

# LIABILITY AND RESPONSIBILITY FOR SPACE DEBRIS, ABANDONED AND UNREGISTERED SPACE OBJECTS, AND FOR DAMAGES CAUSED DURING RESCUE OPERATIONS

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## **Abstract**

The range of damages that may be caused by means of space activities place space object's registry system, insurance, and the legal regime for space operators, in the role of safeguards of the rights of those potentially damaged by space objects or activities; moreover, they show the need of updating the Liability Convention to include new situations unruled in the present text. Therefore, the creation of local registries of space objects and space operators as a *sine qua non* requirement to allow space activities, must be compulsory and not a mere faculty of the launching State. It should also be an obligation the transmission of thorough information of the space mission to the General Secretary of the United Nations. The infringement to these duties should be punished with the seizure of the object or vehicle not adequately registered, or abandoned. It should also be considered the hypothesis of non-required rescue and the compensations for damages caused

during rescue operations both in outer and in air space, as well as on the Earth surface or over seas.

## **Ethics in space**

There shall never be peaceful utilization of outer space, if ethics is not observed as the metalaw framework. A sincere and open international cooperation requires plain and complete exchange of information among the diverse launching authorities. This may be difficult when States pursue defense objectives in the utilization of outer space; but it must be reminded that these goals are unlawful in accordance to art. IV of the Outer Space Treaty, which establishes that outer space, must be utilized with peaceful purposes exclusively.

Ethics deserves a major place in space activities. On this subject, ESA and UNESCO have prepared a joint report on the ethics of space that has been presented recently.<sup>1</sup>

*"Ethics is a fundamental aspect of human society. For those who are involved in*

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*space activities, ignoring this debate is not an option," said Antonio Rodotà. "At the European Space Agency we are committed to ensuring that the ethics of space science and technology will be considered in our decisions and in our programmes", he added.*

These activities must be performed taking into account that celestial bodies, outer space, and their natural resources are common heritage of mankind. Consequently, those places are not property of the launching States or authorities, but of humankind. The utilization of outer space must be adjusted to the use of any common thing, respecting the right of other proprietors of future or simultaneous enjoy of said things and resources. Any construction, facilities, or debris left in the common space or celestial body, should be in no case an obstacle to the exercise of others right. Otherwise, we could not recognize this utilization of outer space, celestial bodies, or natural resources, as peaceful, but as a conflict generator and abusive utilization. Hence, we can conclude that space debris and abandoned space objects, are the result of an improper use of space in prejudice of any space nation that may aspire to perform a space activity in the space area or using the same natural resources.

### **The principle of peaceful utilization of outer space and in the benefit of all nations**

The Russian Federation Law on Space Activities is an example of complete local regulation of space activities in accordance to the space international treaties in force.

Said Law states the goals and purposes of any Russian space activity (Article 3): 1. Space activity shall be carried out with the aim of promoting the well being of the citizens of Russian Federation, the development of Russian Federation and ensuring its security, as well as solving global problems of humankind. 2. Main tasks of space activity under the jurisdiction of Russian Federation shall be:

- Providing access to outer space;
- Studying of the Earth and outer space;
- Developing science, techniques, and technologies, enhancing economic efficiency;
- Ensuring defense capabilities of Russian Federation and control over the implementation of international treaties concerning armaments and armed forces.

In its art. 4 the Russian law establishes, among other, the following Principles of Space Activity:

- access to information about space activity;
- independence of expertise on issues of space activity;
- provision of safety in space activity, including protection of the environment;
- promotion of international cooperation in the field of space activity;
- international responsibility of the state for space activity performed under its jurisdiction.

In order to assure the peaceful utilization of outer space, said law states:

2. In order to ensure strategic and ecological security it is prohibited in Russian Federation:

- to put into the orbit around the Earth or to deploy in outer space otherwise nuclear weapons and any other kinds of weapons of mass destruction;
- to test nuclear weapons and any other kinds of weapons of mass destruction in outer space;
- to use space objects and other space technology as a tool to influence the environment for military and other hostile purposes;
- to use the Moon and other celestial bodies for military purposes;
- to create deliberate immediate threat to safety of space activity, including safety of space objects;
- to create harmful contamination of outer space which leads to unfavourable changes of the environment, including deliberate elimination of space objects in outer space.
- Other space activity under the jurisdiction of Russian Federation, which is prohibited by international treaties of Russian Federation, is not allowed as well.

This could be linked with the protection of space environment against space debris. Another precise provisions rule liability and full compensation regime for the damages caused by means of space activities in national order.

### **The principle of international cooperation**

The principle of international cooperation, enshrined in the Outer Space Treaty, has been regulated in the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the interest

of all States, taking in particular account the needs of developing countries.

Said Declaration remarks the legal fundament of the principle, when recalling that space activities shall be carried out for the benefit and in the interests of all States, irrespective of their degree of economic, social or scientific and technological development, and shall be the province of all mankind. Particular account should be taken of the needs of developing countries (Principle 1).

Prof. Ferrer is right when he affirms that international cooperation may be seen in two ways: positive and negative. That is to say: cooperating by means of any contribution the cooperative part may afford, and allowing the activities without putting any obstacle. Is a fact, that to get cooperation, parties must convene progressively in a bilateral, multilateral or regional level, their contributions to the projected activity on an equitable and mutually acceptable basis (Principle 4). Contractual terms in such cooperative ventures should be fair and reasonable and they should be in full compliance with the legitimate rights and interests of the parties concerned as, for example, with intellectual property rights (Principle 2).

In this sense, the Party that must put its best effort to reach cooperation is the State with relevant space capabilities and with programs for the exploration and use of outer space, so it must contribute to promote and fostering international cooperation on an equitable and mutually acceptable basis. It clearly appears the duty of developing countries to expound fairly the needs and interests without profiting from the legal obligation space States have to achieve said cooperation.

Good faith and fair play should always rule international relations.

In connection to the process of planning cooperation, information plays a fundamental role. To let COPUOS play its role in this sense, information should be thoroughly given by both parts in the cooperation. The State proposing cooperation and the second contributor must give truthful and sincere information about the real purpose and conditions of the projected or in process space mission, as well as the expectative on the results of it.

### **Concept of launching state**

The Outer Space Treaty provides that each nation is responsible for the activities of its governmental and non-governmental entities in outer space. A nation is liable if it either "launches a space device," "has it launched," or is the nation "whose territory or installations are used to launch the space devices."<sup>2</sup>

The view was expressed that new launching technology, including mobile launchers, created some uncertainty in application of the concept of the "launching State" under the Liability Convention and the Registration Convention. Space activities require authorization and continuing supervision by the appropriate State. Both the Liability and the Registration Conventions contain adequate provisions for successfully handling any specific situation involving a private space launch. While it might be generally helpful to have an agreed definition of what "procuring" a space launch meant for the purposes of the above instruments, it should be realized that such an interpretation by the Legal Subcommittee would be a doctrinal one, because only

States parties to an international treaty had the authority to provide an authentic interpretation of that treaty.<sup>3</sup>

The view was expressed that a State authorizing the launch of a space object, for instance through a license or official registration, was a State "procuring the launch" of a space object under the Liability Convention and the Registration Convention. However, the view was also expressed that authorization was not necessarily synonymous with procurement.<sup>4</sup>

### **Local registries of space objects and operators**

The creation of a local registry of space objects should be an obligation for State Parties. The Convention on Registration of Space Objects did not establish said creation as an obligation for the State Party. This should be modified, for the omission of the creation of the national registry of space objects might derive in evading the international liability duty of the launching State.

The creation of local registries for space operators is a natural consequence of the international liability of states for damages caused by space activities. This registry allows the State to claim the operator for the damages it had to compensate. By other side, it is a manner to control the efficiency and solvency of the operator, be it individual or juridical person.

### **Abandoned and unduly registered space objects**

Once performed the useful life, some space objects, duly registered by a State of launching, are abandoned in (near or far) orbits. This abandonment has a close

connection with a possible renouncement of the property right of the State of registration and with the right of trajectory said State was exercising when the space object was placed in outer space orbit.

Does this renouncement mean that the space object becomes a *res derelictae*? If so, does this imply that any State may appropriate the object for itself? Could this appropriation be considered as a measure of space environment protection? If we accept the right of appropriation of an abandoned space object in outer space, could this thought lead us to the recognition of the right of appropriation by the State in whose territory a space object makes an unwanted landing? These possibilities endanger the legal symmetry among space authorities. Abuses may rise among States in different stages of development or with economical or political conflicts besides the space originated damage; this may only be elucidated by a third neutral authority.

It should be taken into account that the Liability Convention extends the State's responsibility to damages caused by space objects and the concept of space object encompasses its component parts. In other words, there is a kind of debris that generates the launching state liability when causing damages: the component parts of an abandoned space object colliding with another space object in outer space or, otherwise, falling to the surface and damaging private property, for instance. I agree with the proposition of including the concept of space debris in the definition of space object in the Outer Space Treaty and in the Liability Convention.<sup>5</sup>

## **International responsibility of States and international organizations**

We have already analyzed the liability of the launching States when the damage is produced by abandoned space objects (or their identifiable fragments). However, what happens when the damages are caused by space debris (in outer space or on the surface) which launching State cannot be determined? If the damage is caused in space by space dust or micro particles (i.e. paint flakes), the liable State cannot be identified and hence, the whole liability space system falls down.

However, prevention seems to be the best procedure to avoid these damages. In addition, the best way to generate the will of prevention in launching States is creating an efficient organization of justice and administration. By other side, it should be established the obligation of insurance to legitimate any space activity.

Launching authorities do not know what kind of debris may derive from their space object, therefore, the possibility of losing the right of recovering the spacecraft wreckage as it is already expended, may be stimulating to put the best effort in preventing the production of debris.

In any case, a fund should be created by all Launching States, to compensate damages caused by small particle debris that make unable to identify the launching responsible State.

## **Art. IX of the Outer Space Treaty. Necessary steps taken towards removing space debris.**

The presence of man-made debris in orbit about the Earth endangers any spacecraft operating in that environment. The level of hazard to a given spacecraft depends on the size of the spacecraft, the number and size of debris fragments in its environment, and the length of time the spacecraft remains on orbit.<sup>6</sup>

It has been said that space debris is all useless man made objects in outer space.<sup>7</sup> Some debris is what we can call *mission-related debris*, because they are the natural result of space missions or their deployment or rocket stages. Some debris derives from unexpected situations such as non-previewed explosions, some other, from explosions for military purposes such as the ASAT tests.<sup>8</sup> The same author explains that once created above a certain altitude, the space debris will survive almost forever. The only force that may act in a positive manner is the atmosphere that brakes the debris with a force proportional to the falling velocity and the density of the atmosphere.

The position paper of the International Academy of Astronautics on space debris also states that: space debris are considered to be every man-made object in outer space whether it still exists as a whole or whether it is fragmented to any size in the event that such object is not functional and there is no reasonable expectation of it assuming or resuming its function.<sup>9</sup>

The main problem of the on-orbit debris hazard is that it is self-perpetuating. This derives from: 1) a single spacecraft launch can be responsible for a multitude

of hazardous objects in space; 2) orbital debris tends to disperse randomly, producing high intersection velocities and making avoidance extremely difficult; and; 3) objects accumulate in Earth orbit rather than passing through the near Earth space in the manner of meteoroids. Evasive maneuvering techniques may reduce the *present* probability of collision for specific satellites in certain circumstances, but do not provide a practical long-term solution.<sup>10</sup>

Past design practices and deliberate and inadvertent explosions in space have created a significant debris population in operationally important orbits.<sup>11</sup>

The space shuttle orbiter has maneuvered to avoid collisions with other objects on several occasions. Regarding satellite constellations, if a potential collision will lead to the creation of a debris cloud that may result in damage to other constellation members, it may be worthwhile to perform a collision avoidance maneuver.<sup>12</sup>

In the more distant future, it may be necessary to completely remove all satellites and upper stages from orbit. This removal will not be feasible until new technology is developed.<sup>13</sup>

The only natural mechanism opposing debris buildup is removal by atmospheric drag. However, this process can take a very long time, especially from high altitudes, and causes debris to migrate from higher to lower altitudes. Another mechanism, collection by a spacecraft ("orbital garbage truck") would be extremely difficult and expensive. Prevention of debris formation is the most effective approach.<sup>14</sup>

The AIAA Position Paper on Space Debris agreed with the Scientific and

Technical Subcommittee that consideration of space debris was important and that international cooperation was needed to expand appropriate and affordable strategies to minimize the potential impact of space debris on future space missions. The Committee also agreed that it was essential for Member States to pay more attention to the problem of collisions of space objects, including those with nuclear power sources, with space debris, and other aspects of space debris, in accordance with paragraph 32 of General Assembly resolution 51/123.<sup>15</sup>

The AIAA Position concludes, among other thoughts that: The space debris issue should be faced by all space users, and coordinated action should be taken immediately if the future use of space is not to be seriously restricted. Design to tolerate debris impact (bumpers) or to provide evasive capability may supply a measure of protection to particular satellites, but the most effective approach is to eliminate the need for such action by constraining the generation of further debris.<sup>16</sup> This last one is on my point of view, the most urgent, due to the increasing number of debris since the Paper was elaborated.

There are many sources of debris. One source is discarded hardware. For instance, many upper stages from launch vehicles have been left on orbit after they are spent. Many satellites are also abandoned after end of useful life. Another source of debris is spacecraft and mission operations, such as deployments and separations. These have typically involved the release of items such as separation bolts, lens caps, momentum flywheels, nuclear reactor cores, clamp

bands, auxiliary motors, launch vehicle fairings, and adapter shrouds.

The majority of breakups have been due to explosions. Three collisions are known to have occurred since the beginning of the space age. In addition, the debris research community has concluded that at least one additional breakup was caused by collision. The cause of approximately 22% of observed breakups is unknown.

At altitudes of 2,000 km and below, it is generally accepted that the debris population dominates the natural meteoroid population for object sizes 1 mm and larger.<sup>17</sup>

The UN Secretariat has informed about the steps taken towards the removal of space debris. The document analyzes a broad scope from debris mitigation and prevention to the environmental protection of the GSO and active spacecrafts up to the recommendations given by the International Federation of Astronautics.<sup>18</sup>

In order to minimize the creation of space debris, the Canadian Radarsat program has established a system-level requirement that any solid debris resulting from the operation of a restraint/release mechanism must be contained; that is, all contractors are required to design systems in which no debris is released by the spacecraft during its deployment in orbit.

In all cases, in order to eliminate the potential for explosion, appropriate operational procedures will be established to make passive all energetic subsystems when the satellite has been placed in a graveyard orbit.

The International Academy of Astronautics, approved a position paper to evaluate the need and urgency for

action and to indicate ways to reduce the hazards posed by such debris. In the report on the study, it was recommended that the following action be taken immediately (A/AC.105/570):

- No deliberate breakup of spacecraft that produces debris in long-lived orbits;
- Minimization of mission-related debris;
- "Safing" (venting) procedures for all rocket bodies and spacecraft that remain in orbit after completion of their mission;
- Selection of transfer orbit parameters to ensure the rapid decay of transfer stages;
- Re-orbiting of geostationary satellites at end-of-life (minimum altitude increase of 300-400 km);
- Separated apogee boost motors used for geostationary satellites should be inserted into a disposal orbit at least 300 km above the geostationary orbit;
- Upper stages used to move geostationary satellites from GTO to GSO should be inserted into a disposal orbit at least 300 km above geostationary orbit and freed of residual propellant<sup>19</sup>

The International Academy of Astronautics stated in its Annual Report (1999) that the subject of space debris is constantly with us, and now that the International Space Station is beginning its deployment, we have to come to agreement on rules of debris mitigation. United Nations technical report on Space Debris was produced with the help of many members of our academy. In said

Report the cooperation with national academies was remarked.

### **Jurisdiction and control as right and duty. Damages caused by abandoned or unduly registered objects.**

Article VIII of the Outer Space Treaty recognizes the right of jurisdiction and control of the State of registry over the space object, crew, and mission. This right replaces sovereignty, which was expressly renounced by States in article II of said Treaty, and is the necessary balance to the international responsibility assigned to launching States for the damages caused with their space objects. If the control is not exercised, the conduct of a launching State or authority could be easily qualified as unlawful for its negligence and guiltiness. However, in facts, the liability could not be worsened to said State, because it is absolute whether the damage is caused in outer space or on the surface, nevertheless a punishment to its omission should be established.

The questions are, which punishment could be legally adequate? Moreover, what authority could be able to impose the punishment?

These new aspects would generate the need of a protocol to the Liability Convention. In such a protocol, the State from which non-control attitude derives a damage with an abandoned space object, could even lose its property right and its jurisdiction and control, as well, over object and crew.

Another point to solve is which is the natural legal authority in this circumstance. We must remind that if a damage is caused in outer space, it is



produced within an environment that belongs to humankind. If the facts are produced in a place owned by other part (in this case, humankind), this third part is legitimate to solve the legal conflict and apply its justice. The decision of the commission created by the Liability Convention is binding for the parts, only if they submit to the commission, the solution we propose here, should be always binding.

Finally, we arrive to an old conclusion: an Organization of Administration and Justice representing humanity should decide on outer space, geostationary orbit, the Moon and other celestial bodies and their natural resources. The only organization at the present, is the ITU but this is a technical administration authority in order to prevent inoperability of the geostationary orbit for a chaotic exploitation.

### **Rescue in space. Abusive operations.**

The Rescue Agreement does not refer to rescues in space; as well as the Moon Agreement only considers rescues performed on the lunar surface. It could be interesting to analyze what should be the responsibility and conditions of rescue in outer space or on a celestial body, inasmuch if an unwanted rescue that causes damages, generates the rescuing state responsibility and liability.

Concerning a rescue initiative, we must have in mind that the launching State or authority entitles the jurisdiction and control over said space object. Therefore, any rescue operation despite said State or authority will, must be considered unlawful, and consequently neither remuneration nor compensation for

damages during the operations should be recognized. Nevertheless, if the rescue or assistance is provided to an abandoned or unregistered space object, the operation could be considered as a protective measure to the space environment and, particularly, to other space objects in orbit or displacing across the space or, otherwise, ready to land or take-off from the surface of a celestial body.

Another missing regulation is on the expenses of a rescue operation. As there is no international regulation, the procedure of assistance, in space or surface, should be established, as well as it should be instituted the obligation of insurance on rescue and assistance operations as an obligation prior to any space activity.

### **Conclusions**

1. A commission should be established to study the creation of an international Space Authority with administrative and judicial functions.
2. Abandonment of a space object should be considered a space trespassing.
3. Damages caused by abandoned space objects would determine the loss of the right to recuperate the wreckage of the space object.
4. A protocol to the Convention on Registration of Space Objects should establish the obligation of the creation of the national registries of space objects and space operators.
5. A protocol to the Liability Convention should establish the obligation of insurance for any space launching and mission.

6. The component parts of a space object should duly identify the launching State or authority.
7. Rescue operations in outer space or celestial bodies, should be requested, or accepted by the launching State or authority to generate right of remuneration and compensation.
8. Any State before performing any space activity should afford to a common fund to cover damages derived from small particle debris during the space mission.

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## References

<sup>1</sup> Professor Alain Pompidou and Antonio Rodotà, *The ethics of outer space*; to be presented to the media on 10 July 2000 in Paris.

<sup>2</sup> Bonnie E. Fought *Legal Aspects Of The Commercialization Of Space Transportation Systems*, AIAA, Position Paper.

<sup>3</sup> Committee on the Peaceful Uses of Outer Space *Report of the Legal Subcommittee on its thirty-ninth session*, held in Vienna from 27 March to 6 April 2000 A/AC.105/738 3 VIII. Review of the concept of the "launching State" thirty-ninth session, held in Vienna from 27 March to 6 April 2000 A/AC.105/738 3 VIII. Review of the concept of the "launching State", Par. 80 and 81.

<sup>4</sup> Committee on the Peaceful Uses of Outer Space *Report of the Legal Subcommittee on its thirty-ninth session*, cit. par. 83 and 84.

<sup>5</sup> *Forum for Air and Space Law*, cit., p.254.

<sup>6</sup> *AIAA Position Paper, Space Debris*, Prepared by the Aiaa Technical Committee on Space Debris Systems, July 1981.

<sup>7</sup> R. Oosterlinck, The Exploitation of Outer Space, Chapter 3 of *The Law of International Relations*, Compiled under supervision of K. Tatsuzawa, Ed. Local Public Public Entity Study Organization, Chuogakuin University, Japan, 1997, In its foot note 101 he remarks Prof. Gorove's definition of debris: "no longer functioning, no longer controlled, non useful or abandoned space object or part of such", 32nd Colloquium of the IISL, p. 97, 1989.

<sup>8</sup> R. Oosterlinck, op. cit., p. 525.

<sup>9</sup> International Academy of Astronautics, Committee on Safety, Rescue and Quality, compiled by an ad-hoc expert group, August 27, 1992 and Report of the ESA Space Débris Working Group of November 1988. Referred to in *Forum for Air and Space Law*, vol. 1 International Space Law in the Making, edited by Marietta Benkö in cooperation with Willem de Graaf, 1993, p. 255 in note N° 8.

<sup>10</sup> AIAA Position Paper cit.

<sup>11</sup> AIAA Position Paper cit.

<sup>12</sup> The Aerospace Corporation, op. cit., loc. cit.

<sup>13</sup> The Aerospace Corporation, op. cit., loc. cit.

<sup>14</sup> AIAA Position Paper cit.

<sup>15</sup> *General Assembly Official Records* Fifty-second Session; Supplement No.20 (A/52/20); II. Recommendations and Decisions; B. Report of the Scientific and Technical Subcommittee on the work of its thirty-fourth session (agenda item 7), and implementation of the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (agenda item 9 (a))

<sup>5</sup> Space debris

<sup>16</sup> AIAA Position Paper cit.

<sup>17</sup> *What is Orbital Debris?*, Aerospace Organization, 3/18/99 in www.aero.org

<sup>18</sup> A/AC.105/605, para. 80

<sup>19</sup> It has observer status with the Committee on the Peaceful Uses of Outer Space, and initiated a study on orbital debris, which was prepared by an ad hoc expert group of its Committee on Safety, Rescue and Quality, which was approved in October 1993 as an official International Academy of Astronautics position paper.