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dep.aeroespacial@sener.es**ORBITAL SPACE PORTS:
THEIR OPERATING PROCEDURES AND LEGAL FRAME**

How to leave Earth gravity well is today the major obstacle to develop large scale activities in space. There is not any immediate solution, even a medium term one, to substitute rocket propulsion (Fig. 1 & 2). Neither the Seales effect, gravitations, magnetic fields and other exotic propulsion devices have yet demonstrate to have a practical engineering solution, some of them even have not proven their own existence!.

Therefore, to be able to explore space in a continuous way, and with substantial capabilities, it is mandatory to operate from outer space as much as possible, and thus by making orbital space ports, either artificial ones or else by taking advantage of celestial bodies. The idea is to explore outer space, but also to exploit the concept of the “greater Earth” (Fig. 3).

For the purposes of this paper “orbital space port” is understood to be a permanently inhabited facility, whose object is to solve the needs of the space traffic¹ and, situated in Earth orbit or beyond, including a celestial body, will be for peaceful purposes in accordance with International Law. Because of this, we consider a space port as an

assembly of space objects whose purpose is that the platform orbits in outer space, goes through it (displacement), if it is possible, or remains fixed in a celestial body. By this means, we can distinguish space orbital ports from celestial space ports, when the latter are positioned on a celestial body. The space ports will be national or international despite if the construction, utilization and exploitation is carried out by non governmental entities, and in accordance with the OST (Outer Space Treaty), the space activities of this entities shall be authorized and continuously supervised by the appropriate State.

While the authors do not discuss the preminence of OST in all space activities, it is however convenient to remind a few areas of potential conflict inherent in the Treaty :

- a) the boundary of Outer Space has not yet been determined. It would be desirable that the signatory States will reach an agreement on this subject.
- b) We must reflect on the concept of Common Heritage of Mankind, because the Outer Space and the celestial bodies are not located in Earth, and there is a sense of property by Humanity reaching beyond Earth rejecting other possible ways of intelligence that could arrive and could ask themselves why the outer space and celestial bodies belongs to Mankind. Perhaps, in this context, we prefer the “*res communis omnium*” concept that includes the non appropriation, allowing the exploration and use of outer space overall. In this sense, the article 1 of the OST applies perfectly, as establishes that outer space exploration and use shall be the province of all mankind. In a similar way, the article 11.1 of the Moon Treaty that states that the Moon and its natural resources are the common heritage of mankind, perhaps it must be modified like the rest of this treaty.
- c) The claim not to have military devices in orbit is naive to say the least, as it can easily be overturned by giving a civilian name to any device. Besides they are plenty of dual use devices that will be, in *bona fidae*, difficult to clasiffy, for instance, the rockets themselves. What is required is the application of ethics in space affairs (re. Sterns & Tennen IAF Hyrebad) to prevent abuses in the applycation and interpretation of the OST. The space

ports will have an evolutionary capability but shall remain a civil facility, and its operation and utilization shall be for peaceful purposes, in accordance with International Law. The Partner States in a space port will ensure that any addition is consistent with the overall program, in accordance with ethics in the space port affairs.

Konowing the Space Ports are a group of space objects, it emerges the need to find an adequate definition of an space object, because the international conventions are not accurate on such matter and do not define terms like space station, space installation or space port. In this sense, we think that an space object is all man-made element whose purpose is the exploration, utilization and exploitation from and for outer space, the moon and other celestial bodies, although manufactured in Earth or in outer space, understanding the latter like the contiguous zone to air space in wich a space object can describe an orbit around the Earth, finding its lowest limit at 80 Km over the sea level.

The article 1d) of the Liability Convention for damages caused by space objects and the article 1b) of the Convention on Registration of objects launched into space establishes that “the term space objects includes component parts of a space object as well as its launch vehicle and parts thereof”, this aclaration, nor a definition, help us to classify space objects as composed by space payload and space vehicles, the later can also be classiffied attending the mission aim as conventional launcher, an space shuttle or an aerospace vehicle when the sole purpose will be to facilitate a service in outer space, the moon and other celestial bodies.

The space objects composing a space port, must be registered in the register of the launching State and in the United Nations General Register. In this context, the launch State concept includes international organizations, but not the non governmental entities, by the way, we propose the distinction between launching State (international organizations and governmental agencies included) and “launching entitie” that would include the activities carried out by private entities. The creation of this new legal figure would imply to reform not only the Registration convention but all the *Corpus Iuris Spatialis*.

Respect the space objects made or launched from a space port, they will be registered in both registries, national and international, and in one that must be called “space registry” sited in the installation..

The Registry system carried out in a space port will follow the same system established by the IGA 1998ⁱⁱ related to the International Space Station (Fig.4), meaning that each Partner will register in its own national registry the elements it provide, ESA will have its own register, reaching an agreement with the member States of the Agency about the State of registry. Also, each Partner shall retain jurisdiction and control over the elements it registers and over the personnel in or on the space ports who are its nationals.

Is interesting to note that the OST, the inspirer of the rest of the *Corpus Iuris Spatialis* clearly indicates that the ownership rights of any space object, even if it comes back to Earth or stays in another celestial body, remains with the initial owner. However the article 6 of the Intergovernmental Agreement (IGA) of 1998, that rules the operation of the ISS (Fig.3) allows the transfer of ownership, with a clear distinction between material elements or data. The important element is the recognition of rights for those working in outer space, the moon or other celestial bodiesⁱⁱⁱ.

Respect to the persons on board a space port, each Partner State shall retain jurisdiction and control over the elements and persons it provides, like other elements that, through an agreement, will be subjected to it. Also, it can occur that members of other crews will be accomodated in the space port, in this case it will be necessary to suscribe the appropriate agreements.

In this point is when we perceive the need to have a legal regulation for private enterprises that will like to work and operate in space. There is already work^{iv/v} on this subject that must cover several aspects like the obligation to provide information on the kind of activities being done in space, emergency procedures, acceptance of liabilities, *et allia*.

In practice what will happen is that the space authority of the involved State (or States, as with the European Space Agency) is the one to monitor and control those private space activities of its members. It is obvious that specific agreements shall be reached when people or equipment from another party are using the installations of the original party, but such cannot be a major obstacle. The same applies to the liability, being the normal practice that each Partner renounces to claim liabilities the other party, the so called “cross-waiver of liabilities” when the damage arising out of protected space operations. The protected space operations means all launch vehicle activities, space ports activities, and payload activities on Earth, in outer space or in transit between Earth and outer space in implementation of the intergovernmental agreement related to the space port, MOU’s, and implementing arrangements, if they are. The term “protected space operations” also includes all activities related to the evolution of the space port. This cross-waiver of liability shall not be applicable to “claims between a Partner State and its related entity or between related entities; claims made by a natural person, his/her state, survivors or subrogees (except when a subrogee is a Partner State) for bodily injury to, or other impairment of health or death of such natural person, claims for damage caused by willful misconduct; intellectual property claims and claims for damage resulting from a failure of a Partner State to extend the cross-waiver of liability of its related entities”. Except as otherwise provided, the Partner States shall remain liable in accordance with the Liability Convention.

The cross-waiver of liability does not cover the space debris, but they are specific mitigation guidelines^{vi} provided by the Scientific and Technical Subcommittee of Copuos (based on the technical content and the basic definitions of the Inter-Agency Space Debris Coordination Committee -*IADC*-) related to the mission planning, design, manufacture and operational (launch mission and disposal) phases of spacecraft and launch vehicle orbital stages like limit debris released during normal operations, minimize the potential for break-ups during operational phases, limit the probability of accidental collision in orbit, avoid intentional destruction and other harmful activities, minimize potential for post-mission break-ups resulting from stored energy, limit the long-term presence of spacecraft and launch vehicle orbital stages in the low Earth orbit region after the end of their mission and limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit region after the end of their mission in an orbit above the GEO^{vii}.

In any case it would be convenient to have an specific *code of conduct* that, among other things, will make liable of damages produced by space debris those States whose space activities were the origin of such space debris, and they must cooperate to avoid harmful contamination and also adverse changes in the outer space and Earth environment. Also, States must give particular attention to the damages caused by space objects carrying on board nuclear powered sources^{viii}, that may cause damages to goods or persons being in outer space or in Earth. The States that shall be liable to pay a compensation by the caused damages shall be determined in accordance with International Law and the principles of justice and equity, restoring the victim to the condition which would have existed if the damage had not occurred.

In fact, although the authors do not share any specific concern about nuclear sources, i.e., the Earth is naturally radioactive and there are many other substances as dangerous or more than radioactive isotopes, it is clearly a real concern of legislators. But the use of nuclear energy for long term missions will become mandatory until mankind finds another source of energy, and therefore its use must be subject to international legislation.

If we analyze the proceedings needed to resolve a dispute arising from the activities in outer space, the moon and other celestial bodies, by States, international organizations or private entities, it seems that with the existing legislation, we are able to proceed with consultations or mutual change of opinions between the parties to resolve the dispute. In case the parties do not reach a solution, it would be necessary to bring the dispute to a binding peaceful settlement, as *praxis* demonstrates that parties prefer in most cases arbitration than a court settlement.

The space ports will have a human crew. It is somehow surprising to notice how little the OST says about man in orbit, specially in the areas of Intellectual Property Rights (IPR), and in case of wrong behaviour, even criminal one. Although the IGA 1998 develops a bit more this matter, it is confined of course to the international space station (ISS). It is logical to assume that the laws and procedures that apply on Earth will be translated to space, being the applicable legislation the one of the State that has

registered the space port, and if they are several, the specific agreements, like the IGA 1998, that certainly will be negotiated and agreed upon.

It would be convenient to include in a unique legal body a combined set of dispositions that rules the intellectual property rights applicable to all States of the International Community participating in space activities in accordance with the conventions and international treaties in such matter. Because of the difficulty of this armonization, the Partner States in the International Space Station concluded that “an activity occurring in or on a space station element shall be deemed to have occurred only in the territory of that element’s registry”. Respect the European Partner (ESA), does not exercise territorial jurisdiction over their member States, and therefore it applies the internal regulations of the Agency, wich establish contractual clauses to the personnel of the ESA and its contractors. All questions arisen because of the IPR, and not specified in the IGA 1998, will be subject to the Partner States domestic laws, like the settlement of disputes by the national jurisdictions.

The IGA also refers to technology transfer, encouraging the Partners a mutual transfer of technical data and goods necessary to implement their respective obligations. The transfer will be restricted when technical data and goods are to be protected for export control purposes, or for proprietary rights purposes or are classified. The proprietary rights, and the confidentiality, of the data and goods will be not affected while on board a space transportation system of another Partner or passing through its communication systems, including its ground network and the communications systems of its contractors. Also, each Partner State shall facilitate the movement of persons and goods necessary to carry out the space port activities into and out of its territory, subject to its laws and specific regulations.

The *Corpus Iuris Spatialis* says nothing about the criminal infractions done as consequence of man being in space. The IGA 1998 authorize the Partner States to exercise criminal jurisdiction over its nationals and over another Partner State nationals when concurring specific circumstances. In this matter we shall recur to the Partner States national legal systems, including the extradition. Notwithstanding, the IGA establishes a consultation system between the Partners to resolve any matter arising out of space station cooperation. If the consults are not enough, the concerned Partner States

may submit that issue to an agreed dispute resolution system such as conciliation, mediation or arbitration.

The ISS Multilateral Coordination Committee approved in september 2000 the Code of Conduct for International Space Station Crews^{ix}. This Code of Conduct set forth regulations, established by all Partners, wich define the conduct of personnel on board. In this context, crew member is every person approved for flight to the ISS, professional or not, for legal cover purposes. Crew members must comply with the general rules of conduct, the Code of Conduct and with the ISS commander's orders^x. Also the ISS Commander, the highest authority on board, fully and accurately informs the flight director about the activities carried out in the space station and looks after for the physical security of operations and utilization of data and for the protection of crew members human rights "no research on human subjects shall be conducted wich could be expected to jeopardize the life, health, physical integrity or safety of the subject", developing an experiments ethic^{xi} conduct. The ISS Commander also is responsible for security, maintaining the order on board, and using physical force, if it will be necessary.

But the logic may extend to unchartered territories: what about people born in space? And people that will like to switch citizenships?. Understandably, the IGA 1998 does not refer to this issues, but at least gives guidelines for future developments, like changes in civilian status or disciplinary matters, by conferring to the ISS Commander an status akin, although not totally identical, to a ship captain, in accordance with the code of conduct for the international space station crew.

The legislation shall cover not only man-made orbital space ports, but also those built over natural bodies, like the moon, mars, or asteroids. It is clear that a more developed body of legislation is needed (and it is not to soon), as we sternly believe two points : that sustainable growth for all mankind is only possible by the utilization of space, and that private enterprise is the most efficient way to reach a goal, and even more one that boasts to give equal oppourtunuty to all.

The freedom of outer space utilization and exploration allows the possibility of an establishment in a celestial body like Moon or Mars, using celestial facilities for working and living, comfortably, in a hostile environment. The establishment of space ports in a celestial body does not imply ownership over the plot occupied., but the first to arrive will choose the best area. The human establishment in the Moon will bring the exploitation of the in-situ resources^{xii}, permitting life and all necessary to implement the programmed space activities. The space debris guidelines shall be applicable to the space ports as the garbage elimination, taking specially account of those who carry chemical products, in a manner that would not cause harmful interference with activities of other States and avoiding the harmful contamination and adverse changes in the environment of the Moon, if it really exists. All activities conducted in the Moon or other celestial bodies will be regulated by the agreement or agreements that rules the facility.

The Corpus Iuris Spatialis shall be based on the OST, but being practical and with a much bigger perspective than the narrow one due to the Cold War and the prevalent conditions of the 60's, with a feud between two superpowers. For instance, a new application to the space activity is the detection, and if possible destruction of large space objects that may impact on Earth and making a major disaster, if not wiping out all mankind altogether (Figs. 4 and 5). But if anyone has the capability to destroy or to modify the trajectory of a rock of more than 1 Km of length in its major axis, and moving at 20Km/sec, is such capability a weapon?. Before entering in arcane classifications, we believe everybody will be very happy to have in space the means to prevent a major disaster. The same can be said on orbital solar power stations and in general on every large artifact with high power density in orbit.

Conclusions.

I- Space exploration and exploitation shall be encouraged, under the provisions of the OST of 1967, and the modifications and extensions agreed by Earth Nations, under the auspices of the United Nations and the observance of International Law.

II- The presence (continuous or not) of space ports, whether as artificial bodies or supported by natural celestial bodies, in outer space will not be considered as an appropriation by the State, or States, involved. However such State, and its individuals, will have the right to exploit their discoveries and developments while in orbit.

III- The space ports are permanently inhabited facilities, whose aim is to solve the needs of the space traffic in accordance with international law. A space port is a group of objects assembled, being understood that an space object is a all man-made element whose purpose is the peaceful exploration and use of outer space and the celestial bodies. We can distinguish orbital and celestial , and national and international space ports. The activities carried out in those civil installations must deal with the ethics, and will have an evolutionary capability in accordance with International Law.

IV- Any person, whether a professional astronaut or a simple passenger, in orbit will be considered as envoy of all mankind, but also will be under the rules and obligations of the space legislation and the specific one of the State has registered the space port in question. Furthermore, legislation shall be drawn to cover the future emancipation of significant constituencies and significant lapse of time in outer space, learning from past events in the History of mankind.

V- The Partner States related with the Space Port Program not only shall retain jurisdiction and control over the personnel who are its nationals, but over the elements it registers being international liable by the damages to the another State or its natural or juridical persons by such object, or parts thereof,, except if the Partner

State has stated a cross-waiver of liability between them or other exceptions. States, also, will be liable for the damage caused by their space debris to others (objects or persons), being convenient to have a specific code of conduct that mitigates and corrects the impact of this non operative space objects.

VI- For the purposes of the registry system in the space ports, it would be convenient to create an *ad hoc Registry*, located in the appropriate installation, that registers the elements manufactured in the space port and those that are launched from. When a private entitie launches a space object it could be considered a “launching entitie” instead of launching State.

VII- Intellectual property is understood to have the meaning of article 2 of the convention establishing the WIPO, for purposes of intellectual property law, an activity occurring in or on a space port flight element shall be deemed to have occurred only in the territory of the Partner State of that element’s registry, except ESA registered elements where the European Partner States consider the activity have occurred within its territory. The Partner States shall consider that an activity occurring in or on a space port flight element shall be deemed to have occurred in the territory of the Partner State.

VIII- The Partner States in the space ports may exercise criminal jurisdiction over the personnel in or on any flight element who are they respective nationals and over the perpetrator of a heavy misconduct in orbit after consultations between the parties involved. The extradition is also contemplated.

IX- All space activities shall be for peaceful purposes, wich does not preclude dual purpose activities in space, nor even the presence of the military in orbit (as it has been in the past). The weapon is not the contraption in orbit, but the mind and purpose of its owner. The space port together with its additions of evolutionary capability shall remain a civilian facility, and its operation and utilization shall be for peaceful purposes, in accordance with International Law.

X- In relation with disputes settlement arising due to the cooperation in a space port, it seems that the logical procedure is to settle the matter through consultations between the cooperating agencies, and if it still needs to be resolved, the concerned partners may submit that issue to a binding court or arbitration.

XI- We also share the vision of Dr. Eilene Galloway that legislation for space activities shall cover space itself, and not just celestial bodies and that specific legislation shall be produced for machines invented and/or operated in outer space. But also, Dr. Galloway tell us not to try to cover everything, but to have legislation flexible enough to adapt to new developments.

In fact, when the space structures, also beyond our solar system, will be independent enough to allow life on board for large spans of time without Earth's support, the question will arise why a legal renvoi is required to the domestic legal systems for regulating the activities carried out in outer space, the moon and other celestial bodies. Also, each space or celestial installation shall rule all activities on board. The space facilities will have their own registry and responsibility systems, and an effective dispute settlement system on board. Also, we can predict that the earthly nationalities will disappear having instead the place of birth (installation A) located in the celestial body (B) or in the orbit (C). It will be necessary to elaborate a code of conduct that rules the activities and security of the persons on board.

The authors of this paper are vital optimists : mankind has plenty of defects, from greed and cruelty to egoism, but also plenty of virtues, from courage and friendship to solidarity. Let's give individuals the right to express themselves freely in space, of course always with total respect to the law, and ourselves we will surprised by the results.

FIGURES:

Fig. 1: Gravity wells

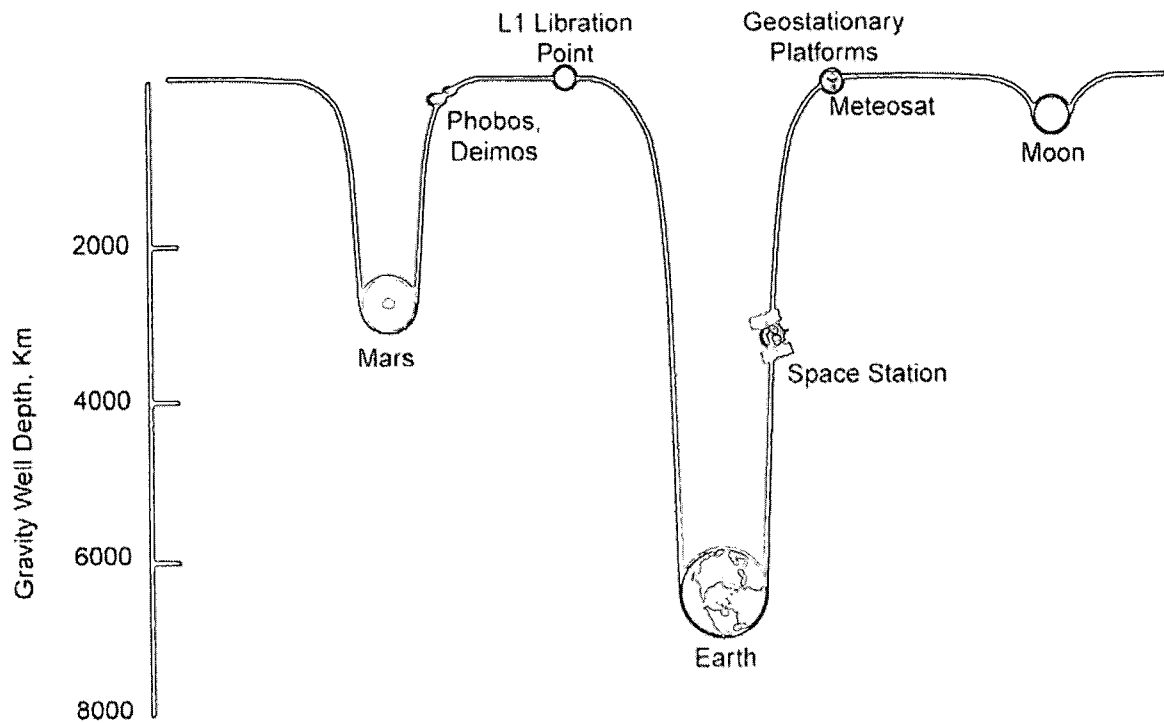
Fig. 2: Soyuz Rocket

Fig. 4: Greater Earth

Fig. 4: ISS

Fig. 5: NEOs

Fig. 6: Impact probability



Well depths represent the escape energies needed

Fig. 1 – Gravity wells

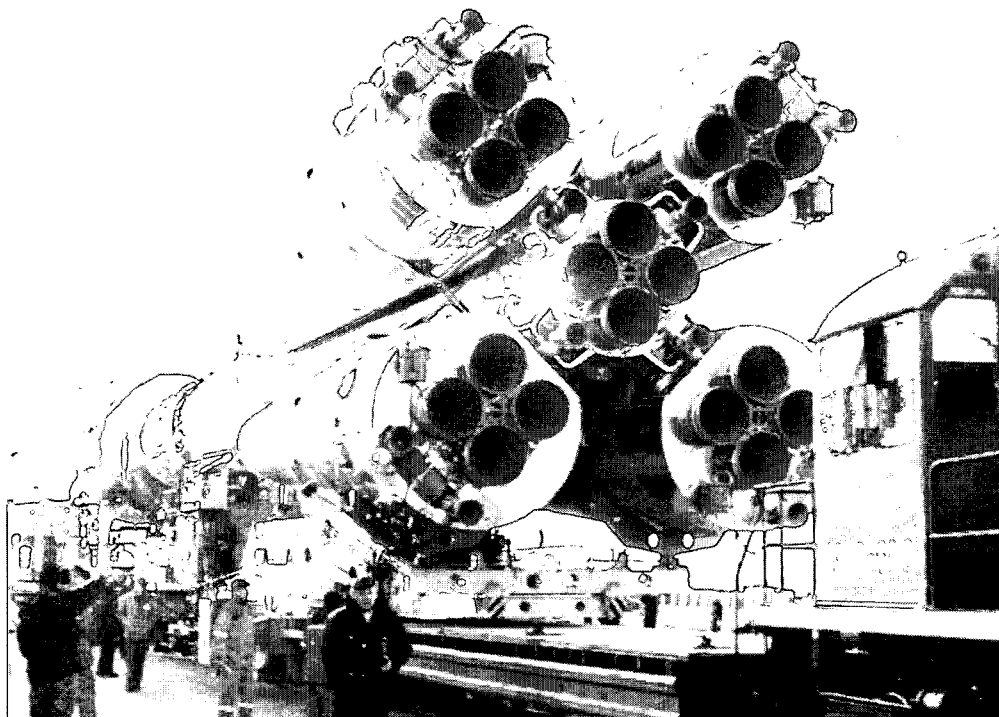


Fig. 2 – SOYUZ Rocket

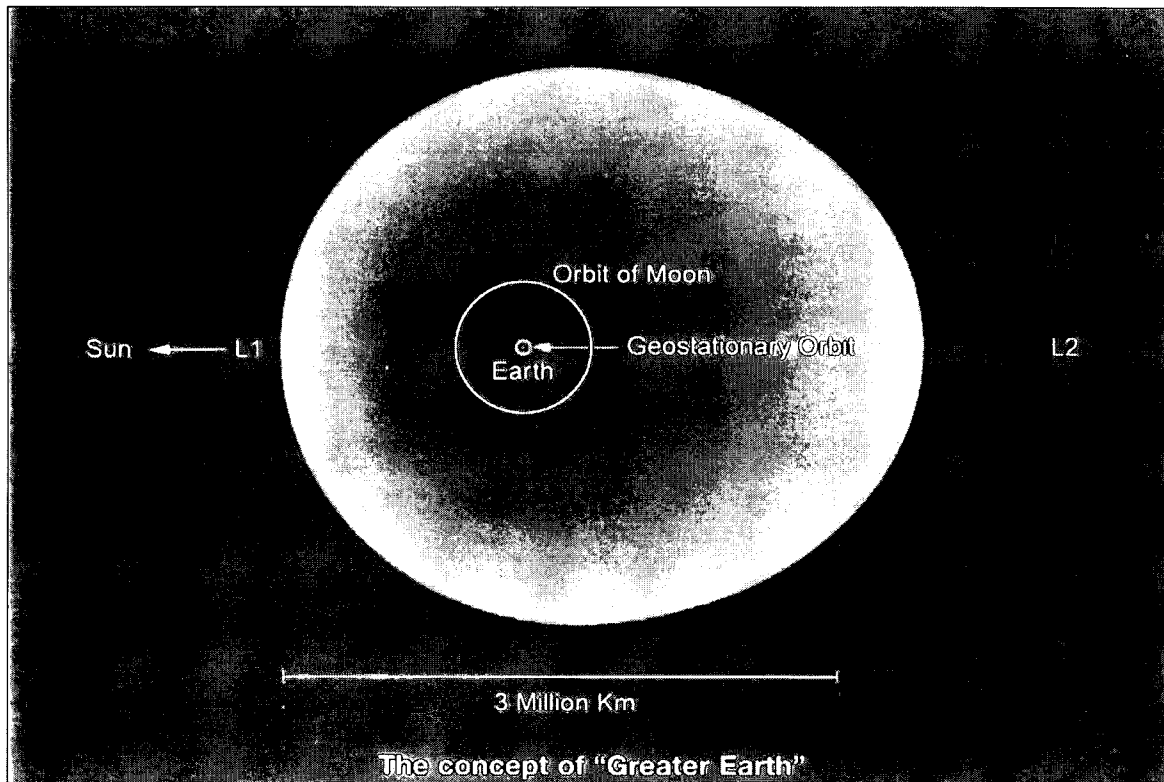


Fig. 3 – Greater Earth

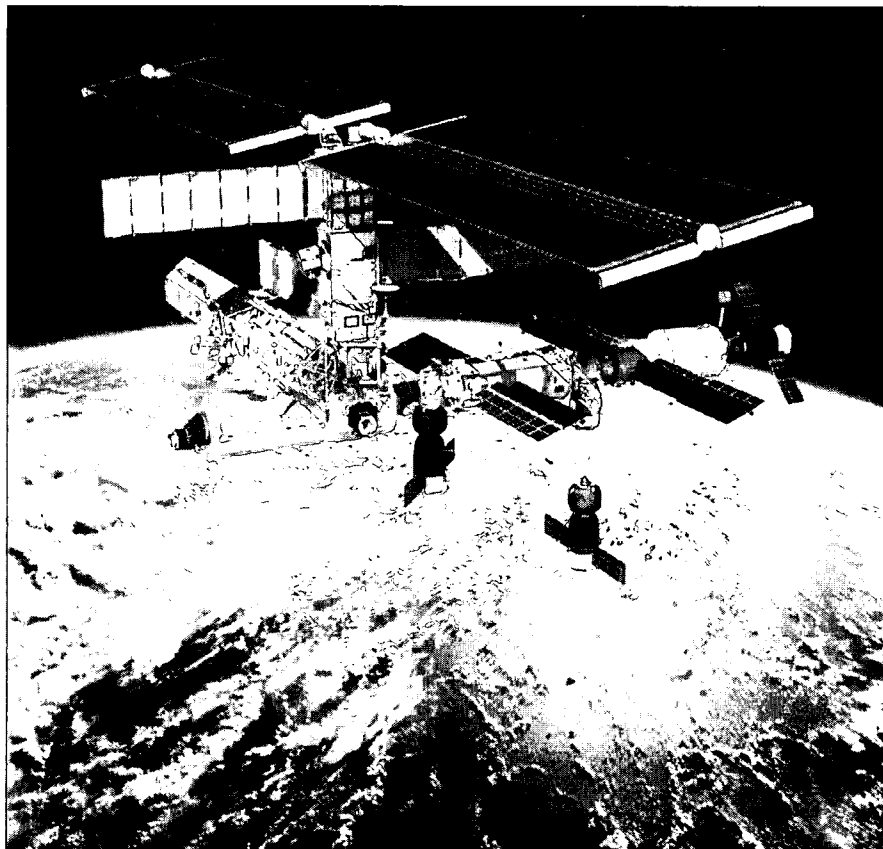


Fig. 4 – ISS

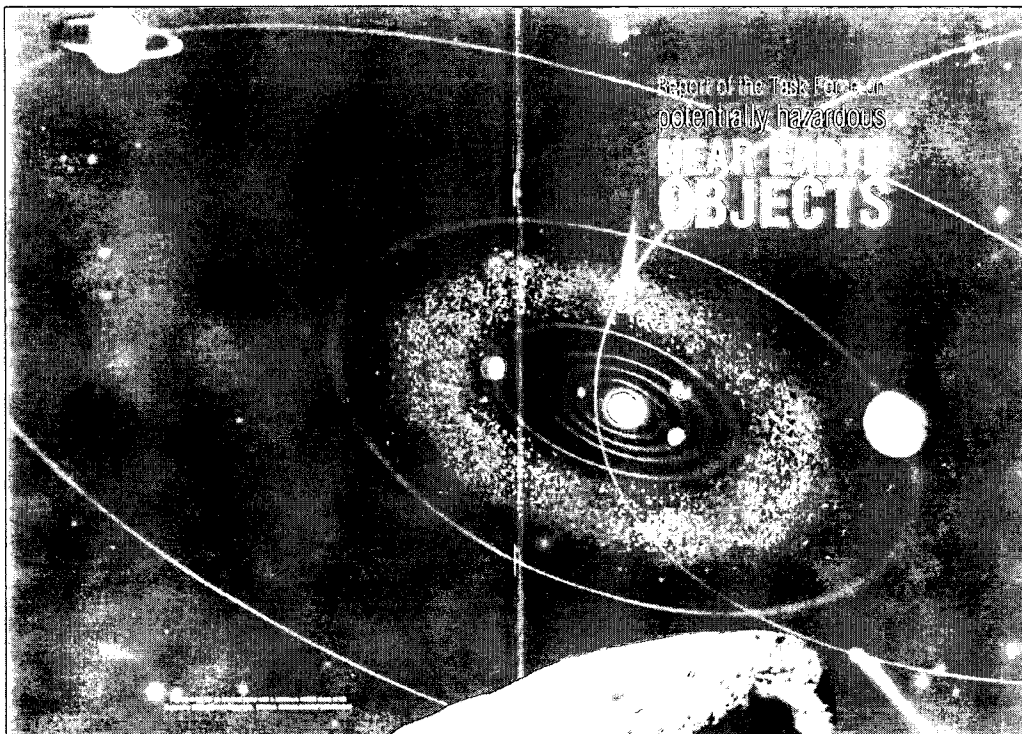


Fig. 5 – NEOs

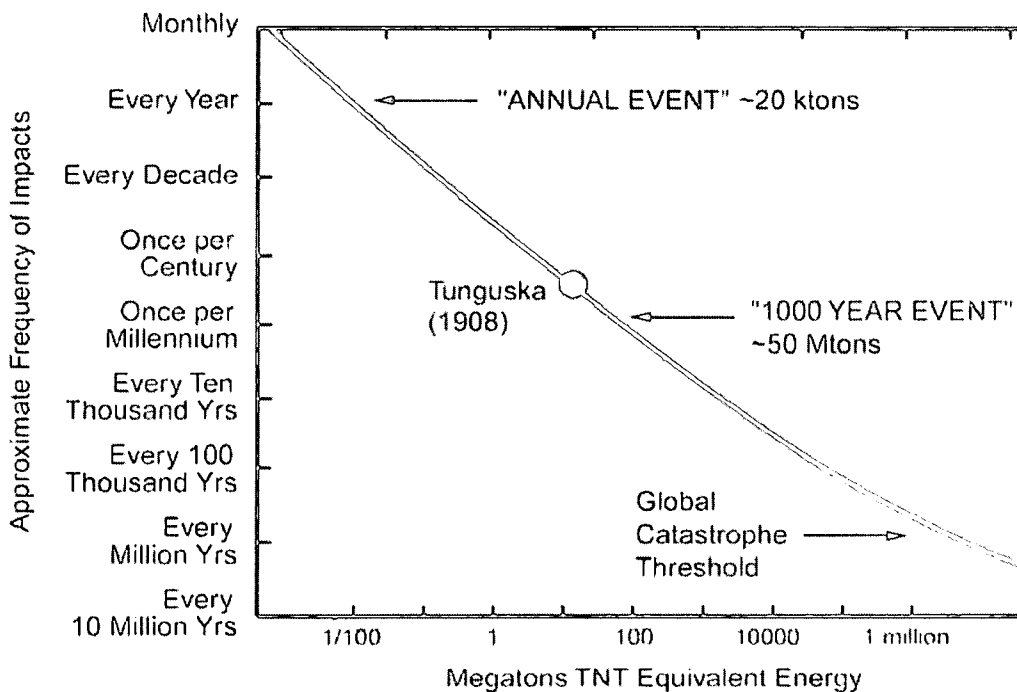


Fig. 6 – Impact Probability

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