

A New Liability Regime for the Space Sector – an Economic Imperative

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ABSTRACT

It is not always easy to establish liability pursuant to international law of outer space, yet damages in the space sector can be considerable. The damaging potential of space activities can exceed the capacity of any single space faring entity to make reparation. Absolute and unlimited liability could render the highly hazardous activities uninsurable. Complex causation questions may complicate the situation further. The mere determination of the liable entity can be a problem. Accordingly, allocation of losses within a larger community of relevant entities to balance the competing concerns would seem useful. It could better retain the economic viability of the space sector, yet still secure adequate indemnification for damages. Compensation claims for damage resulting from particularly risky activities should be facilitated, but operators of activities that are deemed necessary yet entail high risks should be shielded from excessive claims. The setting in the space sector seems in many respects similar to that in the use of nuclear power, which also entails significant risks. In this sector, the solutions adopted include, inter alia, 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. There are also certain other examples of international trust fund mechanisms serving very similar purposes which the space sector could draw inspiration from.

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I. INTRODUCTION

Liability for damages in the space sector is problematic in various ways. Firstly, it can already be a challenge to determine the most appropriate (or even any) liable entity or entities. This is partly due to deficiencies in the legal instruments of the international law of outer space. The five U.N. space treaties date back to the 1960s and 1970s; at that time, it was not easy to imagine the needs of the modern space sector in this respect. It can also be difficult to determine the source of damages which take place in outer space, possibly tens of thousands of kilometres from the Earth. In addition, complex causation questions cannot be avoided. Consider, for instance, the problems in attributing damage to particular pieces of space objects and, moreover, the potential cumulative effects of damaging events. 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),² there may be various ‘launching states’ equally liable for compensation.³

² Convention on International Liability for Damage Caused by Space Objects, Nov. 29, 1971, 961 U.N.T.S. 187.

³ The term “launching state” includes “(i) A State which launches or procures the launching of a space object; (ii) A State from whose territory or facility a space object is launched”. See Convention on International Liability for Damage Caused by Space Objects, art. I.c.

The problems related to liability in the space sector are manifold and involve various aspects of law and policy. Some of them have been known for decades, some are of more recent origin. What is common to many of them is that they revolve around questions of significant economic importance. This article focuses on these issues.

In the following pages, the article will first explain, in brief, why an improved liability system increasingly is an economic imperative for the space sector. After that, the current international liability regime pertaining to space activities and its shortcomings are examined. The article will then move to the area of nuclear liability, which could serve as a model for an improved liability regime for the space sector. In addition, some other liability regimes are also examined for the same purpose. Finally, a proposal for a new space liability regime is presented, as well as certain particularly important lessons that the space sector ought to learn from the analogous areas of human activity.

II. WHY DO WE NEED A BETTER LIABILITY SYSTEM FOR SPACE ACTIVITIES?

From an economic point of view, the current international regulation of liability in space activities entails various problems. One of these is the above mentioned fact that, pursuant to the Liability Convention, a single damaging incident may involve several 'launching states' who are equally liable for compensation. This can result in overlapping insurance coverage. Obviously, at least from the point of view of the victim, "too much" insurance is normally better than no insurance at all. However, from the point of view of insurance markets, such a situation is far from desirable. In addition, the extensive definition of a launching state used by the convention can result in rather unfair outcomes in terms of liability. At the same time, however, the definition remains vague enough to complicate in many cases the determination of which states in fact can be seen as constituting liable launching states.

Moreover, the damaging potential of space activities exceeds the capacity of any single space faring entity to make reparation. In particular, if nuclear power sources are used, damage can be considerable. For instance, if

radioactive materials from defunct satellites enter the atmosphere and fall down to densely inhabited areas of the Earth, the consequences can be drastic.⁴ Even in the case of less serious incidents, absolute and unlimited liability (as currently established by the Liability Convention for damages taking place on Earth) would directly raise the costs of space activities and thus limit the development of space industry. It could also render what are inherently highly hazardous activities uninsurable.⁵ Additionally, the victims' well-secured position may occasionally be excessively strong from the perspective of space faring entities.

Where damages occurring in outer space are concerned, the Liability Convention offers a fault liability system. This system entails numerous problems of legal and economic nature which necessitate a more feasible liability regime sooner or later. The current system can result in very high damages also where incidents in outer space are in question. The apportioning of liabilities among different states involved can be complicated and may even lead to unfair or quite haphazard outcomes.

Furthermore, the criteria offered by the Liability Convention for determining compensation are rather ambiguous; so is even the definition of damage that needs to be compensated. Additionally, damage to environment of the global commons, any activity involving a mere risk of damage, as well as damage to nationals of the launching state and foreign nationals participating in the space operation fall completely outside the scope of the current international space liability regime. Even in relatively unequivocal cases of compensable damage proving the fault and/or the causality required can be impossible.

On balance, the space sector needs a clearer, fairer and more rational liability system. Above all, the allocation of losses within a larger community

⁴ Thus far the most famous incident of the type has been the *Cosmos 954* case, where a former USSR nuclear-powered satellite disintegrated over remote northern areas of Canada in 1978. The case was settled by an ad hoc protocol between the two countries in 1981. Protocol between the Government of Canada and the Government of the Union of Soviet Socialist Republics 1981, Apr. 2, 1981, 20 I.L.M. 689. See more below. For a more detailed treatment of the *Cosmos 954* case, see PHILIPPE SANDS, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW, 897-898 (2003).

⁵ Insurance can even represent c. 1/4 of the budget of a space mission. Laurence Ravillon, *Arbitral Disputes in the Space Activities Sector* 7 INT'L BUS. L. J. 801, 814 (2003).

of relevant entities is necessary to balance the competing concerns and retain the economic viability of the space sector, while still securing 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) but entail high risks should be shielded from excessive claims.⁶

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 formulae. This is also called “socialization of risks”.⁷ For instance, limited liability for ship owners in maritime law has existed since at least the 17th century. Such treatment has been justified by the highly dangerous nature of maritime transport and its necessity for society.⁸ 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.

III. CURRENT LIABILITY REGIME OF THE UN SPACE LAW

In principle, the U.N. space treaties provide a party suffering a loss as a result of space activities with a very favourable international liability regime as compared to most other areas of hazardous activities. The general rule, according to Article VI of the Outer Space Treaty,⁹ is that states bear international responsibility for activities in space. Article VII, moreover, establishes international liability of launching states. The launching state is

⁶ Jutta Brunnée, *Of Sense And Sensibility: Reflections On International Liability Regimes As Tools For Environmental Protection* 53 INT'L & COMP. L. Q. 351, 357 (2004).

⁷ Guido Fernando Silva Soares & Everton Vieira Vargas, *The Basel Liability Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wasted and Their Disposal* 12 Y.B. OF INT'L ENVTL. L. 69, 74 (2003).

⁸ See Robin R. Churchill, *Facilitating (Transnational) Civil Liability Litigation for Environmental Damage by Means of Treaties: progress, problems, and prospects*, 12 Y.B. OF INT'L ENVTL. L. 3, 35-36 (2003). It has been argued, however, that in the modern world such special treatment of a particular industry constitutes no longer justifiable subsidies. *Id.*

⁹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, Jan. 27, 1967, 610 U.N.T.S. 205.

liable for damage to another state party or to its natural or juridical persons caused by its space object “or its component parts on the Earth, in air or in outer space, including the Moon and other celestial bodies”. The Liability Convention complements these provisions by setting out more detailed rules for cases of “space damage” involving different states.

First, the Liability Convention establishes two separate regimes of liability: one of absolute liability (without any ceiling) to be applied in the case of damage caused by a space object “on the surface of the Earth or to aircraft flight” (Art. II),¹⁰ and another based on fault liability which applies when the damage occurs in outer space (Art. III).¹¹ All space activities are ultra-hazardous. Therefore it has been deemed appropriate that those engaged in such activities (and gaining profit from them) should also bear the risk of any ensuing damage, whereas possible victims on Earth deserve full compensation. Article V of the Liability Convention improves the possibilities of victims of damage to obtain compensation by establishing joint and several liability of all launching states for joint launches and the right of the victim state to seek the entire compensation from any or all of the launching states.

The intention of the liability regime of all of the U.N. space treaties has indeed been to give a high level of protection to third parties not involved in a space project. Pursuant to the preamble to the Liability Convention, a focal motive for the convention was the “need to elaborate effective international rules and procedures concerning liability for damage caused by space objects and to ensure, in particular, the prompt payment under the terms of this Convention of a full and equitable measure of compensation to victims of

⁹ Pursuant to art. VI, exoneration from absolute liability is to be granted “to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents”, except in cases where the launching state has caused the damage by violating international law. See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, art. VI.

¹⁰ Such inclusion of two parallel systems of liability within a single multilateral convention is quite unusual in international law. Another example is the (not yet in force) Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal, (Dec. 10, 1999) <http://www.basel.int/meetings/cop/cop5/docs/prot-e.pdf>, see art. 4 and art. 5, Silva Soares and Vieira Vargas, *supra* note 7, at 94.

such damage”. As is stated in a document called “Advantages of Adherence to the Convention on International Liability for Damage Caused by Space Objects” (produced by a Working Group on the Status and Application of the Five United Nations Treaties on Outer Space under the Legal Subcommittee of the UNCOPUOS), “[b]y concentrating internationally the concept of absolute or objective and unlimited liability for any damage caused by space objects on the surface of the Earth or to aircraft in flight, the [Liability] Convention has become a unique case and a real novelty in contemporary public international law concerning the protection of victims”.¹²

However, although this system may, by and large, afford victims of space operations considerable protection, it can appear far less just from the point of view of the states involved in the launch of a space object. Firstly, the Liability Convention does not apply at all to “damage caused by a space object of a launching State to: (a) Nationals of that launching State; (b) Foreign nationals during such time as they are participating in the operation of that space object from the time of its launching or at any stage thereafter until its descent, or during such time as they are in the immediate vicinity of a planned launching or recovery area as the result of an invitation by that launching State” (Art. VII). This limitation obviously excludes many of those most likely to suffer damage in case of an accident. Secondly, a major problem in this respect is the overly extensive definition of a launching state. Pursuant to the Liability Convention, “[t]he term ‘launching State’ means: (i) A State which launches or procures the launch of a space object; (ii) A State from whose territory or facility a space object is launched (Art. I.c).¹³ Hence, most launches will involve several launching states, of which only few typically have a real say in the operation of the space mission. Application of the Liability Convention may thus result in liability of states that are in fact little more than “innocent bystanders”.

It may even be complicated to determine which states constitute the launching states under the Liability Convention. Above all, the procurement

¹² *Report of the Legal Subcommittee on the work of its 45th session 2006, held in Vienna from 3 to 13 April 2006*, Annex I, Appendix, para. 3, U.N. Doc. A/AC.105/871 (Apr. 24, 2006).

¹³ Para. 3 of art. V of the Liability Convention further specifies that a state “from whose territory or facility a space object is launched shall be regarded as a participant in a joint launching”. On the concept of launching state, *see also* G.A. Res. 59/115, U.N. Doc. A/RES/59/115 (Jan. 25, 2005).

of the launching of a space object is anything but an unequivocal expression, particularly where space objects launched by private entities are concerned. "Procurement" may be interpreted to include financial backing for a launch, a request by one state to another to launch a satellite of the requester or a private individual or enterprise providing payload for a launch, for instance. Any such link could cause a country to be considered a "launching state". Even state members of an international organization requesting the launch services of some state could be considered states "procuring" the launch of a space object. On the other hand, such activities as supplying minor components to the payload or the sale of a satellite should not be enough to qualify as "procurement".¹⁴ The Liability Convention does not, however, define the concept in detail. Particularly in light of the rapid development of launching technology and privatization of the space sector, the definition of the term "launching state" is increasingly insufficient.¹⁵

Application of the UN space treaties may, thus, result in somewhat questionable outcomes. The Liability Convention also regulates situations where damage is caused "elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, and of damage thereby being caused to a third State or to its natural or juridical persons", in which case "the first two States shall be jointly and severally liable to the third State" (Art. IV.1). In principle, this means that, for instance, if a piece of space debris hits a spacecraft of another state and this causes further damage to a third state, both the launching state of the debris (where its identity can be established) and that of the ("innocent") spacecraft damaged by it are jointly and severally liable for possible damage to any other states. In the case of damage which occurs in outer space, fault liability applies (Art. IV.1.b),

¹⁴ Carl Q. Christol, *Protection of the Space Environment - Debris and Power Sources in THE USE OF AIRSPACE AND OUTER SPACE FOR ALL MANKIND IN THE 21ST CENTURY - PROC. OF THE INT'L CONF. ON AIR TRANSPORT & SPACE APPLICATION IN A NEW WORLD* 253, 271-272 (1993).

¹⁵ *Review of the Status of the Five International Legal Instruments Governing Outer Space*, para. 11.c, Working paper submitted by Germany on behalf of Austria, Belgium, Czech Republic, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland, UNCOPUOS Legal Subcommittee 37th session, Mar. 23 - Apr. 3, 1998, U.N. Doc. A/AC.105/C.2/L.211/Rev.1 (March 30, 1998).

whereas for damage on Earth (or to aircraft in flight) liability is absolute (Art. IV.1.a). If a spacecraft with a nuclear power source (NPS) is involved and parts of it fall back to Earth, the damage may be very grave and the ensuing absolute liability accordingly significant. Moreover, the victims are allowed to ask for full compensation from any one of the liable states, who are then to apportion it between themselves according to fault (Art. IV.2). Consequently, if there is no fault on behalf of the launching state of the NPS-equipped spacecraft but only on the part of the launching state of the piece of debris (no matter how small that piece is), the latter is to pay all of the compensation pursuant to the Liability Convention.¹⁶ Even in such a case, the victims of damage on Earth can, on the other hand, legitimately demand the entire compensation from the innocent state, which may eventually encounter difficulties in collecting it from the state at fault (despite its undeniable right to do so pursuant to the Liability Convention).

As concerns the amount of reparation for damage, Article XII provides that compensation for harm caused by space activities shall “provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred”. This standard could result in very high damages, particularly in the case of harm to the health or lives of people. On the other hand, the very general reference in Article XII to “international law and the principles of justice and equity” for determining the compensation is open to a variety of interpretations. The preamble to the Liability Convention states equally ambiguously that the payment should be “a full and equitable measure of compensation”. Damage is, moreover, only compensable if it results in “loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations” (Art. I.a). This excludes any damage to the environment itself, whether occurring in outer space or on Earth in areas outside the national sovereignty of states. Hence, a potential polluter does

¹⁶ This illustrative example has been presented by Armel Kerrest, *Space Debris, Remarks on Current Legal Issues* PROC. OF THE THIRD EUROPEAN CONF. ON SPACE DEBRIS 869, 870-871 (2001). The author suggests that liability rules should be amended so as to avoid outcomes where damage resulting from nuclear pollution is not compensated by the user of the NPS. *Id.* at 873.

not need to worry much about environmental losses, even when they can affect the environment significantly, as long as there is no damage to “foreign” property or persons. As mentioned above, the Liability Convention also restricts its scope by excluding damage caused to citizens of the same country which launched the space object in question, as well as to foreign nationals participating in that space operation (Art. VII). Furthermore, under Article III, persons (as well as property) must be on board a space object in order to recover damages, a condition which in principle would, for instance, exclude incidents in which astronauts engaged in extravehicular activities are killed.

It is also questionable whether the Liability Convention’s “damage” actually covers anything but clearly material damage. If it is interpreted to include only strictly material damage, instances like interference caused by telecommunication satellites to space activities of others would, at worst, not fall under the scope of the Liability Convention’s provisions at all.¹⁷ Moreover, the ambiguous terminology of the Liability Convention can even be interpreted to exclude all damages caused by space debris: it applies to damage “caused by a space object” and the only definition Article 1.d gives for a space object is that it includes “component parts of a space object as well as its launch vehicle and parts thereof”. Such a definition is very vague, being nearly no definition at all. This provision appears to refer to space objects that are entire units, extending at most to component parts (also unitary) thereof.¹⁸ There seems to be no great difficulty in designating inactive satellites as well “space objects”. The situation gets most complicated in the case of little pieces of debris, as one can argue that such an item constitutes neither a space object nor a component part of one (nor a launch vehicle or a part thereof). It seems especially debatable whether a piece of fragmentation debris and micro-particulate matter can be regarded as a “space object” or a “component part”. Even less clear is the situation with other types of pollution

¹⁷ See Carl Q. Christol, *Protection of Space from Environmental Harms* 4 ANNALS OF AIR & SPACE L. 433, 447-450 (1979).

¹⁸ The provision has even been interpreted as dealing with not only entire but preferably fully operating units, i.e., “functioning unitary entities”. Christol, *supra* note 14, at 256. (According to the author, harms produced by space debris nevertheless invoke liability under the existing treaty regime. *Id.*)

and contamination, including space mission litter. Questions have also been presented regarding the legal status of rockets that never reach outer space, for instance, due to a launch failure.¹⁹

However, if space debris does not qualify as a space object for the purposes of the Liability Convention, the instrument becomes largely meaningless in establishing liability for space activities. The most common and hazardous form of potential damage related to space activities would then fall wholly outside the scope of any international legal regulation.²⁰ Consequently, it has been argued that “anything which has been launched into outer space whatever its size” qualifies as a “space object”.²¹ Alternatively, space debris can even be regarded as a “component part” of a space object.²² Such a practical approach with a focus on safety and environmental concerns – by considering space debris as constituting either a space object or at least a component part of it – seems to be the only feasible interpretation given the hazards space debris poses today.²³ The question of a legal distinction between a valuable spacecraft and worthless space debris obviously still requires serious consideration. If space debris should be defined as a space object under the U.N. space treaties, it has been recommended that an additional protocol be elaborated for determining exactly which provisions of the space treaties apply to space

¹⁹ Howard A. Baker, *Liability for Damage Caused in Outer Space by Space Refuse* 13 ANNALS OF A. & SPACE L. 183, 209 (1988). It has been pointed out that if an object simply ceases to be functional, this should have no influence on its legal status. The fact that even an attempted launch qualifies as “launching” under the Liability Convention (art. I.b) also seems to support the conclusion. See GEORGE T. HACKET, FORUM FOR AIR AND SPACE LAW VOLUME 2: SPACE DEBRIS AND THE CORPUS IURIS SPATIALIS 58 (Marietta Benkö & Willem de Graaff eds., 1994).

²⁰ On technical aspects of space debris in more detail, see LOTTI VIHKARI, THE ENVIRONMENTAL ELEMENT IN SPACE LAW: ASSESSING THE PRESENT AND CHARTING THE FUTURE 31-45 (2008).

²¹ See Kerrest, *supra* note 16, at 870 and 873 footnote 1. See also the *European Code of Conduct for Space Debris Mitigation*, (June 28, 2004) <http://www.stimson.org/wos/pdf/eurocode.pdf>. The Code of Conduct defines *space debris* as “[a]ny man made space object including fragments and elements thereof, in Earth orbit or re-entering the Earth’s atmosphere, that is non-functional”, and *space object* as “[a]ny man-made space system and any of its components or fragments” The *Code of Conduct*, *ibid.* at 13-14.

²² This is the position taken in *The Report of the ESA Space Debris Working Group* 67 (Nov. 1988).

²³ One explanation presented for the lack of a substantive definition of the term “space object” in the Liability Convention (and other UN space treaties) is that there was a common understanding of the meaning of the term at the time these instruments were drafted. See HACKET, *supra* note 19, at 56-57. For a discussion concerning the notions “damage” and “space object” in UN space treaties, see, e.g., *Report of the 64th Conference of the ILA* 164-167 (1991).

debris and which to valuable space objects. If space debris is not deemed to be a space object, the protocol could determine when it is perhaps permissible to remove or re-orbit space debris in order to prevent collisions or close encounters with functional spacecraft.²⁴

Regardless of the interpretation of “space object”, mere activity involving a risk of damage, no matter how hazardous, can never result in liability under the provisions of the U.N. space treaties. Moreover, even in cases of indisputable material damage, proving the fault and the causality required is often an insurmountable obstacle. For instance, even if debris particles of all sizes were included in the legal definition of a “space object”, great practical difficulties would remain in establishing liability of the launching state. In most cases, it is almost impossible to prove in a given case that the damage was even caused by space debris, that a particular piece of debris is part of a registered space object of a certain state and, furthermore, that there exists such fault (when the incident takes place in outer space) on the part of the launching state that it can be held liable for the damage.²⁵ More generally, there are obvious difficulties involved in establishing any fault when standards of conduct for handling the environmental hazards of space activities have yet to be adopted.²⁶ This seems problematic particularly in the case of damage caused by space debris. Moreover, it is very difficult, if not impossible, to ascertain what kind of damage certain debris can cause, let alone when a particular form of damage will occur. Even where some kind of a prediction of a possible collision can be made, there rarely exists any possibility of carrying out manoeuvres to avoid it. Not surprisingly, the rationale for fault-based liability for damage caused in outer space has been frequently questioned.²⁷

Thus far the only claim that has ever been presented under the Liability Convention has been that of Canada in the *Cosmos 954* case, where a former

²⁴ See INTERNATIONAL ACADEMY OF ASTRONAUTICS, *COSMIC STUDY ON SPACE TRAFFIC MANAGEMENT* 15 (Corinne Contant-Jorgenson, Petr Lála & Kai-Uwe Schrogl eds., 2006).

²⁵ The situation is typically less complicated where damage is caused by space debris falling down to Earth: there is no need to establish fault because the absolute liability regime applies and, moreover, objects that are capable of entering the Earth atmosphere tend to be large and heavy and thus more likely to be identifiable. See Kerrest, *supra* note 16, at 870.

²⁶ Nicolas M. Matte, *Environmental Implications and Responsibilities in the Use of Outer Space* 14 ANNALS OF AIR & SPACE L. 419, 435 (1989).

²⁷ *E.g.*, Baker, *supra* note 19, at 214-215; HACKET, *supra* note 19, at 211-212.

USSR nuclear-powered satellite disintegrated over remote northern areas of Canada in 1978. The Canadian claim for some 6 million Canadian dollars was based on the Liability Convention, the Outer Space Treaty and general principles of international law.²⁸ It covered, *inter alia*, the costs of restoring the territory rendered partly unfit for use by radioactive debris scattered over large areas, hence constituting damage to property within the meaning of the Liability Convention.²⁹ Canada also reserved the right to present additional claims, e.g., for compensation for the costs of establishing a Compensation Commission under the Liability Convention. Eventually, however, the dispute was not resolved by invoking the Liability Convention but by a protocol between the two states in 1981.³⁰ The Soviet Union agreed to pay 3 million Canadian dollars “in full and final compensation” which Canada in turn accepted “in full and final settlement of its claim”.³¹ However, the *Cosmos 954* case provides an interesting precedent in one important respect concerning the interpretation of the Liability Convention: at least in this incident “space debris” was evidently considered a “space object” as it sufficed, in the light of the initial Canadian claim, to establish liability under the Liability Convention.³² On the other hand, it can be argued that the case only supports the conclusion that particularly hazardous (radioactive) space debris constitutes a “space object” under the UN space law. Besides, the Soviet Union never officially admitted liability.³³

IV. NUCLEAR LIABILITY

As has been explained above, the current international space liability system as established by the UN Liability Convention is far from satisfactory.

²⁸ *Statement of the Canadian Claim*, paras. 14-24, 18 I. L. M. 899 (1979).

²⁹ The total costs of the Canadian government were apparently much higher, however (some 14 million Canadian dollars); what is more, the US helped with the cleanup operations. Jason Reiskind, *Toward a Responsible Use of Nuclear Power in Outer Space: the Canadian initiative in the United Nations* 6 ANNALS OF AIR & SPACE L. 461, 463 (1981).

³⁰ *Supra* note 4.

³¹ For a more detailed treatment of the *Cosmos 954* case, see SANDS, *supra* note 4, at 897-898.

³² However, the Soviet Union never officially admitted liability and the dispute was ultimately not resolved by invoking the Liability Convention. Besides, it can be argued that the case only supports the conclusion that particularly hazardous (radioactive) space debris constitutes a “space object” under the UN space law. Baker, *supra* note 19, at 211-213.

³³ Baker, *supra* note 19, at 211-213.

There is no question about whether it needs to be improved or not – the question is merely how long we can afford to live without a better system. Thus far the space sector has been spared of considerable damaging incidents but as soon as a major accident necessitating a feasible space liability system occurs, we will most likely be in trouble in terms of liabilities. Creating a better space liability system may not be an easy task, yet an imperative one. It would be wise to try to learn from the solutions of similar areas of human activity while we still have time. The setting in the space sector seems, in many respects, similar in particular to that in the use of nuclear power, which also entails significant risks. There the solutions adopted include 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 Energy³⁴ of 1960 and the IAEA's Vienna Convention on Civil Liability for Nuclear Damage³⁵ of 1963, the former of which was strengthened by the Brussels Supplementary Convention³⁶ in 1963. These were the first treaties to facilitate international civil liability claims for environmentally harmful activities.³⁷ 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 Convention³⁸ 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

³⁴ 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, July 29, 1960, 956 U.N.T.S. 264.

³⁵ Convention on Civil Liability for Nuclear Damage, May 21, 1963, 1063 U.N.T.S. 265.

³⁶ 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, Jan. 31, 1963, 1041 U.N.T.S. 358.

³⁷ The Paris Convention is regional in scope, whereas the Vienna Convention is a global treaty.

³⁸ Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, Sept. 21, 1988, 1456 U.N.T.S. 101.

of the operator of a nuclear installation, whereby there is no need to prove fault or negligence.³⁹ 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 defined by the International Monetary Fund),⁴⁰ which was increased by the Brussels Supplementary Convention up to 300 million SDRs (Art. 3).⁴¹ In order to secure indemnification for damages, the operator is required to maintain insurance (or other form of financial security) covering its liability.⁴² 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.⁴³ 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.⁴⁴ The 10-year period was set because insurance usually is not available for longer.⁴⁵ A 1997 Protocol to Amend the Vienna Convention on Civil Liability

³⁹ See the Vienna Convention, art. II and the Paris Convention, art. 3. 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). See the Vienna Convention, art. IV.3 and the Paris Convention, art. 9.

⁴⁰ 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, *supra* note 8, at 8.

⁴¹ 300 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. 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. See Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, Sept. 12, 1997, 36 I.L.M. 1462 (1997), art. 7.

⁴² See the Paris Convention, art. 10 and the Vienna Convention, art. VIII.

⁴³ For more details about the operation of such national insurance pools, see Tom Vanden Borre, *Are nuclear operators liable and insured in case of an Act of Terrorism on a Nuclear Installation or Shipment? Rethinking Nuclear Energy and Democracy after 09/11*, Presented at a Symposium organized by PSR/IPPNW in Switzerland (2002), http://www.ippnw.ch/content/pdf/Sympo_26042002/VandenBorre.pdf.

⁴⁴ See the Paris Convention, art. 8 and the Vienna Convention, art. VI.

⁴⁵ Churchill, *supra* note 8, at 9.

for Nuclear Damage (see more below) 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.⁴⁶

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.⁴⁷ 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).⁴⁸ 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).⁴⁹ 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.⁵⁰

The system of the Vienna and Paris Conventions met with criticism for its failure to cover purely environmental damage, for instance.⁵¹ 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

⁴⁶ Churchill, *supra* note 8, at 11.

⁴⁷ See the Brussels Supplementary Convention, art. 3.b.

⁴⁸ Under the Brussels Supplementary Convention, contributions to the international fund are based (50 per cent) on the ratio between the GNP of each states 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).

⁴⁹ See the Brussels Supplementary Convention, art. 3.b.iii.

⁵⁰ See PATRICIA W. BIRNIE & ALAN E. BOYLE, *INTERNATIONAL LAW & THE ENVIRONMENT* 94 (2002).

⁵¹ See Churchill, *supra* note 8, at 10-11.

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.⁵² 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” (Art. 3).⁵³ However, although in force, this protocol has thus far gained only five members.⁵⁴

In 1997, another instrument dealing with compensation, the Convention on Supplementary Compensation for Nuclear Damage⁵⁵ 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).⁵⁶ It presents, for instance, a new formula (building upon the 1963 Brussels Supplementary Convention) for joint state contributions to the retrospective

⁵² *Nuclear Energy Agency, 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 (Feb. 10, 2004), <http://www.nea.fr/html/general/press/2004/2004-01-note.html>.

⁵³ 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).

⁵⁴ The ratifying states are Argentina, Belarus, Latvia, Morocco and Rumania. In addition there are 10 other signatory states.

⁵⁵ Convention on Supplementary Compensation for Nuclear Damage, Sept. 12, 1997, <http://www.iaea.org/Publications/Documents/Conventions/supcomp.html> (not yet in force).

⁵⁶ 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 see arts. XVIII-XIX, June 17, 1994, 33 I.L.M. 1514 (1994).

international fund for amending nuclear accidents.⁵⁷ Pursuant to the 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). However, this convention is not yet in force.⁵⁸

In 2004, the contracting parties to the Paris and Brussels Conventions signed protocols⁵⁹ 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 trans-boundary implications.⁶⁰

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

⁵⁷ 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).

⁵⁸ It has gained only four ratifications (by Argentina, Morocco, Rumania and the USA).

⁵⁹ 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, the Paris Convention, Feb. 21, 2004, 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), Feb. 21, 2004, http://www.nea.fr/html/law/brussels_supplementary_convention.pdf.

⁶⁰ Compare the original art. 2 of the Paris Convention and the same article as amended by the protocol.

will cover any damage in excess of the 1.5 billion Euros.⁶¹ The 2004 protocol also changed the convention's unit of account to Euro, to avoid fluctuations in the value of the SDR.⁶²

V. OTHER LIABILITY REGIMES

Another interesting precedent for the space sector 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,⁶³ 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.⁶⁴ 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.⁶⁵

A related system is that established by the International Convention on Civil Liability for Oil Pollution Damage⁶⁶ and the complementary International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage,⁶⁷ 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 (Art. 10 *et seq.*). Unlike in the context of nuclear liability, there have been many claims pursued under

⁶¹ Uranium Information Centre, *Civil Liability for Nuclear Damage*, UIC Nuclear Issues Briefing Paper # 70 (May 2006), <http://www.uic.com.au/nip70.htm>.

⁶² See *Nuclear Energy Agency*, *supra* note 52. 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).

⁶³ Convention on Liability and Compensation for Damages in Connection with the Carriage of Hazardous and Noxious Substances by Sea, May 3, 1996 (not yet in force), 35 I.L.M. 1415 (1996).

⁶⁴ 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).

⁶⁵ For a more detailed account of the convention, see, e.g., Churchill, *supra* note 8, at 21-22; Silva Soares & Vieira Vargas, *supra* note 7, at 82-84.

⁶⁶ Convention on Civil Liability for Oil Pollution Damage, Nov. 29, 1969, 973 U.N.T.S. 3.

⁶⁷ Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Dec. 18, 1971, 1110 U.N.T.S. 57.

the international oil pollution liability regime, both against ship owners and the Fund.⁶⁸

One more example is the Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal,⁶⁹ which also has yet to enter into force. 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).⁷⁰ The system 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;⁷¹ 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” (Art. 15.1), with these including the Technical Co-operation Trust Fund. 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

⁶⁸ Churchill, *supra* note 8, at 19. For a more detailed treatment of international liability and the fund system in oil pollution, see, e.g., SANDS, *supra* note 4, at 912-923. For an informative assessment of conventions concerning liability for pollution from ships, see Churchill, *supra* note 8, at 15-22.

⁶⁹ Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal, Dec. 10, 1999 (not yet in force), <http://www.basel.int/meetings/cop/cop5/docs/prot-e.pdf>.

⁷⁰ 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, May 21, 2003 (not yet in force), available at http://www.unece.org/env/civil-liability/documents/protocol_e.pdf.

⁷¹ The liability limits are in Annex B.

mechanisms or establishing new mechanisms". During the negotiations, developing and developed states were in disagreement over the need to establish an international fund for complementing inadequate compensation. The outcome of the disagreement was the obscure Article 15.⁷²

The channelling of liability directly to the actual operators has often encountered resistance. An example set in another context is the 1993 Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment (Lugano Convention),⁷³ which was negotiated under the auspices of the Council of Europe. The Lugano Convention applies generally to all potentially environmentally harmful activities and envisages, in principle, strict and unlimited liability of operators.⁷⁴ In order to secure compensation, it 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.⁷⁵ Nevertheless, the convention has not managed to receive even the three ratifications required for it to enter into force (Art. 32.3).

One more 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.⁷⁶ 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.

⁷² Silva Soares & Vieira Vargas, *supra* note 7, at 94. For a more detailed treatment of the history of the Basel Protocol, *see id.*

⁷³ Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment, June 21, 1993 (not yet in force), 32 I.L.M. 1228 (1993).

⁷⁴ Chapter II. There are exemptions in art. 8, though.

⁷⁵ Churchill, *supra* note 8, at 27-28.

⁷⁶ Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels, Oct. 10, 1989, http://www.unece.org/trans/danger/publi/crtd/doc/crtd_e.doc (not yet in force).

VI. A PROPOSAL FOR AN IMPROVED SPACE LIABILITY REGIME

Given the potential for massive adverse impacts caused by space activities, this sector would need feasible and functional risk management just as the other areas of human activity entailing risks of similar severity. This should include clear allocation of the burden of compensation between private and governmental stakeholders within a system where the victim of harm can easily, and without excessive cost, identify the entity from which to demand reparation in the first instance. From the point of view of anyone suffering damage the latter is essential; from the point of view of the space industry, the former.

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; the polluter-pays principle does not work very well in the space sector. The reasons have been explained above in more detail. They include the problems of potentially very high damages, as well as questions of proof and establishing fault (when damages taking place in outer space are concerned). 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 interests of the various stakeholders in the space sector 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.⁷⁷ When designing such a system, one needs to keep in mind the developing countries' demand that it is the space faring 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. A system which does not appear fair both internationally and nationally would be unable to create much incentive to comply with the rules.

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

⁷⁷ Motoko Uchitomi, *Sustainable Development in Outer Space - applicability of the concept of sustainable development to space debris problems* PROC. OF THE FORTY THIRD COLLOQUIUM ON THE L. OF OUTER SPACE 71, 77-78 (2000).

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 discourage damage prevention as liability is covered by insurance in any case. On the other hand, if the safety record and practices of operators directly affected the terms of insurance, this would encourage (or even require) them to act more cautiously.⁷⁸ 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. Again, perceived fairness is essential.

In cases where the liable entity remains unknown, the entire reparation for damage should come from the international fund. This would be very useful where damage caused by debris that cannot be traced back to any launching state is concerned, for instance.⁷⁹ With the compensation fund as

⁷⁸ See Churchill, *supra* note 8, at 36.

⁷⁹ For a proposal for a fund which would cover damage caused by unknown debris, see Kerrest, *supra* note 16, at 870; JOEL S. GREENBERG, ECONOMIC PRINCIPLES APPLIED TO SPACE INDUSTRY DECISION 395 (2003); Nandasiri Jasentuliyana, *Strengthening International Space Law: the role of the United Nations* PROC. OF THE THIRD ECSL COLLOQUIUM ON INT'L ORGANISATIONS AND SPACE L. 87, 91 (1999). 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 Paul G. Dembling & Swadesh S. Kalsi, *Pollution of Man's Last Frontier: Adequacy of Present Space Environmental Law in Preserving the Resource of Outer Space*, XX NEDERLANDS TIJDSCHRIFT VOOR INTERNATIONAAL RECHT 125, 145 (1973). The establishment of an international fund to compensate victims of damage caused by space objects has also been suggested in Bruce A. Hurwitz, *An International Compensation Fund for Damage Caused by Space Objects* PROC. OF THE THIRTY-FOURTH COLLOQUIUM ON THE LAW OF OUTER SPACE 201 (1992).

only the last resort, disadvantages related to such funds, e.g., a diminished preventive effect, are also minimized.⁸⁰ In addition to state resources, the international fund could be augmented also by the space industry.⁸¹

VII. LESSONS TO LEARN

In addition to utilizing liability regimes of areas similar to the space sector as technical models when designing a new space liability regime it is, however, of utmost importance that also the shortcomings of the other liability systems are thoroughly examined. 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.⁸² Causality presents a considerable challenge for any space-related liability regime as well.

Nevertheless, in practice, 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. As explained above, a fund could be harnessed for providing compensation even in cases where the source of damage cannot be identified or fault established.

⁸⁰ For an assessment of the potential disadvantages of compensation fund systems, see NICOLAS DE SADELEER, *ENVIRONMENTAL PRINCIPLES: FROM POLITICAL SLOGANS TO LEGAL RULES* 59 (2002); Alan E. Boyle, *Making the Polluter Pay? Alternatives to State Responsibility in the Allocation of Transboundary Environmental Costs*, in *INTERNATIONAL RESPONSIBILITY FOR ENVIRONMENTAL HARM* 363, 363 (Francesco Francioni & Tullio Scovazzi eds., 1991). 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, *supra* note 8, at 9-10.

⁸¹ Churchill, *supra* note 8, at 40.

⁸² Churchill, *supra* note 8, at 34-35, 37-38.

However, a fund cannot operate without funds. Accordingly, the space faring nations might not be too receptive to such ideas 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. A liability system which is in force on a low level of commitment or just between few or relatively irrelevant contracting states can be worse than no liability system at all. At least it is likely to remain of little consequence.

In practice, the industrialized states have succeeded in furthering their agendas while the priorities of less developed states have been largely ignored. One example is the negotiation 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.⁸³ 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 in fact been seriously questioned.⁸⁴

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. The challenges in valuing damage seem to become even more problematic if viewed from the perspective of the insurance industry.⁸⁵

⁸³ See Silva Soares & Vieira Vargas, *supra* note 7, at 103-104.

⁸⁴ See, e.g., Churchill, *supra* note 8, at 32; Brunnée, *supra* note 6, at 351.

⁸⁵ *Report of the 64th Conference of the ILA 1991*, *supra* note 23, at 178-179.

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.

On balance, it would clearly be far more effective to prevent damage altogether, all the more so as there does not 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. In particular in cases of creation of considerable amounts of space debris, the only feasible remedy at the moment is financial compensation. The next problematic question would then be to whom such compensation ought to be directed as outer space is a completely international area. One suggestion has been to make compensatory payments 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.⁸⁶ However, the identification of such states and the allocation of payments might not be an easy task either.

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. 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.⁸⁷ A fund mechanism applicable for preventive

⁸⁶ See HACKET, *supra* note 19, at 173-174.

⁸⁷ *E.g.*, para. 113 of the *Report of the Scientific and Technical Subcommittee of the UNCOPUOS on its 43rd session*, Vienna, Feb. 20 – March 3, 2006, U.N. Doc. A/AC.105/869 (March 16, 2006).

purposes could be one option to create such support. A fund mechanism seems practical also because it could provide a relatively effective anticipatory way to secure the availability of assets when needed.⁸⁸ A fund system has been proposed even for the removal of obsolete space objects which obviously would greatly diminish the risk of damaging accidents.⁸⁹ The costs of such removal are still quite prohibitive, however.

However, the application of economic mechanisms for controlling space activities might prove infeasible also due to the fact that these 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.⁹⁰ 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. Given the high risks involved, this could prevent space activities altogether. Economic instruments may even be used for penalizing undesirable behaviour by levying charges which are substantially higher than the costs that the behaviour 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.

VIII. CONCLUSION

The amount of space activities is rising steeply. It seems to be only a matter of time when this sector also will, in practice, need a feasible regime

⁸⁸ See MARK WILLIAMSON, *SPACE: THE FRAGILE FRONTIER* 270 (2006). For a more detailed discussion concerning fund mechanisms, see VIKARI, *supra* note 20, at 225-230.

⁸⁹ *Report of the 64th Conference of the ILA 1991*, *supra* note 23, at 176, 178.

⁹⁰ DE SADELEER, *supra* note 80, at 36.

for the allocation of liabilities. The current liability system established by the U.N. space treaties is quite outdated and will hardly be able to satisfy the space sector for much longer. Although it provides the victim of damage a relatively secure position, liabilities may be allocated somewhat randomly. Economic risks for space actors are excessive. In many cases even securing damages for the victims can be difficult, if not impossible.

This article has proposed a novel approach drawing on international liability systems of similar areas of high-risk activities. Well-designed tiered systems and collective loss-sharing arrangements could prove useful in channelling the risks and ensuring means for adequate compensation in the space sector. 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 cannot be 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 also be needed for space activities. Otherwise space activities will one day no longer be economically feasible. Solutions adopted for similar situations in other fields of human activity should therefore be thoroughly examined in order to avoid unnecessary failures in regulating space liabilities.