

## LIABILITY FOR DAMAGE CAUSED BY SPACE DEBRIS

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### Abstract

Research carried out in outer space has shown that the amount of debris, of different shapes and of various origin, is increasing, and causing worries for the international scientific community especially for the amassing in the orbits closer to earth and in the geostationary orbit, which are the orbits most populated by satellites and where the risk of collision is greatest.

Of the two UNCOPUOS Subcommittees only the scientific one has recently considered the problem by approving a triennial work plan. In order to regulate the behaviour of the States and to establish the liability for the damage which might be caused by space debris, the United Nations conventions on outer space may only be applied in part.

A general prohibition of contamination of outer space and an invitation to international cooperation to prevent pollution can be found in art. IX of the Space Treaty. The vagueness of the terms used and the lack of a specific forecast of a phenomenon which was not worrying at the time of the creation of the United Nations conventions or of other agreements which may be applied, make the regulation incomplete and insufficient.

At present a joint effort is being made by the international scientific community to find out

the best active and passive measures to prevent the pollution of outer space. At the same time in the international legal community the obligation to protect the environment, and space environment too, for the safeguard of mankind, is increasing more and more. In answer to this which is becoming a common law rule States and Organizations must undertake the obligation to adopt the studied preventive measures. For this purpose the most feasible legal suggestion, at least for the moment, would be to formulate some "Principles concerning the protection of space from damage caused by debris" to be adopted through a United Nations resolution, as recently happened for the use of nuclear power in outer space. Some important problems this resolution would have to face have been considered in this paper.

### Situation resulting from research on space debris

Many studies, among which the important European conference held in Darmstadt from April 5th to April 7th 1993, have shown the results of the research on space debris<sup>1</sup>. In the last thirty years more than four thousand satellites have been launched, of which only 5% are operative; most part of the space objects on orbit around the Earth are space debris made by man: non-operative payloads, spent rocket stages, objects connected to operations which remain in outer space (ex. nuts and bolts), microparts deriving from multiple causes (solid propellents used by vector rockets, crumpling of paint, etc), fragments deriving from explosions and collisions and finally inactive satellites. Of the 7184 objects which have been observed the satellites were only

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1777 (of which 350 were operative) and 5407 were space debris<sup>2</sup>.

The sensing is done by earth-based radars capable of following objects of approximately 4cm in diameter at 200-300 Km altitude, of 10 cm at 1000 Km or of 1 m at 5000 Km. Between 30.000 and 70.000 objects under 1 cm and millions of smaller ones are untrackable. Optical instruments such as the GEODSS (Ground-based Electro-optical Deep Space Surveillance) capable of sensing objects of 1 cm in Low Earth orbit and of 20 cm in Geostationary orbit are used. The Geosynchronous orbit is monitored by optical telescopes operating from Russia, the United States, France, Japan, Switzerland and the United Kingdom. In situ experiments are conducted with special detectors and by trying to make exposed surfaces in outer space return to earth.

Approximately 50% of the trackable debris has been produced by the explosion of satellites. The most populated orbit is between 500 and 1200 Km, but the most dangerous ones are the ones closer to Earth and the geostationary orbit for the presence of a large number of satellites. The tests show that the collisions may be the most dangerous factor for the future if no adequate measures for the control of the debris are taken<sup>3</sup>.

At present the space debris are mostly by the United States and especially by the US Space Command which succeeded to NORAD in 1988. Study projects for the surveillance, models, analysis of the damage, protection and control of the debris are also conducted by Russia, Japan and the ESA. The ESA conducts two in situ integrated and complementary programs: EURECA (in cooperation with the United States) and the Long Duration Exposure Facility (LDEF)<sup>4</sup>.

The problem of pollution in outer space is more and more urgent for the world scientific community who at the moment, is mostly oriented towards the observation of the phenomenon, the modeling of the present position of the debris and its future evolution, experiments in laboratory, the effects of the explosions and collisions on orbit and the study of the measures of prevention and mitigation of the production of debris. Economical and political reasons limit the planning and the

realization of the appropriate strategies in order to guarantee total security for space activities.

It is necessary to abandon the classical position of immediate profit and to invest greater and increasing resources in the theoretical and experimental study of the problem, in the planning of strategies for long term protection of space activities and finally for the study of the existing rules and of the rules to be developed for the regulation of the phenomenon.

Technical-legal organizations (IFA, ILA, IISL, AIAA, AIA) are starting to express their positions about the problem. The ESA also participates with Japan (NASDA), the United States (NASA) and Russia (RKA) in the Inter-Agency space Debris Coordination Committee (IADC) whose primary purpose is to exchange information on research activities concerning space debris (measurements, environment and data-base, protection, mitigation).

In accordance the General Assembly resolution n. 48/39 of December 10th 1993 the topic of space debris appeared on the agenda of the UNCOPUOS Scientific and Technical Subcommittee for the first time in the session of February 1994<sup>5</sup>. In the last meeting of February 1995<sup>6</sup> the Subcommittee agreed on the following work-plan:

1996 session: Measurement of space debris and effect of the environment on space systems

1997 session: Modeling of space debris environment and risk assessment

1998 session: Space debris mitigation measures.

Space debris mitigation comprises reduction of the space debris population and protection against space debris. Measures for space debris reduction include methods for space debris prevention and removal. Prevention methods comprise: suitable design and operation of space systems; passivation of energy storage devices to avoid breakup; retention of covers and separation devices; transfer to disposal orbit. Removal includes retrieval from Earth, destructive reentry into the atmosphere and transfer to an orbit with a reduced orbital lifetime. Protection against space debris includes: active protection

with shielding and passive protection through avoiding collision with space debris<sup>7</sup>.

The legal Subcommittee of UNCOPUOS has still not faced the subject of space debris and we are still far from the introduction of the topic in the agenda. During the last session of April 1995, in the official consultations of the President with the delegations on the methods of work and in the order of the day, the possibility of placing in the near future two points concerning space debris emerged: one concerning the study of the present applicable rules for the debris, the other on the legal aspects concerning the production of debris.

### Existing legal instruments

From the legal point of view the problem is extremely complex because at present there is a lack of willingness from the States, at least the industrialized ones who carry out space activities to accept the strict limitations which imply remarkable additional costs.

Before prospecting new legal solutions specifically taking into consideration the problem of debris, it is necessary to examine which dispositions included in the multilateral agreements of the United Nations on space law may be extended to regulate the conduct of the States in respect of the production of debris, even if in an extremely general way<sup>8</sup>.

The 1967 Treaty on the principles governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies establishes in art. I that the exploration and use of outer space must be carried out for the benefit and in the interests of all countries, freely and without discrimination of any kind, on a basis of equality and in accordance with international law. This rule relates to another general principle of law, which establishes the obligation to exercise one's rights in order not to prejudice the interests of other subjects, already included in the Latin phrase "*sic utere tuo ut alienum non laedas*"<sup>9</sup>. If this principle is connected to the forbidding of national appropriation established by art. II it is possible

to deduce as a corollary the generic obligation of non interference in the activities of others. Damaging contamination may also be considered illicit interference, with the production of potentially dangerous space debris or of radioactive energies or substances which might endanger the legal activities of other States. The use on the part of one State which excludes the use by others because it causes a remarkable prejudice to the security of the activities is without doubt contrary to the principle of free exploration and use of outer space<sup>10</sup>.

Art. IX is the one most directly referring to the prevention of damage originating from space debris, even though such terms is not used. It establishes that in the exploration and use of outer space, including the Moon and other celestial bodies, the States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance with due regard to the corresponding interest of the other States Parties to the Treaty. They must avoid any harmful effect deriving from the contamination of outer space, of the Moon and of other celestial bodies and also adverse changes in the environment of the earth resulting from the introduction of extraterrestrial matter. Undoubtedly the rule foresees a prohibition of pollution of the space and earth environment, but the terms used (corresponding interest, harmful contamination, adverse changes) are extremely generic and the prohibition is not very coercive<sup>11</sup>.

The second part of art. IX foresees a special procedure in the case of a State having reason to believe that its activity might cause potentially harmful interference with activities of other States Parties. The State must undertake appropriate international consultations before proceeding with any such activity or experiment. And also a State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party would cause potentially harmful interference with the activities of others may request consultation concerning the activity or the experiment. This way the road to international cooperation for the prevention of pollution opens. Once more, however, the

expressions used (has reason to believe, potential harmful interference, may request consultation) do not bind the State to particular behaviour but the State is left free to judge the situation subjectively and to decide on the appropriateness or not of the consultations, which might also be refused<sup>12</sup>.

Another important legal topic is the one concerning the jurisdiction and control of the space object. Art. VIII of the Treaty on the principles states that a State Party on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. With reference to the problem of debris, and particularly to the debris represented by the inactive satellite, the above mentioned disposition indicates that the launching State shall retain jurisdiction and control even on the inactive satellite; an important specification for the application of the regime of responsibility.

According to Art. VI the launching State shall bear international responsibility also for those activities carried out by "non-governmental entities" in outer space. This exception to the general rule of international law is a consequence of the retaining of jurisdiction and control over these private subjects which must be carried out in observance of the specific obligations, established by the same article, in order to prevent damage.

Because in the agreements concerning outer space the term "space object" is always used it is important to establish if the term also includes the debris in order to refer to the launching State which retains the jurisdiction, control and responsibility of the object. Both in the Convention on Liability (art. I,d) and in the one on Registration (art. I,b) it is specified that the term "space object" also indicates the components, the vector and the components of the latter. Even if a space debris comes from one of these elements the term is still too generic to include the whole phenomenon. It is therefore necessary to find an articulated definition of the term "debris" in respect of the currently existing situation, but subject to revision in the future.

**The Convention on Registration of Objects launched in Outer Space** of 1975 is important for the identification of the object and also eventually of the debris. If changes were to be brought to the Convention<sup>13</sup> the identification of the debris would be more possible. Among the information specified by art. IV of the Convention to be given to the Secretary General of the United Nations for the registration in the international registry it could be useful to also place the news concerning the preventive measures adopted in order to prevent the formation of debris, including the solutions adopted for the inactive satellites. Art. IV,2, establishes that the State "may" give the Secretary General supplementary details concerning the launched space object; an appropriate change could involve the "obligation" to forward all the possible information in the event of an environmental prejudice or of the production of debris caused by space activities. In the event of explosions of the object, in order to be able to identify the debris which caused the damage, it would be extremely useful for the State who has suffered the damage to be able to refer to the information concerning the explosion (time and place of the explosion, number of debris caused, etc.) immediately sent to the Secretary General.

If a State has difficulty in identifying a space object which has caused damage, art. IV of the Convention already establishes the cooperation of the other States which have installations for the observation and control of the flight of space objects. This cooperation would be extremely useful in the event of damage by space debris whose identification is more and more complex.

**The Convention on International Liability for Damage caused by Space Objects** of 1972 may also be applied to the damage caused by space debris, if they are included, at least generically, in the term "space object", as mentioned above. Naturally this is only possible if the debris can be referred to the State which launched the object it came from. If the debris is an inactive space object, the registration number immediately identifies the launching State; if it is

the case of detached parts, the smaller the size of the debris the more difficult the referral will be<sup>14</sup>.

The Convention may be applied to the damage caused by the debris only to other space objects. Art. I, in fact, specifies that the term damage designates the loss of human lives, personal damage or other prejudices to health, or the loss of goods of the State or of natural persons or corporations, or of International Organizations. The damage caused to the environment by harmful contamination and dangerous interference is not taken into consideration<sup>15</sup>. Consequently, at the present state of the law, it is not possible to consider a State responsible for the damage caused to the space environment. This approach to the problem is called "sci-lab perception" because it considers outer space, the Moon and other celestial bodies useful laboratories for scientific activities and therefore harmfulness only exists if the use of the space for this purpose is endangered<sup>16</sup>.

Art. II of the Convention foresees an absolute objective liability in the event that the damage is caused on the Earth's surface or to aircrafts in flight. This kind of liability may also be extended in the case that the cause of the damage is the identified debris<sup>17</sup>.

More serious problems, as regards the claim of the damages caused by debris, are submitted by Art. IV which establishes a fault liability if the damage is caused in outer space to another space object. The difficulty consists in identifying what could be the notion of fault in outer space, space activities being lawful. However, positive law foresees that if damage is caused to a space object compensation can be obtained only if the guilty behaviour of the launching State is proven. If this proof of the liability is already extremely difficult, because it might be attributed to the maker or to the launching service, if the damage happens soon after the launching, in the event of the damage occurring months or years after the launching the proof of the liability is practically impossible. First of all it would be necessary to prove that the space debris comes from a certain space object of a specified State and then to prove the guilty

behaviour. Probably in the future it will be more the case of absolute liability for all kinds of damage caused by space objects and their components, but in the meantime it is necessary to study the possibility of a particular kind of fault liability.

As for the creation of rules of conduct obliging the launching State to specific behaviour, such as sending into higher orbits the satellites now inactive in the geostationary orbit, the non-observance of these rules would place the behaviour of the State at fault. Once the rules of conduct obliging the States to take preventive measures are made, the proof that these measures have not been taken would be the proof itself of the fault<sup>18</sup>.

Art. V of the Convention establishes a solidal liability for all the States involved for the damages caused by a jointly launched space object. There is a similarity between this case and the case of the damage being caused by an unidentifiable debris. All the States which could have caused the debris would be jointly and severally held liable for the damage caused by it<sup>19</sup>.

The creation of an International Fund made up with the contributions of the States before carrying out the launch has been suggested. The amount of the contribution would be fixed in respect of the mass, the size and the harmfulness of the object to be launched. This Fund would repay the victims in the event of the debris being unidentifiable<sup>20</sup>. This solution however does not seem to be very feasible especially because of the determination of the amount of the contribution and also because of the participation of developing countries who are starting to carry out space activities and who could object that the harmful situation has already been created by those industrialized countries who have been carrying out the same activities since earlier times.

The problem has been posed if a State, other than the launching one, may recuperate in orbit the non functioning objects or the fragments of an object belonging to another State. With an extensive interpretation of art. 5 of the **Agreement on the Rescue of Astronauts, the**

**Return of Astronauts and the Return of Objects Launched into Outer Space** of 1968, some authors have answered in the affirmative<sup>21</sup>. The expressions "beyond the territorial limits of the launching State" (art. 5,3) and "in any other place" (art. 5,4) have also been referred to outer space and therefore it would be possible to justify the intervention of the other States who must warn the launching authorities who must immediately take effective measures to avoid any possible danger. However it seems that this interpretation goes beyond the limits given by the same Convention. Recuperation concerns the space object or its elements which have fallen on the Earth (art. 5,1) and in any case the jurisdiction and control over the space object belong to the registering State (art. VIII, Treaty on the Principles).

A more incisive rule for the protection of environment is art. VII of the **Agreement governing the Activities of States on the Moon and Other Celestial Bodies** of 1979. The main obligation for the States exploring and using the Moon is to avoid prejudicing the Moon's balance with harmful transformations or by bringing polluting material. Should the States intend to place radioactive substances they must inform the Secretary General of the United Nations explaining the purpose of the operation. The Agreement was not very successful due to the limited number of ratifications. The terms used are however generic, the obligation for the forewarning is only considered for radioactive substances and no sanctioning mechanism has been established.

Some Treaties not specifically formulated for the regulation of space activities may be applied for the protection of the space environment. **The Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water**, Moscow August 5th 1963, prohibits explosions in the air and in water, but also in outer space. The Treaty has been ratified by many Countries, among which, except for China and France, all the countries who are capable of producing radioactive contamination<sup>22</sup>.

**The Convention on the Prohibition of Changes to the Environment for Military or other Hostile Purposes** of May 18th 1977 may also be applied. The Convention is also applied to the space environment and therefore the voluntary explosions of military satellites would be prohibited. A advisory Committee of experts for the control of the carrying out of the Agreement is also foreseen<sup>23</sup>.

At previously mentioned the formation of debris, including no longer operative satellites, may cause greater danger in particular orbits such as the **geostationary orbit** used for communication satellites. Some dispositions are interesting for this subject. Art. 29 of the **Radio Regulations of the World Administrative Radio Conference (WARC)**<sup>24</sup> prohibits disturbances and interference in radiofrequencies by satellites which are no longer operative. Furthermore, art. 35 of the **International Telecommunication Union Convention** of 1982 obliges States not to cause harmful interference with their stations to the activities legally carried out by others. A recommendation of the ITU of 1993 on debris in the geostationary orbit invites the States to avoid the production of debris in the orbit and to de-orbit the satellites at the end of their active life<sup>25</sup>.

Mention must be made of the **Principles relevant to the Use of Nuclear Power Sources in Outer Space** of December 14th 1992 which despite not prohibiting the use of the nuclear energy which is indispensable in outer space do dictate some rules of conduct and criteria for a safe use. Principle n. 3 establishes that the States must ensure that the space objects do not release radioactive matter causing significant contamination of outer space and that they must act in security orbits when the nuclear power sources are in action. Strict cooperation is foreseen among States, from the obligation of information to the request for consultation and assistance from other States in the event of malfunctionings on board with the danger of the return of the radioactive matter on Earth. Recalling the Treaty on the principles and the **Convention on Liability** the Principles establish the responsibility of the States even for the damage

caused by such space objects or by their components (principle n. 9)<sup>26</sup>.

From the study of the rules regulating the activities of the States in outer space it appears that the international law regulation concerning the protection of the space environment from the pollution of debris is rather generic and incomplete.

Some authors think that a rule of common law is emerging which obliges the States to prevent the formation of debris and ensuring the safeguarding of the space environment<sup>27</sup>. The practice of the States and Organizations is moving, for example, towards sending the satellites situated in the geostationary orbit towards higher orbits just before they become inactive<sup>28</sup>. The unilateral Soviet moratorium on the antisatellite tests operating since 1983 is a measure for disarmament but also an important reduction of the production of space debris<sup>29</sup>. The American directive of January 5th 1988 addresses the American policy towards a "minimization of the creation of space debris" even if subordinate to the "mission requirements and cost effectiveness".

A general principle obliging the prevention of pollution of the environment is traceable in art. 21 of the Stockholm Declaration of 1972 adopted by the United Nations in the Conference on Environment. Some resolutions of the General Assembly specifically consider it a rule of general international law. The principle is recalled in the Charter of the Economic Rights and Duties of the States and in principle 2 of the Rio Declaration, adopted in the United Nations Conference on Environment and Development in Rio De Janeiro in 1992<sup>30</sup>. The principle may also be extended to the prevention of the pollution of outer space but it is necessary to determine the measures which are technically effective for the prevention of the formation of debris.

### **Interdisciplinary cooperation for prevention**

At present there is ample support for the scientific community for a policy of identification of the debris, for prevention and reduction of the

dangers. The policy carried out mostly by the United States, China and Russia<sup>31</sup> turns to the study of the most appropriate measures for the prevention of the formation of debris. It is then up to the legal community to study the way to make the adoption of these measures compulsory.

The measures at study, in accordance with the pluriannual plan established by the above mentioned scientific Subcommittee of the UNCOPUOS are **passive and active measures**. The first are for the protection of the space objects, with forms of shielding to avoid possible collisions with debris. The active measures go from a better conception of the rockets and pay loads, in order to reduce the possibility of involuntary explosions, to the removal of the propellant from the upper stages which is one of the major sources of debris<sup>32</sup>.

Furthermore they are also trying to prevent possible explosions through the passivation of energy storage devices at the end of their life. Measures can also be taken to reduce the number of objects related to the mission, such as separating bolts, instrument covers and clamp-bands. It may be useful to develop a technology of reusable launchers in order to avoid the debris created by the detachment of the upper stages of the satellite.

A further preventive measure consists in stopping deliberate explosions of space objects, mostly of military character.

The removal of inactive satellites belongs to the active measures. The inactive satellite may be considered a space debris<sup>33</sup>. The Consultative Committee on International Radio is studying, for the protection of the geostationary orbit, a project of law which should shortly become a recommendation for the reorbiting of inactive satellites in a graveyard orbit placed at least 300 Km away from the geostationary orbit<sup>34</sup>.

The debris may be destroyed in low orbits for the phenomenon of the "atmospheric drag" so that by obliging the space objects to follow a well determined return trajectory over wide ocean areas, they will pass through dense regions of atmosphere and be completely burned (destructive reentry).

The nuclear power sources are taken into consideration for space applications to generate power or for propelling purposes. Some space vehicles of the United States and of Russia are endowed with them. The community has considered the impending dangers connected to the use of nuclear power in outer space and with the Resolution 47/68 of December 14th 1992<sup>35</sup>, the General Assembly of the United Nations issued the above mentioned "Principles relevant to the Use of Nuclear Power Sources in Outer Space".

The set of Principles, not being able to prohibit the States to use the nuclear matter necessary for the production of power, intends to dictate some guide-lines and criteria for a safe use. The States must adopt measures for a security control in the phase preceding the launch, during the stationing in outer space and during the phase of reentry.

The use of nuclear power may also cause particularly dangerous debris especially in the event of a collision. Some further security measures may be suggested, such as the obligation for the nuclear power systems to operate in orbits far from the geostationary orbit. The latter should only be used for transit or for the assembly with a destination towards other not dangerous regions<sup>36</sup>.

This resolution of principles is particularly interesting as an example of regulation, with an effectiveness which is less constructive than a Treaty, for problems which are becoming more and more urgent such as the creation of space debris.

### Suggestions for a legal solution

The international cooperation is moving to study the most appropriate technical measures to solve the problem of the pollution of outer space, but the agreement is being found especially in the identification of those measures for the prevention of the formation of the debris.

We have seen how the technical and scientific Subcommittee of the UNCOPUOS has placed the determination of these measures in its program and how the practice of the States and Organizations operating in outer space is oriented towards the adoption of these measures. Such preventive measures could be collected in a code of conduct stipulated by scientists and technical experts on the UNCOPUOS. These measures should be rather flexible in order to be easily readjusted in view of technical development. The States and Organizations should accept the code of conduct and commit themselves to observe the adoption of these measures. Specific measures adopted in the Regulation of radiocommunications of the UIT could help to prevent the dangerousness of the geostationary orbit.

We have seen how the dispositions included in the agreements on outer space do not completely cover the problem of debris. Some amendments have been suggested to widen the coverage of the Conventions. However, the review of an agreement often involved longer times than the formulation of new and more specific legal instruments.

A global international agreement on the problem of space debris seems to be possible according to some authors<sup>37</sup>, or at least the stipulation of partial agreements<sup>38</sup> on some questions which are becoming more and more important. However, at present it is rather utopian to think of a formulation of a specific convention because the States lack the will to undertake definitive commitments and probably the number of ratifications would be very low.

The problem should be considered by the legal Subcommittee of the UNCOPUOS and the most feasible solution would be the formulation of "Principles for the protection of the space



environment from damage caused by space debris" on the example of those formulated for the regulation of the use of nuclear power in outer space<sup>39</sup>. These principles, connected to the dispositions of the agreements on outer space which already regulate some matters, would complete them with more specific and clarifying provisions. The principles could be approved through a resolution of the General Assembly of the United Nations according to a practice which seems to have been consolidated also for other subjects (remote sensing, direct television). Certainly, a resolution does not have the same compulsory value as a Treaty, but it has an exhortation value; however, it could be the first step towards a future decision of the States to formulate a Convention. The practice followed by these States for the approval of these resolution is by "consensus", that is to say without voting but also without explicit contrary opinions, and it seems to be at present the best kind of agreement to be reached. This practice however cannot be followed by the opposition of reserves to the "consensus" which would nullify the contents of the resolution of its most important commitments.

The resolution of principles should face some important subjects: first of all the **definition of the terms** to clarify the connection space object-liability. The term space object must include also the debris created by man. For **debris** one must intend those produced by inactive satellites or by other operations in outer space or by intentional or unintentional explosions or by collisions or "abandoned satellites". For **environment** one must intend the Earth environment, within and outside the national jurisdiction, and the space environment. **Damage** is referred to persons or things belonging to the States, to private parties or to Organizations. Damage is also what is caused to the earth and space environment.

The principles should specify the **obligations for cooperation** that the States must undertake for the protection of the environment: adoption of measures established by the scientific sector, for the prevention of the formation of debris; cooperation for the development of

technologies for the prevention, reduction and control of the space debris; to encourage the exchange of information and to ask for consultations in the event of the production of hazardous debris.

In its 66th Conference held in Buenos Aires on August 14th-20th 1994, the International Law Association adopted the "ILA Buenos Aires International Instrument on the Protection of the Environment for Damage Caused by Space Debris" to be forwarded, through the Secretary General of the United Nations to the COPUOS and to other governmental and non-governmental institutions for further considerations and actions. The Instrument very clearly considers the part concerning the definitions and obligations, and more briefly the one concerning responsibility and liability, recalling the Treaty on the principles and the Convention on Liability. In the part concerning the regulation of dispute settlements much freedom has been left to the parties.

**International responsibility**, in accordance with the Treaty on the principles, is retained by the States also for the activities of private parties which the States must endure to be carried out in observance of the rules contained in the principles.

For the regime of the **liability** for damages it would be necessary to make some further specifications. There should be a specific provision of liability for damage caused by space debris and other space objects, but also for pollution of the space environment similar to what has been established for the marine environment. The Montego Bay Convention of 1982, in force since 1994, underlines that the marine environment is an indivisible a limited heritage and that it may be irreparably damaged, and therefore the States are responsible towards the whole international community in the event of the violation of the rules made for the protection of the marine environment. Art. 192 obliges the States to protect and preserve the marine environment, and art. 235 establishes international responsibility for the States in the event of a lack of fulfilment of these obligations, apart from the damage to other States<sup>40</sup>.

The liability should be adapted to the possibility of damage caused to other space objects in space by debris, considering the fault is determined even only by proving that the State had not taken the compulsory preventive measures, as mentioned above.

### Conclusions

Even if in the future a regime of absolute responsibility should be adopted, which countries are very averse to accept, there would still be the enormous difficulty of identifying the space debris which would have caused the eventual damage to other space objects and therefore of establishing which States would be responsible for compensation.

The solution to the problem, which should be urgently found, before the increase of the space debris should render space missions extremely risky, is in prevention. The studies of the international scientific community, prompted by leader countries and by some organizations, are trying to establish which preventive measures would prohibit or make the production of debris less probable.

It is necessary for the States to adopt those policies which, even though being expensive, would offer greater security in the future and therefore consider as compulsory the adoption of those measures preventing the pollution of outer space.

Even though the legal formula suggested by the resolution of the Principles of the United Nations lacks in binding force, at present it seems to be the most realistic for a first agreement among States as in the past for other problems concerning man's activity in outer space.

### NOTES

<sup>1</sup>Space Debris, The report of the ESA Space Debris Working Group. ESA SP-1109, ESA/C(89)24, rev.1 and ESA/C(93)62, see FLURY, Proceedings of the first European Conference on Space Debris, ESA,SD-01, Paris, France 1993

<sup>2</sup>NASA Satellite Situation Report 1988, see BAKER, Space Debris: Legal and Policy Implications, Dordrecht 1989, CECCHI, Obbligo di non interferenza e tutela dell'ambiente spaziale, Rivista d Diritto Internazionale 1994, p.655

<sup>3</sup>For measurements,modelling, impact tests, risk analysis see FLURY, Summary of the first European Conference on Space Debris, Proc. of 36th Colloquium on the law of outer space, 1993,, p. 386; VERESHCHETIN, Environmental risks arising of space activities and their legal mitigation, in CATALANO SGROSSO, Outer Space Law, New Developments and Prospects, Padova 1994, p. 81

<sup>4</sup>ESA bulletin , nov.1993, p. 81, p. 112 and ESA bulletin 1994, p. 21

<sup>5</sup>Journal of Space Law, 1994, p. 118

<sup>6</sup>UNCOPUOS, Report of the Scientific and Technical Subcommittee on the work of its thirty-second session, G.A., A/AC.105/605, 24 february 1995

<sup>7</sup>For the major provisions in international law see BAKER, Policy considerations for the regulation of space debris ,Proc. of the First European Conference on Space Debris, Darmstadt, 5-7 april 1993, p.689, ESA SD-01

<sup>8</sup>CATALANO SGROSSO, La responsabilità degli Stati per le attività svolte nello spazio extra-atmosferico, Padova 1990, p.6

<sup>9</sup>See CECCHI, note 2, p. 664

<sup>10</sup>MATEESCO-MATTE, La pollution aérospatiale et le régime juridique des responsabilités, Annuaire de droit maritime et aérospatial 1991, p. 250

<sup>11</sup>See MARTIN, Droit des activités spatiales , Paris 1992, p.80; VERESHCHETIN, note 3, p. 93

<sup>12</sup>The art. X states that the Convention could be revised after ten years, see MATEESCO MATTE, note 11, p.268

<sup>13</sup>MARTIN, note 12, p. 82, the A. examines also the concept of fault in outer space

<sup>14</sup>For six different types of environment damage (caused by debris circulating in space, by harmfulcontamination and harmful interference, by nuclear and radioactive space activities, by space stations, by solar satellites and to the ozone layer) see DIEDERIKS-VERSCHOOR, An Introduction to Space Law, Deventer, Boston 1993,p.116

<sup>15</sup>BAKER, Space Debris: Legal and Policy Implications, Dordrecht, 1989, p.89;CHRISTOL,The Modern International Law of Outer Space, New York 1982, p.132

<sup>16</sup>Exemples of damage caused on the surface of the earth are provided by the Skylab which came down over Australia in July 1979, and the Cosmos 954 satellite which disintegrated over Canada in 1978; and in this case the

Liability Convention was applied, see the case in CATALANO SGROSSO, note 9, p.37

<sup>17</sup>MARTIN, Liability issues on space debris, the opinion of a teacher in international law, ; Proc. of the 36th Colloquium on the law of Outer Space, 1993, p. 405; MARTIN, Les Débris Spatiaux: Remarques sur le Visible et l'Invisible en Droit, Zeitschrift für Luft und Weltraumrecht 1994, 1, p. 30

<sup>18</sup>BENKO, Space Debris - Legal Problems to be solved within United Nations, Proc. of the First European Conference on Space Debris, Darmstadt, Germany, 5/7 april 1993, ESA SD-01, p.682

<sup>19</sup>Like the Fund for Compensation for Oil Pollution Damage (International Convention on Civil Liability for Oil Pollution Damage of 29.11.69 and International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage of 18.12.71) REIJNEN, Some observations on legal and policy issues in regard to space debris, *ibidem* note 19, p. 673

<sup>20</sup>CHRISTOL, Suggestions for Legal Measures and Instruments for Dealing with Debris, in BOCKSTIEGEL, Environmental Activities in Outer Space, State of the Law and Measures of Protection, 9 Studies in Air and Space Law, 1990, 258

<sup>21</sup>Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, Moscow, 5 August 1963, 14 UST 1313; TIAS 5433; 480 UNTS 43; 120 ratifications as of March 1994 in United Nations Treaties and Principles on Outer Space 1994, A/AC.105/572

<sup>22</sup>In GOROVE, United States Space Law, Nationals and International Regulation 1982, II, A.6., p. 67

<sup>23</sup>LEANZA, The Future of International Telecommunications, N.Y., 1992, p. 2105

<sup>24</sup>Rec. ITU-R S. 1003; UN doc. A/AC.105/C.1/CRP.4, feb. 9th 1995; For the GSO see REIJNEN, DE GRAAFF, The pollution of Outer Space, in particular of the Geostationary Orbit, Dordrecht, 1989, p. 92

<sup>25</sup>United Nations Treaties and Principles on Outer Space 1994, A/AC.105/572, p. 47

<sup>26</sup>MATTESCO MATTE, note 11, p. 271; MARTIN, note 18, p. 35; CECCHI, note 2, p. 672

<sup>27</sup>DIEDERIKS-VERCHOOR, note 15, p. 119

<sup>28</sup>VERESHCHETIN, note 3, p. 97

<sup>29</sup>Resolutions 2995 (XXVII) e 2996 (XXVII); Rio Declaration on Environment and Development, A/CONF. 151/26, p. 8

<sup>30</sup>U.N.Doc. A/AC.105/510/Add.1,5,21 Feb.1992; U.N.Doc. A/AC. 510/Add. 3,2,26 Feb. 1992

<sup>31</sup>See FLURY, note 3, p. 390. Removal of residual propellant from upper stages in increasingly applied: Ariane, Thor-Delta, H-1

<sup>32</sup>CHRISTOL, Scientific and Legal aspects of space debris, Proc. of 36th Colloquium on the Law of Outer space 1993, p. 368; BAKER, note 16 p.91, GOROVE, in Journal of Space Law 1990, n.2, p.143

<sup>33</sup>CCIR Working Party 4 A- Environmental Protection of the Geostationary Orbit (Draft new recommendation) Doc. S/141 E, 17 June 1992; see JAKHU, Space Debris in the Geostationary Orbit: A Major Challenge for Space Law, Annals of Air and Space Law 1992, p. 322; ITSO (International Telecommunication Satellite Organization) removed from geostationary orbit the satellite Series III

<sup>34</sup>United Nations Treaties and Principles on Outer Space 1994, A/AC. 105/572, p. 47

<sup>35</sup>BERTOTTI, ANSELMO, FARINELLA, The regulation of Nuclear Power System in Near-Earth Space, intervention in the ad Hoc Committee on prevention of an arms race in outer space of the Conference on Disarmament, 8 June 1993

<sup>36</sup>MATTESCO MATTE, note 11, p.276; CHRISTOL, note 33, p. 380

<sup>37</sup>VERESHCHETIN, note 3, p.96

<sup>38</sup>BENKO, note19, p. 679

<sup>39</sup>CARACCILO, Il progetto di codice minerario e la responsabilità per i danni all'ambiente marino, in CICIRIELLO, L'impatto ambientale delle attività di esplorazione e sfruttamento dei fondali marini internazionali, Napoli 1995, p. 149; BOYLE, Marine Pollution under the Law of the Sea Convention, American Journal of International Law, 1985, vol 79, p. 366; NOLKAEMPER, Deep Sea- bed Mining and Protection of the Marine Environment, Marine Policy, 1, 1991, p. 63. The Convention is in force since november 16th 1994. At the date october 15th 1995, 67 States ratified the Convention. On July 29th 1994 the Agreement to apply the part XI of the Convention was signed, in UNGA Doc. A/48/950, june 9th 1994