Volume 6 Number 1 2006

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# Examples of space damages in the light of international space law

**Abstract:** The issue of liability arising to third parties as a result of space activities, has been discussed by academics for nearly fifty years.[1] It has however had a limited practical implications, due to the very few events where third party damage has been sustained. When disaster strikes third parties as well as those directly involved are financially affected. This article considers how these issues are treated under international law. Basic rules of international space law were mentioned, with a special emphasis put on liability issues. Several examples of space accidence and submitted claims were shown.

**Keywords**: international space law; third party liability, space activity, space damage.
**JEL codes**: G 22, K13, K 33.

## 1. Introduction

Space flights have become common. In spite of this, that kind of activity can be risky, because there are quite a lot of accidents. Not only the owners of very expensive space equipment but also third parties suffer the effects of these accidents. The aim of this paper is to consider how issues of legal liability for space damage are identified by international law.

As a part of discussion, it was necessary to define the term "international space law" and to present its basic acts and principles. A special emphasis was put on the analysis of issues connected with legal responsibility under international space law. To illustrate the problem numerous examples of space accidents were described.

As space activities until recently have almost exclusively been a state sponsored enterprise, on occasions where damage was sustained within national boundaries, these events were considered to be purely domestic matters, dealt with by governments and generally without recourse to any form of insurance. There are only a couple of well publicized claims of third party liability caused by space objects.

[1] The "First Colloquium on the Law of Outer Space" took place in Hague in 1958.

This situation may however be changing due to the increased number of launches. An additional cause for an increase in third party claims which has already come to light is that due to the break-up of the Soviet Union, you will now get claims between sovereign states. Previously any damage would have been addressed to the Soviet central government. Moreover, republics within current Russian Federation are also increasingly vocal regarding damages sustained from space objects[2].

## 2. Genesis of international space law

The basic laws of celestial mechanics – a knowledge of which was a prerequisite of conquering space – had already been established in the 16th and 17th centuries, thanks to the revolutionary work of Copernicus, Kepler and Newton. It was only in the 20th century that technology needed to overcome the earth's gravitational force was developed. However, apart from technology we also do need the law.

In accordance with the basic principles of international civil law, liability is based in the first place on the laws of the country on whose territory the damage occurs (*lex loci delicti*) (e.g.: American Commercial Space Launch Act, German Air Traffic Act, Russian Law of Space Activity). If, however, the space object causing damage in one country originated in another country, litigation may turn out to be extremely laborious. This is because civil law claims may be very difficult to assert for a variety of reasons, e.g. limits of indemnity, problems with regard to the onus of proof, inequality in terms of the strength of the parties involved, and the difficulty of getting court decisions executed. Because of these shortcomings, special rules on liability were established by the United Nations (Meredith, Robinson, 1992, p. 7; Pino, 1991, pp. 175-6).

But the road to establish international regime was quite long. In the late 50's of the previous century an academic debate began as to liability for third party damage caused by space activities. In 1962 US delegates raised the need for liability regime before the UN Outer Space Committee, Legal Sub-Committee. It was because of the event of 5th September 1962, when a 3-kilogram metal object landed on the street in Manitowoc, Wisconsin, and the Unites States believed it to have been from Sputnik 4, launched by the Russians in 1960. Unfortunately, the Soviet Union showed little interest in preparing a draft instrument as they considered that liability would arise in accordance with international law.

The principle that the State bears international responsibility for national activities in outer space and that each State which launches or procures the launching of an object into outer space is internationally liable for damage sustained on

[2] See section 5.

earth, in airspace or in outer space, was set out in the 1963 Declaration on the Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space. These were subsequently incorporated subject to minor textual adjustment into "Outer Space Treaty 1967" (Schmid, 2000) that initiated the origin of International Space Law.

Space law can be described as the body of law applicable to and governing space-related activities. The term "space law" is most often associated with the rules, principles and standards of international law appearing in five international treaties and five sets of principles governing outer space which have been elaborated under the auspices of the United Nations Organization. However, space law also includes international agreements, treaties, conventions, rules and regulations of international organizations (e.g. the International Telecommunications Union), national laws, rules and regulations, executive and administrative orders, and judicial decisions (Grzegorczyk, 1973, p. 7).

## 3. Major acts of international space law

The launching of the first artificial earth satellite – Sputnik 1 – on 4th October 1957 changed the way in which the discussion on the legal regulation of space activities was dealt with in university circles, as no longer was it purely treated as an academic extension of the established body of air law, but took on a relevancy which had previously been absent. In connection with the specificity of space activity and its "over-territorial" character, it was decided that the responsibility for damage should be regulated by international law. From the late 1960s a series of five treaties and conventions were agreed that covered the exploration of space and the legal ramifications for events on the ground:

- The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty", adopted by the General Assembly in its resolution 2222 (XXI)), opened for signature on 27 January 1967, entered into force on 10 October 1967; 98 ratifications and 27 signatures (as of 1 January 2005);
- The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement", adopted by the General Assembly in its resolution 2345 (XXII)), opened for signature on 22 April 1968, entered into force on 3 December 1968; 88 ratifications, 25 signatures, and 1 acceptance of rights and obligations (as of 1 January 2005);
- The Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention", adopted by the General Assembly in its resolution 2777 (XXVI)), opened for signature on 29 March 1972, entered into force on

1 September 1972; 82 ratifications, 25 signatures, and 2 acceptances of rights and obligations (as of 1 January 2005);

- The Convention on Registration of Objects Launched into Outer Space (the "Registration Convention", adopted by the General Assembly in its resolution 3235 (XXIX)), opened for signature on 14 January 1975, entered into force on 15 September 1976; 45 ratifications, 4 signatures, and 2 acceptances of rights and obligations (as of 1 January 2005);
- The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement", adopted by the General Assembly in its resolution 34/68), opened for signature on 18 December 1979, entered into force on 11 July 1984; 11 ratifications and 5 signatures (as of 1 January 2005).

The international legal principles in these five treaties provide for non-appropriation of outer space by any one country, arms control, freedom of exploration, liability for damages caused by space objects, safety and rescue of spacecraft and astronauts, prevention of harmful interference with space activities and the environment, notification and registration of space activities, scientific investigation and exploitation of natural resources in outer space as well as settlement of disputes. Each of the treaties lays great stress on the notion that the domain of outer space, the activities carried out therein and whatever benefits might accrue therefrom, should be devoted to enhancing the well-being of all countries and humankind, and each includes elements elaborating the common idea of promoting international cooperation in outer space activities.

The five sets of legal principles adopted by the United Nations General Assembly provide for the application of international law and promotion of international cooperation and understanding in space activities, the dissemination and exchange of information through transnational direct television broadcasting via satellites and remote satellite observations of the Earth and general standards regulating the safe use of nuclear power sources necessary for exploration and use of outer space:

- The Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (General Assembly resolution 1962 (XVIII) of 13 December 1963);
- The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (resolution 37/92 of 10 December 1982);
- The Principles Relating to Remote Sensing of the Earth from Outer Space (resolution 41/65 of 3 December 1986);
- The Principles Relevant to the Use of Nuclear Power Sources in Outer Space (resolution 47/68 of 14 December 1992);
- The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (resolution 51/122 of 13 December 1996).

These treaties, conventions and sets of principles constitute the bulk of what is referred to as "space law", intended as that branch of public law which deals with activities taking place beyond the atmosphere. From a practical point of view, the effect of these acts is somehow limited. The main reasons for incomplete practical effect of those rules is that they mostly deal with issues of principal and not day-to-day activities of aerospace companies (d'Angelo,1994, p.10; see also Lachs, 1972).

## 4. International space law – liability issues

Space activity and the use of spacecraft entail the possibility of inflicting damages on third parties, for which the owner or the user of a satellite is usually responsible. In the event of an explosion of a rocket only a few meters above the ground, the potential loss could be enormous.

The "Outer Space Treaty" provides the basic framework on international space law, including the following principles:

- the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind;
- outer space shall be free for exploration and use by all states;
- outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means;
- states shall not place nuclear weapons or other weapons of mass destruction in orbit or on celestial bodies or station them in outer space in any other manner;
- the moon and other celestial bodies shall be used exclusively for peaceful purposes;
- astronauts shall be regarded as the envoys of mankind;
- states shall be responsible for national space activities, whether governmental or non-governmental;
- states shall avoid harmful contamination of space and celestial bodies.

Moreover, the "Outer Space Treaty" touches on the issues connected with third party liability for damage caused by space objects. Article VII states that:

„Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies".

It should be emphasized that in the field of international space law two interrelated terms are often used inconsistently: "responsibility" and "liability". Some languages (French, Polish) use the same word for both notions: "responsibilité",

"odpowiedzialność"[3]. In English, the distinction of these words is not clear-cut. Neither of these terms has been defined in space law but the term "liability" has been used to set the launching state's liability for damage caused by space objects, whereas the word "responsibility" has been used to mandate international responsibility by the appropriate State party for national activities in outer space. It appears that in connection with "liabilities" we are dealing with legal consequences (mostly in terms of damages) arising from a particular behavior. In contrast, it seems that when we speak of "responsibilities" we think primarily about obligations imposed on people and institutions who are supposed to carry out certain activities or are accountable in given situations, though not necessarily in the form of compensation for damages (Gorove, 1991, pp. 224-225; Grzegorczyk, 1973, pp. 145-146). Basically, responsibility is connected with the obligation of control and thus with a fault or a wrongful or unlawful act. Liability may be a consequence of a fault but may also be related to an act without any fault (Kerrest, 1997; Galicki, 1991, pp. 53-60; for a detailed examination of the distinction between responsibility and liability, see also: Cheng, 1995, p. 300 and Horbach, 1991, p. 47).

Basic rules of the "Outer Space Treaty" connected with international responsibility and liability were even enlarged upon in the "Liability Convention", according to which the signatory States are responsible for all acts and omissions of their government agencies and of all their natural or juridical persons.

Liability convention system is sometimes criticized. This results from the fact that some people expect too much of it. The fundamental aim of the "Liability Convention" is rather narrow: liability for damage to "innocent" victims, victims not taking part in the activity. For that purpose the convention may be really efficient. It is far less efficient for the damages to other space State's property and not efficient at all in many other cases (Kerrest, 2002, p. 2).

Article II of the "Liability Convention" states that: "A launching State[4] shall be absolutely liable to pay compensation for damage caused by its space object[5] on

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[3] The problem has also another reason – there are many terminological discrepancies between genuine (English, French, Russian, Spanish, Chinese) texts of treaties. Moreover Polish translation is commonly criticized. See: Górbiel 1985, p 123; Galicki 1991, p. 7.

[4] The term "launching State" means (article I): (1) A State which launches or procures the launching of a space object; (2) A State from whose territory or facility a space object is launched.

Thus, even in situations where launches occur in internationals waters, such as respect of the Sea Launch venture, a number of States may nevertheless be deemed to be a launching State for the purposes of the "Liability Convention". The Sea Launch company, owned by corporations from several countries, is registered in the Cayman Islands, but having its home port facility at Long Beach, USA. It may be argued that as a result that Cayman/UK, the USA, Norway, Russia and the Ukraine may be a launching State for the purposes of the "Liability Convention", in addition to the State, whose national has procured the launch, i.e. the satellite operator (Schmid, 2000, p. 4).

[5] The term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof (article I).

the surface of the earth or to aircraft flight." There is no limit to the amount of indemnity but compensation is restricted to damage caused directly by space objects. Amount of damages should be assessed in accordance with international law and principles of justice and equity.

In this context the term of "damage" should be explained. In article I of the "Liability Convention" damage means "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."

Such a general definition of a "damage" gives rise to serious doubts. For instance it does not answer if that term includes only direct damages or indirect and moral damages too (Górbiel, 1985, p. 107). Also there is a trouble with application of the Convention to a damage caused to "humanity" as a whole, because humanity is not a legal person – there is a similar problem in other fields of international law. The "Liability Convention" of course applies to space debris, as to any space object, but only when the damage caused by the debris is the one referred to in article I. Thus the fact of creating a space debris is difficult to consider as a damage by itself if no specific damage to a property is caused. Moreover, there are several cases of damage where application of the "Liability Convention" is not clear or even not possible. It does not apply to (Kerrest, 2002, p. 6-8):

- people taking part in the launch;
- damage caused to launching State's nationals;
- sharing of the risks and also liability between launching States when, as it is currently common, more than one is involved;
- relationship between a State and the national entities it is liable for;
- return to the Earth (especially in the case of space shuttles), as the Convention deals with a launching State.
- damage to the space environment or even to the earth environment

Of course the liability or responsibility in some of the above cases results from the "Outer Space Treaty" (article VI).

In addition, damage on the earth is clearly distinguished from damage in outer space. The first one occurs, if a space object inflicts damage on the surface of the earth or to aircraft in flight. In such a case the liability of a launching State shall be absolute. However, liability for damage to other space objects in outer space is based on fault[6]. In consequence such regulations of space law usually cause the necessity of buying insurance policy against third party liability. Also treating damage on the earth and damage in outer space differently is very important when assessing the liability risk, because, according to Kowalewski (2002, p. 11), the liability based on fault, creates usually less intensive "risk of third party liability".

[6] Articles III, IV, VI.

Moreover, this distinction in space law also requires a definition of where "outer space" starts. There are many different opinions and this has created both scientific and legal problems. Simply speaking, outer space begins where airspace finishes (Antonowicz, 1998, p. 144). Another definition is that outer space begins at the lowest altitude at which it is technically feasible for a satellite to orbit the earth, which is currently about 80 kilometers above sea level (Space flight and insurance, 1992, p. 9). According to this definition, the true birth of space flight was in 1942 when a German A-4 (also called V2) rocket was launched because its altitude exceeded 80 km. Another source (Jelonek, ed., 1997, p. 46) announces that space begins at about 180km, which is where the density of atmosphere becomes so thin that it enables a few days' free flight around the earth. Although there is no clear-cut lower limit of outer space, international practice assumes that outer space "begins" at the altitude of about 100 km above see level (Danilenko, 1983, p. 74; for a more detailed discussion about delimitation, see: Górbiel, 1981, pp. 85-118; Grzegorczyk, 1973, pp. 84-97).

The compensation provided for in the "Liability Convention" depends on the identification of the space object that is responsible for the damage. This is to be guaranteed by the "Registration Convention" which demands that each State launching an object into outer space register the said object. If it is possible to confirm who launched the given space object, the injured party can claim its compensation on the basis of principles given in the "Liability Convention"[7].

The "Liability Convention" was drafted with a view to bring in a high degree of formality to the management of third party space claims, whereby claims would be submitted and negotiated at a diplomatic level. This structure may have been satisfactory in the early 1970's, but raises questions as to the manner in which the Convention is to be applied today, in the period of increased commercialization of space activities and the involvement of insurers in the claims handling process. Due to the lack of formal interpretation of the provisions of the "Liability Convention" by courts, issues regarding its interpretation and the scope of its application may be open to debate (For a more detailed discussion about liability issues see also: Rajski, 1974; Grzegorczyk, 1973).

It is important to emphasize that in the context of damage sustained within the territory of a launching state, the "Liability Convention" has no application and accordingly any claim will be dealt with in accordance with the law of the launching State. For this reason, the case of the Baikonur launch complex is quite interesting. As the Baikonur launch complex is operated by the Russians but situated within the territory of Kazakhstan, under the terms of the "Liability Convention" Kazakhstan would be deemed to be a launching State with all the consequences. Thus, if damage sustained within the territory of Kazakhstan by a space object launched from the Baikonur,

[7] Articles VIII-XX.

legal responsibility according to the rules of the "Liability Convention" would not be applicable. However, the lease agreement between Russia and Kazakhstan[8] states that in the event of damage connected with the operation of Baikonur launch complex for the Russian space programs, Russia is liable as a launching State in accordance with the "Liability Convention" and Kazakhstan is not regarded as being a participant in a joint launch or as a launching State. As a result of this provision, Kazakhstan can apply the terms of the "Liability Convention" to submit claims to Russia (Schmid, 2000).

## 5. Examples of damages made by space objects on the Earth

Damages inflicted on third parties occur more often on the earth. During take-off, there is a possibility that the launch vehicle or its parts (e.g.: external tanks, strap-on boosters) can cause damage to any objects on the ground, sea or to aircraft in flight. For this reason, satellites are usually launched in a seaward direction, sometimes indeed from a platform on the sea (e.g.: a Sea Launch rocket). Shipping lanes nearby and airspace in the region of the launch are closed during launching time. If a launch vehicle deviates from its nominal trajectory and threatens to cause damage, it can be blown up by a built-in self-destruction device, thus minimizing the risk of damage. The most dangerous are those accidents that arise on the launch pad or within a minute or thereabouts of take-off. This happened in 1986 when a Titan rocket exploded at a height of only 240 meters, destroying both the launch pad and the launch facilities. Material damage exceeded US$40mn. In another case a farmer from Georgetown in Texas had a 200-kilogram fuel tank from a Delta II booster rocket landing nearly intact just 50 meters from his house (Coffin, 1997, p. 70). Other examples include:

- the second stage of a Thor Able Star rocket fell to the ground in Cuba and killed a cow – the US Government had to pay to Cuba US$2 million in compensation, thus creating one of the most expensive cows in history (Bulloch, 1988, p.212);
- the failure of a Long March 3B rocket on 14th February 1996 which pitched over before clearing the launch tower. It crashed into a hillside 22 seconds into flight, killing at least 100 people and destroying the attached Intelsat 708 satellite (Anselmo, 1999, p. 31);
- the failure of a Zenit launcher on 9th September 1998 causes forest fires in Siberian Republics (Altai and Khakasia) – claim reported in amount of US$150.000;
- the failure of a Proton launcher on 5th July 1999, which resulted in an 80-ton rocket fragment plummeting to the ground, 6 miles from the town of Salamalkol

[8] Clause 8.4.(d).

(Kazakhstan), with a further 200-kilogram piece falling into a yard of a home in a nearby village. Kazakh Authorities presented a claim to the Russian Government in the amount varying between US$270,000 and US$288,000;
- another failure of a Proton rocket on 27th October 1999, 3 min 40 sec into its flight, with the reported claim paid by Russia to Kazakhstan in the region of US$400,000 (for these and more examples of accidents, see: Schmid, 2000);
- at least 21 people were killed in August 2003 in Alcantara (Brazil) after the explosion of a VLS-3 rocket on the launch pad. The rocket booster was mistakenly ignited during tests, three days prior to the scheduled launch.

## 6. Issues of damages in outer space and during re-entry

It is also possible for harm to be inflicted on third parties during the operation of spacecraft. Damages in outer space are usually connected with either a collision or through electromagnetic interference in transmissions of one satellite or terrestrial radio links caused by the system of another satellite. However, there is no doubt that a guilty party is obligated to compensate for that damage.

A spacecraft could suffer damage as a result of collision with another object. A crash is possible with three kinds of objects:
- with another operating satellite;
- with space debris;
- with a heavenly body such as a meteor, in which case there would be no liability.

The chance of a collision between two operating spacecrafts is very small. These objects are under constant control of the ground stations which track their orbits. It has been recommended for several years that satellites that have reached the end of their working life-span be moved away from their geostationary orbit. Satellites from low orbits are usually de-orbited. They partly or completely burn up in the atmosphere, with any debris theoretically falling into oceans. One example of a space object being treated in this way was the Space Station MIR, taken out of commission in 2001. Other satellites are shifted to higher orbits. In the second case the altitude increase should be at least 150 kilometers. The fuel required for that operation is equivalent to the amount needed for six weeks active station-keeping (Blassel, 1985, p. 75).

Human activity in outer space has resulted in the appearance of many objects orbiting the earth. The majority no longer serve any useful purpose – old satellites, fragments of rockets – but are a danger to the functioning spacecrafts. One example occurred in August 1997, when a 200-kilogram discarded rocket motor floating in the earth's orbit passed within 2,5 kilometers of an ozone-measuring satellite worth

tens of millions of dollars. NASA alerts its space shuttles of a possible collision when any other object comes within 50 kilometers of the orbiters (Coffin, 1997, p. 68).

Article II of the "Registration Convention" imposes on launch operations the obligation to catalogue all objects sent into space. Moreover, the launching State should furnish to the United Nations, as soon as practicable, the following information concerning each space object (article IV):

- name of launching State or States;
- an appropriate designator of the space object or its registration number;
- date and territory or location of launch;
- basic orbital parameters, including:
  - nodal period[9];
  - inclination[10];
  - apogee[11];
  - perigee[12];
- general function of the space object.

Since 1957 about 9,000 objects have been logged that are still being tracked. Over 100 000 bits of debris are still in space that are too small to follow. Such debris includes pieces of aluminum chuffed from satellite boost stages, blobs of liquid metal coolant that leaks from discarded space reactors, debris resulting from satellite explosions, and lens covers and other hardware discarded during normal satellite operations. Some of this material will remain in earth orbit for hundreds or even thousands of years (Ailor, 2000, pp. 21-22). However, only 7% of the registered objects are still functioning – the rest are nonfunctional satellites (20%), rockets' upper stages (16%), remains after missions (12%) and different fragments (45%). This means that over 90% of objects sent into outer space are now non-functional debris. Space (orbital) debris is technically defined as any man-made earth-orbiting object which is non-functional, with no reasonable expectation of assuming or resuming its intended function or any other function for which it is or can be expected to be authorized, including fragments and parts thereof (Flury, 1999, p. 43).

Currently the possibility of an operational satellite being damaged or destroyed by space debris is small (estimated by actuaries at about 0.01%), but as the amount of debris in space increases, the possibility of an operational satellite being hit is rising. This process is irreversible since the cleaning-up of space is economically (and also technically) unfeasible. Most space debris is located in orbital regions that are frequently used for a multitude of applications (low orbits: 800 to 1600 kilometers and geostationary orbit: of about 36,000 kilometers above the earth's surface).

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[9] The time between two successive northbound crossings of the equator – usually in minutes.

[10] Inclination of the orbit – polar orbit is 90 degrees and equatorial orbit is 0 degrees.

[11] Highest altitude above the Earths surface – in kilometers.

[12] Lowest altitude above the Earths surface – in kilometers.

For large close earth orbiting spacecraft and for space debris there is a risk of falling to the ground. The lower the orbit and the bigger the mass, the greater the chance of a re-entry. A satellite falling to the earth has the same effect as a natural meteor. When it passes through the atmosphere, huge heat and pressure develops and the object is broken up into numerous pieces, most of which are completely burnt up. Only a very few large pieces survive to reach the ground. Some examples of re-entries from outer space:

- the spent stage of a Saturn V rocket, weighing about 22 tons, which fell into the Atlantic east of the Azores in January 1978;
- the American Skylab, weighing approximately 80 tons, crashed over the western coast of Australia in July 1979 – a $400 fine for littering was imposed by the town of Esperance;
- the 40-ton Russian space laboratory Salyut 7 crashed in February 1991 – the largest pieces, weighing just a few kilograms, were found in the Andes near the border between Chile and Argentina (Space flight and insurance, 1992, p. 63-64).

Fortunately, despite the large size of these objects, the risk of damage to the earth is quite low – over 2/3 of the earth's surface is the sea and much of the land is sparsely populated.

However, we should also mention here a tragic accidence of space shuttle Columbia, destroyed during re-entry on 1st February 2003. Nobody of a seven-person crew had a chance to survive. NASA reported that in a corridor 100 miles long and 10 miles wide, there were 45 000 pieces of wreckage recovered, adding up to almost half the total weight of Columbia. The debris of the orbiter fell on a sparsely populated area near the Texas/Arizona border. Altogether NASA received 66 claims for property damage and loss of cattle, totaling US$500,000. The corridor of debris passed 15 miles south of Houston and Fort Worth. Nevertheless, it also has to be said that the debris of the space shuttle Columbia did not hit or hurt a single person (Stahler, 2003, p. 6). After that accident, NASA has changed landing procedures. Nowadays orbiters arrive from the seaward direction, instead of the land.

What causes more concern is the environmental damage that can be caused by spacecraft with nuclear power generators on board. On 24th January 1978 the Russian satellite Cosmos 954 crashed in North-West Canada, contaminating large areas with radioactivity. Based on the provisions of the "Liability Convention" and general principles of international law, a claim in the total amount Can$ 6.04 million was submitted[13], although the matter was settled some time later following negotiation, in the amount of Can$ 3 million[14]. There are still spacecrafts that use nuclear materials for power supplies. This constitutes a serious risk.

[13] Taken from the Statement of Claim submitted by Canada to the Soviet Union, dated: 23.01.1979.

[14] That is the best publicized claim of space third-party damage.

## 7. Conclusions

It should be emphasized that with the development of space transportation – both commercial and non-commercial (governmental, scientific, etc.) – issues of risk management are very important in view of the considerable financial commitments of launch participants and the enormity of damages that may occur. In addition to the risk involved in the loss or failure of spacecraft which we have frequently observed, space activities create exposure to potentially "astronomical" (or even "out of this world") liability to third parties injured by the malfunctioning spaceship or rocket boosters.

The exploitation of space brings the hazard of inflicting harm on third parties, which could evoke civil liability of a guilty party. So far, as a result of space activity or rather failures during space activity, hundreds of people have been killed, not to mention huge financial losses. To protect oneself against claims, it is of course possible to buy third party liability insurance for space losses. The need to procure third-party liability insurance is based on protection against financial claims resulting from certain fundamental principles of international space law (mainly the "Outer Space Treaty" and the "Liability Convention") as well as national legislation, executive orders, administrative regulations and judicial decisions that control or otherwise influence the conduct of activities in space (Meredith, Robinson, 1992, p. 7).

Thus far there have been only a few cases of third-party liability for space losses. It should also be noted that there has never been a substantial claim on a space liability insurance policy. It remains to be seen if this type of coverage would remain available if a major accident was to occur. The tragedy of the Columbia space shuttle shows that potential damages could be enormous (if the catastrophe had occurred above a city).

However, we should also note that the current liability regime needs improvement – not by changing the "Liability Convention" – but by completing it and solving the problems caused by its shortcomings. General or special agreements between launching States' domestic laws are the way of this improvement.

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