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### NUCLEAR LIABILITY – A FEASIBLE MODEL FOR THE SPACE SECTOR?

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#### 1 INTRODUCTION

Liability for damages in the space sector is problematic in many ways. Firstly, it can already be a challenge to determine the most appropriate (or even any) liable entity or entities. Complex causation questions cannot be avoided; considering, for instance, the problems in attributing damage to particular pieces of space objects and, moreover, the potential cumulative effects of damaging events.<sup>1</sup>

Furthermore, the damaging potential of space activities exceeds the capacity of any single spacefaring entity to make reparation. Even in the case of less serious incidents, absolute and unlimited liability would directly raise the costs of space activities and thus limit the development of space industry. In addition, it could render what are inherently highly hazardous activities uninsurable.<sup>2</sup>

The allocation of losses within a larger community of relevant entities to balance the competing concerns thus seems necessary in order to retain the economic viability of the space sector, yet still secure adequate indemnification for damages. On the one hand, compensation claims for damage resulting from particularly risky activities (even when undertaken with all due care) should be facilitated; on the other, operators of activities that are deemed necessary (or at least socially beneficial) yet entail high risks should be shielded from excessive claims.<sup>3</sup>

In areas of human activities analogous to the space sector, liability has often been shared between the producer of damage and society according to different kinds of formulas. This is also called “socialization of risks”.<sup>4</sup> For instance, limited liability for ship owners in maritime law has existed since at least the 17<sup>th</sup> century. Such treatment has been justified by the highly dangerous nature of maritime transport and its necessity

for society.<sup>5</sup> Some “socialization of risks” would seem necessary also in the space sector. In this respect the most feasible area to draw inspiration from might not be maritime but nuclear law, however.

#### 2 NUCLEAR LIABILITY

The setting in the space sector seems similar in particular to that in the use of nuclear power, which also entails significant risks. There the solutions adopted include, i.a., a three-tiered system of compensation with absolute but limited liability of the operator of a nuclear installation, coupled with limited liability of the state in which the installation is located, and an international compensation fund.

This is the system of liability sharing in Western Europe, which is embodied in several instruments, starting with the OECD’s Paris Convention on Third Party Liability in the Field of Nuclear Energy<sup>6</sup> of 1960 and the IAEA’s Vienna Convention on Civil Liability for Nuclear Damage<sup>7</sup> of 1963, the former of which was strengthened by the Brussels Supplementary Convention<sup>8</sup> in 1963. These were the first treaties to facilitate international civil liability claims for environmentally harmful activities.<sup>9</sup> Most Western European countries are parties to these conventions which were linked in 1988 by a Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention<sup>10</sup> that combined the two into one expanded liability regime.

In its first tier, this regime combines operator liability and insurance obligations. The system is based, at the first level, on strict (absolute) liability of the operator of a nuclear installation, whereby there is no need to prove fault or negligence.<sup>11</sup> Although irrespective of fault, liability of the nuclear installation operator is qualified by limitations on the amount of compensation to be paid and time. According to the Vienna Convention, “[t]he liability of the operator may be limited by the Installation State to not less than US \$5 million for any one nuclear incident” (Art. V). Furthermore, the Paris Convention set a maximum liability of 15 million Special Drawing Rights (SDRs, as

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defined by the International Monetary Fund),<sup>12</sup> which was increased by the Brussels Supplementary Convention up to 300 million SDRs.<sup>13</sup> In order to secure indemnification for damages, the operator is required to maintain insurance (or other form of financial security) covering its liability.<sup>14</sup> In addition to limitations on amount, the liability of a nuclear installation operator is limited in time: a general rule is that compensation rights are extinguished if damage claims are not instituted within ten years.<sup>15</sup>

On the second tier, the risks from the use of nuclear energy are borne by the state in which the nuclear installation is located: above the operator's limit of liability, claims are covered by supplementary public funds of the installation state up to a total of 175 million SDRs.<sup>16</sup> For damages exceeding this limit there is a further third tier, an international compensation fund to which the convention parties jointly contribute in proportion to their installed nuclear capacity and gross national product (GNP).<sup>17</sup> The limit on damages which the international fund will cover is 125 million SDRs (thus the total compensation available from all sources is 300 million SDRs).<sup>18</sup>

This third tier is a form of international collective loss sharing which, by taking into account the amount of nuclear capacity of contracting states, partly also emphasizes the idea of making the polluter pay. The primary liability of the nuclear installation operator obviously derives from the same principle. Nevertheless, it has been asserted that the basic concept behind this liability regime is actually not that of the polluter-pays principle but rather an equitable sharing of the risk of ultra-hazardous activities, which also involves an element of state subsidy.<sup>19</sup>

The system of the Vienna and Paris Conventions met with criticism for its failure to cover purely environmental damage, for instance.<sup>20</sup> A significant amendment to the system was introduced in 1997 by a Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage. Among other things, the protocol broadened the definition of nuclear damage to include environmental damage and preventive measures: the new definition refers specifically to economic loss, the cost of measures to reinstate a significantly impaired environment, loss of income resulting from that impaired environment and the cost of preventive measures (Art. 2.2) – all of which are likely to constitute major parts of damage resulting from a serious nuclear incident.<sup>21</sup> The 1997 protocol also increased the limit of operator liability under the Vienna Convention to 300 million SDRs (of which a maximum of 150 million may be paid from public funds if the installation state so wishes) and simplified the procedure for amending the liability limits in the future (Art. 7). Moreover, the protocol extended the geographical scope of the Vienna Convention to “apply to nuclear damage wherever suffered”.<sup>22</sup>

In 1997, another instrument dealing with compensation, the Convention on Supplementary Compensation for Nuclear Damage<sup>23</sup> was adopted. This free-standing treaty offers the possibility of a global nuclear regime in that it can be adhered to by all states regardless of whether they are parties to any existing nuclear treaties (or have nuclear installations on their territories).<sup>24</sup> It presents, for instance, a new formula (building upon the 1963 Brussels Supplementary Convention) for joint state contributions to the retrospective international fund for amending nuclear accidents.<sup>25</sup> However, this convention is not yet in force.<sup>26</sup>

In 2004, the contracting parties to the Paris and Brussels Conventions signed protocols<sup>27</sup> to amend the instruments which increased their compatibility with the IAEA Conventions amended/adopted in 1997. Like the Vienna Convention as amended by the 1997 protocol to it, the revised Paris Convention contains a detailed definition of ‘nuclear damage’, allowing for a broader range of damage to be compensated than the previously existing categories of personal injury and damage to property only (Art. I.a.vii.). Equally important was the expansion of the geographical scope of the convention: the revision allows for victims in more countries to be compensated in case of a nuclear accident with transboundary implications.<sup>28</sup>

The most important change introduced by the amending protocol, however, was the substantial increase in the three tiers of compensation of the Brussels Supplementary Convention: the new limits of liability set by the protocol are a minimum of 700 million euros for the nuclear installation operator, a maximum of 500 million euros for the installation state, and a collective state contribution of at most 300 million euros (Art. 3, paras. a-b.). The resulting total of 1.5 billion euros is a considerable increase over the previous SDR amounts established by the Brussels Supplementary Convention (approximating a total of 350 million euros only). Beyond this new available total compensation, it is at least tacitly assumed that the installation state will cover any damage in excess of the 1.5 billion euros.<sup>29</sup>

### **3 OTHER LIABILITY REGIMES**

Another interesting precedent is provided by the liability system of the International Convention on Liability and Compensation for Damages in Connection with the Carriage of Hazardous and Noxious Substances by Sea,<sup>30</sup> which establishes the “International Hazardous and Noxious Substances Fund” (Art. 13) to provide compensation (up to 250 million SDR per incident) for damage which is not compensated in the first tier by ship owners.<sup>31</sup> The fund is financed by contributions from the importers and receivers of cargo containing hazardous or

noxious substances. The convention has not, however, received enough ratifications to enter into force.<sup>32</sup>

A related system is that established by the International Convention on Civil Liability for Oil Pollution Damage<sup>33</sup> and the complementary International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage,<sup>34</sup> according to which supplementary funds for compensation of damages are provided by the oil industry, i.e., all persons receiving oil by sea in contracting states.<sup>35</sup>

One more example is the Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal,<sup>36</sup> which also has yet to enter into force.<sup>37</sup> The system set out in the protocol includes a trust fund mechanism, the Technical Co-operation Trust Fund, which is maintained by voluntary contributions. It is, however, not a compensation fund for covering damage that exceeds the liability limits of the protocol;<sup>38</sup> the protocol only provides that “[w]here compensation under the Protocol does not cover the costs of damage, additional and supplementary measures aimed at ensuring adequate and prompt compensation may be taken using existing mechanisms”,<sup>39</sup> with these including the Technical Co-operation Trust Fund.

The channeling of liability directly to the actual operators has encountered resistance also in other contexts. The 1993 Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment (Lugano Convention),<sup>40</sup> which was negotiated under the auspices of the Council of Europe, applies generally to all potentially environmentally harmful activities and envisages in principle strict, unlimited liability of operators.<sup>41</sup> In order to secure compensation, the Lugano Convention requires states to ensure that operators conducting dangerous activities in their territory have appropriate insurance or other financial security (Art. 12).

Initially, the idea was to develop a complementary instrument concerning an additional compensation fund (similar to the fund established for compensation for oil pollution damage). However, due to the reluctance of states to adhere to the Lugano Convention, this plan has been put aside.<sup>42</sup> Nevertheless, the convention has not managed to receive even the three ratifications required for it to enter into force (Art. 32.3).

Another example of a system of strict liability of the operator (combined with mandatory insurance requirements; Arts. 13-17) is that of the 1989 Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels.<sup>43</sup> This convention provides for limits of liability, though (Arts. 9-12). Nevertheless, it has thus far only one state party (Liberia) and has thus also not entered into force.

#### **4 A DRAFT FOR A SPACE LIABILITY REGIME**

In the space sector, given the potential for massive adverse impacts caused by the activities, feasible and functional risk management would also be needed. This should include, i.a., clear allocation of the burden of compensation between private and governmental stakeholders within a system where, moreover, the victim of harm can easily and without excessive cost identify the entity from which to demand reparation in the first instance.

Obviously, compensation for the victims of accidents and other negative consequences of space activities cannot be guaranteed simply by making the immediate actor at fault pay. Instead, tiered systems and collective loss-sharing arrangements similar to those adopted in other fields of high-risk activities internationally could prove useful in channelling the risks and ensuring means for adequate compensation.

One tool for achieving a balance between the different interests might be an international ‘space damage fund’ or similar instrument that takes into account the extent of states’ space activities as well as their economic situation.<sup>44</sup> When designing such a system, one needs to keep in mind, i.a., the developing countries’ demand that it is the spacefaring nations who should bear the costs of their activities. At the national level as well, those gaining the economic benefits of space activities ought to bear the primary responsibility.

Hence, a mechanism similar to the post-disaster compensation regime of the nuclear sector in Western Europe could be one option. The first tier would consist of strict operator/owner liability with compulsory insurance (or other financial security). It has been argued, however, that the common requirement in civil liability treaties of insurance coverage for the full limit of operator liability – even where this is restricted to a certain sum – may not necessarily be an advantageous one. At worst, it could in fact discourage damage prevention as liability is covered by insurance in any case. On the other hand, if the safety record and practices of operators affected the terms of insurance, this would encourage (or even require) them to act more cautiously.<sup>45</sup> Hence, the introduction of absolute but limited operator liability with obligatory insurance could optimally prove quite useful.

Operator liability (and the insurance to cover it) would then be backed up by supplementary state liability and, ultimately, by an international joint state fund. The international fund could be financed by contributions based on economic factors as well as the amount of space activities. Such a system seems fair in many ways. It does not burden an individual operator with excessive liability, yet clearly directs liability towards it that is commensurate with its control over and benefits derived from the hazardous activities. At the same time, it

secures compensation by resorting to the next tiers if needed. In addition, the level of state liability and the international fund would be constructed in a way that takes cognizance of states' actual role in space activities as well as their economic capacity.

In cases where the liable entity remains unknown, the entire reparation for damage should come from the international fund.<sup>46</sup> With the compensation fund as only the last resort, disadvantages related to such funds, e.g., a diminished preventive effect, are also minimized.<sup>47</sup> In addition to state resources, the international fund could be augmented also by the space industry.<sup>48</sup>

### **5 LESSONS TO LEARN**

The different kinds of civil liability treaties outside the space sector have been criticized for not providing compensation in cases of damage to non-economic components of the environment when restoration is not possible (irreparable ecological damage), for instance. Even where damage is in principle compensable, it may not be fully compensated, either due to limits of liability or because the funds available eventually prove insufficient. Another problem seems to be that many liability systems do not address adequately the problems in establishing a causal link between the damage and the harmful activity suspected of having caused it.<sup>49</sup> Causality presents a considerable challenge for any space-related liability regime as well.

However, there are few other possibilities than international funds for providing even somewhat adequate compensation for damage in case of a major space accident. This limitation is obviously due to the extent of damage but also to the likely difficulties in even identifying the liable entity, or the 'launching state' with substantial enough connection with the damage, and, moreover, establishing fault. A fund could be harnessed for providing compensation even in cases where the source of damage cannot be identified or fault established.

The spacefaring nations might not be too receptive to such ideas, however, as they could be placed under an obligation to make available significant amounts of money for potential damage reparation. Considering the precedents from other areas of international activities, prospects for a 'space damage fund' seem increasingly bleak: most of the above-mentioned civil liability systems with compensation funds (with the exception of the oil pollution compensation mechanisms) have either not entered into force at all or have done so to a limited extent only.<sup>50</sup>

In practice, the industrialized states have succeeded in furthering their agendas while the priorities of less developed states have been largely ignored.<sup>51</sup> Considering the less successful examples of international

liability systems in gaining acceptance and functionality, the rationality of spending the limited negotiating resources on developing new liability regimes has been seriously questioned.<sup>52</sup>

Moreover, these mechanisms are retrospective: they are activated only when a damaging incident has already taken place. Especially in cases of major environmental disasters, this can easily lead to solutions that are 'too little, too late'. Even if pure environmental damage were compensated in principle, the compensation would remain an extremely problematic question for various reasons, some beyond the sphere of international space law, not least the challenges related to calculating the value of such damage in monetary terms.<sup>53</sup>

Even if these issues were resolved, there would be additional challenges in designing the liability system, including questions such as the determination of the relevant damage and appropriate time limits for liability given that the occurrence of damage in outer space may involve (very) long time lags. The difficulties in addressing and evaluating cumulative effects of damage in space would complicate the situation further.

It would clearly be far more effective to prevent damage altogether, all the more so as there does not (at least as yet) even exist sufficient technology for eradicating the space debris already generated, for instance. Obviously, 'restitution in kind' is in most cases practically impossible where degradation of outer space is concerned.<sup>54</sup>

Hence, a more feasible system could be an international fund that also supports preventive measures. Such a fund could be put in action in a preventive sense at least as concerns harm prevention in cases where a potentially damaging incident has already taken place or where there is a substantial threat of such an incident. An even more advanced preventive mechanism would be one where an international fund is harnessed to provide deterrent support for complying with damage prevention measures, i.e., prior to the actual occurrence of any foreseeable damage.<sup>55</sup> A fund mechanism seems practical also because it could provide a relatively effective anticipatory way to secure the availability of assets when needed.<sup>56</sup>

However, the application of economic mechanisms for controlling space activities might also prove infeasible due to the fact that the activities do not completely fit into the framework of realities and rationality on which economic mechanisms are typically built. For instance, the presumption behind the polluter-pays principle is that the charges related to polluting activities increase in proportion to the seriousness of pollution. Hence it should be in the interest of the polluters to reduce environmental degradation emanating from their activities.<sup>57</sup> This obviously requires that the charges are set at a level adequate for generating such a

preventive effect. In the space sector, this level would typically need to be quite high, considering how expensive space activities are in the first place.

Economic instruments may even be used for penalizing undesirable behavior by levying charges which are substantially higher than the costs that the behavior actually results in. This should further increase the preventive function of such instruments, but for space activities it would easily entail exorbitant costs. On the other hand, despite the extreme expenses involved, economic considerations do not necessarily always play the most prominent role in space mission design and operation; this is most definitely the case where national security interests are at stake.

## 6 CONCLUSION

Well-designed tiered systems and collective loss-sharing arrangements could prove useful in channelling the risks and ensuring means for adequate compensation in space activities. The first tier could consist of absolute but limited operator/owner liability with compulsory insurance. This could be backed up by supplementary state liability and, ultimately, by an international fund. If the source of damage cannot be identified or fault established, the entire reparation could come from the fund. This would be the case where damage has been caused by unknown space debris, for instance.

Such a system should include clear allocation of the burden of compensation between different stakeholders within a system where the victim of harm can easily identify the entity from which to demand reparation. At best, it could even support preventive measures, instead of providing mere post-disaster compensation.

Although it might not be realistic to expect the space sector to endorse such a progressive approach in the very near future, the experiences from analogous areas of high-risk activities suggest that sooner or later something similar will be needed also for space activities. The more and less functional solutions to similar situations should then be thoroughly examined in order to avoid unnecessary failures.

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<sup>1</sup> Additional problems may derive from the fact that, pursuant to the 1972 Convention on International Liability for Damage Caused by Space Objects (hereinafter Liability Convention), there may be various ‘launching states’ equally liable for compensation, which can, i.a., result in overlapping insurance coverage (see the definition of the term “launching state” in Art. I of the Liability Convention). Convention on International Liability for Damage Caused by Space Objects, adopted 29 November 1971 by UNGA Res. 2777 (XXVI); in force 1 September 1972. 961 UNTS 187, 24 UST 2389, TIAS 7762. <<http://www.unoosa.org/pdf/publications/STSPACE11E.pdf>> [17.9.2009]. All the websites referred to below were last accessed on 17 September 2009 unless otherwise indicated.

<sup>2</sup> Insurance can even represent c. 1/4 of the budget of a space mission. Ravillon 2003, p. 814.

<sup>3</sup> Brunnée 2004, p. 357.

<sup>4</sup> Silva Soares – Vieira Vargas 2003, p. 74.

<sup>5</sup> See Churchill 2003, pp. 35-36. It has been argued, however, that in the modern world such special treatment of a particular industry constitutes no longer justifiable subsidies. Ibid.

<sup>6</sup> Convention on Third Party Liability in the Field of Nuclear Energy, as amended by the additional Protocol of 28th January 1964 and by the Protocol of 16th November 1982. Done 29 July 1960; in force 1 April 1968. <[http://www.nea.fr/html/law/nlparis\\_conv.html](http://www.nea.fr/html/law/nlparis_conv.html)>

<sup>7</sup> Done 21 May 1963; in force 12 November 1977. 1063 UNTS 265, 2 ILM 727 (1963). <<http://www.iaea.org/Publications/Documents/Infcircs/1996/inf500.shtml>>.

<sup>8</sup> 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. Done 31 January 1963; in force 4 December 1974. <<http://www.nea.fr/html/law/nlbrussels.html>>.

<sup>9</sup> The Paris Convention is regional in scope, whereas the Vienna Convention is a global treaty.

<sup>10</sup> Done 21 September 1988; in force 27 April 1992. <[http://www.nea.fr/html/law/nljoint\\_prot.html](http://www.nea.fr/html/law/nljoint_prot.html)>.

<sup>11</sup> Art. II of the Vienna Convention, Art. 3 of the Paris Convention. An exception to this is “damage caused by a nuclear incident directly due to an act of armed conflict, hostilities, civil war, insurrection” or “a grave natural disaster of an exceptional character” (unless the law of the installation state provides to the contrary). Art. IV.3 of the Vienna Convention, Art. 9 of the Paris Convention.

<sup>12</sup> States may also establish by national legislation greater or lesser amounts of operator liability (though not less than five million SDRs; Art. 7.b). Most states have set such national limits. Churchill 2003, p. 8 fn. 18.

<sup>13</sup> Art. 3. 300 million SDRs is currently equal to about 470 million US dollars. For more about the SDR, *see* <<http://www.imf.org/external/np/exr/facts/sdr.htm>>. For the daily USD value of an SDR, *see* <[http://www.imf.org/external/np/fin/data/rms\\_sdrv.aspx](http://www.imf.org/external/np/fin/data/rms_sdrv.aspx)>. The 1997 Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage also sets a 300-million-SDR limit on the operator's liability (Art. 7). Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage. Done 12 September 1997; in force 4 October 2003. 36 ILM 1462 (1997). <<http://www.iaea.org/Publications/Documents/Conventions/protamend.html>>. Although in force, this protocol has thus far gained only few members.

<sup>14</sup> Art. 10 of the Paris Convention, Art. VII of the Vienna Convention. This has resulted in national insurance pools where several insurance companies contribute to cover a small part of the liability of an operator, as the capacity for individual insurers to cover nuclear risks is usually limited. For more details about the operation of such national insurance pools, *see* Vanden Borre 2002, p. 7.

<sup>15</sup> Art. 8 of the Paris Convention, Art. VI of the Vienna Convention. The 10-year period was set because insurance usually is not available for longer. Churchill 2003, p. 9 fn. 23. The 1997 Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage introduced an extended period of 30 years for presenting claims for death and personal injury (Art. 8). This seems quite reasonable, considering for instance that cancers may materialize relatively slowly after the actual exposure to radiation. Churchill 2003, p. 11.

<sup>16</sup> Art. 3.b of the Brussels Supplementary Convention.

<sup>17</sup> Under the Brussels Supplementary Convention, contributions to the international fund are based (50 per cent) on the ratio between the GNP of each state party and the total of the GNPs of all of them for the year preceding the nuclear incident, and (50 per cent) on the ratio between the thermal power of the reactors in the territory of each party and the total thermal power of the reactors sited in all of them (Art. 12.a).

<sup>18</sup> Art. 3.b.iii of the Brussels Supplementary Convention.

<sup>19</sup> *See* Birnie – Boyle 2002, p. 94.

<sup>20</sup> *See* Churchill 2003, pp. 10-11.

<sup>21</sup> Background information note for the Press Communiqué on the revision of the Paris Convention on Nuclear Third Party Liability and of the Brussels Supplementary Convention. Press Communiqué 10 February 2004.

<<http://www.nea.fr/html/general/press/2004/2004-01-note.html>>.

<sup>22</sup> Art. 3. However, a state party may decide to exclude (by national legislation) from the application of the Vienna Convention “damage suffered (...) in the territory of a non-Contracting State; or (...) in any maritime zones established by a non-Contracting State in accordance with the international law of the sea” provided that this non-Contracting State at the time of the nuclear incident “has a nuclear installation in its territory or in any maritime zones established by it in accordance with the international law of the sea; and (...) does not afford equivalent reciprocal benefits” (Art. 3).

<sup>23</sup> Done September 12, 1997; not yet in force. <<http://www.iaea.org/Publications/Documents/Conventions/supcomp.html>>.

<sup>24</sup> However, a state not party to the Paris Convention or the Vienna Convention must have comparable national legislation. If a state has civilian nuclear power plants, it must also be a party to the Convention on Nuclear Safety (Arts. XVIII-XIX). Done 17 June 1994; in force 24 October 1996. 33 ILM 1514 (1994).

<<http://www.iaea.org/Publications/Documents/Infcircs/Others/inf449.shtml>>.

<sup>25</sup> Pursuant to this formula, states would contribute funds in accordance with their nuclear capacity and an amount based on the ratio of their contributions to the UN budget (Art. IV.1).

<sup>26</sup> It has gained only four ratifications (by Argentina, Morocco, Rumania and the USA).

<sup>27</sup> Protocol to amend the convention on third party liability in the field of nuclear energy of 29th July 1960, as amended by the additional protocol of 28th January 1964 and by the protocol of 16th November 1982 (Paris Convention), done 21 February 2004 <[http://www.nea.fr/html/law/paris\\_convention.pdf](http://www.nea.fr/html/law/paris_convention.pdf)> and Protocol to amend the convention of 31st January 1963 Convention of 29th July 1960 on third party liability in the field of nuclear energy, as amended by the additional protocol of 28th January 1964 and by the protocol of 16th November 1982 (Brussels Supplementary Convention), done 21 February 2004. <[http://www.nea.fr/html/law/brussels\\_supplementary\\_convention.pdf](http://www.nea.fr/html/law/brussels_supplementary_convention.pdf)>.

<sup>28</sup> Compare the original Art. 2 of the Paris Convention and the same article as amended by the protocol.

<sup>29</sup> Civil Liability for Nuclear Damage, UIC Nuclear Issues Briefing Paper # 70, May 2006, <<http://www.uic.com.au/nip70.htm>> [19.11.2007]. The 2004 protocol also changed the convention's unit of account to euro, to avoid fluctuations in the value of the SDR (*see* Background information note for the Press Communiqué on the revision of the Paris Convention on Nuclear Third Party Liability and of the Brussels Supplementary Convention, above fn. 21). Furthermore, the protocol altered the shares which provide the basis of joint state contributions to the international fund: 65 per cent based on installed nuclear generating capacity and 35 per cent on the ratio between the GNP of each contracting party and the GNPs of all of them (Art. 12.a).

<sup>30</sup> Done 3 May 1996; not yet in force. 35 ILM 1415 (1996).

<<http://www.jus.uio.no/lm/imo.carriage.by.sea.liability.compensation.damage.connected.to.hazardous.and.noxious.substances.convention.1996/>>.

<sup>31</sup> Art. 14.5. In accordance with this system, liability is shared in the first tier between the ship owner and the receiver of the cargo (Art. 7). Insurance is compulsory (Art. 12). There are sliding-scale limits on liability, depending on the ship tonnage (Art. 9).

<sup>32</sup> For a more detailed account of the convention, *see, e.g.*, Churchill 2003, pp. 21-22; Silva Soares – Vieira Vargas 2003, pp. 82-84.

<sup>33</sup> Done 29 November 1969; in force 19 June 1975. 973 UNTS 3, 9 ILM 45 (1970).

<<http://www.admiraltylawguide.com/conven/civilpol1969.html>>.

<sup>34</sup> Done 18 December 1971; in force 16 October 1978.

1110 UNTS 57, 11 ILM 284 (1972).

<<http://www.admiraltylawguide.com/conven/oilpolfund1971.html>>.

<sup>35</sup> Art. 10 *et seq.* Unlike in the context of nuclear liability, there have been many claims pursued under the international oil pollution liability regime, both against ship owners and the Fund. Churchill 2003, p. 19. For a more detailed treatment of international liability and the fund system in oil pollution, *see, e.g.*, Sands 2003, pp. 912-923. For an informative assessment of conventions concerning liability for pollution from ships, *see* Churchill 2003, pp. 15-22.

<sup>36</sup> Done 10 December 1999; not yet in force. <<http://www.basel.int/meetings/cop/cop5/docs/prot-e.pdf>>.

<sup>37</sup> Again, there is strict liability, balanced by a liability ceiling (Arts. 4, 12; Annex B). Moreover, there is a time limit for claims, either ten years from the incident (Art. 13.1) or five years “from the date the claimant knew or ought reasonably to have known of the damage” (Art. 13.2). Fault liability applies when damage is caused by non-compliance with the Basel Convention or by “wrongful intentional, reckless or negligent acts or omissions” (Art. 4). In such cases also the liability ceilings of the system are not applicable (Art. 12.2). Insurance or other financial security is required (Art. 14). Another very similar system is that provided by the 2003 Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters, which provides for strict operator liability (Art. 4) with liability ceilings (Art. 9 and Annex II) and time-limits for claims (Art. 10), as well as fault liability in case of “wrongful intentional, reckless or negligent acts or omissions” (Art. 5). Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes and to the 1992 Convention on the Transboundary Effects of Industrial Accidents. Done 21 May 2003; not yet in force. <[http://www.unece.org/env/civil-liability/documents/protocol\\_e.pdf](http://www.unece.org/env/civil-liability/documents/protocol_e.pdf)>.

<sup>38</sup> The liability limits are in Annex B.

<sup>39</sup> Art. 15.1. The second paragraph of the article further states that “[t]he Meeting of the Parties shall keep under review the need for and possibility of improving existing mechanisms or establishing new mechanisms”. During the negotiations, developing and developed states were very much in disagreement over the need to establish an international fund for complementing inadequate compensation. The outcome of the disagreement was the obscure Article 15. Silva Soares – Vieira Vargas 2003, p. 94. For a more detailed treatment of the history of the Basel Protocol, *see* *ibid.*

<sup>40</sup> Done 21 June 1993; not yet in force. 32 ILM 1228 (1993).

<<http://conventions.coe.int/Treaty/EN/Treaties/Html/I150.htm>>.

<sup>41</sup> Chapter II. There are exemptions in Art. 8, though.

<sup>42</sup> Churchill 2003, pp. 27-28.

<sup>43</sup> Done 10 October 1989; not yet in force. <[http://www.unece.org/trans/danger/publi/crtd/doc/crtd\\_e.doc](http://www.unece.org/trans/danger/publi/crtd/doc/crtd_e.doc)>.

<sup>44</sup> *See also* Uchitomi 2001, pp. 77-78.

<sup>45</sup> *See* Churchill 2003, p. 36.

<sup>46</sup> For a proposal for a fund which would cover damage caused by unknown debris, *see* Kerrest 2001, p. 870; Greenberg 2003, p. 395; Jasentuliyana 1999, p. 91. The establishment of an international fund to compensate victims of damage caused by space objects has also been suggested in Hurwitz 1992. Some decades ago, a proposal was made for a fund to cover only damage caused by re-entering, unidentifiable space objects impacting the Earth. *See* Dembling – Kalsi 1973, p. 145.

<sup>47</sup> For an assessment of the potential disadvantages of compensation fund systems, *see* de Sadeleer 2002, p. 59; Boyle 1991, p. 363. It should be noted, moreover, that some states have abstained from ratifying the Vienna Convention and Paris Convention examined above, because it may be possible to obtain greater compensation for nuclear damage outside this regime through national legislation. *See* Churchill 2003, pp. 9-10.

<sup>48</sup> *See* *ibid.*, p. 40.

<sup>49</sup> *Ibid.*, pp. 34-35, 37-38.

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<sup>50</sup> They may be in force on a low level of commitment or just between few or relatively irrelevant contracting states. *Ibid.*, p. 32.

<sup>51</sup> One example is the negotiations concerning the 1999 Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal, where private economic interests prevailed over the demands of developing countries concerning a global fund to assist in cleaning waste spills where reparation cannot be obtained from any other entity. *See* Silva Soares – Vieira Vargas 2003, pp. 103-104.

<sup>52</sup> *See, e.g.*, Churchill 2003, p. 32; Brunnée 2004, p. 351.

<sup>53</sup> The challenges in valuing damage seem to become even more problematic if viewed from the perspective of the insurance industry. *See, e.g.*, Report of the 64<sup>th</sup> Conference of the ILA 1991, pp. 178-179.

<sup>54</sup> *See also* Hacket 1994, pp. 173-174. The author concludes that where the creation of considerable amounts of space debris is concerned, the only feasible remedy is financial compensation. Pursuant to Hacket, compensatory payments should be made to those states which “have a vital interest in the contaminated orbital regions”, i.e., states whose existing space activities or those under preparation are hampered by the space debris. *Ibid.*, p. 174.

<sup>55</sup> For instance, it has been proposed in the discussions of the UNCOPUOS that “ways and means to provide technical and economic support” should be explored to alleviate the cost impact that compliance with space debris mitigation measures inevitably has on space operations. *E.g.*, para. 113 of the Report of the Scientific and Technical Subcommittee of the UNCOPUOS on its 43<sup>rd</sup> session, Vienna, 20 February – 3 March 2006. UN Doc. A/AC.105/869. <[http://www.unoosa.org/pdf/reports/ac105/AC105\\_869E.pdf](http://www.unoosa.org/pdf/reports/ac105/AC105_869E.pdf)>. A fund mechanism applicable for preventive purposes could be one option to create such support. A fund system has been proposed also for the removal of obsolete space objects. Report of the 64<sup>th</sup> Conference of the ILA 1991, pp. 176, 178. The costs of such removal are still quite prohibitive, however.

<sup>56</sup> *See* Williamson 2006, p. 270. For a more detailed discussion concerning fund mechanisms, *see* Viikari 2008, pp. 225-230.

<sup>57</sup> de Sadeleer 2002, p. 36.