

Compensating Nuclear Damage: A Comparative Economic Analysis of the U.S. and International Liability Schemes

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COMPENSATING NUCLEAR DAMAGE: A COMPARATIVE ECONOMIC ANALYSIS OF THE U.S. AND INTERNATIONAL LIABILITY SCHEMES

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INTRODUCTION[†]

The international and the American compensation systems for nuclear damage both originated in the early sixties of last century. Both systems were at the time governed by similar, if not the same, principles. One of those principles was that a small part of the total compensation was paid by the nuclear operator, while a much larger part of the total compensation was paid through public funds.¹ However, the international and United States' systems of nuclear liability and insurance have since developed quite differently. The American nuclear compensation system, based on the Price-Anderson Nuclear Industries Indemnity Act, originally adopted in 1957, has been revised approximately every ten years.² Initially, the Price-Anderson Act consisted of a two tier system whereby a small part was covered by the nuclear operator (\$60 million) and a much bigger part of the total compensation (\$500 million) was provided for by public funds.³ Since its 1975 revision, the two-tiers system has dramatically changed. The

[†] We are very grateful to Karine Fiore, Norbert Pelzer and to the participants in the joint conference of the European Association for Law & Economics (EALE) and the Geneva Association for the Study of Risk and Insurance (Lecce, June, 15-16, 2007), and in the seminar at the LSU Law Center (Baton Rouge, Jan. 17, 2008) for useful comments on earlier drafts. Michael Faure is grateful to the Centre of Civil Law Studies at Louisiana State University (Baton Rouge) for providing research assistance for this paper. In addition, we benefited from information provided to us by John Hoffman (ANI) and Omer F. Brown (Harmon, Wilmot, Brown & Bagwell, L.L.P) for which we are equally grateful. We are indebted to Wanchi Tang (Maastricht) and Sally Brown Richardson (LSU) for highly useful research-assistance. The views reflected in this paper only reflect the personal views of the authors and is written under their sole responsibility.

¹ For an overview of all principles of nuclear liability law, *see infra* Part I.B.

² Act to Amend the Atomic Energy Act of 1954, Pub. L. No. 85-256, 71 Stat. 576 (1957).

³ *Id.* at Pub. L. No. 85-256, § 4(c), 71 Stat. 576, 577 (1957) (prior to numerous subsequent amendments).

individual liability of the operator and the collective tier are financed by all licensed American nuclear operators through the so-called retrospective premiums, and thus no longer through public funding.⁴ In 2005, an important change to the Price-Anderson Act was adopted whereby the total amount of compensation reached \$10.76 billion.⁵

Despite the fact that the principles of nuclear liability are quite similar in the American and international systems, the U.S. was, until recently, not a member of any of the nuclear liability conventions. However, on May 21, 2008, the U.S. deposited its instrument of ratification of the 1997 Convention on Supplementary Compensation for Nuclear Damage ("CSC") at the offices of the International Atomic Energy Agency ("IAEA").⁶ This is an important shift in U.S. policy since it will, as soon as CSC will enter into force, become a member, for the first time, of the international nuclear compensation system. Moreover, the Energy Independence and Security Act of December 19, 2007, provides the way the U.S. will execute its obligations under the CSC.⁷ As a result of the Act implementing the Convention, nuclear suppliers will be obliged to participate in the retrospective risk pooling program to cover the costs of the U.S. contribution pursuant to the Convention on Supplementary Compensation.⁸

The nuclear compensation scheme based on the principles of the international conventions has been subject to much criticism in the legal literature⁹ and to some critical economic analysis, as well.¹⁰ The background

⁴ See Omer F. Brown II, *Nuclear Liability Coverage Developments in the United States of America*, in PROCEEDINGS, NUCLEAR INTER JURA '93: BIENNIAL CONGRESS OF THE INTERNATIONAL NUCLEAR LAW ASSOCIATION: NUCLEAR ENERGY AND SUSTAINABLE DEVELOPMENT—THE ROLE OF LAW II.5.6-1, 4-5 (Associacao Brasileira de Direito Nuclear ed., 1995) (copy available with the author); Omer F. Brown II, Paper Presented at the Price-Anderson Contractors Policy Issues Study: Legislative History of Government Indemnification under the Price-Anderson Act 1-22 (Sept. 1984) (on file with author).

⁵ See *infra* Part II.A.3.

⁶ INTERNATIONAL ATOMIC ENERGY AGENCY, STATUS: CONVENTION ON SUPPLEMENTARY COMPENSATION FOR NUCLEAR DAMAGE 1 (May 21, 2008), available at http://www.iaea.org/Publications/Documents/Conventions/supcomp_status.pdf.

⁷ The Convention on Supplementary Compensation ("CSC") was ratified as part of the Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934, 121 Stat. 1492, 1741 (2007); see *infra* Part II.C.

⁸ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(a)(2)(B), 121 Stat. 1492, 1742 (2007).

⁹ See, e.g., Herman Cousy, *Een nieuwe vorm van schuldloze aansprakelijkheid: Aansprakelijkheid voor schade veroorzaakt door het vreedzaam gebruik van kernenergie*, 9 JURA FALCONIS 35 (1974) (for Belgium); G.E. van Maanen, *Pleidooi voor verbetering van de rechtspositie van slachtoffers van kernongevallen*, 42 NEDERLANDS JURISTENBLAD 1342 (1986) (for the Netherlands).

¹⁰ See, e.g., Michael Trebilcock & Ralph A. Winter, *The Economics of Nuclear Accident*

for this criticism is related to the fact that both the international system of liability and the compensation due by the nuclear operator to victims of nuclear accidents are regulated by conventions that originated in the early 1960s whose principles have not particularly changed.

One can therefore notice that today the U.S. compensation scheme, as instituted by the amended Price-Anderson Act, has features that distinguish it from the international regime. Notwithstanding recent changes in the international regime, the total amount of compensation in the Price-Anderson scheme is, as we shall demonstrate in this paper, substantially higher than under the international regime. Substantial amounts can be raised for compensation in the U.S. scheme through retrospective premiums. Moreover, in the U.S. scheme, the liability is not—as it is in the international regime—exclusively channelled to the nuclear operator.¹¹

Another important element is the different evolution of the two compensation schemes. Where the U.S. phased out all public funding, the international regime reaffirmed, and even increased, public funding under the nuclear liability conventions created in response to the Chernobyl accident. As a result, the U.S. compensation scheme seems to be financed at a larger scale through market participants rather than through public funding. However, under both systems the liability of the nuclear operator is limited, even when including countries like Germany, Switzerland, and Japan, that have introduced an unlimited liability for the nuclear operator.

Previously, scholars argued that substantially higher amounts of compensation could be provided through a pooling of nuclear operators.¹² This idea recently received support from an international authority in the area of nuclear law.¹³ Interestingly, to some extent, such a pooling system exists in the U.S. where the mutual insurance scheme of the nuclear operators is complementary to the traditional nuclear insurance pool.

Given the fact that some scholars have suggested that the regime of the Price-Anderson Act would to some extent be more efficient than the

Law, 17 INT'L REV. L. & ECON. 215 (1997).

¹¹ For a more detailed discussion of these differences, see *infra* Parts III & IV.

¹² Michael G. Faure & Göran Skogh, *Compensation for Damages Caused by Nuclear Accidents: A Convention as Insurance*, 17 THE GENEVA PAPERS ON RISK AND INSURANCE 499, 509 (1992); Jean-Robert Tyran & Peter Zweifel, *Environmental Risk Internalization Through Capital Markets (ERICAM): The Case of Nuclear Power*, 13 INT'L REV. L. & ECON. 431, 434 (1993).

¹³ Norbert Pelzer, *International Pooling of Operators' Funds: An Option to Increase the Amount of Financial Security to Cover Nuclear Liability?*, 79 NUCLEAR L. BULL. 37, 46 (2007).

compensation regime in the international regime, we would like to submit the Price-Anderson Act and its recent changes to an economic analysis. The goal of this paper is therefore to examine, using the tools of the economic analysis of law, whether the liability and insurance regime installed by the Price-Anderson Act shows less of the inefficiencies than the international regime.¹⁴ The crucial question in that respect is, of course, whether the parties who are involved in creating the nuclear risk, operators and others, such as nuclear suppliers, are exposed to the social costs created by their activities.

There are also several other reasons to look more closely at the compensation regime for damages caused by nuclear accidents and compare the Price-Anderson Act with the international regime. *First*, the international regime of the Nuclear Energy Agency (“NEA”) suffers from a serious problem, as an increase of the liability of the nuclear operator to €700 million (\$1.112 billion), as agreed upon in 2004, is not yet in force as of July 2008.¹⁵ One of the reasons is that nuclear operators apparently failed to obtain insurance coverage for this substantial amount.¹⁶ This merits the question of how the Price-Anderson regime can generate substantially larger amounts of coverage than the international regime and not suffer from similar insurance problems. *Second*, the U.S. has for the first time ratified an international convention related to nuclear liability and compensation—the CSC.¹⁷ This merits analyzing the consequences of this change in U.S. policy towards the international nuclear liability conventions. *Third*, after September 11, 2001, everyone realizes that nuclear installations can also be subject to terrorist attacks.¹⁸ Although, as we will show below, terrorism is not excluded from the international

¹⁴ Our focus will be more specifically on the international conventions of the Nuclear Energy Agency (“NEA”). See *infra* Part I.A.

¹⁵ Council Decision (EC) No. 294/2004 of 8 Mar. 2004, art. 2(1), 2004 O.J. (L 97) 53, 54. Despite an European Union (“EU”) Council Decision on March 8, 2004, in which Member States which are a party to the Paris Convention were urged to ratify these changes within a reasonable time and, if possible, before December 31, 2006. *Id.*

¹⁶ Michael G. Faure & Karine Fiore, *The Civil Liability of European Nuclear Operators: Which Coverage for the New 2004 Protocols?—Evidence from France*, 8 INT’L ENVTL. AGREEMENTS 227, 234-38 (2008).

¹⁷ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934 (2007).

¹⁸ See, e.g., Mark Holt, *Summary* to CONGRESSIONAL RESEARCH SERVICE (“CRS”) REPORT FOR CONGRESS, *Nuclear Energy Policy* (2007); Matthew L. Wald, *N.R.C. Excludes Terrorism as a Licensing Consideration*, N.Y. TIMES, Jan. 11, 2003, at A11 (highlighting the fact that public hearings on terror risk would provide too much information about the vulnerability of nuclear installations).

regime,¹⁹ the question arises whether sufficient compensation is available under international conventions or the Price-Anderson Act if, as a result of a terrorist attack, a nuclear accident takes place. *Fourth*, all of these questions merit further research now that nuclear energy has regained popularity as an alternative to fossil fuel in an attempt to reduce carbon dioxide ("CO₂") emissions.²⁰ That nuclear alternative may, however, only be economically viable in the long run if nuclear operators are able to internalize the social costs created by their activities.²¹ In other words, nuclear operators must be able to provide full compensation in case of a nuclear accident.

The issue of the social costs of the nuclear liability scheme is far from a theoretical discussion. Indeed, the European Commission presented its energy package on January 10, 2007 entitled "An Energy Policy for Europe."²² In the different documents presented, the European Commission rightly noted the huge challenges Europe is facing in terms of climate change, security of supply, and liberalization of the electricity and gas market.²³ On the future of nuclear energy, the Commission stated that nuclear energy is one of the ways of limiting CO₂ emissions and that nuclear energy is likely to form part of the energy policy in several Member States.²⁴ In the U.S., there also appears to be a renewed interest in nuclear energy given that the Nuclear Regulatory Commission ("NRC") has already extended the lifetime of sixteen nuclear power plants by twenty years, thus enabling those reactors to be in operation for sixty, instead of forty

¹⁹ See *infra* notes 58-60 and accompanying text.

²⁰ See MARK HOLT, CRS REPORT FOR CONGRESS, NUCLEAR ENERGY POLICY 6 (July 12, 2007) (stating that climate change is an import reason for renewed interest in nuclear energy); see also, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF NUCLEAR POWER: AN INTERDISCIPLINARY MIT STUDY 78-79 (2003), available at <http://web.mit.edu/nuclearpower>.

²¹ See Richard L. Garwin, Senior Fellow for Science and Technology, Council on Foreign Relations, Presentation at the Nuclear Control Institute (Apr. 9, 2001), available at <http://www.fas.org/rlg/010409-nci.htm> (recommending the internalization of costs to ensure the future viability of nuclear energy); Cindy Folkers, Price-Anderson Act: Unnecessary & Irresponsible, Nuclear Information and Resource Service, Oct. 2001, <http://www.nirs.org/factsheets/priceandersonactfactsheet1001.htm> (last visited Sept. 24, 2008) ("every nuclear power plant designer, supplier and operator should be required to internalize the insurance costs to the full extent of the risks and consequences associated with splitting the atom to create electricity.").

²² *Communication from the Commission to the European Council and the European Parliament, An Energy Policy for Europe*, COM (2007) 1 final (Jan. 10, 2007).

²³ *Id.* at 3-5.

²⁴ *Id.* at 17-18.

years.²⁵ Similarly, in October 2008, thirteen applications were under review and twenty-two were due to submit license renewal.²⁶ Moreover, significant initiatives for new commercial reactors are included in the Energy Policy Act of 2005²⁷ and the Energy Independence and Security Act of 2007.²⁸ President Bush said at the signing of the latter, “[i]f we’re serious about making sure we grow our economy and deal with greenhouse gases, we have got to expand nuclear power.”²⁹ It is not in our intention to comment on these policy issues. However, it is relevant to point out some of the economic consequences of the use of nuclear power, certainly in view of the “competition,” both in Europe and in the U.S., between nuclear energy and other energy sources, including renewable energy sources. The goal of this paper is to address the issue of nuclear liability and insurance from an economic perspective. A normative implication, or policy relevance, of this examination is that we will also address the question of to what extent the liability (Price-Anderson Act) and insurance system that is in place in the U.S. may constitute a valuable alternative to be considered for the international regime.

With this purpose in mind, our paper is structured in the following format. After our introduction, we will analyze the nuclear liability conventions, both those of the first and second generation in Section I. In Section II, we will sketch the structure of the compensation regime in the Price-Anderson Act. In that respect, we will pay more attention to the 2005 changes in the Price-Anderson Act and to the 2007 ratification of the CSC. Within Section III, we will discuss the manner in which nuclear risk is insured. Given the complexity of both the U.S. and international systems, we will provide some examples in Section IV of how the systems work in case of a nuclear accident. Understanding how the systems work

²⁵ U.S. NUCLEAR REGULATORY COMMISSION, 2008-2009 INFORMATION DIGEST 98-112 (2009), available at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/v20/sr1350v20.pdf> (listing the license issue and expiration dates for each of the 104 reactors in the U.S.). See generally U.S. NUCLEAR REGULATORY COMM’N (NRC), BACKGROUND: REACTOR LICENSE RENEWAL 1 (2007), available at [www.nrc.gov/reactors/operating/licensing/renewal/html](http://www.nrc.gov/reactors/operating/licensing/renewal.html).

²⁶ U.S. NRC, *Status of License Renewal Applications and Industry Activities*, <http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html> (last visited Sept. 22, 2008).

²⁷ Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 641-45, 119 Stat. 594, 794-99 (2005).

²⁸ See Ann MacLachlan, *U.S. Ratification Boosts Plan for International Nuclear Liability*, 49 NUCLEONICS WEEK, Jan. 3, 2008, at 6 (discussing the positive effects of the CSC).

²⁹ President George W. Bush, Remarks at the Signing of H.R. 6, the Energy Independence and Security Act of 2007 (Dec. 19, 2007) (transcript available at <http://www.whitehouse.gov/news/releases/2007/12/20071219-6.html>).

in case of a nuclear accident is important to comprehending the subsequent economic analysis. Section V will provide an economic analysis of the U.S. liability and insurance regime, addressing to what extent the Price-Anderson Act enables incentives to be provided to the parties involved in the nuclear risk and addresses the financing of the compensation scheme.

Using this economic framework, we will then compare the main features of the U.S. system—in the light of economic analysis—with the current international regime and analyze the comparative efficiency of both schemes in Section VI. A few obvious policy conclusions from the economic analysis of the U.S. system for the international regime will thus be presented. The paper concludes in the last section.

I. COMPENSATION OF NUCLEAR DAMAGE ON THE BASIS OF THE NUCLEAR LIABILITY CONVENTIONS

We will explain the international nuclear liability regime by first giving an overview of all the different conventions. After that we will analyse the principles of the nuclear liability conventions.

A. *Overview*

At the beginning of the development of private nuclear industry, two international regimes regulated the civil liability for damage caused by nuclear accidents, i.e., the regimes created compensation mechanisms for nuclear damage.³⁰ The first treaty regime was established under the auspices of the OECD NEA and consists of the Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960 ("The Paris Convention") and the Brussels Supplementary Convention to the Paris Convention on Third Party Liability in the Field of Nuclear Energy of January 31, 1963 ("The Brussels Supplementary Convention").³¹ The Paris Convention introduced the major principles of the international nuclear liability conventions.³² The Brussels Supplementary Convention provided for additional compensation of damages in case the coverage of the operator under the Paris Convention was inadequate or insufficient.³³

³⁰ See generally NUCLEAR ENERGY AGENCY, LIABILITY AND COMPENSATION FOR NUCLEAR DAMAGE: AN INTERNATIONAL OVERVIEW (OECD, 1994).

³¹ *Id.* at 11.

³² *Id.*

³³ See *id.* Both the Paris and Brussels Supplementary Conventions have been supplemented by a few additional protocols. The Protocol to the Paris Convention of November 16,

The second nuclear liability treaty regime was developed under the aegis of the International Atomic Energy Agency ("IAEA"): the Vienna Convention on Civil Liability for Nuclear Damage of May 21, 1963 ("the Vienna Convention").³⁴ The Vienna Convention, as does the Paris Convention, introduces five major principles of international nuclear liability law.³⁵

The NEA treaty regime is regionally confined (i.e., Western Europe, Slovenia and Turkey),³⁶ while the IAEA treaty regime is worldwide in scope.³⁷

There were no significant changes to the different nuclear liability treaties until after the Chernobyl accident on April 26, 1986.³⁸ The accident triggered a revision process for both the NEA and IAEA regimes, resulting in the adoption, on three different dates, of several new international conventions.³⁹ It is too much of a digression to discuss all of these changes within this paper.⁴⁰

1982 adjusts some of the definitions and imposes liability on the operator for damage to the means of transport. The Protocol to the Paris Convention of November 16, 1982 changes the unit of account into SDR (Special Drawing Rights) and increases the liability amounts in each of the three tiers from 120 million in the first tier up to 300 million SDRs in the third. Although the basic text is always that of the Paris Convention, when referred to, it will include the additional protocols as well. See M. Lagorce, *Bilan et Analyse Critique de la Convention de Paris et de la Convention Complémentaire de Bruxelles après les Protocoles de 1982*, in NUCLEAR THIRD PARTY LIABILITY INSURANCE: STATUS AND PROSPECTS, PROCEEDINGS OF THE MUNICH SYMPOSIUM: 10-14TH SEPTEMBER 1984 24-41 (NEA-IAEA, 1985).

³⁴ See International Atomic Energy Agency, Vienna Convention on Civil Liability for Nuclear Damage, INFCIRC/500 20 Mar. 1996, <http://www.iaea.org/Publications/Documents/Infircs/1996/inf500.shtml> (last visited Sept. 27, 2008) [hereinafter Vienna Convention].

³⁵ *Id.*

³⁶ See Nuclear Energy Agency, Paris Convention on Nuclear Third Party Liability, Latest Status of Ratifications or Accessions, <http://www.nea.fr/html/law/paris-convention-ratification.html> (last visited Sept. 27, 2008).

³⁷ See INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA CONVENTION ON CIVIL LIABILITY FOR NUCLEAR DAMAGE, REGISTRATION NO: 1277 1-2 (2007), available at http://www.iaea.org/Publications/Documents/Conventions/liability_status.pdf.

³⁸ See Julia A. Schwartz, *International Nuclear Third Party Liability Law: The Response to Chernobyl*, in INTERNATIONAL NUCLEAR LAW IN THE POST-CHERNOBYL PERIOD 41-44 (OECD-NEA, 2006); *Foreword to INTERNATIONAL NUCLEAR LAW IN THE POST-CHERNOBYL PERIOD 3* (OECD-NEA, 2006).

³⁹ See Schwartz, *supra* note 38, at 44-57. After the Chernobyl accident several conventions concerning nuclear safety issues have been adopted as well. See Odette Jankowitsch-Prevor, *The Convention on Nuclear Safety*, in INTERNATIONAL NUCLEAR LAW IN THE POST-CHERNOBYL PERIOD 155-68 (OECD-NEA, 2006). In this paper, we only discuss the international conventions dealing with nuclear liability and compensation.

⁴⁰ For a detailed discussion, see Tom Vanden Borre, *Shifts in Governance in Compensation for Nuclear Damage, 20 Years after Chernobyl*, in SHIFTS IN COMPENSATION FOR

For our purposes, it is important to mention that the first result was the 1988 adoption of the Joint Protocol between the Paris and Vienna Convention, basically linking the territorial scope of both conventions.⁴¹ The second result, two new legal instruments were adopted into the IAEA regime on September 12, 1997: the Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage (“the Protocol to the Vienna Convention”)⁴² and CSC.⁴³ Where the Protocol to the Vienna Convention—quite logically—modifies the Vienna Convention, the CSC is an independent “stand-alone” convention, since any country can join the Convention without having to be a party to either the Paris or the Vienna Convention.⁴⁴

Finally, the revision process of the NEA regime also resulted in the opening for signature of two new instruments on February 12, 2004: the Protocol to amend the Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960 (“the Protocol to the Paris Convention”)⁴⁵ and the Protocol to amend the Convention of January 31, 1963 supplementary to the Convention of July 29, 1960 on Third Party Liability in the Field of Nuclear Energy (“the Protocol to the Brussels Supplementary Convention”).⁴⁶

In order to make the distinction between the different treaties, it is useful to distinguish between the nuclear international liability

ENVIRONMENTAL DAMAGE 261-309 (Michael Faure & Albert Verheij, eds., 2007); Chloée Degros, *La Responsabilité Civile Nucléaire: un état des lieux, Rapport belge*, in LES RESPONSABILITÉS ENVIRONNEMENTALES DANS L'ESPACE EUROPÉEN: POINT DE VUE FRANCO-BELGE 303 (G. Viney & B. Dubuisson, eds., 2006); Schwartz, *supra* note 38, at 37-72; Ronald Dussart Desart, *The Reform of the Paris Convention on Third Party Liability in the Field of Nuclear Energy and of the Brussels Supplementary Convention: An Overview of the Main Features of the Modernisation of the two Conventions*, 75 NUCLEAR L. BULL. 7-33 (2005).

⁴¹ NUCLEAR ENERGY AGENCY, *supra* note 30, at 94-96.

⁴² International Atomic Energy Agency, Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage (1997), available at <http://www.iaea.org/Publications/Documents/Conventions/protamend.html>.

⁴³ INTERNATIONAL ATOMIC ENERGY AGENCY, CONVENTION ON SUPPLEMENTARY COMPENSATION FOR NUCLEAR DAMAGE, IAEA DOC. INFCIRC/567 para. 1 (1998), available at <http://www.iaea.org/Publications/Documents/Infcircs/1998/infirc567.pdf> [hereinafter CSC].

⁴⁴ *Id.* at art. XVI (“This Convention shall be open for signature, by *all states* . . .” (emphasis added)).

⁴⁵ Nuclear Energy Agency, 2004 Protocol to Amend the Paris Convention, <http://www.nea.fr/html/law/paris-convention-protocol.html> (last visited Sept. 27, 2008).

⁴⁶ Nuclear Energy Agency, 2004 Protocol to Amend the Brussels Supplementary Convention on Nuclear Third Party Liability, <http://www.nea.fr/html/law/brussels-supplementary-convention-protocol.html> (last visited Sept. 27, 2008).

regime of the first generation on the one hand—the Paris Convention, the Brussels Supplementary Convention and the Vienna Convention—and the nuclear international liability regime of the second generation on the other hand—all the later Conventions and Protocols. The conventions of the first generation are those that came into being in the early 1960s at the birth of the Nuclear Era, while the conventions of the second generation were introduced after the Chernobyl accident. The nuclear liability conventions of the first generation consisted of three conventions, the nuclear liability conventions of the second generation added five more treaties. Thus, as a result of the revision process, the international nuclear compensation system consists of no less than eight international conventions. Table 1 gives an overview of the different conventions.

TABLE 1: OVERVIEW OF THE INTERNATIONAL NUCLEAR LIABILITY CONVENTIONS

Overview of the International Nuclear Liability Conventions		
	<i>First generation</i>	<i>Second generation</i>
NEA regime	Paris Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960	Protocol to amend the Convention on Third Party Liability in the Field of Nuclear Energy of July 29, 1960 of February 12, 2004
	Brussels Supplementary Convention to the Paris Convention on Third Party Liability in the Field of Nuclear Energy of January 31, 1963	Protocol to amend the Convention of January 31, 1963 supplementary to the Convention of July 29, 1960 on Third Party Liability in the Field of Nuclear Energy of February 12, 2004
IAEA regime	Vienna Convention on Civil Liability for Nuclear Damage of May 21, 1963	Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage of September 12, 1997
		Convention on Supplementary Compensation for Nuclear Damage of September 12, 1997
NEA & IAEA		Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention of September 21, 1988

Several of the discussed protocols and conventions of the second generation have not entered into force yet. The Protocol to the Vienna Convention entered into force on October 4, 2003, but only had limited success—only five countries were members in mid-2008.⁴⁷ The CSC was even more limited since it was not yet in force as of October 2008. Only four countries have ratified the Convention, including the United States.⁴⁸ The Protocol to the Paris Convention and the Protocol to the Brussels Supplementary Convention were opened for signature on February 12, 2004, but as of July 2008 neither of these instruments had entered into force.⁴⁹ Table 2 outlines the entry into force provisions of all the second generation protocols.

TABLE 2: OVERVIEW OF ENTRY INTO FORCE PROVISIONS

Overview of Entry into Force Provisions		
Convention	Article	Content
Protocol to the Paris Convention	S(b)	This Convention shall come into force upon the deposit of instruments of ratification, acceptance or approval by not less than five of the Signatories. For each Signatory ratifying, accepting or approving thereafter, this Convention shall come into force upon the deposit of its instrument of ratification, acceptance or approval.
Protocol to the Brussels Supplementary Convention	Article 20 c) & d)	c) This Convention shall come into force three months after the deposit of the sixth instrument of ratification, acceptance or approval. d) For each Signatory ratifying, accepting or approving this Convention after the deposit of the sixth instrument of ratification, acceptance or approval, it shall come into force three months after the date of the deposit of its instrument of ratification, acceptance or approval.

⁴⁷ These countries are Argentina, Belarus, Latvia, Morocco, and Romania. INTERNATIONAL ATOMIC ENERGY AGENCY, PROTOCOL TO AMEND THE VIENNA CONVENTION ON CIVIL LIABILITY FOR NUCLEAR DAMAGE, REGISTRATION NO. 1759 1 (Jul. 4, 2003), available at http://www.iaea.org/Publications/Documents/Conventions/protamend_status.pdf.

⁴⁸ INTERNATIONAL ATOMIC ENERGY AGENCY, *supra* note 6.

⁴⁹ Nuclear Energy Agency, Paris Convention on Nuclear Third Party Liability: Latest status of ratifications or accessions, <http://www.nea.fr/html/law/paris-convention-ratification.html> (last visited Sept. 27, 2008); Nuclear Energy Agency, Brussels Supplementary Convention: Latest Status of Ratifications or Accessions, <http://www.nea.fr/html/law/brussels-convention-ratification.html> (last visited Sept. 27, 2008).

<p>Protocol to the Vienna Convention</p>	<p>Article 21 1) & 2)</p>	<p>1) This Protocol shall enter into force three months after the date of deposit of the fifth instrument of ratification, acceptance or approval. 2) For each State ratifying, accepting, approving or acceding to this Protocol after the deposit of the fifth instrument of ratification, acceptance or approval, this Protocol shall enter into force three months after the date of deposit by such State of the appropriate instrument.</p>
<p>Convention on Supplementary Compensation</p>	<p>Article XX 1) & 2)</p>	<p>1) This Convention shall come into force on the ninetieth day following the date on which at least 5 States with a minimum of 400,000 units of installed nuclear capacity have deposited an instrument referred to in Article XVIII. 2) For each State which subsequently ratifies, accepts, approves or accedes to this Convention, it shall enter into force on the ninetieth day after deposit by such State of the appropriate instrument.</p>

It is important to mention that even though the U.S. has historically had an important influence on the coming into being of the international conventions, the U.S. itself was until recently not a party to any of the above mentioned nuclear liability conventions. As already mentioned, the U.S. ratified the CSC and thus, as soon as this convention will enter into force, the U.S. will be part of the international nuclear liability system. One can expect that U.S. adherence to the CSC might be an argument for other countries to join the CSC as well, leading to the CSC's entry into force.⁵⁰

The U.S. was not the only country operating outside the international nuclear liability system. Indeed, adherence to both the NEA and IAEA international nuclear liability conventions, and thus to the international nuclear compensation scheme, is far from general. McRae calculated that of the ten countries with the largest installed nuclear capacity, only one-half are members of the international scheme.⁵¹ Overall, the

⁵⁰ For example, U.S. adherence might cause Japan to join the CSC. Japan's ratification would trigger the CSC's entry into force.

⁵¹ See Ben McRae, *Overview of the Convention on Supplementary Compensation*, in REFORM OF CIVIL NUCLEAR LIABILITY INTERNATIONAL SYMPOSIUM, BUDAPEST, HUNGARY, 31 MAY-3 JUNE 1999 171, 175 (OECD, 2000). These countries are Canada, France, Germany, Japan, the Republic of Korea, the Russian Federation, Sweden, Ukraine, the United Kingdom, and the United States. *Id.* Members of the international scheme include France, Germany, Sweden, Ukraine and the United Kingdom. *Id.*

nuclear power-generating countries that operate outside the international compensation regimes account for more than half of worldwide installed capacity.⁵² Several nuclear power-generating countries operating outside the international compensation system have, however, adopted principles into their domestic liability law that are similar to the principles of the international conventions. In this paper, we only address the national nuclear liability system of the U.S., given the interesting evolution of the American nuclear liability and insurance scheme.

Some of the differences between the regime of the international conventions and the U.S. national scheme will be highlighted below. Before doing so, we will first briefly identify the main principles underlying the international conventions.⁵³

B. Principles Underlying The International Nuclear Liability Conventions

The compensation regime introduced in the Paris and Vienna conventions is based upon a variety of principles: strict liability, legal channelling of the liability to the nuclear operator, limitation of liability, compulsory insurance and exclusive jurisdiction of one court.⁵⁴

According to Article 3 of the Paris Convention:

the operator of a nuclear installation shall be liable . . . for (i) damage to or loss of life of any person; and (ii) damage to or loss of any property other than (1) the nuclear installation itself and any other nuclear installation, including

⁵² *Id.* Also, non-nuclear power generating countries feel reluctant to join either the Paris or Vienna Convention because, in their view, these Conventions do not sufficiently address the concerns of the victims of a nuclear accident. *Id.*

⁵³ Again, we should reiterate that within the scope of this paper, we only briefly mention the main principles of the conventions, more particularly those which we find important for our subsequent economic analysis. For deeper analysis of the principles, see Michael G. Faure, *Economic Models of Compensation for Damage Caused by Nuclear Accidents: Some Lessons for the Revision of the Paris and Vienna Conventions*, 2 EUR. J. L. & ECON. 21 (1995).

⁵⁴ For a discussion of the first four principles, see *id.* at 24-26. This fifth principle—exclusive jurisdiction of the courts of the contracting party in whose territory the nuclear incident occurred, art. 13(a) of the Paris Convention—will remain undiscussed because it is less relevant for the economic analysis in this paper. Given the similarity of the provisions in Paris and Vienna Conventions, the analyses hereunder will focus on the provisions of the Paris Convention.

a nuclear installation under construction, on the site where that installation is located; and (2) any property on that same site which is used or to be used in connection with any such installation.⁵⁵

This liability is established “upon proof that such damage or loss was caused by a nuclear accident in such installation or involving nuclear substances coming from such installation”⁵⁶ Thus, a victim wanting to introduce a claim against a nuclear operator does not have to prove a fault committed by the operator. This type of liability is generally known as *strict liability*.

According to Article 9 of the Paris Convention:

The nuclear operator shall not be liable for damage caused by a nuclear incident directly due to an act of armed conflict, hostilities, civil war, insurrection or, except in so far as the legislation of the Contracting Party in whose territory his nuclear installation is situated may provide to the contrary, a grave natural disaster of an exceptional character.⁵⁷

The *Exposé des Motifs* of the Paris Convention uses the words “absolute liability” since the nuclear operator will not be able to escape from liability using “classic exonerations such as force majeure, acts of God or intervening acts of third persons, whether or not such acts were reasonably foreseeable and avoidable.”⁵⁸

The only exonerations lie in the case of damage caused by a nuclear incident directly due to certain disturbances of an international character such as acts of armed conflict and hostilities, of a political nature such as civil war and insurrection, or grave natural disasters of an exceptional

⁵⁵ Nuclear Energy Agency, Convention on Third Party Liability in the Field of Nuclear Energy of 29th July 1960 as amended by the Additional Protocol of 28th January 1975 and by the Protocol of 16th November 1982, art. 3(a), available at http://www.nea.fr/html/law/nlparis_conv.html [hereinafter Paris Convention].

⁵⁶ *Id.* art. 3(a).

⁵⁷ *Id.* art. 9.

⁵⁸ Nuclear Energy Agency, *Exposé des Motifs*, Revised text of the *Exposé des Motifs* of the Paris Convention, approved by the OECD Council on the 16th November 1982, para. 48, http://www.nea.fr/html/law/nlparis_motif.html, para. 48 (last visited Sept. 28, 2008) [hereinafter *Exposé des Motifs*].

character, which are catastrophic and completely unforeseeable, on the grounds that all such matters are the responsibility of the nation as a whole.⁵⁹

The nuclear operator, therefore, is liable for damage caused by acts of terrorism.⁶⁰

Article 6 of the Paris Convention introduces the principle of channelling liability to the nuclear operator.⁶¹ This channelling has two implications: first, in case of a nuclear accident as defined pursuant to the Paris Convention, only the operator can be held liable under the conditions of the Paris Convention and, second, no one else but the operator is liable as the operator does not, in principle, have any right of recourse.⁶² This means that the Paris Convention constitutes the only legal basis for victims to claim compensation for damage suffered as a result of a nuclear accident, excluding other legal provisions, especially those based on general tort law. Due to the exclusion of any other basis for a liability claim, victims of nuclear incidents may only sue the nuclear operator.⁶³ This type of liability is also referred to as "exclusive liability."⁶⁴

According to Article 7 of the Paris Convention, the maximum liability of the operator in respect of damage caused by a nuclear accident shall be 15 million Special Drawing Rights ("SDRs"), €15.518 million or \$24.654 million.⁶⁵ Article 7 of the Paris Convention allows for "any Contracting Party taking into account the possibilities for the operator obtaining the insurance or other financial security required pursuant to Article 10 may

⁵⁹ *Id.*

⁶⁰ See Nathalie L.J.T. Horbach, Omer F. Brown II & Tom Vanden Borre, *Terrorism and Nuclear Damage Coverage*, 20 J. ENERGY NAT. RESOURCES L. 231 (2002).

⁶¹ Paris Convention, *supra* note 55, art. 6 states: "The right to compensation for damage caused by a nuclear incident may be exercised only against an operator liable for the damage in accordance with this Convention Except as otherwise provided in this Article, no other person shall be liable for damage caused by a nuclear incident"

⁶² *Id.*; see *id.* at art. 1(a) (defining operator "as the person designated or recognised by the competent authorities as the operator of a nuclear installation.").

⁶³ For a more detailed discussion, see Norbert Pelzer, *Channelling: Concept and Policy under the Paris and the Vienna Conventions*, in JOINT CEC/IAEA/NEA, TRAINING SEMINAR ON NUCLEAR LAW BRATISLAVA, AUGUST 30-SEPT. 2, 1994 2-11 (1994) (on file with author).

⁶⁴ Schwartz, *supra* note 38, at 40.

⁶⁵ See Paris Convention, *supra* note 55, art. 7(b). The exact value of the SDR is determined by the International Monetary Fund ("IMF"). *Id.* For this article, we used the exchange rate of July 16, 2008: 1 SDR = €1.034500 = \$1.643610. International Monetary Fund, Currency units per SDR for July 2008, http://www.imf.org/external/np/fin/data/rms_mth.aspx?SelectDate=2008-07-31&reportType=CVSDR (last visited Sept. 28, 2008).

establish by legislation a greater or lesser amount⁶⁶ In no event, however, shall any amounts so established be less than 5 million SDR, €5.173 million or \$8.218 million.⁶⁷ The limitation of liability was considered to be necessary in order to not obstruct the development of nuclear industry. The *Exposé des Motifs* explains that “unlimited liability could easily lead to the ruin of the operator without affording any substantial contribution to compensation for the damage caused.”⁶⁸ The reason for this limitation was purely economic: the liability of the operator was limited to the amount for which the insurance market was able to provide coverage.⁶⁹

The operator’s liability is also subject to a time limit. According to Article 8 of the Paris Convention, the victim’s right to compensation is “extinguished if an action is not brought within ten years from the date of the nuclear incident.”⁷⁰ The Contracting Parties, nevertheless, have the option to establish a period longer than ten years, provided that the operator’s liability is covered by insurance or some other financial guarantee.⁷¹

The 1963 Brussels Supplementary Convention of the NEA adds two other layers of publicly available funds to this liability regime. According to Article 3 of the Brussels Supplementary Convention, “the Contracting Parties undertake that compensation in respect of the damage . . . [caused by a nuclear accident] shall be provided up to the amount of 300 million Special Drawing Rights per incident” (€310.350 million or \$493.083 million).⁷²

⁶⁶ Paris Convention, *supra* note 55, at art. 7(b)(i).

⁶⁷ *See id.* at art. 7(b). It is striking that, according to the wording of Art. 7 of the Paris Convention, a maximum liability can be considered to have been introduced. In practice, many countries did not implement this provision too strictly—either imposing a higher amount of liability (e.g., in Belgium an amount of € 300 million) or introducing a system of unlimited liability (Germany). GARY S. URICCHIO, AMERICAN NUCLEAR INSURERS, NUCLEAR LIABILITY OUTSIDE THE U.S. 3 (Apr. 2008) (for Belgium); World Nuclear Association, Civil Liability for Nuclear Damage, <http://www.world-nuclear.org/info/inf67.html> (last visited Sept. 28, 2008) (for Germany). Thus, contrary to a strict reading of Art. 7 of the Paris Convention, several Contracting Parties took the liberty of going beyond the “maximum limit” of 15 million SDRs. The liability limit under the Vienna Convention is \$5 million minimum. Vienna Convention, *supra* note 34, at art. V(1).

⁶⁸ *Exposé des Motifs*, *supra* note 58, at para. 45.

⁶⁹ NORBERT PELZER, BEGRENZTE UND UNBEGRENZTE HAFTUNG IM DEUTSCHEN ATOMRECHT 13 (Nomos 1982).

⁷⁰ Paris Convention, *supra* note 55, at art. 8(a).

⁷¹ *Id.*

⁷² Nuclear Energy Agency, Convention of 31st January 1963 Supplementary to the Paris Convention of 29th July 1960, as amended by the Additional Protocol of 28th January 1964 and by the Protocol of 16th November 1982, art. 3(a), available at <http://www.nea.fr/>

Such compensation shall be provided:

- i) up to an amount of at least 5 million Special Drawing Rights [€5.173 million, \$8.218 million], out of funds provided by insurance or other financial security, such amount to be established by the legislation of the Contracting Party in whose territory the nuclear installation of the operator liable is situated;
- ii) between this amount and 175 million Special Drawing Rights [170 SDRs = €175.865 million = \$279.414 million], out of public funds to be made available by the Contracting Party in whose territory the nuclear installation of the operator liable is situated;
- iii) between 175 and 300 million Special Drawing Rights [125 million SDRs = €129.313 million = \$205.451 million], out of public funds to be made available by the Contracting Parties according to a formula for contributions . . . [which is based on the GNP and the thermal capacity of the reactors].⁷³

The 1963 Brussels Supplementary Convention, thus, introduces two additional tiers of compensation for covering nuclear damage in addition to the first tier of private funds provided for by the Paris Convention.⁷⁴ The two additional tiers of public funds include one “national” public fund to be made available by the Installation State and one international solidarity fund to be made available by all Contracting Parties.⁷⁵

In the NEA regime, the Protocol to the Paris Convention of 2004 introduces a new liability limit in the Paris Convention. According to the new Article 7 of the Paris Convention, “[e]ach Contracting Party shall

html/law/nlbrussels.html [hereinafter Brussels Supplementary Convention].

⁷³ *Id.* at art. 3(b).

⁷⁴ *See id.*

⁷⁵ *See id.*, at art. 3(b)-(c). However, the Installation State can escape from its obligation to make national public funds available. Under the Brussels Supplementary Convention, each Contracting Party has indeed a certain freedom. It can either establish the maximum liability of the operator, pursuant to the Paris Convention, at 300 million SDRs, and provide that such liability shall be covered by the insurance of the nuclear operator (in that case the Installation State has met its obligation under the Convention and must not provide for national public funding). *Id.* Or, the Contracting Party can also set the maximum liability of the operator at an amount at least equal to the insurance of the nuclear operator and provide that, in excess of such amount and up to 300 million SDRs, public funds shall be made available by some means other than as cover for the liability of the operator. *Id.* For more details, see Vanden Borre, *supra* note 40.

provide under its legislation that the liability of the operator in respect of nuclear damage caused by any one nuclear incident shall not be less than 700 million euros" (\$1.112 billion).⁷⁶ According to the Protocol to the Brussels Supplementary Convention the Contracting Parties shall "undertake that compensation in respect of nuclear damage . . . shall be provided up to an amount of 1 500 million euro [\$2.383 billion] per nuclear incident" ⁷⁷ The public compensation will be divided as follows:

- i) up to an amount of at least 700 million euro [\$1.112 billion] funds provided by insurance or other financial security or out of public funds provided pursuant to Art. 10(c) of the Paris Convention . . . ;
- ii) between [this amount] and 1 200 million euro [€500 million; \$794.40 million] public funds to be made available by the Contracting Party in whose territory the nuclear installation of the operator liable is situated;
- iii) between 1 200 million euro and 1 500 million euro [€300 million; \$476.64 million] out of public funds to be made available by the Contracting Parties according to the formula for contributions⁷⁸

Two other important changes to the Paris Convention must also be mentioned. First, Article I(B) of the Protocol to the Paris Convention changes the definition of nuclear damage. This will include not only personal injury claims and property damage claims, but also, to the extent determined by the law of the court with jurisdiction, economic loss arising from loss or damage, the costs of measures of reinstatement of impaired environment, loss of income deriving from a direct economic interest in any use or enjoyment of the environment, and the costs of preventive measures.⁷⁹ Second, Article 8 of the Paris Convention is being modified so that

⁷⁶ Nuclear Energy Agency, Protocol to Amend the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982, February 12, 2004, art. H(a) [hereinafter the Protocol to Amend the Paris Convention].

⁷⁷ Nuclear Energy Agency, Protocol to Amend the Convention of 31 January 1963 Supplementary to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy, as amended by the additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982, February 12, 2004, art. C [hereinafter the Protocol to Amend the Brussels Supplementary Convention].

⁷⁸ *Id.*

⁷⁹ See Protocol to Amend the Paris Convention, *supra* note 76, at art. B.

with respect to loss of life and personal injury, the nuclear operator will be liable for thirty years from the date of the nuclear accident, while ten years will remain the limit for other nuclear damage.⁸⁰ It should be noted that the Protocol to the Vienna Conventions of 1997 provides for similar, if not identical, changes.⁸¹

To cover his liability, the operator is required to have and maintain insurance or other financial security for the amount of his liability and of such type and terms as the competent public authority shall specify.⁸² This financial security may be in the form of conventional financial guarantees or ordinary liquid assets, insurance coverage or other. A combination of insurance, other financial security and State guarantee may be accepted.

Finally, the CSC, adopted on September 12, 1997, is a new and independent legal instrument, which means that a state does not need to be party to the Vienna or Paris Conventions in order to become a party to the CSC.⁸³ According to CSC Art. III(1)(a)(i), "the Installation State shall ensure the availability of [at least] 300 million SDRs [€310.350 million, \$493.083 million]"⁸⁴ The Installation State is free to choose how this amount is funded (private insurance, regional agreement, etc.). A State meets its obligation under Article III(1)(a) of the CSC when it imposes a nuclear liability on the operator for the entire amount.⁸⁵ Thus, this Article does not oblige a State to make public funds available.

However, according to Article III(1)(B) of the CSC, the Contracting Parties shall, beyond the amount available under the first tier, make public funds available.⁸⁶ Basically, this formula provides the basis for an international fund of approximately 300 million SDRs if all countries having nuclear power plants on their territory become members to the CSC.⁸⁷

⁸⁰ See *id.* at art. I(a).

⁸¹ See Protocol to Amend Vienna Convention on Civil Liability for Nuclear Damage, IAEA Doc. INFCIRC/566, Sept. 29, 1997, art. 8, available at <http://www.iaea.org/Publications/Documents/Conventions/protamend.html> [hereinafter Protocol to amend the Vienna Convention].

⁸² See Paris Convention, *supra* note 55, at art. 10(a); see also Protocol to Amend the Paris Convention, *supra* note 76, at art. K(a).

⁸³ CSC, *supra* note 43, at arts. XVIII-XIX.

⁸⁴ *Id.* at art. III(I)(a)(i).

⁸⁵ See *id.* at art. III(4) ("The interest and costs awarded by a court in actions for compensation of nuclear damage are payable . . . and shall be proportionate to the actual contributions made . . . by the operator liable . . .").

⁸⁶ See *id.* at art. III(I)(b).

⁸⁷ See *id.* at art. IV(1)(a); McRae, *supra* note 51, at 176.

The admittedly rather complicated⁸⁸ evolution of the nuclear compensation regime is summarized in Table 3.

TABLE 3: AVAILABLE AMOUNTS OF COMPENSATION

Amount in Millions (USD)			
Convention	Contributor	First Generation	Second Generation
Paris Convention	Nuclear operator	\$8.218	\$1,112
Brussels Supplementary Convention	Installation State (or nuclear operator)	\$279.414	\$794.40
	Collective State Fund	\$205.451	\$476.64
Total NEA regime		\$493.083	\$2,383
Vienna Convention	Nuclear operator	\$5.000	\$246.542
	Collective State Fund	—	\$246.542
Total Vienna Convention		\$5.000	\$493.083
CSC	Operator/ Installation State		\$493.083
	Collective State Fund		\$493.083
Total CSC			\$986.166

The important lesson from Table 3 is the varied growth in compensation across the regimes. Under the second generation NEA regime, once this will be in force, total compensation of €1.5 billion (\$2.383 billion)

⁸⁸ Nathalie L.J.T. Horbach, *Lacunae of International Nuclear Liability Agreements*, in CONTEMPORARY DEVELOPMENTS IN NUCLEAR ENERGY LAW: HARMONISING LEGISLATION IN CEEC/NIS 81-85 (Natalie L.J.T. Horbach ed., 1999) (discussing how one can indeed hold that there is a labyrinth of international conventions dealing with nuclear liability issues).

will be available, of which €700 million (\$1.112 billion) will be financed by the operator, as compared to the 1963 total of only €356 million (\$565.61 million). The total amount available under the Vienna Convention is, as the table clearly shows, nearly equal to the amount which was set by the Brussels supplementary Convention in 1963. The public funding component of the nuclear compensation mechanism of the second generation is either newly created or has been kept at the same relative level as the 1963 level.⁸⁹ In absolute terms, there is considerably more public funding in the conventions of the second generation. Under the Brussels Supplementary Convention the public intervention has more than doubled,⁹⁰ and the IAEA regime added a public compensation component where one did not exist under the conventions of the first generation.

II. COMPENSATION OF NUCLEAR DAMAGE IN THE U.S.

In the United States, nuclear liability is governed by the Price-Anderson Act adopted in 1957.⁹¹ A specific feature of the Price-Anderson Act is that it has been regularly revised.⁹² In practice the revisions took place approximately every decade. First, we will discuss the most important aspects of the Price-Anderson Act, as well as its evolution over the years. Second, we will pay attention to a specific feature of U.S. nuclear law: the property rule. Finally, we will discuss a recent development in U.S. policy: the ratification and implementation of the CSC.

A. *The Price-Anderson Act and its Evolutions over the Years*

1. The 1957 Regime

The original Price-Anderson Act divided the costs of insuring against nuclear accidents between the private nuclear operator and a government program.⁹³ The government program effectively imposed some of

⁸⁹ See Vanden Borre, *supra* note 40.

⁹⁰ Compare Brussels Supplementary Convention, *supra* note 72, at art. 3 with Protocol to Amend the Brussels Supplementary Convention, *supra* note 77, at art. C.

⁹¹ Act to Amend the Atomic Energy Act of 1954 (Price-Anderson), Pub. L. No. 85-256, 71 Stat. 576 (1957).

⁹² The Price-Anderson Act has been revised in 1966, 1975, 1988, and 2005. See Pub. L. No. 89-645, 80 Stat. 891 (1966); Pub. L. No. 94-197, 89 Stat. 1111 (1975); Pub. L. No. 100-408, 102 Stat. 1066 (1988); Pub. L. No. 109-58, 119 Stat. 779 (2005).

⁹³ Vanden Borre, *supra* note 40, at 299.

the insurance cost on “the nation that benefits from the development of nuclear energy”⁹⁴ The Price-Anderson Act required that the operator purchase insurance coverage for \$60 million, while the government made \$500 million available for compensation in case of a civil nuclear accident.⁹⁵ By having public funds provide the majority of compensation, the American nuclear energy industry benefited greatly.⁹⁶

The current Price-Anderson Act includes a provision defining an extraordinary nuclear occurrence (“ENO”).⁹⁷ “[I]n case of a nuclear accident, the Nuclear Regulatory Commission [(“NRC”)] is given the power to determine whether . . . there is an [ENO].”⁹⁸ ENO classification prevents the operator from exercising tort law defenses.⁹⁹ Therefore, the Price-Anderson Act effectively creates strict liability for nuclear operators in the event of a nuclear accident.¹⁰⁰ The only exceptions are for claims arising out of an act of war, workmen’s compensation claims, and claims for damage to on-site property at a licensed nuclear facility.¹⁰¹ As a result of this

⁹⁴ *Id.*

⁹⁵ Act to Amend the Atomic Energy Act of 1954 (Price-Anderson), Pub. L. No. 85-256, 71 Stat. 576, 577 (1957).

⁹⁶ Vanden Borre, *supra* note 40, at 299 n.106.

⁹⁷ Act to Amend the Atomic Energy Act of 1954, as amended, Pub. L. No. 89-645, 80 Stat. 891, 891 (1966).

⁹⁸ Vanden Borre, *supra* note 40, at 299.

⁹⁹ Brown (1995), *supra* note 4, at 4; Omer F. Brown II, *Recent Developments from the Perspective of the United States, in CONTEMPORARY DEVELOPMENTS IN NUCLEAR ENERGY LAW: HARMONISING LEGISLATION IN CEEC/NIS 479* (Natalie L.J.T. Horbach ed., 1999); Dan M. Berkovitz, *Price-Anderson Act: Model Compensation Legislation?—The Sixty-Three Million Dollar Question*, 13 HARV. ENVTL. L. REV. 1, 1-2 (1989).

¹⁰⁰ Vanden Borre, *supra* note 40, at 299. “Under the ‘omnibus’ coverage feature of the Price-Anderson Act, the system covers ‘anyone liable’ for ‘public liability.’ ‘Public liability’ is defined in the Act as ‘any legal liability arising out of or resulting from a nuclear incident.’” *Id.* at 299-300.

¹⁰¹ American Nuclear Insurers, Nuclear Energy Liability Policy: Facility Form, Insuring Agreements § IV (on file with author) [hereinafter ANI Facility Form]. The American Nuclear Insurers (“ANI”), *see infra* Part III.B (discussing ANI as the American insurance pooler), Facility Form nuclear liability policy currently may not cover “any legal liability” except for the exceptions in the statute. *See* American Nuclear Insurers, Facility Form Policy, <http://www.nuclearinsurance.com/Facility%20Form.html> (last visited Sept. 30, 2008). The Facility Form policy provides that ANI will “. . . pay on behalf of the named insured all sums which the insured shall become legally obligated to pay as covered damages because of bodily injury or property damage, or as covered environmental cleanup costs because of environmental damage.” ANI Facility Form, Amendatory Endorsement NE-71 (Jan. 1, 1990), § 1 (emphasis added). “Covered environmental cleanup costs” are defined as “. . . only those environmental cleanup costs which are incurred directly for monitoring, testing for, cleaning up, neutralizing or containing environmental damage

provision, anyone who can be held liable for the damage of a nuclear accident, including, for example, the supplier, can benefit from the liability insurance coverage of the nuclear operator.

The functioning of this system was demonstrated after the Three Mile Island accident in which all defendants, the nuclear operator, as well as the designer and constructor of the nuclear power plant, were represented by one single law firm.¹⁰² Thus, unlike the international compensation regime, the Price-Anderson Act has a system of economic channelling and not legal channelling.¹⁰³ Like the international compensation system, though, the Price-Anderson Act limits the liability of the nuclear operator.¹⁰⁴

2. 1975: A Shift from Public to Private Funding Regime

An important step in shifting the burden to the 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.¹⁰⁵ The Joint Committee on Atomic Energy argued that in the early years of nuclear energy development, the nuclear industry was not capable of bearing the financial burden arising from nuclear electricity production, but that after several years the industry

as the result of an extraordinary nuclear occurrence or transportation incident; but covered environmental cleanup costs do not include on-site cleanup costs." *Id.* at § 3. In other words, the ANI policy already is written to exclude such environmental damages as those resulting from a simple "nuclear incident" and damages *res nullius* or *res communis*. This could result in a situation where the facility operator would be liable, but not have primary insurance from ANI. In this situation, coverage could be provided by retrospective assessments from all power plant operators. *See infra* Part III.C.

¹⁰² Brown (1999), *supra* note 99, at 481.

¹⁰³ Under a system of legal channeling of liability "[a] claim against these other persons is *legally* impossible, precisely because of the fact that liability is completely concentrated on one person." Tom Vanden Borre, *Channelling of Liability: A Few Juridical and Economic Views on an Inadequate Legal Construction*, in CONTEMPORARY DEVELOPMENTS IN NUCLEAR ENERGY LAW: HARMONISING LEGISLATION IN CEEC/NIS 13, 27 (Natalie L.J.T. Horbach ed., 1999). Economic channeling means that the rules of ordinary tort law remain applicable, but that the economic burden of such liability lies with only one person. "Other persons than those to which liability is economically channeled can therefore be held legally liable, in the sense that they can reclaim the amounts paid from the one who is economically liable." *Id.* This is exactly the case under the Price-Anderson Act. Suppliers can be held liable, but their liability is covered by the omnibus coverage of the nuclear operator. *See id.* at 28.

¹⁰⁴ *See* Act to Amend the Atomic Energy Act of 1954 (Price-Anderson), Pub. L. No. 85-256, 71 Stat. 576, 577 (1957).

¹⁰⁵ H.R. Rep. No. 94-648, at 10 (1975).

should take its responsibilities.¹⁰⁶ This could be achieved by shifting the burden of the government towards the industry.¹⁰⁷

The government shifted the burden to the nuclear industry by introducing a new concept in the compensation scheme, the so-called *retrospective premium*.¹⁰⁸ This is a premium financed by all American nuclear operators which have received a licence from the NRC. When the damage exceeds the amount of the nuclear operator's individual liability coverage of \$60 million, the retrospective premium comes into play. This effectively constitutes a second tier of compensation. 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.¹⁰⁹ Basically, the 1975 amendment to the Price-Anderson Act gradually replaced the public funding by a collective tier of all U.S. licensed nuclear operators.

The NRC was given the power to determine the amount of this premium and in 1975, set this premium at \$5 million, per the statutory recommendation.¹¹⁰ It was also decided that the individual liability insurance coverage of each nuclear operator should be consistent with the evolution on the American nuclear insurance market.¹¹¹

By 1982 government indemnification had been completely replaced by the retroactive premiums.¹¹² After 1982, the U.S. nuclear compensation scheme was entirely privately funded.¹¹³ Nuclear operators provided the 1957 amount of indemnification—\$560 million—with \$160 million of private insurance and \$400 million of collective insurance.¹¹⁴ The collective “amount increased as new nuclear reactors became operational.”¹¹⁵

¹⁰⁶ *Id.*

¹⁰⁷ *Id.* at 2.

¹⁰⁸ *See id.* at 9.

¹⁰⁹ *See id.*

¹¹⁰ An Act to Amend the Atomic Energy Act of 1954, as amended, Pub. L. No. 94-197, 89 Stat. 1111, 1112 (1975); *Statement Concerning the Price-Anderson Act: Hearing Before the Subcomm. on Capital Markets, Insurance and Government Sponsored Enterprises of the H. Com. on Financial Services*, 107th Cong. (2001) [hereinafter *Price-Anderson Hearing*] (statement of Marjorie S. Nordlinger, Senior Att’y, U.S. Nuclear Regulatory Commission), available at <http://www.nrc.gov/reading-rm/doc-collections/congress-docs/congress-testimony/2001/>.

¹¹¹ *See Price-Anderson Hearing*.

¹¹² *Id.* at 3-4.

¹¹³ *Id.*

¹¹⁴ Vanden Borre, *supra* note 40, at 301.

¹¹⁵ *Id.*

3. 2005: Increase to \$10.76 Billion

The most recent amendment of the Price-Anderson Act took place in 2005 in the Energy Policy Act of 2005, signed by the President on August 8, 2005.¹¹⁶ The liability of the individual operator was increased to \$300 million.¹¹⁷ However, the amount available in the second (collective) tier, was set at \$95.8 million, plus an extra 5% for legal costs, with a maximum annual retroactive premium of \$15 million per reactor per year.¹¹⁸ Given the fact that in 2005 104 reactors had a license,¹¹⁹ the total available amount in the U.S. is \$10.76 billion: \$300 million of the first tier + the second tier of \$10,461 million [(95.8 + 5%) x 104].¹²⁰ Moreover, the Energy Policy Act of 2005 extended Price-Anderson coverage through the end of 2025.¹²¹

The changes and the total amount available today in 2008 are summarized in Table 4.

TABLE 4: SCHEMATIC OVERVIEW OF PRICE-ANDERSON ACT COMPENSATION

Schematic Overview of Price-Anderson Act Compensation (in Million Dollars)				
Year	Individual liability nuclear operator	Additional funding		Total amount available
		Government indemnity	Retrospective premium	
1957	60	500	—	560
1982	160	0	400	560
2005	300	0	10461	10761

¹¹⁶ Energy Policy Act, Pub. L. No. 109-58, 119 Stat. 779 (2005); see Nuclear Energy Agency, *United States: Price-Anderson Act Renewal (2005)*, 23.2 NEA NEWS, 2005, at 32-33.

¹¹⁷ See Nuclear Energy Agency, *supra* note 116.

¹¹⁸ *Id.*

¹¹⁹ U.S. NRC, List of Power Reactor Units, <http://www.nrc.gov/reactors/operating/list-power-reactor-units.html> (last visited Sept. 30, 2008) (as of Nov. 2007, 104 reactors still had licenses).

¹²⁰ See Nuclear Energy Agency, *supra* note 116, at 32.

¹²¹ Energy Policy Act of 2005, Pub. L. No. 109-58, § 602, 119 Stat. 594, 779 (2005).

B. The NRC Property Rule

After the Three Mile Island accident, it became clear that cleanup of the onsite damage to the nuclear power plant would be far more important than the third-party liability coverage of the nuclear operator.¹²² The NRC argued that this could cause a delay in the decontamination of the site,¹²³ which of course would cause damage to third parties. The NRC argued that it was necessary that the sums available for the property insurance of the power plants should in the first used for decontaminating the nuclear site and for stabilizing the nuclear reactor.¹²⁴ Therefore, the NRC introduced the so-called property rule.¹²⁵ According to the property rule, each power reactor licensee:

shall take reasonable steps to obtain insurance available at reasonable costs and on reasonable terms from private sources or to demonstrate to the satisfaction of the NRC that it possesses an equivalent amount of protection covering the licensee's obligation, in the event of an accident at the licensee's reactor, to stabilize and decontaminate the reactor and the reactor station site at which the reactor experiencing the accident is located¹²⁶

Every operator must have a minimum coverage for each reactor station site of \$1.06 billion.¹²⁷

The property rule, though, does not automatically require that operators who suffer any nuclear accident must first spend the insurance proceeds on stabilization and decontamination. Spending on stabilization and decontamination are only prioritized if the estimated costs of these activities exceed \$100 million.¹²⁸ In the event that such spending is prioritized, "[t]he

¹²² Changes in Property Insurance Requirements of NRC Licensed Nuclear Power Plants, 49 Fed. Reg. 44645, 44649-50 (Nov. 8, 1984) (to be codified at 10 C.F.R. pt. 50).

¹²³ *Id.* at 44649.

¹²⁴ *Id.* at 44647, 44649.

¹²⁵ The language prioritizing decontamination was introduced in 1984. *See id.* at 44650. The current version of the language was adopted in 1990. Stabilization and Decontamination Priority and Trusteeship Provisions, 55 Fed. Reg. 12163, 12166 (Apr. 2, 1990).

¹²⁶ Conditions of Licenses, 10 C.F.R. § 50.54(w) (2008).

¹²⁷ *Id.* at § 50.54(w)(1). These funds are to be used only for a safe shutdown and on-site cleanup. *Id.* This was required by NRC after the Three Miles Island accident when the operator did not have sufficient funds to pay for on-site cleanup. *See* Changes in Property Insurance Requirements of NRC Licensed Nuclear Power Plants, 49 Fed. Reg. at 44648.

¹²⁸ 10 C.F.R. § 50.54(w)(4)(i).

priority . . . must remain in effect for 60 days or, upon order of the Director [of the NRC], for such longer periods”¹²⁹ The regulation indicates that the prioritization should stop only when the reactor stops posing “any significant risk to the public health and safety.”¹³⁰

Accordingly, the property rule guarantees a first party insurance coverage of the property damage to the nuclear power plant. By requiring that funds be made available for the decontamination of the plant, decontamination will lead to a reduction of risks to the public, and thus to a reduction of third-party losses. In that sense, the property rule can be beneficial to victims of a nuclear accident.

C. *2007-2008: Implementation of the Convention on Supplementary Compensation*

On May, 21, 2008, the U.S. deposited its instrument of ratification of the CSC at the Vienna headquarters of the IAEA.¹³¹ Section 934 of the Energy Independence and Security Act of December 19, 2007 provided for the cost allocation of the CSC and thus implemented the obligations of the U.S. under CSC.¹³² An aim of the Energy Independence and Security Act was to establish a funding mechanism under the Price-Anderson Act for the U.S. contribution to the international nuclear liability compensation system.¹³³ CSC implementation was initially provided for by a separate law on the CSC cost allocation.¹³⁴ As a result of an amendment submitted by Senator Voinovich, the CSC was introduced into the Energy Independence and Security Act on June 21, 2007.¹³⁵ The Senate passed the bill on December 13, 2007,¹³⁶ and the House of Representatives followed suit on December 18, 2007.¹³⁷ The act was signed by the President the following day—December 19, 2007.¹³⁸ The CSC is thus

¹²⁹ *Id.*

¹³⁰ *Id.*

¹³¹ INTERNATIONAL ATOMIC ENERGY AGENCY, *supra* note 6.

¹³² Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934, 121 Stat. 1492, 1741 (2007).

¹³³ *Id.* at 121 Stat. 1742.

¹³⁴ 152 CONG. REC. S10798-S10802 (daily ed. Sept. 29, 2006).

¹³⁵ 153 CONG. REC. S8206, S8212-14 (daily ed. June 21, 2007); Library of Congress: Thomas, H.R. 6, All Actions, <http://thomas.loc.gov/cgi-bin/bdquery/z?d110:HR00006:@@S> (last visited Oct. 1, 2008) (recording Sen. Voinovich’s amendment).

¹³⁶ 153 Cong. Rec. S15432 (daily ed. Dec. 13, 2007).

¹³⁷ 153 Cong. Rec. H16752 (daily ed. Dec. 18, 2007).

¹³⁸ Remarks on Signing the Energy Independence and Security Act of 2007, 43 WEEKLY COMP. PRES. DOC. 1612-14 (Dec. 19, 2007).

merely a small portion in the much broader Energy Independence and Security Act. Significantly, in his press statement, the President made no mention of the implementation of the CSC.¹³⁹ He did, however, mention the necessity to provide incentives for nuclear energy, *inter alia*, as a reaction to climate change.¹⁴⁰

It is interesting to briefly mention the findings and purpose of the implementation of the CSC as formulated in section 934(a). It states, *inter alia*, that the “[CSC] benefits U.S. nuclear suppliers that face potentially unlimited liability for nuclear incidents [outside the U.S.] that are not covered by the Price-Anderson Act by replacing a potentially open-ended liability with a predictable regime”¹⁴¹ Also important is that the Energy Independence and Security Act requires that “nuclear supplier[s] . . . participate in a retrospective risk pooling program . . . to cover the contingent costs . . . ” of the U.S. contribution pursuant to the CSC.¹⁴² This means that, according to the Energy Independence and Security Act, the U.S. Treasury will pay into the fund provided for by the CSC but, the costs will be reimbursed by a payment program that suppliers have to set up. Thus, the U.S. obligation under the CSC will be shifted to market participants—the nuclear suppliers. This illustrates that the fact a country has an obligation to make public funds available, as under an international convention, but that does not necessarily mean that the taxpayer will eventually have to pay for it.¹⁴³ Note that the U.S. contribution to the second tier of the CSC will vary between roughly 40 and 100 million SDRs (\$65.332 and \$164.361 million).¹⁴⁴

The fact that the U.S. passed this legislation implementing the CSC is a remarkable evolution in civil nuclear liability compensation for two reasons. First, it changes U.S. policy by entering the U.S. civil nuclear industry into the international nuclear liability regime, though only the CSC. The fact that the U.S. ratified the CSC is in itself not be enough for

¹³⁹ *See id.*

¹⁴⁰ *Id.* at 1614.

¹⁴¹ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(a)(1)(D), 121 Stat. 1492, 1741 (2007).

¹⁴² *Id.* at 121 Stat. at 1744.

¹⁴³ *See infra* Part V, for further discussion of the consequences of implementing the CSC.

¹⁴⁴ The contribution of each country in the CSC indeed depends on the number of countries that become member to the CSC. For a calculator, *see* IAEA, Calculator—Convention on Supplementary Compensation for Nuclear Damage, <http://ola.iaea.org/CSCND/Calculate.asp> (last visited Oct. 1, 2008).

the entry into force of the CSC.¹⁴⁵ It is, however, a very important step and might motivate other States to join the CSC. For example, if either France or Japan were to become a member, it would trigger the entry into force of the CSC.¹⁴⁶ Second, it is important because the U.S. has immediately shifted its financial burden under the CSC to the private sector nuclear suppliers. Thus, the U.S. has a policy of not making the taxpayer finance this international obligation.¹⁴⁷

III. NUCLEAR INSURANCE

In this section we will analyze the system of nuclear insurance because it has a major influence on liability and the compensation for nuclear damage. First, we will discuss the nuclear insurance pools. Second, we will examine the way the nuclear risk is insured in the United States. Finally, we will compare the existing nuclear mutual insurance schemes in the U.S. and Europe.

A. *The Nuclear Insurance Pools*

Traditional insurance companies do not provide coverage for damage caused by a nuclear accident.¹⁴⁸ Insurance for nuclear damage is generally provided for by nuclear insurance pools.¹⁴⁹ The insurance of

¹⁴⁵ To enter into force, the CSC requires that at least five states ratify the convention and that at least 400,000 units of installed nuclear capacity be covered under the convention. CSC, *supra* note 43, at art. XX; *supra* Table 2.

¹⁴⁶ Both France and Japan have enough installed nuclear capacity to qualify both conditions for the CSC's entry into force. See CSC, *supra* note 43, at art. XX; IAEA, Calculator— Convention on Supplementary Compensation for Nuclear Damage, <http://ola.iaea.org/CSCND/Calculate.asp> (last visited Oct. 1, 2008).

¹⁴⁷ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(a)(1)(H), 121 Stat. 1492, 1742 (2007). The Act explicitly specifies that "any such contribution should be funded in a manner that does not . . . shift to Federal taxpayers liability risks for nuclear accidents at foreign installations." *Id.*

¹⁴⁸ See J.C. Dow, *The Organisation and Development of International Liability Capacity and National Market Pools, with Special Reference to New "Nuclear Countries,"* in NUCLEAR THIRD PARTY LIABILITY INSURANCE: STATUS AND PROSPECTS, PROCEEDINGS OF THE MUNICH SYMPOSIUM: 10-14TH SEPTEMBER 1984 177 (NEA-IAEA, 1985).

¹⁴⁹ See S.M.S. Reitsma, *Nuclear Insurance Pools: History and Development,* in NUCLEAR ACCIDENTS: LIABILITIES AND GUARANTEES, PROCEEDINGS OF THE HELSINKI SYMPOSIUM, 31 AUGUST-3 SEPTEMBER 1992 341 (NEA-IAEA, 1993); J.C. DOW, NUCLEAR ENERGY AND INSURANCE (Witherby & Co., 1989); W.E. Belser, *Über die Zweckmäßigkeit der Poolung von Atomrisiken,* 18 VERSICHERUNGSWIRTSCHAFT 572 (1959); *Nuclear Power: Insurance*

nuclear risks through nuclear insurance pools could be regarded as a bundling of resources at a national level.¹⁵⁰ Such bundling allows the creation of a supply to meet the demand for insurance coverage¹⁵¹ for damage resulting from nuclear incidents. As a result, small insurance companies can participate in the insurance of nuclear risks without putting their own financial capacity at risk.¹⁵² In this respect, the market can provide for insurance coverage for risks that surpasses the capacity of any individual member of the pool. Indeed, through the existence of such pools, every insurance company that wishes so can execute a contract with the pool in which it will be decided which part of the coverage that company will insure.¹⁵³ Every pool member declares annually the amount it is willing or able to provide in insurance coverage.¹⁵⁴ The capacity of the pool is therefore equal to the contributions of all its members.¹⁵⁵ When payments have to be made, each member of the pool will have to contribute a ratio of its participation as contractually agreed with the pool.¹⁵⁶ Re-insurance of the nuclear risk will take place among pools.¹⁵⁷ According to insurers, this strategy results in a two-fold advantage. Since every member of the pool knows exactly for which amount it will be responsible, members are willing to insure a much larger part of the nuclear risk than with respect to conventional industrial risks.¹⁵⁸ Moreover, re-insurance is directly

and the Pooling System, SPECIAL EDITION OF THE NUCLEAR POOLS' BULLETIN (1992) (on file with author).

¹⁵⁰ Dow, *supra* note 148, at 178 (describing the national pools that developed in European countries in the late 1950s).

¹⁵¹ *Id.* at 177. Most pools provide for coverage for third party liability as well as damage to the operator itself. *Id.* at 179-80. The (mandatory) liability insurance of the operator covers in general the compensatory consequences of extra-contractual liability of the operator of a nuclear installation for damage resulting from a nuclear incident, even if the incident was directly due to a grave natural disaster. Cf. *Exposé des Motifs*, at para. 48 ("The only exonerations lie in the case of . . . grave natural disasters of an exceptional character . . ." (emphasis added)). This policy should be clearly separated from the policy covering potential damage to the operator itself. Dow, *supra* note 148, at 179-80.

¹⁵² See Dow, *supra* note 148, at 180-81.

¹⁵³ See American Nuclear Insurers, SFP Policy, <http://www.nuclearinsurance.com/SFP.html> (last visited Oct. 1, 2008) (advertising the ANI's participation in pooled insurance).

¹⁵⁴ Dow, *supra* note 148, at 178.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.*

¹⁵⁷ See *id.* That is why a large number of insurance companies worldwide had to interfere as reinsurer in respect of the Three Mile Island accident in 1979. The two American pools were reinsured with most other pools in the world. See 1 PRESIDENTIAL COMMISSION ON CATASTROPHIC NUCLEAR ACCIDENTS, REPORT TO THE CONGRESS ch. 1 (1990), available at <http://www.state.nv.us/nucwaste/news/rpcna/prcna07.htm>.

¹⁵⁸ See Dow, *supra* note 148, at 178-79.

established between the different national pools without intervention of third parties, which minimizes the costs.¹⁵⁹

Most countries with nuclear power plants have their own national nuclear insurance pools.¹⁶⁰ The effect is that, as far as third party liability is concerned, a Belgian nuclear operator can only buy insurance with the Belgian pool, the German operator with the German pool, and so forth.¹⁶¹ Even if the nuclear operators tender for the most favorable insurance offer, they only receive offers from their national pool. The monopolistic position of the nuclear insurers has been heavily criticized.¹⁶²

These pools provide coverage for both third-party liability and damage to the nuclear power plant itself (first party liability).¹⁶³ These two forms of liability coverage draw against each other in the pools.¹⁶⁴ In other words, if the capacity of a nuclear insurance pool is partially used to cover property damage to the nuclear installation, there will be less capacity left for cover third-party liability. Some argue that first party liability coverage should surpass third-party coverage.¹⁶⁵ One justification for increased first party coverage is that nuclear accidents will always affect the nuclear power plant, causing first party damage, but will not always affect the surrounding area, which would trigger third-party liability.¹⁶⁶

¹⁵⁹ See Reitsma, *supra* note 149, at 345.

¹⁶⁰ See, e.g., Dow, *supra* note 148, at 178.

¹⁶¹ Cf. American Nuclear Insurers, About ANI, <http://www.nuclearinsurance.com/About%20ANI.html> (last visited Oct. 1, 2008) ("We directly write nuclear liability insurance for nuclear facilities in the United States . . .").

¹⁶² Michael G. Faure & Roger Van den Bergh, *Restrictions of Competition on Insurance Markets and the Applicability of EC Antitrust Law*, 48 KYKLOS 65, 78-82 (1995); see also Faure, *supra* note 53, at 31-32.

¹⁶³ See Dow, *supra* note 148, at 179-80.

¹⁶⁴ Faure, *supra* note 53, at 26.

¹⁶⁵ Dow, *supra* note 148, at 80; see also *supra* notes 122-30 and accompanying text.

¹⁶⁶ W. Müller, *The Role of the Insurance Industry in Covering Nuclear Third Party Liability Risks*, in NUCLEAR THIRD PARTY LIABILITY INSURANCE: STATUS AND PROSPECTS, PROCEEDINGS OF THE MUNICH SYMPOSIUM: 10-14TH SEPTEMBER 1984 171 (NEA-IAEA, 1985). Müller notes:

In view of the rising cost of erecting nuclear energy plants, nuclear property insurance, which is likewise borne by the nuclear pools, is under considerable pressure and, in turn, represents an involvement by the insurance industry to the machinery insurance which, in the case of a nuclear power plant, also goes into the millions. Both forms of cover have priority over liability insurance, since a theoretical large scale nuclear occurrence would probably first affect the material assets within the plant, then the surrounding area.

It is naive to consider only the third party suffering loss or damage—as occasionally happens—and to regard property insurance

Nuclear insurers have urged for the removal of first party liability from the nuclear insurance pools.¹⁶⁷ Under current arrangements, the insurers would still retain a monopoly in the nuclear insurance market, causing the premiums on first party insurance to be relatively high.¹⁶⁸ Insurers have spoken favorably of the undoing of the protectionism of the early civil nuclear age and the introduction of a more competitive system for nuclear insurance.¹⁶⁹ “Given [the] high concentration on the nuclear insurance market in some countries, initiatives have been taken by the nuclear industry, in cooperation with some brokers, to withdraw first-party insurance from the nuclear pools and to cover this through a new mutual insurance fund of nuclear power plant operators.”¹⁷⁰

Before discussing the existing nuclear mutual insurance scheme in more detail, it is important to highlight the way the U.S. nuclear insurance market functions, particularly with respect to the first (individual) and second (collective) layer of the nuclear operator’s liability.

B. Third Party Liability Insurance in the U.S.

Just as in Europe, U.S. operators can only operate a nuclear power plant with a license, and they can only obtain licenses when they are able to prove compliance with the liability insurance provisions of the Price-

as an unnecessary appendage which only absorbs capacity. Every reasonable person knows that a nuclear power plant requires a heavy investment and that not only the operators, but also their creditors, should be protected. It is quite simply foolish to regard the loss of this investment as a sort of ‘punishment’ for having brought about a nuclear occurrence and to ignore the interests of the power supply company and the investors in safeguarding their material assets.

Id.

¹⁶⁷ See *id.*; Michael G. Faure & Véronique Bruggeman, Presentation at the 24th Annual Conference of the European Association of Law and Economics in Copenhagen, Denmark: Catastrophic Risks and First-Party Insurance 15 (Sept. 13-15, 2007), available at www.cbs.dk/content/download/67298/930270/file/Véronique%20Bruggeman.pdf (indicating that pooled insurance may fail to provide coverage because of a lack of competition in the insurance market).

¹⁶⁸ Faure, *supra* note 53, at 26.

¹⁶⁹ L.L.J. Vigneron, Discussion in Session II of the Munich Symposium on Nuclear Third Party Liability and Insurance (Sept. 10-14, 1984), in NUCLEAR THIRD PARTY LIABILITY INSURANCE: STATUS AND PROSPECTS, PROCEEDINGS OF THE MUNICH SYMPOSIUM: 10-14TH SEPTEMBER 1984 (NEA-IAEA, 1985), at 192.

¹⁷⁰ Faure, *supra* note 53, at 26 (citation omitted).

Anderson Act.¹⁷¹ “The NRC requires each licensee to show proof that it has liability insurance that includes the \$300 million of primary insurance coverage . . . required by the Price-Anderson Act.”¹⁷² “[The] NRC and the licensee also sign an indemnity agreement that requires the latter to maintain an insurance policy in the same amount.”¹⁷³ “[However, the] NRC relies on American Nuclear Insurers [(ANI)]. . . to send [it] the annual endorsements documenting proof of insurance after the licensees have paid their annual premiums. In addition to the primary insurance coverage, licensees must show proof of secondary insurance to NRC,” i.e., retrospective premiums.¹⁷⁴ This is however not a “genuine” insurance policy like the one in the first tiers, but it is common practice that every nuclear operator signs a bond for payment or retrospective premiums as proof of the secondary insurance.¹⁷⁵ “This bond is a contractual arrangement between the licensee and American Nuclear Insurers that obligates the licensee to pay [ANI] the retrospective premiums” if necessary.¹⁷⁶

A study performed by the U.S. General Accounting Office (“GAO”) in May 2004 noted that “licensees must provide evidence that they are maintaining a guarantee of payment of retrospective premiums.”¹⁷⁷ According to the GAO report

the licensee must provide the NRC with evidence that it maintains one of the following six types of guarantees: (1) surety bond, (2) letter of credit, (3) revolving credit/term loan agreement, (4) maintenance of escrow deposits of government securities, (5) annual certified financial statements showing either that a cash flow can be generated and would be available for payment of retrospective premiums within three months of submission of the statements or a cash reserve or combination of these, or (6) such other type of guarantee as may be approved by the Commission.¹⁷⁸

¹⁷¹ See UNITED STATES GENERAL ACCOUNTING OFFICE, REPORT TO CONGRESSIONAL REQUESTERS, NUCLEAR REGULATION: NRC'S LIABILITY INSURANCE REQUIREMENTS FOR NUCLEAR POWER PLANTS OWNED BY LIMITED LIABILITY COMPANIES 1 (2004).

¹⁷² *Id.* at 2.

¹⁷³ *Id.*

¹⁷⁴ *Id.*

¹⁷⁵ *Id.* at 2-3.

¹⁷⁶ *Id.* at 2-3.

¹⁷⁷ UNITED STATES GENERAL ACCOUNTING OFFICE, *supra* note 171, at 7.

¹⁷⁸ *Id.* at 7-8.

If a nuclear accident in the U.S. exceeds the primary coverage of \$300 million, the ANI will immediately collect the retrospective premiums.¹⁷⁹ ANI believes, as reported to the GAO that “the bond for payment of retrospective premiums is legally binding and obligates the licensee to pay the premium.”¹⁸⁰ If the operator fails to pay its share of the retrospective premiums, ANI is contractually obligated to pay up to \$30 million of the premiums, and collect it later from the licensees.¹⁸¹ However, if the licensee fails to pay this deferred premium, the NRC reserves the right to pay those premiums on the licensee’s behalf and recover the premiums from the licensee.¹⁸²

Of course, such a bond might cause the nuclear operator’s insolvency in case of a nuclear accident. This specific issue has been addressed in the U.S., especially when limited companies are concerned. The NRC does not seem to conduct an in-depth financial review to determine the licensee’s ability to pay the retrospective premiums. Instead, the NRC reviews a licensee’s financial ability to safely operate its plant and to contribute decommissioning funds to the future retirements of the plant.¹⁸³ Apparently the NRC is of the opinion that if an operator is able “to cover these two larger expenses, they are likely to be capable of paying their retrospective premiums.”¹⁸⁴ However, “[ANI] goes further than the NRC and requires limited liability companies provide a letter of guarantee from their parent or other affiliated companies with sufficient assets to cover the retrospective premiums.”¹⁸⁵ The GAO reports that if the parent company does not provide a letter of guarantee, the ANI can refuse to issue the bond for payment of retrospective premiums.¹⁸⁶ In that case, the company would have to rely upon other means to show the NRC proof of secondary insurance.¹⁸⁷

As already indicated, the nuclear insurance pools generally offer insurance coverage both for property damage and third party liability.¹⁸⁸ This, however, is not the case in the U.S.: the ANI pool only concerns third-party liability. In the U.S., the nuclear insurance pool insures only the

¹⁷⁹ *Id.* at 1, 8.

¹⁸⁰ *Id.* at 8.

¹⁸¹ *Id.* at 3.

¹⁸² *Id.* at 8.

¹⁸³ UNITED STATES GENERAL ACCOUNTING OFFICE, *supra* note 171, at 9.

¹⁸⁴ *Id.*

¹⁸⁵ *Id.* at 3.

¹⁸⁶ *Id.* at 9.

¹⁸⁷ *Id.*

¹⁸⁸ See *supra* notes 148-70 and accompanying text.

individual third-party liability of the nuclear operator. As such, the retrospective premium is not insured. The retrospective premium is, as was just explained, a call to which operators need to respond *after* an accident takes place, and only if the damage exceeds the liability limit of the American operator—\$300 million. In the latter case the NRC merely requires a bond whereby the operator is obligated to pay ANI the retrospective premiums.

ANI “write[s] nuclear liability insurance for nuclear facilities in the United States, and assume[s] reinsurance shares on nuclear business written by other nuclear pools and mutual insurers throughout the world.”¹⁸⁹ In the 1970s, there were two nuclear insurance pools in the United States.¹⁹⁰ Since 1998, the ANI is the only remaining nuclear insurance pool in the U.S.¹⁹¹ Property insurance is being taken care of by Nuclear Electric Insurance Limited (“NEIL”), incorporated under the laws of Bermuda with its place of business in Delaware.¹⁹² NEIL is one of the existing nuclear mutual insurance systems set up by operators. Its functions are discussed below.

C. *The Nuclear Mutual Insurance Systems*

1. U.S.

The origins of NEIL go back to 1973 when about fourteen American nuclear operators created their own mutual insurance system, called Nuclear Mutual Limited (“NML”).¹⁹³ After the accident at Three Mile

¹⁸⁹ American Nuclear Insurers, *supra* note 161.

[ANI’s] Domestic Syndicate offers third-party nuclear liability insurance to domestic operators of nuclear power reactors, nuclear fuel fabrication facilities, waste disposal and other nuclear facilities. It also writes nuclear liability insurance for suppliers of products or services (including transportation services), to these facilities.

[The] Foreign Syndicate provides reinsurance to foreign nuclear pools for placement at nuclear facilities overseas and in Canada and Mexico. Reinsurance is assumed on a facultative basis . . . The Foreign Syndicate also writes direct liability coverage for U.S. suppliers of products or services to foreign nuclear facilities.

Id.

¹⁹⁰ See PRESIDENTIAL COMMISSION *supra* note 157.

¹⁹¹ Dow, *supra* note 148, at 178.

¹⁹² Nuclear Electric Insurance Limited, NEIL History, <http://www.nmlneil.com/members/default.aspx> (follow “About NEIL” hyperlink; then follow “Company Information” hyperlink; then follow “NEIL History” hyperlink) (last visited Oct. 2, 2008). Note that a significant portion of NEIL is reinsured with ANI. American Nuclear Insurers, *supra* note 161.

¹⁹³ DOW, *supra* note 149, at 267-68.

Island, a second nuclear mutual insurer emerged: NEIL.¹⁹⁴ The reason why these mutuals (captive insurance companies) were created, was to provide the nuclear operators with an alternative to the insurance offered by ANI.¹⁹⁵

Today, NEIL insures nuclear plants and their generating units for costs associated with interruptions of electric generation due to accidental physical damage to insured sites, decontamination expenses, and other risks of direct physical loss at insured sites.¹⁹⁶ “The primary property program provides insurance coverage of \$500 million per occurrence. The excess program provides property insurance coverage of \$2.25 billion per occurrence in excess of \$500 million per occurrence.”¹⁹⁷ Thus, NEIL’s total coverage of property damage in the U.S. amounts to \$2.75 billion. It is generally acknowledged that NEIL has been a success. According to Dow, this is partially thanks to NEIL’s ability to attract important reinsurance support from ANI because NEIL covers risks not insured by ANI.¹⁹⁸ Nuclear operators supported both NEIL and ANI, enabling NEIL’s reinsurance through ANI without operators accumulating commitments.¹⁹⁹

In 1999, NEIL started the activities of its subsidiary, called Overseas NEIL (“ONEIL”) located in Dublin, in order to expand its international activities.²⁰⁰ In 2001, ONEIL insured sites in Belgium, Germany, South Africa, South Korea, Sweden, and Switzerland.²⁰¹

Hence, in the U.S., there is a clear distinction in nuclear insurance. The American pool, ANI, only offers third-party liability cover.²⁰² Property damage is insured with the operator’s own mutual insurance scheme, NEIL.²⁰³ However, NEIL and the ANI work closely together as far as reinsurance is concerned.²⁰⁴ In Europe, the distinction between third-party insurance and property damage insurance is not as clear because nuclear

¹⁹⁴ Nuclear Electric Insurance Limited, *supra* note 192.

¹⁹⁵ DOW, *supra* note 149, at 268 (“[ANI] and NML regarded each other as strong competitors who could not be expected to collaborate.”).

¹⁹⁶ NUCLEAR ELECTRIC INSURANCE LIMITED, 2006 ANNUAL REPORT 20 (2006), available at <http://www.nmlneil.com/Members/AboutNEIL/ar2006.pdf>.

¹⁹⁷ *Id.*

¹⁹⁸ DOW, *supra* note 149, at 268.

¹⁹⁹ *Id.*

²⁰⁰ Richard A. Abdo et al., *Letter from our Chairmen and President*, in NUCLEAR ELECTRIC INSURANCE LIMITED, ANNUAL REPORT: CHANGING TIMES ENDURING STRENGTH 2 (1999), available at <http://www.nmlneil.com/Members/AboutNEIL/ar1999.pdf>.

²⁰¹ Nuclear Electric Insurance Limited, *Facing Business Challenges*, <http://www.nmlneil.com/Members/AboutNEIL/2001ar/fbchallenge.html> (last visited Oct. 3, 2008).

²⁰² American Nuclear Insurers, *supra* note 161.

²⁰³ Nuclear Electric Insurance Limited, *supra* note 192.

²⁰⁴ American Nuclear Insurers, *supra* note 161.

insurance pools offer both. In Europe, however, several operators have combined forces into two mutual insurance schemes.

2. Europe

In Europe, nuclear operators created mutual insurance schemes as a reaction to the nuclear insurance pools.²⁰⁵ In 1978, European Mutual Association for Nuclear Insurance ("EMANI") was created with the goal of reducing the insurance premiums of its members.²⁰⁶ EMANI offers coverage for certain insurance risks relating not only to nuclear power stations, but also to other nuclear facilities in several European countries.²⁰⁷ As EMANI is a mutual insurance association of nuclear operators, the capacity offered by EMANI is independent from the capacity of the nuclear insurance pools,²⁰⁸ the latter basically being an association of "regular" insurance companies. EMANI, more specifically, provides insurance coverage for material damage and business interruption.²⁰⁹ However, and this is a difference between the U.S. and Europe, American nuclear operators insure against business interruption for quite considerable amounts while European nuclear primarily cover damage to their installations, protecting against business interruption liabilities to a lesser extent.²¹⁰

At the end of 2002, European Liability Insurance for the Nuclear Industry ("ELINI") was also created.²¹¹ As EMANI, ELINI is a Belgian mutual insurance association.²¹² The aim of ELINI is "to provide insurance capacity for nuclear liability risks of its Members."²¹³ The capacity of ELINI is independent from the capacity offered by the various nuclear insurance

²⁰⁵ DOW, *supra* note 149, at 269.

²⁰⁶ *Id.* at 269 (describing the role of EMANI as a coinsurer, thereby spreading risk and reducing premiums).

²⁰⁷ EUROPEAN MUTUAL ASSOCIATION FOR NUCLEAR INSURANCE [EMANI], ANNUAL REPORT 2003 14 (2003), available at <http://www.emani.be/EMANI2003.pdf>.

²⁰⁸ *Id.*

²⁰⁹ *Id.*

²¹⁰ Compare NUCLEAR ELECTRIC INSURANCE LIMITED, 2007 ANNUAL REPORT 13 (2007) (emphasizing NEIL's efforts against service interruption), available at <http://www.nmlneil.com/Members/AboutNEIL/ar2007.pdf>, with EMANI, *supra* note 207, at 14 ("EMANI's current portfolio is principally based on property damage cover . . .").

²¹¹ EUROPEAN LIABILITY INSURANCE FOR THE NUCLEAR INDUSTRY [ELINI], ANNUAL REPORT 2006 14 (2006).

²¹² *Id.*

²¹³ *Id.*

pools.²¹⁴ ELINI is thus able to provide “[a]dditional insurance capacity in view of the revised Paris and Brussels Supplementary Conventions.”²¹⁵ It can also offer “[a]lternative insurance capacity for terrorism and [for the] 30-year prescription period.”²¹⁶ Thus, ELINI is the first worldwide mutual insurance company of nuclear operators aimed at offering nuclear third-party liability coverage. Where NEIL is primarily active on the first-party insurance market, ELINI is trying to develop a European third-party liability insurance market, and is thus active on the same market as the traditional nuclear insurance pools. However, it seems that in the next few years, ELINI will not be a real competitor to the pools, but instead will be offering excess capacity,²¹⁷ especially on issues that are difficult to insure on the primary nuclear insurance market, such as the 30-year prescription period, terrorism coverage, and environmental damage.²¹⁸ As discussed earlier, these are typically the issues raised by the nuclear liability conventions of the second generation, especially the Protocol to the Paris Convention and the Protocol to the Vienna Convention.²¹⁹

Only private or public companies or authorities operating nuclear installations can become members of EMANI and ELINI.²²⁰ Companies such as EDF, British Energy, E.ON, RWE, and Vattenfall are members of EMANI and/or ELINI.²²¹

One can notice considerable differences in the success of the mutual nuclear insurance schemes in the U.S. and in Europe. It is striking that the growth of EMANI was quite slow. In the first decade of its existence, the insurance capacity of EMANI remained rather moderate at approximately €150 million (\$238.32 million).²²² The capacity increased to about €400 million (\$635.52 million) by the end of the 1990s, and amounted to €700 million in 2005 (\$1.112 billion).²²³ ELINI’s maximum insurance

²¹⁴ *Id.*

²¹⁵ *Id.*

²¹⁶ ELINI, *supra* note 211, at 14.

²¹⁷ *Id.* (“It is not expected that ELINI, as a relatively small member of the liability market, deals with claims in the event of a catastrophe.”)

²¹⁸ *Id.*; *Accord Insuring a Nuclear Future*, LLOYD’S MARKET, Aug. 2008, at 10, available at <http://www.lloyds.com/NR/rdonlyres/304DB810-EA6C-4539-9330-2FF84772A05B/0/TheMarketIssue32008.pdf>.

²¹⁹ *See supra* Part I.B.

²²⁰ ELINI, *supra* note 211, at 15.

²²¹ EMANI, ANNUAL REPORT 2007 7 (2007), available at <http://www.emani.be/Annual%20Report%202007.pdf>; ELINI, ANNUAL REPORT 2007 6 (2007), available at http://www.elini.net/ELINI_2008_FINAL.pdf.

²²² *See* EMANI, *supra* note 207, at 16.

²²³ *See id.*

capacity in 2006 was €104.85 million (\$166.58 million).²²⁴ An important element explaining this lack of enthusiasm from the industry to step into this European nuclear mutual insurance scheme seems to be the "lack of solidarity among [European] nuclear power station operators."²²⁵ It is indeed quite striking that European nuclear operators have varied policies for their coverage of property damage: some buy coverage with the nuclear pools, others are member of EMANI, and still others opt for the American captive, NEIL.²²⁶

These different policies in insuring property damage have two consequences that interact with the capacity available for covering third-party liability. First, the fact that some nuclear operators insure their property damage with the pool decreases the overall capacity of the pools to cover other risks, i.e., third-party liability.²²⁷ Second, European operators have been less inclined to participate in mutual third-party liability schemes, like EMANI.²²⁸ The lack of cooperation means that, as mentioned, European nuclear operators buy large insurance coverage for property damage, but seem to be less interested in buying coverage for business interruption, aggravating the lack of third-party liability coverage.²²⁹

Also remarkable is the fact that the overseas activities of NEIL has slowly grown,²³⁰ such that, little by little, ONEIL is becoming an EMANI competitor. It is not within the scope of this paper to explain why at least some European nuclear operators seem to favor the American instead of the European nuclear captive. However, one should consider an important difference between the captives: the activities and membership of NEIL are strictly limited to nuclear electricity operators while EMANI's members and activities extend to nuclear waste companies, fuel fabrication facilities, nuclear research laboratories as well.

²²⁴ ELINI, *supra* note 211, at 17.

²²⁵ M. Debaets, *The Insurance of Nuclear Power Stations*, in PROCEEDINGS: NUCLEAR INTER JURA '91, NUCLEAR LAW AND NUCLEAR ENERGY FOR THE FUTURE, BATH, ENGLAND 23 SEPTEMBER-26 SEPTEMBER 1991 195, 198 (AIDN/INLA, 1991).

²²⁶ NUCLEAR ELECTRIC INSURANCE LIMITED, *supra* note 196, at 34-35; *see supra* notes 160-61 and accompanying text; *supra* note 221 and accompanying text;

²²⁷ Debaets, *supra* note 225, at 195-96.

²²⁸ *See id.* at 196.

²²⁹ Among the large policies purchased by nuclear operators, only EMANI and NEIL cover service interruption. *See* EMANI, *supra* note 207, at 14; NUCLEAR ELECTRIC INSURANCE LIMITED, *supra* note 196, at 20. Even within those policies for service interruption, NEIL, for example, only covers up to \$4.5 million per week for a single incident. NUCLEAR ELECTRIC INSURANCE LIMITED, *supra* note 196, at 20.

²³⁰ *See supra* note 201.

IV. OVERVIEW AND EXAMPLES

A few examples may illustrate how the two nuclear compensation systems discussed in this paper, the U.S. and the international, work. Suppose first that a nuclear accident takes place in the U.S., causing \$200 million of damage. In that case, only the individual liability of the nuclear operator would come into play. As discussed, each operator must be covered up to \$300 million—the amount at which individual liability is capped. If that same accident takes place in Europe, the available amount will first depend on the amounts available under the national legislation of the country where the accident takes place. If the accident takes place in Belgium, there would be €300 million (\$476.64 million) available,²³¹ and thus all damage would be compensated for under the third party liability coverage of the nuclear operator. If the accident took place in France, there would be €90 million (\$142.992 million) available from the operator²³²—EDF—which is partially covered through nuclear third party insurance; the French State would have to pay the remaining €60 million (\$95.328 million), as part of the second tier of the Brussels Supplementary Convention.²³³

Suppose now that in a second example a nuclear accident occurs in the U.S. causing \$7 billion of damage. In the first layer, the liability insurer will have to compensate \$300 million. This leaves a remainder of \$6.7 billion to be covered. The second layer is totally financed through the collectivity of nuclear operators.²³⁴ Therefore, the \$6.7 billion will be financed collectively by all the 104 nuclear operators in the U.S. through ANI, equaling \$64.423 million per nuclear power plant. However, they do not have to pay this amount of \$64.423 million at one time. It will be collected through retrospective premiums which are currently limited to \$15 million annually.²³⁵ The result is that the second layer (\$6.7 billion) will be financed by the operators of all 104 nuclear power plants in a period of five years, whereby each will pay \$15 million during the next four years and \$4.423 million in the fifth year.

²³¹ URICCHIO, *supra* note 67, at 3.

²³² *Id.*

²³³ Nuclear Energy Agency, Brussels Supplementary Convention, <http://www.nea.fr/html/law/brussels-supplementary-convention.html> (last visited Oct. 4, 2008).

²³⁴ See *supra* Parts III.A-B.

²³⁵ Licensee Guarantees of Payments of Deferred Premiums, 10 C.F.R. § 140.21 (2008); see *supra* note 118 and accompanying text.

In summary, the first \$300 million comes from insurance provided by the American pool, the remainder is to be provided by the operators of each power reactor. The NRC guarantees these retrospective premiums, subject to reimbursement with interest by the operators.²³⁶ In other words, victims do not have to wait until the operators have paid the retrospective premiums. It is the regulatory authority who advances the compensation in the second layer (\$6.7 billion) and collects this from the operators. In total, if an accident had taken place in 2007, the \$7 billion of damage would be paid by the operators in the manner described in Table 5.

TABLE 5: EXAMPLE U.S.

Contributor			
Year	Operator	Collectivity (104 operators x \$15 million)	Total
2007	\$300 million	\$1.560 billion	
2008	—	\$1.560 billion	
2009	—	\$1.560 billion	
2010	—	\$1.560 billion	
2011	—	\$460 million	
Total	\$300 million +	\$6.7 billion	= \$7 billion

If the same accident were to take place in Europe, causing \$7 billion (€4.4 billion) in damages, one would again have to take into account the legislation of the country. The total available amount in Belgium would be €429 million: €300 million third-party liability and €129 million of the third tier of the Brussels Supplementary Convention (total = \$682 million; third-party liability = \$477 million; third tier = \$205 million).²³⁷ In France, about €350 million (\$556 million) would be available of which €90 million (\$143 million) would come from the nuclear operator's liability insurance.²³⁸ This implies that in Belgium, an amount of €3.97 billion (\$6.3 billion), and in France an amount of €4.05 billion (\$6.43 billion), would remain uncompensated. If the nuclear liability conventions of the second

²³⁶ See *supra* note 182 and accompanying text.

²³⁷ See *supra* notes 232-33.

²³⁸ *Id.* and accompanying text.

generation would be in force, a higher amount would be available—the difference between the total amount of damage and the total amount available under the revised Brussels Supplementary Convention.²³⁹ But still, €2.9 billion (\$4.6 billion) would remain uncompensated.

Finally, let us briefly address the impact of the already mentioned CSC—the first nuclear liability convention adhered to by the United States. As we already mentioned, the CSC may be important since it provides for a second layer of 300 million SDR.²⁴⁰ The CSC is a third layer of coverage in addition to the U.S. operator's liability of \$300 million and the second layer of collective liability paid through retrospective premiums of \$10.461 million.²⁴¹ This may lead to an additional amount of victim compensation on top of the already available \$10.7 billion available. If the CSC were in force today, the total available amount in the U.S. would be \$10.7 billion plus 300 million SDR (\$493.083 million). This contribution covers the “costs resulting from a covered incident outside the United States that is not a Price-Anderson incident.”²⁴² The 2007 Act requires the suppliers of nuclear energy to pay also this third layer of compensation under the CSC.²⁴³ This convention has, however, not entered into force yet.²⁴⁴ How much precisely the nuclear operators will have to contribute to this third layer will also depend upon who the other contributors to the CSC are.²⁴⁵ As already indicated, the contribution of the U.S. in the second tier of CSC will vary between roughly 40 and 100 million SDRs (\$ 65.332 and 164.361 million).²⁴⁶ The nuclear suppliers in the U.S. are now considering establishing a captive insurance company in order to pay for their contribution under the CSC.²⁴⁷

²³⁹ Nuclear Energy Agency, 2004 Protocol to Amend the Brussels Supplementary Convention on Nuclear Third Party Liability, <http://www.nea.fr/html/law/brussels-supplementary-convention-protocol.html> (last visited Oct. 4, 2008) (noting the revised Brussels Supplementary Convention would cover €1.5 billion).

²⁴⁰ See CSC, *supra* note 43, at art III(1)(a)(i).

²⁴¹ See *supra* notes 117-20 and accompanying text.

²⁴² Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(e)(1), 121 Stat. 1492, 1744 (2007).

²⁴³ *Id.*

²⁴⁴ See *supra* note 145.

²⁴⁵ See *supra* note 144.

²⁴⁶ *Id.*

²⁴⁷ Cf. Ben McRae, *The Compensation Convention: Path to a Global Regime for Dealing with Legal Liability and Compensation for Nuclear Damage*, 61 NUCLEAR L. BULL. 25, 29 (2001) (noting that the CSC allows countries to choose how they will fund their CSC contributions).

V. THE PRICE-ANDERSON ACT: AN ECONOMIC ANALYSIS

We will first discuss the key features of our economic analysis. Next, we will look in more detail at the issues of cost internalization and risk differentiation.

A. *Key Features*

From an economic perspective, the basic rule which should underlie a nuclear liability regime is rather straightforward. The legal regime should provide incentives for nuclear operators to internalize their risk costs in order to maximize prevention.²⁴⁸ The basic idea is that by exposing nuclear operators to the full risk costs they are generating, an efficient internalization of the nuclear risk can take place. Of course, this internalization can be reached through a variety of legal and economic tools. For the nuclear sector, *ex ante* safety regulation plays a crucial role. Liability rules have an important function in complementing safety regulation. However, on the basis of this straightforward economic analysis of nuclear liability law, it is clear that a nuclear operator should be exposed to the full costs his activity generates in order to provide optimal incentives for prevention.²⁴⁹

From this simple rule follow a few equally simple rules as far as the structure of the regime of nuclear liability is concerned. Nuclear operators should, in principle, be fully liable for the potential damage caused by their activity. To the extent that compensation is provided through another source, be it government or insurance, mechanisms should be put in place that take into account the nuclear operators' preventive efforts. In insurance, these are the well-known techniques. Assigning full liability is known as risk exposure as a remedy to moral hazard.²⁵⁰ In case of government provided compensation, the financing should in principle be risk-related such that a government fund is financed by risk-based premiums paid by operators.²⁵¹

²⁴⁸ See Michael Faure, *Financial Compensation for Victims of Catastrophes: A Law and Economics Perspective*, 29 *LAW & POL'Y*, 339, 342 (2007).

²⁴⁹ This follows from the standard economic analysis of tort law. See STEVEN M. SHAVELL, *ECONOMIC ANALYSIS OF ACCIDENT LAW* (Harvard Univ. Press, 1987); Steven M. Shavell, *Strict Liability versus Negligence*, 9 *J. LEGAL STUD.* 1 (1980).

²⁵⁰ Steven M. Shavell, *On Moral Hazard and Insurance*, *Q. J. ECON.* 541 (1979); see also Michael Faure & Ton Hartlief, *Remedies for Expanding Liability*, 18 *OXFORD J. LEGAL STUD.* 681, 684 (1998).

²⁵¹ For further reading on conditions for efficient functioning of compensation funds, see Faure, *supra* note 248; Pelzer, *supra* note 13, at 39.

As we will indicate below, the international nuclear compensation regime has been heavily criticised in law and economics literature for not respecting these general principles.²⁵² Prior to addressing the question of to what extent a similar criticism applies to the U.S. Price-Anderson Act, let us briefly address some of the principles of the nuclear liability and compensation model which were discussed above,²⁵³ which to some extent constitute the basis of the U.S. Price-Anderson regime as well.

The Price-Anderson Act is also based on the principle of the strict liability of the nuclear operator.²⁵⁴ It is not hard to argue that, based on the economic analysis of tort law, nuclear accidents are certainly activities which should be submitted to a strict liability rule. The reason is that they can be considered a unilateral accident, that is an accident whereby only the injurer can influence the accident risk.²⁵⁵ In this case, only a strict liability rule provides an incentive to the injurer not only to adopt an efficient care level, but also to adopt an efficient activity level.²⁵⁶ This is also a way to minimize the total expected accident costs the operator has to bear.²⁵⁷ An important condition for a strict liability rule to be efficient, however, is that the amount of compensation to be paid to the victim should be equal to the actual damage caused by the operator.²⁵⁸ That may be a problem when, like in the nuclear liability case, the potential damage can be of a much higher magnitude than the individual wealth of the operator. In case of such an insolvency problem, a strict liability rule may lead to underdeterrence.²⁵⁹ This so-called “judgment proof problem” has been advanced in the literature as an important argument in favor of imposing a duty on the operator to provide financial guarantees, for example, in the form of compulsory insurance.²⁶⁰ Therefore, the fact that

²⁵² See Michael G. Faure & Roger Van den Bergh, *Liability for Nuclear Accidents in Belgium from an Interest Group Perspective*, 10 INT'L REV. L. & ECON. 241 (1990); Faure & Skogh, *supra* note 12; Faure, *supra* note 53; Trebilcock & Winter, *supra* note 10.

²⁵³ See *supra* Part I.B.

²⁵⁴ See Donald E. Jose & Michael A. Garza, *The Price-Anderson Public Liability Action And Strict Liability 4* (bepress Legal Series, Paper 2022, 2007), available at <http://law.bepress.com/cgi/viewcontent.cgi?article=9586&context=expresso>.

²⁵⁵ See Shavell, *supra* note 249.

²⁵⁶ *Id.* at 2-6.

²⁵⁷ *Id.*

²⁵⁸ See *id.*

²⁵⁹ Steven M. Shavell, *The Judgment Proof Problem*, 6 INT'L REV. L. & ECON. 45, 54 (1986).

²⁶⁰ *Id.*; see Göran Skogh, *Mandatory Insurance: Transaction Costs Analysis of Insurance in* ENCYCLOPEDIA OF LAW & ECONOMICS, VOLUME II: CIVIL LAW & ECONOMICS 521 (B. Bouckaert & G. De Geest eds., 2000), available at <http://encyclo.findlaw.com/tablebib.html>;

the Price-Anderson Act introduced compulsory insurance for the liability of the individual operator of \$300 million makes sense.

A second condition for strict liability to be efficient is that the nuclear operator be fully exposed to the damage that may be caused through his activity.²⁶¹ This economic principle may conflict with the limit on compensation found in both the international regime, and the Price-Anderson Act. Below, we will examine to what extent the limit on compensation in the Price-Anderson Act creates inefficiencies. It should finally be mentioned, however, that an important difference between the international regime and the Price-Anderson Act is that in the Price-Anderson Act there is no *legal channelling* of liability to the licensee of a nuclear plant.²⁶² This channelling of liability has been criticized in economic and legal literature because it excludes from liability all other parties who could have contributed to the loss as well and whose incentives, as a result of the exclusive channelling of liability to the nuclear operator, will remain unaffected.²⁶³ The major reason for adopting legal channelling in the international conventions was to shield U.S. suppliers from liability.²⁶⁴ A study written under the auspices of Harvard Law School and the U.S. Atomic Industrial Forum concluded that the easiest solution to protect suppliers was to abolish any causes of action in tort against suppliers by channelling all third-party tort suits to operators.²⁶⁵ Beyond that, the "advantages" of legal channelling are, in our view, rather limited. Basically, legal channelling limits potential problems arising from the concurrence of lawsuits,²⁶⁶ which is economically beneficial because it decreases administrative costs. But granting victims the possibility of suing different persons for a given damage offers far greater economic benefits in terms of prevention and compensation of victims. It is indeed highly questionable whether the marginal benefits of legal channelling, limiting the concurrence of lawsuits and therefore the administrative costs, outweigh the economic costs—limitation

Michael G. Faure, *Economic Criteria for Compulsory Insurance*, 31 THE GENEVA PAPERS ON RISK AND INSURANCE 149 (2006); P.J. Jost, *Limited Liability and the Requirement to Purchase Insurance*, 16 INT'L REV. L. & ECON. 259 (1996); Mattias Polborn, *Mandatory Insurance and the Judgment Proof Problem*, 18 INT'L REV. L. & ECON. 141 (1998).

²⁶¹ See Shavell, *supra* note 259, at 47, 55.

²⁶² See *supra* note 103 and accompanying text.

²⁶³ See Faure, *supra* note 53, at 28.

²⁶⁴ See Vanden Borre, *supra* note 103, at 28.

²⁶⁵ INTERNATIONAL PROBLEMS OF FINANCIAL PROTECTION AGAINST NUCLEAR RISK: A STUDY UNDER THE AUSPICES OF HARVARD LAW SCHOOL AND ATOMIC INDUSTRIAL FORUM, INC. 58-59 (Harvard Law School & Atomic Industrial Forum 1959).

²⁶⁶ See Vanden Borre, *supra* note 103, at 27-30.

of lawsuits and lower incentives for potential injurers. A similar reduction of tertiary accident costs is obtained in the U.S., thanks to the omnibus coverage of the nuclear operator.²⁶⁷ The Price-Anderson Act has a system of economic channelling which means that claims against third parties remain possible, but the operator of the nuclear installation has the legal obligation to include all those into the coverage under his nuclear liability insurance.²⁶⁸ Therefore, we can also conclude that economic channelling can contribute to the limitation of tertiary accident costs and, consequently, that the U.S. Price-Anderson Act is more efficient than the international nuclear liability compensation scheme.

We will now address more closely to what extent the Price-Anderson Act enables the economic rules of thumb of cost internalization and risk differentiation.

B. *Cost Internalization: Then and Now*

The economic principle of cost internalization as a remedy to market failure caused by externalities requires the nuclear operator's full exposure to the nuclear damages. If a financial cap would be put on his liability, or if a part of the compensation would be paid by the state, this would effectively create a subsidy to the nuclear industry.²⁶⁹ Originally, the Price-Anderson regime definitely suffered from this problem. The nuclear operator in 1957 was only liable for \$60 million, whereas the government agreed to make an additional amount of \$500 million available.²⁷⁰ At that time, there was a clear subsidy to the nuclear energy production and a lack of internalization of the costs caused by a nuclear accident. Even the NRC argued that the Price-Anderson Act provided a real subsidy to the industry, though its magnitude was difficult to estimate.²⁷¹ Dubin and Rothwell estimated the cumulative value of the subsidy to industry (in 1985 dollars) to be \$111 billion by 1988 and growing to \$131 billion by 2001.²⁷² Later

²⁶⁷ See *supra* notes 100-02 and accompanying text.

²⁶⁸ See Pelzer, *supra* note 63.

²⁶⁹ For a calculation of the extent of this subsidy, see KARINE FIORE, THE NUCLEAR LIABILITY LIMIT IN THE OECD CONVENTIONS 1 (2007), available at http://www.aee-france.fr/aeeese/aeeese_eve/Prix_papier_2007/prix_AEERE_2007_KFioire_nuclear.pdf.

²⁷⁰ See *supra* note 3 and accompanying text.

²⁷¹ See U.S. NUCLEAR REGULATORY COMMISSION, THE PRICE-ANDERSON ACT—THE THIRD DECADE (NUREG-0957) G-12 (1983).

²⁷² Jeffrey Dubin & Geoffrey Rothwell, *Subsidy to Nuclear Power Through Price-Anderson Liability Limit*, 8 CONTEMP. ECON. POL'Y 73, 76 (1990). *But see* Anthony Heyes & Catherine

Rothwell argued that, in economic terms, it is not a direct subsidy in the sense that there is no direct payment made by government to anyone; at the same time, he argues that there is a "potential (or expected) subsidy."²⁷³ This subsidy may artificially increase the competitiveness of nuclear energy as compared to other energy sources, and may potentially have a negative impact on prevention.²⁷⁴ As we stated above, the Price-Anderson Act has been revised many times, taking into account *inter alia* the possibilities for the operator to obtain coverage on the insurance market. Today, the U.S. nuclear operator is individually liable for \$300 million and in the second layer, an additional amount is available of \$10.461 billion, making the total amount available \$10.761 billion.²⁷⁵ Whether the current system leads to an efficient internalization of the costs of a potential nuclear accident in the U.S. cannot be easily answered, because there are several aspects to consider.

The first question that arises is whether the total available amount in case of a nuclear incident in the U.S. today (\$10.76 billion) will be sufficient to cover the costs of an average nuclear incident. That depends to a large extent on the estimates of the costs of a nuclear accident. In the literature, various scenarios are described, whereby the damages range from \$10 billion to \$100 billion.²⁷⁶ Depending upon the scenario one follows, there could potentially still be accidents for which the damage is substantially higher than the compensation available today in the Price-Anderson regime.²⁷⁷ Before the recent change in 2005, which brought the total compensation available to \$10.761 billion, the literature concluded that there was indeed a subsidy resulting from the financial limit on the

Liston-Heyes, *Subsidy to Nuclear Power Through Price-Anderson Liability Limit: Comment*, 16 CONTEMP. ECON. POL'Y 122-24 (1998) (arguing that Dubin & Rothwell overstate the subsidy by at least a factor of four).

²⁷³ Geoffrey Rothwell, *Does the US Subsidize Nuclear Power Insurance?*, POLICY BRIEF, STANFORD INST. FOR ECON. POL'Y RES., Jan. 2002, available at http://siepr.stanford.edu/papers/briefs/policybrief_jan02.pdf.

²⁷⁴ For a more detailed analysis of the consequences of the subsidy resulting from the financial limit on liability, see Michael G. Faure & Karine Fiore, *An Economic Analysis of the French Nuclear Liability Subsidy* (Centre d'Analyse Economique Aix-Marseille, Working Paper, DR35, 2006).

²⁷⁵ See *supra* note 120 and accompanying text.

²⁷⁶ See UNITED STATES GENERAL ACCOUNTING OFFICE, REPORT TO CONGRESSIONAL COMMITTEES, NUCLEAR REGULATION: A PERSPECTIVE ON LIABILITY PROTECTION FOR NUCLEAR ACCIDENT 18 (1987), available at <http://archive.gao.gov/d28t5/133093.pdf>; Dubin & Rothwell, *supra* note 272, at 73-79; Heyes & Liston-Heyes, *supra* note 272, at 122-24.

²⁷⁷ *Id.*

liability of the operator in the Price-Anderson Act,²⁷⁸ but depending upon the scenarios, this may still be the case today.

The second crucial question is whether under the current regime all those who contribute to the nuclear risk—note these are not only nuclear operators, but also suppliers of nuclear material and potentially others—are exposed to the risk to the full extent. As such, there is still a financial cap on the liability of the individual operator of \$300 million. This amount is clearly lower than the average costs of a nuclear accident.²⁷⁹ However, there is an additional amount of \$10.461 billion available through the second layer, financed through retrospective premiums by the collectivity of all nuclear operators. Disregarding, for a moment, the fact that this amount may, as just mentioned, still be lower than the costs of an average nuclear accident, let us address whether the fact that it is not the individual operator, but the collectivity of operators that pay the second layer, negatively affects the cost internalization. That should, of course, not necessarily be the case. The fact that the second layer shifts a part of the risk costs of the nuclear accident to the collectivity of nuclear operators does not necessarily mean that there would be no cost internalization. The conclusion would be the same if the second layer would not be paid through the collectivity of nuclear operators but, say, through insurance. Whether costs are still efficiently internalized, in the sense that adequate incentives are provided to individual operators, will depend on the question of whether operators will have to contribute to the collective layer according to the risk they pose and, accordingly, whether there is some risk differentiation. This question will be addressed below.

So far we have indicated that the Price-Anderson Act may still provide incentives for cost internalization to nuclear operators, in a first layer through their insurance based individual liability up to \$300 million and in the second layer through their contributions of the collectivity. The third question arises, however, as to how this system also provides incentives for an efficient cost internalization by parties other than nuclear operators who could equally influence the nuclear risk. One can, for example, think about suppliers of nuclear material. In this respect, it should first be repeated that under the Price-Anderson Act, there is no legal

²⁷⁸ See Dan M. Berkovitz, *Price-Anderson Act: Model Compensation Legislation?—The Sixty-Three Million Dollar Question*, 13 HARV. ENVTL. L. REV. 1 (1989).

²⁷⁹ See *id.* For that reason the Price-Anderson Act has also been criticized in U.S. legal circles for providing too few incentives for accident prevention as a result of this financial limit. *Id.* at 48-58.

channelling to, or exclusive liability of, the nuclear operator.²⁸⁰ Others who would have contributed to a nuclear accident are therefore still fully exposed to liability.²⁸¹ This liability can be called on either by potential victims directly or through a recourse action exercised, for example, by the insurer of the nuclear operator.²⁸²

Also, the U.S. has now implemented the CSC through the Energy Independence and Security Act of 2007, and the act stipulates that the CSC will be financed by the nuclear suppliers.²⁸³ The argument is that U.S. nuclear operators today face potentially unlimited liability for nuclear accidents. The CSC's implementation forces U.S. nuclear suppliers to participate in a retrospective risk pooling program to cover the costs following from the U.S. contribution to the CSC, as far as accidents outside the U.S. are concerned.²⁸⁴ Therefore, the additional compensation under the CSC, of 300 million SDRs, will be financed through contributions from U.S. nuclear suppliers. However, the obligation to participate in the retrospective risk pooling program shall be deferred until the U.S. is called on to provide funds pursuant to the CSC,²⁸⁵ in other words, until a covered incident has occurred. Of course, to the extent that the Energy Independence and Security Act replaces the liability of the nuclear supplier through a participation in the retrospective risk pooling program, a problem could still arise if the participant's contribution would be less than the full risk costs created. In that sense, a final judgment on whether the Energy Independence and Security Act leads to a full cost internalization for nuclear suppliers remains hard to make.

Finally, in judging whether the Price-Anderson Act, combined with the Energy Independence and Security Act implementing the CSC, provides adequate incentives for cost internalization one should remember that both Acts principally replace the unlimited exposure to liability of nuclear operators and suppliers by a system of limited liability with collective funding through a retrospective risk pooling system.²⁸⁶ However, the U.S. compensation system has—especially compared to its origins in 1957—dramatically changed, for today, unlike in the international regime,

²⁸⁰ See *supra* notes 101-04 and accompanying text.

²⁸¹ See *id.*

²⁸² See *id.*

²⁸³ See *supra* note 142 and accompanying text. The CSC is not yet in force. *Supra* note 48.

²⁸⁴ This is comparable to the way in which the second layer is financed under the Price-Anderson Act.

²⁸⁵ See Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(e)(2), 121 Stat. 1492, 1744 (2007).

²⁸⁶ See *id.* §§ 934 (a)(1)(B), 934(e)(2).

no public funds are provided to compensate for the damage caused by nuclear accidents.²⁸⁷ Even though the NRC may advance compensation to the victims, the total compensation due will finally be paid by either operators under the Price-Anderson Act, or suppliers under the CSC through the retrospective premiums.²⁸⁸ The U.S. system can, in that sense, not be criticized for the fact that it would provide a large subsidy to the nuclear industry by providing public money to compensate potential accident victims. The only questions which remain are whether the total amount of compensation available approximately equals the estimated costs of an average nuclear accident, and whether the system which has been put in place is sufficiently risk based so that it provides adequate incentives for prevention.

C. *Risk Differentiation*

A final judgment on the efficiency of the U.S. nuclear compensation system will depend on its ability to expose those who contribute to the nuclear risk to the costs of their activity. Assuming for a moment that the available amount today of \$10.761 billion from the Price-Anderson Act plus 300 million SDRs from the CSC for a nuclear accident outside the U.S., equals the costs of an average nuclear accident, the question arises to what extent the financing of the system is such that it is risk related. The importance of this question from an economic perspective may be obvious. If the operators' or suppliers' exposure to liability is replaced by another compensation mechanism, the new mechanism should, in principle, be financed in such a way that appropriate incentives for prevention are still provided. In this respect, three different situations can be distinguished.

The first layer of liability of the nuclear operator under the Price Anderson Act is, since 2005, \$300 million, which must be covered through insurance. The insurance is provided through ANI, the U.S. nuclear insurance pool.²⁸⁹ Even though ANI is effectively a monopolist, it has incentives to optimize profits through a system of adequate risk differentiation,²⁹⁰ just as any commercial insurance company. Hence, it can be assumed that

²⁸⁷ See *infra* Part II.A.2.

²⁸⁸ See *id.*; *infra* Part II.C.

²⁸⁹ See American Nuclear Insurers, *supra* note 153.

²⁹⁰ See Michael G. Faure & Karine Fiore, *The Coverage of the Nuclear Risk in Europe: Which Alternative*, 33 GENEVA PAPERS ON RISK AND INSURANCE 288, 305 (2008) (describing the incentives for risk-sharing pools to risk differentiate efficiently), available at http://www.grjm.net/documents/carine-fiore/GP_risk-sharing_faure_fiore_2008.pdf.

ANI adopts premium policy conditions to the individual risk posed by every installation and operator. This corresponds to the classic economic outcome for insurance companies: to maximize profits insurers will adapt policies to reflect the risk posed by the insured.²⁹¹ A problem arises, however, in the fact that ANI is a monopolist.²⁹² Empirical research has shown that in monopolistic insurance markets, incentives for insurers to differentiate risks are reduced as compared to competitive insurance markets.²⁹³ Thus, ANI has reduced incentives to optimally differentiate risks. However, since even a monopolist can raise profits by risk differentiation, it can be assumed that ANI, at least to some extent, practices risk differentiation. Information provided to us by ANI shows that ANI does indeed differentiate among risks. They employ several factors (e.g., location, reactor type, MWT capacity) in developing premiums.²⁹⁴ The most relevant is the so-called Engineering Rating Factor ("ERF"), which looks at individual reactor performance based on twelve separate areas that are considered indicators of insurance risk.²⁹⁵ ANI subsequently assigns an ERF to each operating power reactors. The ERF can lead to a 20% credit or a 30% debit on premiums.²⁹⁶

The second and probably most exciting layer constitutes the \$10.461 billion to be financed by the collectivity of the 104 active U.S. nuclear operators. These retrospective premiums are linked to the size and number of the nuclear reactors being operated by each licensee.²⁹⁷ It is therefore not merely a fixed amount for every licensee. The more reactors one licensee has operating, the higher the amount of the retrospective premium.²⁹⁸ A few questions can be asked concerning this retrospective premium.

²⁹¹ See, e.g., Katherine Taylor Eubank, *Paying the Costs of Hazardous Waste Pollution: Why is the Insurance Industry Raising Such a Stink*, 1991 U. ILL. L. REV. 173, 191-92 (1991).

²⁹² See *supra* note 191 and accompanying text.

²⁹³ For a summary of this literature, see Michael G. Faure & Roger Van Den Bergh, *Competition on the European Market for Liability Insurance and Efficient Accident Law*, 9 MAASTRICHT J. EUR. & COMP. L. 279 (2002).

²⁹⁴ E-mail from John Hoffman, Director of Underwriting, American Nuclear Insurers, to Tom Vanden Borre (Dec. 20, 2007, 21:07 EST) (on file with author).

²⁹⁵ *Id.*

²⁹⁶ *Id.*

²⁹⁷ See *Price-Anderson Hearing*, *supra* note 110.

²⁹⁸ For example, Entergy Nuclear Operations, Inc. owns or operates eleven (11) reactors in the United States, while Ameren UE owns or operates only one (1). U.S. Nuclear Regulatory Commission, List of Power Reactor Units, <http://www.nrc.gov/reactors/operating/list-power-reactor-units.html> (last visited Oct. 6, 2008). The retrospective premiums for Entergy are likely to be much higher than those for Ameren.

First, it is striking that for the second layer of liability coverage, no *ex ante* amounts have to be paid as if there were an insurance system, only retrospective premiums.²⁹⁹ The major advantage from a financial perspective is that as long as no accident happens, the amounts do not have to be paid, no reserves must be made, and capital is not unnecessarily immobilized.³⁰⁰ The NRC pre-finances the compensation to the victim and subsequently collects the retrospective premiums from the licensees, each paying a share based on the number of reactors it owns of the 104 reactors operating.³⁰¹ The only disadvantage of the system is that the insolvency risk is shifted first to the NRC and then to the collectivity of operators. It is unclear how seriously one should consider this insolvency risk. On the one hand, there are many techniques which force operators to provide guarantees for the payment of the retrospective premium in the second layer. For example, the operator should provide a bond to the ANI guaranteeing payment of the retrospective premium.³⁰² However, this may just be a paper operation in practice if it is not supported by collateral or financial securities to back up this financial obligation. We indicated that in some cases ANI would require limited liability companies to provide letters of guarantee from parents or affiliated companies, which could provide some proof of payment.³⁰³

On the other hand, the amount each operator potentially has to provide in the second layer is substantial, totalling at least \$95.8 million,³⁰⁴ which could result in at least one of the 104 operators becoming insolvent. However, in that case, the NRC can collect the remaining amount from other operators, while still limiting the liability for each operator to \$95.8 million.³⁰⁵ To the extent that the damage is below the limit, this may provide some incentives for operators to monitor each others' solvency. One has to realize, though, that the viability of the Price-Anderson regime depends upon whether, in case of a major accident, operators will effectively be able to finance the second layer through retrospective premiums. Interestingly, when the General Accounting Office ("GAO") allowed the NRC to review and comment on the GAO's draft report regarding the NRC's liability insurance requirements, the NRC commented on April 29, 2004

²⁹⁹ See Pelzer, *supra* note 13, at 43.

³⁰⁰ *Id.*

³⁰¹ See *supra* note 182 and accompanying text.

³⁰² See *supra* notes 174-80 and accompanying text.

³⁰³ *Id.*

³⁰⁴ See *supra* note 118 and accompanying text.

³⁰⁵ See *supra* note 182 and accompanying text.

that, “[f]inally, GAO agrees with NRC’s conclusion that all its reactor licensees have sufficient assets that they are likely to be able to pay the retrospective premiums.”³⁰⁶ However, in a reaction, the GAO immediately argued that “the report does not take a position on the licensee’s ability to pay the retrospective premiums[;] [w]e did not evaluate the sufficiency of the individual licensee’s as such to make these payments.”³⁰⁷ Whether the licensees will be able to pay these retrospective premiums thus remains an unresolved issue.

The retrospective premium has been fixed by regulation.³⁰⁸ This only concerns the amount which has to be paid by each operator per year, which since 2005 has been \$15 million.³⁰⁹ Thus, through this regulatory intervention, the financial risk for the operator can be limited to \$15 million annually. Also, the total financial risk for all operators in this second layer is limited to \$10.461 billion, which means for each of the 104 operating power plants, \$100.59 million.³¹⁰

The amounts of the contribution in retrospective premiums are, in principle, the same for every nuclear operator.³¹¹ Hence, at first blush, one could criticize the financing of the second layer because it lacks any element of risk differentiation. However, this statement should be balanced. First, the retrospective premiums are a function of the number of operating reactors. Since the risk created will first of all depend on the number of reactors a licensee has, there is definitely an element of risk differentiation. However, this seems of course rather limited since it is clearly not only the number of reactors that may influence the risk, but also other elements such as the technology used and safety programs implemented, for example.³¹²

Second, one should realize that the financing of the second layer has effectively become the collective responsibility of all nuclear operators in the United States. Therefore, there is a strong incentive for a mutual monitoring since any low quality operation will lead to increased financial exposure for the other operators.

It should also be mentioned that the financing of the second layer via retrospective premiums corresponds with a prediction made in the

³⁰⁶ UNITED STATES GENERAL ACCOUNTING OFFICE, *supra* note 171, at 21.

³⁰⁷ *Id.* at 10.

³⁰⁸ See *supra* note 118 and accompanying text.

³⁰⁹ See *supra* note 235 and accompanying text.

³¹⁰ See *id.*

³¹¹ See *id.*

³¹² See *supra* note 294 and accompanying text.

law and economics literature, more particularly by Skogh.³¹³ Skogh argued that in those cases where probabilities are *ex ante* unknown or difficult to measure, which will of course be the case with nuclear risk, a system of mutual risk sharing has the major advantage that operators can agree to mutually share in each others losses even if probabilities are *ex ante* unknown.³¹⁴ Indeed, in the U.S. system, no *ex ante* premium has to be fixed, but losses can be shared *ex post*.³¹⁵ The structure of this second layer therefore seems to correspond with the point made in law and economics literature that for this type of large losses where probabilities are unknown, mutual risk sharing may be more effective than insurance which requires *ex ante* information in order to fix premiums.³¹⁶

Third, the recent Energy Independence and Security Act of 2007 implementing the CSC, introduces a similar retrospective pooling system funded by the U.S. nuclear suppliers to finance the U.S. contribution to the CSC in the case of a foreign accident.³¹⁷ Section 934(e) of the Energy Independence and Security Act provides that the nuclear supplier will have to participate in a retrospective payment program.³¹⁸ The contribution will be fixed according to a risk informed assessment formula.³¹⁹ The Energy Independence and Security Act provides that the Secretary shall, by regulation, determine the risk-informed assessment formula for the allocation among nuclear suppliers of the retrospective premium to be paid.³²⁰ The contributions will be determined on the basis of the risk contributed by each nuclear supplier.³²¹ This shows that, in determining the

³¹³ See Göran Skogh, *Development Risks, Strict Liability, and the Insurability of Industrial Hazards*, 13 THE GENEVA PAPERS ON RISK AND INSURANCE 247, 253-54 (1988).

³¹⁴ *Id.* at 252-54.

³¹⁵ *Id.*; see also Göran Skogh, *Insurance and the Institutional Economics of Financial Intermediation*, 16 THE GENEVA PAPERS ON RISK AND INSURANCE 59 (1991).

³¹⁶ See Skogh, *supra* note 313; Skogh, *supra* note 315.

³¹⁷ This contribution will, *inter alia*, depend upon who the other members of the CSC are, as already indicated, the contribution of the U.S. in the second tier of CSC will vary between roughly 40 and 100 million SDRs (\$65.332 and 164.361 million). See *supra* note 144.

³¹⁸ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(e)(1), 121 Stat. 1492, 1744 (2007).

³¹⁹ See S. REP. NO. 109-346, at 4 (2007).

³²⁰ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(e)(2)(c), 121 Stat. 1492, 1744 (2007).

³²¹ *Id.* It refers, *inter alia*, to the following elements to be taken into account: "the nature and intended purpose of the goods and services supplied by each nuclear supplier . . . ; the quantity of the goods and services supplied by each nuclear supplier . . . ; the hazards associated with the supplied goods and services . . . "; and the hazards associated with particular forms of transportation. *Id.* § 934(e)(2)(c)(i)(I)-(III).

contribution of each nuclear supplier, a formula shall be developed which, in principle, takes into account the particular risks constituted by each nuclear supplier.

In sum, one can notice that in the U.S. nuclear compensation system risks are, to an important extent, shifted from individual nuclear operators or suppliers to third parties—either insurers or the collectivity of operators and/or suppliers. At the same time, one notices that in the Energy Independence and Security Act implementing the CSC, the amount an operator or supplier contributes to the particular compensation system is determined on the basis of the risk constituted by the particular operator or supplier.³²² This seems to a large extent to correspond with the lesson from the law and economics literature that if liability is moved away from a potential injurer via insurance or another compensation mechanism, alternative techniques, such as risk differentiation, must be used to provide potential injurers with sufficient incentives for prevention. One should bear in mind, however, that the system's ability to effectuate cost internalization depends upon the assumption that the amount currently available would be sufficient to cover the costs of an accident. Whether the funds available will cover the cost of an accident depends on the damage assessment estimate used. Also, we must reiterate that the new retrospective pooling program to implement the CSC system will only apply to damage caused by a nuclear accident outside the United States.³²³ Thus, for nuclear accidents in the U.S., the situation remains unchanged.

Finally, we should formulate a few observations concerning the mutual nuclear insurance scheme in the U.S. under NEIL. NEIL is in fact a risk sharing agreement between operators, and not a commercial insurance company.³²⁴ In the economic literature it has often been advanced that these type of risk sharing agreements by operators may create better results than commercial liability insurance for the simple reason that the information needed to exercise an adequate risk differentiation to monitor moral hazard may be much more available among the operators themselves than between operators and insurers.³²⁵ This corresponds with the idea that through collective risk sharing via a pool, the pool will have excellent incentives for a mutual monitoring.³²⁶ Indeed, if

³²² See S. REP. NO. 109-346, *supra* note 319, at 5.

³²³ Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 934(e)(1), 121 Stat. 1492, 1744 (2007).

³²⁴ See Nuclear Electric Insurance Limited *supra* note 192.

³²⁵ See Skogh, *supra* note 313; Skogh, *supra* note 315.

³²⁶ See Faure & Skogh, *supra* note 12; *supra* note 316 and accompanying text.

one operator would for example have a substandard plant³²⁷ this would immediately increase the financial exposure of the other operators. Thus, the mutual monitoring via the pool should exclude bad risks or lead to a risk differentiation whereby contributions to the captive are linked to the risk constituted.

As mentioned, NEIL only offers first-party insurance coverage.³²⁸ This might seem strange. But, as is especially the case with catastrophic liability risks being covered under a risk sharing agreement, the “regular” insurance market is quite reluctant to insure those types of risks. Insurance market reluctance will only increase after the entry into force of the Protocol to the Paris Convention providing for a liability time limit of thirty years for coverage of personal injury damage and ten years for all other nuclear damage, including environmental harms.³²⁹ In this respect, it is not surprising that a specific mutual scheme aiming at covering these types of risk was created in Europe also—ELINI.³³⁰

VI. PRICE-ANDERSON ACT: A MODEL FOR THE INTERNATIONAL REGIME?

A. *Advantages of the Price-Anderson Model*

We began in Section I by establishing the complicated legal history of the international nuclear compensation regimes and compared this to the U.S. compensation regime which, to some extent, has different features than the international regime. Early literature has already criticized the international regime from an economic perspective.³³¹ The criticism was rather straightforward. The legal channelling of liability in the international conventions has the major disadvantage that many parties, other than the nuclear operator, who could equally influence the risk of a nuclear accident are not exposed to liability.³³² Also, the financial limit on the liability of the licensee of the nuclear plant remains too low, which, in combination with the large public funds made available in the international

³²⁷ Which would already be difficult given the heavy regulatory controls. *See supra* notes 25, 171 and accompanying text.

³²⁸ *See supra* note 203 and accompanying text.

³²⁹ *See* Protocol to Amend Paris Convention, *supra* note 76, at art. I.

³³⁰ *See supra* notes 211-16 and accompanying text.

³³¹ *See* sources cited *supra* note 252.

³³² *See* Trebilcock & Winter, *supra* note 10.

regime, leads to a substantial subsidization of nuclear energy, and thus to an insufficient cost internalization.³³³

Even though we have indicated that it is hard to make a final, positive judgement on the U.S. compensation regime given the fact that the real costs of a nuclear damage can still be higher than the compensation available, the U.S. regime seems in many respects to be more in line with the law and economics literature with respect to nuclear liability.

A first advantage of the U.S. regime is that it seems far more dynamic than the international regime. The Price-Anderson Act started in 1957 with a relatively low financial limit—\$60 million—on the liability of the operator, but a large amount of government intervention—\$500 million. But by 1975, the Price-Anderson Act already provided for a dynamic system whereby the relationship between private and public funding could change, taking into account *inter alia* developments in the insurance market.³³⁴ The fact the Price-Anderson Act organized insurers at the federal level, and not at the state level as most U.S. insurance markets,³³⁵ the U.S. nuclear insurance market could create substantially higher amounts of compensation. Today, the coverage of the nuclear risk in Europe still takes place via the nuclear insurance pools, which are organized at a national, member state level, and therefore, not surprisingly, have generated amounts of insurance coverage that are too low.³³⁶ The U.S. federal government has systematically removed itself from covering the nuclear risk such that by 1982 the \$560 million of required compensation was entirely financed by private funds.³³⁷

It is very striking that in the beginning, the international regime and the American nuclear compensation scheme were very similar, but today the differences between the two systems are quite spectacular. Today, in the U.S., the total amount of compensation available is \$10.761 billion, of which \$300 million is financed through the individual liability of the nuclear operator and \$10.461 billion through the collective responsibility of all operators financed through retrospective premiums. Today, the NEA regime requires a total amount of available compensation of 300 million SDRs (roughly €310.35 million; \$493.08 million).³³⁸ Once the

³³³ See, e.g., Faure & Fiore, *supra* note 274; FIORE, *supra* note 269.

³³⁴ See *supra* note 111 and accompanying text.

³³⁵ 43 AM. JUR. 2D *Insurance* § 24 (2008) (“Insurance company regulation is matter which is traditionally left to states . . .”).

³³⁶ See *supra* notes 237-39 and accompanying text.

³³⁷ See *supra* note 112 and accompanying text.

³³⁸ See *supra* note 33.

Protocols to the Paris and Brussels Supplementary Conventions enter into force, the total amount of compensation available will be €1.5 billion (\$2.383 billion), of which €700 million (\$1.112 billion) will be financed by the nuclear operator and €800 million (\$1.271 billion) by public funds.³³⁹ Of course, the Contracting Parties have the freedom to charge the cost of their obligation to the nuclear operators and thus, indirectly contributing to more internalisation.³⁴⁰ But even if the Contracting Parties were to do so, thereby imposing a liability limit of €1.2 billion (\$1.907 billion), a part of the damage would still be paid by public funds. Unless all Contracting Parties opt for unlimited liability of the nuclear operator, no one will be liable for damage in excess of €1.5 billion (\$2.383 billion).

The conclusion, therefore, is rather straightforward. The economic goal of cost internalization can hardly be reached in the international regime for two main reasons. In the NEA regime, the individual liability of the nuclear operator seems at first blush high—€700 million (\$1.112 billion) compared to \$300 million in the U.S. Price-Anderson Act—but is only a small fraction of the potential costs of a nuclear accident, estimating the damage to be between \$10 billion and \$100 billion.³⁴¹ Second, the second layer of compensation in the international regime is entirely provided through public funds³⁴² whereby no risk related financing takes place whatsoever. The second and third layer of public funds in the NEA regime and the second layer under CSC are a pure subsidy to the nuclear industry and contribute nothing to cost internalization.³⁴³ This criticism can be partially addressed if the Contracting Parties charge the operators for the costs of making public money available. However, these costs should be market reflective and should take into account risk differentiation, as discussed. It is far from certain that any governmental institution is well equipped enough to assume this difficult task, let alone in a more efficient manner than an insurance company or mutual insurance scheme.

On the other hand, in the U.S. the second layer is not only considerably higher than in the international regime (\$10.461 billion compared to €800 million, \$1.271 billion, in the NEA regime), but it is also financed through the collectivity of the nuclear operators and hence contributes

³³⁹ See *supra* note 77 and accompanying text.

³⁴⁰ *Id.*

³⁴¹ See sources cited *supra* note 276. This is also the case in the IAEA regime, where the revised liability amount is 300 million SDRs (\$493.083 million). See International Atomic Energy Agency, *supra* note 42.

³⁴² See *supra* notes 72-75 and accompanying text. As far as the NEA regime is concerned: the second layer by the installation state and a collective state fund in the third layer. *Id.*

³⁴³ See sources cited *supra* notes 12, 53 and accompanying text.

to a cost internalization.³⁴⁴ The situation is, moreover, only worse if one compares the Price-Anderson Act with the regime under the Vienna Convention where the amounts are even dramatically lower than in the NEA regime.³⁴⁵ An important feature of the U.S. regime is that, indeed, a system has been developed whereby the second layer of compensation does not merely consist of public funding, but is the collective responsibility of industry. The task of the government in this respect is limited to pre-financing the compensation to the victim and collecting the retrospective premiums from the operators.³⁴⁶ Moreover, in order to limit the risk exposure of the operators, the annual retrospective premiums are determined by law. However, in the end, it is the nuclear operators that contribute to finance the second layer of \$10.461 billion through these retrospective premiums.

The retrospective nature of the premium does create a potentially important insolvency risk. This can, to some extent, be mitigated through other controls on the solvency of operators and via the mutual monitoring inherent in financing the second layer through an industry run mutual, or, as ANI does, by asking guarantees of affiliated companies.³⁴⁷ A potential danger of relying on retrospective premiums is indeed the insolvency risk. The advantage is, however, that no *ex ante* assessment of probabilities is necessary and no capital needs to be immobilized *ex ante*.³⁴⁸ A similar system has been worked out for financing the U.S. contribution to the CSC through risk dependant retrospective premiums to be paid by nuclear suppliers.

The last important difference between the U.S. and the international regime is that the U.S. regime has no legal channelling of liability to operators. The U.S. implementation of the CSC furthers this trend by explicitly involving nuclear suppliers in the financing of nuclear risk, as far as nuclear accidents outside the U.S. are concerned.³⁴⁹ The international regime, on the contrary, inefficiently excludes liability of all others than the licensee who could have contributed to the risk.³⁵⁰

³⁴⁴ See *supra* Part V.B.

³⁴⁵ See *supra* Table 3.

³⁴⁶ See *supra* note 182 and accompanying text.

³⁴⁷ See *supra* notes 177-80 and accompanying text.

³⁴⁸ See Pelzer, *supra* note 13, at 48. A system of pooling with retrospective premiums can therefore also be more advantageous than the payment of insurance premiums which is basically considered "lost money." *Id.*

³⁴⁹ See Vanden Borre, *supra* note 40, at 27.

³⁵⁰ See *id.*

The lesson seems, therefore, to be rather clear: the U.S. Price-Anderson Act and its recent amendments seem to have understood and incorporated the lessons from economic analysis. The various parties who contribute to nuclear risk are exposed to substantial amounts of liability which may provide incentives for prevention and cost internalization. Economic literature had already often suggested that the international regime should be changed to expose more fully those creating the nuclear risk to the costs of their activity. Within a regime where insurance is only provided through nationally operating insurance pools within member states, forcing nuclear suppliers to internalize costs remains difficult. The U.S. model demonstrates that if a compensation regime were to be organized as a collective responsibility of the nuclear industry, thereby excluding public funding, much higher amounts of compensation can be provided to victims, and a better internalization of the nuclear risk can be promoted.³⁵¹ This, however, presupposes cooperation between nuclear operators which currently fall under the international regime, and also assumes there are possibilities of a mutual monitoring which is essential in a system of collective responsibility, such as under the Price-Anderson Act. Perhaps socio-economic or institutional impediments have thus far prevented the creation of a similar risk sharing agreement among nuclear operators in Europe. Pelzer noted that during the negotiations to revise the Vienna Convention, experts discussed the international pooling of operators' funds, but such suggestions did not find support and eventually failed.³⁵² Pelzer argued that using private operators' money in one country to meet the obligations of operators in other countries was unfeasible because "[t]here is no universal risk community of operators."³⁵³

Two important factors facilitated cooperation with the U.S. nuclear industry. First, all operators are subject to a single federal regulator, the NRC.³⁵⁴ In the case of Europe, each country has its own regulatory structure not only on nuclear safety, but also on the approval of the form of financial security to be presented by the nuclear operator.³⁵⁵ On top of that, and despite several EU Directives on nuclear safety focusing more

³⁵¹ Pelzer recently concluded that the Price-Anderson compensation system, "perfectly complements the capacity of private insurance industry in a most cost-effective way." Pelzer, *supra* note 13, at 43.

³⁵² *Id.* at 45.

³⁵³ *Id.* at 45-46.

³⁵⁴ U.S. Nuclear Regulatory Commission, About NRC, <http://www.nrc.gov/about-nrc.html> (last visited Oct. 8, 2008).

³⁵⁵ See *supra* notes 52-53 and accompanying text.

on issues concerning radiation protection and less on operational safety issues, there are differences in the way nuclear power plants are being operated throughout Europe.³⁵⁶ With this in mind, nuclear operators can take the view that differences in those safety issues create market distortions impeding closer cooperation. However, it is our view that a cross-border cooperation between European nuclear operators within a mutual insurance scheme will decrease differences and enhance overall nuclear safety. Indeed, under the existing mutual insurance schemes, the operators send inspectors to the installations.³⁵⁷ Also, a difference in premium is operated depending on factors such as location of the plant (as in whether it is near a large city), age of the plant, and ERF.³⁵⁸ Third, one has to bear in mind that today the market in Europe is quite concentrated in terms of the number of nuclear power plants per operator, e.g., in France, the state-owned Electricité de France ("EDF") operates fifty nine nuclear power plants.³⁵⁹

B. Feasibility of the Price-Anderson Model at an International Level

Given the fact that our analysis indicated that the American nuclear liability and insurance system is superior to the international system,³⁶⁰ the adoption of the American model internationally should be envisaged.³⁶¹ The key issue in such a model is to phase-out all state funding in the international, and of course national, nuclear compensation schemes.³⁶² In other words, the issue is the replacement of the current collective state funding with a collective tier funded by nuclear operators.

³⁵⁶ See, e.g., *Amended Proposal for a Council Directive (Euratom) Laying down Basic Obligations and General Principles on the Safety of Nuclear Installations & Amended Proposal for a Council Directive (Euratom) on the Safe Management of the Spent Nuclear Fuel and Radioactive Waste*, COM (2004) 526 final (Aug. 9, 2004).

³⁵⁷ See, e.g., *Preface to NUCLEAR POOLS' FORUM, INTERNATIONAL GUIDELINES FOR MACHINERY BREAKDOWN PREVENTION AT NUCLEAR POWER PLANTS* (American Nuclear Insurers 2000) (describing the Guidelines "as a document for the insurance inspector.").

³⁵⁸ See *supra* notes 294-96 and accompanying text.

³⁵⁹ See World Nuclear Association, *Nuclear Power in France*, Aug. 2008, <http://www.world-nuclear.org/info/inf40.html> (last visited Oct. 8, 2008).

³⁶⁰ Our analysis focused on the NEA regime, but the same holds true for the IAEA regime.

³⁶¹ Pelzer, *supra* note 13, at 49. Pelzer argues that a pooling mechanism can even be in the interests of operators since it leads to higher coverage which can protect the operator "against legal or political pressure to provide additional assets for compensation in excess of the [limited] liability amount." *Id.*

³⁶² See *id.* at 46-55.

Basically, Europe would thus follow the American example, more than twenty five years later.

It should be possible to follow the U.S. example in Europe since the U.S. is not the only country in the world to have a similar two-tier system. In Germany, the liability of the nuclear operator is unlimited;³⁶³ there is, however, a limit to the security requirement, €2.5 billion (\$3.972 billion),³⁶⁴ of which €256 million (\$406.733 million) is to be provided by each plant's operator insurance.³⁶⁵ The other part is to be provided collectively by the operators of all seventeen nuclear reactors.³⁶⁶ Hence, there is some experience in Europe with a risk sharing pool among operators. All nineteen German nuclear power plants concluded a so-called "solidarity agreement" whereby they accept liability towards the other partners to contribute a certain percentage of the total amount due based on a square root of the thermal reactor power.³⁶⁷ If a nuclear accident occurs, the guarantee is due to be paid "provided neither the operator nor the respective parent company are in a position to provide the money necessary for the compensation"³⁶⁸

The funding of a Price-Anderson type regime at the international level should not be too difficult because in nine Western European countries alone, there are 135 nuclear reactors in operation, which is more than the current 104 reactors in the second tier of the U.S. compensation system.³⁶⁹ Vanden Borre notes that

[i]f all these operators should contribute [, for example,] or [sic] €10 million [\$15.888 million] in the second tier (one tenth of the current amount of the second tier in the US), an amount of €1.35 billion [\$2.145 billion] of private funding would be immediately available in the second tier. It even seems that there is nothing in the Protocol to amend the Paris Convention that would oppose such a solution in

³⁶³ Gesetz über die friedliche Verwendung der Kernenergie un den Schutz gegen ihre Gefahren (Atomgesetz), Dec. 23, 1959, BGBl 1959, Aug. 29, 2008, BGBl. I at 1793.

³⁶⁴ *Id.* at § 13(3).

³⁶⁵ World Nuclear Association, *Nuclear Power in Germany*, June 2008, <http://www.world-nuclear.org/info/inf43.html> (last visited Oct. 9, 2008).

³⁶⁶ *Id.*; Paul Dangelmaier, *Nuclear Liability Insurance in the Federal Republic of Germany*, in *NUCLEAR ACCIDENTS: LIABILITIES AND GUARANTEES* 425, 428 (NEA-IAEA, 1992).

³⁶⁷ See Pelzer, *supra* note 13, at 43-45.

³⁶⁸ *Id.* at 44.

³⁶⁹ For a discussion of the basic conditions to implement international pooling, see *id.* at 50-55.

order to be able to cover the €700 million [\$1.112 billion]. Indeed, according to the amended Art. 10, a) of the Paris Convention, the operator shall, in order to cover the liability under the Convention, be required to have and maintain insurance or other financial security of such type and terms as the competent public authority shall specify. Hence, such a solution would require at least a co-ordinated approach between the competent public authorities of the countries involved.³⁷⁰

Pelzer argues that, unlike the Price-Anderson Act, an international pooling system should preferably be introduced on a voluntary, rather than a mandatory, basis.³⁷¹ Making risk pooling mandatory, as does the Price-Anderson Act, would cause legal problems in specific jurisdictions such as Germany. There it could be argued that forcing operators to contribute to cover compensation for an accident caused in another operator's reactor would violate constitutional property rights.³⁷² He, therefore, strongly suggests making a pooling model voluntary.

We are not convinced that these legal problems cannot be overcome if the legislature can at least justify why in this specific case the pooling through retrospective premiums must be introduced. A pooling model on a voluntary basis can be difficult to create if there is not a convention behind the operators to force them to pool. The voluntary nature would also have the disadvantage that there would be little guarantee that money would effectively be available to compensate victims after an accident, for example if the private pooling arrangement was subsequently altered. Therefore, we would prefer a mandatory participation in the pooling scheme as in the model of the Price-Anderson Act.

The model we suggest is based on three assumptions. First, the model is to be applied on a limited international basis—at least at the onset of setting up such a model. The reason for this is quite simple: such a model can only work if the operational safety of the participating nuclear power plants is similar or at least comparable. Pooling has an important effect on the prevention of nuclear accidents: those operators wanting to participate in the pool will have an incentive to enhance the safety of their power plants. Second, the model is conceived in such a

³⁷⁰ Vanden Borre, *supra* note 40, at 306-07.

³⁷¹ Pelzer, *supra* note 13, at 49-50.

³⁷² *Id.* at 49.

way that enough funds will be available over a certain period of time, for example, ten years. The funds of the second tier should only be gradually available. Third, the model will only work if major regulatory issues have been resolved. By far the most important regulatory issue is the creation of a European independent regulatory body, a kind of *European Nuclear Regulatory Agency*. This body will issue permits to nuclear installations falling under the international nuclear liability regime and will determine the way the operators will insure their liability.

CONCLUDING REMARKS

Worldwide, a variety of differing regimes exist for the coverage of damage caused by civil nuclear accidents. At the international level, two different regimes developed: one from the OECD/NEA and the other from the IAEA. What is striking is that the U.S. played an important role in supporting the creation of these international regimes,³⁷³ but did not join the regimes until very recently. Instead, the U.S. started its own regime in 1957 with the Price-Anderson Act. A similar, separate legal development can also be noticed in the area of damage caused by oil pollution. The U.S. actively cooperated with the creation of the civil liability convention for oil pollution and its subsequent changes, but did not join the conventions.³⁷⁴ The U.S. instead created its own separate regime with the Oil Pollution Act of 1970.³⁷⁵

The attitude of the U.S. in the 1950s is easy to explain. Its primary goal in supporting an international convention on civil nuclear liability was to make sure that liability would be legally channelled to the licensee of a nuclear plant, thus excluding the potential liability of U.S. suppliers who provided nuclear material to European power plants.³⁷⁶ Domestically, however, the U.S. created the Price-Anderson Act in 1957 with a higher compensation and without a legal channelling of liability.³⁷⁷

Since the end of the 1950s when the separate regimes were created, much has changed, and particularly in recent years, some important

³⁷³ See Vanden Borre, *supra* note 40, at 262-66.

³⁷⁴ See Hui Wang, *Shifts in Governance in the International Regime of Marine Oil Pollution Compensation: A Legal History Perspective*, in *SHIFTS IN COMPENSATION FOR ENVIRONMENTAL DAMAGE 199* (Michael Faure & Albert Verheij, eds., 2007).

³⁷⁵ *Id.*

³⁷⁶ *Supra* note 264. For a full discussion of the potential scope of the liability of suppliers, see Arthur Murphy, *Third Party Liability of Suppliers in International Nuclear Transactions*, in 3 *LAW AND ADMINISTRATION* 166-86 (J.L. Weinstein, ed., 1962).

³⁷⁷ See *supra* Part II.A.1.

changes to the regimes were adopted. The basic reasons for these recent changes are clear: the international regime is recognizing that the underlying justifications for supporting nuclear power through publicly funded liability regimes are no longer valid. The international nuclear compensation regime in the conventions and the American compensation scheme in the Price-Anderson Act began in the 1950s based on the idea that nuclear energy development had to be supported, which justified limiting liability and making public funding available to provide compensation to accident victims.³⁷⁸ The U.S. realized that this justification was no longer valid and, as a result, in 1982 the U.S. completely abandoned the public funding of nuclear damage. The international regime today still, to a large extent, relies on public funding.³⁷⁹

In this paper we addressed the U.S. and international regimes from an economic perspective, paying especially attention to the U.S. regime, as earlier studies had already criticized the international regime from an economic perspective.

The regimes show some similarities. For example, in both regimes the nuclear operator's liability is strict and the operator must provide a financial guarantee for the first layer of strict liability. Both strict liability, given the unilateral character of nuclear accidents, and compulsory insurance, given the insolvency risk, can be supported by economic analysis. Economics, though, was always critical of both the financial limit on nuclear operator's liability and the legal channelling of the liability to the operator. This channelling takes the form of exclusive liability in the international conventions, but is nonexistent in the Price-Anderson Act.

Of course, many have argued that the damages in case of a nuclear accident can be of such a magnitude that traditional financial instruments such as insurance may not be able to provide adequate coverage. However, the Price-Anderson Act demonstrates that this is not necessarily a reason to move to public funding as the international regimes do; a valuable alternative can consist of a second layer which is the collective responsibility of all the operators, financed through retrospective premiums. The international regime's choices to limit the liability of the operator and to subsidize victim compensation through public funding may have negative consequences. To the extent that unlimited liability rules provide incentives for prevention, the limitation of liability does create an incentive for the externalization of costs, which may lead to underdeterrence. To some extent nuclear operators will still have sufficient incentives because both

³⁷⁸ *Id.*

³⁷⁹ *See supra* Part II.A.2.

of safety regulation and from their own interest not to lose the investment in the nuclear plant. As a result of the financial limit, however, the potential complementary function of liability rules in providing additional deterrence above the requirements set by safety regulation is lost. The limits on liability in the international regimes also effectively create a subsidy for nuclear power which may disturb the competitiveness of nuclear energy compared to other energy sources which lack this subsidy. A relatively too high demand will follow. It can be useful to bear this in mind in the debate on climate change and the role of nuclear energy therein.

The deficiencies of the international nuclear compensation scheme seem to be substantially less in the American regime since the total amounts of compensation are substantially higher, equalling the costs of a nuclear accident in an optimistic scenario, and are financed by the liable operator in combination with the collectivity of operators, thus leading to a better internalization of the nuclear risk. An open question is whether the nuclear risk in the U.S. is effectively internalized in the prices paid for nuclear energy. That would suppose that, nuclear operators already take into account the fact that, in the future, they may be exposed to liabilities to pay retrospective premiums. This foresight should be calculated into the premiums which energy users pay today. Otherwise, today's prices of nuclear energy in the U.S. remain too low and the costs of nuclear power are shifted to future generations, who will have to pay higher prices to finance the retrospective premiums. It is questionable whether such a full internalization, also taking into account future retrospective premiums, effectively takes place in U.S. energy prices today.

A disadvantage of the low limits, combined with the still low compensation in the international regime, is also that victims may remain largely uncompensated. This is quite worrisome, given the fact that many countries, such as Finland and France, that are building new nuclear power plants, rely on nuclear energy as a solution to the climate change problem. That supposes adequate compensation is available in the unlikely event of a nuclear accident. If this is not the case, a nuclear accident may have serious disruptive effects on the socio-economic situation of the affected region.

The U.S. example gives us an important lesson for the international regime. Through a mutual risk sharing by the nuclear industry on the one hand, higher amounts of compensation for victims can be generated, and on the other hand, public funding can be reduced, as a result of which a better internalization of the costs of a nuclear accident will take place. Of course one point for further research is, as just mentioned,

to what extent an effective internalization of the nuclear risk takes place in the U.S. today, meaning that energy prices do already reflect the retrospective premiums that operators may have to pay to cover future liabilities. Another question which merits further research is how a system of mutual risk sharing could be worked out at the European level, for example, for the European nuclear operators which are now under the scope of the NEA Conventions. The question arises whether a similar model of mutual risk sharing, either through *ex ante* reserves or through retrospective premiums would also be feasible in Europe and what the precise financial consequences of such a model would be.

Finally, the entire system also teaches a lesson on the relative power of the nuclear interest groups in their lobbying efforts, and this lesson is seen in both the U.S. and in Europe. From a U.S. perspective, the international conventions protect the interests of the American suppliers given the fact that the legal channelling protects—or is at least aimed at protecting—them from being held liable for nuclear accidents in Europe.³⁸⁰ So, American policy has been twofold: protecting the interests of the American nuclear suppliers abroad (via the legal channelling), while at the same time phasing-out public funding for damage caused by a domestic nuclear accident. As far as the legal channelling is concerned, the result of the American policy does not achieve the goals of our economic analysis. But as far as the Price-Anderson Act, in combination with the success of the mutual insurance scheme (NEIL), is concerned, the outcome is rather positive in terms of cost internalization and risk differentiation. Nuclear operators in Europe have apparently been able to better protect their interests as compared to their colleagues in the U.S., in the sense that there is only cost internalization of some form to a very limited extent. Even if, academically, one were to show that the NEA Conventions could be modelled according to the Price-Anderson Act, this does not mean that one can expect this to take place in the near future. Political reality will probably teach that different stakeholders involved will put a lot of effort in lobbying in order to maintain limited liability and state intervention. Once more, public choice theory teaches that legislators will often not follow the predictions of economic theory, but rather the demands of powerful interest groups which provide support to wealth-maximizing politicians.

³⁸⁰ Also the recent implementation of the CSC by the U.S. should be seen in this light: it replaces a potentially open-ended liability of nuclear suppliers with a predictable regime.