

EUROPEAN CHALLENGES TO PROMOTING INTERNATIONAL POOLING AND COMPENSATION FOR NUCLEAR REACTOR ACCIDENTS

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1. INTRODUCTION

Debate about liability and compensation arrangements for nuclear reactor accidents increased markedly after the 1986 Chernobyl accident. This accident brought into stark relief numerous deficiencies in the existing international nuclear liability and compensation regime. It highlighted that many countries with nuclear power plants were not part of any international liability and compensation agreement, meaning that victims in other countries might receive no compensation at all for damage they suffer after a reactor accident causing damage that crossed national borders. Moreover, the sheer scale of the Chernobyl accident showed that the potential range and scale of damage far exceeded the restrictive definitions and liability and compensation amounts in the current system. In short, the established nuclear liability and compensation system could not cope with tens or hundreds of billions of dollars worth of damage spread over multiple countries.

The subsequent revision of the international nuclear liability and compensation conventions has sought to address these deficiencies by establishing higher liability amounts and broadening the range of compensable nuclear damage, whilst leaving much of the original 1960's nuclear liability and compensation architecture unchanged. Even with these proposed increases in operator liability and

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compensation amounts, it remains the case that not all the potential costs of a large nuclear accident will be covered by the revised conventions. Moreover, many countries and nuclear power plants remain outside of the regime established by the international conventions, leaving a significant gap in the coverage of accidents having transboundary consequences. The revisions of the nuclear liability and compensation conventions have also highlighted an additional problem in that the nuclear insurance industry seems unable to cover the full range and extent of the newly expanded third party liability of nuclear operators as required, thereby complicating the ratification and entry into force of the revised instruments.

Under these circumstances, governments might be tempted to continue to limit the liability of nuclear operators and rely on the provision of additional compensation from public funds in the event of a reactor accident. However relatively low levels of operator liability and compensation amounts which are markedly less than the possible damage caused by a serious nuclear reactor accident, mean that risks associated with nuclear power are borne by the general public and that the generation of nuclear electricity is effectively subsidised.

Rather than seeking new financial guarantees through government intervention, it is argued in this paper that a better way forward would require that nuclear operators cover the insurance gaps through their own resources. International pooling of operators' funds has been suggested as one such solution.¹ The principal advantage of an operator pooling system is that large sums of private money, as opposed to public funds, can be made readily available to compensate victims of a nuclear accident. There are other potential advantages for the operator, including that this option could be a cost-effective supplement and alternative to other forms of financial security, provided pooling can be organised appropriately. This paper also considers whether such pooling might offer additional benefits, particularly in the European context, for example by realising greater harmonisation in

¹ Pelzer, Norbert (2007), "International Pooling of Operators' Funds: an Option to Increase the Amount of Financial Security to Cover Nuclear Liability? Discussion paper for the IAEA INLEX Group Meeting on 21-22 June 2007", *Nuclear Law Bulletin* No. 79, pp. 37-55.

liability and compensation arrangements, addressing the current and evolving structure of the electricity market, and by strengthening nuclear safety.²

2. COSTS ARISING FROM A SERIOUS NUCLEAR REACTOR ACCIDENT

While it is generally acknowledged that the potential consequences of nuclear reactor accidents could be large and widespread, estimates of the likelihood and off-site consequences of a serious nuclear reactor accident vary widely.³

There is no single, internationally-accepted, methodology for assessing and valuing damage likely to result from a serious nuclear accident, particularly for damage arising in different countries. Different assessments include or exclude categories of damage to a greater or lesser extent, sometimes even entirely excluding particular types of damage from consideration. It is not unusual for different risk analyses carried out at the same reactor, or different reactors of the same type, to produce central value estimates that differ from one another by several orders of magnitude. Upper- and lower-bound estimates of damage can vary similarly, with no secure criteria for selecting among the conflicting expert assessments.

A variety of nuclear reactor accident scenarios have been described, in which the damages typically range from US\$ 100 million to US\$ 10 billion, although some cost estimates are dramatically higher.⁴ Following the Chernobyl accident, the US General Accounting Office (GAO) conducted an analysis of the off-site financial consequences of a major nuclear accident for all 119 nuclear power plants

² The analysis and discussion presented in this paper draws on Carroll, Simon (2008), "Perspective on the Pros and Cons of a Pooling-type Approach to Nuclear Third Party Liability", *Nuclear Law Bulletin* No. 81, pp. 75-97.

³ By "serious nuclear reactor accident", here is meant an accident where there is a breach of the containment, loss of integrity of the core and uncontrolled emission of core substances into the environment.

⁴ The "Sandia siting report" (1982) concluded that a very large accident could cause damages in the order of USD\$ 695 000 million, cited in: Faure, Michael (1995), "Economic Models of Compensation for Damage Caused by Nuclear Accident: Some Lessons for the Revision of the Paris and Vienna Conventions", *European Journal of Law and Economics* 2, pp. 21-43. An assessment conducted by Prognos AG in 1992 for the federal German government estimated the worst case accident scenario for the Biblis-BPWR power station at over US\$ 6.8 trillion. See: Prognos AG, (1992), cited in: Greenpeace International (1994), "Review of Estimates of the Costs of Major Nuclear Accidents", prepared for the 9th Session of the IAEA Standing Committee on Nuclear Liability, Vienna, 7-11th February 1994.

then operating in the United States. The estimates ranged between a low of US\$ 67 million to a high of US\$ 15 536 million.⁵ More recently, four reactor accident scenarios considered by the EU ExternE project yielded cost estimates for damage ranging from about US\$ 500 million to US\$ 80 000 million.⁶

Against this background of widely diverging estimates, it is worth considering the costs of two actual accidents that caused damage on very different scales: the Chernobyl nuclear reactor accident of 1986; and the Tokai-mura uranium processing accident of 1999.

2.1 The costs of Chernobyl

On 26 April 1986 was a serious nuclear reactor accident following a power excursion in reactor 4 of the Chernobyl nuclear power station. This which led to a large release of radioactivity believed to be comprised of about 4% of the reactor core material.

Large areas of the Ukraine, Belarus and western Russia were contaminated, resulting in the evacuation and resettlement of over 336 000 people. Most of the population of the northern hemisphere was exposed, to various degrees, to radioactivity released by the Chernobyl accident. Even now it is possible to arrive only at a reasonable, but not highly accurate, assessment of the ranges of doses received by the various groups of the population affected by the accident. Some areas of agricultural land still are excluded completely from use and are expected to continue to be so for

⁵ GAO (1987), "Nuclear Regulation: A Perspective on Liability Protection for a Nuclear Power Plant Accident", *GAO/RCED-87-124*, p. 20 and Appendix II.

⁶ European Commission (1995), "Report Number 5, Nuclear Fuel Cycle", *Externalities of Fuel Cycles 'ExternE' Project*, European Commission, DGXII, Science, Research and Development (JOULE), p. 5 (*figures in US\$ are approximate conversions only*). It should be noted that these cost estimates exclude the costs of decontamination, although it is acknowledged that these costs "*can rapidly be very high*", and that there are major limitations to the economic evaluation, arising from uncertainties on the impact (evaluation of source term, difficulties to estimate the environmental impacts due to the long-term contamination, uncertainties on the radiation health effects, etc); uncertainties on the efficiency of countermeasures; and because economic evaluation of some social consequences is nearly impossible. For a description of the methodology and its limitations, see: Sohier, Alain (ed) (2002), "A European Manual for 'Off-site Emergency Planning and Response to Nuclear Accidents'", *SCK-CEN Report R-3594*, December 2002, Chapter 13 – Economic Impact, in particular pp. 245-248.

some time. In a much larger area, although agricultural and dairy production activities are carried out, the food produced is subjected to strict controls and restrictions of distribution and use. The progressive spread of contamination at large distances from the accident site caused considerable concern in many countries outside the former Soviet Union and the reactions of the national authorities to this situation were extremely varied, ranging from a simple intensification of the normal environmental monitoring programmes, without adoption of specific countermeasures, to compulsory restrictions concerning the marketing and consumption of foodstuffs. Some of these restrictions remain in place today.

To-date, the author is aware of no comprehensive overall assessment of the total costs of the Chernobyl accident which compiles and integrates the costs of these different damages, preventive responses and related actions in all affected countries. As a result the total costs of the 1986 Chernobyl accident are likely to remain uncertain and even speculative, but estimates place the costs in the order of tens and even hundreds of billions of US dollars.⁷

2.2 The Tokai-mura criticality accident

On 30 September 1999 a criticality accident occurred in a conversion test building of a JCO nuclear fuel fabrication plant in Tokai-mura, Japan.⁸

⁷ An early estimate put the minimum near-term costs of the Chernobyl accident to be in the neighbourhood of US\$ 15 billion, with longer-term costs of US\$ 75 – 150 billion, see: US Presidential Commission on Catastrophic Nuclear Accidents (1990), *Report to the Congress from the Presidential Commission on Catastrophic Nuclear Accidents* (Volume One), August 1990, p. 73, footnote 10. Another 1990 report estimated that the costs from 1986 through to 2000 for the former Soviet Republics of Belarus, Russia and Ukraine, would be 170-215 billion roubles (at the then official exchange rate this would be equivalent to US\$ 283- 358 billion), see: “Study Says Chernobyl Might Cost 20 times more than Prior Estimates”, *Wall Street Journal Europe*, 29th March 1990. The Belarus Government estimate the total economic damage caused between 1986-2015 will be US\$ 235 billion (1992 June prices), see: Ministry for Emergencies and Population Protection from the Chernobyl NPP Catastrophe Consequences (1999) “The Republic of Belarus: 9 years after Chernobyl, Situation, Problems, Actions”, *National Report*. Another estimate suggests overall economic costs in the Ukraine alone of US\$ 130 billion, see: Vargo, G.J. (ed) (2000), *The Chernobyl Accident: A Comprehensive Risk Assessment*, Batelle Press, reviewed in Thorne, M.C. (2001), *Annals of Nuclear Energy* **28**, pp. 89-91.

⁸ A criticality accident occurs when a nuclear chain reaction accidentally takes place in fissile material, such as enriched uranium or plutonium. In the Tokai-mura accident, workers put a mixture of uranyl nitrate into

The accident was rated Level 4 on the International Nuclear Event Scale (INES), indicating an event without significant off-site risk. There was an evacuation of approximately 50 households within 350 metres of the facility and a recommendation made that people should remain indoors for approximately 300 000 people living within a 10 km radius. Some transportation services were cancelled. On 1st October 1999, schools and other public facilities within a 10 km radius were temporarily closed, as were private companies; and the harvesting of crops and vegetables was suspended. These restrictions were lifted already on the 2nd October 1999.

Over the coming months, a total of 7025 compensation claims were filed. By 30 September 2000, 6885 (98%) of the claims had been settled for a total amount of just under US\$ 120 million.⁹

3. THE DEVELOPMENT OF THE INTERNATIONAL LIABILITY SYSTEM

In the early days of the nuclear industry, government and industry experts identified a major barrier to the establishment of commercial nuclear power programmes: the potential need for payment of considerable damages resulting from a nuclear accident and the lack of adequate available insurance. Unwilling to risk huge financial liability, private companies viewed even the remote possibility of a serious accident as a roadblock to their participating in the development and use of nuclear power. Limitation of an operator's potential liability was considered to be necessary in order not to obstruct the development of nuclear industry. Concern developed also over ensuring adequate financial protection to the public because the public had no assurance that it would receive compensation for personal injury or property damages from the liable party in event of a serious accident. Government

a precipitation tank which was not designed to dissolve this type of solution and thereby caused an eventual critical mass to be formed.

⁹ OECD Nuclear Energy Agency Secretariat (2000), "Tokai-mura accident, Japan: Third Party Liability and Compensation Aspects", *Nuclear Law Bulletin* No. 66, pp. 13-21. The total value of the compensation claims settled by 30 September 2000 was JPY 12.73 billion (p. 17) or about US\$ 118 million (the US\$ amount is an approximate conversion only, using the exchange rate of 30 September 2000). A slightly lower figure of JPY 12.68 billion is given in the table in Annex II of the paper (p. 21), but this figure is for settled claims up to 22 September 2000 only.

lawmakers, nuclear operators and insurers worked together to draft a specific liability framework for the nuclear industry.

This work ultimately led to the creation of the two major international instruments establishing the framework for liability of nuclear operators — the OECD's 1960 Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention),¹⁰ and the IAEA's 1963 Convention on Civil Liability for Nuclear Damage (Vienna Convention).¹¹ Both had two primary underlying objectives: (1) to establish a mechanism for compensating the public for personal injury or property damage in the event of a nuclear accident; and (2) to encourage the development of nuclear power. To meet these objectives, the conventions impose strict, absolute but limited liability on the nuclear site operator with a simultaneous requirement for site operators to have funds secured for meeting their third party liability obligations for compensation following a nuclear accident at the site. In general, insurance is the most common method of meeting this financial security requirement.¹²

While there are some differences in detail, the original Vienna and Paris Conventions have some important features in common. In particular they:

- Allow limitations to be placed on the amount, duration and types of damage for which nuclear operators are liable;
- Require insurance or other financial surety to be obtained by the operator;
- Channel liability exclusively to the operator of the nuclear installation;
- Impose strict liability on the nuclear operator, regardless of fault, but subject to exceptions;

¹⁰ The OECD Secretary General is the depositary for the Paris Convention which has been amended three times by Protocols adopted in 1964, 1982 and 2004. The 1960 Convention and the 1964 Protocol entered into force on 1 April 1968. The 1982 Protocol entered into force on 7 October 1988. www.nea.fr/html/law/nlparis_conv.html

¹¹ The IAEA Director General is the depositary for the Vienna Convention. The Convention entered into force on 12 November 1977. www.iaea.org/Publications/Documents/Infocircs/1996/inf500.shtml

¹² The liability of the operator was typically limited to the amount for which the insurance market was able to provide coverage.

- Grant exclusive jurisdiction to the courts of one country for any given incident, normally the country in whose territory the incident occurs.

Associated with the Paris Convention, is the 1963 “Brussels Supplementary Convention”.¹³ This aims to provide additional funds to compensate damage as a result of a nuclear incident where Paris Convention funds prove to be insufficient. It requires that public funds are to be provided for this purpose, not only by the state where the liable operator's nuclear installation is located, but also by contributions from all parties to the Brussels Supplementary Convention.¹⁴

The system of liability and compensation established by the Vienna and Paris/Brussels conventions has weaknesses and has been criticised, all the more so after the Chernobyl accident clearly highlighted the most serious deficiencies.¹⁵ Compared with the damage caused by the Chernobyl accident, it was obvious that the liability and compensation amounts were woefully low. Many countries were not party to either convention.¹⁶ Not all of the damage, or even the most serious damage, caused by Chernobyl was covered by the definition of damage applicable under either Convention. For example, it became clear that economic losses, the cost of preventive measures, the cost of measures to reinstate an impaired environment and certain other losses resulting from such an impaired environment were likely to constitute major portions of the damage resulting from a nuclear incident. There were also problems with the limits on the time in which claims for compensation

¹³ The 1963 Brussels Convention Supplementary to the Paris Convention of 29th July 1960 on Third Party Liability in the Field of Nuclear Energy. The Brussels Supplementary Convention entered into force on 4 December 1974. No state may become or remain a party to the Brussels Supplementary Convention unless it is a Party to the Paris Convention. www.nea.fr/html/law/nlbrussels.html

¹⁴ The combined Paris/Brussels regime provides for compensation to a maximum amount of 300 million SDR or currently about US\$ 450 million (the US\$ amount is an approximate conversion only, using rates as of 30 January 2009).

¹⁵ For a description of the evolution of international nuclear law following the Chernobyl accident including the developments of the nuclear liability and compensation instruments, see, OECD (2006), *International Nuclear Law in the Post-Chernobyl Period, A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency*, OECD, Paris.

¹⁶ The Vienna Convention was intended to be a global instrument governing civil liability for nuclear damage. However by the time of the 1986 Chernobyl accident, only 10 states had ratified it and not one of these had a major nuclear programme (Argentina, Bolivia, Cameroon, Cuba, Egypt, Niger, Peru, Philippines, Trinidad & Tobago, and Yugoslavia). The Paris (and Brussels) Conventions were originally negotiated to provide a regional liability and compensation regime for nuclear damage for western Europe. They had achieved widespread, but not universal, participation of western European countries by the time of the Chernobyl accident.

could be brought, the claims procedures, and the limitations on which courts had jurisdiction to hear claims.

After the Chernobyl accident, as an interim step intended primarily to address the limited geographical scope of the liability regimes, the parties to both the Vienna and Paris conventions adopted the 1988 Joint Protocol.¹⁷ The Joint Protocol generally extends to states adhering to it the coverage that is provided under the other convention (either Paris or Vienna) to which it is not already a Contracting Party.¹⁸ It thus creates a “bridge” between the two conventions, effectively expanding their geographical scope. In doing so, it ensures that only one of the two conventions will be exclusively applicable to a nuclear incident. At the time it was believed that the link established by the Joint Protocol would induce a greater number of Central and Eastern European (CEEC) countries to join the Vienna Convention, particular those which had formed part of the former Soviet Union. However, this ambition has been only partially realised.¹⁹

It was soon recognised that the Joint Protocol alone would be insufficient. To attract broad adherence to the international nuclear liability conventions and to make them more effective, reform had to be more far-reaching. In short, it had to ensure that, in the case of a nuclear accident, much greater financial compensation would be made available to a much larger number of victims, in respect of a much broader scope of nuclear damage, than ever before. The process of negotiating amendments to the Vienna Convention began in 1990 and was conducted under the auspices of the International

¹⁷ The Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (see: http://www.nea.fr/html/law/nljoint_prot.html). The Joint Protocol entered into force on 27 April 1992.

¹⁸ For example, where a nuclear incident occurs for which an operator in a Paris Convention/Joint Protocol state is liable and damage is suffered by victims in a Vienna Convention/Joint Protocol state, those victims will be able to claim compensation for damage suffered against the liable operator as if they were victims in a Paris Convention state.

¹⁹ Some 18 countries from CEEC have ratified or acceded to the Vienna Convention. Yet only 11 of those 18 countries have ratified or acceded to the Joint Protocol, the instrument which would link them to the regime established by the Paris Convention, a disappointing development for those who had hoped to link all of Europe with one single nuclear liability and compensation regime. See: Schwartz, Julia, A. (2006), “International Nuclear Third Party Liability Law: The Response to Chernobyl”, *International Nuclear Law in the Post-Chernobyl Period*, OECD, pp. 37-72.

Atomic Energy Agency.²⁰ The process concluded in 1997 with the adoption of a protocol amending the Vienna Convention²¹ and of the new Convention on Supplementary Compensation (CSC).²² The Protocol amending the Vienna Convention entered into force on 4 October 2003. The CSC has yet to enter into force.

The Contracting Parties to the Paris and Brussels Conventions concluded in 1997 that while the "Paris/Brussels" regime was viable and sound, it was in need of improvement. Amendments would be needed to increase the liability and compensation amounts, broaden the definition of damage and extend the scope of the conventions, similar as to what had already been done in the context of the revisions to the Vienna Convention. It was also considered necessary to ensure that the Paris/Brussels regime remained compatible with the revised Vienna Convention and also that Paris Convention States would not be hindered from joining the new CSC. Work began officially on revisions in 1998 to the Paris Convention and in 1999 for the Brussels Supplementary Convention, and these

²⁰ Following the 1986 Chernobyl accident, the General Conference of the IAEA decided in 1989 to establish a Standing Committee on Nuclear Liability (SCNL). Its mandate was to examine ways to strengthen the existing international legal regime governing third party liability in the event of another nuclear accident. It focused on two projects: (1) modernizing and strengthening the Vienna Convention to provide a greater level of protection to third party victims of a nuclear accident to which that convention applied; and (2) examining possibilities for mobilising additional funds internationally to supplement national funds made available by the "installation state" under its national law and its obligations under other nuclear liability conventions to which it might also be party. States participating in the work of the SCNL included parties to the Vienna and Paris/Brussels conventions, states with nuclear programmes not party to any of the nuclear conventions, and some states that do not have nuclear power programmes. For a description of the SCNL process and key issues, see, for example: IAEA (2007), *The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage – Explanatory Texts*, IAEA International Law Series No. 3, IAEA, Vienna.

²¹ The 1997 Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage (see: www.iaea.org/Publications/Documents/Conventions/protamend.html).

²² The IAEA Director General is the depositary for the 1997 Convention on Supplementary Compensation for Nuclear Damage. www.iaea.org/Publications/Documents/Conventions/supcomp.html At an early stage of the SCNL negotiations, experts also discussed international pooling of operators' funds. The SCNL considered draft texts that would establish additional tiers of compensation consisting of collective public funds of the Contracting Parties and of operators, but ultimately these did not find sufficient support and were abandoned. Attention concentrated on the proposals which eventually took shape as the new CSC. The CSC is intended to be a free-standing instrument which may be adhered to by all States irrespective of whether or not they are Party to any of the existing nuclear liability conventions. Its objective is to provide additional compensation for nuclear damage beyond that established by the existing conventions and national legislation. It would do this through additional financial contributions from States which become Parties. It should be noted that the CSC does not use operators' resources for its second tier of compensation but exclusively draws the supplementary layer of compensation from public funds. For a description of the negotiation of the CSC and its contents, see, IAEA (2007), *The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage*, *op. cit.*, p. 62 *et seq.*

amendments were adopted in 2004.²³ The 2004 amendments to the Paris and Brussels Conventions have yet to enter into force.

The revisions to the conventions respond to some of the criticisms made previously, by increasing the amount of compensation available, enlarging the time periods during which claims might be made and expanding the range of damage that is covered by the Conventions. In addition to personal injury and property damage, the revised Conventions include certain types of economic loss, the cost of measures to reinstate a significantly impaired environment, loss of income resulting from that impaired environment and the cost of preventive measures, including loss or damage caused by such measures.

The new liability and compensation amounts would be higher than before, with the minimum operator liability required under the revised Paris Convention of about US\$ 900 million and the total compensation available under the revised Paris/Brussels conventions of about US\$ 2000 million.²⁴ The amount provided under the revised Vienna Convention is considerably lower, at approximately US\$ 225 million.²⁵ The revised Paris Convention will officially recognise, for the first time, that a state with an unlimited liability regime may participate in the scheme established by the Convention. It is worth noting also, that State contributions to the combined fund under the revised Brussels Supplementary Convention, will be more closely related to the actual generation of nuclear power by the participating States.²⁶

²³ The 2004 Protocol to Amend the 1960 Paris Convention and the 2004 Protocol to amend the 1963 Brussels Supplementary Convention. www.nea.fr/html/law/paris_convention.pdf and www.nea.fr/html/law/brussels_supplementary_convention.pdf

²⁴ The actual minimum figure under the revised Paris Convention is €700 million and the total compensation available under the revised Paris/Brussels conventions is €1500 million (the US\$ amounts are approximate conversions only, using rates as of 30 January 2009).

²⁵ The minimum level of operator liability under the 1997 amended Vienna Convention is SDR 150 million (the US\$ amount is an approximate conversion only, using rates as of 30 January 2009).

²⁶ Following the example of the Supplementary Compensation Convention which imposes greater responsibility upon nuclear power generating states to provide compensation, the formula for calculating contributions to the international tier under the Brussels Supplementary Convention Protocol moves from one based equally on gross national product and installed nuclear capacity to one based 35% on gross domestic product and 65% on installed nuclear capacity. See: Schwartz, Julia A. (2006), "International Nuclear Third Party Liability Law: The Response to Chernobyl", *op. cit.*

4. PROBLEMS WITH THE “NEW” SYSTEM OF CONVENTIONS

Despite the improvements made by the amendments to the earlier instruments, the revision process has left some of the original criticisms unanswered or only partially addressed. Moreover, there remain problems in bringing the new amended instruments into force and in realising a coherent, comprehensive nuclear liability and compensation regime with broad international adherence.

4.1 Limits remain low and are arbitrary

The raised compensation amounts under the revised conventions may be adequate to deal with an accident with limited off-site consequences, such as that which happened at Tokai-mura in 1999. However, even the new overall compensation amounts under the revised Paris/Brussels conventions remain worryingly low when compared with the costs of the Chernobyl accident. The concern remains that a considerable amount of damage may remain uncompensated for in the event of another major accident on a comparable scale to that of Chernobyl.

Additional problems arise because the individual liability of the nuclear operator potentially can still be limited to a very small fraction of the potential costs of a nuclear accident.²⁷ This potentially shields the operator from the financial consequences of safety-related decisions. A limitation in operator liability below the likely costs of a major nuclear accident also constitutes a subsidy to the nuclear industry. Existing compensation arrangements allowing for State funds to be provided in lieu of industry responsibility for the economic consequences of an accident also are a subsidy to the nuclear industry. They limit the extent of cost internalisation of the risks of nuclear power in electricity pricing, even if they do allow more compensation to be made available to potential victims.²⁸ A further consideration arises in that setting fixed compensation sums is not only arbitrary

²⁷ See, for example, Faure, Michael G. and Vanden Borre, Tom, “Economic Analysis of the Externalities in Nuclear Electricity Production: the US versus the International Nuclear Liability Scheme”, paper presented to Nuclear Inter Jura 2007, Brussels, 2nd October 2007.

²⁸ Some aspects of this criticism can be addressed if States charge the operators for the costs of making public money available.

(in the absence of genuinely robust estimates of probable damage) but it is also unlikely to be valid over the longer term, unless the amounts can be continually adjusted to take into account changes in the economic profile of accident consequences.²⁹

4.2 Membership of the liability regimes remains limited

The goal to ensure broad participation in the new nuclear liability regimes has not been achieved.

The adoption of the 1997 Vienna Convention Protocol was seen as one of the most significant developments to have taken place in nuclear liability law for several decades. It was hoped that this new instrument would attract broad adherence by both nuclear power generating states and non-nuclear power generating states, whether or not they had been Party to the original Vienna Convention.³⁰ The 1997 Vienna Convention entered into force on 4 October 2003, some six years after it had been adopted, having been ratified by the bare minimum number of states required for that purpose. No additional states have since ratified and the lack of wide adherence remains problematic.³¹ Some states, most notably perhaps the Russian Federation, instead chose to become parties to the original Vienna Convention.

²⁹ An illustration of this can be seen in the context of natural disasters. In the United States, until recently, the number of lives lost to natural hazards each year has declined. However, the economic cost of response to, and recovery from, major disasters continues to rise. Each decade, the cost in constant dollars, of property damage from natural hazards, doubles or triples. See: US Geological Survey (2007), "Facing Tomorrow's Challenges – U.S. Geological Survey Science in the Decade 2007-2017", Circular 1309, U.S. Department of the Interior/U.S. Geological Survey, p. 30. A similar "inflation" would be expected for the costs of 'man-made' disasters also.

³⁰ See: Schwartz, Julia A. (2006), "International Nuclear Third Party Liability Law: The Response to Chernobyl", *op. cit.*

³¹ Five countries have ratified the 1997 Vienna Convention: Argentina, Belarus, Latvia, Morocco and Romania. Of these, only Argentina and Romania have a small amount of installed nuclear capacity; the other countries do not have any nuclear power plants.

There has also been a delay in the ratification of the revised Paris Convention and the revised Brussels Supplementary Convention.³² In order for the Protocol amending the Paris Convention to enter into force it must be ratified by two-thirds of the Contracting Parties. For EU Member States, this was supposed to have taken place by the end of 2006, but it has not yet been done.³³ For the Protocol amending the Brussels Convention, ratification by all Contracting Parties is required.

Only four states have ratified the new Supplementary Compensation Convention (CSC).³⁴

The revisions of the original liability and compensation Conventions may not be supportive of ensuring broad adherence by a large number of States. In order to ensure a favourable environment for those considering investing in nuclear programmes, it is necessary for installation States, States involved in the supply of nuclear materials or services for these programmes, and all other States that might be affected by a nuclear accident to be under the umbrella of the same liability and compensation regime. For a liability and compensation regime to be attractive to States seeking to maintain or increase their nuclear power programmes, the burdens imposed by a liability and compensation regime must not be too great. However the expanded definition of damage, extended time frames and raised liability and compensation amounts are proving problematic for some countries.

Conversely, in order to be attractive for a State without nuclear power plants, the liability and compensation conventions must offer sufficient compensation, and the regime must not introduce unacceptable restrictions or burdens when seeking to obtain compensation for losses incurred. For

³² The Protocol to the Paris Convention and the Protocol to the Brussels Supplementary Convention were opened for signature on 12 February 2004, but as of January 2009 neither of these instruments had entered into force.

³³ According to the Council Decision of 8 March 2004, Member States which are Party to the Paris Convention shall take necessary steps to deposit simultaneously their instruments of ratification of the Protocol with the Secretary General of the OECD “*within a reasonable time and, if possible, before 31 December 2006*”. See: Council Decision of 8 March 2004 authorising the Member States which are Party 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, *Official Journal*, L 97/53, 1 April 2004.

³⁴ The four states which have ratified the CSC are: Argentina, Morocco, Romania and the USA. Entry into force requires the ratification of at least 5 states with a combined minimum of 400,000 installed units (MW_{thermal}) of nuclear capacity.

such States, becoming party to one of the nuclear liability conventions is not necessarily an attractive proposition, even if the revisions are taken into consideration. This is not surprising as the Paris and Vienna conventions were essentially developed to nurture nascent nuclear industries, and the recent revisions have done little to alter this fundamental characteristic of the instruments and protecting and promoting nuclear power remains a central feature. Even as revised, the levels of compensation are relatively low when compared to the likely costs of a serious accident. By becoming a party, a non-nuclear power generating State might actually restrict its possibilities for obtaining legal remedies in the event of an accident.³⁵

4.3 Fragmentation and the lack of a coherent international regime

Less than half the world's nuclear reactors are covered by any of the existing international agreements.³⁶ For those that are covered, the nuclear liability conventions do **not** provide one comprehensive and unified international legal regime for nuclear accidents. In fact, there is what has been called a “labyrinth” of intertwined international agreements on nuclear liability, the interrelations of which have become increasingly complicated.³⁷ The complications arise because the earlier and

³⁵ See, for example, Sands, Philippe and Galizzi, Paolo (1999), “The 1968 Brussels Convention and Liability for Nuclear Damage”, *Nuclear Law Bulletin* No. 64, pp. 7 - 27; and Galizzi, Paolo (1998), “Questions of Jurisdiction in the Event of a Nuclear Accident in a Member State of the European Union”, *Journal of Environmental Law* 8(1), pp. 71-97.

³⁶ McRae has calculated that of the 10 countries with the largest installed nuclear capacity, one half are members of an international nuclear liability regime. Overall, the nuclear power generating countries that operate outside the international compensation regimes account for more than half of worldwide installed capacity. See: McRae, Ben (2000), “Overview of the Convention on Supplementary Compensation”, *Reform of Civil Nuclear Liability*, OECD, pp. 171-183, at p. 175. Similarly, Tetley calculates that the Vienna Convention covers 75 reactors, the Paris Convention 130, and that there are 235 reactors outside of these conventions. See: Tetley, Mark (2008), “Nuclear insurance: update on European and UK legislative & commercial positions affecting operations”, *Westminster Energy Forum 'Risk & reward in future nuclear markets'*, London (UK), 7th February 2008.

³⁷ Currently, there are at least eight such agreements, including the 1960 Paris Convention, the 1963 Vienna Convention, the 1963 Brussels Supplementary Convention, the 1988 Joint Protocol, the 1997 Protocol to Amend the Vienna Convention, the 1997 Convention on Supplementary Compensation, 2004 revised Paris Convention and the 2004 revised Brussels Supplementary Convention. For a comprehensive discussion of the interrelationship of the various conventions, see: Horbach, N.L.J.T. (ed) (1999), *Contemporary Developments in Nuclear Energy Law: Harmonising Legislation in CEEC/NIS*, Kluwer Law International, pp 43-85. See also: Brown, O.F. & Horbach, N.L.J.T. (2000), “Liability for International Nuclear Transport: An Overview”, *Reform of Civil Nuclear Liability*, *op. cit.*, pp. 237-261.

revised versions of some of these instruments may coexist, and States may become party to more than one instrument.³⁸

The picture is complex even in a relatively homogenous the European. Until recently most EU Member States were party to the Paris/Brussels regime of nuclear liability and compensation and this was considered a sufficiently uniform situation for the European Commission not to consider specific EU measures in the field of nuclear liability.³⁹ Since the 2004 EU enlargement this is no longer the case. EU States variously are party to the original Vienna convention; the revised Vienna convention; the Paris Convention; some have signalled their intention to adhere to the revised Paris Convention; some are party to both the Paris and Brussels Conventions. The current range of operator liability in Member States goes from the low of about US\$ 65 million in Bulgaria and Lithuania up to unlimited liability in Germany and Sweden. Some EU Member States are not party to any of the international nuclear liability Conventions. Indeed, for EU countries like Ireland, Luxembourg and Austria⁴⁰ – gravely concerned about the risks of nuclear power in neighbouring countries, but with no nuclear

³⁸ A further complication is introduced by transitional measures introduced in the various new instruments, designed to facilitate adherence by new States.

³⁹ Answer of Commissioner Matutes to Written Question E-2489/93 (S. Kostopolous), 1 September 1993 (94/C 240/45), in which it is stated, *inter alia*, that: “All the Member States are parties to the 1960 Paris Convention save Luxembourg and Ireland, which have no nuclear installations on their territory. There is thus no need for the Commission to take the initiative suggested by the Honourable Member [to lay down provisions in insurance law relating to the civil liability of operators of nuclear installations for any damage to persons, property and the environment]”, *Official Journal*, C240/24, 29 August 1994.

⁴⁰ Although not a party to any of the Conventions, Austria has enacted specific legislation covering liability for nuclear accidents. Austria’s nuclear liability legislation rejects many of the fundamental principles underlying the current nuclear liability regimes. Under its legislation, for example, the operator of a nuclear installation may not be exclusively liable. Victims may even assert a claim against a nuclear operator or supplier pursuant to other liability legislation in force, for example product liability legislation. Nor are victims precluded from pursuing claims against more than one defendant. The liability imposed is in all cases unlimited. There are no time limits during which claims may be brought. Prescription periods are determined by the general law of civil procedure of Austria. Austrian courts have jurisdiction to determine claims and Austrian law is applicable, regardless of where the incident causing damage took place, subject only to certain limited exceptions. See: *Federal Law on Civil Liability for Damages Caused by Radioactivity (Bundesgesetz über die zivilrechtliche Haftung für Schäden durch Radioaktivität (Atomhaftungsgesetz 1999)*, BGB1 I, No. 170/1998. A description is given in Hinteregger, M. (1998), “The New Austrian Act on Third Party Liability for Nuclear Damage”, *Nuclear Law Bulletin* No. 62, pp. 27-34.

power plants of their own - it would be difficult indeed to identify many, if any, reasons why they should accede to the current nuclear liability conventions.⁴¹

The impacts of this fragmented and limited membership are considerable. The widely divergent nuclear liability and compensation arrangements currently in place across the various EU Member States have profound implications for victims seeking compensation in the event of an accident as well as for operators needing to provide financial security. They raise concerns also in the context of establishing nuclear safety standards and for competition in the EU electricity market. The problem created by this current situation has been recognised by the European Commission, which is currently undertaking an impact assessment to explore the range of possible solutions and prepare a proposal to the Council.⁴²

5. OBSTACLES TO FINDING A WAY FORWARD

The current situation is that governments have signed up to the revised arrangements for nuclear liability and compensation that the nuclear insurance industry finds difficult to implement and which

⁴¹ It should be noted, in this respect, that Commissioner Matutes response to the Parliamentary question described above, is deficient. Although neither Ireland nor Luxembourg have nuclear installations, they may be affected by a nuclear accident at a reactor located in one of the other EU Member States. In such circumstances, the fact that they are not Party to the Paris Convention might pose problems in that provisions of the Paris Convention might not apply with respect to them. This creates the possibility of claims being pursued through other mechanisms, without the limitations on type of damage, time periods and amounts of liability of the operator, or the channelling, exclusivity, and other special requirements favourable to the nuclear operator, which are established by the Paris Convention. Plaintiffs in such countries might seek compensation through the courts in their own country, i.e. where the damage occurred (or, at the plaintiff's discretion, in the country where the incident occurred), relying on the general conflict of law rules relating to international jurisdiction, including, for example, the 1968 Brussels Convention on the Jurisdiction and Enforcement of Judgements in Civil and Commercial Matters. See: Sands, Philippe and Galizzi, Paolo (1999), "The 1968 Brussels Convention and Liability for Nuclear Damage", *op. cit.* While the outcome of such a proceeding is by no means certain, it might be considered to offer certain advantages not found in pursuing claims pursuant to the limitations of the Paris Convention, see Galizzi, Paolo (1998), "Questions of Jurisdiction in the Event of a Nuclear Accident in a Member State of the European Union", *op. cit.*

⁴² In January 2007 the Commission stated: "*The Commission is aiming at harmonising the nuclear liability rules within the Community. An impact assessment will be started to this end in 2007*", European Commission (2007), "Illustrative Nuclear Programme, Presented Under Article 40 of the Euratom Treaty for the Opinion of the European Economic and Social Committee", *Communication from the Commission to the Council and the European Parliament*, COM(2006) 844 final, 12 July 2007. This aim was restated by EU Energy Commissioner Piebalgs at the *Nuclear Inter Jura Conference 2007* in Brussels on the 2nd October 2007. The assessment had not been published as of 30 January 2009.

the nuclear industry is not comfortable with. Consequently, operators and the insurance industry are putting pressure on governments not to ratify the revised conventions without having first guaranteed their additional exposure risks will be met with Government assistance. These considerations are combining to delay the entry into force of the amended Paris and Brussels conventions. Under these circumstances, governments might be tempted to continue to limit the liability of nuclear operators and rely on the provision of additional compensation from public funds in the event of a reactor accident.

5.1 The need to address the problem of insurance

The nuclear liability conventions and the national legislation implementing them have established a link between insurance coverage and liability amounts. In order to ensure that funds would actually be available to pay claims, the provision of some kind of financial security was made compulsory. Most typically this security has been furnished in the form of third party liability insurance. The desire to protect the industry and the necessity of relying on insurance has required both monetary and temporal limits on compensation. Although the capacity for nuclear insurance has increased greatly over the years, it still remains limited. Governments have generally stipulated a level of financial security that does not exceed the capacity of the insurance industry, and for which the premiums required would not be beyond the capacity of the operators to afford. Thus the capacity of the private nuclear insurance market is also a major factor in determining the amount and extent of liability imposed on nuclear operators.

As Pelzer rightly notes, the consequence of this is that liability amounts exist worldwide which largely correspond to the insurance capacity but which do not necessarily match the nuclear risk.⁴³ The expanded scope of operator liability and the raised liability limits introduced by the amendments need to be seen in this context.

⁴³ Pelzer, Norbert (2007), “International Pooling of Operators’ Funds”, *op. cit.*, p. 37.

During the negotiations to revise the Vienna and Paris conventions, representatives of the nuclear insurance industry stated that some of the proposed amendments would be problematic.⁴⁴ In particular, the nuclear insurance industry were concerned that there was:

- Insufficient private insurance market capacity to insure nuclear operators against raised liability amounts (the amount of cover available);
- An unwillingness of the market to cover extended /extinction periods during which an operator would be liable (the increase from 10 to 30 years); and
- A difficulty in that private insurance could not cover all the categories included in the expanded definition of damage (scope of the cover required).

The nuclear insurance industry concerns with regard to the “full insurability” of these various risks stems from a variety of issues. In some cases, particularly for “reinstating a significantly impaired environment”, insurers take the view that there is no “insurable interest” to be protected, or that there is no quantifiable economic interest. They maintain that it will be difficult to establish the type and extent of damage caused by the accident and at what stage of progression that damage occurred; they point out that it is not always easy to relate decreases in land values to a particular source. They have expressed concerns over uncertainty as to how courts may define or interpret a “significant” impairment of the environment. Finally, they have indicated their opposition to extended prescription periods both on the basis of problems related to causality, but as well, the difficulty of quantifying exposure, the need to defend against speculative claims and the questioned value of legally authorised exposure limits.⁴⁵

⁴⁴ *Ibid*, p. 39. The nuclear insurance industry made its concerns known at an early stage in the discussion of amendments of the Paris Convention, see *Letter of the Comité Européen des Assurances* of 8 December 2000.

⁴⁵ Tetley, M. (2006), “Revised Paris and Vienna Nuclear Liability Conventions – Challenges for Nuclear Insurers”, *Nuclear Law Bulletin* No. 77, pp. 27-39.

This has direct consequences for nuclear operators. Effectively, nuclear operators might no longer be able to obtain private insurance coverage to cover their full liabilities under the amended Vienna and Paris. Tetley summarised the concern thus:

*The financial uncertainties introduced by the new heads of cover under the revised conventions will cause a reduction in insurance cover unless a consistent approach is found to deal with the unquantifiable risks imposed upon the nuclear operators.*⁴⁶

The gap which has opened up between what the liability risks the operators are required to assume under the revised convention and the coverage available from private insurers, is causing problems and is delaying ratification of the revised liability conventions.⁴⁷ Additional difficulties may arise, as the monopoly of the national nuclear insurance pools creates problems for the operators (paying high premiums), and for the authorities, who are also confronted with a problem of information asymmetry (not knowing what the exact capacity of the insurance market is).

5.2 Public financing is not the answer

The contention that aspects of environmental damage under the revised conventions are ambiguous and ill-defined so as to make them completely uninsurable can be challenged. However, the core question that emerges is whether simply because the private insurance industry is not able or willing to make cover available at the appropriate price to the industry, does it automatically mean that the burden should fall on society as a whole?

In accordance with the conventions, gaps in insurance coverage have to be covered by the Installation State that has to step in to the extent that insurance or other financial security is not available or not sufficient. Tetley argues that if insurance cover is not available to cover the increased liability under

⁴⁶ *Ibid*, at p. 39.

⁴⁷ Schwartz, Julia A. (2007), "Alternative Financial Security for the Coverage of Nuclear Third Party Liability Risks", paper presented to Nuclear Inter Jura 2007, Brussels, 2nd October 2007.

the revised conventions, then the liability for the increased scope of cover should be accepted by governments and, moreover, that the charges not be passed on to operators.⁴⁸ This would make liability conditional on the availability of insurance, and is surely not generally acceptable. As Pelzer has commented:

*Legislators cannot agree to that view nor is it in the best interest of operators – not to mention the interest of possible victims – to be tied to the insurance industry without alternatives. For good reasons and after long difficult negotiations, States agreed on the revised conventions with a view to establishing a more risk adequate liability regime and to better protecting victims. There is no “inconsistent approach” which would warrant a change or an insurance adequate streamlining of the new liability concept only for the reason that the insurance industry is unable to cover the liability.*⁴⁹

From the perspective of potential victims there is a pressing need to ensure full and effective compensation for the full liabilities from nuclear power. The appropriate question is how nuclear operators can meet these new liabilities, not how they can escape from them. The challenge is to find a way that enables operators to demonstrate that these liabilities are adequately and securely covered. Nuclear operators will need to obtain financial security for their outstanding liabilities through means other than insurance.

One alternative might be for governments to provide the additional security required, whilst requiring nuclear operators to pay a fee for the service. However State intervention to cover private liabilities would conflict with the polluter-pays principle and would interfere with principles of market economy. It is likely that, at best, the price of State guarantees will only partially reflect the real liabilities.⁵⁰ Under such an arrangement, therefore, ultimately it will be society at large that bears the

⁴⁸ Tetley, M. (2006), “Revised Paris and Vienna Nuclear Liability Conventions – Challenges for Nuclear Insurers”, *op. cit.*, at p. 38. He argues also that these costs should not be passed on to operators as pricing will be difficult, noting that these costs are currently not quantifiable by the insurance industry.

⁴⁹ Pelzer, Norbert (2007), “International Pooling of Operators’ Funds”, *op. cit.*, p. 47.

⁵⁰ These costs should than be market reflective and should take into account risk differentiation etc. It is far from sure that any governmental institution is well equipped enough to assume this difficult task, and thus

cost of damage caused by a nuclear accident. Use of public funds would effectively serve as a continuing subsidy to nuclear electricity generation by failing to internalise the recognised liabilities of nuclear power. In addition, using new and additional public funds to implement the revised liability conventions is likely to generate new public debate about State support for nuclear power. Rather than seeking new financial guarantees through government intervention, Pelzer suggests that nuclear operators would better serve their own interests by identifying solutions to cover the insurance gaps through their own resources.⁵¹

6. POOLING OF OPERATORS' RESOURCES – A PROMISING ALTERNATIVE

Operators' pooling could be used to fill gaps in coverage due to specific exclusions from insurance coverage. Secondly, it could be used to increase the total amount of compensation beyond the capacity of the insurance industry. Using operator pooling for both purposes is desirable. The principal advantage of an operator pooling system is that large sums of private money, as opposed to public funds, can be made readily available to compensate victims of a nuclear accident. There are other potential advantages for the operator, including that this option could be a cost-effective supplement and alternative to other forms of financial security, provided pooling can be organised appropriately.⁵²

There are currently two national operators' pooling arrangements, one in the United States and the other in Germany. The United States pooling system is based on a statutory obligation or duty of the individual operator to contribute, while the German system is formed by a voluntarily concluded

whether such an institution could do so in a more efficient manner than an insurance company or mutual insurance scheme. See, for example, Faure, Michael G. and Vanden Borre, Tom, "Economic Analysis of the Externalities in Nuclear Electricity Production: the US versus the International Nuclear Liability Scheme", *op. cit.*, at p. 31. Similarly, Tetley argues that these costs not be passed on to operators as pricing will be difficult, noting that these costs are currently not quantifiable by the insurance industry; see Tetley, M. (2006), "Revised Paris and Vienna Nuclear Liability Conventions – Challenges for Nuclear Insurers", *op. cit.*, at p. 38.

⁵¹ Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, pp. 48-49.

⁵² *Ibid*, in particular pp. 46 *et seq.*

contract under civil law among the four leading German energy producing companies. Both systems have demonstrated the capacity to deploy considerably larger compensation amounts than those required under the nuclear liability conventions, including the raised amounts following the revisions to the Paris and Brussels Conventions. The sums are orders of magnitude greater than those currently being offered by the insurance industry. These arrangements show that it is possible to have a liability and compensation regime as a collective responsibility of the nuclear industry (thus excluding public funding), that makes available much higher amounts of compensation for victims and ensures a better internalisation of the nuclear risk.⁵³

6.1 The United States national pool

In the United States, nuclear liability is governed by the *Price-Anderson Act*, adopted in 1957. The *Price-Anderson Act* sets out requirements governing maximum available insurance, liability limits and channelling of compensation claims. The United States ratified the CSC in May 2008.⁵⁴

The 1957 Act, just like the international compensation regime, limited the nuclear operator's liability and made public funding available to compensate for victims of a nuclear accident. Under the 1957 Act, the nuclear operator needed to buy all the insurance coverage then available, which at the time was US\$ 60 million. On top of that amount, the government agreed to make available an amount of US\$ 500 million through indemnification agreements. Thus, the major part of the compensation scheme provided for by the 1957 *Price-Anderson Act* consisted of public funds.

⁵³ See, for example, Schwartz, Julia A. (2007), "Alternative Financial Security for the Coverage of Nuclear Third Party Liability Risks", *op. cit.*, at pp. 43 – 45.

⁵⁴ The United States actively participated in the work of the IAEA SCNL and played a major part in the development of the CSC. It also contributed to the work on revising the Paris and Brussels Conventions. For a description of the process relating to the CSC in the United States, see: McRae, Ben (2000), "Overview of the Convention on Supplementary Compensation", *op. cit.* Although the United States signed the CSC on 29 September 1997, it was not until 19 December 2007 that the President of the United States signed into law the Energy Independence and Security Act of 2007, section 934 of which implements the CSC. The ratification took effect on 21 May 2008.

One feature of the *Price-Anderson Act* is that it is periodically revised.⁵⁵ An important step in shifting the burden to the nuclear operator was made in 1975. Although the total compensation amount was at that time kept at the same level as in 1957, it was decided that the part composed of public funds needed to disappear gradually. This was achieved by phasing out the indemnification agreements and replacing them by a system of retrospective assessments. This introduced a new tier in the compensation scheme paid for collectively by nuclear operators, to be used if the damage exceeded the amount of the nuclear operator's individual liability. The contribution from public funds was reduced by a corresponding amount. This collective tier is financed by all American nuclear operators which have received a licence from the US Nuclear Regulatory Commission (NRC). It implies an additional financial protection per power plant and per incident, payable in annual installments up to a certain maximum amount per incident per power plant. The effect of the 1975 amendments to the *Price-Anderson Act* was such that, by 1982, the American nuclear compensation scheme offered exactly the same amount as in 1957, but it was entirely financed by private funds: both the individual and the collective tier had to be provided for by the nuclear operators. It was also decided that the individual liability insurance coverage of each nuclear operator should be consistent with the evolution of the American nuclear insurance market and that thereafter the total amount in the collective tier would increase as new nuclear reactors became operational, with the amount to be contributed per reactor being periodically adjusted for inflation.⁵⁶

The most recent change to the *Price-Anderson Act* was made in 2005.⁵⁷ As a result, the liability of the individual operator is now US\$ 300 million, the second collective tier would yield US\$ 10,46 billion,

⁵⁵ It has been revised in 1966, 1975, 1988 and 2005.

⁵⁶ The amount of the premium per reactor for the second tier is adjusted by inflation every five years. In 1982, operators had to buy an individual insurance coverage of US\$ 160 million and US\$ 400 million of retrospective premiums was to be generated under the second tier, giving a total of US\$ 560 million. In 1988, the individual operator insurance was set at US\$ 200 million, and the second tier would contribute US\$ 9.5 billion, yielding a total of US\$ 9.7 billion [42 USC 2209(b)]. For an overview of the development of the United States liability legislation, see: OECD Nuclear Energy Agency (2000), *Nuclear Legislation: Analytical Study - Regulatory and Institutional Framework for Nuclear Activities (1999 edition)*, OECD, at 'United States', pp. 26-28, available at: <http://www.nea.fr/html/law/legislation/usa.pdf>.

⁵⁷ See NEA (2005), "Legislative updates", *NEA News* **23.2**, OECD, Paris, p. 32.

and the total compensation available amount in the United States would be US\$ 10.76 billion.⁵⁸ If the total cost of an accident is less than this full amount, the per reactor contribution to the second tier is reduced accordingly.⁵⁹

It should be noted that the size of the second tier is proportional to the number of reactors. If the United States nuclear power industry grows, the funds available in the event of a serious accident will increase. It should be noted also that the pooling system at national level in the United States requires that premiums or shares to be paid by an individual operator are only due after a nuclear incident has occurred and where the damage exceeds that covered by the individual operator insurance.

The international regime of the conventions and the United States national nuclear compensation schemes were originally very similar, but they have since evolved along different lines and are now quite markedly different. Both started from the idea that nuclear energy development had to be supported by limiting liability and the use of public funds. In the United States it has since been accepted that this justification cannot be upheld. As a result, by 1982, the United States had effectively abandoned the public funding of nuclear damage, with one exception. Public funds may still be used in the event of a nuclear incident involving damages in excess of the limits established in the *Price-Anderson Act*, whereby Congress could take further actions, including the appropriation of additional funds for compensation. Nevertheless, the result of the changes of the *Price-Anderson Act* has been that the costs of a nuclear accident were increasingly internalised and that considerably greater compensation amounts have been secured than would have been the case without pooling.

⁵⁸ The amount to be contributed to the second (collective) tier is currently set at US\$ 95.8 million per reactor, plus an extra 5% for legal costs, with a maximum of US\$ 15 million per reactor per year. Currently there are 104 nuclear operators in the United States. On the basis of US\$ 300 million of the first tier + [(95.8 + 5%) x 104 = 10,461] of the second tier, the total amount of compensation available is US\$ 10.76 billion. See Faure, Michael G. and Vanden Borre, Tom, "Economic Analysis of the Externalities in Nuclear Electricity Production: the US versus the International Nuclear Liability Scheme", *op. cit.*, at p.15.

⁵⁹ This implies the following if a nuclear accident occurs in the United States causing US\$ 7 billion of damage. In a first layer, the liability insurer will have to pay US\$ 300 million dollars. This leaves a remainder of US\$ 6.7 billion to be covered in the second tier of the compensation scheme. This will be financed collectively by all the 104 nuclear operators in the United States. This means that each nuclear operator will have to pay, in the second layer, a total amount of US\$ 64.4 million (US\$ 6.7 billion/104 nuclear power plants) per power plant. As this payment is currently limited to US\$ 15 million per reactor per year, the outcome is that the second layer (US\$ 6.7 billion) will be financed by the operators over a period of five years, whereby each will pay US\$ 15 million during the next four years and US\$ 4.4 million in the fifth year, *ibid.*

Although there are outstanding issues to consider under the Price-Anderson Act, in particular because individual operator liability remains limited thus still entailing possible recourse to public funds, it can be argued that there are clear advantages under the United States nuclear liability legislation than under the current international nuclear conventions.

6.2 The German national pool

The German *Atomic Energy Act* includes provisions relating to compensation for damage and injuries caused by nuclear energy or ionising radiation.⁶⁰ Germany is a party to the Paris and Brussels Convention, as well as the Joint Protocol.⁶¹ The Paris Convention and the Joint Protocol apply as national law in the Federal Republic of Germany, unless its provisions depend on reciprocity as effected by the entry into force of the Convention.⁶²

The original 1959 German *Atomic Energy Act* was intended to promote nuclear research and the development and use of nuclear energy for peaceful purposes. The German government elected in 1998 decided to phase out the use of nuclear energy for electricity-generating purposes. The legal instrument to implement the phasing-out decision was the *Act on the Structured Phase-Out of Nuclear Power for the Commercial Production of Electricity*.⁶³ While the 1959 *Atomic Energy Act* was aimed at promoting the use of nuclear energy and at preventing damages caused by the use of nuclear energy, the new act changed its purpose substantially. The promotional purpose of the act was deleted and replaced by provisions intended to phase out the use of nuclear energy for the commercial generation of electricity in a structured manner, and to ensure on-going operation up until the date of

⁶⁰ Gesetz über die friedliche Verwendung der Kernenergie und den Schutz gegen ihre Gefahren (Atomgesetz, AtG), Act on the peaceful utilization of atomic energy and the protection against its hazards (Atomic Energy Act).

⁶¹ Germany ratified the 1960 Paris Convention and the 1963 Brussels Supplementary Convention on 1 October 1975.

⁶² Section 25, paragraph 1 of the AtG.

⁶³ *Gesetz zur geordneten Beendigung der Kernenergienutzung zur gewerblichen Erzeugung von Elektrizität*, dated 22 April 2002 [BGBl 2002 I p. 1351].

discontinuation. There were major changes made also to the provisions relating to compensation for damage and injuries caused by nuclear energy or ionising radiation.⁶⁴

In Germany the concept of operators' pooling was discussed as early as the beginning of the 1970s. In order to provide a total financial security of 500 million Deutsch Marks (DEM)⁶⁵, insurers and operators agreed to an arrangement whereby individual nuclear operators obtained third party liability insurance cover for DEM 200 million, and an additional DEM 300 million was covered by the insurers and re-insured by the entirety of the operators of nuclear power plants.⁶⁶ This arrangement remained valid until 2002.

In 2002, as a result of the changes to the German *Atomic Energy Act*, the amount of financial security required for nuclear reactors was dramatically increased, up to €2.5 billion (currently about US\$ 3.2 billion), providing considerably improved protection of victims.⁶⁷ The revised act also explicitly allowed that the financial security can be provided by some other form of financial security other than by third party liability insurance, making it possible to use private or mutual guarantees made by

⁶⁴ For a description and analysis of the revised act, see: Vorwerk, Axel (2002), "The 2002 Amendment to the German Atomic Energy Act Concerning the Phase-out of Nuclear Power", in *Nuclear Law Bulletin* No. 69, pp. 7-14; and OECD Nuclear Energy Agency (2003), *Nuclear Legislation: Analytical Study - Regulatory and Institutional Framework for Nuclear Activities*, OECD, 'Germany', available at: <http://www.nea.fr/html/law/legislation/germany.pdf>. For an unofficial translation, see "Germany: Act on the Peaceful Utilisation of Atomic Energy and the Protection Against its Hazards (Atomic Energy Act) (2002)", Supplement to the *Nuclear Law Bulletin* No. 70 (December 2002), available at: <http://www.nea.fr/html/law/nlb/nlb-70/supplement.pdf>.

⁶⁵ For purposes of rough comparison only, this DEM 500 million can be considered equivalent to US\$ 400 million.

⁶⁶ OECD Nuclear Energy Agency (2000), *Nuclear Legislation: Analytical Study - Regulatory and Institutional Framework for Nuclear Activities (1999 edition)*, *op. cit.*, Germany, p 17. For the second, collective, tier the operators formed a partnership on the basis of which they entered into a contract with six leading insurance contractors in Germany to cover the DEM 300 million. For this the operators paid an advance an annual fee and a deferred premium. Similar to the United States second tier retrospective premium, the deferred premium would fall due only in the event of an accident and causing damage exceeding DEM 200 million. In effect, the operators served as their own reinsurers.

⁶⁷ The maximum limit of financial security to be provided by the licensee of a nuclear power plant for damage resulting from the operation of the plant was increased tenfold from 500 million Deutsch Marks (DEM) to €2.5 billion (Section 13, paragraph 3, sentence 3 AtG). The US\$ amount is an approximate conversion only, using exchange rates as of 30 January 2009.

nuclear power plant operators as financial security.⁶⁸ By doing so, this new version gives greater consideration to the actual wording of Section 10(a) of the Paris Convention.

Nuclear insurance provides nuclear operators with only a portion of the financial security - currently the maximum insurance cover available is €256 million (approximately US\$ 328 million at current exchange rates). Accordingly, alternatives to insurance had to be secured in order to provide the remainder of the financial security required. These had to satisfy the requirements of the German licensing authorities concerning the nature, extent and amount of cover necessary to meet the legal requirement for the financial security.⁶⁹ To raise the remaining amount of financial security needed, the four leading German energy producing companies voluntarily concluded a contract under civil law, to establish the *Solidarvereinbarung* (a “Solidarity Agreement”). This creates an operator pooling system which provides up to € 2.24 billion (approximately US\$ 2.9 billion at current exchange rates) towards the financial security required of them by the German *Atomic Energy Act*.⁷⁰ Under this new arrangement, each partner accepts liability to contribute a percentage of the total amount of coverage to be provided by the liable operator, with the combined total of all partners’ commitments meeting the overall financial security requirement. The size of each partner’s guarantee is determined on the basis of the number of shares it holds in each and every nuclear power plant, of which there are currently 17 operating in Germany.⁷¹ The guaranteed amount must be paid to the liable operator in the event of a nuclear incident, provided that the operator and its parent company together demonstrate that they cannot provide the required compensation amount. As under the American system, no money is required to be paid to this collective tier in advance of a nuclear

⁶⁸ Section 14, paragraph 2 of the AtG.

⁶⁹ The Financial Security Ordinance of 1977, as last revised in 2002, regulates in detail how, and in which individual amounts, financial security has to be provided [BGBl 1977 I p. 220; 2002 I p. 1869, 1906].

⁷⁰ For a description of the liability requirements in Germany, see: OECD Nuclear Energy Agency (2003), *Nuclear Legislation: Analytical Study - Regulatory and Institutional Framework for Nuclear Activities*, *op. cit.*, at ‘Germany’, pp. 24-25. The description of the *Solidarvereinbarung* which follows is based on that given by Pelzer, Norbert (2007), “International Pooling of Operators’ Funds”, *op. cit.*, pp. 44-45.

⁷¹ The parties to the Agreement are: E.ON Energie AG, RWE AG, Energie Baden-Württemberg AG (EnBW), Hamburgische Electricitäts-Werke AG (now: Vattenfall Europe AG). The approximate percentages read as follows: E.ON: 42%, RWE: 25.9%, EnBW: 23.9%, Vattenfall: 8.2%.

accident. In addition, the partners will offer claims handling support to the liable operator through deployment of their infrastructure and expertise.⁷² The partners are required to submit a public accountant's certificate annually to the regulatory authorities attesting to their financial capacity to meet their obligations under the scheme.⁷³

An important feature of the German liability system is that the unlimited liability of the operator of a nuclear installation for damage occurring within Germany.⁷⁴ In the case of damage occurring outside of Germany the maximum liability is determined in accordance with the principle of reciprocity, i.e. the extent to which the state in which the damage occurs has equivalent compensation arrangements in relation to Germany. A special arrangement is in place with Switzerland, a country which has a common border with Germany and which also has unlimited operator liability for nuclear accidents.⁷⁵ In relation to states which do not operate a nuclear installation in their territory, liability is limited to the maximum amount under the Brussels Supplementary Convention.⁷⁶

Germany has reappraised its assessment of the risks of atomic energy on the basis of the experience and knowledge that have been gained throughout the world since atomic energy was first used for electricity production. The decision to promote nuclear power in the 1959 *Atomic Energy Act* has

⁷² C.f. the extra 5% for legal costs added to the per reactor calculation for contributions to the second tier under the Price-Anderson Act.

⁷³ In order to satisfy the regulatory bodies that the guarantors are reliably in a position to meet their obligations when requested, the partners have annually, and in connection with the year-end accounting of the company, to submit a certificate of a public accountant that sufficient solvent means are available [Section 3 of the Solidarity Agreement]. This is the prerequisite for accepting the system as valid maintenance of financial security to be provided by the operator under Sections 13, 14 Atomic Energy Act and Article 10 Paris Convention. Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, p. 45.

⁷⁴ The only exceptions to this rule are if the incident is due to war, insurrection or a grave natural disaster, in which case liability is limited to the state guarantee of €2.5 billion. The operator of a nuclear installation will be indemnified against claims for damages of up to €2.5 billion to the extent that they are not covered by private financial security or that claims cannot be paid out of such security. Such indemnification is borne, up to the amount of €500 million, as to 75% by the federal authorities and as to 25% by the *Land* within which the installation is situated. The federal state covers the amount between €500 million and €2.5 billion alone [Sections 34 and 36 of the AtG].

⁷⁵ On 22 October 1986, an Agreement on Third Party Liability in the Nuclear Field was concluded between Germany and Switzerland. This declares reciprocity in regard to the amount of compensation and to provide for greater uniformity in the compensation regimes in the two countries [BGBl 1988, p. 598]. It entered into force on 21 September 1988.

⁷⁶ Section 31 of the AtG.

been replaced in the 2002 *Atomic Energy Act* by one intended to bring an end to the use of nuclear energy for the commercial generation of electricity in a structured manner.⁷⁷ The German approach to nuclear liability and compensation has evolved in line with this fundamental change to its domestic policies concerning nuclear energy. Similar to the United States, and the system of the international conventions, Germany started from the idea that nuclear energy development had to be supported by limiting liability and the use of public funds. Collective contributions from operators through pooling came into play a decade earlier than in the United States. This operator pooling has enabled the provision of substantially compensation amounts than provided even under the revised Paris and Brussels Conventions, and this without any recourse to public funds.

Some additional distinctions between the German and the United States approaches are worth noting. Unlike the United States, which so far remains outside the international system of conventions, the evolution of the German liability and compensation system took place also in the context of its memberships of the Paris and Brussels conventions.⁷⁸ Although the Paris Convention did not provide for unlimited liability, the situation was nuanced with respect to Germany's domestic law requiring unlimited liability and the amended Paris Convention now explicitly provides for this possibility. The total amount of compensation available from the second, collective, tier in the United States depends on the number of reactors in operation – if this grows, the pool funds grow; if the number of reactors falls, so does the compensation amount. The German second tier is not dependant on the number of reactors. In the event that the damage exceeds the total funds available, the *Price-Anderson Act* provides for possible recourse to public funds through a decision of Congress. If the German €2.5 billion is exhausted, recourse is made to the other assets of the operator for additional compensation amounts. Finally, in the United States, the collective tier is contributed to by reactor operators on a reactor-by-reactor basis. The German system is linked to the reactor operators' parent companies on

⁷⁷ Section 1, No. 1 of the AtG.

⁷⁸ In addition to its active participation in the revision process of the Paris and Brussels Conventions, Germany, along with other Paris Convention states, also actively participated in the work of the IAEA SCNL.

the basis of the proportion of their reactor ownership, a feature which reflects the evolving structure of the power sector, especially in Europe, and is something that will be discussed further below.

6.3 An operator pool coupled with unlimited liability

Operator pooling as described here is a funding mechanism designed to facilitate availability of funds for compensation in amounts greater than would be realisable through insurance alone, and without recourse to public funds. Yet while the current pooling arrangements in Germany and United States offer considerably greater compensation amounts than the current system of liability conventions, including the revised Paris/Brussels conventions, they still do not come close to matching the actual costs of an accident on the scale of Chernobyl.

Obviously the total amount of funding that could be realised by a pooling arrangement is a function of the design of the pool and the basis of contributions to it. Thus it is not difficult to envisage a pooling arrangement being able to raise more funds than the €2.5 billion (approximately US\$ 3.9 billion) or the US\$ 10.76 billion currently available under the German and United States pooling systems. However, it needs to be considered that a severe accident may exhaust even the large financial resources provided through a pooling mechanism. To address this concern, requires maintaining options to further supplement the amounts made available through the pool, in order to ensure additional compensation is available for victims and to remedy damage in the event that the combined insurance and pool funds are insufficient.

On this basis, the creation of such operator pooling should not affect the ultimate liability of the operator, which should be unlimited. As noted earlier, this is the situation already today, with the German nuclear liability pool arrangement. Thus, an operator pool should provide a high minimum level of financial security, with a guaranteed amount of compensation that approaches realistic estimates of the costs of a severe nuclear accident. The ultimate liability of the operator is not affected

in that the liability remains unlimited, and in the event that the damage caused exceeds the financing of the pool, the other assets of the liable operator are available to add to compensation, including possible recourse against the assets of the reactor owners.

7. AN INTERNATIONAL POOLING SYSTEM FOR EUROPE

Given the benefits of the current national operators' pooling systems, the possibility of international operators' pooling deserves consideration. How might international pooling be achievable?

Effective and reliable coverage of nuclear liability by a system of international operators' pooling is likely only to be possible if there is a certain degree of political, legal and economic convergence amongst States whose operators could participate in such a system.⁷⁹ Rather than seeking to realise a truly global operator pooling system, therefore, it would be preferable initially to aim to realise international operator pooling at a regional level. The region arguably with most to gain from international operator pooling is Europe. Operator pooling might be easier to agree upon if it takes place among operators of like-minded States that preferably cooperate already in other fields, such as the EU Member States. Limitation of the system to a certain geographical region makes pooling more reasonable because only in a geographically limited area a natural transboundary risk community may exist. Here there are a large number of reactors, in a sizeable number of countries, with common borders or otherwise in close proximity to one another.

Faure and Vanden Borre have considered the creation of an international nuclear liability system modelled on that currently in place in the United States and concluded that this would best be applied

⁷⁹ Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, pp. 50 - 52.

on a limited international, e.g. European, basis – at least initially.⁸⁰ Their analysis would add to the necessary conditions identified above, by adding a need for a comparable standard of operational safety of the participating nuclear power plants. In their model, the amount of funds to be raised through operator pooling would be introduced gradually, similar to the changes in the United States system which were launched by the 1975 amendments to the *Price-Anderson Act*. Thirdly, they consider that their model will only work if major regulatory issues have been resolved.⁸¹

The United States system is based on a statutory obligation on every individual operator to contribute to the pool. Pelzer suggests that this is not the model to follow at the international level, arguing instead that it should be left up to the industry to decide if and to which extent and under which conditions they are prepared to embark on international pooling of financial means to cover their mandatory nuclear liability.⁸² I tend to agree that participation in any pooling arrangements should be left to the discretion of reactor operators and owners. However, it would be essential for State engagement in creating the necessary conditions to ensure that such pooling is both adequate (from the perspective of society as a whole) and possible (for the operators and owners concerned). States would need to determine the minimum criteria by which pooling arrangements would be deemed adequate in order to meet the mandatory financial security requirements, for example.

An EU-wide pool should operate within a liability and compensation framework which takes into consideration the characteristics of the EU nuclear electricity generating sector. Previously nuclear

⁸⁰ Faure, Michael G. and Vanden Borre, Tom, “Economic Analysis of the Externalities in Nuclear Electricity Production: the US versus the International Nuclear Liability Scheme”, *op. cit.*, at p. 32.

⁸¹ *Ibid.*, at p. 33. Concerning the nuclear regulatory issues, in their view, by far the most important one is the creation of a European independent regulatory body (a kind of *European Nuclear Regulatory Agency*); this body will deliver permits to nuclear installations falling under the international nuclear liability regime and will determine the way the operators will insure their liability.

⁸² Pelzer, Norbert (2007), “International Pooling of Operators’ Funds”, *op. cit.*, p. 50. Note that this conclusion does not, however, exclude State measures designed to support respective efforts of operators to implement international pooling arrangements if States deem them useful.

reactors in Europe tended to be operated by State agencies or national companies. This is no longer always the case, and the system of reactor ownership in Europe is currently undergoing a process of considerable change. Reactor ownership is also shared among private companies in an increasingly privatised electricity sector often operating at EU (and wider) rather than national levels of organisation. Individual reactors may have multiple owners, in some cases there are multiple “part” owners of reactors, with large multinationals who have interests in nuclear reactors located in several EU Member States. While the specific details of the organisation of an EU nuclear operators’ pooling system could be left to the discretion of operators and their respective parent companies, I believe it is essential that the overall liability and compensation context in which such a pool would operate should reflect this evolving pattern of reactor ownership and control.

8. POTENTIAL BENEFITS OF A EUROPEAN OPERATORS POOL

The operators’ pooling approach is attractive because of the potentially much higher amounts of compensation it can guarantee and the improved internalisation of the risks of nuclear power in the costs of generation of nuclear electricity. However, the extent to which these potential benefits can be realised will depend much on the details and implementation of any planned new scheme. Operator pooling *per se* is no panacea – a flawed and inadequate pooling system will not improve the current situation. I have two principal issues of concern: the extent to which the full costs of a Chernobyl-scale accident would be covered; and the potential for unscrupulous operators to spread their risk through the pool.

What compensation amounts could be a feasible through a European pooling system? In nine western European countries alone there are currently 135 nuclear reactors in operation – considerably more than the current 104 reactors contributing to the second tier of the United States compensation system. Applying a similar level of contributions as currently in place in the United States would raise funds

in excess of US\$ 12 billion.⁸³ Even higher amounts are not unfeasible. Yet even these considerable funds would not come close to matching the actual possible costs of an accident on the scale of Chernobyl. However, operator pooling should be seen as simply one means of guaranteeing the necessary funds to provide a high minimum level of financial security. It is not in and of itself a sufficient basis for nuclear liability and compensation.⁸⁴ In my view, the ultimate liability of the operator should remain unlimited. In the event that the damage caused by a nuclear accident exceeds the financing provided through insurance and the operators' pooling system, the other assets of the liable operator would then be available to add to the other compensation amounts. This arrangement would also include possible recourse against the parent companies of the reactor operator liable.⁸⁵

Any pooling arrangement spreads the risk amongst its members, with the result that, (1) for any individual operator, the internalisation of the nuclear risk is less than complete; and (2) the risk per reactor is averaged, so that a "risky" operator transfers a part of its risk to the pool, whereas a "safer" operator accepts a portion of the extra risk. One virtue of the pooling system is that there will be an element of self-policing by the pool members, in their own self-interest. Pool members themselves will have at least minimum requirements concerning the level of nuclear safety and security of the nuclear installations with which the risk will be shared. Operators will only be prepared to pool if the safety and security standards of other installations are up to the standards of their own installations.⁸⁶ Thus, while there would need to be an adequate nuclear regulatory legal framework in all States whose operators wish to cooperate in the pool, there would also likely be an increasing convergence

⁸³ See, for example, the calculations in Faure, Michael G. and Vanden Borre, Tom, "Economic Analysis of the Externalities in Nuclear Electricity Production: the US versus the International Nuclear Liability Scheme", *op. cit.*, at p. 32.

⁸⁴ Assuming that a pooling arrangement would not guarantee full coverage of all conceivable costs and damage arising from nuclear accidents.

⁸⁵ Operators choosing not to engage in the pooling arrangement would still be subject to the requirements of providing the mandatory financial security and subject to unlimited liability, and any associated conditions for these established by the concerned regulatory agencies.

⁸⁶ Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, p. 51. It is conceivable that operators develop formal mechanisms in order to enable the partners to decide on the eligibility of an installation – these might include direct monitoring, inspection and assessments by or on behalf of the pool.

in reactor safety standards even in the absence of a single European-wide nuclear safety regulatory body. If, however, participation in the operator pooling system was mandatory, as in the case of the United States, there may well be a need for a common EU-wide approach to safety regulation and standards, including a single regulatory body.

Operators and their parent companies might have a direct interest in a pooling system. In addition to any political considerations, there may also be financial advantages.⁸⁷ In France, for example, evidence suggests that the monopolistic nuclear operator, Electricité de France (EdF), pays an excessively high price for its insurance cover.⁸⁸ This situation is not restricted to France, and it may be explained partly by the structure of the nuclear insurance markets. In this context it becomes well worthwhile for nuclear operators to develop alternatives to insurance to provide cover for their nuclear third party liabilities. Operator pooling may offer a cost-effective way to cover the full range and extent of the newly expanded third party liability of nuclear operators under the revised conventions and guarantee considerably higher compensation amounts. It is not simply a question of cost, as there is no sign of change yet in insurers' reluctance to cover the full range of risks required by the revised conventions and there is a growing impatience to see these long-sought arrangements brought into full effect.

Insurers too, might see some benefits to international operator pooling. Both the national liability and compensation systems using operator pooling described rely on nuclear insurance for the first tier of their coverage. The insurance industry is the proper and experienced partner in providing this nuclear liability coverage. However, noting that its capacity is finite, both in terms of scope and quantity,

⁸⁷ Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, p. 48.

⁸⁸ Fiore, Karine, and Faure, Michael, *The civil liability of European nuclear operators: which coverage for the new 2004 Protocols? Evidence from France*, Maastricht University, Faculty of Law, available from <http://ssrn.com/abstract=1086287> (accessed 22 January 2008).

there may be gains to the insurers themselves in relieving the insurance industry of the unsought burden of aspects of the revised liability conventions that they do not feel able to cover.⁸⁹

Finally, introducing such an international operator pooling system may lead to more general indirect gains in nuclear safety. Limiting liability and allowing the use of public funds to pay for the costs of a nuclear accident, potentially allows the industry to pay only part of the damage it causes. Ultimately it will be society at large that bears the cost of damage caused by nuclear power. From the perspective of the functioning of the energy markets, this is inefficient as it acts as a subsidy to nuclear power by failing to internalize the full costs of nuclear electricity generation. To the extent that operators' pooling allows compensation amounts more closely related to the potential costs of nuclear accidents, without drawing on public funds, it more efficiently internalises the risks of nuclear power production. In doing so, it also creates economic incentives for further preventive measures improving nuclear safety, thereby complementing safety regulation.

Even with the increases in operator liability and compensation amounts envisaged by the amendments to the international nuclear liability and compensation conventions, it remains the case that not all the potential costs of a large nuclear accident will be covered. In any case, the full benefits of the revisions of the nuclear liability and compensation conventions are not being realised, as States can still adhere to the old, out-dated instruments and because the nuclear insurance industry seems unable to cover the full range and extent of the newly expanded third party liability of nuclear operators as required by the revised instruments. These factors are major factors delaying the possible entry-into-force of the amended instruments and widespread adherence to them. This situation not only impacts on the provision of compensation for damage that would be caused in the event of an accident, but it also has negative implications for reactor safety generally.

⁸⁹ For additional considerations related to the insurance industry, see Pelzer, Norbert (2007), "International Pooling of Operators' Funds", *op. cit.*, pp. 38-39 and pp. 54-55.

In order to address these problems, it is essential that some way is found to ensure that liability and compensation arrangements are put in place that better reflect the actual risks of nuclear accidents. The experience of existing national operators' pooling arrangements shows that, properly designed and implemented, international arrangements for pooling operators' resources could offer a way forward from the current impasse. International operators' pooling could both complement the current level of financial security provided by insurance and guarantee that considerably higher compensation amounts than would be otherwise possible, would be made available in the event of a nuclear accident. International operators' pooling may be a mutually beneficial solution, offering advantages to operators, the electricity sector generally, insurers, and governments. Additional benefits, particularly in the European context, could include greater harmonisation in liability and compensation arrangements at a high-level rather than at a low common denominator, a reduction in distortions to the EU electricity market by elimination of some subsidies to nuclear power generation through better internalisation of the risks of nuclear power generation, and a strengthening of nuclear safety generally.
