessels in 2022. There have been recent reports in the nuclear press⁷³ regarding plans by both operators and regulators to prepare for the introduction of nuclear-powered civilian vessels. Increasing concerns about the greenhouse gas emissions of diesel-fuelled vessels have led to proposals for the use of nuclear power, either to generate hydrogen or ammonia to replace the diesel in internal combustion engines, or directly as the power source for the vessel. Whilst the former option raises no new issues for nuclear liability, the latter is worthy of discussion. Whilst barge-mounted reactors are best viewed as covered by the conventions (see Sect. 12.4.3), nuclear-powered vessels clearly fall outside the definition of “nuclear installation” in the Vienna Convention,⁷⁴ the CSC⁷⁵ and the Paris Convention.⁷⁶ This potential gap in coverage was recognized in the early 1960s; in response the 1962 Brussels

⁷¹Noting also the claimed increased safety margins of next generation SMRs such as molten salt reactors and pebble bed reactors.

⁷²“[T]he Installation State, having regard to the nature of the nuclear installation or the nuclear substances involved and to the likely consequences of an incident originating therefrom, may establish a lower amount of liability of the operator, provided that in no event shall any amount so established be less than 5 million SDRs, and provided that the Installation State ensures that public funds shall be made available up to the amount established pursuant to paragraph 1.” 1997 Vienna Convention, above n. 13.

⁷³<https://www.world-nuclear-news.org/Articles/Q-A-Core-Power-Chairman-and-CEO-Mikal-B-C3%B8e>. Accessed 13 September 2021; <https://www.world-nuclear-news.org/Articles/UK-introducing-regulation-for-nuclear-shipping>. Accessed 13 September 2021.

⁷⁴Vienna Convention, above n. 11.

⁷⁵CSC, above n. 8.

⁷⁶Paris Convention, above n. 11.

Convention on the Liability of Operators of Nuclear Ships⁷⁷ was adopted by the Eleventh Session of the Diplomatic Conference on Maritime Law held under the sponsorship of the Belgian Government and of the IAEA in Brussels from 17 to 29 April 1961. However, that convention has never entered into force. The reasons for that have been explored in detail;⁷⁸ I will not repeat them here. At the time of the discussions to revise the Vienna Convention in the Standing Committee on Nuclear Liability in the 1990s, scepticism about the prospects for civilian nuclear-powered vessels meant that there was little interest in a late proposal to include them in the scope of the revised conventions.⁷⁹ And there was certainly no prospect of including military nuclear-powered vessels within the scope, given the decision to remove the possible ambiguity surrounding the inclusion of military installations generally.⁸⁰

If it considers that action to address this potential future gap in liability coverage is desirable, INLEX may consider a number of issues:

- The chances of the 1962 Brussels Convention⁸¹ entering into force, noting that not only is there the problem of military vessels, the limit on liability has been overtaken by the 1990s conventions, and the convention foresees jurisdiction possibly lying with the courts of multiple States Parties.
- The possibility of amendments to the 1962 Brussels Convention, noting that the depositary is not the IAEA but rather the Government of Belgium.
- The possibility of an amendment to the modernized liability conventions to remove the exception in the definition of “nuclear installation”, noting the glacial pace of ratification of the 1990s conventions.
- Whether there is scope for the IAEA Board of Governors to add nuclear-powered vessels to the scope of the 1997 Vienna Convention⁸² by way of a decision under Article I(1)(j)(iv) thereof.⁸³ It is noted that such a decision could have no effect under the 1963 Vienna Convention⁸⁴ or the CSC,⁸⁵ given that they lack a corresponding provision.
- Whether the issue can be addressed by way of bilateral arrangements between the flag State of the vessel and the State(s) where ports of call are located, as has

⁷⁷Convention on the Liability of Operators of Nuclear Ships and Additional Protocol, opened for signature 25 May 1962, not yet in force (Liability Nuclear Ships 1962).

⁷⁸Handrlica 2009.

⁷⁹IAEA 2017, Footnote 73.

⁸⁰Ibid., p. 28.

⁸¹Liability Nuclear Ships 1962, above n. 77.

⁸²1997 Vienna Convention, above n. 13.

⁸³Under the Paris Convention, the OECD Steering Committee for Nuclear Energy has a similar power.

⁸⁴Vienna Convention, above n. 11.

⁸⁵CSC, above n. 8.

been suggested,⁸⁶ noting that such a solution would not address the concerns⁸⁷ of transit States.⁸⁸

12.6 Conclusion

The nuclear industry continues to evolve, often in ways that could not be foreseen by those who developed the nuclear liability principles in the early 1960s.⁸⁹ The recommendations made by INLEX allow the international liability regime to respond to that evolution in a way which remains faithful to those principles.

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⁸⁶Handrlica 2009.

⁸⁷I make no judgement as to whether such concerns would be technically justified, but they will exist.

⁸⁸Including states whose exclusive economic zones might be transited.

⁸⁹Although it is interesting to read the *travaux préparatoires* for the 1963 Vienna Convention, above n. 11, and see how they discuss issues such as TNPPs which took decades to come to fruition.

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