

International Liability of the United States for Space Shuttle Operations

The Space Shuttle is the United States' largest current endeavor in space. After examining the Space Shuttle itself, and the likelihood of accidents involving the Shuttles, this article will examine the international tort liability of the United States for Space Shuttle operations¹ and will recommend improvements in the existing legal regime.²

I. Overview of Space Shuttle Operations

The Space Shuttle, the world's first reusable spacecraft, heralds a new age in space. Traditional launch systems are completely consumed in the process of placing men or satellites in orbit, but the Space Shuttle is designed to perform at least 100 launches of men and satellites into orbit before extensive refurbishment is required.³ The "primary design and operations goal for the

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¹The Shuttle will first enter space in 1980 for a series of tests. Regular operations should begin later that year.

²A significant amount of public international space law to date has been written in the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). By 1976, the United Nations had generated four major treaties of space law: (1) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 (entered into force for the United States on Oct. 10, 1967) [hereinafter cited as Outer Space Treaty]; (2) the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* April 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 (entered into force for the United States on Dec. 3, 1968) [hereinafter cited as Rescue Agreement]; (3) the Convention on International Liability for Damage Caused by Space Objects, *opened for signature* March 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762 (entered into force for the United States on Oct. 9, 1973); and, (4) the Convention on Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, T.I.A.S. No. 8480 (entered into force for the United States Sept. 15, 1976).

³However, 50 missions may be a more realistic figure for some Shuttle systems. Av. WK. & SPACE TECH., Nov. 8, 1976, at 65.

Space Shuttle Program is to provide routine access to space."⁴ For the next decade, much of what this country and the rest of the Non-Communist world sends into space will leave aboard the Space Shuttle.⁵

A. Nature of Shuttle Operations

The Space Shuttle is one component of NASA's Space Transportation System. The purpose of the Space Transportation System is to reduce the cost of placing objects in orbit around the earth. The Shuttle's primary function is to place objects in low orbits of about 100-150 miles above the earth. The remaining components of the Space Transportation System will move objects from where the Shuttle placed them to higher orbits of up to 22,300 miles above the earth, into heliocentric orbits or onto inter-planetary trajectories. These other components are still being developed.⁶

The Shuttle is composed of three elements: Orbiter, External Tank and Solid Rocket Boosters. The Orbiter, an aerospace vehicle⁷ about the size of a DC-9 jetliner, will carry into space a crew of as many as seven persons or a payload of up to 65,000 pounds. During its missions of seven to thirty days, the Orbiter may deploy, repair and retrieve satellites, operate space laboratories and telescopes, or ferry materials for the construction of permanent space stations and other large space structures.⁸ The Orbiter will be launched vertically, like a rocket, but will land as a glider on specially constructed runways, using aerodynamic surfaces for terminal area approach controls. Two weeks after the Orbiter returns from space it can be ready for another launch.

Two Solid Rocket Boosters are ignited at launch to help provide the necessary thrust to lift the Orbiter out of the earth's atmosphere. About two minutes after launch, the expended Solid Rocket Boosters are jettisoned to fall into the ocean. Tugboats pull the Solid Rocket Boosters back to shore. They are then refurbished and readied for a later launch.

The External Tank is the fuel tank for the Orbiter's main rocket engines. The Orbiter's three main rocket engines must also be ignited at launch to help provide the necessary thrust to lift the Orbiter. About ten minutes after launch the fuel in the External Tank will have been exhausted. By this time the Orbiter will be approaching orbital velocity. The External Tank will be released just prior to orbital entry, and allowed to "tumble," that is, to spin end over end back into the atmosphere. Though most of it will burn up in the

⁴NASA, *SPACE SHUTTLE* vi (1976).

⁵The Soviet Union can also provide commercial launch services. Japan, the European Space Agency, India and China are each developing and/or improving launch capabilities. *AV. WK. & SPACE TECH.*, Nov. 8, 1976, at 43.

⁶Other components are the Interim Upper Stage and the Space Tug. The Interim Upper Stage should be ready by 1981; the Space Tug by 1983. *See generally AMERICAN ASTRONAUTICAL SOCIETY, SPACE SHUTTLE MISSIONS OF THE 80s*, 571-865 (1977).

⁷For a discussion of the term "aerospace vehicle," *see* note 54 *infra*.

⁸Large space-based solar power or communication systems are the standard proffered examples of such "large space structures." *AV. WK. & SPACE TECH.*, Nov. 8, 1976, at 134.

atmosphere, surviving fragments will land in the southern part of the Indian or Pacific Oceans.

The four planned Space Shuttles, each composed of Orbiter, External Tank, and Solid Rocket Boosters, are being developed by NASA and will be the property of the United States Government.⁹ However, there is, and there will continue to be, an unprecedented amount of international involvement in the construction and use of the Space Transportation System.¹⁰

B. Likelihood of Damage or Injury

There are three phases to a Shuttle mission. Each suggests different possibilities for accidental damage or injury. During the Ascent Phase, the Shuttle is either launched to the east from Cape Canaveral, Florida, or to the south from Vandenberg Air Force Base, California. The Solid Rocket Boosters are then jettisoned into the Atlantic or Pacific Ocean. The Ascent Phase concludes with the release of the External Tank for atmospheric burnup. The Orbital Phase encompasses all Shuttle operations in orbit around the earth. The Descent Phase involves the Shuttle reentering the atmosphere and, on a nominal mission, gliding to an unpowered landing at either Cape Canaveral or Vandenberg.

Dangers posed by the Ascent Phase are from a catastrophic failure of the Shuttle itself, from the jettisoned Boosters, and from fragments of the External Tank which may survive atmospheric reentry. The External Tank separates from the Orbiter just prior to the achievement of desired orbital velocity and altitude. The frictional forces of atmospheric reentry then incinerate the massive 75,000 pound aluminum alloy Tank, and surviving Tank fragments will be scattered over remote parts of the Indian or South Pacific Oceans.¹¹ Improper separation or turbulent and unpredictable atmospheric reentry create a slight possibility of fragments falling on populated areas.¹²

⁹For a discussion of NASA's legal authority to operate the Shuttle, see Mossinghoff Sloup, *Legal Issues Inherent in Space Shuttle Operations*, 6 J. SPACE L. 47 (1978) [hereinafter cited as Mossinghoff Sloup]. NASA may turn the management of nearly all Shuttle operations over to private contractors. AV. WK. & SPACE TECH., March 16, 1978 at 12. This will have no effect on the international liability of the United States. See note 38 *infra*.

¹⁰As NASA Administrator Fletcher states, "I want to emphasize that the Shuttle is the work of many nations, and will provide opportunities for space participation for all the nations of the world." L. NAPOLITANO, A NEW ERA IN SPACE TRANSPORTATION 3 (1976). For a creative analysis of the legal aspects of the Space lab/Space Shuttle Program. See also Bourely, *The Legal Framework of the Spacelab/Space Shuttle Programs in Comparison with the Apollo/Soyuz Test Program*, 4 J. SPACE L. 77 (1976). NASA already performs more launches for private industry and foreign governments than it does for itself. HOSENBALL, *Space Law, Liability and Insurable Risks*, 12 FORUM 153 (1976) [hereinafter cited as Hosenball]. See also note 44 *infra*.

¹¹Experience has shown that man-made space objects which re-enter the atmosphere do not completely burn up. See, e.g., Finch & Moore, *The Cosmos 954 Incident and International Space Law* 65 A.B.A.J. 56 (1979); Dembling, *Cosmos 954 and the Space Treaties*, 6 J. SPACE L. 129 (1978).

¹²NASA plans to have the fragments fall over remote parts of international waters. It can be estimated, with very high certainty, that the surviving fragments will fall somewhere in a 1700 mile-long corridor of the Indian Ocean. DOYLE, *Reentering Space Objects: Facts and Fiction*, 6 J. SPACE L. 107 (1978). Of the over 5,000 man made objects which have reentered the atmo-

The Shuttle launch sequence includes abort plans in which the Boosters and External Tank are prematurely jettisoned to allow the Orbiter to make an emergency landing shortly after take-off.¹³ The launch ranges for the Shuttle are over water, and the chances that a mishap during the Ascent Phase would injure or cause damage on earth are extremely remote.

During the Orbital Phase, there is a danger of collision between the Orbiter, or an object the Orbiter places in orbit, and an object which is already in orbit.¹⁴ One accident has already occurred,¹⁵ at a time when there were far fewer man-made objects in space, and nearly all space activities occur within certain preferred orbital paths in the sphere of space surrounding the earth.¹⁶ Computer models already reveal probabilities of collision between orbiting space objects, over a ten-year period, of greater than ten percent for the most highly utilized orbits.¹⁷ This probability could increase to twenty-eight percent by the end of the next decade.¹⁸ As one researcher commented, "it is not a question of whether or not the probability of collisions will become unacceptably high, but rather when this will occur."¹⁹

Against these considerations one must weigh the Shuttle's ability to reduce space collisions. The Orbiter can retrieve endangered satellites by placing them in its cargo bay, or alter a satellite's orbit by attaching "rocket packs." Furthermore, collisions can be anticipated with ground-based tracking systems and the Shuttle will make possible a virtually continuous manned presence in low earth orbit. These factors suggest that within the area of the Orbiter's operations, any increased likelihood of collisions between space

sphere, there are only 47 reported incidents of fragments impacting on land or on ships at sea. Hosenball, *Space Law, Liability and Insurable Risks*, 12 FORUM 153-54 (1976). In one of these incidents, members of the Japanese delegation to the United Nations reported that fragments from a device launched into outer space damaged a Japanese cargo boat and injured five sailors. Diederiks-Verschuur, *The Convention on International Liability Caused by Space Objects*, 15 COLLOQUIUM ON THE LAW OF OUTER SPACE 96 n.3 (1972).

In one very important respect it is quite inappropriate to compare surviving External Tank fragments with meteorites or reentering man-made space objects. The External Tank, and its fragments, will follow preplanned, non-orbital ballistic trajectories in their descent. Accidental harm from objects on a ballistic trajectory planned to terminate in remote parts of an ocean is far less likely than is harm from orbiting or deep space objects — which was shown above to be of very rare occurrence.

¹³AV. WK. & SPACE TECH., June 3, 1974, at 14. NASA's Space Transportation System Traffic Model estimates that for 560 planned Shuttle missions, 31 would have to be aborted. L. NAPOLITANO, *A NEW ERA IN SPACE TRANSPORTATION* 11 (1976).

¹⁴A recent accounting of trackable objects in earth orbit arrived at a total of 3,918. Hosenball, *supra* note 10 at 154. It is estimated that there are two to three times this many non-trackable orbiting objects, and, if space activities continue only at the pre-Shuttle era rate, the number of objects in space will double in ten years. AMERICAN ASTRONAUTICAL SOCIETY, *SPACE RESCUE AND SAFETY* 105, 133 (1975). The Shuttle, of course, will greatly increase the utilization of space.

¹⁵Two American satellites collided in 1965. S. LAY & H. TAUBENFELD, *THE LAW RELATING TO ACTIVITIES OF MAN IN SPACE* 140 (1970) [hereinafter cited as LAY & TAUBENFELD].

¹⁶This is because certain orbital planes are especially useful. For example, most civil communication and meteorology satellites can be found in the geostationary orbit 22,300 miles above the earth's equator.

¹⁷AMERICAN ASTRONAUTICAL SOCIETY, *SPACE RESCUE AND SAFETY* 136 (1975).

¹⁸*Id.* at 135.

¹⁹*Id.* at 180.

objects occasioned by the Shuttle's increased use of space will be offset by the Orbiter's abilities to prevent such collisions.

The Orbiter itself cannot prevent collisions in the highly utilized geostationary orbit. This orbit is far beyond the 100-150 mile orbit range of planned Orbiter operations. But the Orbiter will serve as a platform from which satellites destined for geostationary orbit will be propelled.

Arguably, the Shuttle increases the probability of collision between geostationary satellites. However, the care taken in spacing these satellites, improvements in their guidance and control systems, and prospective Shuttle-facilitated manned capabilities in high-earth orbits pretty well counter this argument. Hence the probable impact of the Shuttle will be a net reduction of accidental damage or injury due to colliding or reentering space objects.

The Descent Phase concludes a Shuttle mission. In this phase the Orbiter reenters the atmosphere, dissipates excess energy, and lands on a runway. Flying a winged vehicle into the earth's atmosphere at a speed of Mach 25 presents formidable risks of loss of Orbiter control and collision with aircraft. Loss of control is the greater risk because the thirty-one minute reentry approach to a runway 4,000 miles away involves, among many other things, reentry temperatures which approach critical limits, steep banking maneuvers at hypersonic speeds and maneuvers during the two minutes when Orbiter speed falls from Mach 5 to Mach 2 when handling and stability control problems can develop.²⁰ The safety margins within which the descent must be accomplished can fairly be characterized as always narrow and occasionally very narrow.

Loss of control will depend on the reliability of the Orbiter systems and the responses of the pilots to particular dangers. The systems required for the descent phase have back-ups, making systems failure very unlikely. Highly advanced simulators capable of duplicating actual flight conditions, including convincing visual imagery, are providing shuttle pilots with the most realistic and extensive training ever given astronauts. Even the most improbable combinations of systems failures are induced to provide Shuttle pilots with experience and engineers with data on the spacecraft's reactions.

Thus, the very high, if not unprecedented, requirements for Shuttle system reliability, coupled with comprehensive testing of these systems and extensive, realistic training of their human operators, makes accidental damage due to loss of Shuttle control an unlikely event.

The Orbiter's reentry flight path will be predetermined, announced in advance and cleared of other aircraft.²¹ Thus, damage during the Descent Phase could only occur as a result of events such as an uncorrectable failure of operating and reserve control systems or a failure to detect aircraft, visually and electronically, in a pre-announced and cleared flight path. The chances of these happening are exceedingly small.

²⁰See *AV. WK. & SPACE TECH.*, May 14, 1979 at 38.

²¹The FAA has cleared airplane descent paths for the Shuttle. *Mossinghoff Sloup, Supra* note 9 at 51.

In summary, there is very little likelihood of accidental injury or damage in all three phases of a Shuttle mission. The chance of an accident on any given Shuttle mission is also especially remote. The probability of an accident over time, with Shuttle launches occurring every several days, year after year,²² is also quite remote as experience gained from actual Shuttle operations will be used to reduce the possibilities of accidents. Given this assessment of the probabilities of Shuttle-caused damage or injury, what is the United States international liability if accidents do in fact occur from Space Shuttle Operations and damage is caused?

II. International Liability for Damages

Damage or injury caused by space vehicles has been of concern since the beginning of the space age in 1957.²³ This concern received formal recognition in 1971 with the United Nations General Assembly's passage of the Convention on International Liability for Damage Caused by Space Objects²⁴ ("Liability Convention"). The Convention establishes legal bases and procedures by which certain tort claims resulting from injury or damage caused by a space object can be settled.²⁵

The tort covered by the Convention is "damage," defined as "loss of life, personal injury or other impairment of health"²⁶ or loss or damage to prop-

²²See AV. WK. & SPACE TECH., May 26, 1975, at 49, where NASA plans for 60 missions a year from 1984-1990 are discussed.

²³For a review of United Nations' concern with this issue, see O. OGUNBANWO, INTERNATIONAL LAW AND OUTER SPACE ACTIVITIES 143-78 (1975); F. NOZARI, THE LAW OF OUTER SPACE 66-83 (1973); S. LAY & H. TAUBENFELD, THE LAW RELATING TO THE ACTIVITIES OF MAN IN SPACE 136-80 (1970); C. CHRISTOL, THE INTERNATIONAL LAW OF OUTER SPACE 352-80 (1966) [hereinafter cited as CHRISTOL]; C. JENKS, SPACE LAW 283-90 (1965); Foster, *The Convention on International Liability for Damage Caused by Space Objects*, CANADIAN Y. B. INT'L L. 137 (1972) [hereinafter cited as Foster].

²⁴The Convention on International Liability for Damage Caused by Space Objects, *opened for signature* March 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762 (entered into force for the United States on Oct. 9, 1973) [hereinafter cited Liability Convention]. As of December 1, 1978, 71 States had signed the Convention, 34 had ratified it and 17 had acceded to its provisions.

²⁵Another remedy available to a foreign plaintiff may be a products liability action against the manufacturer of the Shuttle and its component parts. See Matte, *Product Liability of the Manufacturer of Space Objects*, 2 ANNALS AIR & SPACE L. 375 (1977). Furthermore, manufacturers of the Shuttle, if strictly liable, may not be allowed to share the immunity the government enjoys for ultrahazardous activities. *Smith v. Lockheed Propulsion Co.*, 247 Cal. App. 2d. 774, 56 Cal. Rptr. 128 (Dist. Ct. App. 1967). For a discussion of defendants other than the United States, see, e.g., Dula, *Management of Interparty and Third Party Liability for Routine Space Shuttle Operations*, 26 DRAKE L. REV. INS. L. ANN 741 (1977).

²⁶For an exploration of whether this includes injury affecting mental or social well-being such as loss of consortium, pain and suffering, mental anguish and loss of privacy, see S. GOROVE, STUDIES IN SPACE LAW: ITS CHALLENGES AND PROSPECTS 124-25 [hereinafter cited as GOROVE]; It is the view of a growing number of commentators that "moral" damages such as pain and suffering are encompassed by this definition. However this position is certainly contestable. Foster opines that "despite the problems involved in placing values on pain and suffering, and loss of capacity to enjoy life, compensation may be awarded for such losses." However he concedes national laws on the subject vary greatly, the matter did not receive much consideration during negotiations over the Convention, and the Convention itself fails to expressly provide for non-physical injuries. Foster, *supra* note 23, at 173. Matte has characterized the range of com-

erty²⁷ of states or of persons, natural or juridical, or property of international intergovernmental organizations. . . ."²⁸ However, the Convention does not provide remedies for damage caused by a nation's space activities to that nation's own residents.²⁹ The Convention deals only with international liability, that is, instances where one nation's space activities cause damage in other countries or in nonterrestrial areas. Thus questions of the domestic liability of the United States for damages caused at home are beyond the scope of the Convention and this article.³⁰

A. Provisions of the Convention

1. LIABLE PARTIES AND APPORTIONMENT OF LIABILITY

The liable party is called the "launching State," defined as a State which launches, procures the launch or from whose territory is launched, the damage-causing space object.³¹ This definition of "launching State" will create liability in the United States for many years since the United States will be launching the payload in its Shuttle, which will itself be launched from American territory.

There will often be several parties liable because of the heavy international use of the Shuttle,³² the Shuttle's capability of carrying several different payloads,³³ and because a country which "procures" the launching of an object

pensable damages thusly: "loss of profits, interest, sentimental value, pain and suffering? It is left open, to be decided in each case by the parties concerned, or, failing their agreement, by a claims commission." N. M. MATTE, *AEROSPACE LAW* 157 (1977).

²⁷Loss or damage to property which directly results from an accident involving a space object is clearly within the scope of the Convention. There is uncertainty as to whether the Convention encompasses indirect or consequential damage, that is, damage which results only from the consequences of an act. It is the position of the United States that damage "for which there is only [a] hypothetical causal connection with a particular space activity" is not remunerable under the Convention. STAFF REPORT, COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES, 92D CONG., 2D. SESS, CONVENTION ON LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS, ANALYSIS AND BACKGROUND DATA 24 (Comm. Print 1972).

²⁸Liability Convention, *supra* note 24, art. I.

²⁹*Id.* art. VII.

³⁰Current federal law allows an American injured as a result of Space Shuttle operations to either sue the United States in district court or to obtain relief directly from NASA. Under 42 U.S.C. § 2473(b) (1970), NASA has the power to pay claims for personal injury or property damage, due to authorized NASA activities, which amount to no more than \$5,000. NASA may submit claims in excess of this amount to Congress for their consideration. 42 U.S.C. § 2473(b)(13) 1970.

A substantially damaged American claimant would thus have to file suit against NASA and/or the United States under the Federal Tort Claims Act ("FTCA"), 28 U.S.C. § 1346, 2671-80 (1970). All claims under the FTCA must first be submitted to the administrative agency claimant feels is responsible for his injury. Only after the agency, e.g. NASA, rejects the claim, offers an unsatisfactory settlement, or gives no response within six months, may the claimant file an action in a U.S. district court. Pub. L. No. 89-506, § 2(a), 80 Stat. 306 (1966), *amending* FTCA 28 U.S.C. § 2675(a).

³¹Liability Convention, *supra* note 24, art. II.

³²See note 10, *supra*.

³³As many as five individual satellites can be placed in orbit during a single Shuttle mission. NASA, *SPACE SHUTTLE* 10 (1976).

is also a liable party.³⁴ Under the Convention each nation participating in a multi-national space venture is jointly and severally liable for damages.³⁵

This seemingly straightforward provision may yield bizarre results. For example, NASA is actively soliciting small experimental packages to occupy unused space in the Shuttle cargo bay.³⁶ Conceivably, a foreign scientist, as a private individual or as an employee of his government, could pay a small fee for the Shuttle to carry his experiment. Technically, he could be found to have "procure(d) the launching of a space object."³⁷ This would make his country³⁸ a launching state, and hence jointly and severally liable for any damage the Shuttle causes.³⁹

The Convention spreads liability broadly, but it may unfairly apportion liability among jointly liable states. Injured parties may demand all their compensation from any liable party,⁴⁰ but a victim cannot, under the Convention, seek compensation from his own country.⁴¹ Thus, if a Shuttle mission carrying an Indian⁴² satellite caused damage to an American's house, India and the United States would be launching states,⁴³ but only India would be liable under the Convention. This result becomes especially unfair if the damage had nothing to do with the Indian satellite. Fortunately, Article V of the Liability Convention expressly permits indemnification arrangements between jointly liable States.

Also relevant is NASA's requirement that all Non-United States Government users of its launch services obtain a third party liability policy which covers the United States Government as an additional insured. NASA's enviable safety record has been responsible for several reductions in the cost of these policies.⁴⁴

³⁴Liability Convention, *supra* note 24, art. I.

³⁵*Id.* art. V.

³⁶AV. WK. & SPACE TECH., Nov. 8, 1976, at 41.

³⁷This is because "space object" is very loosely defined as including "component parts of a space object. . . ." "Procures" is left entirely undefined. Liability convention, *supra* note 24, art. I.

³⁸Outer Space Treaty, *supra* note 2. (art. VI imposed responsibility on the State for its national space activities, "whether such activities are carried on by governmental agencies or by non-governmental entities. . . .")

³⁹Liability Convention, *supra* note 24, arts. I, V.

⁴⁰*Id.* art. V.

⁴¹*Id.* art. VII.

⁴²India, a nation with a very progressive space program, has signed a Memorandum of Understanding with NASA under which the Shuttle will launch and deploy the first generation of India's multi-purpose geostationary satellites. SPACEFLIGHT, Jan. 1979, at 29.

⁴³Because India procured the launching of a space object, and because the United States launched the object.

⁴⁴See Hosenball, *Space Law, Liability and Insurable Risks*, 12 FORUM 153, 154 (1976) and Dula, *Management of Interparty and Third-Party Liability for Routine Space Shuttle Operations*, 26 DRAKE L.R. INS. L. ANN. 741 (1977) for further discussion of the availability and cost of third-party liability coverage. See also AV. WK. & SPACE TECH., Apr. 30, 1979, at 20-22 for NASA's efforts to secure underwriting for space shuttle missions.

2. THEORIES OF LIABILITY: NEGLIGENCE AND STRICT LIABILITY

Assuming the United States will usually be a liable party, what kind of liability does this country face when it launches a Shuttle? The Convention focuses on where the damage occurs to determine whether negligence or strict liability applies.

If the damage occurs on the surface of the earth, or to aircraft in flight, then strict liability exists.⁴⁵ If damage occurs in outer space,⁴⁶ liability is based on fault.⁴⁷ For example, during the Ascent Phase, the falling Rocket Boosters and External Tank are possible sources of damage.⁴⁸ If these components hit a flying jet or a person's home, the United States is strictly liable for any damage. On the other hand, a collision with another spacecraft during the Orbital Phase,⁴⁹ would occur in outer space, and the United States would be liable only if it could be proved the Shuttle was being operated negligently.⁵⁰

Suppose the Shuttle places in orbit a satellite which later collides with a Soviet spacecraft. Both objects de-orbit and disintegrate while falling through the atmosphere with fragments of the collision causing damage to residents of a third country on earth. The United States and the Soviet Union are strictly liable to the injured parties on earth.⁵¹ However, because the damage to the Soviet craft occurred in space, the United States will have to compensate the Soviets for their damaged spacecraft only if the United States negligently positioned its satellite.⁵²

The Convention does not provide such clear solutions to all complex space accidents. Suppose the quite remote possibility of a collision between a spacecraft and the Shuttle as the spacecraft is leaving the atmosphere and the Shuttle is reentering it. Since the Convention fails to define the boundary between the earth's atmosphere and space,⁵³ the appropriate theory of liability

⁴⁵Liability Convention, *supra* note 24, art. II.

⁴⁶The question of where space begins has vexed lawmakers longer than even the liability question. For reviews of several suggested definitions of where space begins, see Perek, *Remarks on Scientific Criteria For the Definition of Outer Space*, 19th COLLOQUIUM ON THE LAW OF OUTER SPACE 185 (1977); OGUNBANWO, *INTERNATIONAL LAW AND OUTER SPACE ACTIVITIES* 50-62 (1975); F. NOZARI, *THE LAW OF OUTER SPACE* 113-26 (1973); C. JENKS, *SPACE LAW* 189-91 (1965); A. HALEY, *SPACE LAW AND GOVERNMENT* 75-107 (1963); L. LIPSON & N. KATZENBACH, *THE LAW OF OUTER SPACE* 11-18 (1961). See also REPORT OF THE FIFTY-THIRD CONFERENCE OF THE INTERNATIONAL LAW ASSOCIATION xxii (1969).

⁴⁷Liability Convention, *supra* note 24, art. III.

⁴⁸See notes 11-13 & accompanying text *supra*.

⁴⁹See notes 17-21 & accompanying text *supra*.

⁵⁰See A. HALEY, *SPACE LAW AND GOVERNMENT* 241 (1963) for an exposition of the difficulties of proving negligence in the operation of space vehicles.

⁵¹Although this scenario and conclusion is specified in article IV of the Liability Convention, it may be deduced from the rule given in article II.

⁵²Liability Convention, *supra* note 24, art. IV. The launching State of each space vehicle also apportions the compensation due the damaged party on earth in accordance with fault. If fault cannot be established, the costs of compensation to the damaged party on earth is divided equally among the space parties. However, the injured party on earth is free to seek the full amount of compensation from one or both space parties. *Id.* art. IV.

⁵³See note 46 *supra*.

ity for the damage to the spacecraft and Shuttle is unclear.⁵⁴ However, it is clear that the United States and the spacecraft's State of registry would be strictly liable for any damage on the earth's surface which resulted from the collision.

3. PROCEDURE

Convention articles detail a two-step claims procedure. Only States may present claims for damage suffered due to the space activities of another State or States,⁵⁵ and the first step is the submission of the claim through diplomatic channels,⁵⁶ to a launching State within one year following the damage or identification of the liable launching state.⁵⁷

The second step occurs only if the claim is not settled through diplomatic negotiations⁵⁸ within one year after submission.⁵⁹ In this event, a Claims Commission shall be established.⁶⁰ The Commission will have three members; the claimant and launching State⁶¹ will each select one member and

⁵⁴Since neither the spacecraft nor the Shuttle are "aircraft in flight," the absence of a boundary may not be that serious a problem. Strict liability applies only when persons on the surface of the earth, or aircraft in flight, are injured by a space vehicle or a component thereof. Liability Convention, art. II, note 24 *supra*. There is some doubt as to whether the Shuttle is an aircraft or a spacecraft. An excellent article on the subject utilizes three sets of criteria (appearance, function and purpose) to evaluate the Shuttle. In both the Ascent and Orbital Phases, the Shuttle's spacecraft nature dominates. In the Descent Phase, the spacecraft nature dominates at first and then the aircraft nature becomes dominant as the Shuttle glides to a runway landing. The author concluded that the Shuttle is really an "aerospace vehicle." However, this term has not received international legal acceptance, so the Shuttle must be considered predominately a spacecraft rather than an aircraft. See Sloup, *A Guide for Space Lawyers to Understanding the NASA Space Shuttle and the ESA Spacelab*, ZEITSCHRIFT LUFT- UND WELTRAUMRECHT 196 (1977). Sloup's conclusion, that the Shuttle should be considered a spacecraft for purposes of determining liability, was confirmed by NASA's Office of the General Counsel and by the Chief Counsel of the Federal Aviation Administration (FAA). The latter's opinion is reprinted in Mosinghoff Sloup, *supra* note 9, *Legal Issues Inherent in Space Shuttle Operations* 6 J. SPACE L. 47, 65-66 (1978).

⁵⁵States which may present claims are:

1. States which suffer damage, or whose natural or juridical persons suffer damage;
2. States which suffer damage in their territory by any natural or juridical persons;
3. States whose permanent residents have suffered damage; and
4. a State which belongs to an international intergovernmental organization which has suffered damage and had declared its acceptance of the Convention's rights and obligations.

Liability Convention, *supra* note 24, arts. VIII, XXII.

⁵⁶If diplomatic relations are not maintained with the launching State, the claim may be submitted through a third State which does have relations or through the Secretary-General of the United Nations to the launching State. Liability Convention, *supra* note 24, art. IX.

⁵⁷Liability Convention, *supra* note 24, art. X.

⁵⁸For a discussion of the problems permeating these negotiations, see Bockstiegel, *Arbitration and Adjudication Regarding Activities in Outer Space*, 6 J. SPACE L. 3 (1978).

⁵⁹Liability Convention, *supra* note 24, art. XIV.

⁶⁰*Id.*

⁶¹If there are several claimant or launching States they must collectively agree on single claimant and launching State members. Liability Convention, *supra* note 24, art. XVII. Otherwise joinder would become an easy method of packing the Commission.

together agree⁶² on the third member.⁶³ The Claims Commission will decide the merits of the claim and fix the amount of compensation in accordance with "international law and principles of justice and equity."⁶⁴ There is no ceiling on the amount of damages for which the tortfeasor state(s) can be held liable.

The Claims Commission's decision is binding if the parties so agree, or recommendatory in the absence of such an agreement.⁶⁵ Under the claim procedures a victim's remedies are a little uncertain. Since only governments can present claims,⁶⁶ an individual's claim may never be presented or presented in a manner which does not fully detail the harm he suffered, or if properly presented, compensation may be seriously compromised in the diplomatic negotiation stage. Should the claim reach the Claims Commission, there is the problem of applicable law. "International law and principles of justice and equity"⁶⁷ leaves much to be desired as a discoverable body of law upon which to adjudicate a claim and fix compensation. Lastly, the probability of a merely recommendatory award may render illusory any remedy the Convention does provide.

4. SUMMARY

Thus the Space Shuttle may cause damage or injury without exposing the United States to any binding legal liability. The combined effect of the Convention's substantive and procedural weaknesses tend to make a negotiated settlement problematic and to discourage binding awards.

B. Recommendations

There is no means of enforcing Claims Commission decisions, even binding ones.⁶⁸ The only realistic way to improve the situation is to amend the

⁶²If no agreement is reached on the third member four months after the request for the Commission was made, either party may ask the U.N. Secretary-General to appoint the third member. Should a State fail to appoint a member at all, the United Nations appointee would become a single-member Claims Commission. Liability Convention, *supra* note 24, arts. XV, XVI.

⁶³*Id.*

⁶⁴Liability Convention, *supra* note 24, arts. XII, XVIII. Decisions will be made by majority vote. *Id.* art. XVI.

⁶⁵The Convention further asks for the awards to be considered in good faith and provides for the decisions and reasons for the decisions to be made public. Liability Convention, *supra* note 24, art. XIX.

⁶⁶Under general principles of international law, a person cannot present a claim in an international forum against his own State. This fact necessitated the nation-centered approach of the Convention. See, e.g. Vereshchetin, *State Sovereignty and Use of Outer Space* 15 SOVIET L. GOV'T 75 (1976).

⁶⁷Liability Convention, *supra* note 24, art. XII.

⁶⁸This shorthand statement greatly oversimplifies the means available to the world community to secure compliance with international law. See CHRISTOL, *supra* note 23, at 314-49, for an excellent discussion of how nations should most intelligently employ a wide variety of available coercive and noncoercive measures in obtaining compliance with international space law. Dr. Christol suggests that, under the principle of proportionality, the coerciveness of the means of enforcement should be an increasing function of the threat to international peace and security

Liability Convention in such a way as to make compliance in the interest of the signatories. With this end in mind, two aspects of the Liability Convention are worthy of note.

1. APPLICABLE LAW

Nations may be hesitant to negotiate a settlement or bind themselves to a Commission decision when they do not know what body of law the Commission will apply. Article XII gives the following general outline of applicable law:

The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.⁶⁹

The Convention drafters tried unsuccessfully to agree on a more exact body of applicable law.⁷⁰ However, now that there is a Liability Convention, article XII should serve as a starting point from which the Legal Subcommittee of the United Nation's Committee on the Peaceful Uses of Outer Space (COPUOS) could agree on a more exact set of legal rules.

For example, as things now stand, article XII does not say whether, or to what extent, moral (non-physical) and consequential (indirect) harm is compensable.⁷¹ This would be a good starting point, and the content of the rules developed would be less important than the existence of rules which all signatories have agreed upon.

A liberal body of space tort law is of little utility if it is not observed. It is more reasonable to expect nations to bind themselves to a Claims Commis-

and/or the threat to the sovereign state. *Id.* at 345-47. This thesis retains vitality in space liability law. The effects of noncompliance with Claims Commission decisions upon the peaceful relations existing between a claimant and tortfeasor State can be expected to become increasingly deleterious as the magnitude of the tort grows.

⁶⁹Liability Convention, *supra* note 24, art. XII. See materials cited in notes 26 and 27 *supra* for concepts of compensable damage.

Under this article, Canada will expect the Soviet Union to pay for the cost of returning its wilderness area to the condition it enjoyed before radio-active fragments were scattered across it by Cosmos 954. Canada's claim against the Soviets was in the amount of \$6,041,174.70 (Canadian) (Communique of the Canadian Department of External Affairs No. 8, January 23, 1979), and after amendment is certain to exceed 12 million dollars. Finch & Moore, *The Cosmos 954 Incident and International Space Law*, 65 A.B.A.J. 57 (1979).

⁷⁰See, e.g. Foster, *supra* note 23, at 171-72.

⁷¹The current state of scholarly opinion is that the Convention allows claims for harm which is physical or non-physical and caused either directly or indirectly. However, the less physical and direct the injury, the less likely the recovery. Thus recovery for loss of consortium, a nonphysical harm which results indirectly from a tortious act, would seem unlikely. A stronger case may be made for the pain and suffering which accompanies an injury because the harm has been directly caused, although its nonphysical nature makes valuation difficult. Similarly, a factory owner should have little difficulty recovering for the damage a space object caused to his plant. However, a factory employee who lost wages due to the accident has suffered indirect pecuniary

sion decision when they know what law will be applied, and when they themselves drafted the rules upon which their cause will be decided. Such an innovation would make Commission decisions reasonably predictable, and parties more willing to negotiate a settlement.

2. CEILING ON LIABILITY

The Convention places no monetary limit on the amount of a Claims Commission award. Who is going to negotiate a settlement or agree to comply with a Claims Commission decision on that basis? A monetary ceiling on damages would allow countries to estimate their exposure to liability and would strengthen the operation of the Convention.⁷²

If a ceiling were placed on liability, care should be taken to avoid unjust results. Should limits be placed on a per accident or per victim basis? A per victim limit would avoid the unjust result of dozens of injured victims of one accident having to share an award, the sum of which may have been enjoyed completely by a sole similarly injured victim in another accident. Should the limit be a fixed sum or a sum related to the potential danger of the object launched into space? Although a fixed sum has simplicity in its favor, it would appear more rational for liability limits (like the insurance premiums which pay awards) to vary directly with the amount and probability of the danger.

Whether the monetary limit to liability is fixed or variable, per accident or per victim, a ceiling will increase the likelihood of voluntary compliance with Claims Commission decisions and facilitate negotiation of settlements by providing a boundary within which to negotiate.

C. Effect of a Strengthened Liability Convention

Viewed alone, the proposals for a liability ceiling and a guiding body of applicable law would seem to reduce the liability of the United States for a Space Shuttle tort. The ceiling places an upper limit on awards. The body of law will almost certainly be conservative since it must be a product of compromise between the several legal systems of the members of the United Nations.

However, when the proposed amendments to the Convention are considered in light of their probable effects, American liability exposure is increased. A monetary limit to liability and adoption of a discrete body of applicable law would enhance the chances of voluntary compliance with Liability Convention procedures and remedies and would mean that a given Shuttle tort is more likely to result in an American payment of damages.

harm, and thus has a more difficult chance of obtaining compensation. See notes 26 and 27 and materials cited therein for further opinions on what wrongs are compensable under the Convention.

⁷²*Cf.* F. NOZARI, *THE LAW OF OUTER SPACE* 85 (1973). Nozari feels the lack of a liability ceiling is an important "plus" of the Convention.

Specifically, the innovations facilitate negotiated settlements, encourage payment of recommendatory awards, promote agreements to accept Commission decisions as binding, and increase American exposure to liability for Shuttle operations.

Conclusion

The Space Shuttle's unique characteristic of reusability, and its ability to deliver several different payloads into orbit, will increase the number of man-made objects in space. Very small possibilities of accidental harm exist from jettisoned Shuttle Rocket Boosters, falling fragments of the Shuttle External Tank, and collisions between objects placed in orbit. However, overall the Shuttle program decreases the possibilities that space activities will result in damage or injury, especially in view of the Shuttle's ability to retrieve or alter the path of space objects in low-earth orbits.

The Liability Convention provides a legal route by which one injured or damaged by Shuttle operations would present a claim for compensation by the United States. Deficiencies in the Liability Convention, however, mean that a Space Shuttle tort does not necessarily expose the United States to any binding liability.

As a means of strengthening the Liability Convention, proposals were made to provide incentives for States to comply with Convention procedures and remedies. The proposals called for a definition of the legal standards (applicable law) by which tort liability for space activities could be more precisely determined and for the imposition of a monetary ceiling on liability.

The proposals would theoretically increase American exposure to liability for accidents involving space vehicles by fostering negotiated settlements of claims and voluntary compliance with Claims Commission decisions.

The incredible strides mankind has made in space technology have been accompanied by great steps nations have taken in space law. Now that the Shuttle will make access to space routine, the Liability Convention should operate with assured dependability. The proposed changes in the Liability Convention enhance the certainty of its operation, and hence help keep international space law in pace with new advances in space technology.