PRELIMINARY STUDY TO IDENTIFY PRIVATIZATION OPPORTUNITIES AND CERTAIN RELATED PROJECT FINANCING ISSUES IN THE PERMANENT MANNED SPACE STATION PROGRAM

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EXECUTIVE SUMMARY

This document is a preliminary report intended to tentatively identify privatization opportunities within the context of the current Space Station Program structure. In addition, this report suggests a model under which more extensive privatization may take place. The alternative model should also be examined for the possibility of substantial cost reduction possibilities.

Commercialization opportunities will be reviewed, although it has become clear that government and government sponsored basic research is currently the only viable customer.

Items identified as worthy of further study typically were hardware that is highly desirable but not yet funded, is separable from the primary space station structure, and/or tends to reduce upweight requirements. For example, the pressurized logistics module weighs 23,000 lbs. and may well be carrying items that do not require pressurization. Such items could be transported in a much lighter non-pressurized module in any number of alternative expendable launch vehicles.

Identified candidates for privatization include providing for and transporting astronaut consumables, fuel, and spare parts; waste processing; incremental communications; electricity; pressurized, non-pressurized, and habitable volume, particularly as co-orbitors; EVA's; OMV and OTV.

Under the alternative model NASA provides equipment already procured (and negotiates risk with respect to such equipment), and uses a turnkey, fixed-priced, performance based contract for completion of the Space Station (including ground testing). So little of the Space Station is new technology that this model needs further consideration.

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INTRODUCTION

The purpose of this preliminary study is to identify subsystems and/or tasks pertaining to the Permanent Manned Space Station and Space Station assets, including polar platform, that are candidates for financing and investment by private industry (Privatization). The methodology used was to review briefing papers and other publicly available documents, interviews with Jet Propulsion Laboratory personnel, meetings with private industry, and discussions with investment bankers, a big eight accounting firm and project financing insurance specialists.

This report should be viewed as preliminary, entailing only a few weeks of work by a single individual in an area that requires months of work by numerous professionals to fully assess.

This study was undertaken with a view to the need of NASA to improve the efficiency of the Space Station Program, reduce its cost to the taxpayers, and maximize basic research value. Further, the study should assist in implementing the NASA policy of not being engaged in matters that will be undertaken by private industry.

PRIVATIZATION DISTINGUISHED FROM COMMERCIALIZATION

Privatization has been very successful, saving a variety of governments billions of dollars. However, commercialization must be distinguished from privatization.

Commercialization is where private industry sells a product or service to a variety of customers. Government may or may not be one of the customers.

Privatization is where private industry performs a government service, such as trash collection, prisons, hospitals, food service, bill collection, engineering, construction, etc. on a contractual basis.

Privatization becomes compelling when a competitive private industry segment can do an undertaking much cheaper than government. When one realizes, as an example, that NASA's software development costs are $700 per line, to private industry's $15-20 per line, common sense demands further investigation.

ROLE OF PROJECT FINANCE

Project finance has become a key element in privatization. This is because project finance serves to mitigate risks by spreading it among the sponsors, suppliers, customers, and financial institutions.

Project finance techniques have therefore resulted in a much broader competition to participate in privatization efforts

than if a company could look only to internal resources for funding.

The basis of any private project financing is risk identification in the completion, operation and market aspects of the projects and in mitigation of those risks to commercially acceptable levels.

Most basically, project financing requires a customer. It has become clear in the course of this study that the only viable customer for Space Station value and assets is the government, including government sponsored research and development. Therefore, the federal government's long-term commitment to the program is an essential factor in fostering privatization in the Space Station Program.

We have seen in the last five years an explosion of participation in project finance by institutions around the world. This has resulted in large part from the willingness of major corporations to take financial risks with respect to hardware and events that are within their control. It is safe to assume from public and private communications that the aerospace companies which want to be major players in the Space Station either already have made such commitments or are on the verge of doing so.

This is not to say that any company will gamble its entire future on one risk, no matter how certain it may be that the risk will not occur. Therefore, capital availability is a

major limiting factor when juxtaposed with major risk assumption.

It is more likely than not that NASA can shift a substantial amount of the risk in the Space Station to private industry. Government need not absolutely guarantee payment irrespective of performance. Indeed the financial community, as a result of the default on WPSS and revocation of natural gas contracts is adverse to and skeptical of absolute guarantees (take or pay contract). The better contract, the more acceptable contract, and the one that is most advantageous to NASA is the "take if delivered contract," meaning that the government only pays if the equipment or contractor performs to specification. Such an approach also gives NASA a strong incentive to consider operational factors, an incentive missing in the current program.

ITEMS CONSIDERED FOR PRIVATIZATION

The purpose of this study is to identify subsystems, major development tasks, and major operational tasks, including polar platform, which have the potential for privatization. The following items were examined:

1. Data Collection
2. Data Dissemination
3. ECLSS
4. Communication Equipment/Communication Satellites/Transmission Services
5. Waste Disposal
6. Fuel Supply
7. Electricity
8. Pressurized Volume/Habitable Volume/Unpressurized Volume
9. Diagnostics/Repair/Avionics Vehicle
10. Crew Emergency Return Vehicle (CERV)
11. Launch Vehicle/Launch Processing
12. Standardized Procurement of Small Items/Equipment Rental
13. Docker
14. Test Beds
15. Integration Facilities (Ground and In orbit)
16. Space Station Control Centers
17. Extra Vehicular Activity (EVA)
18. Telerobotics
19. Operator Training
20. Operation Capability Development
21. Software Support Environment
22. Program Support Contract
23. Commercial Earth and Oceans (Polar Platform)
24. Tourism
25. Orbital Maneuvering Vehicle and Orbital Transfer

PRELIMINARY ANALYSIS

Below are tentative conclusions as to subsystems and tasks that are candidates for privatization.

Strong feelings were encountered during examination of various systems, particularly where the suggestion of an alternative procurement approach could imperil progress already made, or upset a fragile path still solidifying.

HURDLES

As part of the study then, 11 reasons why the task or subsystem may not be a likely candidate for privatization were developed. These are:

1. The item is a traditional role for one of the NASA Centers.

   Items that fall in this category were felt not to be candidates because a given center had traditionally performed the functions or procured the particular service or hardware. There is an implicit assumption that the particular item has been commercialized or is perfectly capable of being provided on a performance basis by commercial firms. Essentially the historical interest of the NASA center outweighed NASA's policy of not competing with private industry.

2. Proprietary Center Interests.

Centers have identified certain areas for expanded capability. In such areas privatization is viewed as conflicting with the political and proprietary interests of a given center irrespective of desirability, availability and/or lower cost in the commercial sector.

3. Work Package Already Funded.

Certain items in the Space Station Program are already funded or "past the point of no return." Changing course, therefore, seems more likely than not to result in delays and/or additional costs.

4. Safety.

Safety is an obvious and major concern to everyone in and around the program. However, potentially disturbing safety issues were encountered during the study. This is because there is a basic conflict of interest regarding safety where a single institution is responsible for both writing detailed equipment specifications and for evaluating the safety of the resulting system, particularly where, as with NASA and its centers, politics is such a strong element. Procurement using the alternative model, discussed below, could mitigate the problem.

5. No Competitive Industry.

The worst situation NASA could find itself in is to pay for the development of a critical Space Station component on a quasi-project finance basis and, if the contractor does not perform, have no alternative but to complete the work with the defaulting contractor. Therefore, it was felt that an item should be privatized only if there are several suppliers capable of providing that item.

6. Integration difficulties.

All of the components of the Space Station need to work well together. Some items do not seem susceptible to being broken off and procured individually.

7. Capital Capacity.

Project finance capacity may be in the eight to ten billion dollar range. Financing in excess of 50 million dollars is time consuming and difficult. The amount of capital available is probably closer to three billion dollars although this issue needs further study and real world testing.

8. Risk Insurance Capacity.

Companies are typically willing to take risks for items, events and subcontractors within their control. However, a company's willingness to take risk for factors outside of their control is limited and need either to be exclusions of their contract or covered by some form of insurance. The large losses sustained by the institutional insurance market in space activities ($400 million taken in, and $900 million paid out) limits world-wide appetite for supplying such insurance. It may well be that government must provide backstop coverage for certain risks, such as property loss due to explosions during launch, in order to facilitate privatization.

9. Technological Risks.

Technological risks can occur for hardware when there is no commercially available equipment, and where upscaling or downscaling of comparable technology is not a minimal engineering risk. A company will then tend to consider successful development not to be with in its control.

10. Unpredictability of Requirements.

Because of flexibility of requirements and the unpredictability of future events, some items preclude

fixed price turnkey contracts and must be developed on a cost plus basis.

11. Not Generic to Space Station Program

Part of the more general NASA program. Not separable to Space Station alone.

PRELIMINARY CONCLUSIONS

DATA COLLECTION

Certain data is continuously collected such as temperature and pressure. A possible concept is to pay x number of dollars to collect and provide that information to both in-orbit and ground-based users. It was felt by the interviewees, however, that the Centers have a strong proprietary interest in data collection. Further data collection is so integral to so many systems that potential integration problems could easily result. Not recommended for further study.

DATA DISSEMINATION

This item is closely tied in to the overall NASA program and is difficult to break out. Not recommended for further study.

ECLSS

The ECLSS is already funded and well underway. Therefore, it appears impractical to break it out for privatization. In addition, it is likely that integration difficulties will be pronounced by breaking out the ECLSS system from the balance of the Space Station, and is probably best further studied only as part of the alternative model approach.

COMMUNICATION EQUIPMENT/COMMUNICATION SATTELITES/TRANSMISSION SERVICES

It was generally felt that the communication and transmission area is a good candidate for privatization for a variety of reasons. First, much of the activity in the area is not yet funded and the technical constraints of the current system may require significant incremental capability. As an example, at least two more communication satellites must be launched, but it is unclear that White Sands has capacity for the incremental data handling requirements. One idea advanced is potentially to privatize White Sands and the NASA communications system. The amount of dollars involved appear well within capital availability and there are a variety of qualified firms in this area. Recommended for further study.

WASTE DISPOSAL

A variety of firms seem capable of developing a system or systems to burn waste in the atmosphere, or a system to digest waste to create usable fuels, products, or just to significantly reduce mass and the corresponding down weight requirements. Seems to be worthy of further study.

FUEL SUPPLY

The cost of launching liquid fuels is enormous and could easily result in large operational cost overruns. Private

industry could supply fuel, fuel modules and transportation. My understanding, however, is that there is some confusion as to what types of fuels are required and where they will come from. For example, I have been variously told that some of the fuel will be hydrogen and oxygen for "hydrogen and oxygen resisto jets" that will come from the waste liquids and waste water produced in the Space Station. I have also been briefed that the liquid waste produced is part of a closed system that is then recycled, making this source of hydrogen and oxygen unavailable for propulsion. However, when the decisions are made, fuel supply is worthy of further study.

ELECTRICITY

There is no question that several firms are competent to supply the photovoltaic, solar dynamic, or other types of electric systems that may be specified. The question is whether, if spare parts are needed, the firms are prepared to pay the launch costs of transporting the spare parts to space. Definitely worthy of further investigation.

PRESSURIZED VOLUME/HABITABLE VOLUME/UNPRESSURIZED VOLUME

Several firms have already proposed to provide volume on a project finance basis. Resistance to this has come from NASA for reasons that are not clear. There is no question that volume requirements can be handled by private industry

for the basic Space Station. If this becomes impractical for political reasons, then private industry should clearly be considered for incremental volume requirements, such as for co-orbitors and commercial applications associated with the Space Station. Indeed it is highly improbable that the cost of government provided volume can be competitive with project financed privately provided volume. Clearly worth further study.

DIAGNOSTICS/REPAIR/AVIONICS VEHICLE

These vehicles are contemplated as co-orbitors and seem necessary to the program. This is because currently the Space Station anticipates that when a module breaks or becomes inoperative that it will be taken out of the Space Station, transported down to earth, repaired on earth, transported back to space and reinstalled. The upweight costs associated with this approach are horrendous, and do not seem properly accounted for. In many cases, a diagnostics vehicle capable of accurately identifying the specific problems could allow repair of a module by replacement of a chip or some other simple fix. There is no reason this cannot be done in space at much less cost. In addition, a small amount of milling and other hardware repair capability could be co-orbited to reduce the huge cost of lifting a module back into space after repair on earth. Co-orbitors could also be used for storage. An excellent candidate for privatization.

CREW EMERGENCY RETURN VEHICLE

An emergency return capability is currently not a part of the Space Station Program. At least it is not budgeted. The assumption seems to be that in the event of an emergency the Space Shuttle will be launched to rescue the crew. Under ideal circumstances this will work fine. After all, we have not had an effective emergency return capability in any of our space programs to date. However, the Challenger accident has reprioritized the safety issue and CERV may be desired. It is estimated that development costs of such a vehicle may be $1.2 billion to $5 billion or more. A suggestion was made that we look to the Hermes being developed by the French as the CERV. CERV is an aspect of the program not absolutely essential and provides us with a way of working with the French without depending on them too much. Possible area for privatization.

LAUNCH VEHICLE/LAUNCH PROCESSING

Several companies are interested in "trucking" unmanned operational (as opposed to construction period) payloads. One possible approach is to give a rocket manufacturer a contract for X successful launches (probably should be more than fifteen). In the event of rocket failure, the manufacturer would have to supply an additional rocket or rockets at its own expense. Excellent candidate for privatization.

STANDARDIZED PROCUREMENT OF SMALL ITEMS/EQUIPMENT RENTAL

A variety of components too small to be considered here could very well be obtainable on a project finance basis. Some examples include microscopes, centrifuges, diagnostic equipment, and other items that are removable. NASA may want to explore, as an innovative contracting method, project financing relatively small components by paying for them on a performance basis rather than on a capital basis. May be worth further study.

DOCKER

NASA is currently a party to a classic privatization program with Space Industries, Inc. In this program, Space Industries, Inc. has agreed to design and furnish to NASA a docker. The docker can then be used by Space Industries for its related and unrelated programs. Presumably, other interested entities, including NASA itself could lease purchase or license use of the docker.

TEST BEDS

Not suitable for privatization as a separate item. Should be reconsidered as part of the alternative model.

INTEGRATION FACILITIES (Ground and In-Orbit)

Not suitable for privatization as a separate item. Should be reconsidered as part of the alternative model.

SPACE STATION CONTROL CENTERS

Not suitable for privatization as a separate item. Should be reconsidered as part of the alternative model.

EXTRA VEHICULAR ACTIVITY

The amount of EVA required is somewhat uncertain. It may be possible that some hardware related to EVA are privatizable although the lack of competitive industry makes it difficult to consider extensively. Not recommended for further study.

TELEROBOTICS

The technical challenge of the required telerobotics is formidable. There does not appear to be a viable ground based industry to support privatization of this item.

OPERATOR TRAINING

Not suitable for privatization as a separate item. Should be reconsidered as part of the alternative model.

OPERATIONS CAPABILITY DEVELOPMENT

Not suitable for privatization as a separate item. Should be reconsidered as part of the alternative model.

SOFTWARE SUPPORT ENVIRONMENT

Already funded. Not recommended for further study.

PROGRAM SUPPORT CONTRACT

Already funded. Not recommended for further study.

POLAR PLATFORMS

Polar platform can be divided into three general areas: the platform itself, the instrumentation on the platform, and the data collected from those instruments. Private industry currently builds the platforms and some have even built them at their own risk with no certain customer. The platform itself seems an excellent candidate and is recommended for further study. Instruments proposed for polar platform are cutting edge technology and difficult to envision as privatizable. Not recommended for further study. The market for data collected by those instruments are of doubtful commercial value.

TOURISM

Millions of people all over the world would love to go into space. There is a remote possibility that visits could be made to the Space Station although the greater likelihood is that a visitor would just be taking a ride on the Space

Shuttle as opposed to occupying the Space Station for an extended period. Not recommended for further study.

ORBITAL MANEUVERING VEHICLE AND ORBITAL TRANSFER VEHICLE

This reusable tugboat is a desirable feature of the program but is not yet funded. In addition, several vendors seem capable of developing the OMV/OTV. Probably worth some additional study.

ALTERNATIVE MODEL - THE EXPANDED TURN-KEY APPROACH

An alternative model examined divides the program into major segments with some segments managed by NASA and others the responsibility of private industry. In particular, a system was examined whereby private industry would provide on a turnkey basis a complete Space Station designed to meet the criteria set forth in the "Program Requirements Document."

Under the alternative model, three particular objectives are prioritized, they are:

- o Safety
- o Cost and schedule optimization; and
- o Maximizing the basic research value of the space station to government and private industry

The following is suggested as a straw man approach to the alternative model:

I. A company (or more likely a consortium) is selected to build, transport and install everything specified in the "Program requirements" document including initial science payloads.

   - o Contract would be turn-key fixed price with the following exceptions: 1) items already procured, or substantially procured by NASA (some risk sharing is possible here) and 2) exclusions negotiated with a contractor.

- o NASA provides manpower and shuttle services at defined cost. Contractor has the option of using other vehicles for unmanned transportation.

- o JSC/MSFC are "owner's representatives," to assure safety considerations and quality assurance.

II. Operations

Nasa provides:

- o Manned Transportation
- o Test Beds
- o Quality Assurance
- o Safety
- o Developing and Coordinating Scientific Activities

III. Items that probably should be privatized during the operation phase

- o maintenance of items constructed during the construction phase including volume, software, docker, electricity
- o unmanned launches and related service
- o incremental communications requirements
- o logistical services
- o polar platform

- o co-orbitors
- o fuel
- o waste disposal

IV. Items that need further study

- o NASCOM (including White Sands)
- o Data Collection
- o OMV/OTV
- o CERV
- o EVA
- o Training

V. Payment considerations

- o progress payments and/or financeable contracts of some form will be required
- o bulk of payments can be made on a basis analogous to lease rental payments

The alternative model assures that the governments interest is protected as Johnson Space Flight Center (JSC) could appropriately play the role of "owners' representative" and be responsible for assuring that the hardware delivered meets operational requirements and is safe. Marshall Space Flight Center (MSFC) could be responsible for development of the heavy lift launch vehicle, a space plane for transportation of astronauts and any other non-commercially available vehicles required by the program. JSC is then

responsible for continuous development of new tasks and experiments to be performed on the Space Station.

SUGGESTED STUDY METHODOLOGY

The purpose of additional study is to test the real world response to privatization opportunities with a view to implementing viable proposals from private industry.

The following procedure is suggested:

1) Determine a single point of responsibility within NASA for both the study and resulting programs.
2) Engage independent outside investment bankers, accounting firms and legal support. Firms employed should have a strong privatization and project finance background with demonstrated deal making capability in the billions of dollars.
3) Assign a team of NASA experts to work with the outside professionals to examine risks associated with the Space Station Program in great detail. The team should prepare a document well suited to due diligence requirements.
4) NASA should identify all the reasons why a particular item is not suitable for privatization.
5) Assemble appropriate NASA decision makers to decide what risks the government is willing to take.
6) Assemble a team of interested parties to establish detailed safety procedures and to assure that safety has the highest possible priority at all phases of the privatization program.

7) Issue to the public in a series of public forums around the country a "request for expression of intent to bid" on items identified by NASA as privatization opportunities.
8) Select items with appropriate response for implementation.
9) Appoint a team to monitor the progress of the implementation.