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UPDATING OF LUNAR TREATY

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ABSTRACT

This paper specifies why and how the respective principles and treaties governing activities of people on the moon should be modified / amended and stresses the need to do that as soon as possible due to the expected development of industrial space activities.

INTRODUCTION

The extension of international law to outer space is typically done in three steps: identification of problems related to legal aspects, formulation of corresponding legal principles and incorporating such principles in general multilateral treaties [1]. This paper deals predominantly with the first two steps.

PROBLEM

Among the most pressing problems of our civilization is shortage of energy sources, their uneven distribution and pollution of environment caused by their exploitation.

One of the ways how to ease this situation was proposed by Dr. Glaser in Science in the year 1968 under the name of Space Power Satellite, the SPS [2]: To collect solar radiation above atmosphere of the earth, transmit it to ground and insert as electricity into the power grid. See the Fig. 1.

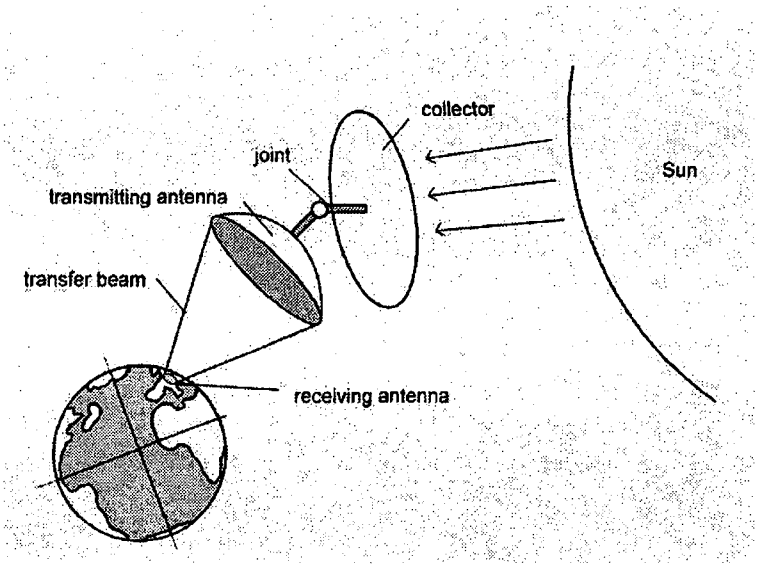

Fig. 1 Sketch of the solar power satellite

Energy of solar radiation is received by the collector, converted into electricity, led through the rotating and swinging joint to adjust to different motions of the sun and earth, sent as microwave beam by the transmitting antenna to earth and there converted and put into the utilities power grid.

The sun is compared to our needs an infinite source both in magnitude and time, the transmitting beam can be directed to anywhere on the earth, there would be no smoke or wastes resulting from the SPS operation, and even most of the waste heat would be left in space.

In spite of that Glaser's promising idea had not been implemented in the past almost 40 years. There were two main obstacles: money and pollution related to the construction.

NASA contracted studies of feasibility of Glaser's project in the seventies [3]. Some assumptions were set, like that the transmitting beam had to be in the microwave region, and all parts had to be manufactured on earth and transported to orbit from there.

Final evaluation in the year 1980 stated: Costs and pollution caused by mining, manufacture, space transport, irradiation by the microwave beam, dimensions of the receiving antennas of the system of 60 SPS stations of 5 GW_{el} each would be too high.

In the subsequent years some enthusiasts tried to solve difficulties. Miller and Akin [4] published a study showing that initial capital costs of space manufacture would be higher but operational lower than those of terrestrial production [4]. An example of their thinking is in the Fig. 2. Not only in their paper the moon was the centre of construction activity, see e.g. works of groups of which the driving force was prof. H. H. Koelle [5-7] and many others like [8-10].

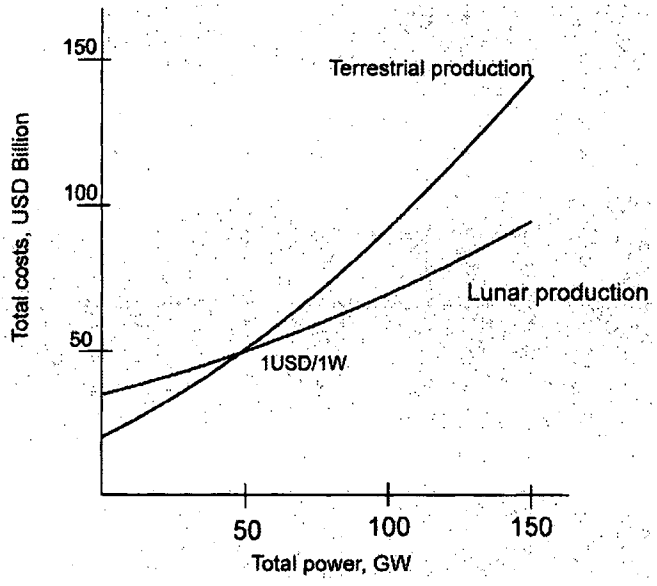

Fig. 2 Costs

The capital costs (investment) of manufacture on the moon are higher but the operational costs are lower than those on earth. At some amount of installed capacity becomes the "lunar" electricity cheaper.

Let's go the moon then.

THE MOON

The moon is a rocky airless sphere of radius of 1700 km and surface area of 36 millions km^2 (approximately area of Africa, 7 % of area of the earth). Volume of the moon is approximately 2 % of volume of the earth, density 60 % of average density of earth, so the mass of the moon is roughly 1 % mass of the earth, [11].

The moon circles the earth in distance of 380 000 km once in approximately 27 terrestrial days. It also rotates round its axis. Interesting is that period of this rotation is the same; the lunar day lasts 27 terrestrial days. From which results that the moon faces earth all the time with the same face. An observer residing on the near side of the moon sees ceaselessly the surface of the earth. Fortunately for him he can observe various parts of it, because the period of rotation of the earth is different and the plane of the moon travel round the earth is tilted towards the plane in which rotates the earth. On the other hand an inhabitant of the other side of the moon has nice opportunity to see the whole universe round us. Without limitations of atmosphere, lights of cities, dust and pollen of flowers and trees, which so readily cover lenses and mirrors of terrestrial astronomers.

Being rocky moon offers also many valuable materials – like 42 % of oxygen, 21 % silicon, 13 % iron, and others like calcium, aluminum, magnesium etc. [12].

These can be easily transported into space, because due to smaller mass of the moon its gravitation force is 0,166 of the earth, roughly 6 times lower. To this corresponds also the energy needed to raise a body into space and from it resulting costs, Fig. 3.

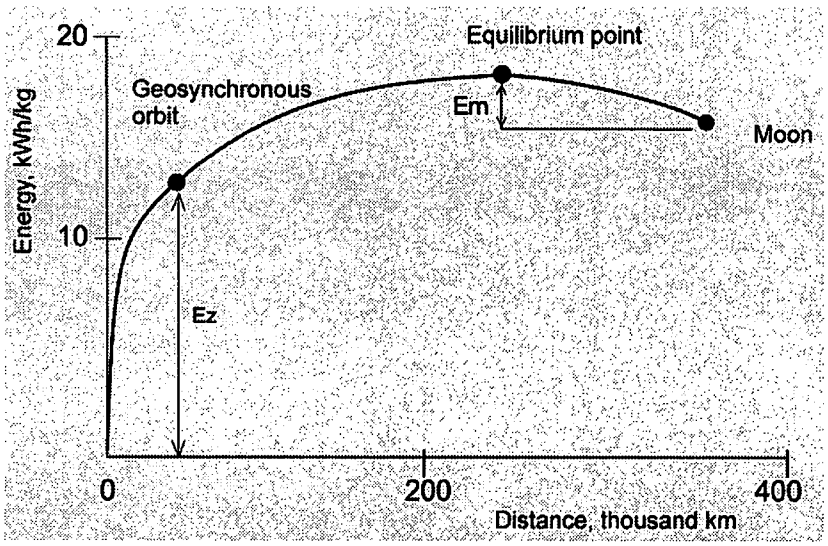

Fig. 3 Gravitational well

On vertical axis is energy (costs) needed to transport load from one place in space to other, on horizontal axis is the distance (time needed for transport) of the selected points. The earth is the "zero" point.

Small but some gravity of the moon is other advantage in comparison to work in a complete weightlessness of an orbit of earth or a place in open space. There is no danger that your spanner or friend starts flowing away for ever into the infinite universe.

The perfect vacuum which governs on the moon is favorable for special types of production. It is not only much better than can be achieved on surface of the earth, but capacity of its "vacuum pumps" is unlimited. Sensitive parts of space stations can be produced there and transported to place of destination without need to be protected against damaging influence of the terrestrial atmosphere.

It would be fair to list also some disadvantages of stay on the moon. There is no air there, so people have to wear pressurized suits and live in well tighten and sheltered quarters. Long day and night result in big differences in

temperatures. No atmosphere also means no protection against meteorites and radiation. And nonexistence of greenery gives the surrounding rather sad look.

To summarize: Building of big space structures, like collectors of solar energy of space power satellites can be made feasible by using of space resources, especially of the moon. This is going to be very costly enterprise, not quite corresponding in its time scale to the election campaigns of politicians. But the pressures of need one day will prevail and after that will result an avalanche of trips, constructions, use and misuse of the moon. To prevent the last reasonable rules, laws and mechanisms for enforcing of the laws must be defined. The sooner the better.

PRINCIPLES

We have just defined what is needed: rules how to use the moon reasonably. Something like highway code for human activities there. Next we can start to define the principles. The basic intentions are to allow development of industry on the near side of the moon only, to reserve the other side, the far side, for science.

What is covered by the principles agreed up to now?

The UN General Assembly adopted the basic legal principles governing the activities of states in the exploration and use of outer space in the year 1963, [13], they were further refined in the Treaty on Principles ... in 1967, [14].
This Treaty says except others (in the following the "state" means "The State Party to this Treaty"):

Article:

I: No discrimination, free access to all areas.

IV: Use only for peaceful purposes, but military personnel can be used for scientific research. Any equipment necessary for peaceful exploration shall not be prohibited (anywhere).

VI: States are responsible for activities of non-governmental entities; their activities require authorization / continuous supervision of the state.

VIII: A state retains jurisdiction and ownership of objects launched into outer space.

IX: Exploration should avoid contamination (of the moon), adverse changes in the environment of the earth and harmful interference with space activities of other states.

XI: The Secretary General of the UN shall be informed of space activities.

XII: Right of inspection of space facilities of other states.

XV: Any state can propose amendments to this Treaty on Principles.

These Principles are general; they cover the whole outer space, including the moon and other celestial bodies. Because the moon of our earth is a unique natural source and its near and far side have different special advantages, we think that the principles on its exploitations should be defined in more detail.

On base of the above mentioned principles the UN member states adopted the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, which entered into force in 1984, [15].

This Agreement recognizes in its preamble that "... the moon, as the natural satellite of the earth, has an important role to play in the exploration of outer space.", and says in its Article

1. Provisions of this Agreement relating to the moon shall apply to other celestial bodies.
3. The moon shall be used exclusively for peaceful purposes; the use of military personnel for peaceful purposes shall not be prohibited.
4. Due regard shall be paid to the interests of present and future generations ...
5. States shall inform UN Secretary General of their activities.
6. No discrimination, right to collect on and remove from the moon samples for scientific purposes.
7. Paragraph 1: No disruption of lunar environment, no harmful affecting the environment of earth. Par. 2: Notification of placement of radio-active materials on moon. Par. 3: Designation of areas of special scientific interest for special protective arrangements.
8. Exploration and use of the moon anywhere on or bellow its surface.
9. Establishment of manned and unmanned stations on the moon (anywhere).
11. The moon is common heritage of mankind; no part of it shall become property of any state or other entity. The states will establish the international régime, including appropriate procedures to safeguard the orderly and safe development of the natural resources of the moon, the rational management of those resources, the expansion of opportunities in the use of those resources. Interests and needs of the developing countries and efforts of the countries, which have contributed to the exploration of the moon, shall be given special consideration.
12. States retain jurisdiction over their personnel, and ownership of their facilities and equipment.
14. States shall bear responsibility for their activities and have authority /right of supervision of non-governmental entities.
17. Any state can propose amendments to this Agreement.
18. Ten years after the entry into force of this Agreement (1984) review of it shall be included in the agenda of the General Assembly of UN.

This Agreement follows rather closely the Principles listed in the Treaty [14]. New is recognition of the unique status of the moon in preamble and its role in this Agreement, right to exclude parts of the moon only for scientific purposes which rather contradicts to do specified activities on the moon anywhere, like placement of radio-active materials in Art. 7, exploration in A.8, stations in the Article 9.

PROPOSED EXTENSION

Once we recognize importance of the moon for space industry and science, we should define "special lunar" principles and treaty, which would ensure reasonable development of the moon.

The corresponding principles should include:

First: Moon must never be used as a deposit site for any type of terrestrial wastes. Wastes created by lunar activities might be at the beginning transported back to earth, but as soon as possible they should be recycled on spot.

Second: Only the near side of the moon shall be used for industry. The far side has to be reserved for scientific purposes only. The system of telescopes for wide range of wavelengths (no limitation by the atmosphere, no dispersed light in the sky like at terrestrial observation facilities, etc. [16, 17]) will make possible discoveries undreamed of. They will allow also spotting of dangerous space bodies well in advance of collision.

Third: All industrial activities on the Moon must observe strict rules, prohibition of explosives probably one of them. They could create clouds of small particles of which time of settlement is unknown. Additionally, vibrations caused by explosions could influence scientific activities on the far side.

Fourth: Responsibilities and penalties have to be defined, enforcement of laws ensured.

To become the lunar enthusiast is useful to read the The Moon Book by geologist B.M. French, [18]. Despite being first printed in 1977, it still retains it flair. Some ideas and pictures in this paper were taken from the book Verifik 1 [19].

Lunar base plans of different nations and/or private companies can be speeded up by energy and environmental concerns significantly. Thus modification of the lunar legislature is as urgent as ever.

SUMMARY

Purpose of this paper was to draw attention to the fact that the moon of our earth is a unique natural resource, which can help to solve our energy problems and make possible advancement of science undreamed of. Unless it is spoiled during its development
To prevent that a special lunar treaty is suggested. Strict exclusion of the far side of the moon only for science should be one of its leading rules.

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