



Open Research Online

The Open University's repository of research publications and other research outputs

The global nuclear liability regime post Fukushima Daiichi

Journal Item

How to cite:

Heffron, Raphael J.; Ashley, Stephen F. and Nuttall, William J. (2016). The global nuclear liability regime post Fukushima Daiichi. *Progress in Nuclear Energy*, 90 pp. 1–10.

For guidance on citations see [FAQs](#).

© 2016 The Authors

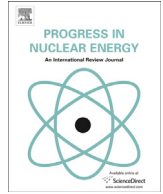
Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1016/j.pnucene.2016.02.019>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk



The global nuclear liability regime post Fukushima Daiichi



Raphael J. Heffron^{a,*}, Stephen F. Ashley^b, William J. Nuttall^b

^a Energy and Natural Resources Law Institute, Queen Mary University of London, London, WC2A 3JB, UK

^b Department of Engineering and Innovation, The Open University, Milton Keynes, MK7 6AA, UK

ARTICLE INFO

Article history:

Received 17 September 2015

Received in revised form

9 January 2016

Accepted 18 February 2016

Available online 4 March 2016

Keywords:

Nuclear law
Nuclear liability
Fukushima
India
UK
US

ABSTRACT

Nuclear liability regimes are important as they ensure that potential victims will be compensated promptly and efficiently after a nuclear accident. The accident at Fukushima Daiichi in Japan in 2011 prompted a review of the global nuclear liability regime that remains on-going. Progress has been slow, but over the next few years the European Union is set to announce its new proposals. Meanwhile, in 2015, another global nuclear liability regime, the Convention on Supplementary Compensation for Nuclear Damage, has entered into force. This paper aims to move the debate in the literature on nuclear liability and focuses on the four following major issues: (1) reviews third-party nuclear liability regimes currently in operation around the world; (2) analyses the international nuclear liability regime following the accident at Fukushima Daiichi; (3) comparatively assesses the liability regimes for nuclear energy and the non-nuclear energy sector; and (4) presents the future outlook for possible developments in the global nuclear liability regime.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

“Accidents and calamities...are the universal legislators of the world.” Plato, *The Laws*.¹

The accident at Fukushima Daiichi was a watershed moment for the global nuclear energy industry that has since led to an industry-wide revision of practices and regulations within the international nuclear energy community. The estimated costs of the incident at Fukushima Daiichi vary according to different calculations (as detailed in Section 4) but in every case, the incurred costs of the accident so far have been significantly higher than existing capped liability limits that are in operation around the world, as detailed further in Section 2. This has prompted the international nuclear energy community to scrutinise and revise what ‘liability’ means in the sector.

‘Nuclear Liability’ has been an area of legal scholarship for many decades, and has its roots especially in the area of tort law and more

specifically in relation to the examination of law and accidents.² This article aims to advance the legal literature with not just a focus on nuclear accidents themselves, but also we intend to extend the discussion to: (1) a comparative review of the issues surrounding nuclear liability internationally; and (2) a comparative analysis of nuclear and non-nuclear energy accidents.

Nuclear accidents are transboundary in nature especially where there is an off-site release of radioactive material. Hence, various international liability regimes have been developed for the nuclear energy sector to which countries can be members. The nuclear energy sector demonstrates a level of international cooperation on liability for transboundary pollution and damage that is not observed in other parts of the energy industry. Nuclear liability regimes are of vital importance for two main reasons: (1) the ability for the nuclear energy industry to function; and (2) for the protection of the public as potential victims of a nuclear accident. For example, India is relying on significant growth of its nuclear energy sector to meet future electricity demands. However, as will be described in Section 3, uncertainty surrounding the extent of their liability for suppliers in its national liability regime has deterred potential non-domestic investors. Furthermore, nuclear liability regimes enshrine commonality that is important because of the potential cross-boundary effects that a nuclear accident may have on other countries.

Actions for damages and for injuries suffered are major areas of law. In general, the issue of accidents and insurance is approached

* Corresponding author.

E-mail address: r.heffron@qmul.ac.uk (R.J. Heffron).

¹ Plato, *The Laws* [of] Plato; Translated with an Introduction by Trevor J. Saunders. (Penguin 1970).

² Steven Shavell, *Economic Analysis of Accident Law* (Harvard University Press 1987).

from the perspective of law and economics, or through an economic analysis of the law. Here there are two questions that will be asked: (1) what is the effect of the legal rules (descriptive); and (2) is the current system desirable and what should it look like (normative)?^{3,4} This paper examines the issue of accidents and insurance in the energy sector, and in particular, after a major accident. In this context, this paper provides four contributions: (1) it examines the third-party nuclear liability regimes currently in operation around the world and maps out the divergence between liability limits in the event of an accident in the European Union; (2) it analyses the international nuclear liability regime post the Fukushima Daiichi accident; (3) it comparatively assesses the liability regimes for nuclear energy and the non-nuclear energy sector; and (4) it presents the future outlook for possible developments in the global nuclear liability regime. More specifically, Section 2 details the current global nuclear liability regime while also analysing what it means if it is applied, i.e. if there were to be an accident. Section 3 focuses on global nuclear liability regime in light of the accident at Fukushima Daiichi, and Section 4 explores the difference between third party liability regimes for different energy sources. Finally, in Section 5, the paper advances the debate on whether the current global nuclear liability regime is desirable and points to what it should look like.

2. Current nuclear liability regimes

Many international institutions play a role in the energy sector. One of the most influential in terms of the international energy sector is the International Atomic Energy Agency (IAEA) which plays a lead role in the international nuclear energy industry. There are no similar UN-affiliated international institutions for other energy sources. The IAEA is located in Vienna, Austria, and 162 countries are currently Member States. It acts as an international driver of the nuclear energy sector, and it has a particular focus on maintaining the safe operation of nuclear energy plants across the world.

The IAEA is responsible for ensuring what are, in essence, global safety and security standards for the industry. It also gives law and policy advice, to assist countries in implementing laws to safely develop nuclear energy infrastructures. The IAEA also plays a role in the event of an accident. The main action by the IAEA in this context is its promotion of a liability regime for nuclear accidents. This encompasses a number of international treaties on nuclear liability.

There are three main international liability agreements, and the members of IAEA are all signed up to one or more of these three agreements. There are two main international third party nuclear energy liability regimes operating at present:

- (1) the “Paris and Brussels” Conventions, that are under the auspices of the Organisation for Economic Co-operation and Development (OECD); and
- (2) the “Vienna” Convention that is under the auspices of the IAEA.

There also exists a third nuclear energy liability regime, which is the Convention on Supplementary Compensation for Nuclear Damage (CSC), also under the auspices of the IAEA but which is championed by the USA and while only a few countries have ratified it, the CSC recently came into force, as further detailed in Section 5.

These liability regimes are an example of international cooperation in one area of the energy sector. Such liability regimes are not present for other energy sources and this highlights the value of research in this area in that other energy sources and global industrial sectors can learn from the nuclear energy sector and the liability regimes in place for accidents. A brief overview of the international nuclear liability regimes currently in force are detailed in Sections 2A–C.

2.1. The USA - Price–Anderson Act of 1957

The first nuclear liability regime was developed by the USA. The USA's third-party liability convention operates under the Price–Anderson Act of 1957. This Act inserted the new Section 170 into the Atomic Energy Act of 1954⁵ and has been revised several times, most recently by the Energy Policy Act of 2005⁶ that extends its application to the civil nuclear energy sector for a further 20 years.

The purpose of the Price–Anderson Act is to provide a Federal compensation fund should there be a nuclear accident. The Price–Anderson Act, in essence, requires each reactor site to pay an annual premium. Insurance protection consists of two tiers: the first tier provides \$375 million in liability insurance per incident based on maximum level of private insurance available; the second tier (if the first tier is exhausted), allows each nuclear reactor site to pay up to a maximum of \$111.9 million per nuclear incident and is classed as a retrospective premium equal to its proportionate share of the excess loss (i.e. the loss beyond the first tier amount of \$375 million).⁷ Estimates of the US insurance pool suggest that \$12.6 billion in insurance cover is available.⁷ Hence, The Act does limit liability and does not guarantee payment should possible funds already have been exhausted. Instead, in the instance where the damages are likely to exceed the applicable amount of aggregate public liability, the Nuclear Regulatory Commission will seek and give recommendations for additional sources of funds from the US government after they have conducted an assessment of potential costs.⁸

2.2. The Paris and Vienna Conventions

Thereafter, the OECD established a nuclear liability regime with the Paris Convention (PC) in 1960, which has since been updated in 1964 and 1982.⁹ It was signed first by Western European states.¹⁰ It requires ratification by national legislation of a contracted state. It is based on seven principles¹¹ outlined in Table 1 below.

⁵ Atomic Energy Act of 1954, Pub. L. No. 83–703, 42 U.S.C. § 2011 et seq. (1954), as amended by Pub. L. 85–256 (the “Price–Anderson Act”) 42 U.S.C. § 2210.

⁶ Energy Policy Act of 2005, Pub. L. No. 105–98, 42 U.S.C. § 19 (2005).

⁷ Helen Cook, *The Law of Nuclear Energy* (Sweet & Maxwell: Thomson Reuters 2013) 86–87.

⁸ The Price–Anderson Act (n 5) ss (i).

⁹ Paris Convention on Third Party Liability in the Field of Nuclear Energy (29 July 1960), 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 (Paris Convention); the most recent revision is not yet in force.

¹⁰ The countries that have ratified the Paris Convention are: Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Turkey and United Kingdom. Austria and Luxembourg have signed the Paris Convention but not ratified it. Switzerland has ratified the Paris Convention but it does not take effect until the 2004 Protocol comes into force. It is open to all OECD member countries and non-OECD countries if all the contracting countries agree.

¹¹ For more discussion on these and more detailed review of the nuclear liability regime prior to the accident at Fukushima Daiichi please see: Anthony Thomas and Raphael J Heffron, “Third Party Nuclear Liability: The Case of a Supplier in the United Kingdom” (Faculty of Economics, University of Cambridge, UK 2012) Working Paper <<http://www.repository.cam.ac.uk/handle/1810/242219>> accessed 9 January 2016.

³ *ibid*

⁴ Steven Shavell, *Foundations of Economic Analysis of Law* (The Belknap Press of Harvard University Press 2004).

Table 1
The Seven Principles of the Paris Convention, as equally applicable to the Vienna Convention.

	Principle
1	Strict liability
2	Channelling liability to the operator
3	Limitation of liability in time
4	Limitation of liability in amount
5	Insurance or other financial security
6	Jurisdiction
7	Applicable law

The Vienna Convention (VC), established by the IAEA, is similar to the PC in its aims and was signed in 1963 mainly by non-OECD countries in Eastern Europe and Latin America.¹² The two conventions are similar in terms of the aforementioned seven principles but differ in number of other aspects such as financial liability limits, territorial scope and dispute resolution.¹³

The Brussels Supplementary Convention (BSC) was the next development, and it was signed in 1963 by the majority of the same countries that signed the PC.¹⁴ In essence, it is complimentary to the PC and allowed additional funds to be made available to victims of a nuclear accident.

The accident at Chernobyl in 1986 prompted the provision of additional funds to victims of a nuclear accident. Notably, The Joint Protocol that entered into force in 1992, which offers linkages between countries that adopted either the PC or the VC.¹⁵

2.3. The revised conventions and the CSC (new nuclear liability limits)

The revised Vienna Convention (RVC) was introduced in 1997 and increased the minimum financial security required from US\$5 million to 300 million Special Drawing Rights (SDRs), broadened the definition and geographical scope of nuclear damage and increased the time-period for certain claims to be raised.^{16,17} The CSC (also introduced in 1997) in many ways is an alternative

nuclear liability convention. It can act as supplementary to the PC and VC/RVC, providing an additional international fund that allows second-tier compensation.¹⁸ Countries not party to the PC or VC/RVC can join the CSC so long as their national legislation is in agreement with the provisions of the Annex to the CSC with the first-tier of compensation fixed at 300 million SDRs. The CSC is based on seven principles that are similar to that of the PC, as shown in Table 1. The CSC required ratification from at least five countries that contain 400,000 units of installed capacity¹⁹ for it to enter into force.

The other amendments take the form of the 2004 Protocol to Amend the Paris Convention and the 2004 Protocol to Amend the Brussels Supplementary Convention (hereafter referred to as the revised Paris Convention (RPC) and revised Brussels Supplementary Convention (RBSC)). The aim of the RPC and RBSC was to increase the scope of, limit of and time to claim compensation for instances of loss of life and personal injury as a result of a nuclear accident; with the Protocols having factored in the losses experienced as a result of Chernobyl.²⁰ The RPC plus RBSC now cover a lower liability limit of €1.5 billion, and like the RVC broadened the definition, geographical scope and timeliness for certain claims to be raised.²¹ A summary of the losses that can be claimed is shown below; it is noted that the PC only covers items (i)–(iii):

- (i) loss of life or personal injury;
- (ii) loss of or damage to property;
- (iii) economic loss arising from (i) and (ii) above;
- (iv) the costs of measures of reinstatement of impaired environment;
- (v) loss of income deriving from a direct economic interest in any use or enjoyment of the environment; and
- (vi) the cost of preventative measures including loss or damage caused by such measures.
- (vii) any other economic loss, other than any caused by the impairment of the environment if permitted by general law on civil liability of a competent court^{22,23}

2.4. The principle of channelling

One of the key principles of present nuclear liability regimes is the channelling principle, where all liability is channelled to the operator.²⁴

The channelling principle is expressed best in the phrase from the first paragraph of IAEA Implementing Legislation drafting notes (see Table 2 below) and along with the accompanying phrase from both the Vienna and Paris Conventions “Except as otherwise provided in this Convention, no person other than the operator shall be

¹² The full title is the: Vienna Convention on Civil Liability for Nuclear Damage (21 May 1963) (Vienna Convention); Vienna Convention Countries are Argentina, Armenia, Belarus, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Cameroon, Chile, Croatia, Cuba, Czech Republic, Egypt, Estonia, Hungary, Latvia, Lebanon, Lithuania, Mexico, Montenegro, Niger, Nigeria, Peru, Philippines, Poland, Republic of Moldova, Romania, Russian Federation, Saint Vincent & the Grenadines, Senegal, Serbia, Slovak Republic, The former Yugoslav Republic of Macedonia, Trinidad and Tobago, Ukraine and Uruguay.

¹³ DG Tren, European Commission, 2005. ‘TREN/CC/01–2005 Legal Study for the Accession of Euratom to the Paris Convention on Third Party Liability in the Field of Nuclear Energy.’ Report <http://www.mng.org.uk/gh/private/2009_12_accession_euratom.pdf> accessed 9 January 2016.

¹⁴ Convention of 31 January 1963 Supplementary to the Paris Convention of 29 July 1960, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982 (Brussels Supplementary Convention); it entered into force in 1974 and the following countries are a party to the Brussels Convention: Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Slovenia, Spain, Sweden and the United Kingdom. Austria, Luxembourg and Switzerland have signed it but it is not in force.

¹⁵ 1988 Joint Protocol on the Application of the Vienna Convention and the Paris Convention (Joint Protocol).

¹⁶ 1997 Protocol to amend the Vienna Convention on Civil Liability for Nuclear Damage (Revised Vienna Convention).

¹⁷ The SDR is an international reserve asset, created by the IMF in 1969 to supplement its member countries’ official reserves <<http://www.imf.org/external/np/exr/facts/sdr.htm>> accessed 9 January 2016. On July 26 2015, 1SDR = 1.393 US\$.

¹⁸ With regard to the CSC, first-tier compensation corresponds to the amount made available by a nation state; whereas second-tier compensation corresponds to an international fund which Contracting Parties contribute toward that can be used when first-tier compensation is exhausted.

¹⁹ Units of installed capacity refers to the thermal MW rating of the plant (referred to as MWt). One unit is one MWt.

²⁰ Julia A Schwartz, ‘Liability and Compensation for Third Party Damage Resulting from a Nuclear Incident’, *International Nuclear Law: History, Evolution and Outlook* (OECD 2010) <<http://www.oecd-nea.org/law/isnl/10th/isnl-10th-anniversary.pdf>> accessed 9 January 2016.

²¹ This is a combined total from under the Paris–Brussels regime and under a three-tier compensation system with: the operator’s financial security will be at least €700 million; the state in whose territory the liable operator’s installation is situated and will have liability up to €500 million; all of the contracting parties may have a liability up to €300 million.

²² Carlton Stoiber and others, ‘Handbook on Nuclear Law: Implementing Legislation’ (2010) 104–106 <http://www-pub.iaea.org/MTCD/publications/PDF/Pub1456_web.pdf> accessed 9 January 2016.

²³ Paris Convention (n 9).

²⁴ Cook (n 7) 177.

Table 2
IAEA Model provisions on Liability of the Operator provisions on Liability of the Operator. Stoiber and others (n 22).

Article##: liability of the operator
1. Subject to the provisions of this Law, only the operator of a nuclear installation shall be liable for nuclear damage wherever suffered, upon proof that such damage has been caused by a nuclear incident at the operator's nuclear installation.
2. Liability for nuclear damage caused by nuclear material which was stolen, lost, jettisoned or abandoned lies with the operator who was last authorized to possess such material
3. Liability for nuclear damage shall apply to nuclear damage wherever suffered.

liable for nuclear damage".²⁵

Through the nuclear liability regimes, liability is legally channelled (i.e. it can be considered as exclusive liability). In essence this follows that a nuclear operator will be solely liable for the accident. This means that all victims will be compensated by the operator and reduces the cost burden for victims and the speed to which they can receive compensation. The responsibility of suppliers to nuclear operators falls on the operator themselves but in some cases there may be specific clauses within contracts between the operator and supplier in relation to the supplier being liable to a certain degree.²⁶

3. An International review of the nuclear liability regime post-Fukushima

One issue surrounding the conventions is that not all countries have signed and ratified (i.e., enter into force) these conventions, especially the most recent revisions to the conventions. To illustrate this, the map in Fig. 1 below highlights the 'patchwork' of conventions that are in force in Europe. A synopsis from the most recent OECD review of Liability Amounts and Financial Security Limits²⁷ is presented. At present, there are 21 countries that have signed the RVC, of which 12 have ratified these. Of the 28 EU Member States, only Latvia, Poland, and Romania have signed and ratified the RVC; whilst the Czech Republic, Hungary, Italy, and Lithuania have signed the RVC. Under the non-legislative EU Act 2013/434/EU²⁸: Bulgaria, the Czech Republic, Estonia, Lithuania, Hungary, Poland, and Slovakia are authorised to ratify the RVC.

The RPC has only been ratified by two countries: Norway and Switzerland. It has been signed by 13 of the EU member states and Turkey. One reason why there have been few ratifications of this convention across Europe is that under EU directive 2004/294/EC²⁹ all Member States (with exception of Austria, Denmark, Ireland, and Luxembourg)³⁰ should simultaneously ratify, i.e. enter into force the revised Convention at the moment they sign the RPC.

²⁵ Revised Vienna Convention (n 16) art II para 5; Paris Convention (n 9) art 6b

²⁶ Karine Fiore, 'No-Fault Compensation Systems' in Michael Faure (ed), *Tort Law and Economics* (Edward Elgar Publishing 2009).

²⁷ Organisation for Economic Co-operation and Development, 'Nuclear Operator Liability Amounts and Financial Security Limits, July 2014' <<https://www.oecd-nea.org/law/2014-table-liability-coverage-limits.pdf>> accessed 9 January 2016.

²⁸ Council Decision (EU) 2013/434/EU of 15 July 2013 authorising certain Member States to ratify, or to accede to, the Protocol amending the Vienna Convention on Civil Liability for Nuclear Damage of 21 May 1963, in the interest of the European Union, and to make a declaration on the application of the relevant internal rules of Union law [2013] OJ L220/1.

²⁹ Council Decision (EC) 2004/294/EC of 8 March 2004 authorising the Member States which are Contracting Parties to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy to ratify, in the interest of the European Community, the Protocol amending that Convention, or to accede to it [2004] OJ L97/53.

³⁰ The exception of Austria, Ireland, and Luxembourg stems from Council Decision 2004/294/EC (n 29) only applying to Member States that are Contracting Parties to the Paris Convention. Denmark is excepted due to Articles 1 and 2 of the Protocol on the position of Denmark annexed to the Treaty on European Union and to the Treaty establishing the European Community.

Interestingly, all of the states that were members of the EU prior to 2004 signed the convention (albeit with reservations from Germany, Austria, Greece, and Sweden). Of the post-2004 countries, only Slovenia has signed the Convention (under Directive 2007/727/EC³¹). It is suggested that the requirement of simultaneous ratification may act as a barrier to the majority of states ratifying the RPC.³²

With the ongoing uncertainty around which countries have signed and ratified which conventions, the nuclear liability regime was in a state of relative confusion prior to the accident at Fukushima Daiichi. Burns (2012)³³ has highlighted interesting statistics that further demonstrate the level of uncertainty on the potential effectiveness of existing nuclear liability regimes. His conclusion is the majority (74 per cent) of the world's reactors in operation or under construction are in eight states: Canada, China, France, India, Japan, South Korea, Russia, and the US. More importantly however, six of these countries — Canada, China, Japan, South Korea, India and the US — which account for 57 per cent of the world's reactors that are either in operation or under construction were until recently outside the scope of an international third party nuclear liability regime. Both Japan and the US are now as of April 2015 under the CSC liability regime.

There are renewed efforts post-Fukushima Daiichi to reduce the uncertainty around nuclear liability regimes in Europe. The European Union, as stated earlier, is aiming to revise the nuclear liability regime. In addition, the IAEA has called for a move towards developing a global nuclear liability regime. This was agreed by members of the IAEA in the IAEA's Action Plan on Nuclear Safety that was developed in 2011 by the Board of Governors and endorsed by all Member States at the IAEA General Conference in 2012.³⁴ A functional and transparent nuclear liability regime is important from the context of the number of countries that aim to build nuclear energy plants for the first time. In addition, there are new developments in the nuclear industry that also add to the case for reform. For example, Chinese nuclear energy firms are planning to enter the European market in the UK and Romania (a cooperation agreement was signed in July 2014 and a contract is on schedule to be signed).³⁵ Russian and South Korean nuclear energy

³¹ Council Decision (EC) 2007/727/EC of 8 November 2007 authorising the Republic of Slovenia to ratify, in the interest of the European Community, the Protocol of 12 February 2004 amending the Paris Convention of 29 July 1960 on Third-Party Liability in the Field of Nuclear Energy [2007] OJ L294/23.

³² Maxine Symington, 'Nuclear Energy Policy Update: Key Recommendations from the Conference on Nuclear Third Party Liability' (Wragge Lawrence Graham & Co, 28 January 2014) <<http://www.wragge-law.com/insights/nuclear-energy-policy-update-key-recommendations-f/>> accessed 9 January 2016.

³³ Stephen G Burns, 'A Global Nuclear Liability Regime: A Journey or a Destination?' (2012) <http://www.burges-salmon.com/inla_2012/10156.pdf> accessed 9 January 2016.

³⁴ International Atomic Energy Agency, 'IAEA Action Plan on Nuclear Safety' (2014) <<https://www.iaea.org/sites/default/files/actionplann.pdf>> accessed 9 January 2016.

³⁵ World Nuclear Association, 'Nuclear Power in Romania' (November 2014) <<http://www.world-nuclear.org/info/Country-Profiles/Countries-O-S/Romania/>> accessed 9 January 2016.

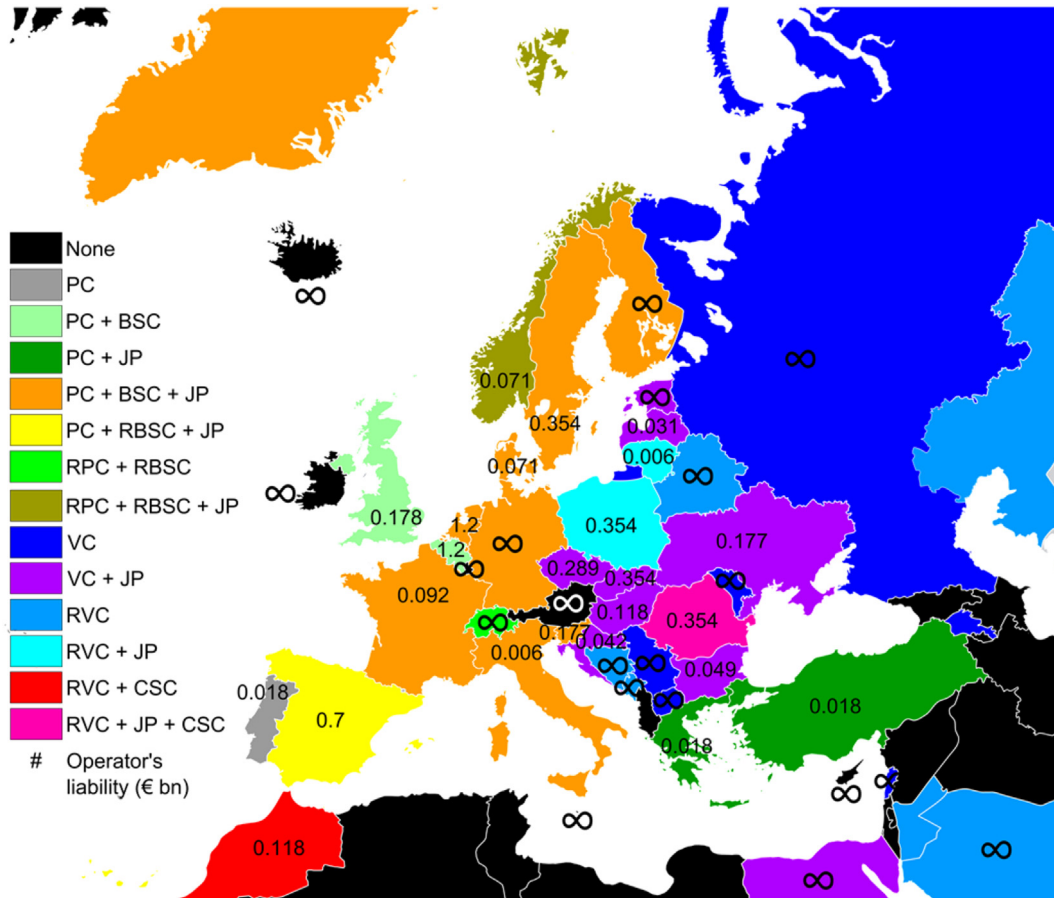


Fig. 1. Nuclear Liability Regime in EU countries including Operator's liability. Constructed by authors from OECD data contained in n 27. Acronyms: Paris Convention (PC); Brussels Supplementary Convention (BSC); Joint Protocol (JP); Revised Brussels Supplementary Convention (RBSC); Revised Paris Convention (RPC); Vienna Convention (VC); Revised Vienna Convention (RVC); Convention on Supplementary Compensation for Nuclear Damage (CSC).

Table 3

Section 17 of The Civil Liability for Nuclear Damage Act (2010). Civil Liability for Nuclear Damages Act, 2010 (n 37); The Civil Liability For Nuclear Damage Rules, 2011 (n 52).

Operator's right of recourse
17. The operator of the nuclear installation, after paying the compensation for nuclear damage in accordance with section 6, shall have a right of recourse where-
(a) such right is expressly provided for in a contract in writing;
(b) the nuclear incident has resulted as a consequence of an act of supplier or his employee, which includes supply of equipment or material with patent or latent defects or sub-standard services;
(c) the nuclear incident has resulted from the act of commission or omission of an individual done with the intent to cause nuclear damage.

companies are also planning international operations, in Turkey and UAE, respectively.³⁶

The approach of India has been in contrast to the rest of the international nuclear industry. India has its own national nuclear liability that is set out in The Civil Liability for Nuclear Damage Act (2010).³⁷ One significant difference compared to other liability regimes is that liability is not exclusively channelled to the operator. Nuclear suppliers are also prospectively liable and this is specified in Section 17 of the Act (as detailed in Table 3). India has also signed

the CSC (see Section 5). However, Section 17 contravenes the Annex of the CSC.³⁸ The intention in this paper is not to discuss in depth the clause (b) in Section 17, but to highlight more its ambiguity or vagueness.

The intent behind the direction by India in terms of civil nuclear liability is unclear. If anything it effectively prevents foreign suppliers from operating in India and it has stalled industry progress. This it seems was contrary to one of the intentions of The Civil Liability for Nuclear Damage Act in India, which was to attract foreign nuclear technology investment.³⁹ Compensation for major

³⁶ World Nuclear Association, 'Nuclear Power in Turkey' (October 2015) <<http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Turkey/>> accessed 9 January 2016; World Nuclear Association, 'Nuclear Power in the United Arab Emirates' (September 2015) <<http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/United-Arab-Emirates/>> accessed 9 January 2016.

³⁷ Civil Liability for Nuclear Damage Act 2010 <<http://dae.nic.in/sites/default/files/civilnucliab.pdf>> accessed 9 January 2016.

³⁸ Arghya Sengupta and Sanhita Ambast, 'A Dangerous Recourse? A Critical Relook at Section 17 of the Civil Liability for Nuclear Damage Act, 2010' (2012) 3 International Journal of Nuclear Law 292.

³⁹ MP Ram Mohan, 'Nuclear Liability Law of India: An Appraisal of Extent of Liability, Right of Recourse and Transboundary Applicability' (2014) 17 Journal of Risk Research 115.

industrial accidents (especially from foreign companies) is a public issue in India after the Bhopal disaster in 1984 where compensation was extremely slow in been received by victims and that was if it was received at all.⁴⁰ There may be an attempt to avoid similar problems, but if anything the new law creates more confusion.⁴¹ For example in its current state, a victim of a nuclear accident may have to take a multitude of court cases against several suppliers and the operator—especially in the instance where the operator invokes Section 17 clause (b) “the nuclear incident has resulted as a consequence of an act of supplier or his employee” (see Table 3). In this context, it is also unclear in terms of administrative law if the Indian court systems has improved in terms of speed to compensate claimants; and especially in light of this been an issue after the Bhopal accident. It has been noted in the literature that the Indian legal system is far from being in a situation to manage the legal consequences of a nuclear accident.⁴²

Overall, many authors are positive towards the Indian approach to nuclear liability regime and its imposition of liability on suppliers though it is not exactly clear why.⁴³ There are several themes that emerge. One of these is that the international nuclear liability regime is in need of reform and the Indian approach is the way forward. This is despite one commentator noting that “In fact, in India, the operator companies will also be wholly government-owned, which could explain in part why the Indian government chose to introduce an expanded concept of supplier liability”.⁴⁴ Yet this issue is never addressed. There also seems to be a distrust of foreign companies in the sector and also perhaps distrust in the state nuclear company — Nuclear Power Corporation of India Limited (NPCIL) — which will operate the nuclear reactors in the country. Indeed, a case that was before the Indian courts in 2004 highlighted this problem — *People's Union for Civil Liberties v Union of India* (2004) 2 SCC 476 — and this case concerned the disclosure of 130 issues of safety concern by the Atomic Energy Regulatory Board.⁴⁵ The disclosure was held not to be in the Indian State's interest and to be an issue of national security. This case highlighted the widespread view that the Indian nuclear industry operated under a veil of secrecy.^{46,47}

A significant oversight in the academic literature concerns the role of the nuclear safety regulator in India (Atomic Energy Regulatory Board, AERB) and its effect on India's relationship with the international nuclear liability regimes. There has just been one notable review of the AERB and other government agencies in India

such as the Department of Atomic Energy and the Atomic Energy Commission. In this case the roles of the Indian government, the AERB and the other latter agencies have been heavily criticised with the authors pointing three key problems which have served to reduce the importance of the need for India to sign an international nuclear liability convention. These are: (1) the attitude that is demonstrated by comments made by the Chairman of the Atomic Energy Commission who stated that the probability of an accident was ‘one in infinity’; (2) the lack of independence of the AERB from the influence of Government; and (3) the comment by the Secretary of the Department of Atomic Energy who stated that Indian reactors were 100 per cent safe.⁴⁸

The regulator has a role to ensure safety in the activities of the suppliers, as has the nuclear operator. Not allowing liability to be passed on to suppliers does not reduce the role of the AERB to ensure that suppliers provide safe, reliable and non-defective equipment and services. Even NPCIL has commented that the effect of the Civil Liability for Nuclear Damage Act (2010) in India will be to reduce business activity in the Indian nuclear energy industry to a standstill.⁴⁹

Nevertheless, it is clear that despite the introduction of the Civil Liability for Nuclear Damage Bill in India, there remains a realisation that the issue of supplier liability is important in the nuclear energy industry. Further clarification will happen in this area, and in particular after the recent meeting in January 2015 between the US and India between their Presidents, Barack Obama and Narendra Modi, respectively. The outcome of this meeting will ensure there is a limit to the amount a supplier will be liable for in the event of a nuclear accident — though exact specifics still have yet to emerge.⁵⁰ In June 2015, a Rs 1500 crore (\$234 million) Indian nuclear insurance pool was announced - this insurance pool comprises domestic insurers plus Nuclear Risk Insurers which manages the UK's nuclear insurance pool.⁵¹

In India, it seems the operator will not have strict liability until there is a major shift in Indian legislation. In particular, the supplier needs to consider the Civil Liability for Nuclear Damage Rules (2011) that apply from the same day the Civil Liability for Nuclear Damage Act went into force (11 November 2011).⁵² The three main issues as identified by a Committee on Subordinate Legislation of the Lok Sabha, which produced a Report on the Civil Liability for

⁴⁰ A similar argument is made by Ted Jones, ‘NEI Nuclear Notes: Why India's Nuclear Liability Law Is Harming Indian Interests’ <<http://neinuclearnotes.blogspot.co.uk/2013/10/why-indias-nuclear-liability-law-is.html>> accessed 9 January 2015.

⁴¹ Ayushi Sutaria, ‘Placing the Indian Civil Nuclear Liability Regime in Context: The Extent of Supplier's Liability’ (2014) 17 Journal of Risk Research 97.

⁴² Anupam Jha, ‘Dynamics of Legal Regime on Safety of Nuclear Power Plants in India after Fukushima Disaster’ (2014) 17 Journal of Risk Research 145.

⁴³ Arya Hariharan, ‘India's Nuclear Civil Liability Bill and Supplier's Liability: One Step Towards Modernizing the Outdated International Nuclear Liability Regime’ (2011) 36 Wm. & Mary Envtl. L. & Pol'y Rev. 223; Mohit Abraham, *Nuclear Liability: A Key Component of the Public Policy Decision to Deploy Nuclear Energy in Southeast Asia - American Academy of Arts & Sciences* (American Academy of Arts and Sciences 2014) <<https://www.amacad.org/content/publications/publication.aspx?d=1499>> accessed 9 January 2016; MV Ramana and Suvrat Raju, ‘Nuclear Safety before Vendor Interests’ *The Hindu* (30 October 2012) <<http://www.thehindu.com/opinion/op-ed/nuclear-safety-before-vendor-interests/article4044438.ece>> accessed 9 January 2016; MV Ramana and Suvrat Raju, ‘Profitability without Accountability’ *The Hindu* (16 February 2015) <<http://www.thehindu.com/opinion/op-ed/comment-profitability-without-accountability/article6898851.ece>> accessed 9 January 2016.

⁴⁴ Abraham (n 43).

⁴⁵ Jha (n 42).

⁴⁶ *ibid.*

⁴⁷ Yash Thomas Mannully, ‘Law Relating to Nuclear Liability and Compensation in India’ (2010) 3 International Journal of Nuclear Law 112.

⁴⁸ MV Ramana and Ashwin Kumar, ‘“One in Infinity”: Failing to Learn from Accidents and Implications for Nuclear Safety in India’ (2014) 17 Journal of Risk Research 23; *ibid.* 27.

⁴⁹ Zee News, ‘N-Liability Bill Changes Tough, No Supplier Will Come: NPCIL’ (*Zee News*, 24 August 2010) <http://zeenews.india.com/news/nation/n-liability-bill-changes-tough-no-supplier-will-come-npcil_650351.html> accessed 9 January 2016.

⁵⁰ Dan Roberts, ‘Obama and Modi Agree to Limit US Liability in Case of Nuclear Disaster’ *The Guardian* (Delhi, India, 25 January 2015) <<http://www.theguardian.com/world/2015/jan/25/obama-modi-limit-us-liability-nuclear-disaster>> accessed 9 January 2016.; Ministry of External Affairs (Government of India), ‘Frequently Asked Questions and Answers on Civil Liability for Nuclear Damage Act 2010 and related issues (28 February 2015)’ <<http://www.mea.gov.in/press-releases.htm?dtl/24766/Frequently+Asked+Questions+and+Answers+on+Civil+Liability+for+Nuclear+Damage+Act+2010+and+related+issues>> accessed 27 July 2015, which notably states that “Section 17 states that the operator shall have a right of recourse. While it provides a substantive right to the operator, it is not a mandatory but an enabling provision. In other words it permits but does not require an operator to include in the contract or exercise a right of recourse.”

⁵¹ World Nuclear Association, ‘Nuclear Power in India’ (January 2016) <<http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/India/#NuclearLiability>> accessed 9 January 2016.

⁵² The Civil Liability For Nuclear Damage Rules, 2011 <http://dae.nic.in/writereaddata/liab_rules.pdf> accessed 27 July 2015.

Table 4

Issues concerning Rule 24 of the Civil Liability for Nuclear Damage (CLND) Act, 2011. OECD, 'Annual Report on India' (2012) 90 OECD-NEA Nuclear Law Bulletin 119.

- Rule 24(1) provides that any contract under S. 17(a) of the Civil Liability for Nuclear Damage Act shall not be for an amount less than the amount of the operator liability specified under S. 6(2) of the CLND Act, or the value of the contract itself, whichever is less.
- Rule 24(2) states that the right of recourse referred to in Rule 24(1) shall be for the duration of the initial licence issued under the Atomic Energy (Radiation Protection) Rules, 2004, or the product liability period, whichever is longer. Such initial licence is granted for five years.
- Section 6(1) of the Civil Liability for Nuclear Damage Act specifies that the maximum amount of liability with respect to each nuclear incident shall be SDRs 300 million (approximately USD 450 million) or such higher amount as may be notified by the government of India. Section 6(2) further subdivides the liability of an operator for each nuclear incident, and with respect to nuclear reactors having thermal power equal to or above ten MW, it shall amount to Rupees 1500 Crores (approximately USD 292.4 million)."

Nuclear Damage Rules, 2011 (on 28 August 2012)⁵³ which are outlined in Table 4 below.

In essence Rule 24 aims to limit the wide scope of Section 17 (b) of the Civil Liability for Nuclear Damage Act (see Table 3) both limiting the right of recourse of an operator on a supplier in time and the financial amount. However, it is perhaps not sufficiently unambiguous in asserting these limits. Also, the question as to whether Rule 24 is enforceable over Section 17 (b) of the Civil Liability for Nuclear Damage Act remains open. Indeed, it has been asserted that Rule 24 could not be relied upon. It is not only inconsistent with Section 17 (b) but would also be prohibited by the Indian Supreme Court.⁵⁴ Hence, despite the introduction of Rule 24, the situation remains the same and is why the US nuclear industry have sought, through the intervention of President Obama, further clarification of the issue of supplier liability in India.

4. A comparative focus between nuclear and non-nuclear energy sectors

In many analyses of the nuclear liability regime, it has been held that a major nuclear accident will be extremely costly, with some studies suggesting that it could cost as much as £5000 billion.⁵⁵ In general these studies allude that the existing financial limits of liability are insufficient and therefore it is considered that the nuclear energy industry is in receipt of a subsidy.⁵⁶ The various approaches to calculating the damages from a nuclear accident by these studies can be excessive. Recent cost estimates on nuclear energy accidents from the Institute for Radiological Protection and Nuclear Safety (IRSN) in France estimates the cost of ~€120 billion for a severe nuclear accident and ~€430 billion for a major nuclear accident, such as Chernobyl or Fukushima, occurring in France.⁵⁷ As of 2014, ~\$21 billion has been claimed from the accident at Fukushima Daiichi.⁵⁸ The current projected cost of Fukushima is

estimated at ~€36.5 billion which is significantly below the IRSN figures⁵⁹ but much greater than the \$12.6 billion U.S. insurance pool and the €1.5 billion limit of the RPC + RBSC. Hence, discussion is presently focussed on what the lower limit of third-party nuclear liability should be and how the insurance sector can increase its coverage.

As a comparison, accidents in offshore oil and gas can be very costly in terms of human life and financially. For example, the major accident at the Piper Alpha rig in the North Sea in the UK on 6 July 1988 caused 167 fatalities.⁶⁰ Piper Alpha cost \$1.4 billion (\$3.6 billion in 2014 US\$ values) in insurance claims and was unprecedented for the sector in realising the potential scale and spread of insurable claims across geographical and business scope.⁶¹ The operating company, Occidental, paid £66 million to families of the deceased, but this compensation was not awarded through the UK criminal or civil courts.⁶²

More recently, the BP Deepwater Horizon Oil Spill in the Gulf of Mexico in 2010 (which began on the 20 April 2010) caused so far has cost BP near \$43 billion, as outlined in Table 5.⁶³ This may be set to increase further with BP having been found grossly negligent in its activities that may have led to a potential fine of \$18 billion under the Clean Water Act by the US courts.⁶⁴ That figure was then reduced to a \$13.7 billion in the US courts but the expectation was that the Judge would seek a fine close to that maximum amount that will take the cost of the accident close to \$55 billion — with a final decision expected in the summer of 2015.⁶⁵

The final fine is estimated to be \$5.5 billion under the Clean Water Act penalty, with an additional \$7.3 billion for natural resource damages, \$4.9 billion in economic claims to five states and \$1 billion in 400 local government claims — however, it is expected

⁵³ Committee on Subordinate Legislation, Lok Sabha Secretariat, *The Civil Liability For Nuclear Damage Rules, 2011* <<http://164.100.47.134/lsscommittee/Subordinate%20Legislation/27%20Report%20nuclear.pdf>> accessed 9 January 2016.

⁵⁴ Sengupta and Ambast (n 38).

⁵⁵ Hans-Jürgen Ewers and Klaus Rennings, 'Economics of Nuclear Risks — A German Study' in Olav Hohmeyer and Richard L Ottinger (eds), *Social Costs of Energy* (Springer Berlin Heidelberg 1994) <http://link.springer.com/chapter/10.1007/978-3-642-85120-9_11> accessed 27 July 2015; Duncan EJ Currie, 'Problems and Gaps in the Nuclear Liability Conventions and an Analysis of How an Actual Claim Would Be Brought under the Current Existing Treaty Regime in the Event of a Nuclear Accident, The' (2006) 35 *Denv. J. Int'l L. & Pol'y* 85.

⁵⁶ Jeffrey A Dubin and Geoffrey S Rothwell, 'Subsidy to Nuclear Power Through Price—Anderson Liability Limit' (1990) 8 *Contemporary Economic Policy* 73; Anthony G Heyes and Catherine Liston-Heyes, 'Subsidy to Nuclear Power Through Price—Anderson Liability Limit: Comment' (1998) 16 *Contemporary Economic Policy* 122.

⁵⁷ Patrick Momal, 'The Cost of Nuclear Accidents', NEA Workshop on Approaches to Estimation of the Costs of Nuclear Accidents, May 2013 <<http://www.oecd-nea.org/ndd/workshops/aecna/presentations/documents/PatrickMomal-Costestimationmethodology.pdf>> accessed 9 January 2016.

⁵⁸ Toyohiro Nomura, 'The Japanese experience on claims management after the Fukushima Daiichi accident', Stakeholder Conference on Nuclear Third Party Liability and Insurance, January 21 and 22, 2014 <<http://ec.europa.eu/energy/en/events/international-workshop-nuclear-liability>> accessed 9 January 2016.

⁵⁹ Japan Atomic Energy Commission (Yoshihiro Nagaoki), 'Estimation of Accident Risk Cost of Nuclear Power Plants', NEA Workshop on Approaches to Estimation of the Costs of Nuclear Accidents, May 2013 <<http://www.oecd-nea.org/ndd/workshops/aecna/presentations/documents/YoshihiroNAGAOKI-EstimationofAccidentRiskCostofNPP.pdf>> accessed 9 January 2016.

⁶⁰ Cullen, W. D. 1990. *The public inquiry into the Piper Alpha Disaster*. Department of Energy: London, HMSO, London, UK.

⁶¹ Lloyd's, '1988 The Piper Alpha Explosion.' (28 May 2013) <<http://www.lloyds.com/lloyds/about-us/history/catastrophes-and-claims/piper-alpha>> accessed 9 January 2016; Lloyd's, 'Piper Alpha after the Fire' (5 July 2013) <<http://www.lloyds.com/news-and-insight/news-and-features/market-news/industry-news-2013/piper-alpha-after-the-fire>> accessed 9 January 2016.

⁶² Terry Macalister, 'Piper Alpha Disaster: How 167 Oil Rig Workers Died' *The Guardian* (4 July 2013) <<http://www.theguardian.com/business/2013/jul/04/piper-alpha-disaster-167-oil-rig>> accessed 9 January 2016.

⁶³ Margaret Cronin Fisk, Brian Swint and Laurel Brubaker Calkins, 'BP's Oil Spill Deal Sours as Claims Add Billions to Cost - Bloomberg Business' *Bloomberg* (4 June 2013) <<http://www.bloomberg.com/news/articles/2013-06-04/bp-s-oil-spill-settlement-sours-as-claims-add-billions>> accessed 9 January 2016.

⁶⁴ Margaret Cronin Fisk and Jef Feeley, 'BP Found Grossly Negligent in 2010 Gulf of Mexico Spill' *Bloomberg* (4 September 2014) <<http://www.bloomberg.com/news/articles/2014-09-04/bp-found-grossly-negligent-in-2010-gulf-of-mexico-spill>> accessed 9 January 2016.

⁶⁵ For a recent discussion on the penultimate stage of the BP Ruling, see Dominic Rushe, 'Deepwater Horizon Oil Spill Legal Saga Enters Final Chapter' *The Guardian* (19 January 2015) <<http://www.theguardian.com/business/2015/jan/19/bp-oil-spill-deepwater-horizon-final-fine-clean-water-act>> accessed 9 January 2016.

Table 5
Cost to BP of BP deepwater horizon oil spill.^a

Issue	Amount BP has spent/set aside, in 2010 US\$
Litigation and settlement costs	\$25.87 billion
Spill response costs	\$14.30 billion
Clean Water Act penalties	\$3.51 billion
Environmental costs	\$3.03 billion
Other costs	\$1.94 billion
Sub-total	\$48.65 billion
Less recoveries	\$5.68 billion
Total	\$42.97 billion

^a Daniel Gilbert and Justin Scheck, 'BP Is Found Grossly Negligent in Deepwater Horizon Disaster' *Wall Street Journal* (5 September 2014) <<http://www.wsj.com/articles/u-s-judge-finds-bp-grossly-negligent-in-2010-deepwater-horizon-disaster-1409842182>> accessed 9 January 2016.

that this will be stretched out over 18 years (at \$1.1 billion a year) and the expectation is BP will deduct the majority of these fines out of taxes.⁶⁶

Similar to the nuclear industry, oil industry liability rests with the operator. This is mainly achieved through Knock-for-Knock indemnity contracts.⁶⁷ The offshore oil and gas industry has no similar third-party agreements such as the PC, the VC, or the CSC — with the exception of transportation. The marine oil sector for oil tankers has an international liability regime governed by the International Marine Organization to which 133 countries are signatory.⁶⁸ Oil tanker accidents are insured for between €7 million to €136 million depending on units carried and two mechanisms are in place if the cost of the accident exceeds this to pay further compensation: (1) the International Oil Pollution Compensation Fund (IOPC) 1992 increases the amount up to 203 million SDRs; and (2) the IOPC 2003 Supplementary Fund Protocol raises this to 750 million SDRs.⁶⁹ Even still this compensation fund may not be sufficient, as highlighted by the Exxon-Valdez oil spill that yielded punitive damages of \$5 billion (in 1995 US\$).⁷⁰

A key issue for the operator, BP, as a result of the Deepwater Horizon disaster, was again the broadening of scope of damages beyond that experienced with Piper Alpha. Timeliness was also a key issue for BP in settling claims; even though they have since argued they settled too early in some cases,⁷¹ due in part, to the division of geographical areas into settlement zones according to proximity to the spill.

There are two major lessons for the nuclear insurance industry

from the BP Deepwater Horizon case and these are:

- (1) timeliness is very important in the claims management process; and
- (2) each major accident in the oil and gas sector will mean an increase in the scope and scale of those individuals and entities that seek, and can claim damages.

These are similar to what has happened in the nuclear energy sector after its major accidents. Chernobyl, as stated earlier, broadened the scope of the categories of damage that could be claimed and prompted updates to the nuclear liability regime. Fukushima Daiichi has shown that timeliness is very important and that again the scope for claiming by those affected to some degree by the accident has also increased. The logic dictates that as a result of a future accident in the nuclear energy sector, the scope of claims will increase. In essence, the definition of loss may expand and become more inclusive and expansive. There maybe other reasons for this in that, public trust in the industry is considered of vital importance and a return to 'business as usual' as soon as possible is more important for the industry than the amount of compensation finally claimed.⁷²

5. Conclusion and future outlook

After Fukushima Daiichi, as after Chernobyl, the accident prompted a desire to review and possibly to reform the nuclear liability regime to ensure victims are adequately compensated.⁷³ To-date discussion around the global nuclear liability regime post Fukushima Daiichi has received little attention in academic literature and this article aims to address this. Over the next few years, the global nuclear liability regime is set to come under scrutiny at an international institutional level, and in particular, because of developments in the EU and also due to the CSC coming into force.

The EU has so far played a lead role in reviewing the international global nuclear liability regime. The EU held a meeting on this subject matter in January 2014.⁷⁴ The meeting was preceded by an EC Public consultation on nuclear liability⁷⁵ and the ambition of this meeting was to build on this consultation and also begin to draft a new approach for nuclear liability within the EU. The necessity of the consultation by the EU Commission and the need for a revision of the liability regime had been previously questioned in 2013 by the nuclear industry.⁷⁶ Observations from the January 2014 meeting were no clearer, though it was highlighted that there were lessons to be learned from the accident at Fukushima Daiichi. In particular, these related to the claims management process, an

⁶⁶ BP, 'BP to Settle Federal, State and Local Deepwater Horizon Claims for up to \$18.7 Billion With Payments to Be Spread Over 18 Years' (2 July 2015) <<http://www.bp.com/en/global/corporate/press/press-releases/bp-to-settle-federal-state-local-deepwater-horizon-claims.html>> accessed 9 January 2016; Daniel Gilbert and Sarah Kent, 'BP Agrees to Pay \$18.7 Billion to Settle Deepwater Horizon Oil Spill Claims' *Wall Street Journal* (2 July 2015) <<http://www.wsj.com/articles/bp-agrees-to-pay-18-7-billion-to-settle-deepwater-horizon-oil-spill-claims-1435842739>> accessed 9 January 2016.

⁶⁷ For more on Knock-for-Knock contracts see: Chidi Egbchue, 'Reviewing "Knock for Knock" Indemnities Following the Macondo Well Blowout' (2013) 7 *Construction Law International* 7.

⁶⁸ International Convention on Civil Liability for Oil Pollution Damage (CLC), <<http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-on-Civil-Liability-for-Oil-Pollution-Damage-%28CLC%29.aspx>> accessed 9 January 2016.

⁶⁹ The International Oil Pollution Compensation Funds, <<http://www.iopcfunds.org/about-us/legal-framework/1992-fund-convention-and-supplementary-fund-protocol/>> accessed 9 January 2016.

⁷⁰ RT Paine and others, 'TROUBLE ON OILED WATERS: Lessons from the Exxon Valdez Oil Spill' (1996) 27 *Annual Review of Ecology and Systematics* 197.

⁷¹ Associated Press in New Orleans, 'Judge Orders BP to Stick by Deepwater Horizon Payouts Agreement' *The Guardian* <<http://www.theguardian.com/environment/2014/sep/24/bp-ordered-deepwater-horizon-payouts-agreement>> accessed 9 January 2016.

⁷² This point is addressed further in Section 5 though is an area in need of further research.

⁷³ This does prompt the argument that the development of nuclear law needs to be more proactive and is too reactive at the moment. It should not wait until there is an accident to reform. See the following for more discussion on this though a different reason is asserted for why nuclear law should be more proactive in its formulation: RJ Heffron, 'The Need for Proactive over Reactive Nuclear Law for the International Nuclear Industry' (2013) 11 *Oil, Gas & Energy Law Journal (OGEL)* <<https://www.ogel.org/article.asp?key=3335>> accessed 9 January 2016.

⁷⁴ Stakeholder Conference on Nuclear Third Party Liability and Insurance, January 20 and 21, 2014 <<http://ec.europa.eu/energy/en/events/international-workshop-nuclear-liability>> accessed 9 January 2016.

⁷⁵ EC Public consultation on nuclear liability <<https://ec.europa.eu/energy/en/consultations/consultation-nuclear-liability>> accessed 9 January 2016.

⁷⁶ Carolina Parra-Serrano, 'Necessity of New EU Nuclear Liability Proposals Questioned by Industry' [2013] *Post Magazine* <<http://m.postonline.co.uk/post/news/2302292/necessity-of-new-eu-nuclear-liability-proposals-questioned-by-industry>> accessed 9 January 2016.

Table 6

Estimated Nuclear Reactors under the Scope of the CSC International Nuclear Liability Regime. Constructed by the authors using data contained in n 79 and n 83.

Country/region	Number of reactors			Capacity (MW _{th})		
	In operation	Under construction	Total	In operation	Under construction	Total
CSC contracting states						
Argentina	3	1	4	5354	100	5454
Japan	48	2	50	131,073	7852	138,925
Morocco	0	0	0	0	0	0
Romania	2	0	2	4360	0	4360
UAE	0	3	3	0	11,949	11,949
United States	99	5	104	306,274	17,025	323,299
	152	11	163	447,061	36,926	483,987
CSC signatories						
India	21	6	27	19,771	12,819	32,590
Canada	19	0	19	45,487	0	45,487
Czech Rep.	6	0	6	12,016	0	12,016
Ukraine	15	2	17	41,750	6400	48,150
	61	8	69	119,024	19,219	138,243
Noted CSC non-signatories						
South Korea	24	4	28	62,703	15,752	78,455
China	24	25	49	59,459	73,912	133,461
	48	29	77	122,252	89,664	211,916

issue that Japanese national authorities struggled with initially.⁷⁷

In contrast, the US is pursuing a different agenda, and is pushing the CSC as the global solution towards third-party nuclear liability,⁷⁸ especially recommending that a country's national law needs to be in line with the Annex of the CSC. At present six countries have ratified the CSC, these are: Argentina, Morocco, Romania, Japan, UAE, and the USA (which from Table 6 totals 152 reactors in operation and 11 reactors under construction) and came into force on 15 April 2015.⁷⁹ There are 13 other signatories, four of which have installed nuclear capacity, including: Canada, Czech Republic, India, and Ukraine.⁸⁰ Japan was the most recent country to sign and ratify the CSC, and with 48 nuclear reactors of installed operation, and brought the CSC into force on 15 April 2015.⁸¹ However, it is unlikely that all of Japan's capacity will come back online, with recent estimates from Reuters,⁸² coupled with data from the IAEA's Power Reactor Information System,⁸³ suggesting that circa a third of the 48 nuclear reactors are likely to come back online; a third and their return to operation remains uncertain; and the final third unlikely to come back into operation. Nevertheless, the CSC is now in force.

This paper has assessed what the international nuclear regimes are (in Section 2). In Section 3 the effect of these regimes is highlighted through Fig. 1 where the map of Europe shows the effect of the 'patchwork' of conventions that are in force which results in varying levels of liability amounts and financial security limits. The absence of a common coherent liability regime that is accessible to victims raises many issues, but principally the question of whether there is merit in the range of international nuclear liability regimes themselves. Section 3 also discusses the nuclear liability regime in

India where it is evident that India has to engage in reform of its own domestic liability laws before further development will happen in relation to being a signatory to an international nuclear liability regime.⁸⁴ In the penultimate section, it is clear that from a comparative focus between nuclear and non-nuclear energy sectors that the international nuclear industry is more advanced in its approach to accidents. Non-nuclear energy sectors have lower liability limits and yet (based on the BP Deepwater Horizon Oil Spill) result in similar if not higher amounts of compensation. Further, it will in more likelihood be necessary to pursue action in the courts after an accident for a non-nuclear energy sector as there is not the same cooperation on liability as there is in the nuclear energy sector.

The effect of the Fukushima Daiichi accident is set to continue on the nuclear energy sector in relation to liability and compensation. Indeed, issues are around compensation and accidents are a contentious area and as one legal scholar noted: "One thing seems clear. If we are concerned... with accident compensation, the tort law system is unsatisfactory."⁸⁵ The debate will continue and in relation to the nuclear energy sector and liability, Burns (2012) highlights the essence of the future direction that research in the area should take:

"The Fukushima Daiichi accident brings a new focus to the international liability debate, one that is not merely about theoretical problems and impacts of a nuclear accident. In my own view, the accident does not so much newly reveal heretofore "unknowable" or "unthinkable" events and impacts as it does the need for conscientious re-dedication to the essential tenets of nuclear safety and the courage to face the "what ifs" and consequences of an accident."

The area of nuclear liability identifies with previous literature on the issue of torts and accidents and the law, in that it is an area that

⁷⁷ n 74.

⁷⁸ Ben McRae, 'The Convention on Supplementary Compensation for Nuclear Damage: Catalyst for a Global Nuclear Liability Regime' (2007) 79 OECD-NEA Nuclear Law Bulletin 17.

⁷⁹ International Atomic Energy Agency, 'Convention on Supplementary Compensation for Nuclear Damage' (Latest Status: 17 April 2015) <https://www.iaea.org/Publications/Documents/Conventions/supcomp_status.pdf> accessed 9 January 2016.

⁸⁰ *ibid*

⁸¹ As this brings the total installed capacity to more than 400,000 MW_{th}, a condition needed to bring the CSC into force as mentioned in Section 2C.

⁸² Reuters, 'FACTBOX-Outlook for Japan Nuclear Reactor Re-Starts' *Reuters* (1 April 2014) <<http://www.reuters.com/article/2014/04/01/japan-nuclear-restarts-idINL4N0MTOK020140401>> accessed 9 January 2016.

⁸³ All units of installed capacity taken from International Atomic Energy Agency, 'Power Reactor Information System' <<http://www.iaea.org/PRIS/home.aspx>> accessed 9 January 2016.

⁸⁴ Mannully (n 47), who stated that India can be characterized as having an "inadequate development of tort law and lack of legal and legislative developments in the area of complex liability cases."; World Nuclear Association, 'Civil Liability for Nuclear Damage' (June 2015) <<http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/Liability-for-Nuclear-Damage/>> accessed 9 January 2016.

⁸⁵ R Ian McEwin, 'No-Fault Compensation Systems' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics, Volume II. Civil Law and Economics*. (Edward Elgar 2000) 745 <<http://encyclo.findlaw.com/3600book.pdf>> accessed 9 January 2016.

has been recognised as complex and where there remains a lack of a definitive way forward. It is certain that after a nuclear accident there is a need to restore public trust in the industry and in essence, there needs to be less uncertainty as to how to achieve this. There is no immediate solution but certainly the possibility of the harmonisation of the current regimes needs further examination, however, new departures such as what has happened in India do not indicate a way forward.⁸⁶ In particular, developments between Rosatom and its plans to build in Finland, India and Turkey point towards further complexity with international nuclear liability regimes. All three countries have signed separate and different bilateral agreements with Russia relating to nuclear liability.⁸⁷

Finally, while an accident within the nuclear sector may inevitably exceed the amount stated in the legal liability cap though to what extent will be determined by the characteristics of the accident and the response to the accident. Nevertheless, it is evident

that the issue of liability in the nuclear energy sector is not a unique question when accidents and the energy sector are considered. If anything, the nuclear energy sector is further along the in the process of resolving this issue than in other parts of the energy sector, for example, in the offshore oil and gas industry.

Acknowledgements

We acknowledge support from the UK Engineering and Physical Sciences Research Council under grant no. EP/K007580/1, as part of the research project “Management of Nuclear Risks: Environmental, Financial and Safety (NREFS)” led by Professor Philip J. Thomas at City University London. The views expressed herein are those of the authors alone and the usual disclaimers apply. Regarding data availability: data provided in full within this article.

⁸⁶ This is similar to the view expressed by Robert J Gruendel and Els Reynaers Kini, ‘Through the Looking Glass’ (2012) 2012 Nuclear Law Bulletin 45, who stated in relation to the Indian “variations among national liability regimes may exacerbate the phenomenon of fragmentation of international conventions pertaining to the nuclear sector”.

⁸⁷ In Finland’s (Paris Convention) case it has signed an agreement with Russia (Vienna Convention) that in effect agrees that the Joint Protocol will be in force for that project, World Nuclear Association, ‘Nuclear Power in Finland’ (17 July 2015) <<http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Finland/>> accessed 9 January 2016; In India there is an agreement that India will determine the insurance premium for each component and Russia will pay this premium for 20 years, Sonal Patel, ‘India’s Nuclear Liability Law: Breakthrough for Russia, Stalemate Endures for U.S.’ (*POWER Magazine*, 5 January 2014) <<http://www.powermag.com/indias-nuclear-liability-law-breakthrough-for-russia-stalemate-endures-for-u-s/>> accessed 9 January 2016; In Turkey, where Rosatom is building a nuclear plant at Sinop, Russia and Turkey have signed a bilateral agreement where the project will be subject to the “international agreements and instruments to which the Republic of Turkey is or will be a party and national laws and regulations of the Turkish Party”. Please see: Agreement Between the Government of the Republic of Turkey and the Government of the Russian Federation on Cooperation in Relation to the Construction and Operation of a Nuclear Power Plant at the Akkuyu Site in the Republic of Turkey, Article 16, OG No.27721 of 6 October 2010 (also in English), as quoted in Erinç Ercan and Horst Schneider, ‘Turkish Nuclear Legislation: Developments for a Nuclear Newcomer’ (2013) 92 OECD-NEA Nuclear Law Bulletin 29.