SOLAR POWER SATELLITES AND SECURITY CONSIDERATIONS: THE CASE FOR MULTILATERAL AGREEMENTS +

Paul G. Dembling and Delbert D. Smith***

It is now feasible to begin planning to tap the sun's energy in outer space via solar power satellites (SPS), and to transmit that energy to ground stations on Earth for use as an economically competitive source of electric power.[1] Such a power source is projected to be operating on an experimental basis in the United States sometime during the 1990's.

The idea of SPS was proposed by Dr. Peter E. Glaser of the Arthur D. Little Company in 1968.[2] He envisioned a gridlike structure in outer space, some 15 miles long and 3.2 miles wide, an area of approximately 50 sq. miles.[3] This giant structure would be located in the Earth's geostationary orbit, some 22,300 miles above the equator. The massive size of the SPS would allow for maximum concentration of sunlight for the purpose of generating electricity. The energy thus generated would be transmitted from the SPS in the form of microwaves to ground stations on the Earth, where it would be transformed back into electricity for use in the national grid.

An operational SPS of the dimensions described herein would produce twice the useable power generated by Grand Coulee, the largest hydro-electric dam in America. Calculations are that it would take 45 of these fully operational structures to match the current electrical generating power of the United States.

There still remain unsolved problems and unanswered questions regarding the technological and financial aspects of SPS. For instance, the cost of developing and constructing even one such platform would be extremely high. In addition, questions regarding the system's effects on the Earth's environment have yet to be satisfactorily answered. These essentially technological problems and questions, however, can presumably, in time and through proper research and development, be eliminated.

The international legal, political, and institutional problems must also be confronted and resolved. These problems pose potential long-term impediments to SPS

---

*Partner in the law firm of Schnader, Harrison, Segal and Lewis, Washington, D.C. Former General Counsel of NASA and of the General Accounting Office.

**Partner in the law firm of Schnader, Harrison, Segal and Lewis, Washington, D.C.

+ The views expressed herein are those of the authors and not necessarily those of the law firm of Schnader, Harrison, Segal and Lewis.

[1] *Solar Powered Satellites: Hearings Before the Subcommittee on Space Science and Applications, and the Subcommittee on Advanced Energy Technologies and Energy Conservation Research, Development, and Demonstration, of the Committee on Science and Technology, U.S. House of Representatives,* 95th Congress, 2nd Session (April 12, 13, 14, 1978) No. 68 at 340. (Testimony of Dr. Peter E. Glaser, Vice President, Engineering Sciences, Arthur D. Little Inc., Cambridge, Mass.).

[2] *Solar Powered Satellites, supra* note 1, at 355 (Statement of Honorable Don Fuqua, Chairman of the House Committee on Science and Technology).

[3] Glaser, *Power From The Sun: Its Future,* 162 SCIENCE 857-61 (Nov., 1968).

feasibility, regardless of technological achievements. One of the most controversial of these problems involves the military implications of the SPS. This is the subject of this paper.

From an "Owner State" point of view, the massive SPS, of which there may eventually be many and on which a State may some day depend for a large percentage of its energy needs, would be a target for any space-capable nation with intentions hostile to the interests of that state.

Conversely, a non-"Owner State" fears that the SPS could be used for military purposes and that in such case the SPS would pose a threat to its national security. Specifically, the concern is that the huge amount of energy absorbed by the SPS could, with proper equipment, be harnessed for use as a tremendously powerful weapon. Such a weapon could be used offensively against objects in space or on Earth. Defensively, it could be used to protect the owner's SPS, its other space objects and the State's land mass from attack.

The premise of this paper is that international multilateral agreements could serve to minimize potential vulnerabilities of the SPS and could also help minimize potential threats attributed to the SPS by foreign States. With the understanding that no agreements are ever absolute assurances against military threats and vulnerabilities, an analysis can be made of the alternative types of multilateral agreements which are available, and the mechanics used in formulating such agreements.

I. Types of Multilateral Agreements

There are three general categories of international multilateral agreements of relevance to the development of SPS facilities. These categories consist of binding agreements, non-binding agreements, and agreements which form the charter of distinct legal entities such as international organizations.

International treaties are agreements of a contractual nature that create legal rights and obligations between the party Nation-States.[4] Treaties are considered binding in the sense that the sanctity of treaties is an integral part of international law which is based on the observance of good faith between States.[5] The usefulness of binding agreements to mitigate against threats or vulnerability associated with SPS facilities would be dependent upon the extent to which parties exercised good faith in their observance of the treaty obligations. Often treaties include provisions by which States can withdraw from their terms and conditions. For example, all four existing multilateral space-related treaties permit parties to withdraw upon notice.[6] Thus, the concept of "binding" when associated with treaties is true only in a temporal sense.

---

[4]I. OPPENHEIM, INTERNATIONAL LAW, §491 (8th ed., 1963).

[5]J. L. BRIERLY, THE LAW OF NATIONS 331 (6th ed., 1963).

[6]The four existing multilateral space-related treaties are: (1) Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 (entered into force with respect to the United States, Oct. 10, 1967) (for an analysis of this treaty, *see* Dembling & Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR. LAW & COM. 419 (1967)); (2) Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space (Agreement on Rescue and Return), Apr. 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119 (entered into force

Certain international agreements are considered nonbinding in the sense that there was never any intention by the parties to be bound by the terms and conditions of such agreements. An important example of this type of agreement is the current effort within the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) to draft "principles" for the conduct of operational direct broadcast satellite activities[7] and satellite remote sensing activities.[8] Presumably, there is also a good faith obligation to non-binding "principles." Thus, the distinction between binding and non-binding multilateral agreements may be more formalistic than practical.

The third general category of international agreements are those which create international organizations. While such treaties and the resultant organizations have traditionally been utilized as tools for the coordination of activities among States for mutual benefit, less developed States have in recent years advocated their use as vehicles to force the sharing of benefits among States. For example, with justification derived from concepts such as the "Common Heritage of Mankind"[9] and the "New Economic Order",[10] some States have demanded that an international authority be established to govern the distribution to all States of benefits from the mining of the ocean floor.[11] It is apparent that, given the growing predilection by States for preserving their rights with regard to space-related resources such as radio frequency spectrum, geostationary orbital slots, and moon resources, there will be an increasing amount of pressure for the creation of administrative international organizations by which to distribute space-related benefits among the nations. This pressure may become apparent with regard to SPS space segment development as well.

---

with respect to the United States, Dec. 3, 1968) (for an analysis of this treaty, *see* Dembling & Arons, *The Treaty on Rescue and Return of Astronauts and Space Objects*, 9 WM. & MARY L. REV. 630 (1968)); (3) Convention on International Liability for Damage Caused by Space Objects (Convention on Liability), *opened for signature* March 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762 (entered into force with respect to the United States, Oct. 9, 1973); (4) Convention on Registration of Objects Launched into Outer Space (Convention on Registration), January 14, 1975, XI, 28 U.S.T. 695, T.I.A.S. No. 8480 (entered into force with respect to the United States, Sept. 15, 1976). The sections of the above treaties which permit parties to withdraw upon notice are: (1) Article XVI of the Outer Space Treaty, (2) Article IX of the Agreement on Rescue and Return, (3) Article XXVII of the Convention on Liability, and (4) Article XI of the Convention on Registration.

[7]COPUOS Report on Draft Principles for the Conduct of Operational Direct Broadcast Satellite Activities, U.N. Doc. A/36/20.

[8]COPUOS Legal Subcomm. Report on Satellite Remote Sensing Activities, U.N. Doc. A/AC105/305.

[9]Staff of Senate Comm. on Commerce, Science, and Transportation, 96th Cong., 2d Sess., Agreement Governing The Activities of States On The Moon And Other Celestial Bodies (The Moon Treaty), 452-54 (Comm. Print 1980).

[10] *Id.* at 385, 386 and 452-54.

[11]Informal Composite Negotiating Text/Revision 1, Article 153, U.N. Third Conference on the Law of the Sea, 8th Sess. (March 19-April 27, 1979).

II. Concerns for an SPS Multilateral Treaty

The creation of an international organization for the ownership and operation of SPS facilities might theoretically be the optimum for alleviating the threats to international security associated with an SPS system. However, such an approach has been considered unlikely for the first United States SPS system for a number of reasons. Among these are the delays and excessive costs involved in international projects.[12] In addition, there are foreign policy concerns, including limitations on technology transfer and freedom from dependence on foreign energy sources.[13] Therefore, it would seem unlikely that there would be promulgation of a multilateral treaty that would create a new international organization with regard to the ownership of the SPS. However, given a tendency among developing States to claim portions of the benefits derived from utilization and exploitation of international resources, and given the view that monitoring of SPS facilities should be conducted by an independent authority, there may be pressure to create an international organization which, although not part of the management or control of SPS facilities, would manage the distribution of benefits from or otherwise monitor such facilities. [14]

A multilateral agreement might serve as a means for protecting the security of non-"Owner States" while diffusing pressure for the establishment of a separate international entity to undertake the actual development effort which might better be left to the private sector or might be more efficiently accomplished by a single government. There are a number of forms which a multilateral SPS agreement could take. Since the purpose of the agreement would be to assure against military threats and vulnerabilities associated with SPS facilities, the binding treaty form would be optimal. The principle of good faith adherence to the terms and conditions of binding treaties would afford the maximum amount of assurances to all parties that SPS facilities would not be utilized as offensive military weapons and that they would not be vulnerable to military aggression. It is important to note that the concerns of non-"Owner States" are with regard to offensive, or aggressive use of military force.

> General principles of law with respect to outer space have been adopted, but those relating to "peaceful purposes" do not restrain states from providing for their own self-defense, or using force to protect their space objects if they are attacked, and, more particularly, they do not deny them measures of military preparedness consistent with an advancing military technology.[15]

Given the fact that treaties are temporal, at best, there must be underlying checks and balances which will support the continued good faith adherence of treaty provisions by all parties.

---

[12]Staff of Senate Comm. on Commerce, Science and Transportation, 95th Cong., 2d Sess., The Third Law Of The Sea Conference (Comm. Print 1978).

[13]Staff Report on The Moon Treaty, *supra* note 9.

[14] *Id.*

[15]H. Almond, *Military Activities In Outer Space-The Emerging Law* (Paper by Harry H. Almond, Jr., Professor of International Law, The National War College, Washington, D.C.).

III. Multilateral Considerations Affecting a United States SPS

Any agreement associated with SPS development must be based upon underlying benefits to all parties or there will be little motivation for continued good faith adherence to treaty provisions. Thus, it is appropriate to assess the relative benefits to and negotiating positions of various States with regard to the unilateral development by the United States of an SPS system. Any such agreement would contain numerous provisions ranging from standards for environmental protection to prohibition of certain types of weapons systems and, therefore, a complete identification of all possible provisions is beyond the scope of this paper. However, a few salient substantive provisions can be analyzed.

A. Negotiating Positions

The unilateral development of an SPS by the United States will be considered by other nations as an appropriate subject for international accord designed to reduce or eliminate perceived and real threats which such nations may have with regard to the satellite. Thus, the impetus for the creation of an international agreement for SPS development will likely emanate from foreign nations. As a result, the United States might have a favorable negotiating position from which to bargain for provisions designed to diffuse the vulnerabilities of SPS development in return for provisions intended to forestall perceived and real threats.

The United States could choose to refrain from including systems or components in a solar power satellite which would produce threats, and any international agreement designed to eliminate such threats would serve to ratify this unilateral policy. However, from the perspective of foreign nations it is obvious that, once the SPS was in existence, there would be few nations which would have the practical ability to affect the space segment of the facility in order to prevent perceived or real threats should the United States policy change with regard to the military potential of the system. Therefore, foreign nations will seek ways in which to achieve leverage *vis a vis* the United States to help ensure the elimination of threats.

For space powers, such leverage may be in the form of the development and implementation of their own solar power facility or appropriate military systems. For the majority of nations, however, negotiating leverage may derive solely from their combined voting strength within already established international organizations, their united economic strength, and in their united efforts with regard to allocation of international resources, such as the geostationary orbit and radio frequency spectrum. It is likely, therefore, that an international agreement for solar power satellites will be founded on tradeoffs between provisions which attempt to eliminate perceived and real threats from a U.S. developed SPS system, and provisions which attempt to eliminate vulnerabilities of the U.S. system.

It is anticipated that, from the perspective of the United States, the value of a multilateral agreement will be significant in reducing certain types of vulnerabilities. Although an international agreement may not be entirely effective in the elimination of military vulnerabilities, just as it may not be entirely effective in the elimination of military threats attributed to solar power satellites, an international agreement would be very useful in eliminating institutional and international legal vulnerabilities. These

institutional and international legal vulnerabilities may range from claims of right to a portion of the power supplied by the SPS system on the basis of the "Common Heritage of Mankind" theory, to claims that SPS development be banned in order to avoid interference with the established utilization of the radio frequency spectrum for telecommunications purposes.

Since institutional and international legal vulnerabilities will be most critical during the formative stages of the SPS development, the beneficial impact for the United States of an international agreement would necessarily take effect early in the developmental process. Thus, the promise of early elimination of institutional and international legal barriers would be a tangible benefit that foreign nations could offer in return for assurances that the threats attributed to SPS systems will not materialize and, in return for mechanical and systematic methods to verify, monitor and enforce such assurances. Consequently, the United States would achieve the elimination of such vulnerabilities prior to the development of its SPS system. The United States could personally continue minimization of such vulnerabilities as long as it demonstrates adherence to policies and procedures which reduce or eliminate perceived or real threats.

The bargaining position between the United States and those States which possess the capabilities of militarily affecting the SPS space segment is quite different from that between the U.S. and the majority of States. In such cases, bilateral treaties may be adopted between the space powers on the basis of their unique bargaining positions.

B. Selected Provisions

A recent study on military implications of a SPS system identified two salient subjects for an international SPS agreement. The first involves the concept of proximity rules and the second involves the concept of inspection.

Proximity rules have been defined by the study as "specified 'keep out' zones in the vicinity of space facilities which are to be protected,"[16] and, it is stated that "precedent for such rules exists in the form of offshore territorial limits claimed by various nations."[17] However, proximity rules would have to be reconciled with Article II of the 1967 Outer Space Treaty[18] which states: "[O]uter space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." The specified zones established by such proximity rules, which would be defined relative to the SPS space facility, would constitute a claim over an ascertainable portion of outer space. One commentator has asserted that the concept of appropriation in Article II suggests the existence of two subsidiary elements: temporary nonexclusive use and permanent exclusive use.[19] To the extent that a SPS satellite would not be considered a permanent use of a particular

---

[16] *On The Military Implications Of A Satellite Power System (SPS), Draft, Science Applications, Inc., 3-37 (April, 1980).*

[17] *Id.*

[18] Outer Space Treaty, *supra* note 6, Art. II.

[19] Gorove, *Interpreting Article II of the Outerspace Treaty*, 37 FORDHAM L. REV. 352 (1969).

portion of space even though the facility would have a relatively long lifetime, it would follow that such specified zones would also not be considered a permanent use. However, by definition, such zones would be reserved for exclusive use and therefore may constitute an appropriation of a portion of outer space. Thus, an SPS multilateral agreement would be useful to either exempt such zones from the restrictions posed by Article II or to define the word "appropriation" such that the zones would not be within said definition.

The second subject is that of the concept of inspection. Article XII of the 1967 Outer Space Treaty provides that:

> All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.[20]

Of importance is the fact that Article XII is applicable only to stations, installations, equipment and space vehicles on the moon and other celestial bodies and therefore the Article is not applicable to all facilities in space. If the inspection concept was included in an international SPS agreement, inspections which would be conceptually analogous to those contemplated in Article XII would apply to SPS space facilities. However, the scope of such SPS inspections could be much broader than those contemplated under Article XII if they were to be conducted by resident inspectors rather than visiting inspectors upon notice.

The concept of inspection is somewhat controversial in the United States. As embodied in the United States Constitution, prohibition on unreasonable searches[21] is a principal freedom which has been ingrained in American political philosophy. Clearly, application of this philosophical precept has met with limited success in the context of inspections for safety or health reasons, especially in non-residential property. The true basis for criticisms of international inspection mechanisms is probably linked to notions of sovereignty, or even of national security itself.

In the context of the current debate surrounding the "Moon Treaty,"[22] which has been recently approved by the United Nations General Assembly and opened for signature and ratification, the issue of inspections has again been raised. Some critics of the Moon Treaty assert that the Treaty would expand the right of foreign governments to inspect U.S. space facilities beyond the right already established in Article XII of the

---

[20]Outer Space Treaty, *supra* note 6, Art. XII.

[21]U.S. Const. amend. IV.

[22]The proper title of the "Moon Treaty" is "An Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Treaty), U.N. Doc. A/AC.105-L.113/Add. 4 (1979); see also U.N. G.A.O.R. supp. 20, Doc. A/3420 (1979) (it is highly unlikely that the United States will ratify the Moon Treaty in its present form).

1967 Outer Space Treaty.[23] In voicing criticism of this inspection scheme, it has been said that:

> In the interest of verification, the treaty allows any State Party to inspect all facilities in space, whether the facilities are owned by a nation, corporation or individual. While some form of verification is desirable, this provision makes legal the unrestricted searches of private residences as well as government facilities . . . . These are intolerable infringements of human rights.[24]

Thus, although the concept of inspection has at least limited precedent in international outer space law, the concept would probably be subject to criticism in the United States.

Criticism of the residential inspection concept may also be formulated on the basis of undue cost, lack of need, lack of reciprocity of inspections of terrestrial or space weapon systems which would be utilized against SPS facilities, feasibility and practicability. In addition, there is little precedent in international law, politics or relations for the formulation of a supra-national elite cadre of international representatives entrusted with inspection of important domestic facilities. While it is conceivable that such criticisms can be overcome, and unprecedented action is always possible, it might be prudent to consider alternatives to the concept of residential inspection. Remote sensing, system design and periodic inspection might provide the basis for such alternatives.

IV. Mechanics in Researching Multilateral Agreements

Most multilateral space-related treaties have originated within the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS). Traditionally, a draft treaty will not be recommended to the U.N. General Assembly unless it has received unanimous consensus of approval from COPUOS.

Upon approval by the United Nations General Assembly, a multilateral agreement would be open for signature and ratification, and the treaty would enter into force upon deposit of instruments of ratification from a requisite number of States. The ratification

---

[23] Article XV (1) of the Moon Treaty states:

> Each State Party may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement. To this end, all space vehicles, equipment, facilities, stations and installation on the moon shall be open to other States Parties. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. In pursuance of this article, any State Party may act on its own behalf or with the full or partial assistance of any other State Party or through appropriate international procedures within the framework of the United Nations and in accordance with the Charter.

It should be noted that unlike the 1967 Outer Space Treaty, the Moon Treaty does not make inspection the subject of reciprocity.

[24] *The United Nations Moon Treaty*, Draft Position Paper, AIAA Los Angeles Section at 2 (February 14, 1980).

process is unique to each State. A multilateral agreement would not enter into force for the United States until its particular process was completed, even though such agreement would be in force for other States. Moreover, international law is complicated by the procedures which permit States to ratify an agreement with reservations[25] or merely to consent to be bound by an agreement through accession.[26]

A multilateral space-related treaty, however, need not be created through the United Nations. An alternative method would be the convening of a treaty conference, such as was done in the case of the Convention Relating to the Distribution of Programme Carrying Signals Transmitted by Satellite. The text of this treaty was initially formulated during meetings of a Committee on Governmental Experts which was jointly sponsored by the U.N. Educational, Scientific and Cultural Organization and the World Intellectual Property Organization, and was finally completed at a Diplomatic Conference which was especially convened for its consideration and adoption.

Finally, it should be noted that agreements reached in the context of the International Telecommunication Union (ITU) are also a type of multilateral agreement. Although this body concerns itself with questions of technical coordination and frequency allocation for radio communications, it is anticipated that SPS development will be of increasing concern to the ITU and may eventually become the subject of the ITU's Radio Regulations. The ITU, at the 1979 General World Administrative Radio Conference, adopted a resolution "to undertake appropriate studies on all aspects of the effect of such radio transmissions of power from space on radio communication service, and to make appropriate recommendations taking into account the ecological and biological implications."[27]

Conclusion

It is probable that, similar to the case of direct broadcasting satellites, SPS will become the subject of both ITU and COPUOS multilateral agreements. As the foregoing discussion indicates, the development of SPS systems might benefit from the adoption of a unitary multilateral agreement affecting their military role and security. It is of importance that the role of a multilateral agreement for these purposes be addressed now, before any single nation is committed to the development of an SPS system.

---

[25]Articles 19 through 23 of the Vienna Convention on the Law of Treaties is a codification of international law with regard to reservations. Vienna Convention on the Law of Treaties, *opened for signature* May 23, 1969, U.N.G.A. United Nations Conference on the Law of Treaties, A/CONF 39/27.

[26]"Accession is the formal entrance of a third State into an existing treaty, so that it becomes a party to the treaty, with all rights and duties arising therefrom. Such accession can take place only with the consent of the original contracting parties." Oppenheim, *supra* note 4, Section 532.

[27]ITU Recommendation No. 3 is reproduced as an Appendix to this paper.

APPENDIX

RECOMMENDATION NO. 3

Relating to the Transmission of Electric Power
By Radio Frequencies From A Spacecraft

The World Administrative Radio Conference, Geneva, 1979

considering

(a) that it may become technically feasible in the future to convert some portions of the sun's radiation into electric power on board a spacecraft and to transmit that power to Earth by means of radio transmissions and that such power could augment the world's energy resources;

(b) that the possibility of such high power radiation may adversely affect the propagation of radio waves for other services through the ionosphere;

recognizing

(a) that it would be necessary to ensure that the radio transmission of electric power from sapce did not give rise to harmful interference to radiocommunication services;

(b) that an assessment needs to be made of any likely ecological and biological effects of radio transmissions of power from space, including in particular to aircraft passing through antenna beams used for such transmissions;

noting

that the Special Preparatory Meeting report to the World Administrative Radio Conference, Geneva, 1979, recognized the technical possibility of a solar power satellite;

noting also

the provisions of Article 6 of the Radio Regulations referring to the obligations on administrations not to cause harmful interference to radio communication services operating in accordance with the Regulations;

recommends the CCIR

to undertake appropriate studies on all aspects of the effects of such radio transmissions of power from space on radio communication services and to make appropriate recommendations taking into account the ecological and biological implications;

invites the Secretary-General

to send this Recommendation to the Secretary-General of the United Nations.