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The Need for an Effective Liability Régime for Damage Caused by Debris in Outer Space

James P. Lampertius
University of Michigan Law School

STUDENT NOTES

THE NEED FOR AN EFFECTIVE LIABILITY RÉGIME FOR DAMAGE CAUSED BY DEBRIS IN OUTER SPACE

*James P. Lampertius**

Look here, brother —
who you jivin' with this cosmic debris?
—Frank Zappa

The most serious hazard facing human activities in outer space is the risk of collision with space debris.[1] Manmade space debris has already caused damage to a number of satellites[2] and is the most likely cause of a number of serious accidents.[3] Due to its high speed (an average of ten kilometers per second[4]) and largely untrackable nature,[5] space debris threatens the future development of manned spacecraft and space stations. The problem is becoming more severe with the multiplication of debris[6] and the increased use of outer space, particularly with the advent of commercial and military activities.

The purpose of this Note is to point out the failure of the current liability system to provide for an adequate legal mechanism of recovery for damage or loss of life caused by collisions with space debris. International responsibility for national activities in outer space is a fundamental principle of international law.[7] Yet a claim attributed to damage by space debris is "difficult, if not impossible, to prove" under

* University of Detroit, B.A. (1989); University of Michigan Law School, Class of 1992.

1. HOWARD A. BAKER, SPACE DEBRIS: LEGAL AND POLICY IMPLICATIONS 1 (Utrecht Studies in Air and Space Law Vol. 6, 1989).

2. *See infra* notes 21-30 and accompanying text (discussing the harm and the evidence); *see also* BAKER, *supra* note 1, at 11-12; ANNEX TO COSPAR STATUS REPORT ON SPACE DEBRIS (1987), UN Doc. A/AC.105/403 (1988), *reprinted in* 1 SPACE LAW, B.III.11 (Karl-Heinz Böckstiegel and Marietta Benkö eds., 1990) [hereinafter 1987 COSPAR STATUS REPORT] (COSPAR is the nongovernmental international Committee on Space Research).

3. *See infra* notes 28-30 and accompanying text.

4. Howard A. Baker, *Space Debris: Law and Policy in the United States*, 60 U. COLO. L. REV. 55, 64 (1989).

5. *See infra* notes 15-16 and accompanying text (discussing the "visibility limit" of radar and the amount of untrackable debris); *see also infra* notes 83-93 and accompanying text (discussing the need for monitoring and tracking space objects).

6. *See infra* notes 31-33 and accompanying text (discussing the "cascade effect" that multiplies space debris).

7. *See* Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, art. VI, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 2415, 610 U.N.T.S. 205, 209 (entered into force Oct. 10, 1967) [herein-

the current liability system.[8] This Note analyzes the major difficulties in establishing liability for damage and presents a number of solutions to overcome these obstacles to recovery.

Part I describes the current situation of space debris and the risks of collision. It offers data on what constitutes space debris as well as its concentration, location, and sources. This Part also considers the evidence of damage caused by space debris and the likelihood that damage will increase in the future.

Part II presents the current body of space law governing liability for damage caused by space debris. Although no convention or treaty relates to the problem of space debris per se, the provisions of three major international space documents are relevant: the 1967 Outer Space Treaty,[9] the 1972 Liability Convention,[10] and the 1976 Registration Convention.[11] This Part puts forth these provisions. It describes how, despite enunciating general principles, the drafters of the Outer Space Treaty and the Liability Convention left liability for damage in outer space an unresolved issue. Part II also considers the Registration Convention as a possible means for identifying the State responsible for the space refuse — a necessary element for accountability. It shows, however, that the Registration Convention is largely ineffective for this purpose.

Part III delves into the reasons why liability under the current system is largely illusory. First, it considers the problems of fault-based liability provided by the Liability Convention. Four difficulties exist in establishing fault-based liability for damages in outer space: the uncertainty over what "fault" means; the absence of any indication regarding what duty or standard of care is necessary; the difficulty of actually proving culpability; and the problem of foreseeability. Second, this Part analyzes the problem of causation — the difficulty of proving who is responsible for the debris that caused the damage.

Part IV presents possible solutions for creating a working liability system. It describes the strict liability system proposed by commentators as an alternative to a fault-based system. Strong arguments exist both for and against strict liability. The conclusion drawn through a comparison of these positions is that although a strict liability system

after Outer Space Treaty] ("State Parties to the Treaty shall bear international responsibility for national activities in outer space.").

8. Stephen Gorove, *Environmental Risks Arising from Space Activities: Focus on the Liability Convention, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE 131 (Karl-Heinz Bockstiegel ed., Studies in Air and Space Law Vol. 9, 1990).

9. Outer Space Treaty, *supra* note 7, 18 U.S.T. at 2410, 610 U.N.T.S. at 205.

10. The Convention on International Liability for Damage Caused by Space Objects, *opened for signature* Mar. 29, 1972, 24 U.S.T. 2391, 961 U.N.T.S. 187 (entered into force Sept. 1, 1972) [hereinafter Liability Convention].

11. Convention on Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 (entered into force Sept. 15, 1976) [hereinafter Registration Convention].

would be beneficial theoretically, it is doubtful that spacefaring nations are prepared to accept this standard.

Part IV proposes an alternative solution: fault liability with a defined standard of care and a rebuttable presumption of negligence. Although a standard of care is difficult to establish, helpful guidance exists in the "rules of the road" of admiralty and air law. Commentators have proposed several rules as a basis for allocating fault. Part IV also describes methods for minimizing identification problems. It provides for an enhanced duty of information and consultation and calls for the marking of all space objects. It presents theories of joint liability to allocate liability when one cannot identify the specific tortfeasor. The acceptance of joint liability theories by spacefaring nations, though, is unlikely.

Finally, Part V addresses the need for a multilateral, unified approach to liability for damage caused by space debris. Customary law and isolated agreements are not the appropriate fora for the development of a legal régime. Nor will a comprehensive convention seeking the consensus of all nations be a workable approach. Rather, multilateral consultations and discussions outside the auspices of the United Nations present the best fora for viable and prompt solutions.

I. THE CURRENT HAZARD OF SPACE DEBRIS

A. *The Statistics*

Space debris consists not only of fragments of exploded rocket stages or broken-up satellites but also a plethora of smaller items.[12] In the three decades of the space age, humans have launched approximately 18,000 objects into space.[13] These activities have left a mass of orbital refuse within 2,000 kilometers of the earth surface that has 15,000 times more mass than that of natural meteoroid debris.[14]

Today, more than 7,100 objects larger than twenty centimeters in size (the "visibility limit" of radar) exist in an outer space ring around

12. Major Bernard K. Schafer, U.S.A.F., lists some of these other items:

> The smaller items include human wastes, in the form of actual trash bags "heaped over the side" of spacecraft from previous manned space missions; clouds of urine ice crystals; a lost Hasselblad camera; large quantities of small copper needles placed into orbit 3,600 kilometers (2,300 miles) into space to act as passive radio reflectors; millions of metal shards, the product of some sixty explosions in space resulting from unintentional and intentional destruction of space objects; and finally, clouds of gas molecules such as hydrazide, nitrogen, and hydrogen chloride, the propellants and effluents from spacecraft propulsion systems.

Bernard K. Schafer, *Solid, Hazardous, and Radioactive Wastes in Outer Space: Present Controls and Suggested Changes*, 19 CAL. W. INT'L L.J. 1, 4 (1989). By far the most prolific sources of space debris are explosions and break-ups. COSPAR AND THE INTERNATIONAL AERONAUTICAL FEDERATION (IAF), ENVIRONMENTAL EFFECTS OF SPACE ACTIVITIES, ANNEX TO REPORT, at 12, U.N. Doc. A/AC.105/420 (1988) [hereinafter 1988 COSPAR & IAF REPORT].

13. 1987 COSPAR STATUS REPORT, *supra* note 2, at 3.

14. Robert F. Stamps, *Orbital Debris: An International Agreement is Needed*, *in* PROCEEDINGS OF THE THIRTY-SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE 152, 153 (Int'l Inst. of Space Law of the Int'l Astronautical Fed'n, 1989).

the earth.[15] The quantity of untrackable space refuse is unknown. Conservative estimates indicate the amount of nontrackable debris to be two to four times the number of trackable objects.[16]

B. *The Location and the Probability of Collision*

The largest concentration of refuse is in the altitude range of 350 to 1,250 kilometers, exactly where most satellites, space stations, and the space shuttle operate.[17] Howard Baker, in his book *Space Debris: Legal and Policy Implications*, tracks a number of studies of collision probabilities.[18] He explains that "conclusions regarding the rate of growth of the space debris population suggest an imminent risk of collision."[19] For example, a 1987 study predicted that the probability that a space station would be struck by space debris was one in ten.[20]

C. *The Harm and the Evidence*

As a measure of the damage orbiting debris can inflict, a 0.5 millimeter paint chip would easily puncture a space suit and kill an astronaut or cosmonaut working outside a spaceship.[21] The impact of an object one centimeter in diameter with a space station could penetrate the pressurized crew module, killing the crew and causing the station to break up.[22] Other harm from collision can occur simply in the "graceful" degradation of satellites.[23]

There are already a number of examples of damage to satellites caused by debris. A General Accounting Office publication noted, "A NASA report covering the first thirty missions of the space shuttle showed that there had been damage to twenty-seven windows on eighteen shuttle flights."[24] This damage was described as "small pits, bruises or hazing."[25]

In June 1983, the third stage of an Ariane launcher collided with a small subsatellite, rendering it inoperable.[26] After the April 1984

15. BAKER, *supra* note 1, at 3; 1988 COSPAR AND IAF REPORT, *supra* note 12, at 9. The North American Aerospace Defense Command (NORAD) conducts most of the surveillance.

16. 1988 COSPAR & IAF REPORT, *supra* note 12, at 12; *see also* BAKER, *supra* note 1, at 33.

17. 1987 COSPAR STATUS REPORT, *supra* note 2, at 4; *see also* BAKER, *supra* note 1, at 22.

18. BAKER, *supra* note 1, at 32-39.

19. *Id.* at 35.

20. *Id.*

21. *Id.* at 10; Bhupendra Jasani & Martin Rees, *The Junkyard in Orbit*, BULL. ATOM. SCIENTISTS, Oct. 1989, at 24-25.

22. Baker, *supra* note 4, at 58.

23. BAKER, *supra* note 1, at 10.

24. U.S. GENERAL ACCOUNTING OFFICE, GAO/IMTEC-90-18, SPACE PROGRAM: SPACE DEBRIS A POTENTIAL THREAT TO SPACE STATION AND SHUTTLE 26 (1990) (Rep. to the Comm. on Science, Space, and Technology).

25. *Id.*

26. Tim Furniss, *Ariane's Big Fix*, FLIGHT INT'L, Sept. 20, 1986, at 48.

shuttle mission, an electronic box of the U.S. Solar-Max satellite showed 160 holes caused by paint chips.[27]

It is difficult to conclusively determine if debris has caused serious accidents in space, but some unexplained satellite malfunctions may have been debris-related.[28] On January 6, 1978, Cosmos 954 lost pressurization, started to tumble, and rapidly decayed. One commentator expressed the opinion that the satellite collided in flight with some other object.[29] The wreck of the Cosmos 1275 may be another collision casualty. It broke up several weeks after the launch at an altitude close to 1,000 kilometers.[30]

D. *The Increasing Problem*

Collision probabilities will increase in the future because of the increasing number of space objects.[31] This increase will occur even if not another single space object is launched because of a phenomenon called the "cascade effect."[32] Because new debris is generated in any collision of two objects, the amount of debris is constantly expanding.[33]

Increased use of space through commercial and military activities will only aggravate the problem of debris and cause increasing tension between nations.[34] Furthermore, little can be done at present about inactive objects and debris already in orbit. Although proposals exist

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27. 1987 COSPAR STATUS REPORT, *supra* note 2, at 5.

28. *See* Jasani & Rees, *supra* note 21, at 25 (offering examples); *see also* 1988 COSPAR & IAF REPORT, *supra* note 12, at 17; BAKER, *supra* note 1, at 11.

29. 1988 COSPAR & IAF REPORT, *supra* note 12, at 17.

30. BAKER, *supra* note 1, at 12.

31. *See* 1988 COSPAR & IAF REPORT, *supra* note 12, at 16. The report states that:

> [t]he collision probability is proportional to the relative velocity of the two objects, to their sizes and, what is most important, to the number of objects per unit volume of space, i.e. to the density of space objects. The relevant formula contains the square of the density. Thus an increase in the number of space debris by 5% raises the collision probability by 10% and an increase by 40% doubles the collision probability.

Id.

32. *See* BAKER, *supra* note 1, at 45 n.134 ("In 1970, while investigating the collision danger to spacecraft posed by asteroids, the cascade effect was hypothesized to explain the formation of asteroid belts.").

33. One report noted, "[A] typical collision between an old rocket body or payload and a small fragment larger than 4 cm could produce 10,000 particles larger than 1 cm and over 1 million particles larger than 1 mm." 1988 COSPAR & IAF REPORT, *supra* note 12, at 17.

34. *See, e.g.*, Jasani & Rees, *supra* note 21, at 25 (illustrating the tension experienced between the United States and France over the explosion of the Ariane V16 launch vehicle, threatening to cripple the only U.S. reconnaissance satellite then in operation).

Military anti-satellite testing poses the greatest danger. *See* 1987 COSPAR STATUS REPORT, *supra* note 2, at 5. According to the report,

> [t]he United States anti-satellite-weapon test in which the Solwind satellite was destroyed by collision generated 257 "observable" fragments, with a much larger number of "non-observable" pieces of debris. Future tests as part of the Strategic Defense Initiative programme would therefore be potential generators of a flood of man-made space debris.

Id.

for sweeping up space junk,[35] they remain only models. Cleaning actions are beyond the capabilities of present technology.[36]

II. THE BODY OF SPACE LAW GOVERNING LIABILITY

While compensation for damage caused in outer space by space debris will never be an adequate substitute for preventing the generation of space debris, some legal mechanism is necessary in order that recovery for losses may be possible. Providing an effective legal remedy will also provide a disincentive to the continuation of hazardous activities in the future.

A. *The 1967 Outer Space Treaty*

As the first international document concerning space law, the 1967 Outer Space Treaty contains the general principles that govern activities in space.[37] It also includes three provisions on liability. Article VI provides that "[p]arties to the Treaty shall bear international responsibility for national activities in outer space."[38] Article VII provides generally that virtually any State directly participating in a launch can be rendered internationally liable if damage is caused by the launched object.[39] Article IX imposes a duty to refrain from hazardous activities without first consulting the proper parties.[40] These provisions, however, are neither comprehensive nor susceptible to precise application.[41] Realizing the inadequacy of the Outer Space Treaty for resolving space law disputes, the U.N. Committee on Peaceful Uses of Outer Space (COPUOS) drafted the 1972 Convention on Liability For Damages Caused By Space Objects.[42]

B. *The 1972 Liability Convention*

The Liability Convention established a dual system of liability dependent on where the damage has occurred. Article II of the Liability Convention refers to harm experienced on the surface of the earth or

35. James Beard, *Sweeping Up Space Junk*, DISCOVER, Dec. 1988, at 22.

36. BAKER, *supra* note 1, at 1.

37. *See* Outer Space Treaty, *supra* note 7.

38. *Id.* art. VI, 18 U.S.T. at 2415, 610 U.N.T.S. at 209.

39. *Id.* art. VII, 18 U.S.T. at 2415, 610 U.N.T.S. at 209.

40. Article IX provides that a nation State that has "reason to believe that an activity or experiment planned by it . . . would cause potentially harmful interference with activities of other States Parties . . . shall undertake appropriate international consultations before proceeding." *Id.* art. IX, 18 U.S.T. at 2416, 610 U.S.T. at 209-10.

41. Marc S. Firestone, Comment, *Problems in the Resolution of Disputes Concerning Damage Caused in Outer Space*, 59 TUL. L. REV. 747, 752 (1985).

42. *See id.* at 750-58 (analyzing the history behind the Outer Space Treaty and the Liability Convention); *see also* NANDASIRI JASENTULIYANA & ROY S.K. LEE, 3 MANUAL ON SPACE LAW 209-594 (1979) (documenting all *travaux préparatoires* and related documents in the drafting of the Liability Convention).

to aircraft in flight. It provides for absolute liability.[43] Article III of the Liability Convention deals with damage in outer space and provides for fault-based liability. Article III states:

> In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.[44]

Article III should cover the case of damage caused in outer space by debris. However, two problems exist in the application of the Liability Convention to damage caused in space by manmade debris: whether "space objects" include space debris, and the vagueness of the fault standard.

1. Do "Space Objects" Include Space Refuse?

The term "space object" is not defined in the Liability Convention, which merely provides that " 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."[45] Howard Baker has criticized this phrase as "riddled with uncertainty."[46] At the time of drafting the Convention, failure to define "space object" was not considered a problem.[47] This lack of definition was the result of the acceptance by the drafters of the suggestion that "space object" had a reasonably understood and clear meaning and that it was only necessary to include in a definition all the component parts and equipment of a space object that could cause damage.[48] Nonetheless, the Convention's definition of "space object" should cover space debris even under a strict interpretation of "space object," as it is matter originating from component parts of space objects or their launch vehicles.

2. The Unresolved Issue of Liability

A more significant problem is the unresolved issue of liability for damage caused in outer space. Although the treaty requires proof of fault for damages in outer space, it neither defines "fault" nor refers to

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43. Liability Convention, *supra* note 10, art. II, 24 U.S.T. at 2392, 961 U.N.T.S. at 189.

44. *Id.* art. III, 24 U.S.T. at 2392, 961 U.N.T.S. at 190.

45. *Id.* art. I(d), 24 U.S.T. at 2392, 961 U.N.T.S. at 189.

46. BAKER, *supra* note 1, at 80.

47. CARL Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 83-84, 108-09 (1982).

48. *See* W.F. Foster, *The Convention on International Liability for Damage Caused by Space Objects*, 10 CAN. Y.B. INT'L L. 137, 145 (1973) (analyzing the draft definitions submitted to the Legal Sub-Committee of the Liability Convention). Note that the draft definitions do provide some guidance as to the meaning of "space object": although the definitions differ, they all agree that a space object or space device must be designed for movement in outer space. *Id.* This, however, is not helpful in an application to space debris.

a standard of care for determining fault. This omission was not an accidental oversight; the drafters of the Liability Convention intentionally left liability for damage in outer space an unresolved issue.[49] They had several reasons for doing so.

First, it was believed that the possibility of damage in space was remote.[50] The major concern at the time of the negotiations was harm to persons and property on Earth.[51] Even though the drafters addressed liability for outer space acts, they were "primarily concerned with a possible collision [between or with active] space objects."[52] The drafters recognized that the need for a treaty would arise when activities in space became more "frequent and numerous."[53]

Second, the drafters feared that an attempt to define the standard of care in outer space for purposes of fault-based liability would prevent the completion of the Liability Convention.[54] The Convention proved to be "one of the most difficult and lengthy treaty negotiations since 1945."[55] The drafters had to accommodate the diverse political interests of the United States, the Soviet Union, India, and the European nations.[56] From the outset, the United States and the Eastern Bloc countries had strikingly different views of the legal régime that should govern activities in outer space.[57] These differences delayed the negotiation process, causing nearly ten years of debate.[58]

C. *The Registration Convention*

If States are to be accountable for damage caused by their space refuse, there must be some means of identifying the State responsible for the refuse. Identification of the "ownership" of the debris is an

49. *See* Firestone, *supra* note 41, at 761.

50. The Legal Sub-Committee of the Liability Convention did not address several questions thought to be "relatively exotic" at the time, such as damage caused in outer space. *See* MYRES S. MCDOUGAL ET AL., LAW AND PUBLIC ORDER IN SPACE 592-93 (1963) (recognizing the possibility of a collision in outer space, but discounting its probability). "[T]he hazards of collision and other forms of interference involving spacecraft do exist, and such a possibility has been generally recognized. . . . [However], because of the mere handful of space vehicles operating in the vast reaches of space, one might expect collision or interference only as an extreme rarity." Herbert Reis, *Some Reflections on the Liability Convention for Outer Space*, 6 J. SPACE L. 125, 127 (1978); CHRISTOL, *supra* note 47, at 79.

51. BAKER, *supra* note 1, at 79; *see also* MCDOUGAL ET AL., *supra* note 50, at 534.

52. *See* STAFF OF SENATE COMM. ON AERONAUTICAL AND SPACE SCIENCES, 92D CONG., 2D SESS., REPORT ON THE CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS[:] ANALYSIS AND BACKGROUND DATA 27 (Comm. Print 1972), *cited in* BAKER, *supra* note 1, at 80 n.221.

53. Reis, *supra* note 50, at 127.

54. Firestone, *supra* note 41, at 761.

55. Reis, *supra* note 50, at 125.

56. Firestone, *supra* note 41, at 755.

57. *Id.* at 753; *see also* Foster, *supra* note 48, at 140.

58. Foster, *supra* note 48, at 140; Firestone, *supra* note 41, at 753.

indispensable element for determining responsibility. Without identification, the necessary link of causation is lost.

The Convention on Registration of Objects Launched into Outer Space requires the registration with the United Nations of any space object launched into earth orbit or beyond.[59] Howard Baker explains the relevance of the Registration Convention to the problem of space debris: "[T]he extent to which provisions are made in space law for the identification of space refuse is determined by the extent to which identification of space objects is provided for under the Registration Convention."[60]

The Registration Convention was drafted in order to provide for attribution of nationality and identification of space objects.[61] It imposes obligations on contracting States to furnish information to the U.N. Secretary General and to help other States identify objects which have caused damage.[62] However, the Registration Convention does little to identify or aid in the identification of space refuse. Howard Baker states that "in addition to accomplishing very little toward the establishment of a system which positively identifies space objects, the information which the Convention does require cannot be used by international organizations to correlate observations of space objects."[63] Part III explains the numerous reasons why the Registration Convention is ineffective in providing for identification of space debris.[64]

III. The Illusory Character of the Liability System

The purpose of this Part is to explore in detail the weaknesses of the current liability system and the reasons critics find the system largely meaningless as applied to damage caused in outer space. The difficulties associated with the identification of space debris and the practical problems encountered in proving fault in many cases make recourse under the Liability Convention largely futile.

A. *The Uncertainty Over the Meaning of "Fault"*

The drafting of the article III "fault" principle of the Liability Convention has been criticized for its ambiguity.[65] The root of the

59. Registration Convention, *supra* note 11, art. II(1), 28 U.S.T. at 698, 1023 U.N.T.S. at 17.

60. Baker, *supra* note 1, at 75.

61. *Id.* at 76.

62. Article IV requires notification and furnishing of information regarding space objects. Registration Convention, *supra* note 11, art. IV(3), 28 U.S.T. at 69, 1023 U.N.T.S. at 17. Article VI provides that other States shall assist in monitoring, tracking, and identifying space objects causing damage. *Id.* art. VI, 28 U.S.T. at 69, 1023 U.N.T.S at 18.

63. Baker, *supra* note 1, at 76.

64. *See infra* notes 85-95 and accompanying text.

65. One commentator vents frustration with this ambiguity: "Quaere: does 'fault' mean 'blame', 'negligence', or what? . . . [I]t seems natural to equate fault with ordinary negligence, but this does not necessarily follow." Morris D. Forkosch, Outer Space and Legal Liability

difficulty appears to be the different interpretations of the term in international law: fault can either mean subjective blameworthiness or objective breach of a preexisting legal duty.[66] Howard Baker poses a solution: "[I]t has been suggested that subjective fault is applicable to the Liability Convention, since objective fault is no more than a restatement of a basic principle of State liability under international law."[67] Further, if "fault" means only objective breach of a preexisting legal rule, a State is free to do whatever it wishes unless it can be demonstrated that there is a limiting rule of international law.[68]

B. *The Absence of a Standard of Care*

Fault liability presumes that a standard of care exists by which one can judge the reasonableness of the defendant's actions.[69] Specifically, "in order to establish whether a State is at fault for a collision . . . there must first be an accepted standard of care for traffic in outer space, and a breach of that standard of care . . . ."[70] However, the Liability Convention lacks any indication as to what standard of care exists for outer space activity.[71]

No customary law currently exists regulating space debris,[72] other

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80 (1982). It is noteworthy that the "fault" standard under general principles of international law is associated with negligence:

> If the law annexes a sanction to a certain conduct only if the harmful effect of this conduct was intended or was brought about by negligence, we speak of responsibility based on fault . . . if the law annexes a sanction to a certain conduct even if the harmful effect is brought about without intention or negligence on the part of the delinquent, we speak of absolute responsibility.

HANS KELSEN, PRINCIPLES OF INTERNATIONAL LAW 11-12 (1952).

66. Howard Baker explains this difficulty: " 'Fault' may be considered subjective or objective; the latter implies a pre-existing legal duty, while the former implies a finding of blameworthiness such as that in the law of negligence." BAKER, *supra* note 1, at 84; *see also* MODESTO S. VASQUEZ, COSMIC INTERNATIONAL LAW 103-04 (1965).

67. BAKER, *supra* note 1, at 84 (citing Jochen Pfeifer, *International Liability for Damage Caused by Space Objects*, 30 ZEITSCHRIFT FÜR LUFT UND WELTRAUMRECHT 215, 255 (1981)).

68. One commentator notes that "[i]n general, the international legal system is consensual . . . . In other words, a state is free to do whatever it wishes unless it can be demonstrated that there is a limiting rule of international law." Stamps, *supra* note 14, at 154.

69. With regard to application of liability, "[u]nintentional conduct is deemed faulty only when it is shown to have violated some standard of conduct." Firestone, *supra* note 41, at 767. Whatever the tradition — common law, civil law, Soviet law, admiralty law — the concept of fault presupposes a standard of conduct. *See id.* at 767-69.

70. Stamps, *supra* note 14, at 154.

71. BAKER, *supra* note 1, at 84; *see also* Firestone, *supra* note 41, at 767 ("In the context of space law, however, there is no standard of conduct and the concept of fault is meaningless."); *see also* Stamps, *supra* note 14, at 154 ("[T]here is no internationally accepted standard of care for traffic in outer space.").

72. *See* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN SPACE 147-87 (Karl-Heinz Böckstiegel ed., Studies in Air and Space Law Vol. 9, 1990) (collecting commentary on the customary law of the protection of the outer space environment given at an international colloquium in Cologne in 1988); *see also* Dietrich Rauschning, *Customary Law in General Principles of International Law Concerning the Protection of Outer Space from Pollution?*, *in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra*, at 181, 182. Rauschning notes, "The existence of

than possibly a duty of consultation.[73] From the beginning of the space age, scholars have acknowledged the necessity of international rules of the road for space and called for analogies to admiralty and air law.[74] But admiralty and air law rules, in themselves, are inadequate to form a customary law basis.[75]

Some commentators have suggested the application of generally recognized principles of law to provide these rules.[76] It is, however, doubtful that such rules are clear enough to provide a rule of decision.[77]

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and increase in debris in outer space produced by man show that there is no general practice of preventing pollution in outer space by debris among the states responsible for launching the spacecraft; a rule of customary law on this point has not yet developed." *Id*; *see also* Firestone, *supra* note 41, at 770 ("No rules of the road govern outer space activities. Nor is there custom or jurisprudence which prescribes correct conduct."). *But see* Schafer, *supra* note 12, at 17-33 (providing extensive analysis of international treaties, declarations, activities of international organizations, international cases, and domestic practice to conclude that both the elements of practice and *opinio juris* exist for a customary international rule against pollution of space.).

A solution to the present problem has been suggested:

> It may be correct that . . . at present no rule of public international law can be established which would prohibit states to create outer space debris. As soon as the scientists [are] able to prove that additional debris would create not only a theoretical but a very practical risk for new space activities or even for the Earth a new rule [might well come] into existence.

Jochen A. Frowein, *Customary International Law and General Principles Concerning Environmental Protection in Outer Space, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra*, at 163, 165.

73. *See* Gennady M. Danilenko, *Space Activities and Customary Law of Environmental Protection, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 169, 173. It is suggested that

> [a] survey of international practice indicates that at this stage there exist or at least are emerging customary rules of a procedural character concerned with the environmental protection. Of major importance is the principle of notification establishing a duty to provide potentially affected states with relevant information concerning any serious environmental threat.

Id.; *see also* Maureen Williams, *Customary International Law and General Principles of Law, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 153, 159 ("[T]he obligation to consult is part of customary international law."). For further discussion, see *infra* notes 127-30 and accompanying text.

74. MCDOUGAL ET AL., *supra* note 50, at 527. McDougal stated in 1963:

> The unique nature both of navigation in space and spacecraft itself is certain to result in demands for the establishment of 'Rules of Space Navigation' to be patterned partly according to the existing and well-tested rules of the road for ships and aircraft, and partly incorporating special principles and techniques dictated by the novelty of anticipated problems.

Id. In the context of admiralty law, Gilmore and Black have observed, "The Rules of the Road . . . are of extreme importance in the allocation of collision liability. More often than not, the finding of 'fault' on the part of a ship in collision rests on her having violated one of the Rules." GRANT GILMORE & CHARLES BLACK, JR., THE LAW OF ADMIRALTY 489 (1975).

75. Myres McDougal has observed, "In determining community policies to govern liability for deprivation caused by collision between spacecraft, and limited to such spacecraft, certain attendant factors must be taken into consideration which do not obtain in situations involving impact damage in the terrestrial environment." MCDOUGAL ET AL., *supra* note 50, at 623 (listing factors such as the greater likelihood of contributory fault and assumption of risk).

76. *See, e.g.*, Frowein, *supra* note 72, at 165 (noting that the willingness of the International Court of Justice to consider general principles of humanitarian law in the Nicaragua decision may extend to applying general principles of environmental protection to rules against contamination of outer space); Williams, *supra* note 73, at 153.

77. Firestone, *supra* note 41, at 770; *see also* Robert Jennings, *Customary Law and General*

C. *The Difficulty of Proving Fault*[78]

Another obstacle associated with fault-based liability is the difficulty of proving fault. It is highly likely that in most cases involving collisions, specific fault or negligence will be "difficult, if not impossible, to prove."[79] For example, the cause of almost half the satellite breakups cannot be discerned, and little capability exists to classify the breakups' causes without a significant amount of mission-specific information.[80]

Nicholas Johnson, in testimony to the U.S. House of Representatives, explained the reasons for this difficulty:

> [W]e do not know the cause of a large number of satellite fragmentations. . . . One [reason] is simply, there is a lack of data. They were old satellites, nonfunctional, they were rocket bodies, they simply fragmented unexpectedly, and it's very hard to do a Sherlock Holmes kind of a process and find out what caused it. We have tried in many cases.[81]

The burden on the injured nation to prove negligence is further complicated by the difficult nature of international discovery procedures and evidential matters.[82]

D. *The Problem of Foreseeability*

Even if proof of fault is made, lack of foreseeability may still foreclose liability. R.T. Swenson explains that "[f]or almost all spacecraft, once the satellite is placed in orbit, the launching State has neither the ability to foresee a future collision nor the ability to make the substantial manoeuvre to avoid one."[83] The inability to predict only becomes

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Principles of Law as Sources of Space Law, in ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 149, 151-52. Jennings notes:

> General principles of law seem to me to be a source of limited usefulness; especially in space law. There are some principles — good faith, fault, causality, *audiatur et altera pars*, *res judicata* and the like — which are general principles of law and therefore of international law . . . . But when the idea is extended from these basic notions of justice to municipal law analogies generally, I wonder whether it is very useful . . . . [I]t has to be at such a level of abstraction that one has in the end advanced little if at all from the starting point.

Id.; *see also* Rauschning, *supra* note 72, at 185. Again, expounding on the point:

> General principles of law, general principles of international law or general norms of customary international law covering the protection of the environment are either not applicable to the prevention of pollution in space or are not capable of giving more specific solutions to our question than the widely accepted Outer Space Treaty of 1967.

Id.

78. For an excellent analysis of this problem, see BAKER, *supra* note 1, at 84-86.

79. Gorove, *supra* note 8, at 131.

80. J. Kenneth Schwetje, *Liability and Space Debris, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 29, 42.

81. *Orbital Space Debris: Hearing Before the Subcomm. on Space Science and Applications of the Comm. on Science, Space and Technology*, 100th Cong., 2d Sess. 112-73 (1988) (statement of Nicholas L. Johnson, Advisory Scientist).

82. BAKER, *supra* note 1, at 85.

83. Raymond T. Swenson, *Pollution of the Extraterritorial Environment*, 25 A.F. L. REV. 70, 80 (1985); *see also* BAKER, *supra* note 1, at 84. Baker provides an example of the difficulty of foreseeability: "[P]redictions of possible collisions between an active satellite and a manned

worse when one of the objects is space debris, as that object will not be controlled and may not be detectable.

Article III of the Liability Convention does not state whether the damage caused must be reasonably foreseeable. Commentators have stated that only a causal connection between the accident and the damage need be established;[84] however, it is likely that any defendant State will contend vigorously that foreseeability is a necessary element under a fault standard.

E. *The Problem of Identification*

The most practical problem in establishing liability for damage caused by a collision with space debris is proving who is responsible for the debris. Currently there exists no internationally accepted system of monitoring or tracking space objects.[85] Even domestic systems, like the North American Aerospace Defense Command (NORAD), would need a very advanced technology to provide unequivocal reliability in identifying the precise source of debris[86] — the type of reliability necessary for assertions of liability.

Lieutenant Colonel F. K. Schwetje explains the extent of the problem as follows:

> Damage could be caused by a large, trackable object that has been identified prior to the collision as a space object of a particular nation. This is fairly unlikely, however, because if the object is trackable, some measures for warning and avoidance are available. The more likely situation is the destruction of a space object by a small unobserved, untrackable fragment.[87]

One solution could be to look to the unique characteristics of certain satellite orbits in the identification of debris fragments: "An object's inclination is its most stable orbital parameter, and, as such, would be a good quantity to discriminate the national origin of trackable orbiting objects."[88]

However, two problems exist with this approach: first, most inclinations are shared by a variety of countries,[89] and second, the approach only helps in situations where the damage was caused by trackable debris. Thus, absent the most egregious circumstances, the source of debris damage cannot be determined with any degree of accuracy. As stated earlier, the Registration Convention was designed

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spacecraft as the STS orbiter can only be made 12-24 hours in advance; when two unmanned active satellites are involved, the prediction time is even less." *Id.*

84. Foster, *supra* note 48, at 158.

85. Gorove, *supra* note 8, at 131.

86. *Id.*

87. Schwetje, *supra* note 80, at 41.

88. *See id.* (discussing the strengths and weaknesses of this solution).

89. *Id.*

to help with problems of identification.[90] Howard Baker explains that the Registration Convention has proved to be ineffective for the identification of space debris for a number of reasons.[91] First, it is unclear whether the Registration Convention applies beyond active satellites and any trackable operational debris accompanying them. Second, article IV of the Registration Convention requires only a "paucity of information."[92] Third, article IV disregards the need for timeliness. Instead, it only requires that information be furnished "as soon as practicable."[93] This requirement does not imply that information must be conveyed in advance, but only when it is feasible to do so. Prior consultation is critical to preventing collisions and lack of timeliness could defeat not only the purpose of the Registration Convention but also the Liability Convention.[94] Fourth, the Registration Convention provides only for voluntary marking of space objects. Yet another reason for the ineffectiveness of the Registration Convention in providing identification is the questionable degree of actual compliance with the Convention.[95]

IV. PROPOSED SOLUTIONS

From the discussion above, it should be apparent that the practical problems associated with the identification of space debris and the difficulties in proving fault make the compensation provision in the Liability Convention largely meaningless. To the extent that deserving claimants exist — claimants who cannot be assumed to have accepted the risk of other States' generation of debris — the system unfairly allocates liability. Each State in effect must bear its own losses in all but the most egregious circumstances. But with the increasing probability of collision and the increase in the number of space users, pressure will exist for changes in the current liability system.

The following proposals seek to remedy the weaknesses of the fault system: a strict liability amendment to the Liability Convention or, in the alternative, fault liability with a defined standard of care and rebuttable presumption of negligence. To minimize the identification

90. *See supra* text accompanying notes 59-60.

91. *See* BAKER, *supra* note 1, at 76-78 (providing an extensive explanation of the limitations of the Registration Convention).

92. *Id.* at 77. Baker further states that "the [information] requirements of paragraph 1 of Article IV have been described as insufficient even for avoiding collisions between two trackable, active space objects, and as 'useless' for assessing the space refuse problem." *Id.*

93. Registration Convention, *supra* note 11, art. IV, 28 U.S.T. at 699, 1023 U.N.T.S. at 17.

94. BAKER, *supra* note 1, at 77.

95. *See* Hamilton DeSaussure, *Do We Need a Strict, Limited Liability Regime in Outer Space?, in* PROCEEDINGS OF THE TWENTY-SECOND COLLOQUIUM ON THE LAW OF OUTER SPACE 117, 118 (Int'l Inst. of Space Law of the Int'l Astronautical Fed'n, 1980) ("It will undoubtedly remain true that a certain number of objects will be launched into space without ever appearing on any registry.").

problems, a more stringent duty of providing information and consultation accompanied by the marking of space objects will help. Finally, theories of joint liability are considered.

A. *Strict Liability*

A number of commentators strongly contend that article III of the Liability Convention should be amended from fault-based liability to strict liability.[96] This suggestion is not new; in the drafting stages of the Convention the United States proposed a standard of absolute liability regardless of location.[97] However, the suggestion met with universal disapproval.[98]

1. The Arguments Against Strict Liability

The principal rationale against strict liability is the concept of reciprocal risk.[99] It is based on the principle that there is no reason to favor one launching State over another.[100] Myres McDougal offered this argument as early as 1962:

> [I]t is fair to assume that either one or both of the participants involved in a collision may have, through their acts or omissions, contributed to the accident. Furthermore, such participants *can* be presumed to have willingly accepted the risks inherent in space activities. In view of these unique factors it would seem a sound policy to dispense in such situations with the principle of absolute liability. . . .[101]

Another argument against strict liability is that the result of such a standard would be "absurd . . . and sometimes unjust."[102] Also, concerns exist that insurance for space exploration will become too costly.[103] Finally, there is a sense that a progressive legal order should

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96. *See, e.g.*, BAKER, *supra* note 1, at 84-86 (concluding that an absolute liability scheme is superior to the fault-based system of the Liability Convention); DeSaussure, *supra* note 95, at 117.

97. *See* UNITED NATIONS, COMMITTEE ON THE PEACEFUL USE OF OUTER SPACE, CONVENTION CONCERNING LIABILITY FOR DAMAGE CAUSED BY THE LAUNCHING OF OBJECTS INTO OUTER SPACE; UNITED STATES: PROPOSAL, U.N. Doc. A/AC.105/C.2/L.8/Rev.1, *reprinted in* JASENTULIYANA & LEE, *supra* note 40, at 247, 248.

98. *See* Foster, *supra* note 48, at 154 n.58.

99. *See* CHRISTOL, *supra* note 47, at 107 (explaining that the drafting of a dual system of liability in the Liability Convention was "based on practical considerations" as the assumption of reciprocal risks); *see also* Edward Hennessey, Note, *Liability for Damage Caused by the Accidental Operation of a Strategic Defense Initiative System*, 21 CORNELL L.J. 317, 329 (1988) (discussing the fact that the assumption of reciprocal risks underlies a fault system).

100. *See* Foster, *supra* note 50, at 154-55 ("The position of both parties in this situation is equal; in undertaking space activities they must implicitly be understood to have accepted the risks involved. Nor is there any reason to favor one launching state over another.").

101. MCDOUGAL, ET AL., *supra* note 48, at 624.

102. N.M. MATTE, AEROSPACE LAW: FROM SCIENTIFIC EXPLORATION TO COMMERCIAL UTILIZATION 161 n.35 (1977), *quoted in* BAKER, *supra* note 1, at 85 n.265.

103. *See* Andrew R. Sebok, *International Tort and Insurance Law and Practice: What Has Become of Our World?*, 24 TORT & INS. L.J. 390 (1989) (explaining the difficulty in obtaining tort insurance for transboundary harm); *see also Events of Interest*, 17 J. SPACE L. 72 (1989)

be able to provide for fault-based liability — overcoming the tendency for absolute liability that is characteristic of primitive legal systems.[104]

2. The Arguments For Strict Liability

Theoretically, the arguments for strict liability are stronger than the counterarguments. First, while strict liability may appear to be "absurd . . . and sometimes unjust," a negligence régime is "equally absurd and unjust."[105] One only has to consider the weaknesses of the fault-based system: the uncertainty over what "fault" means, the absence of any indication of what standard of care is necessary, the difficulty of actually proving culpability and the problem of foreseeability.[106] It is unjust when a State causes damage through negligent conduct and its negligent conduct cannot be proved, thus forcing other States to bear the expense of its activities.[107]

Furthermore, it is important to consider the abnormally dangerous or ultrahazardous character of space activities that generate refuse. For example, test explosions in outer space of many weapon types generate an especially large amount of debris.[108] Howard Baker best explains why States that proliferate debris should be held strictly accountable:

> Since its early days, space law has accepted the approach that States which undertake activities based on technological developments are responsible for the results arising from those developments. The proliferation of space refuse is one such result. In these situations, "responsibility [should be] imputed to the person or entity making the initial decision to engage in the activity which exposes others to risks where possibly no amount of foresight or feasible protective measures may avert injuries."[109]

Finally, in formulating policy it is important to consider just who must bear the costs of damage: the victim or the entity causing the

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(summarizing B. Kraselsky's concern at a space debris workshop that "if nothing is done [about the debris problem] . . . insurance companies will begin charging for the risk").

104. KELSEN, *supra* note 65, at 12.

105. BAKER, *supra* note 1, at 85.

106. *See supra* notes 65-95 and accompanying text.

107. *See* BAKER, *supra* note 1, at 85 (stating this argument).

108. Era G. Zhukova-Vasilevskaya, *Protection of the Outer Space Environment According to the Norms and Principles of International Space Law, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 101, 104. The 1987 COSPAR Status Report states:

> The United States anti-satellite weapon test in which the Schwind satellite was destroyed by collision generated 257 "observable" fragments, with a much larger number of "non-observable" pieces of debris. Future tests as part of the Strategic Defense Initiative programme would therefore be potential generators of a flood of man-made space debris.

1987 COSPAR STATUS REPORT, *supra* note 2, at 5.

109. BAKER, *supra* note 1, at 85 (quoting STAFF OF SENATE COMM. ON AERONAUTICAL AND SPACE SCIENCES, 92D CONG., 2D SESS., REPORT ON THE CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS: ANALYSIS AND BACKGROUND DATA 26 (Comm. Print 1972) (testimony of R.H. Campbell)).

harm. With commercial launchings, the cost of orbital debris prevention will be passed onto the customer, thus forcing actors to take into account the costs of activity which creates hazards for others. The benefits of space activities must be weighed against the possibility of substantial harm that can result from a collision with a space object and the foreclosure of future activities.

3. The Reality

Realistically, though, it is doubtful that spacefaring nations are prepared to accept the standard of strict liability as a general principle.[110] One only has to consider the difficulty in applying strict liability for damage caused by space objects on the surface of the Earth — where the Liability Convention expressly provides for absolute liability.[111]

Furthermore, there is a strong view against the existence of a basis for strict liability in general or customary law.[112] The Soviet representative at the drafting of the Liability Convention supported this view[113] — and as a major spacefaring nation, the views of the Soviet Union carry a significant amount of weight.[114]

This view also finds support in the work of the International Law Commission on Liability for Injurious Consequences Arising Out of Acts Not Prohibited by International Law.[115] Quentin-Baxter, Special Rapporteur of the Commission, has stressed that absolute liability is "at present a product only of particular conventional régimes."[116]

Thus, although a strict liability system theoretically may be a good idea, it is doubtful that it could generate the acceptance necessary for its implementation.

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110. *See* Danilenko, *supra* note 73, at 177 (determining that "states are not prepared to accept the standard of absolute liability as a general principle operating independently of specific treaty regimes"); *see also* Robert Quentin-Baxter, *Preliminary Report on International Liability for Injurious Consequences Arising out of Acts not Prohibited by International Law*, [1980] 2 Y.B. Int'l L. Comm. 252-55, U.N. Doc. A/CN.4/SER.A/1980 ("in cases not governed by any conventional regime, settlements are usually effected upon a non-principled and *ex gratia* basis").

111. For example, the applicability of absolute liability to the Cosmos-954 incident has been questioned, despite Canada's claim to be entitled to hold the Soviet Union absolutely liable for damage resulting from the disintegration of the Soviet satellite over the northern part of its territory. *See* Danilenko, *supra* note 73, at 177.

112. *See supra* note 110.

113. *International Liability for Injurious Consequences Arising Out of Acts Not Prohibited by International Law*, U. N. Doc. A/CN.4/334/ADD.2/1980, *reprinted in* [1980] 1 Y.B. Int'l Law Comm. 245, 254, U.N.Doc. A/CN.4/SER.A1/1980 (statement of N. Ushakov, USSR).

114. With regard to the Soviet Union, "[i]t is doubtful that decisions by majority, even by absolute majority, will lead to viable legal regimes, especially when the outvoted minority includes the states most affected by any such decision." Gennady M. Danilenko, *Outer Space and the Multilateral Treaty-Making Process*, 4 HIGH TECHNOLOGY L. J. 217, 228-29 (1989).

115. *See* Quentin-Baxter, *supra* note 110, at 254.

116. Robert Quentin-Baxter, *Third Report on International Liability for Injurious Consequences Arising Out of Acts Not Prohibited by International Law*, [1982] 2 Y.B. Int'l L. Comm. 52, U.N. Doc. A/CN.4/SER.A/1982.

B. *Improved System of Fault Liability*

1. A Defined Standard of Care

A more probable solution will be for spacefaring nations to develop rules of the road to supplement the fault-based liability system. McDougal has stated that the most relevant model for allocation of liability for collisions in outer space "would appear to derive from community experience in the allocation of liability for collision of ships at sea and collisions of aircraft in flight."[117]

Early space law commentators Jessup and Taubenfeld suggested that

> [w]e may find it necessary to add to our arrangements for outer space a space navigation code, analogous to the International Code of Signals and International Collision Regulation for ships at sea and the navigation code of the air constituted by the . . . annexes to the Convention on International Civil Aviation. A space navigation code might include provision for the removal of derelicts or other obstructions.[118]

Baker notes that several standards have been proposed as a basis for allocating fault:

> A launching state would be negligent if it:
>
> 1. abandoned deliberately an active satellite where the technology existed to retrieve it;
> 2. failed to maintain the required spacing between satellites in the GEO;
> 3. failed to place a potentially inactive satellite in a disposal orbit;
> 4. refused to remove space refuse resulting from its space activities.[119]

2. Shifting the Burden of Proving Negligence

Another necessary change to a system of fault liability is acceptance of a rule that would state that leaving inactive space objects or space debris in orbit is negligence per se. R. Cargill Hall argued for such a standard prior to the Liability Convention.[120] The Italian delegate to the Liability Convention made a proposal for a rebuttable pre-

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117. MCDOUGAL ET AL., *supra* note 50, at 620. For rules of collision law, see generally GILMORE & BLACK, *supra* note 74, at 395, § 6-42.

118. PHILLIP C. JESSUP & HOWARD J. TAUBENFIELD, CONTROLS FOR OUTER SPACE 249-50 (1959).

119. BAKER, *supra* note 1, at 84.

120. R. Cargill Hall, *Comments on Salvage and Removal of Man-Made Objects from Outer Space*, 33 J. AIR L. & COMMERCE 288, 297 (1967). The argument for per se liability noted that,

> [s]hould precedent and custom prevail, however, in the case of removal — destruction of inactive man-made objects where a state retains title to its hazardous debris in Earth orbit but refuses to remove these objects, and where other states refrain from interfering with the debris to the peril of spacecraft navigation, it would seem that a corresponding corollary should obtain: absolute liability should be imposed upon the state of registry for any damage caused by its debris in outer space, or at least some form of the res ipsa loquitur [negligence per se] should follow.

Id.

sumption of common fault. However, it was rejected.[121] Today, given the hazards posed by debris, legal scholars have renewed the argument for a finding of fault for the generation of debris.[122]

A strong justification for a rebuttable presumption of negligence is the fact that the information relating to the creation of the hazard probably will be only within the hands of the tortfeasor. This is true especially in such sensitive space activities as military tests where discovery of the evidence by the injured party will be very difficult.[123]

Judge Learned Hand explained this justification in providing for the presumption of fault in U.S. admiralty law for collision situations:

> But there are situations in which the law does not put the duty upon the sufferer to make proof at the outset; either because the facts are especially within the owner's knowledge, or, as in the case of collisions with an anchored vessel, because usually there must be some fault, it is thought just to require the owner to explain, and if he does not, to charge him.[124]

One critic of this theory, however, claims that it in effect creates strict liability: "The present state of space technology does not permit activities in space that are completely debris-free . . . . [N]o debris removal scheme is immediately adoptable. I would suggest that more is necessary to establish fault than mere production of debris."[125] Because of this similarity to strict liability, "acceptance of such a rule by the spacefaring nations at this time does not hold out much of a promise."[126]

C. *Minimizing the Identification Problems*

Even if modification of the Liability Convention is accepted, the problem of identification, except for larger space objects, still must be addressed.[127] The most important action is to provide for the marking of all space objects, including potential space refuse.[128]

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121. U.N. Doc. A/AC.105/C.2/SR.79 at 10, SR.99 at 122, & SR.116 at 65.

122. Gorove, *supra* note 8, at 131-32; *see also* presentation of Professor Gorove at an International Colloquium organized by the Institute of Air and Space Law, Cologne University, held at Cologne, May 16-19, 1988, *summarized in Events of Interest*, 16 J. SPACE L. 92 (1989).

123. Hennessey notes:

> A State asserting United States liability for damage caused by its SDI system would find it difficult, and perhaps impossible, to gather the information necessary to prove fault in the design, construction or operation of the system. This difficulty would result from U.S. reluctance to divulge information about a sophisticated military system.

Hennessy, *supra* note 97, at 329.

124. Cranberry Creek Coal Co. v. Red Star Towing & Transport Co., 33 F.2d 272 (2d Cir. 1929), *cert. denied*, 280 U.S. 596 (1929).

125. Schwetje, *supra* note 80, at 41.

126. Gorove, *supra* note 8, at 131.

127. *See supra* notes 85-95 and accompanying text.

128. *See* BAKER, *supra* note 1, at 157 (providing for marking as part of an overall solution to the problem of space debris).

Also, a strict duty of prior consultation and full information is needed, which the Registration Convention currently fails to provide.[129] The obligation to consult is laid down in article IX of the 1967 Space Treaty[130] and is part of customary law.[131] Precedent for the duty of prior consultation exists in the West Ford Project, carried out by the United States in 1962, which consisted of the launching of a belt of copper needles into orbit.[132]

A theoretical solution to the identification problem is to provide for a joint liability theory. Such a theory represents an attempt to allocate liability according to risk contribution among tortfeasors when one cannot identify a specific tortfeasor.[133] It means shifting the burden of proof as to causation to defendant States negligently contributing to the debris hazards. This theory exists in United States domestic law for products liability.[134] It is almost certain, however, that spacefaring nations would reject this theory given that it is even more extreme than the imposition of strict liability alone.

V. THE NEED FOR A MULTILATERAL APPROACH

Commentators uniformly maintain that only international cooperation can solve the problem of orbital debris.[135] Also, actors must agree on a workable liability system before conflicts over damage arise. Thus, a unified, planned approach by current actors is crucial.[136]

Customary law is not the appropriate tool. "It is generally recognized that as a matter of legal policy the reliance on international custom is advisable primarily in situations where treaty regulation is inadequate."[137] However, customary international law cannot be expected to fill the gaps of the Liability Convention. Customary law is confined to general rules — not suitable for regulating specific ques-

129. *See supra* notes 61, 85-96, and accompanying text.

130. Outer Space Treaty, *supra* note 7, art. IX, 18 U.S.T. at 2416, 610 U.N.T.S. at 209-10.

131. Williams, *supra* note 71, at 159. He notes that "the obligation to consult is part of customary law. It is of particular relevance where advanced space technologies are being used in connection with weather control by means of satellites and the ever-increasing range of ultrahazardous activities." *Id.*

132. *Id.* The experiment prompted COSPAR to convene a meeting to examine the effects of the experiment.

Today COSPAR provides information on launch activities and orbiting space objects that is superior to the UN registry. Baker, *supra* note 1. However, the information still is inadequate for identification of space debris. Williams, *supra* note 73, at 131.

133. Glen O. Robinson, *Multiple Causation in Tort Law: Reflections on the DES Cases*, 68 VA. L. REV. 713, 717 (1982).

134. *See generally id.*

135. BAKER, *supra* note 1, at 155; *see also* DeSaussure, *supra* note 95, at 118 ("As manned activity in space becomes routine, the need for a refined, uniform and predictable legal regime will become urgent.").

136. BAKER, *supra* note 1, at 155.

137. Danilenko, *supra* note 73, at 169.

tions in the field of technology.[138] Gennady Danilenko offers a second reason why customary law is inappropriate: "Unlike treaty, custom is an unsuitable instrument for the creation of an anticipatory, forward-looking legal framework. It is always based on the existing state practice and in this respect, as Judge V. Koretsky put it, 'turns its face to the past.' "[139]

While customary law will not work, neither will a comprehensive convention through the auspices of the United Nations. In recent U.N. efforts in the area of environmental protection, conflicts between the industrialized nations and the less-developed nations have been intense.[140] For example, a more focused approach avoids the pitfalls of getting waylaid by simultaneously trying to resolve the disputed claims of equatorial nations.[141] The search for a consensus may only result in frustration and harmful delay.[142]

Jürgen Reifarth has called for such discussions outside the United Nations:

> Unlike other subjects . . . the topic of space debris does not involve a balancing of interests; what is important is that the common safety interest of the space nations be satisfied. As the problem of space debris is of great urgency to all space nations, the forum to be chosen for concluding international agreements should promise an objective and fruitful discussion speedily leading to an acceptable solution . . . . [T]he Outer Space Committee of the United Nations does not seem to be the right forum for such a discussion. I would prefer a bilateral or unilateral approach, which — at least at the beginning — should take place outside the UN.[143]

Neil Hosenball, testifying before the Subcommittee on Space Science and Applications of the U.S. House of Representatives, argued

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138. Rauschning, *supra* note 72, at 184.

139. Danilenko, *supra* note 73, at 179 (analyzing the efficacy of customary law in the fields of environmental protection and space law).

140. Stamps, *supra* note 14, at 157.

141. *Id.*

142. Gennady Danilenko explains how it is too difficult to reach such a consensus:

> The search for a consensus tends to result in settling on the lowest common denominator, so as to prejudice the positions of the states involved. Such a consensus often serves only as a disguise for continued disagreement. The disputes over the meaning of the common heritage of mankind principle incorporated into Article 11 of the Moon Treaty illustrate this trend.

Danilenko, *supra* note 114, at 226. Neil Hosenball discusses the time concern: "The only concern I have is, if we're talking about this becoming a crisis in the year 2000, I'm not sure working through the UN and the committee will solve the problem in 10 years." *Orbital Space Debris: Hearing Before the Subcomm. on Space Science and Applications of the Comm. on Science, Space and Technology*, 100th Cong., 2d Sess. 64 (1988) (statement of S. Neil Hosenball) [hereinafter *Testimony of Neil Hosenball*].

143. Jürgen Reifarth, *An Appropriate Legal Format for the Discussion of the Problem of Space Debris, in* ENVIRONMENTAL ASPECTS OF ACTIVITIES IN OUTER SPACE, *supra* note 72, at 301, 309.

for a similar forum, but would prefer that it be multilateral.[144] He recommends bringing together the interested parties: the Soviet Union, ESA Arianespace, the United States and its commercial providers, China, India, and all other countries that now have the capability to generate orbital debris in space.[145]

To the extent possible, multilateral negotiations of spacefaring nations are preferable to bilateral discussions in that numerous, inconsistent approaches are avoided. At any rate, a prompt agreement by these spacefaring nations resolving issues of liability would go a long way to prevent unnecessary escalation of this threat to future space activity.

CONCLUSION

Now that nations realize dumping and explosions seriously threaten future operations, space polluters can no longer have a free license for such activities. With increasing use and the advent of commercialization of outer space, nations hopefully will react to the pressure for a working liability scheme. At the very least, rules of the road to implement the Liability Convention are necessary. Given a workable liability system, nations will be able to ensure that space remains accessible and safe as humanity's final frontier.

144. *Testimony of Neil Hosenball, supra* note 142, at 66-67.

145. *Id.*