OVERVIEW OF OFFICE OF SPACE TRANSPORTATION SYSTEMS

FUTURE PLANNING

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SUMMARY

This paper summarizes the Space Transportation Systems' key milestones as well as the future planning of the Office of Space Transportation Systems. It includes a brief description and identification of candidate new starts with target development initiation and first flight dates.

INTRODUCTION

With the Space Shuttle era about to commence, how to obtain the most benefits from these new OSTS systems is of primary interest to OSTS planners. As a result of evaluating approved systems capabilities, the new opportunities of the Space Shuttle era, and the capabilities need to take advantage of these new opportunities, the Advanced Programs Division has identified eight near-term candidate new-start activities. This paper begins with a brief summary of the Space Transportation Systems' schedule but primarily addresses these new start candidates.

MISSION OF THE OSTS

The mission of the Office of Space Transportation Systems (OSTS) includes the definition, design, development, production, operations, and management of the Space Transportation System. The present thrust of the OSTS mission is to effectively exploit the capabilities of the Space Transportation System. Specific goals of the OSTS are enumerated in Figure 1.

TARGET MILESTONES OF THE OSTS

The approved space transportation target milestones are summarized in Figure 2. As indicated, the first manned orbital flight is targeted for mid-1979, with the first operational flight planned for a year later. By late 1983, the fourth orbiter should have been delivered. Spacelab first delivery is planned for early 1980. The decade of the eighties is aimed at effectively operating the newly developed reusable Shuttle system. It marks a major step forward in reducing the costs of transporting men and material to and from space.

SPACE SYSTEMS ENGINEERING

Advanced Programs is responsible for the definition of OSTS new-start candidate programs. Until the Shuttle is operational, future space systems engineering will focus on systems enhancing the usefulness and effectiveness of the Shuttle. As a consequence, studies and engineering support associated with permanently manned space stations in low Earth orbit and geosynchronous orbit and other ambitious missions have been deferred.

The present focus of space systems engineering is summarized in Figure 3. It includes extending and enhancing the mission duration of the Orbiter and Spacelab up to 90 days, providing supplementary on-orbit electrical power for experiments and payloads, enabling orbiter-tended space construction and assembly of large space structures, and studying the requirements and concepts for transportation of larger payloads from low to high Earth orbit.

SPACE SYSTEMS ENGINEERING PROGRAM SCHEDULE

The Advanced Programs planned near-term new-start candidates--initiation of Phase C/D (Δ) and initial operations capability (Δ)-- are presented in Figure 4. As indicated, definition system and subsystem studies and engineering support activities for these candidates are planned. These are our currently identified flight systems development candidates for initiation in the FY 80-82 time period. We will, of course, continue to study concepts and systems together with the other NASA Program Offices that could become new-start candidates in the FY 81-84 time period. Examples are geosynchronous platforms, low Earth orbit construction platforms, a manufacturing experimentation module to be attached to a free-flying power module, solar terrestrial observatory platforms, a life science experimentation module, and a solar power satellite demonstration platform.

SKYLAB REBOOST/DEORBIT MISSION

For several years we have been studying Teleoperator Retrieval System concepts. With the decision to proceed with a project to either preserve Skylab in orbit or provide for a controlled reentry, various concepts to accomplish this mission were evaluated. A system called the Teleoperator Retrieval System (TRS) was selected. This reusable system, of course, has significant potential for a variety of other missions. For example, it can be used to retrieve satellites and stabilize them for Shuttle pickup. It can also be used for stand-off space operations close to the Shuttle itself. The TRS is shown in Figure 5. It will be available in late 1979 for delivery to orbit by the Shuttle. It will be carried to Earth orbit in the payload bay of the Shuttle in an early Orbital Flight Test (OFT) flight. When the Shuttle is in position, the TRS will be ejected from the Shuttle's payload bay and flown to the Skylab. Then, controlled by a video link from the Shuttle, it will dock with Skylab and, if the reboost mission is selected, boost Skylab to an altitude of approximately 220 n. mi. The TRS will then undock and remain in orbit to be retrieved on a later Shuttle flight for subsequent use. The deboost-mission profile is similar except that after separation from the TRS, Skylab will go to a planned impact in a broad ocean area. The choice between reboost and deboost need not be made until late in the development program for the TRS.

25-KW POWER/SERVICES MODULE

Additional on-orbit electrical power and duration, beyond that available from the baseline Shuttle orbiter, is required (Figure 6). Two competitive technical approaches for provision of additional on-orbit needs are being evaluated by NASA Headquarters.

The Marshall Space Flight Center (MSFC) approach (Figure 7) is based upon proceeding directly to develop a 25-KW Power Module that is based on utilizing available subsystems or subsystems already in development. The module provides additional on-orbit electrical power, heat rejection, active stabilization, and can be operated in a sortie mode with the Shuttle and Spacelab. It can also be used as a free-flyer to support palletized payloads.

The Johnson Space Center (JSC) technical approach (Figure 8) is based on an incremental phased approach, to provide augmented power, heat rejection and duration capability for Shuttle missions. The JSC initial increment is a remote manipulator system deployed solar array carried up and down on each mission that augments the Shuttle fuel cells on the sun side of each orbit. It allows variations in fuel cell output to tailor missions to particular power and duration requirements. The second increment then involves developing a free-flyer module to handle those requirements that cannot be accommodated with the deployed array initial increment.

KEY FACTORS IN CONCEPT SELECTION

Significant factors driving the on-orbit augmentation concept selection include: Users requirements (i.e., power, heat rejection, duration and when required), the missions and operations system flexibility, the need and timing for use, the orbit inclination and duration flexibility, the relative growth potential, and the costs versus benefits accrued.

These and other relevant factors are presently being evaluated with near-term concept selection intended to allow development initiation in FY 80.

SPACE TETHER

The Space Tether (Figure 9) can provide a needed operational capability that is presently not available. Scientific measurements of Earth from Earth's upper atmosphere cannot presently be made continuously or efficiently. Satellites decay in orbit in the upper atmosphere and deorbit in a matter of hours. Sounding rockets give only short-duration readings as they pass up and down through the upper atmosphere. The Tethered Satellite System (Space Tether) offers a means for performing a wide variety of relatively long-duration scientific and operational missions in the upper atmosphere. The instruments capable of performing Earth-dynamics or atmospheric and space plasma physics measurements can be suspended by the Space Tether from the payload bay of the Space Shuttle and trolled through the Earth's upper atmosphere at altitudes of approximately 120 kilometers. Two Phase B definition studies are presently under way and should be completed in early 1979. A verification flight should be accomplished in 1982 and initial operational capability (IOC) is planned for 1983.

SPACE FABRICATION DEMONSTRATION

In-orbit fabrication of structural elements offers promise as a method for efficiently packaging and transporting to space the materials for large space structures and as a concept for highly automated construction (Figure 10). Full development of a space fabrication capability will require an orbital demonstration to proof test a space fabrication machine, handling fixtures, and structural assembly concepts. The demonstration will have to include transporting structural materials into space, fabricating structural elements or trusses using the fabrication machine, assembling the structural elements into a useful space configuration, and mounting sensors for test and applications purposes.

In FY 1979 and FY 1980 the Grumman-built beam builder will be at the Marshall Space Flight Center for test, evaluation, and demonstration. In addition, some study effort will be initiated to evaluate modification of the beam builder to fabricate beams using composite materials. Finally, a study will be accomplished to define a flight demonstration of space fabricating equipment.

A space fabrication and erection test flight and a space construction platform will provide engineering support for NASA missions involving large space systems. In the early 1980's relatively small platforms can obtain scientific and global type information while communications would be advanced by developing a narrowband technology antenna. In the mid-1980's medium-sized platforms at mid latitudes and small polar platforms would provide increased scientific capability, and a large power module would be available for a range of activities. The late 1980's and early 1990's might see the development of small geosynchronous platforms, space science laboratories, cryogenic telescopes, global services platforms, narrowband communications satellites, and an SPS test article. Late in the 1990's would possibly see the placing in orbit of SETI antenna, and solar power satellites.

SATELLITE PLACEMENT, RETRIEVAL, MAINTENANCE, AND REPAIR

The Shuttle system being developed will provide new capabilities for satellite placement, retrieval, maintenance and repair that will be very useful to Shuttle payload users in the 1980's. The systems or systems combinations that will provide this capability include the Orbiter/Remote Manipulator System (RMS), Orbiter/RMS/Extravehicular Mobility Unit (EMU), Orbiter/RMS/EMU -- Manned Maneuvering Unit (MMU), Orbiter/EMU-MMU, Orbiter/RMS/Teleoperator Retrieval System (TRS), and the Orbiter/TRS combination.

In FY 79 we will be studying system requirements and the capabilities of the above-mentioned systems to establish how currently planned capabilities can be exploited and what new capabilities will be required. Operations at "stand-off" distances from the Orbiter in low Earth orbit of 800-1600 KM will be studied to determine how to augment the TRS capabilities. We will also continue to investigate maintenance and repair activities both in low Earth orbit and geosynchronous orbit. Our studies and engineering support activities are directed to determining what capabilities should be provided in the 1983-85 time frame. The current target is a hardware start of some type in FY 1981. (See Figure 11.)

SOLAR ELECTRIC PROPULSION STAGE

NASA will use the Inertial Upper Stage (IUS) being developed by the U. S. Air Force for certain high-energy missions, including some automated planetary missions. However, studies have shown that certain planetary missions cannot be performed without assistance from an additional class of propulsive vehicle. A Solar Electric Propulsion Stage (SEPS) is one concept that has been under study for several years. Another alternative is to integrate the thrustors and solar arrays into the planetary spacecraft because the total system in a sense operates as a spacecraft for mission durations of several years. Development of a SEPS module is included in our present five-year plan as a FY 81 new start with an IOC capability of 1985. (See Figure 12.)

SKYLAB REHABILITATION

The large living quarters and crew accommodations aboard Skylab can be effective adjuncts to Shuttle-Spacelab long-duration missions. Figure 13 is an artist's sketch of Skylab being utilized with a power module to support a large space structure, space fabrication, and assembly demonstration mission. Studies are under way to identify reactivation requirements for Skylab onboard systems, subsystems, and experiments and to identify additional uses and benefits associated with rehabilitation and reuse. Representative candidate missions include the following areas of investigation:

- Degradation of materials and equipment from long-term space exposure
- Space construction engineering
- Space processing
- Bio-Science
- Communications
- Earth and space sciences

SPACE POWER SYSTEMS ENGINEERING

Studies have indicated that in the mid 80's there will be requirements for hundreds of kilowatts in orbit in order to satisfy a wide range of future new space opportunities. Figure 14A describes key missions that will require power in the 100's of KW level. These include such things as construction of large structures, materials processing, communications, solar power technology development, as well as scientific and application missions.

The most appropriate power level to be developed after the 25-KW Power Module is not known at this time. Figure 14B shows a space construction platform. Attached to and forming a part of this construction platform is a 250-KW power array that could be used in space construction operations as well as in technology demonstrations. Figure 14C shows another concept of a multi-hundred-kilowatt power module being constructed. This construction approach, of course, would be important in demonstrating space construction technology applicability to a wide range of future large structures including solar power satellites.

Recent activity involving the Offices of Space Science, Space and Terrestrial Applications, Aeronautics and Space Technology, and Space Transportation Systems has resulted in identifying potential large space systems as shown in Figure 14D. This chart shows that power levels in the multi-hundred kilowatts are likely to be required by the 1986 time period.

In responding to anticipated future needs, OSTS has been investigating how to best provide power modules of the 100's of KW's size. We are targeting for an operational capability in the 1986-1987 time period. Two systems concepts studies are presently under way (Figure 14E). These studies are investigating power modules that would have the potential of providing hundreds of kilowatt power in orbit for such space operations as materials processing, space construction, advanced communications systems, and other future applications and scientific projects. The JSC/MDAC study could be described as a "clean sheet" modular approach since it is not committed to using any existing available hardware. The MSFC/LMSC study is based on evolving from the 25-KW Power Module in an orderly and timely fashion.

During the FY 79-80 time period conceptual studies and preliminary design activities will be continued. Better definition of user requirements will be accomplished by working directly with the other program offices as they shape their long range plans. These efforts will establish the power level and best concepts for the multi-hundred KW system.

The power-related and space construction technology efforts of the next 5-6 years are important because they will most assuredly influence the capabilities and systems that are selected for this large power module. OAST future new initiatives, as well as some of the R&T base work in both the power and large structures area, are being phased to support technology needs for this system.

ORBITAL TRANSFER VEHICLE

The Space Transportation System being developed restricts manned operations to low earth orbit. Higher energy unmanned missions are constrained by the capabilities of the currently approved inertial upper stage and the spinning satellite upper stages; therefore, space systems engineering projects involving construction of large structures and assembly of large power modules will of necessity be concentrated in low Earth orbit through the mid 80's. Our planning indicates a need for an orbital transfer vehicle (OTV) having manned geosynchronous capabilities by the late 80's. Such an OTV might also be needed for such potential missions as disposal of nuclear wastes, demonstration of space power technology, and maintenance and repair of geosynchronous large space platforms. The OTV (Figure 15) is planned to be an FY 1982 development initiation.

SPACE SOLAR POWER SYSTEM DEMONSTRATION

(MULTI-MEGAWATT SYSTEMS)

The development of a large power module in low Earth orbit constitutes a desirable first step in the evaluation of the technologies necessary to the space solar power concepts. The solar energy satellite test article could utilize a large power module, a phased array transmitting antenna and a maneuverable space rectenna to conduct selected microwave tests.

Based partially on the SPS demonstration information, a commitment might be forthcoming to develop multi-gigawatt systems capable of supplying a large percentage of the national electric grid total power. The multi-gigawatt system operating from geosynchronous orbit could be operational in the late 1990's.

MATERIALS EXPERIMENTATION MODULE

A manned materials processing module which could be flown in the late 1980's in conjunction with a 250-KW Power Module is shown in Figure 16. High-value products such as semiconductor materials, optical materials and high temperature materials such as turbine blades could be produced on an economical scale. These processes will require major dedicated facilities in space that will utilize hundreds of kilowatts of power. Initially, the Space Shuttle orbiter, with additional power and on-orbit time, will facilitate the operation necessary to prove out the processing concepts and actually make some marketable materials. Beyond that, small Shuttle-tended free flyers and materials processing modules attached to a space station will make larger quantities of high-value products for earth markets.

CONCLUDING REMARKS

Eight new programs (new-start candidates) responsive to near-term future opportunities and requirements have been reviewed. These new starts extend and enhance the capabilities of the Shuttle orbiter and Spacelab, provide supplementary on-orbit electrical power for experiments and payloads, enable Shuttle Orbiter-tended space construction and the usage of the products thereof, and allow the transportation of larger payloads between low and high Earth orbit. More specific details on many of these candidates will be presented in other papers at this symposium.

OFFICE OF SPACE TRANSPORTATION SYSTEMS MISSION

- TO PROVIDE EASY, LOW COST ACCESS TO, FROM, AND WITHIN SPACE FOR PAYLOADS AND SYSTEMS DEVELOPED BY NASA AND OTHER USERS
- TO DEVELOP MORE EFFECTIVE CAPABILITIES FOR HUMANS TO LIVE, WORK, AND CONDUCT EXPERIMENTS IN SPACE FOR EXTENDED PERIODS OF TIME
- TO DEVELOP FLIGHT SYSTEMS THAT WILL ENHANCE THE STS' UNIQUE CAPABILITIES AND GREATLY EXPAND ITS USEFULNESS
- TO PLAN AND CONDUCT SPACE OPERATIONS

Figure 1.

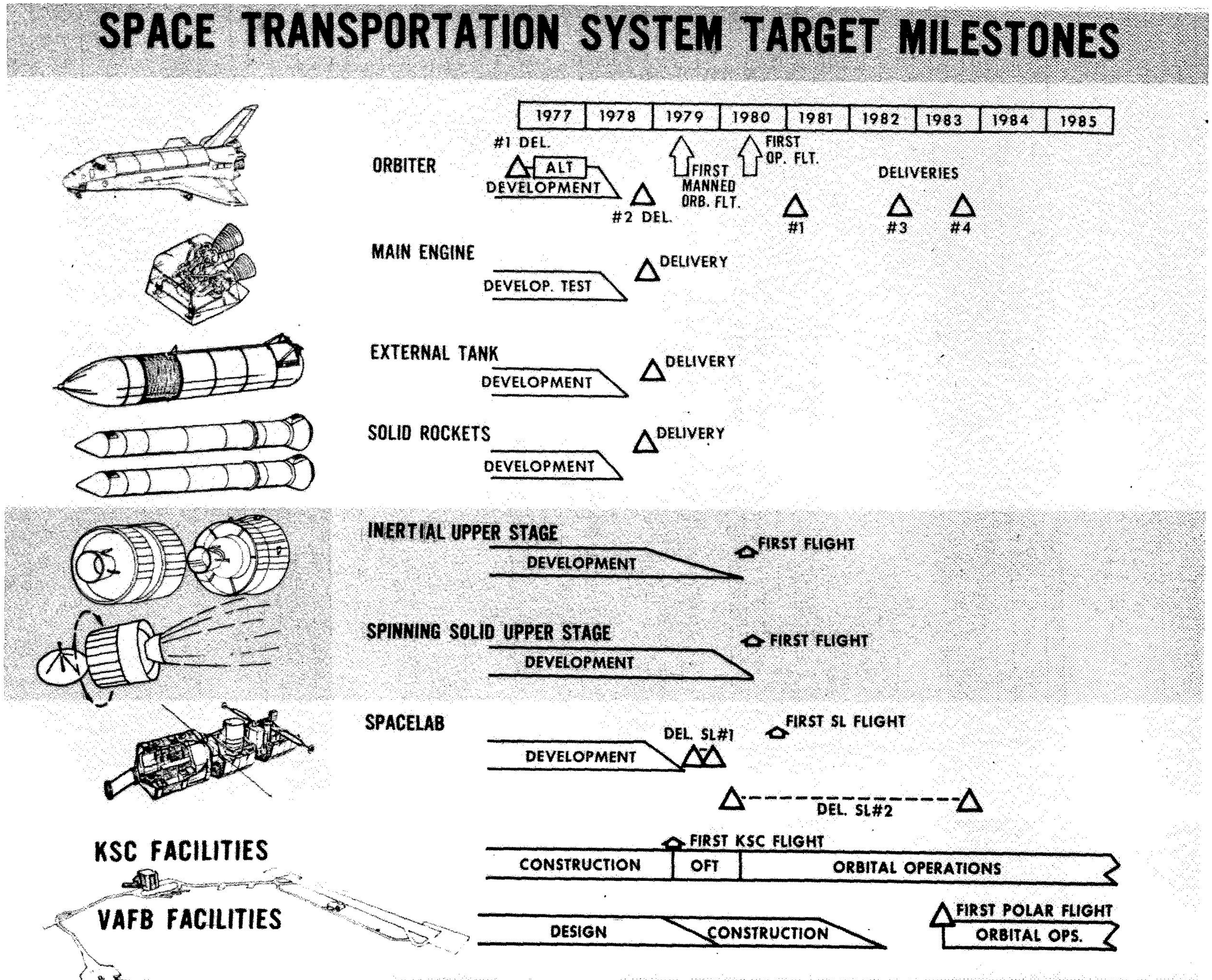

SPACE TRANSPORTATION SYSTEM TARGET MILESTONES
1977
1978
1979
1980
1981
1982
1983
1984
1985
ORBITER
#1 DEL.
ALT
DEVELOPMENT
#2 DEL.
FIRST MANNED ORB. FLT.
FIRST OP. FLT.
DELIVERIES
#1
#3
#4
MAIN ENGINE
DEVELOP. TEST
DELIVERY
EXTERNAL TANK
DEVELOPMENT
DELIVERY
SOLID ROCKETS
DEVELOPMENT
DELIVERY
INERTIAL UPPER STAGE
DEVELOPMENT
FIRST FLIGHT
SPINNING SOLID UPPER STAGE
DEVELOPMENT
FIRST FLIGHT
SPACELAB
DEVELOPMENT
DEL. SL#1
FIRST SL FLIGHT
DEL. SL#2
KSC FACILITIES
FIRST KSC FLIGHT
CONSTRUCTION
OFT
ORBITAL OPERATIONS
VAFB FACILITIES
DESIGN
CONSTRUCTION
FIRST POLAR FLIGHT
ORBITAL OPS.

Figure 2

SPACE SYSTEMS ENGINEERING

FOCUS:

- TO INCREASE THE SHUTTLE'S AND SPACELAB'S MISSION DURATION FROM THE INITIAL SEVEN TO TEN DAYS TO 60 TO 90 DAYS SO THAT VALUABLE EXPERIMENTS AND MISSIONS THAT WOULD OTHERWISE NOT BE POSSIBLE CAN BE ACCOMPLISHED.

- TO PROVIDE SUPPLEMENTARY POWER FOR EXPERIMENTS AND MISSIONS WHOSE POWER REQUIREMENTS EXCEED THE SHUTTLE'S POWER-GENERATING ABILITY.

- TO ENABLE THE SHUTTLE TO SUPPORT THE ASSEMBLY AND CONSTRUCTION IN SPACE OF THE LARGE STRUCTURES REQUIRED TO MEET PREDICTED NEEDS FOR COMMUNICATIONS, FOR THE SENSING OF VARIOUS ASPECTS OF THE EARTH'S ENVIRONMENT AND SURFACE, FOR THE PROCESSING OF MATERIALS, AND FOR THE GENERATION OF POWER IN SPACE.

- TO TRANSPORT LARGE PAYLOADS SUCH AS THE COMMUNICATIONS, EARTH SENSING, AND SPACE POWER SYSTEMS MENTIONED ABOVE FROM LOW-EARTH ORBIT TO GEOSYNCHRONOUS ORBIT AND RETURN.

Figure 3.

SPACE SYSTEMS ENGINEERING PROGRAM SCHEDULE

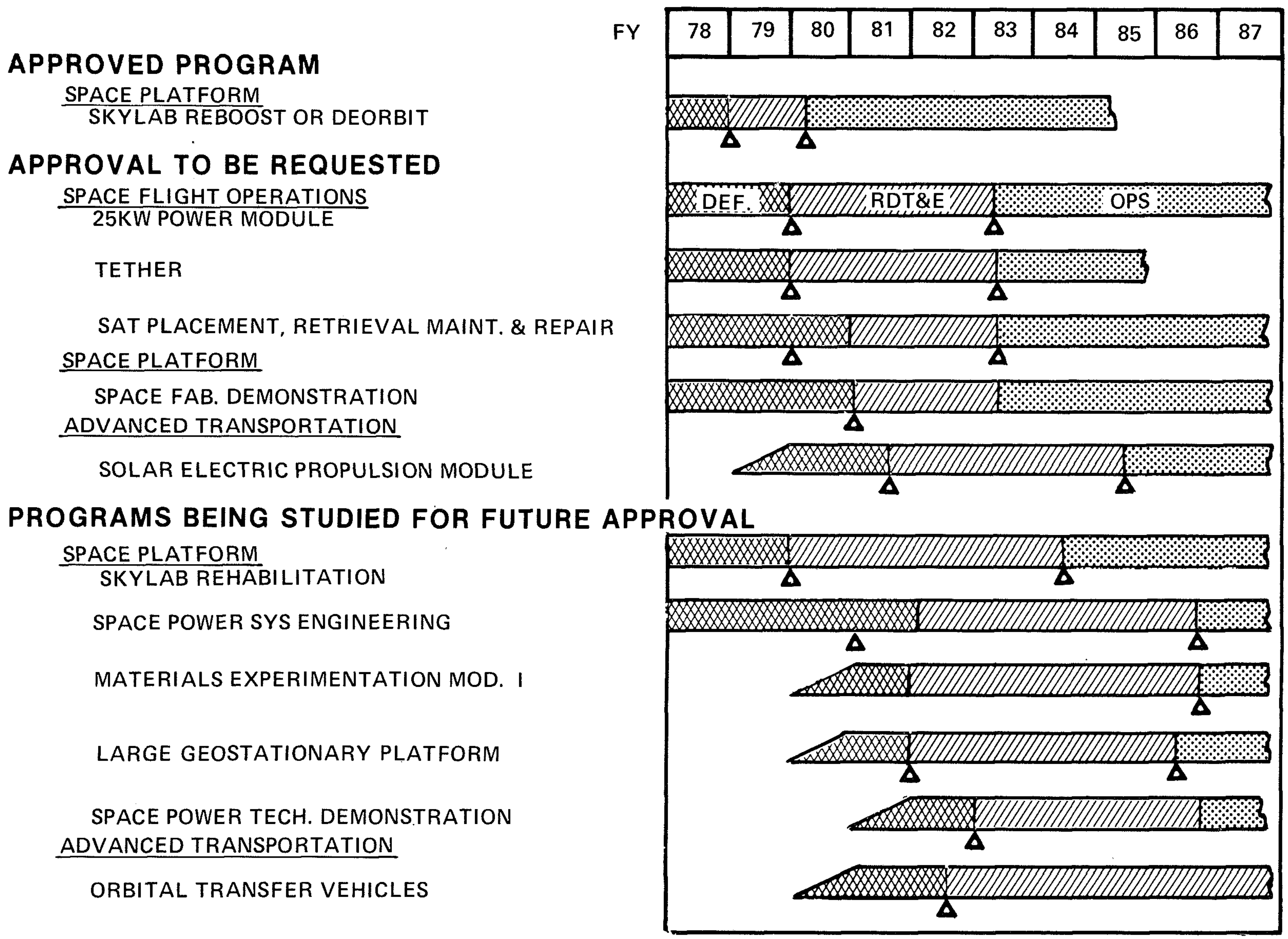


Figure 4.

NASA HQ MT78-1833 (1)
REV. 5-24-78

Skylab Boost Mission Configuration

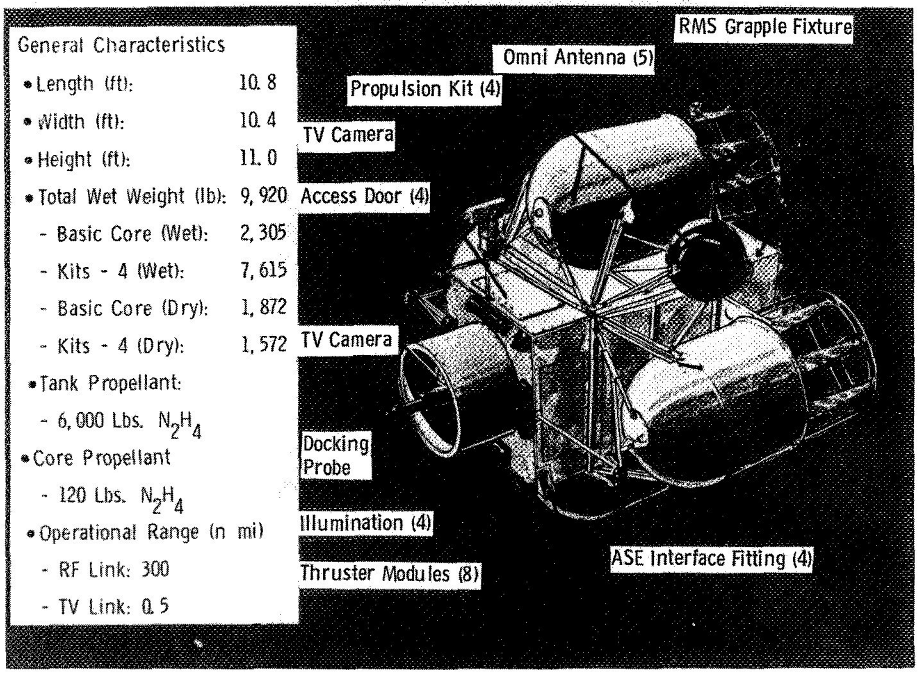


Figure 5.

USER REQUIREMENTS

25 KW POWER MODULE

	POWER/ENERGY REQUIREMENTS	DURATION REQUIREMENT
o SPACE PROCESSING	6-7 KW 12-20 KW	7-10 DAYS* 30 DAYS*
o EARTH OBSERVATIONS/ COMMUNICATIONS	7-15 KW	30 DAYS MINIMUM
o LIFE SCIENCES	NEED 870 WATTS MORE THAN ORBITER CAPABILITY	30 DAYS
o SPACE PHYSICS AND ASTRONOMY	SOLAR TERRESTRIAL OBSERVATORY, PHYSICS AND ASTRONOMY MISSIONS 7-15 KW	30 DAYS MINIMUM*
o TECHNOLOGY	SEVERAL POTENTIAL PAYLOADS W/LARGE ENERGY REQUIREMENTS	15-30 DAYS
o GENERAL	POWER SOURCE FOR SKYLAB REHABILITATION USES	15-30 DAYS

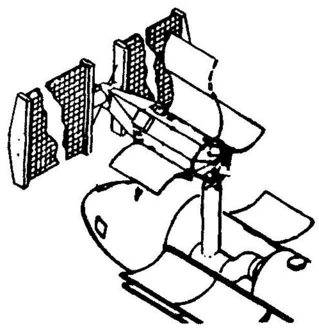
* FREE FLYER CAPABILITY HIGHLY DESIRED

Figure 6.

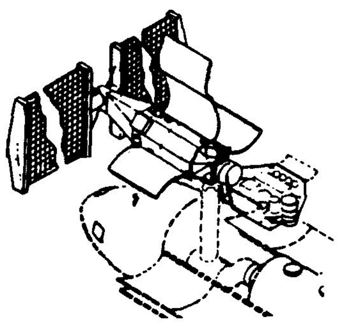
OSTS FIVE YEAR PLAN
MSFC - 25 KW POWER MODULE

25 KW POWER MODULE PRIMARY OPERATIONAL MODES

SORTIE SUPPORT MODE
(PM/(ORBITER/PAYLOAD)



FREE FLYING MODE
(PM/FF PAYLOAD)



CURRENT STATUS

- IN-HOUSE EFFORTS DEFINING CONCEPT SYSTEMS TRADES BASED ON PRELIMINARY CONCEPT
- SCIENCE AND APPLICATIONS USER REQUIREMENTS BEING DEFINED
- CONTRACTED 25 KW POWER MODULE EVOLUTION STUDY, UNDERWAY
- ESA-SPACELAB INFORMATION EXCHANGED

FEATURES

- ORBITALLY STORED
- INITIAL USE CONFIGURATION ACCOMMODATES FREE-FLYERS
- ORBITER EXTENSION MODS UTILIZED
- PROVIDES ACTIVE ATTITUDE CONTROL
- PROVIDES SUPPLEMENTARY COOLING CAPABILITY

Figure 7.

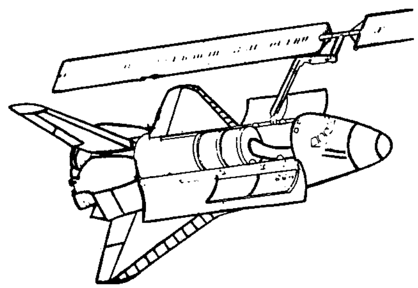
NASA HQ MT78-1838 (1)
4-27-78

OSTS FIVE YEAR PLAN

JSC - ORBITAL SERVICE MODULE

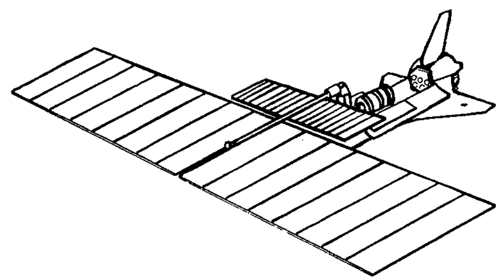
INITIAL CAPABILITY

RMS DEPLOYED ARRAY



FREE FLYING MODE

(OSM/FF PAYLOAD)



CURRENT STATUS

IN HOUSE EFFORTS FOCUSED ON USER REQUIREMENTS AND PRELIMINARY SYSTEMS ANALYSIS AND DEFINITION

CONTRACTED STUDY FOR "CLEAN SHEET" GROWTH DEFINITION

LIMITED SYSTEM AND SUBSYSTEM STUDIES

FEATURES

- PHASED INCREMENTAL BUILD-UP
- INITIAL CAPABILITY NOT ORBITALLY STORED
- EARLY AVAILABILITY
- ORBITER EXTENSION MODS UTILIZED
- FOLLOW-ON CAPABILITY PROVIDES ATTITUDE STABILIZATION
- POWER AND HEAT REJECTION BALANCED

NASA HQ MT78-1834 (1)
4-27-78

Figure 8.

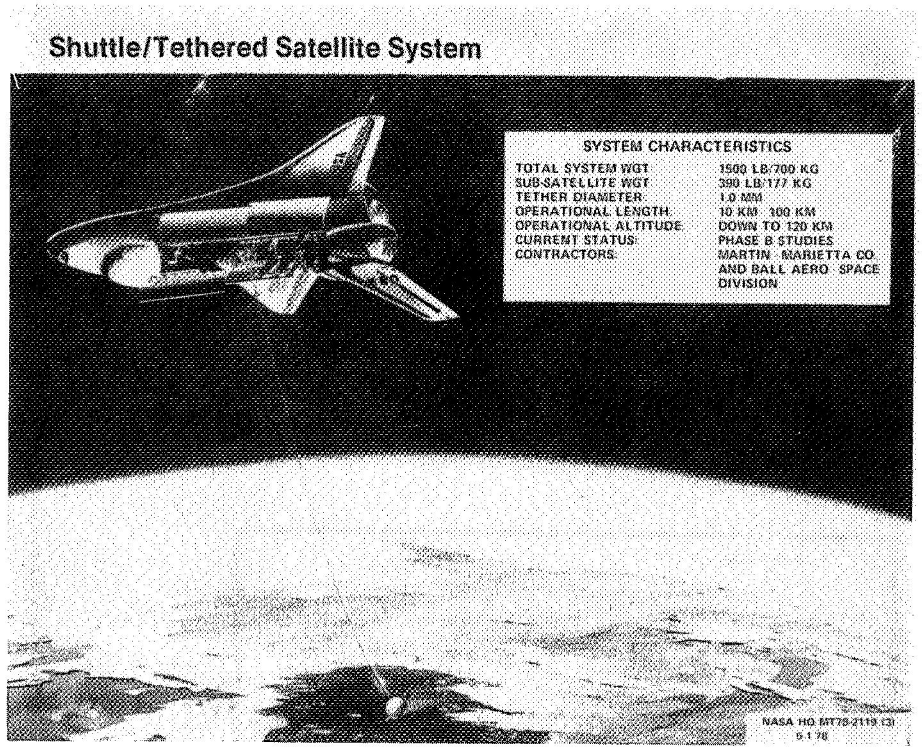


Figure 9.

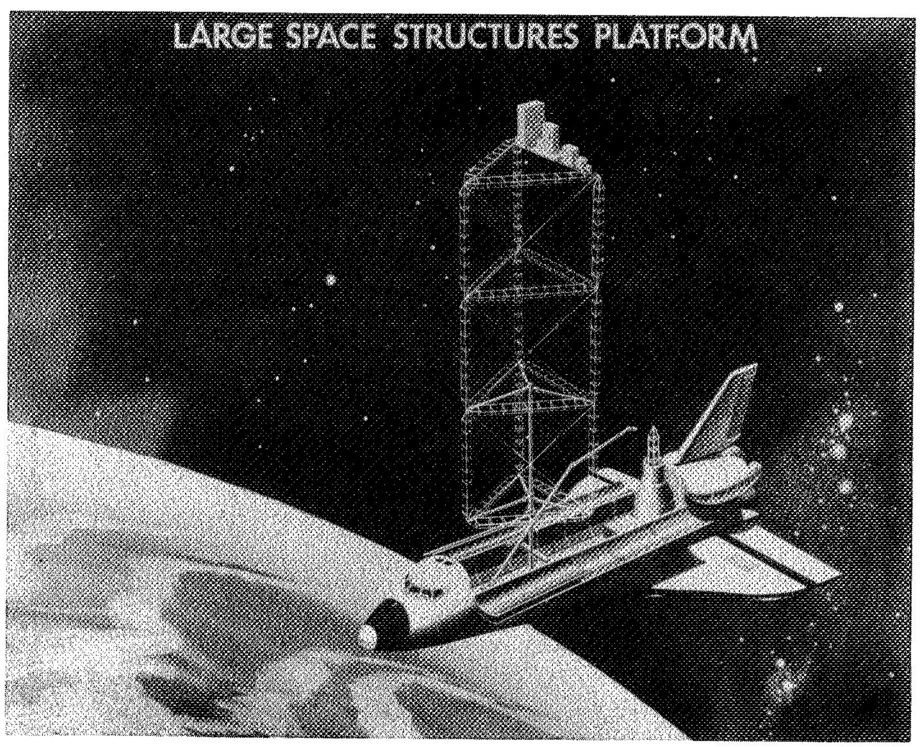


Figure 10.

SATELLITE PLACEMENT, RETRIEVAL, MAINTENANCE, AND REPAIR

OBJECTIVE

- o DETERMINE USAGE OF PLANNED CAPABILITIES
- o DEFINE SYSTEMS REQUIRED IN 1983-1985 TIME PERIOD INCLUDING OPERATIONS 800 -- 1600 KILOMETERS FROM ORBITER

CAPABILITIES TO BE EXPLOITED

- o PLANNED CAPABILITIES
  - o ORBITER
  - o REMOTE MANIPULATOR SYSTEM
  - o EXTRAVEHICULAR MOBILITY UNIT
  - o TELEOPERATOR RETRIEVAL SYSTEM
  - o MANNED MANEUVERING UNIT
- o NEW CAPABILITIES

	MISSION CASES TO BE STUDIED	
	LOW EARTH ORBIT	GEOSYNCHRONOUS EARTH ORBIT
PLACEMENT	X	
RETRIEVAL	X	
MAINTENANCE AND REPAIR	X	X

Figure 11.

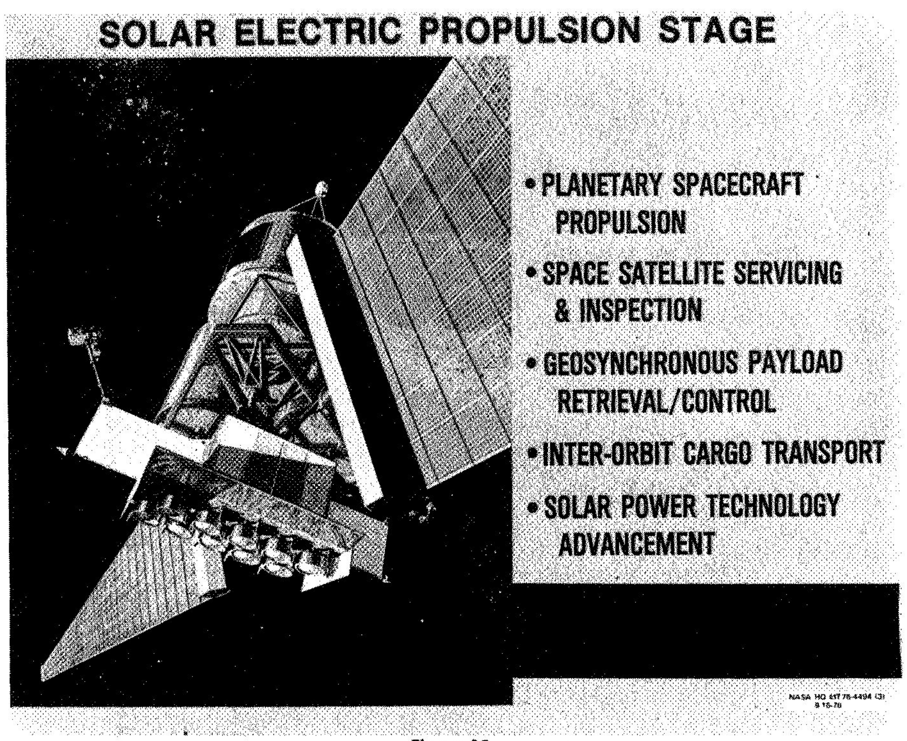


Figure 12.

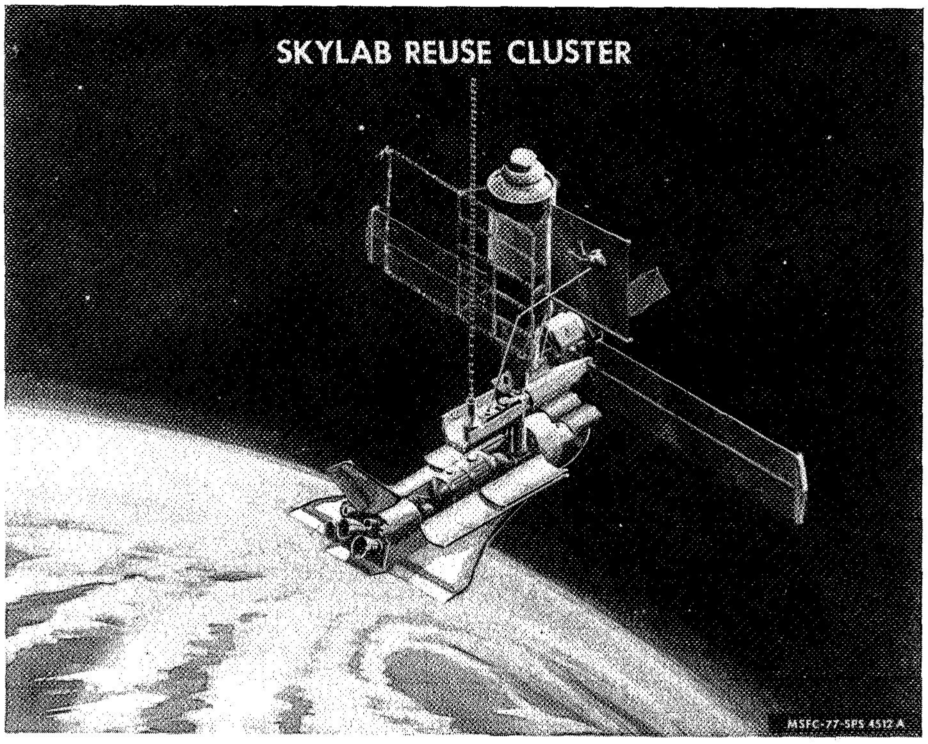


Figure 13.

MULTI-HUNDRED KW POWER REQUIREMENTS

REQUIREMENTS FOR 100's OF KW's IN ORBIT LIKELY FOR NEW SPACE OPPORTUNITIES:

- o CONSTRUCTION AND USE OF LARGE STRUCTURES SYSTEMS
- o MATERIALS/INDUSTRIAL PROCESSES
- o NEW CAPABILITIES IN COMMUNICATIONS
- o SPACE PLATFORMS FOR SCIENCE AND APPLICATIONS
- o TECHNOLOGY DEVELOPMENT FOR SOLAR POWER SATELLITES
- o ADVANCED SPACE PROPULSION

Figure 14A.

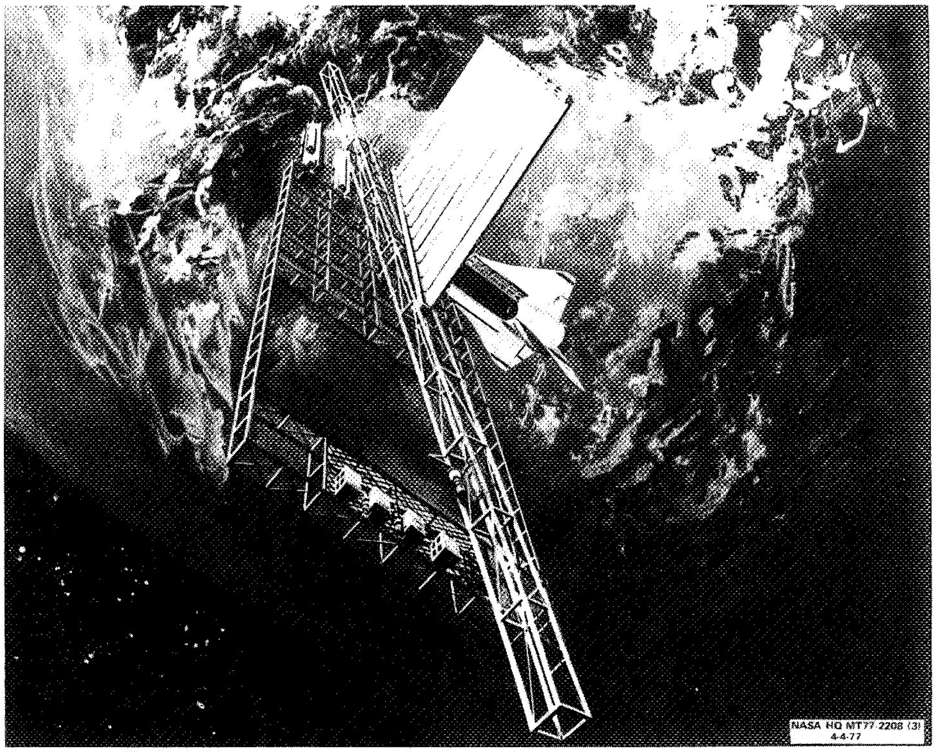


Figure 14B.

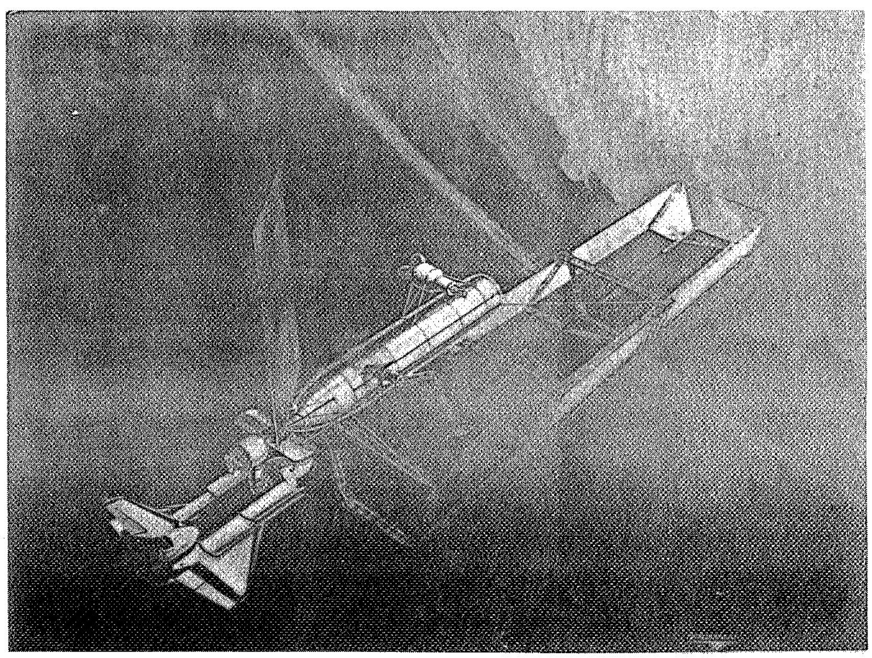


Figure 14C.

NASA MISSIONS INVOLVING LARGE SPACE SYSTEMS

	80 – 84	84 – 86	86 – 90	90 – 2000
SCIENCE	SMALL PLATFORM (MID LATITUDE) 25KW	25KW MEDIUM PLATFORM (MID LATITUDE) SMALL PLATFORM (POLAR)	SMALL GEO PLATFORM 25KW 25-250KW SPACE SCIENCE LABORATORY VLBI GRAVITY WAVE/ PINHOLE SATELLITE	SETI RECEIVING LABORATORY 25KW 250KW
GLOBAL INFORMATION	SMALL PLATFORM 25KW		CRYO TELESCOPE GLOBAL SERVICES PLATFORMS →	
COMMUNICATIONS	NARROWBAND TECHNOLOGY ANTENNA		50-100KW NARROWBAND COMMUNICATIONS SATELLITE	ODSRS
SPACE PROCESSING	25KW	UNMANNED MEM 100KW	25KW GEOSTATIONARY PLATFORM	MANNED MEM 500KW
ENERGY		LARGE POWER MODULE	100,S KW SPS TEST ARTICLE 500W-2MW	SPS 5-10GW
ENGINEERING SUPPORT	SPACE FAB. & ERECTION TEST FLIGHT 25KW	SPACE CONSTRUCTION PLATFORM 250KW		

Figure 14D.

PLANNING FOR MULTI-HUNDRED KW POWER MODULE

CURRENT ACTIVITIES: TWO SYSTEMS CONCEPTS STUDIES UNDER WAY
- JSC/MDAC - "CLEAN SHEET" MODULAR APPROACH
- MSFC/LMSC - EVOLUTION FROM 25 KW POWER MODULE

OUTPUT: USER REQUIREMENTS AND SYSTEMS CAPABILITIES
SYSTEMS CONCEPTS, SCHEDULES, COST
TECHNOLOGY DRIVERS

FY 79 AND 80: CONTINUE CONCEPTS STUDIES AND DEVELOPMENT OF USER REQUIREMENTS

FY 81: INITIATE PRELIMINARY DESIGN COMPETITION (PHASE B - 2 CONTRACTORS)

FY 82: COMPLETE PRELIMINARY DESIGN AND SELECT DEVELOPMENT CONTRACTOR

FY 84: SYSTEM DESIGN FREEZE

FY 86 - 87: FIRST FLIGHT OF MULTI-HUNDRED KW PLATFORM

Figure 14E.

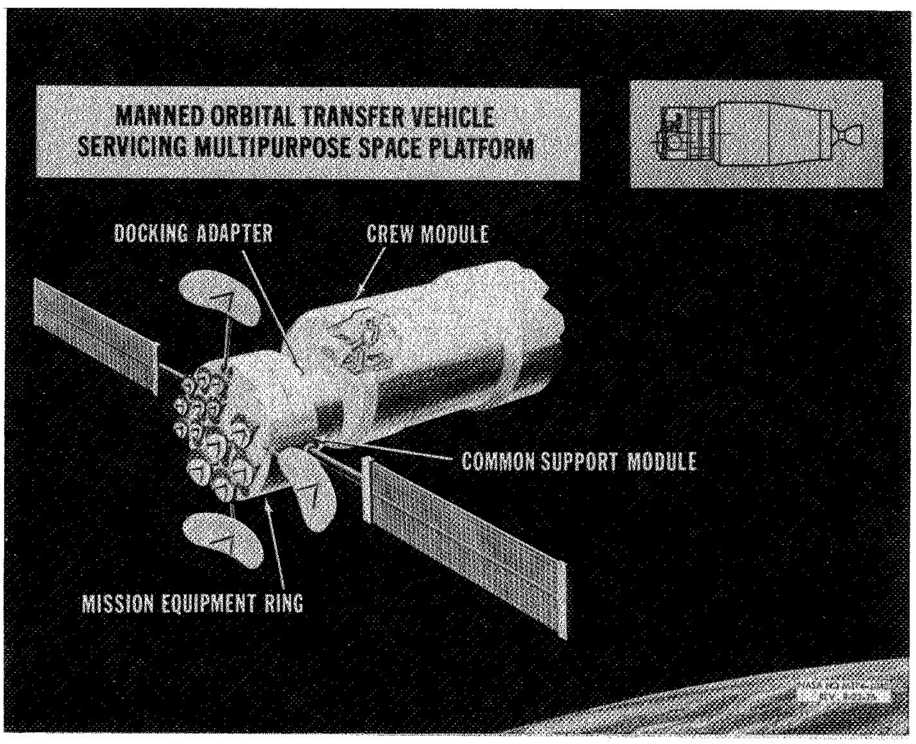


Figure 15.

MATERIALS EXPERIMENTATION MODULE

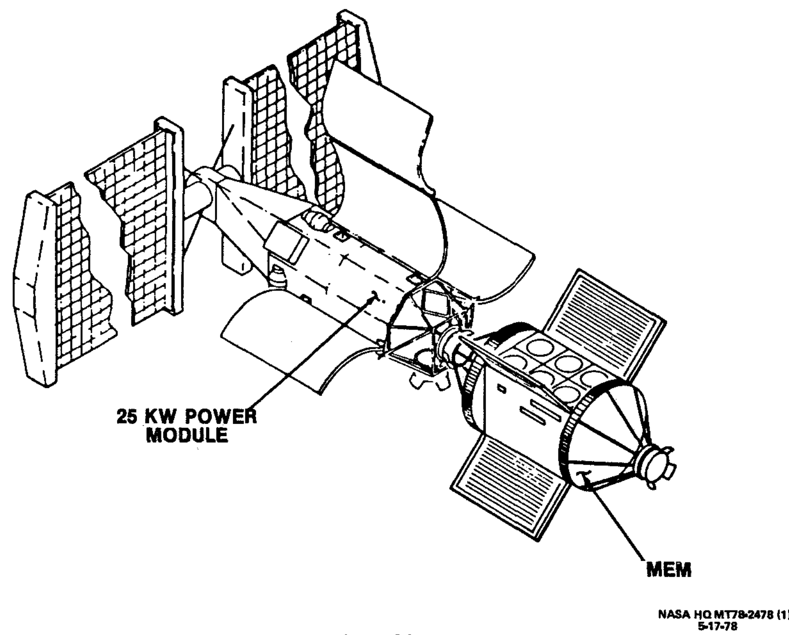


Figure 16.