IAA-01-IAA.7.1.04

LEGAL IMPLICATIONS OF THE CO-HABITATION OF SPACE SOLAR POWER SYSTEMS AND SATELLITE COMMUNICATION SYSTEMS

Patrick A. Salin
CIASL, McGill University
Orbicom, UQAM, Montréal, Canada

Abstract[1]

The prime legal incidence of establishing Space Solar Power Systems (SSPS) on the Geostationary Orbit (GSO) derives from the type of ownership of such systems and from the receivership status of nations that may claim a right to cheaper energy sources, provided initial investment cost is excluded. Standard GSO communication systems were first operated by public satellite organizations that gradually had to share their access to the space segment with private satellite organizations. In the actual deregulatory environment, it is hard to imagine that Intelsat-style public organizations may take the helm in offering a public utility service based on GSO SSPS. So, the way is open to private ventures! This paper assesses where such projects stand and how publicly- and/or privately-owned ventures may start operating this new Outer Space activity in harmony with current GSO and non-GSO projects.

Résumé

Il n'existe pas encore de système d'exploitation solaire dans l'espace (SSPS) qui soit en service, bien que l'énergie solaire soit couramment utilisée dans l'exploitation des satellites. On peut donc penser que l'impact juridique essentiel résultant de l'installation de tels systèmes sur l'orbite géostationnaire ou ailleurs dans l'espace proviendrait de la nature de la propriété qui s'exercerait sur eux et de celle des bénéficiaires de ce type d'énergie qui pourraient être tentés d'invoquer un droit à une énergie peu coûteuse, si l'on met de côté l'investissement initial. Dans le contexte actuel de déréglementation de nombreux types de services publics, il est difficile d'imaginer que de tels services seraient offerts par une entité publique du type d'Intelsat avant sa privatisation. Le secteur est donc ouvert aux entrepreneurs privés ou à un partenariat mixte. Cette étude se concentre sur l'état actuel des projets SSPS, sur les difficultés d'ordre non-scientifique qu'ils rencontrent et sur les nécessités de co-habitation avec les autres programmes de satellites.

* DCL, LLM, MBA. Member IISL, ECSL, ISOC. Author of: *Satellite Communications Regulations in the Early 21st Century – Changes for a New Era*, Utrecht Studies in Air and Space Law, Volume 19. Martinus Nijhoff Publishers, October 2000, 584 pages. ISBN 90-411-1238-3. This book analyses all major events of the satellite communication legal and regulatory environment at the international level, in North America and in Western Europe up to and including WRC-2000. E-mail: salin.patrick@uqam.ca.

Introduction

The Space Solar Power System (SSPS) concept is not new. It was introduced in the late 1960s but was never developed according to the expectations of its supporters, partly because of decreasing space budgets and partly because fears about an oil shortage had diminished by the early 1980s. SSPS was initially considered to be an alternative to the two major types of energy, which were both seen as being threatening to the development of mankind: fossil fuel (detrimental environmental effects and limited reserves) and nuclear energy (high risk and expansion halted). However, this SSPS Concept has not yet been supported to its full potential,[2] even though energy specialists still believe it might offer humanity advantages on Earth like "electrical power as non-polluting and as a solution to global warming", together with several major complementary advantages in the exploration of Outer Space.[3] So far, SSPS has not become a priority for reasons that are not scientific, mostly because of economics and of politics as a consequence of the current legal and regulatory environment. Let us look at the broad environment that seems not having played in support of space-based energy systems, first by presenting the policy aspect (economic and technical) and then the regulatory aspect (the orbital positioning).

I – The policy aspects of having an SSPS program[4]

1. The negative side: cost aspects do not help for the adoption of the SSPS program

Preliminary 1999 evaluations of a 1 GW power plant in geostationary orbit to be in full operation by 2045 would be of $49 billion, excluding launch costs. This is about 150 times the yearly production of a terrestrial 1 GW power plant in the US on the basis of an average price of $0.0035/kWh. In addition, technical measures would have to be taken to make sure that no adverse effect would be created with the functioning of the station itself that could offset the benefits from the use of the station.

In addition, the launch dimension of any SSPS project must be counted on. The launch is an important factor for any space project, especially those of a large size and for constellations. Due to the size of the energy producing facility, putting SSPS in space on the GSO would require powerful launchers at an economic cost, which does not seem to be the case yet. Also to be counted is the fact that for the next coming years, launches will be fully booked for much more profitable satellite communication systems. Hopefully, the development of solid state electronic applications supports the development of SSPS projects. It militates in favour of the miniaturization of control, transmission and sensors and would make such systems more affordable.

These figures must be compared to those returned from the exploitation of the most profitable orbital spots by communication

---

[2] Anne Eisele, *Space Power Plan Lauded – NASA Urged to Seek More Money for Research*, Space New, Nov.3-9, 1997, p. 3. NASA estimates were to envision an orbiting platform that could be launched within 20 years to beam solar power back to Earth.

[3] Alfred Hexter, *Space-Based Power*, Space News, April 27-May 3, 1998, p. 20. The advantages of SPS would be multifold since it would: (i) give purpose to the ISS beyond satisfying shuttle needs and manufacturers, (ii) stimulate the construction of a moon base, (iii) help reduce Outer Space transportation costs, (iv) help establish a micro-gravity manufacturing and research base on the moon and, (v) give focus to space activities. All of that would not be cheap since it has been estimated that a SPS on geostationary orbit would cost twice as much as a coal plant per watt of capacity.

[4] This section is partly indebted to: Marcel Toussaint, Anders Hanson, *Commercial Diplomacy and Regulatory Aspects of Space Power Stations for the Provision of Electrical Power on the Earth*, 51th IAC, 2-6 Oct. 2000, Rio de Janeiro (Brazil). Ref: IAF-00-R-1.04.

satellites at a much more reduced global cost.[5] The magnitude of such SSPS program figures combined with low expected returns makes it easier to understand the reluctance that public and private bodies may have regarding its financing. Yet, it has been calculated that if the energy need of the future 10 billion people of the Earth is indeed multiplied by a factor of 5 during the next 50 years, we will have no other choice but to fund space solar power systems.[6]

This introduces the need/consumption double constraint. We must face the regular growth of the world's population consumption of energy, which is expected to double form its present level to reach 20,000 GW by 2050 according to the World Energy Council. It is also anticipated that actual forms of energy production may have increasingly devastating effects on the global climate. The 1997 Kyoto Conference should lead industrialized countries to limit their capacity of generating power based on first generation natural resources, while they have to meet their own increasing energy needs and at the same time the developing world also has to meet their own energy needs, with 2 billion people already living without electricity and half of them depending on biomass for their cooking needs.

2. The positive side: several positive features

Several favourable factors militate for SSPS. First, the SSPS should benefit from improvements in technology and help implement a progressive space solar policy.

Also, the growing concern of the world's population about the environment speaks in favour of cleaner types of energy systems. Needless to say that if weather disturbances as we have been experimenting during the last five to ten years on almost every continent tend to accelerate, this concern will only increase.

Finally, we have seen a re-organization of the energy sector because of the liberalization of the electricity production with the aim to reduce excessive prices induced by monopoly situations. This should favour the emergence of new energy projects, including SSPSs.

3. The paradox of the lure of the economic development

A pure problem of political and economic development lies behind the question of having access to space-based energy plants: those who could afford it do not need it, and those who can't do in fact need it. If we keep in mind that the space treaties expressly state that the exploitation of Outer Space must be done for the benefit and in the interest of all countries (Art. 1, OST), including developing countries, we may deduce that space-based power units should be exploited by those who can afford it with priority access given to those who need it! This cannot be a capitalistic vision, but this must meet with the objectives of the UN Charter and all other space-related declarations, conventions and recommendation that expressly stipulate the necessity to act in accordance with international co-operation and peaceful purposes. Actually, the aim here is to avoid an increasing disparity of energy services enjoyed between the populations of various countries. Then,

[5] The exploitation of the 101°W by Direct TV using three satellites located on that position returns about $ 4 billion a year. Other slots that are managed by Echostar, SES Astra and Eutelsat have lower but still large revenue figures. An estimated $ 1 billion in investment is necessary to reach critical mass. However, this promises an expected profit ratio which is beyond comparison with what would return an SSPS project. Theresa Foley, *Orbital Slots Are Prime Property*, Via Satellite, September 2001, p. 26-34.

[6] David R. Criswell, *Human Wealth and Evolving Requirements on Large-Scale Commercial Power Systems*, 51st IAC, 2-6 Oct. 2000, Rio de Janeiro (Brazil). Ref: IAF-00-R.1.03.

criteria have been elaborated in order to help countries that have a capacity to be SSP recipients: (i) a need for energy, (ii) an economy that is strong and growing, (iii) an economy that is able to service its debt with small payments in relation to GDP, (iv) a sound electricity infrastructure, (v) appropriate land and climate conditions for antenna emplacement, (vi) a concentrated population and (vii) a capacity to undertake large and modern projects.[7] Kenya has been proposed as a recipient candidate

II – The regulatory dimension of SSPS programs with regards to Outer Space

1) Technico-regulatory issues that are not related to energy production but which may impact on the potential arrival of SSPSs

The density in the occupation of Outer Space is bound to increase as a consequence of the privatization of space communications enterprises and of the commercialization of. space programs. The LEO projects so far have not obtained commercial success, but they are still in place, could be joined by others, while they are competing with standard GSO projects. This creates a spectrum allocation problem, since spectrum is a rare resource and the ITU is presently submerged by the question of the allocation of frequencies. World Radiocommunication Conferences end up becoming tough bargaining events under the influence of tremendous political pressures from countries defending that place their national public interest before the global public interest.

The crowding of orbits may also be a result other the multiplication of various types of satellites that increase in large numbers and include remote sensing satellites, navigational satellites, constellations of broadband data transfer satellites, scientific satellites, etc. They contribute like standard TV and communication satellites to the crowding and also to the pollution of space orbits.

The militarization of space (military communications, spy or "reconnaissance" satellites, space-based laser beams, etc.) is another important feature that does not speak in favour of putting expensive SSPS platforms in space, because of a high probability of being destroyed or simply paralyzed. The mere mention of military satellites that are legitimated because of a perceived defense need will attract other military satellites with reciprocal defense needs, until one crosses the Rubicon by acting in a proactive defense mood, which is a euphemism to simply say that one of these so-called defense satellite may simply attack and destroy any other satellite, whether they are "military" or not.

2) Institutional issues that are related to the commercialization of Outer Space

We see the development of a utilitarian approach. Outer Space is fast becoming a mere extension of the Earth and atmospheric environment, in spite of the existence of space treaties that underline the special status of Outer Space. If this evolution is to be confirmed, then there is a need to regulate this "new market" that Outer Space is becoming, where power systems may someday be used for energy production, just like any energy power plant on Earth. With a potential world population of about 10 billion, it has been predicted that the 2040-2070 period could be a critical window for a change in mankind's resource base from terrestrial to extraterrestrial resources.[8] In

[7] R.B. Erb, *Power From Space – For Whom?*, 51st IAC, 2-6 October 2000, Rio de Janeiro (Brazil), Ref: IAF-00-R.1.05

[8] Supra Toussaint, Hanson, p. 10.

this perspective, we can only reiterate the need for a general purpose World Space Organization in order to charter the extension of human activity into Outer Space.

This new vision could be introduced with the help of the ITU in the current train of reforms it has launched, especially with respect to the backlog in satellite filings. In November 1997, WRC-97 established the 'administrative due diligence' procedure (Resolution 49) which basically requires the disclosure of implementation data for satellite systems (identity of network, name of operator, name of satellite, name of space manufacturer, date of execution of contract, contractual delivery window, number of satellites procured, name of launch provider and launch or in-orbit delivery window). Due to extension delays that countries have requested as authorized by the ITU Radio Regulations, it is not expected this procedure will yield its first impact before the end of 2003. A report presented at WRC-2000 revealed that no impact could be observed so far as a consequence of the new procedure having been implemented. It stems from this observation that since SSPS programs stand far at the end of the line in terms of priority when compared to standard communication satellites, their cause requires a serious push forward if we hope to see any of these projects be delivered in the next decade.

The WTO is also a forum within which a new vision may be fostered, on the basis of the several basic principles it has adopted in order to develop international trade: the most favoured nation clause, the national treatment principle, non-discrimination, dispute settlement by arbitrage, etc. By comparison with the former GATT arrangement, its jurisdiction has also been extended to services, such as telecommunications and financial services, so that energy supply can also be included within these same WTO service arrangements or covered by an agreement on basic energy supply services could be negotiated.

But it may not be appropriate for the WTO to endorse new practices that have been developed by several nations with reference to the allocation of terrestrial mobile frequencies, such as auctions, which, by definition, give a premium to the largest bid. This may not best to foster a cheap way of producing space-based energy. Also, the ratification of the WTO Agreements on telecommunications have not eroded the dominant situation of some national carriers, which will only extend their domination of markets on a global scale. The WTO should not become an instrument to crush domestic policies that become targets for foreign corporations that behave like international predators, as seems to be the case in the telecommunications sector.

Such could not be the case for SSPS because this field has not yet been developed and could hardly be amalgamated to other types of services that would be provided from space (or through space, as in the case for space telecommunications). An active development policy should be encouraged in order to foster the development of energy-producing systems from space, which could borrow some innovative ideas from other space activities that may have an interesting future, such as space tourism.

Conclusion

Lately, attention has been given to the SSPS concept by NASA, under the appellation of the SERT Program (Space Solar Power Exploratory Research and Technology), which recently concluded. Early accounts of the program show that it is possible to

successfully produce and operate a new generation of profitable GEO satcom systems and a family of potential applications of affordable large space solar power systems during the next 25 years.[9]

As to the way these new projects should be managed, it has been proposed that a public-private partnership be created in order to gather the parties interested in these SSPS. They would unite utilities, the power industry, and the emerging countries in order to establish a set of exploitation rules and regulations to organize a project that would be endorsed by the UN for the political dimension and, possibly, by the WTO for the commercial aspects,[10] even though one may still have serious doubts on the final convergence between WTO's *ultima ratio* and the spirit of the space treaties.

[9] J.C. Mankins, *The Prospects for Large GEO Comm-Sats:An Emerging Space Solar Power Application.* 51st IAC, 2-6 Oct 2000, Rio de Janeiro (Brazil). Ref: IAF-00-R.3.03.
[10] supra, Toussaint, Hanson p. 13.