IAE-07-E6.3.06
50th International Colloquium on the Law of Outer Space (IISL) (E6.)
New Legal Development in the Protection of the Space Environment (3.)

STATE RESPONSIBILITY AND NEED OF INTERNATIONAL LEGAL CONSENSUS FOR DEBRIS-FREE ENVIRONMENT

Author: Mr. Sethu Nandakumar Menon, India/France
Researcher, IDEST, University of Paris XI, Paris, France, sethu_nand@yahoo.com
Mr. V. Gopala Krishnan
Indian Space Research Organization (ISRO), Bangalore, India, gopal@isro.gov.in

Abstract

In the last two decades, the global space activities have increased manifold resulting in numerous benefits for humankind through various space-based applications, but at the same time resulting in some undesired menace to outer-space Environment. Space debris is the front-runner of space-menace caused by active players mostly because of the lack of concern to their international responsibility. This paper will address the issue of Space Debris, its status according to International treaties and issues surrounding its existence and will urge for an internationally acceptable legal consultation programme by studying certain important constituent elements, to control and mitigate the threat.

This paper will first look at the definitional aspects of the term 'Space Debris' firstly on a technical view point. The paper will be scrutinizing the main space treaties to bring-out the status of Space debris and to show the prevailing inadequacies to mitigate this menace. Further on, this paper will look into the responsibility aspect of contributing to the creation of Space Debris. Even though, a clear-cut international responsibility is absent at the moment, the paper will critically analyze the extent to which the state responsibility can be inferred and various international obligation surrounding this issue. The Paper will finally scrutinize the pertinent need for an international consultation and consensus which make way for a multi-party workforce to reduce and decrease the threat caused by Space Debris.

Introduction

In the quest of finding a consensus and amicable solution to the issue of 'Space Debris'; the first and the most important step is to define and understand the issue involved in it. Space debris is a one simple word which constitutes numerous items. Hence, it is required to define space debris according to its formation and characteristics. There is also need to define and understand the legal implication of space debris. After examining the definitions, paper check the ambit of threat that is posed by space debris to the future Space missions and payloads.

As there is no internationally accepted legal definition for space debris, three factors have been scrutinized in light of

the space treaties to link space debris to state responsibility. First of all the notion of 'Space Objects' is analyzed and whether space debris can be considered as 'Space Objects' and what are the legal implication involved in it. Secondly, the issue of liability as envisaged in the liability convention is looked up. The issue of liability will have immense importance in case of collision or damage that arises from space debris. In the same line of thought, the control and jurisdiction as envisaged in Outer Space treaty also need to be looked into, as lot of the debris is accounted for its origin.

After perusing the definition and the risks posed by Space debris, the paper will scrutinize the doctrine of State responsibility and International obligation in the ambit of Space Treaties. Article VI and IX of Outer Space Treaty is analyzed in view of the threat posed by space debris. After analysis several issues pertaining to State's responsibility to solve the menace of space debris and how a state is held responsible for its action of creating space debris, the paper verify the different options that are there to find a solution to the legal tussle. The need of co-operation and consultation to reach a consensus on the definition of space debris and to find a solution to mitigate space debris and to take a step forward is discussed in the paper.

Definition and consequence of 'Space Debris'

In simple layman language, space debris means any fragments or trash that orbit around earth in outer space. There are two kinds of debris, namely, 'naturally-occurring orbital debris' and 'man-made debris'. Naturally-occurring debris are the meteoroids and man-made debris are the ones generated by manned and unmanned space program of the world's space faring nations and international organizations.

Screening the risk posed by naturally occurring debris and man-made debris, man-made debris poses much greater harm to future space activities than the naturally occurring meteoroids. Several reasons are pointed out for this. Firstly, the meteoroid population is essentially consistent, while the quantity of space debris is steadily increasing[i]. Secondly, since space debris is largely confined to earth orbits, it occupies a much smaller volume than do interplanetary natural materials [ii] . Thirdly, meteoroids are transient through the near-Earth environment; space debris is permanent in its orbit during its lifetime, thereby posing a risk over a greater period of time [iii] . And finally, as part of the universal background through which earth passes, the presence of the meteoroid population has already been accounted for in spacecraft design[iv].

Another important factor that is common for all space debris is the decay period, which is the length of time an item of space debris will remain in outer space. The decay period is related to its orbital period, that is, the time a space object takes to complete one orbit around earth. If the orbital period is less than 95 minutes, natural decay mechanism will cause the fragments to decay in a relatively short period of time. With lengthier periods, space debris can cause an "essentially permanent threat" to space navigation[v].

For the above mentioned reasons, this paper will be solely looking at the debris

caused by human activities in outer space.

(a) Definition of Space Debris

It is to be noted in the first instance that international space law does not provide for a definition or description of space debris. Hence, definition is to be ascertained from the characteristics.

To define space debris and to know its characteristics, it needs to be divided into different classes depending on its formation. Four classes are identified and they are: fragmentation debris, operational debris, microparticulate debris and inactive payloads.

The first class of space debris, fragmentation debris, is formed when a man-made space object break up in outer space. The break-up can occur as a result of explosion, collision or other unknown reasons. Fragmentation debris from more than 100 identified satellite breakups accounts for more than half of the catalogued space debris objects in the earth orbits and is found at altitude below 2,000 km where many applications satellites function and where all manned operation take place[vi].

One of the most known causes for the formation of fragmentation debris is explosions in outer space. It can be both deliberate and accidental explosion. Deliberate explosion result mainly from military programmes, wherein the explosion are detonated to prevent recovery of military intelligence and to test new military weapons. Accidental explosions are generally related to propulsion system failures [vii] . The reasons behind the explosion and the deliberate stance in conducting such an explosion by any country make it responsible for the formation of space debris. In the same context, the Anti-satellite programmes (ASAT) and Strategic Defense Initiative (SDI) are also reasons for deliberate explosions in outer space. The second source of fragmentation debris, from collision, produces greater quantities of debris than explosion fragments. Moreover, the debris from collision is too small to be tracked and travel at speeds far greater than the debris formed from explosion[viii]. There are also several incidents where debris fragmentation cannot be pointed to a specific cause or incident, which are categorized as 'unknown reasons'.

Debris formed at some stage in a space mission is termed as operational debris. These are launch hardware and also include items placed in outer space, accidentally or deliberately, by humans during manned missions. The largest pieces of operational debris are associated with placing satellites in orbit. They consist of burnt-out first and second stage rocket bodies, orbital transfer vehicles (OTVs) and apogee kick motors[ix].

Microparticulate debris is matters consisting of particles, gases and space glow. It varies in size from 1-100 microns[x]. It is estimated that between 10 billion and thousands of trillions of microparticulate debris are present in outer space [xi] . The main causes of microparticulate debris are solid-propellant rocket motors, manned spacecraft and surfaces of orbiting objects. Microparticulate debris are caused by three causes in the solid-propellant rocket motors, which are, the exhaust plume during rocket firing, the rocket nozzle during the postfire period

and from auxiliary hardware. Another major source for microparticulate debris is from the surfaces of orbiting objects, which constitute mainly the coating materials, such as, paints and their binding agents. Another phenomenon is called spaceglow, which can also be considered as a potential debris source since it interferes with space-based optical measurements[xii].

Lastly, former space mission payloads which are no longer in service and cannot be controlled by their operators constitute debris, termed as 'Inactive payloads'[xiii]. There are thousands of inactive payloads orbiting around Earth at altitudes from a few hundred kilometers to 100,000 kilometers and with orbital lifetimes of many hundreds of years or more[xiv].

(b) Aftermath of Space Debris

After analyzing the definition of space debris, this paper is looking briefly into the aftermath that is experienced and predicted due to space debris. There are various levels of risks that space debris pose to space assets, future space missions and active payloads. Risk and impact from space debris depends on the size of the debris that causes the impact. Possible harms range from loss of the capabilities of a satellite sub-system to spacecraft obliteration[xv]. With respect to the size of the debris, objects of the greatest concern are between 0.1 and 10mm in diameter[xvi]. Now a days, most of the spacecrafts are designed to withstand the impact of space debris to a certain extend. Even with the design protection, spacecrafts and active payloads are vulnerable to debris impact. In this context, it is to be noted that, with speed averaging 10 km/s (more than 35,000 km/hr), a 0.5 mm chip of paint could puncture a standard space suit, killing an astronaut engaged in extravehicular activity (EVA)[xvii]. The impact could seriously damage a spacecraft or destroy a satellite in GEO, since the collision would eject from the satellite a mass of 115 times the mass of the impacting debris[xviii]. It is to be noted that, risk of collision with space debris is becoming a significant factor when considering space operations and the design of spacecrafts[xix]. In the same line, there is the need of maneuvering of satellite to avoid collision with debris. This will increase the quantity of fuel stock in the satellite for maneuvering and thereby limiting the weight factor while designing the satellite. All these factors will cause to add-up expenditure on debris mitigation technologies for space projects and thereby reduce the expenditure for other technology resources.

There have been several instances of hypervelocity impacts on active payloads in space. There has been a hypothesis put forward in 1978, called cascade effect, as a serious consequence to debris impact[xx]. As per the Cascade affect argument, the number of space debris in earth orbit increase and thereby increasing the probability of collision between them, creating secondary debris. Once sufficient secondary debris has been generated, debris flux will increase exponentially with time, even if no new objects are placed in orbit[xxi].

Another major risk that is faced due to space debris is the interference in the scientific and other activities. Space debris may interfere with the acquisition of scientific data from experiments based in space. In the same manner,

collision with active payloads and space debris could release radioactive contamination, which is present in the older payloads, and other various waste products into the outer space environments[xxii], this has a long term repercussion.

State responsibility and International obligation as per Space Treaties

The basic duty of a State to its fellow States is stated clearly in the Roman Principle of *sic utere tuo ut alienum non laeda* (use your own as not to injure another's property[xxiii]). In case of space assets, every State has the same duty to other space faring nations and future space ambitious nations. In the same line of thought, it is to be noted that, principle 21 of the 1972 Stockholm Declaration on the Human Environment, which is accepted as a rule of customary international law, states that 'States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction[xxiv]'. First this chapter looks into the facets of Space Debris that links it to State Responsibility. Further on, paper is looking into the definition and ambit of Article VI and Article IX of the outer space treaty. Thereafter the combination of the Outer Space Law and general principle regarding State Responsibility is analyzed.

(a) Facets of 'Space Debris' relating to State Responsibility

Earlier in the paper, debris has been defined according to its origin and character. There are different arguments in line with its formation and whether certain types are considered as debris. This paper will be considering all the above mentioned formations as debris and would figure out its status in legal terms. A clear definition of the word 'debris' will help to overcome the confusion and to develop a starting point for an international collective mitigation action. In this sub-section, three aspects of space debris is been scrutinized in different angles to link different aspects of 'space debris' to State Responsibility: (i) 'Space objects' and its application to debris, (ii) Issue of Liability for damage caused by debris, and (iii) Control and jurisdiction of debris

This paper verifies whether space debris can be considered as space objects. For the purpose of jurisdiction and control, space objects can be defined as an object launched into outer space by a state[xxv]. As per Article 1(d)[xxvi] of the Liability Convention, the term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof. The same description is given under Article 1 (c)[xxvii] of the Registration Convention. Hence it is to be noted that, even through there is no one specific definition for 'space object', it has been defined generally in the space treaties as 'an object launched into outer space by a state' for the purpose of jurisdiction and control and 'includes component parts as well as its launch vehicle and parts thereof', for the purpose of Liability Convention, Registration Convention etc. There are so many different arguments, as to what are included in the definition of 'space objects'. One major issue will be

regarding the inactive payloads, whether they are considered as space objects. Second issue that needs to be verified is the 'component parts', which cover pretty much all other forms of debris formed from a payload. The status of inactive satellites and spacecrafts is uncertain, since Article I (d) give no indication as to whether a payload must be active to qualify as a 'space object'[xxviii]. If space object is defined as an object designed for use in outer space, then inactive payloads would not be included in the ambit of space object[xxix]. Looking into the second issue of component parts, it is not been defined specifically in any of the space treaties. During the space object debate, it was suggested that 'all objects which were likely to give rise to liability' be included as 'component parts' [xxx]. But there is certain other explanation whereby, it excludes any objects in or attached to a space object which do not 'facilitate the objectives of the launch' or would not be 'conducive to the successful operation of the space object'[xxxi]. It should also be noted here that the fragmentation debris and microparticulate matter will only make the debate more complex.

Coming to the second legal issue of 'Liability of damages caused by debris', it is to be noted that, all the space debris have been left because of the activities of the space faring nations. Hence, it can be said that there is a blanket responsibility of all the space faring nations to be liable for the damage caused by the debris. As per Article VII (b) of the Liability Convention [xxxii], operational state is derived and extends 'from the time of [the] launching or at any stage thereafter until its decent'. As there is no descent for space debris, and as it is left behind in outer space, liability can be carried over to the launching state of the space debris, if the damaged caused due to collision of a space debris can be proved and there is adequate proof of its origin.

Article VIII of the Outer Space Treaty states that, 'A state party to the treaty 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'[xxxiii]. As the term space debris is not mentioned specifically in Article VIII, the simple issue that needs to be addressed is the fact whether space debris comes under the scope of Article VIII. The test of 'effective control' could be established as a means for distinguishing active satellite from inactive payloads [xxxiv]. According to DeSaussure [xxxv], the obligation to co-operate, provide mutual assistance and have due regards for the corresponding interests of other states limit the absolute nature of the provisions in Article VIII. Furthermore, the rights of ownership include the rights of possession, use and disposal, thereby denying a right of encroachment without the consent of the State of registration[xxxvi].

(b) Ambit of Article VI of Outer Space Treaty

As per Article VI of the Outer Space Treaty[xxxvii]:

State Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-

governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present treaty....

This is a clear statement of international responsibility for the activities carried out in outer space by nation states and other international organizations. These outer space activities also include the making of space debris. Hence, as per Article VI of Outer Space Treaty, the States are internationally responsible for damages caused by the space debris in the outer space. Sentence 1 of Article VI is intended to ensure that all space activities, no matter who conducts it, is carried out according to the rules of international law; there by bringing the consequence within the jurisdiction of the State undertaking the activity. In addition, States cannot devolve their Article VI responsibility[xxxviii].

One of the biggest drawbacks which crept into Article VI, is the non establishment of a specific regulatory regime necessary for attribution of the international responsibility for which the principles are provided. Even though, outer space is a global commons, whereby use and exploration is "for the benefit and in the interest of all countries" [xxxix] transcending national boundaries [xl], the traditional approach can "never ensure... protection ...of the outer space from pollution"[xli]. Hence the principle envisaged in Article VI should be viewed in such a way that, the legal obligations flowing from the principle of international responsibility as a commitment to protect the interests of Earth and outer space, as well as the interests of individual nation states. Thereby, States have the responsibility for protection of outer space environment and at the same time protect the national interest for space activities.

(c) Article IX of Outer Space Treaty and State responsibility

The root of Article IX of Outer Space Treaty [xlii] is the avoidance of harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and it also deal with harmful interfere with the activities of other state parties. There are real difficulty in defining the terms, like, 'harmful', 'contamination', and 'interference' [xliii]. States undertaking scientific, commercial or public service space activities are obliged to avoid harmful forward and backward contamination and to adopt measures, where appropriate, for avoiding such contamination [xliv]. But, it need to be noted that, during the drafting of Outer Space Treaty, protection offered in Article IX sentence 2 was never meant to apply to environments of Outer space, the Moon and celestial bodies per se[xlv]. Even then, priority ranking was given to possible environmental harms; this was to avoid interference of one activity with another's[xlvi].

An argument was put forward that the word 'avoid' was used instead of 'barred' thereby allowing for harmful contamination by default [xlvii]. In this context it need to be seen that, even though the word avoid is used, there by not barring the whole procedure and scientific advancement, it cannot be considered as a license to do contamination if there is no other option and the states cannot withdrew itself from the obligation of contamination.

Article IX of the outer space treaty attempts to regulate the freedom to use and explore outer space environment and to make sure that the outer space environment is not contaminated. But the drafting of the article shows that the drafters have only taken a scientific approach and not an environmental approach. The activities are prohibited only to avoid interference with future missions and to limit and control activities which harm the system. If it was a sole environmental approach, there would have been a complete ban and more stringent regulation with straight forward usage of banning provision.

State Responsibility and need of International legal consensus

The principle of State Responsibility of States is portrayed by a leading authority as[xlviii]:

> The Chief need of the principle of responsibility today is a clear statement of the rules of international law, a more precise definition of what obligations the State has under that law. The problem is not so much due to the fact that States refuse to respond to their obligations, as that they are unable, in many instances, to agree upon what those obligations are.

Hence, the most important need in the context of responsibility of states is a clear statement of the rules of international law.

(a) Need for clear International obligations for fixing State Responsibility

As per Article 2 of the Draft Article on 'Responsibility of State for Internationally Wrongful Acts'[xlix], it is stated that:

> There is an internationally wrongful act of a State when conduct consisting of an action or omission:
>
> (a) Is attributable to the State under international law; and
>
> (b) Constitutes a breach of an international obligation of the State

It is thus asserted that, there is a need of rules or regulations either prohibiting or regulating a specific act or omission to attribute international responsibility. In *Spanish Zone of Morocco Claims* case[l], Judge Max Huber said that, "Responsibility is the necessary corollary of a Right. All rights of an international character involve international responsibility". Hence, every state has duty to respect the rights of other states to make a claim on one's own right. This is very important with respect to space debris, as every space faring nation have a duty to respect the rights of other states.

There is a lack of clear definition of the word space debris in international law. Even though the term have been defined in technical sense, with out a clear definition of different types of space debris, with rules and regulations either prohibiting or regulating specific acts or omission; Obligation cannot be attributable on States, thereby lacking the authority to fix international state responsibility.

An analogue is taken from the decision of *Corfu Channel* case[li], where in, it was decided by the court that, Albania is guilty of failure of duty to warn

international shipping against the mining of its territorial waters, and said that "these grave omission involve the international responsibility of Albania". Hence it is summarized that, state responsibility is a duty on the part of state to observe general obligation that are undertaken and is concerned primarily with prevention of any breach of such obligation. Therefore, it can inferred in general terms from Article VI of Outer Space Treaty that states shall bear international responsibility for national activities and formation of a space debris is also part of that national activity and the state have a duty towards other states not to pollute outer space and a duty o warn other states about the Debris and the risk it posses to other states.

From the above discussion, it is clear that there is a need of consultation and consensus need to be reached regarding definition of space debris and other related issues.

(b) Common interest, Co-operation and Consultation

Article 1 of Outer Space Treaty states that, "the exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development". The need of common interest is both the end and means. It is an end in so far as "the law which imposes upon him the obligation of respecting the rights of others in order that his rights may be respected, is based upon the common interest of all the members of the political group to which the state belongs". It needs to be noted that, if there is a conflict between the individual and common objective, common interests should take precedent over individual objectives.

Paragraph 6 of the Legal Declaration[lii] states that, "In the exploration and use of outer space, States shall be guided by the principle of cooperation and mutual assistance and shall conduct all the activities in outer space with due regard for he corresponding interests of other States. If a State has reason to believe that an outer space activities or experiment planned by it or its national would cause potentially harmful interference with activities of other States in the peaceful exploration and use of outer space, it shall undertake appropriate international consultations before proceeding with any such activity or experiment..."

The principles of co-operation and consultation have been upheld through the declaration. Hence, in the collective interest of all the nations, it is the duty of each and every space faring nation to come forward and form a common interest to reach a consensus on the issue of space debris.

(c) Step Forward

There are so many various factors that need to be scrutinized and analyzed to reach a consensus on space debris. This paper have perused several factor involved in the jig-saw and here under is putting forward some of the most fundamental flows that need to be rectified. There is already technical definition of Space debris on various angles, as to formation, size, ingredients etc. But there is not even a single international legal definition which

clearly state space debris as a whole or even the constituent parts. Therefore, the first step is to define and reach a consensus on a legal definition of space debris. There is a need to identify the space debris that causes the damage so that the state responsible for the particular debris can be held responsible for the mishap. The identification of space debris will encourage the space faring nations to consult with each other share the information and work together to void collision and for future debris mitigation progammes.

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[i] D.J.Kessler and S.Y. Su (eds.)*Orbital Debris* Proceedings of a Workshop sponsored by the NASA Lyndon B. Johnson Space Centre, Houston, July 27-29, 1982 (Washington , DC: NASA Scientific and Technical Information Branch, 1985) 8; See also H.A.Baker, *Space Debris: Legal and Policy Implications* (Cmarkimis Nijhoff Publishers, 1989) 3

[ii] D.J.Kessler, "Earth Orbital Pollution" in E.G. Hargrove (ed.) *Beyond Spaceship Earth: Environmental Ethics and the Solar System* (San Francisco: Sierra Club Books, 1986) 48,49

[iii] *supra*, note 1 at 366

[iv] D. Fielder, "Considerations for Policy on Man-Made Debris Propagation Control" in Kessler and Su, *supra* note 1, 412

[v] Baker, *supra*, note 1 at 4

[vi] "Orbital space Debris Threatens Future of Scientific and Commercial Missions" (18 Jul 1988), *Satellite News* 2 at 3 and Baker, *supra*, note 1 at 5

[vii] Ibid, at 5

[viii] Baker, *supra,* note 1 at 7

[ix] OTVs, also called third stage rockets, carry payloads from a low-Earth orbit (LE) to the geostationary orbit (GEO); apogee kick motors circularize the trajectory of the payload at the geostationary altitude.

[x] Baker, *supra,* note 1 at 8

[xi] M.G.Wolfe and L.P.Temple III, "Department of Defense Policy and the Development of A Global Policy for the Control of Space Debris", *30 Colloquium on Law of Outer Space*, Brighton, 1987 at 3

[xii] R.K.Cole, R.G. Albridge, D.J. Dean, R.F. Haglund Jr., C.L. Johnson, H. Pois, P.M. Savundaraj, N.H. Tolk, J. Ye and A.F. Dacch, "Atomic Oxygen Simulation and Analysis" (1987), *15 Acta Astronautica* 889. see also Baker, *supra,* note 1 at 9

[xiii] W.B. Wirin, "The Sky is Falling: Managing Space Objects", *27 Colloquium on Law of Outer Space* 151. Loss of Control over a functioning space object may occur due to the depletion of the station-keeping fuel or the inability to communicate with the object.

[xiv] N.L. Johnson, "Preventing Collisions in Orbit" (May-June 1987), *SPACE* at 17; see also Baker, *supra,* note 1 at 4.

[xv] D.S. Edgecombe, N.H. Fischer and R.C. Reynolds, "Space Craft Design Alternatives to Accommodate Collision Threat Posed by Orbiting Man-made Debris" in G.W. Heath (ed.), *Space Safety and Rescue 1982* at 226; see also Baker, *Supra,* note 1 at 9

[xvi] Special Report of the USAF Scientific Advisory Board *Ad Hoc* Committee on Current and Potential Technology to Protect Air Force Space Missions from Current and Future Debris (Washington D.C.: The Pentagon, 1986) at 4

[xvii] L.P.Temple III, "The Impact of Space Debris on Manned Space Operations", Paper prepared for presentation at the AIAA Space Systems Technology Conference, San Diego, CA, June 1986 at 6; see also Baker, *Supra,* note 1 at 10, see also Wolfe and Temple, *Supra,* note 11 at 3

[xviii] S. Wiesser, "Access to a *Res Publica Internationalis:* The Case of the Geostationary " (1986), 29 *Colloquium on Law of Outer Space* at 147

[xix] Temple, *Supra,* note 129 at 6

[xx] See D.J. Kessler, "Estimate of Particle Densities and Collision Danger for Spacecraft Moving Through the Asteroid Belt" in T. Gehrels (ed.), *Physical Studies of Minor Planets* (Washington D. C.: NASA, 1971) at 595; see also Baker, *Supra,* note 1 at 13; In 1970, while investigating the collision danger to spacecraft posed by asteroids, the cascade effect was hypothesized to explain the formation of asteroid belts.

[xxi] See Baker, *Ibid* at 13

[xxii] See Baker, *Ibid* at 14

[xxiii] B.A.Garner (ed.), *Black's Law Dictionary,* (1999) (west group, 7th ed.) at 1690

[xxiv] *Declaration of the United Nations Conference on the Human Environment.* The Official text of this declaration is contained in *Report of the UN Conference on the Human Environment, UN Doc. A/CONF.48/14 (1972) 2-65 and Corr.1 (1972).*

[xxv] Paragraph 7, *Declaration of Legal Principles Governing the Activities of States in the*

Exploration and Use of Outer Space, UNGA Res. 1962 (XVIII) 13 December 1963.

[xxvi] *Convention on International Liability for Damages Caused by Space Objects,* UNGA Res. 2777 (XXVI) 29 November 1971; 1975 CanTS 7, 24 UST 2389, TIAS 7762 (opened for signature 29 March 1972, entered into force 9 October 1967).

[xxvii] *Convention on registration of Objects Launched into Outer Space,* UNGA Res 3235 (XXIX) 29 November 1971; 1976 CanTS 36, 28 UST 695, TIAS 7762 (opened for signature 14 January 1975, entered into force 15 September 1976).

[xxviii] *Supra,* note 16.

[xxix] See W.F. Foster, "The Convention on International Liability for Damage Caused by Space Objects" (1972), 10*Cndn Yearbook on International Law* at 145

[xxx] UN GAOR, COPOUS, *Seventh Session of the Legal Sub-Committee,* A/AC.105/C.2/SR.102-10 (19 August 1968) Australia at 60

[xxxi] Senate Committee on Foreign Relations, *Convention on International Liability for Damage Cased by Space Objects,* S. Exec. Rep. 38, 92nd Cong., 2nd Sess (1972) 9, cited in C.Q. Chirtol, "International Liability for Damages Caused by Space Objects" (1980), 74 *American Journal on International Law* 349; see also Baker, *supra,* note 1 at 65

[xxxii] *Supra,* note 16.

[xxxiii] *Treaty on Principle Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies,* UNGA Res 2222 (XXI) 19 December 1966; 610 UNTS 205, 1967 CanTS 19, 18 UST 240, TIAS 6347 (opened for signature 27 January 1967, entered into force 10 October 967).

[xxxiv] See A.G. Haley, "Space Age Presents Immediate Legal Problems" (1958) *1 Colloquium on Law of Outer Space* at 6.

[xxxv] H.Desaussure, "An International Rights to Reorbit Earth Threatening Satellite" (1978), *3 Annals Air & Space Law* at 390

[xxxvi] V.D. Bordunov, "Rights of States as Regards Outer Space Objects" (1981), *24 Colloquium on Law of Outer Space* at 91

[xxxvii] *Supra,* note 23.

[xxxviii] C.W. Jenks, *Space Law* (London: Stevens & Sons, 1965) at 211

[xxxix] Article I of Outer Space Treaty, *supra,* note 23.

[xl] See, P.M. Sterns and L.I Tennen, "Principles of Environmental Protection in the *Corpus JurisSpatialis*", (1987) *30 Colloquium on Law of Outer Space* at 172.

[xli] See, A. Kiss, "The International Protection of the Environment" in MacDonald, R.stJ and D. M. Johnson (eds.), *The Structure and Process of International Law (*Netherlands: Matinus Nijhoff, 1986) at 1076; see also See Baker, *Supra,* note 1 at 75

[xlii] *Supra,* note 23.

[xliii] See, S. Gorove, "Pollution and Outer Space A Legal Analysis and Appraisal" (1972), *5 NYU J Int' L & Politics* at 62-63; see also, G.C.M. Reijnen, "Some Aspects of Environmental Problems in Space Law" (1977), 26 *Zeitschrift Luft Weltraumrecht* at 23; see also Baker, *Supra,* note 1 at 95

[xliv] To expand the scope of avoidance of contamination , see the statements of the representative of India in UN GAOR, COPUOS, *Fifth Session of the Legal Sub-Committee,* A/AC.105/C.2/SR.71 and Add.1 (4 August 1966) at 9 and A/AC.105/C.2/PR.71 (4 August 1966) 23-25.

[xlv] See, Baker, *supra,* note 1 at 97.

[xlvi] UN GAOR, COPUOS, *Fifth Session of the Legal Sub-Committee,* A/AC.105/C.2/PR.7 (France, 17 April 1966) at 26.

[xlvii] See, Baker, *supra,* note 1 at 97.

[xlviii] Clyde Eagleton, *The Responsibility of States in International Law,* (New York, N.Y., 1928) at 218; See also S. Bhatt, *Legal Control of Outer Space: Law, Freedom and Responsibility,* (S. Chand & Co (Pvt) Ltd, New Delhi, 1973) at 217

[xlix] Text adopted by the Commission at its fifty-third session, in 2001, and submitted to the General Assembly as a part of the Commission's report covering the work of that session. The report, which also contains commentaries on the draft articles, appears in *Official Records of the General Assembly, Fifty-sixth Session, Supplement No. 10* (A/56/10). Text reproduced as it appears in the annex to General Assembly resolution 56/83 of 12 December 2001, and corrected by document A/56/49(Vol. I)/Corr.4.

[l] See Judge Huber in *Spanish Zone of Morocco Claims* case, Reports of International Arbitral Awards, vol, ii, p. 641

[li] *United Kingdom v. Albania* (Corfu Channel) (1949) ICJ Reports, p. 4.

[lii] *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space,* UNGA Res. 1962 (XVIII) 13 December 1963, see UN GAOR, COPUOS, *Fifth Session of the Legal Sub-committee, A/AC.105/C.2/SR.57 (12 July 966).*