ES78-MSFC-2241

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Final Report

STS PAYLOAD DATA COLLECTION AND ACCOMMODATIONS ANALYSIS STUDY

Volume II - Payload Data Collection

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ES78-MSFC-2241

STS PAYLOAD DATA COLLECTION AND ACCOMMODATIONS ANALYSIS STUDY

FINAL REPORT

VOLUME II

PAYLOAD DATA COLLECTION

AUGUST 1978

PREPARED FOR

INTEGRATED PAYLOAD AND MISSION PLANNING OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NO. NAS8-32711

PREPARED BY

SPACE SYSTEMS DEPARTMENT
ENGINEERING SERVICES DIVISION
TELEDYNE BROWN ENGINEERING
HUNTSVILLE, ALABAMA

FOREWORD

This report summarizes the results of the Space Transportation System Payload Data Collection and Accommodations study (Contract NAS8-32711) performed by Teledyne Brown Engineering Company for the MSFC Integrated Payload and Mission Planning Office from August 24, 1977 to August 25, 1978. This study consisted of two basic tasks:

Task 1 - Payload Data Collection

Task 2 - Spacelab Payload Accommodations Analysis.

This report consists of the following:

Volume I - Executive Summary

Volume II - Payload Data Collection

Volume III - Accommodations Analysis.

The results of this study can be found in greater detail in various other reports published during the term of the study. These reports are:

Task 1 - ES78-MSFC-2251, OSTA Payload Planning Data, Volumes I and II, August 1978

Task 2 - ES77-NASA-02168, Accommodations Versus Space Payload Requirements, December 1977

ES77-NASA-2168, Assessment of Launch Site Accommodations Versus Spacelab Payload Requirements, December 1977

Launch Site Processing Requirements, April 1978

Presentation to NASA JURG Spacelab Payload Accommodations Assessment from User's Viewpoint, May 1978

ES78-MSFC-2213, Spacelab Payload Planners Handbook, May 1978

Spacelab Accommodations Assessment for Earth Observations, Combined Astronomy, and Dedicated Life Sciences, August 1978

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The results of the STS Payload Data Collection study are presented in this volume. The objectives of the study and the approach toward the accomplishment of the objectives are presented. The study dealt with the development of a format for payload data collection and a process for collecting the data. It resulted in payload data volumes and a data deck to be used as input for the Marshall Interactive Planning System. The format is presented and summary matrices of the data generated are included for reference. Detailed data are published in separate volumes and are addended to this report.

APPROVAL:

C. E. Kaylor
Project Manager

1. INTRODUCTION

The objective of the Payload Data Collection Study is to develop and maintain a data base, in suitable format, for use in OSTA mission planning activities. As shown in Figure 1 data are gathered from existing documentation and through the principal contacts at the various NASA Field Centers, compiled into volumes and keypunched into computer input format for mission planning purposes.

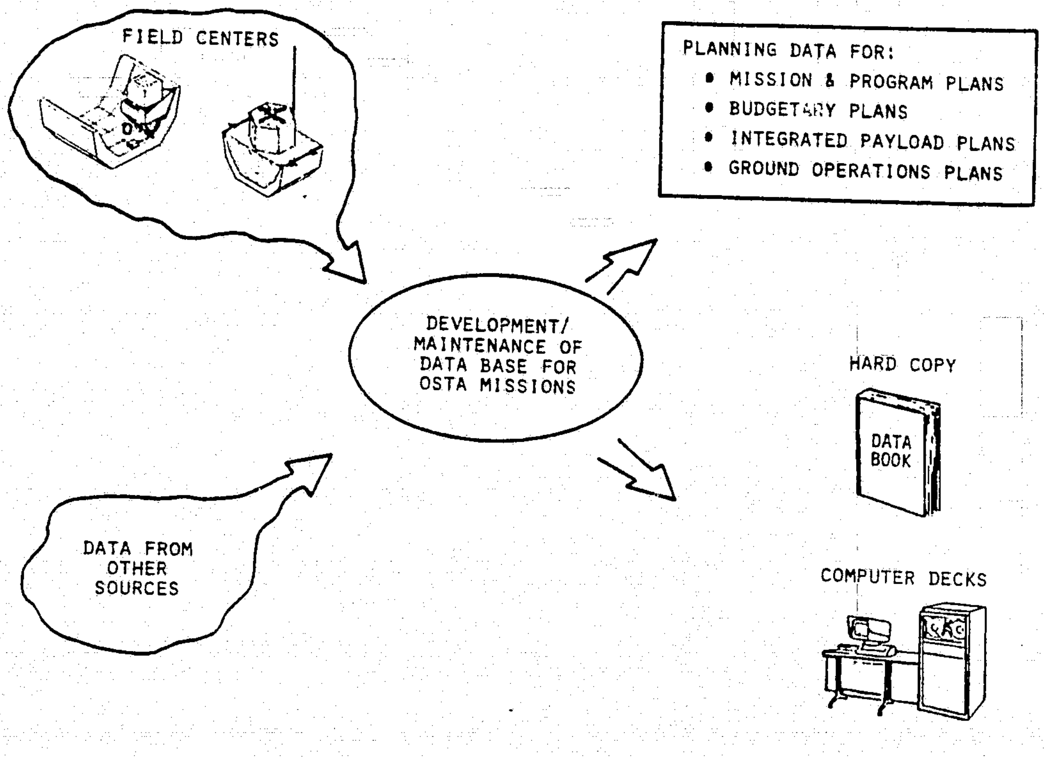

FIGURE 1. OBJECTIVES

The Space Transportation System Payload Data Collection activities of Contract NAS8-32711 began in September 1977 with the development of a format suitable for use in the study and gathering of data for support of immediate planning requirements for OSTA missions. The format development was necessary because of the cumbersome effort to generate and use the computer-entry oriented formats developed earlier. A format was needed which was simple to complete and use, but which would contain all data actually necessary for mission planning activities.

Format development was complemented by initial data collection activities which were driven by the need for quick response in support of mission planning activities at the Marshall Space Flight Center early in the contract period. This resulted in an activity timeline in which format development and preliminary data collection took place concurrently. Thus, the two aspects of this effort were supportive of each other since they offered the opportunity for involvement in the use of the format as the format was actually being developed.

Discipline inventories of investigations/instruments have been fluid and additions/deletions have changed requirements somewhat during the study. This, coupled with the fact that several investigations are in their infancy of development have made it impossible to complete the data base on some of these investigations to the depth desired. However, a broad data base has been developed and delivered which will greatly enhance future mission planning activities. Additions to the OSTA inventory was also necessary to develop a 5-year mission plan. In addition, 26 OAST experiments were brought into consideration for flight in OSTA missions. Preliminary data have been collected on all these investigations/instruments and will be incorporated into the books when all data are verified.

The data books are published with the available up-to-date data. Additional data as they become available with further development of the STS program can be readily added to this base. In addition to these data books, computer decks compatible with input requirements of the Marshall

Interactive Planning System (MIPS) at MSFC have been generated and delivered for use. These input data can also be readily updated either with added investigations or with superseding data.

The data books present the data collected for 82 investigations/instruments and are divided in two volumes. Volume I contains OSTA Payload Planning Data Summary and presents summary level information for use in program, budgetary, and preliminary mission planning. Volume II contains detailed OSTA Payload Planning Data on those investigations/instruments which were identified by OSTA for inclusion in this activity and are at a stage of development which will allow this level of collection. This volume is intended for use in detailed mission planning/definition activities. Out of these 82 investigations/instruments 72 were in the initial OSTA inventory. The remainder which were considered in the 5-year mission plan, were subsequently assigned to the data collection activity.

The procedure for accomplishing this task required the cooperative and coordinated effort of personnel in NASA Headquarters, Marshall Space Flight Center's Spacelab Payload Project Office, and Field Center Principal Investigators/Contacts as well as Teledyne Brown Engineering Company discipline specialists. The involvement of high levels of NASA management personnel early in the program was highly contributive to the success of this project.

2. FORMAT REFINEMENT

Between the time of release of the RFP for this study and authority-to-proceed serious resistance had developed to the use of the format specified in the RFP for data collection. This resistance stemmed from three levels of data required, difficulty of completion on the part of the scientific community, and readability problems for the user. These objectives outweighed the convenience of direct input of data from the computer-oriented format.

TBE study personnel were assigned the task of developing a format which would satisfy the requirements of the mission developer and yet retain the degree of simplicity required for ease of completion by the scientific community.

Numerous consultations with experienced Science and Engineering and Program Development personnel, who had for some time been engaged in the processes of mission planning, identified the needs from one point of view. Discussions with NASA Headquarters personnel who had direct contact with Field Center Principal Contacts were instrumental in developing criteria for the format from another point fo view. In addition, the concurrent acquisition of data for use in an on-going mission planning activity at MSFC gave our personnel further insight into data requirements. This combined experience led to the following criteria for format development:

- Compatibility with other requirements documents (e.g. ERD's)
- Modular construction for multiple uses
- Ease of completion and use.

2.1 FORMAT DESCRIPTION

Using the criteria discussed above, the formats shown in Figures 2, 3, and 4 were developed for both Spacelab and free-flying investigations/instruments. Only one level of data is collected, and a summary sheet for management use is generated from these data.

The formats were organized into four major sections - general information, experiment equipment description, physical characteristics

Page 1 of 2

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym ______________ Code No. ______
Orig. Date ______
Discipline ______________ Rev. Date ______
Submitted by ______________ NASA Hq Approval ______
Contact ______ Center ______ Phone ______
Contact ______ Center ______ Phone ______

Objective

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, use of Payload Specialist, etc.)

Data Sources

Development Status

Planning ☐
Definition Studies ☐
AAFE ☐
Development ☐
Existing Hardware ☐

	Time (mos.)
Modify/Upgrade Existing Hardware	______
Prepare/Refurbish Existing Hardware for Flight	______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

Page 2 of 2
Code No. ______

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight kg ______ Payload Volume cu m ______
Landed Weight kg ______ Pressurized Equipment cu m ______
Pressurized Equipment kg ______ Unpressurized Equipment cu m ______
Unpressurized Equipment kg ______ Control & Display Area sq m ______

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (m) L	W	H	Location in Orbiter

Power

Operating Power W ______ Operating Power Duration ______ hr
Peak Power W ______ Peak Power Duration ______ hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude			
Inclination, deg			

Target(s) ______

NOTES ______

Page 1 of 2

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
FREE-FLYING PAYLOAD
SUMMARY

1-GENERAL INFORMATION

Name/Acronym ______________ Code No. ______
Orig. Date ______
Discipline ______________ Rev. Date ______
Submitted by ______________ NASA Hq Approval ______
Contact ______ Center ______ Phone ______
Contact ______ Center ______ Phone ______

Objective

Description (Physical Package, On Orbit Operations, Control)

Data Sources

Delivery

Shuttle ☐ Shuttle/Upper Stage ☐ Expendable Launch Vehicle ☐

Development Status

Planning ☐
Definition Studies ☐
Development ☐
Existing Hardware ☐

	Time (mos.)
New Development	______
Modify/Upgrade Existing Hardware	______
Prepare/Refurbish Existing Hardware for Flight	______

Flight Schedule (Circle No. If Approved for Flight)

Missions / CY	79	80	81	82	83	84	85	86	87	88	89	90	91
Delivery													
Retrieval													
Service													

Page 2 of 2
Code No. ______

2-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass & Geometry

	Delivery	Service	Retrieval
Total P/L Weight at Launch (kg)			
Total P/L Landing Weight (kg)			
Satellite Weight (kg)			
P/L Length/Width/height (m)			
Satellite Length/Width/Ht. (m)			

Power

Power		To Satellite From Shuttle	From Upper Stage Attached	Detached
Standby	W			
Duration	hr			
Checkout	W			
Duration	hr			
Ascent/Descent	W			

Shuttle Orbit Characteristics

	Delivery Orbit Desired	Max.	Min.	Retrieval Orbit Desired	Max.	Min.
Altitude km						
Inclination deg						

Satellite Mission Characteristics

	Operational Orbit Desired	Max.	Min.
Altitude Apogee km			
Altitude Perigee km			
Inclination deg			
Spin at Separation (rpm)			
Longitude, W deg			

Operational Lifetime ______ mos.

Notes ______

FIGURE 2. SUMMARY FORMAT FOR SORTIE AND FREE-FLYER PAYLOADS

Page 1 of 8

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA

1-GENERAL INFORMATION

Name/Acronym ______________________ Code No. ________
Orig. Date ________
Discipline ______________________ Rev. Date ________
Submitted by ______________________ NASA Hq Approval ______
Contact ______________ Center ________ Phone ________
Contact ______________ Center ________ Phone ________

Objective

____

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

____

Data Sources

____

Development Status

Planning ☐
Definition Studies ☐
AAFE ☐
Development ☐
Existing Hardware ☐

	Time (mos.)
New Development	______
Modify/Upgrade Existing Hardware	______
Prepare/Refurbish Existing Hardware for Flight	______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

Page 2 of 3
Code No. ________

2-EXPERIMENT EQUIPMENT DESCRIPTION

Optical: Yes ☐ No ☐ Spectral Range ______
Detector Type ______ Detector Operating Temp. ______
Telescope Type ______

Camera: Visible ☐ Infrared ☐
Radiometer: Extinction ☐ Cavity ☐
Correlation ☐ Other ______
Photometer: Extinction ☐ Other ______
Interferometer: Michelson ☐
Fabry-Perot ☐
Grating ☐
Spectrometer: Filter ☐ Other ______
Grating ☐
Lidar: ☐ Type ______

Microwave: Yes ☐ No ☐ Frequency Band ______ Antenna Type ______
Radar ☐
Radiometer ☐
Imaging ☐ Type ______

Processing/Manufacturing: Yes ☐ No ☐

Material: Furnace Type ______ Temp. Range ______
Zone Refining ______
Crystal Growing: Melt ☐ Solution ☐ Vapor ☐
Alloying ☐
Purification ☐
Biological: Electrophoresis ☐
Other Type Separation ☐
Others ______
Fluid Phenomena: Flocculation ☐
Convection ☐
Migration ☐
Multiphase ☐

Additional Descriptions (Specific Instrument Characteristics): ______

____

Page 3 of 8
Code No. ________

3-PHYSICAL CHARACTERISTICS

Mass and Geometry

Total Launch Weight kg ______ Payload Volume cu m ______
Landed Weight kg ______ Pressurized Equipment cu m ______
Pressurized Equipment kg ______ Unpressurized Equipment cu m ______
Unpressurized Equipment kg ______ Control & Display Area sq m ______

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension M			Location in Orbiter

Support/Integration Equipment Required in the Orbiter (If Known)

	Qty	Description/Location	Provided by Exp	Provided by S/L	Provided by STS
Keyboard/Data Display Unit					
Computer for Data and/or Exp.					
Remote Acquisition Unit					
High Rate Digital Recorder					
Closed Circuit TV					
Cold Plates					
Thermal Blankets					
Exp. Heat Exchanger					
Single Racks					
Double Racks					
Airlock					
Pointing Subsystem					
Camera					
Remote Manipulator Arm					
Optical Window					

Page 4 of 3
Code No. ________

Power

		Pallet		Module
Standby Power	W	______	W	______
Operating Power	W	______	W	______
Operating Power Duration	Hr	______	Hr	______
Peak Power	W	______	W	______
Peak Power Duration	Hr	______	Hr	______

Environment

Temp., Min/Max (K) ______ Tolerable EMI Level (dBW/m^2) ______
Humidity, Min/Max (%) ______ Tolerable Rad. Rate (J/kg-sec) ______
Inst. Outges Rate (g/hr) ______ Tolerable Acoustics Level (dBOA) ______
Inst. Rad. EMI Level (dBW/m^2) ______ Tolerable Contamination Level (particles/m^3) ______

Potential Hazards

High Pressure ☐ Cryogenics ☐
Pyrotechnics ☐ Propellants ☐
Radiation ☐ Corrosives ☐

Other ____

Special Requirements (Integration Handling Equipment, Mounting Requirements, Specific Component Cooling, Power/Data Connector Locations)

____

Installation Constraints (Scan/Deployment Clearances, Orientation, etc.)

____

FIGURE 3. DETAILED FORMAT FOR SORTIE PAYLOADS

Page 5 of 8
Code No. ________

Sketch (Indicate Viewing Direction, Mounting Surface, Orientation in Rack, Pallet, or Cargo Bay, Approximate c.g. Location, Other Critical Constraints)

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Page 6 of 8
Code No. ________

4-OPERATIONAL REQUIREMENTS

Orbit Characteristics

	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Effect of Deviations in Orbit Characteristics on Objectives ________

Launch Window (Time of Day and/or Season) ________

Target Viewing Requirements

Orientation Requirements: Earth ☐ Solar ☐ None (Low "g") ☐ Limb ☐ Nadir ☐ Solar Occultation through Limb ☐

Other ________

Targets: CONUS ☐ All Land Masses ☐

Specific Targets ________

Constraints: Look Angle from Nadir (deg) ________

Sun Elevation Angle (deg) ________ to ________

Shadow/Sunlit Portion of Orbit: Shadow Requirements ☐ Sunlit Requirements ☐ Not Sensitive ☐

Other Viewing Requirements ________

Number of Observations: Minimum ________ Desired ________

Observation Duration Hr/Obs ________ Mission Duration Hr ________

Energy (kWh): Per Mission ________ Per Observation ________

Pointing, Stability, and Control

Pointing Accuracy, arcsec ________ Stability Rate arcsec/sec ________

Total Pointing Time, hr/msn ________ Field of View (Half Angle) ________ deg

Stability, arcsec ________ Scan Angle: x ________ deg, y ________ deg

Page 7 of 8
Code No. ________

Payload Personnel

Estimated No. of P/L Personnel ________

Total P/L Personnel Time, Man hr/msn ________

Describe How Personnel Used ________

Time per Experiment Cycle/Observation

	Avg Time (hr)	Crew Time (hr)
Setup		
Operating/Monitoring		
Shutdown		
Other		
Total		

Specific Background Required of Instrument Operator: ________

If the Operator of your Instrument has a General Discipline Competence, How Much Training Time would you Anticipate to Familiarize the Operator with your Instrument and Research? ________ hr

Primary Control of the Instrument During Orbital Operations:

Aft Flight Deck ☐ Module ☐ Real Time from POCC ☐ Other ☐.

Description ________

Data/Communications Support

Direct P/L-to-Gnd RF Comm Req'd? ☐ Real Time ________ kbps

Voice ☐ Near Real Time ________ kb/orbit (within one orbit)

TV B&W ☐ Color ☐ Other (Describe) ________

Data Acquisition

Digital Rate, (max), kbps ________

Digital Qty, Total, kb/msn ________

Analog Bandwidth, (max), Hz ________

Analog Duration, Total, hr/msn ________

TV Bandwidth, (max), Hz ________

TV Duration, hr/msn ________

Page 8 of 8
Code No. ________

Other STS Accommodations

Payload Operations Control Center (POCC)

Desired Output Form:
- Tape ☐ Strip Chart ☐
- Tabular Report ☐
- Digital TV ☐

Required Natural Environment Data:
- World Wide Metrological ☐
- Space Environment ☐

Ground Monitoring Requirements:
- Continuous? ☐ Periodic? ☐
- Real-Time? ☐

Remote Site Support ☐

Real-Time Data Processing & Display ☐

Internal & External Voice Comm ☐

Crew Conversation Tape ☐

Initiation of Command ☐

Command: Display ☐ Printout ☐

Trajectory History ☐

Experimenter provided GSE ________

Ground Operations, Environment, and Constraints (Describe Function and/or Time when Needed)

Clean Room Environment Required? Class ________

Temperature Control Required? ±K ________

Power Required? ________ Vdc ________ Vac

Humidity Control Required? % ________

Tolerable Level ________ % R.H.

Experiment Access ________

Fluids Servicing ________

Cryogenics Servicing ________

Launch/Landing Ground Support & Equipment

NOTES (IDENTIFY BY SECTION NO.)

Figure 3 - Continued

Page 1 of 7

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
FREE-FLYING PAYLOAD

1-GENERAL INFORMATION

Name/Acronym ______________________ Code No. ________
Orig. Date ________
Discipline ______________________ Rev. Date ________
Submitted by ______________________ NASA Hq Approval ________
Contact ____________ Center ________ Phone ________
Contact ____________ Center ________ Phone ________

Objective

____

____

____

Description (Physical Package, On Orbit Operations, Control)

____

____

____

____

Data Sources

____

____

Delivery

Shuttle ☐ Shuttle/Upper Stage ☐ Expendable Launch Vehicle ☐

Development Status

			Time (mos.)
Planning	☐	New Development	____
Definition Studies	☐	Modify/Upgrade Existing Hardware	____
Development	☐	Prepare/Refurbish Existing Hardware for Flight	____
Existing Hardware	☐		

Flight Schedule (Circle No. If Approved for Flight)

Missions / CY	79	80	81	82	83	84	85	86	87	88	89	90	91
Delivery													
Retrieval													
Service													

Page 2 of 7
Code No. ________

3-PHYSICAL CHARACTERISTICS

Mass

(kg)	DELIVERY	SERVICE	RETRIEVAL
Total P/L Weight at Launch			
Total PL Landing Weight			
Satellite Weight			
Instr., Experiments Wt.			
Subsystems Weight			
Propulsion			
Structure			
Attitude Control			
Guidance/Navigation			
Thermal Control			
Tracking & Command			
Electrical Power			
Upper Stage Weight			
Interstage			
Stage			
Propulsion			
Cradle			
Service/Retrieval Equip. Wt.			
P/L Positioning Platform			
Module Exchange Mechanism			
Module Magazine			

Geometry

(m)			
P/L Length/Width/Height	/ /	/ /	/ /
Satellite Length/Width/Ht.	/ /	/ /	/ /

STS Provided Support Equipment (RMS, Keyboard, Display, etc.) ________

____

____

Page 3 of 7
Code No. ________

Power

Power		To Satellite: From Shuttle	To Satellite: From Upper Stage, Attached	To Satellite: From Upper Stage, Detached	To Upper Stage from Orbiter
Standby	W				
Duration	hr				
Checkout	W				
Duration	hr				
Ascent-Descent	W				

Satellite Solar Array: Area m^2 ________ Primary Power Level at Mission Start W ________

Shuttle Environment

Temp., Min./Max. (K) ________
Humidity, Min./Max. (%) ________
Tolerable EMI Level (dBw/m^2) ________
Tolerable Rad. Rate (J/kg-sec) ________
Tolerable Acoustics Level (dBOA) ________
Tolerable Contamination Level (particles/m^3) ________

Potential Hazards

High Pressure ☐ Cryogenics ☐
Pyrotechnics ☐ Propellants ☐
Radiation ☐ Corrosives ☐

Other ____

____

____

Special Requirements (Integration Handling Equipment, Mounting Requirements, Specific Component Cooling, Installation Constraints, etc.)

____

____

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Page 4 of 7
Code No. ________

Sketch to Include: Dimension, Shuttle Attachment/Stage Interface, Orientation in Cargo Bay, and c.g. Location

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FIGURE 4. DETAILED FORMAT FOR FREE-FLYER PAYLOADS

4-OPERATIONAL REQUIREMENTS

Shuttle Orbit Characteristics

	Delivery Orbit			Retrieval Orbit		
	Desired	Max.	Min.	Desired	Max.	Min.
Altitude km						
Inclination deg						

Satellite Mission Characteristics

	Operational Orbit		
	Desired	Max.	Min.
Altitude Apogee km			
Altitude Perigee km			
Inclination deg			
Spin at Separation (rpm)			
Longitude, W deg			

Operational Lifetime ______ mos.

Viewing Program ________________________________

____

____

Launch Window (Time of Day and/or Season) ________________

____

Satellite Activation and Checkout: Attached to Orbiter

Activation and Checkout Time ______ hr
Deactivation and Checkout Time ______ hr
Electrical Energy ______ kWh

Describe Activation and Checkout Activity ________________

____

____

Satellite Data/Communications Support

	Shuttle Onlink	Shuttle Uplink	Upper Stage Onlink	Upper Stage Uplink	Operational Satellite Onlink	Operational Satellite Uplink
Direct P/L-to-Gnd RF Comm Req'd?	☐	☐	☐	☐		
TV B&W	☐	☐				
TV Duration, hr	____	____				
Digital Rate, (max.), kbps	____	____				
Duration, (max.), hr	____	____				
Digital Qty, Total, kb	____	____	____	____		
Real-Time kbps	____	____	____	____	____	____
Analog Bandwidth, (max.), Hz	____	____	____	____	____	____
Analog Duration, Total, hr	____	____	____	____	____	____
Storage Quantity kb/day	____	____				
Storage Rate kbps	____	____				

Data/Communications Support (Concluded)

Special Requirements (Explain) ________________

____

____

Payload Personnel	P/L Specialist	Mission Specialist
Estimated No. of Personnel	______	______
Personnel Time, Man hr/msn	______	______

EVA

No. of Planned EVA per Msn ______ EVA Duration ______
Purpose of EVA ________________________________

Payload Operations Control Center (POCC)

POCC Location ______

Desired Output Form
- Tape ☐
- Strip Chart ☐
- Tabular Report ☐
- Digital TV ☐

Remote Site Support ☐

Command
- Initiation ☐
- Display ☐
- Printout ☐

Real-Time Data Processing and Display ☐

Ground Operations, Environment, and Contraints (Describe Function and/or Time when Needed)

Clean Room Environment Required? Class ______
Temperature Control Required? ±K ______
Power Required? Vdc ______
Vac ______
Humidity Control Required? % ______
Tolerable Level ± R.H. ______
Experiment Access Hr Before Launch ______
Fluids Servicing ______
Cryogenics Servicing ______

Other Launch/Landing Ground Support Equipment

____

____

____

____

NOTES (IDENTIFY BY SECTION NO.)

____

____

____

Figure 4 - Continued

of the equipment/facility, and operational requirements. The section on experiment equipment description is deleted from the free-flying payload format simply because mission planning does not require this information. Moreover, science information on most shuttle experiments that are carried by free-flyer for long-term use can be obtained from shuttle payload data sheets. The items that are included in the detailed formats are:

1. General Information

Name/Acronym - Complete name of the Investigation/Instrument/Facility and the acronym by which it will be known.

Code Number - Assigned code number of the I/I/F. Blank if form is being used as a fact sheet.

Originating Date - The date of first use of the form for data submittal on a particular I/I/F.

Revision Date - If form is used for an I/I/F after original submission to update data or for another application.

Discipline - Discipline of planned use of the I/I/F or multiple disciplines when used in a fact sheet.

Submitted By - Name of responsible organization which is submitting the data sheets for planning use.

Contact - Name of individual responsible to NASA for development, scheduling, and use of the I/I/F.

Objective - Concise statement of the science/applications objective of the I/I/F in its planned use.

Description - Brief description of the I/I/F, the activities and operations to be performed, its components, and how it is operated and controlled.

Data Sources - Sources of information used in completing the data sheets.

Development Status - Current status of the development of the I/I/F.

Time (mos.) - Lead time necessary from approval-to-proceed till flight readiness can be attained, or time from submittal of form till flight readiness if I/I/F is currently in an approved development program.

Flight Schedule - Number of planned flights for each year. If approved circle number. If one flight is approved and another planned for the same year use two number 1's and circle one, e.g., (81 / (1) / 1).

2. Experiment Equipment Description

Type of equipment by major classification. If I/I/F cannot be fully defined by use of these descriptions, then additional data in space provided. This section not included for free-flyer format.

3. Physical Characteristics

Mass and Geometry

Total Launch Weight - I/I/F plus all flight support equipment mass charged to the experiment and consumables.

Landed Weight - Items mentioned above except consumables or jettisoned equipment or retrieval equipment for free-flyers.

Pressurized/Unpressurized Equipment - This item separates the equipment which is carried in the Spacelab from that located in the cargo bay.

Payload Volume - This item not included in free-flyer refers to the volume in the stowed mode. However, if the equipment on the pallet requires space (e.g., for transversing scan arc) which it does not occupy in the stowed mode, but which is restricted from use by other equipment, then this space in the total volume.

Control and Display Area - Minimum area of control panel necessary for carrying out experimental control and monitoring of I/I/F.

Major Mission Equipment

Identifies each piece of major equipment - subsystem, upper-stage for free-flyer - by name or function and indicates quantity of each, weight, dimensions, and location.

Support/Integration Equipment

Identifies items of support required for the proposed I/I/F including experiment furnished. Common available items are tabulated. Blank spaces identify required items of equipment, other than the standard items listed.

Power - The levels of power required and approximate durations for standby, operating and peak performances.

Environment - Temperature and humidity limits for the external environment, EMI tolerance level, radiated energy, acoustic energy and particulate contamination from its external environment. I/I/F emission levels of EMI and radiant energy for use in assessing impact on other equipment in the proximity.

Potential Hazards - A list of hazardous conditions that exist in the I/I/F.

Special Requirements - Specialized equipment or procedures necessary for handling or mounting the I/I/F. Also indicates any special requirements for component cooling/heating or restrictions for locations of power and data connectors.

Installation Constraints - Indicates clearances required in the proximity, the physical location of I/I/F for deployment of antennas, scanning of optical systems, etc.

Sketch - Sketch of the major components of the I/I/F giving approximate dimensions and orientation in the x, y, and z directions in the rack, pallet, or cargo bay including approximate center of gravity location when in the launch/landing mode.

4. Operational Requirements

Orbit Characteristics - Indicates desired and max. min. altitude and inclination including free-flyer mission.

Target and Viewing Requirements - Indicates the target of the I/I/F, orientation, angles, elevations, sunshine, etc., required for measurements. Number of observations for experiment and the minimum below which results would be meaningless or incomplete. Also indicates the duration of each observation and the mission duration required to complete the experiment objective.

Pointing, Stability, and Control - Indicates the pointing and stability accuracy required in order that the experiment can be successfully carried out in shuttle mission.

Primary Control - Location from which the shuttle I/I/F will be controlled.

Payload Personnel - Number of payload/mission specialists necessary to operate the I/I/F under peak working conditions.

Time per Experiment Cycle/Operation - Indicates average experiment time and corresponding crew time.

Data/Communications Support - Indicates operational mode of communication between orbiter and ground necessary to direct the activities of the experiment or satellite. Also indicates if data required are in real-time or near real-time, if both then how much each.

Data Acquisition - Indicates the maximum rates and total data necessary to accomplish the goals of the experiment.

Other STS Accommodations - Any other accommodations, than those specified, are required for the experiment.

Payload Operations Control Center - Indicates by the approximate box the data, command, communications, display monitoring, and remote site requirements.

Ground Operations Environments and Constraints - Indicates the functions required for the experiment during ground operations, including integration, test and checkout, and the times or points in the flow at the launch site at which these functions are needed.

Launch/Landing GSE - Delineates any special requirements the I/I/F will have for handling at the launch/landing site.

Summary data sheets for both Spacelab and free-flying payloads, which are suitable for top-level mission planning, were also formulated, These formats are also used for investigations which are not yet well defined and for which data required by the detailed format are consequently not available. The general information for these summary forms is the same as for the detailed form. Pertinent information on physical and operational characteristics necessary for top-level mission planning and executive use are extracted from the detailed sheets for inclusion on the summary sheets.

2.2 FORMAT USE

Experience in the study is extensive enough to draw definite conclusions concerning the utility and acceptability of the format. Data have been collected on approximately 100 investigations/instruments. Two five-year mission plans have been developed during the course of the study using data collected on the formats. This experience has shown that:

- The format is in sufficient detail for mission planning use.
- The data are organized conveniently for mission planning.
- The collection process is convenient for responsible Field Center personnel.
- Summary sheets serve well for overview purposes.

In using the format some items have been found to be superfluous (e.g., EVA requirements). One item of data originally omitted because it could be derived from format data, i.e., total energy, was found to be desirable on the part of the user. These and other minor modifications have been made in the formal data books. Further study of the format should be made in order to enhance its usefulness and acceptability.

3. DATA COLLECTION PROCESS

The process for the Data Collection activity is shown in Figure 5. The process began with the establishment by NASA Headquarters of the active inventory of investigations/instruments for consideration in mission planning activities. Headquarters, in turn named a responsible individual, at one of the various NASA Field Centers, for each investigation/instrument.

MSFC personnel established the requirements for data necessary for their mission planning activities. Teledyne Brown Engineering in contact with NASA Headquarters and MSFC personnel developed a format for use in the activity.

The steps in the data collection cycle are listed in Table I. An important consideration in the data collection effort was to elicit the cooperation of the principal contacts in working with TBE. In this regard a procedure was developed whereby initial contact with the principal contacts was to be made by the appropriate NASA offices. Specifically, for the OSTA payloads the Office of Space and Terrestrial Applications sent a letter to the principal contacts announcing the data collection effort, introducing TBE, and explaining TBE's role in the effort. This letter from OSTA was followed up by a phone call from the Spacelab Payload Project Office (SPPO) at MSFC reiterating the points of the letter and alerting the contacts to expect the arrival of the data format. The data format which was sent out by SPPO was accompanied by a cover letter in which the particular TBE specialist assigned to the payload was introduced. Also, since an important consideration in this data collection effort was to minimize the impact on the activities of the principal contact, the principal contact was presented with the option of working with TBE in one of three modes: (1) to fill out the format himself; (2) to have TBE fill out the format based on resource materials provided to TBE by the contact; or (3) to provide the information via telephone conversations and/or a personal visit to the contact's facility.

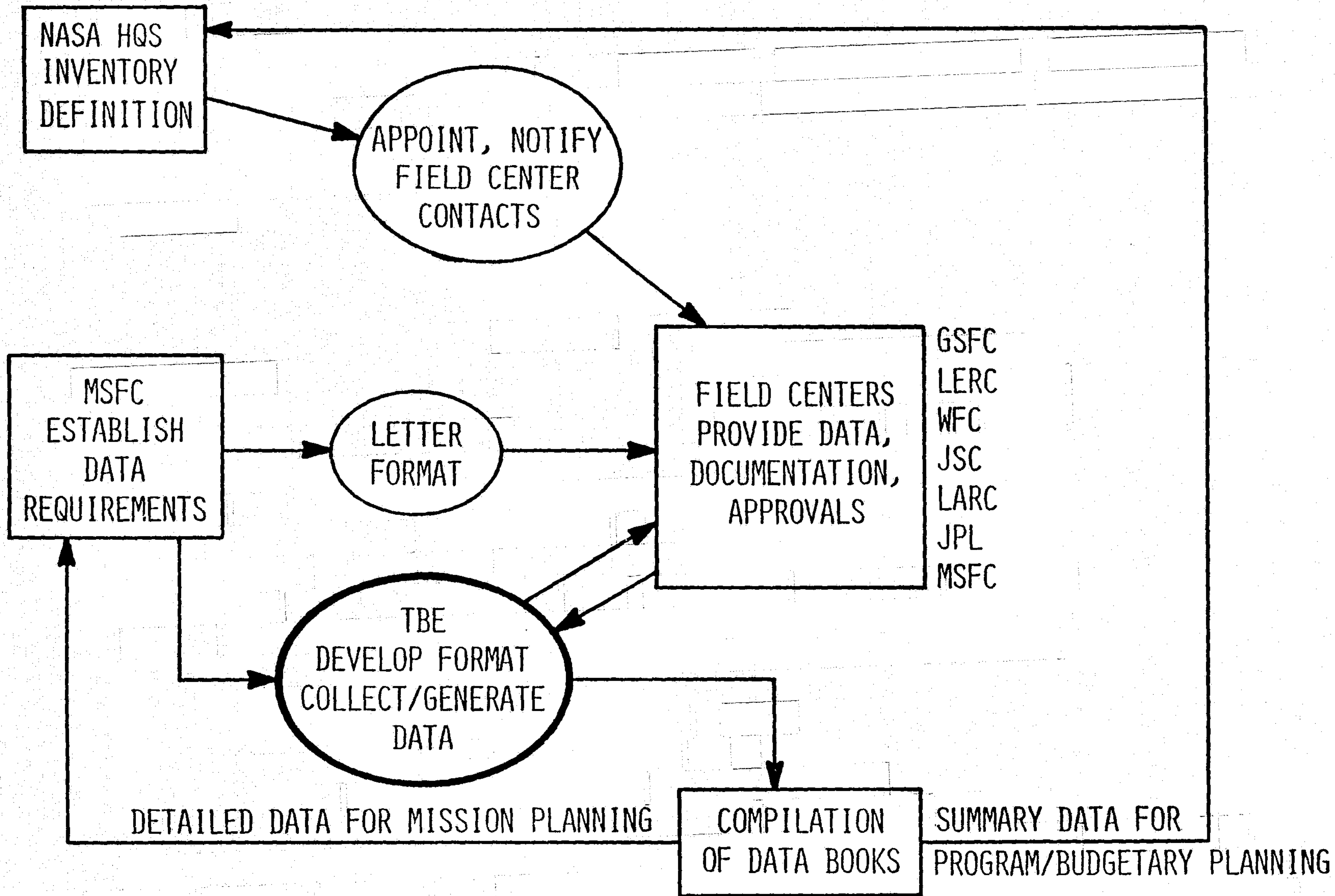

FIGURE 5. DATA COLLECTION PROCESS

TABLE I. DATA COLLECTION CYCLE

	Action	Organization
1.	Introductory letter	NASA HQ
2.	Initial phone contact	MSFC SPPO
3.	Send data forms	MSFC SPPO
4.	Check on receipt and form clarification	TBE
5.	Receive forms from contact	TBE
6.	Review forms and identify other data needs	TBE
7.	Follow up on missing data	TBE
8.	Contact review of data	TBE
9.	Receipt of updates	TBE
10.	Complete data form	TBE
11.	Identify outstanding items	TBE
12.	Update form data as required	TBE

Approximately two weeks after the formats were mailed out a follow-up call was made by a TBE specialist which represented the first contact by the specialist with the principal contact. During the course of the conversation the specialist introduced himself, inquired about the arrival of the data format, answered any questions the contact might have had regarding the format, and emphasized the options open to the contact regarding completion of the format. Most contacts subsequently responded by completing the format themselves or by providing resource materials. Personal visits were arranged to establish a better working relationship and obtain additional data which the principal contact had not provided, or where clarification of existing data was required. Consequently, most OSTA contacts were visited during the data collection effort.

After initial completion of the format via one of the three options the emphasis of the effort then shifted to data refinement. Additional data needs were identified and the missing data was acquired where available. The data formats were then sent back to the principal contacts for examination, updating, and approval. After the approved forms were returned by the contacts those essential data items which were still missing were estimated by the specialist to complete the format to the extent possible. Items not subject to estimation were identified as outstanding.

The OAST data collection effort was initiated at a somewhat later date than the OSTA effort. Since it was necessary to compile a preliminary summary data base quickly, the initial steps in the OAST data collection cycle differed from those of the OSTA cycle. Further efforts in collecting OAST data will follow the procedure outlined above.

4. MISSION PLANNING ACTIVITIES

In the course of the development and maintenance of the OSTA data base, support was also rendered to two mission planning activities through data compilation during the contract period. This activity, although on a very tight schedule, greatly contributed to our insight into data requirements as well as to MSFC's mission planning activities.

4.1 FLIGHT REQUIREMENTS MODEL (1980-83)

A summary data book on 28 investigations/instruments in the OA flight requirements listing was generated for MSFC in connection with Flight Requirements Model Development. This was achieved concurrently with the format development activity. The format used for this book is a 2-page predecessor of the 2-page summary format currently being used. The collected data included:

- Investigation objective
- Instrument description
- Flight schedule
- Mass and volume
- Power
- Orbit
- Target

The data and information were obtained through research into the available documents in the form of NASA reports, experiment requirement documents, fact sheets, industry documents, proposals, etc., and telecons with investigators.

A summary matrix of objective/description and requirements of each investigation/instrument was generated for "easy reference." This is presented in Appendix A.

4.2 PAYLOAD MODEL (1980-85)

Activities for the development of the 1980-85 Payload Model at MSFC required data for the 61 investigations/instruments considered for OSTA missions. Included in this requirement were 16 OSTA and 26 OAST investigations/instruments which were not, at that time, included in the active inventory for data collection. The experience gained during the routine data collection activities was instrumental in enabling TBE to satisfactorily respond to this data requirement on a quick turn-around basis. In addition to providing summary data sheets on these payloads, TBE specialists provided consultation to MSFC Program Development personnel to expand on and clarify the data on all investigations/instruments considered in the mission planning exercise.

A summary matrix of significant parameters on each investigation/instrument in the payload model which will facilitate "quick-look" in the mission planning exercise also resulted from this activity. This summary is presented in Appendix B.

5. RESULTS

The results of the data collection process are contained in several separate documents. The chief outputs, of course, are the detailed data book on all investigations/instruments for which this level of data is available, and the book of summary sheets on these investigations/instruments plus those in the active inventory for which data are more limited. Preliminary copies of the OSTA detailed data book and summary level book to be used as working copies were delivered in June 1978. Formal publications of these two books are addended to this final report.

In addition a working copy summary level format book for the OAST investigations/instruments which were considered for flight in the latest OSTA mission plan was delivered. Formal publication of this book and additions to the OSTA book of the additional requirements cited in the introduction will be accomplished at a later date. A summary of the inventories for which data were collected is presented in Table II.

The status of the overall collection process including late additions is presented in the Status Summary in Table III. It can be seen that the official submittals column is behind the anticipated schedule for the original inventory. The data books are being published formally without approval of principal contacts when necessary.

5.1 DATA VOLUMES

The data volumes include detailed data, for payloads for which data are available, in Volume II and summary sheets for all active inventory investigations/instruments in Volume I.

A quick reference summary of these data was prepared and is included in matrix form in Appendix C. A series of parameter bar charts useful for pointing out major drivers and for compatibility analyses of investigations/instruments for mission planning studies are presented in Appendix D.

TABLE II. INVENTORY SUMMARY

OSTA DISCIPLINE	NUMBER OF PAYLOADS INVESTIGATIONS/INSTRUMENTS/ FACILITIES	FREE FLYING
RESOURCES OBSERVATIONS		
EARTH RESOURCES	11	4
EARTH DYNAMICS	4	3
ENVIRONMENTAL OBSERVATIONS		
WEATHER AND CLIMATE	12	5
ENVIRONMENTAL QUALITY	15	1
OCEAN CONDITION	2	2
MATERIALS PROCESSING	18	-
SPACE COMMUNICATIONS	5	3
OSTA TOTALS	67	18
OAST PAYLOADS	24	2
TOTALS	91	20

TABLE III. STATUS SUMMARY

OSTA SHUTTLE PAYLOADS \ ACTION		DATA FORMS SENT TO PRINCIPAL CONTACT BY MSFC	INITIAL TBE PHONE CONTACT	TBE PERSONAL CONTACT WITH PRINCIPAL CONTACTS	RECEIPT BY TBE OF FILLED IN FORMATS	DATA SENT TO PRINCIPAL CONTACT FOR REVIEW AND SUBMITTAL	DATA SUBMITTED BY PRINCIPAL CONTACT	INCLUSION OF FORMAT IN DATA PACKAGE
RESOURCES OBSERVATIONS								
EARTH RESOURCES	(15)	15	15	15	15	15	9	15
EARTH DYNAMICS	(7)	7	7	4	5	6	6	6
ENVIRONMENTAL OBSERVATIONS								
WEATHER AND CLIMATE	(17)	17	17	13	10	15	10	15
ENVIRONMENTAL QUALITY	(16)	16	16	16	16	16	12	16
OCEAN CONDITION	(4)	4	4	4	2	2	2	2
MATERIALS PROCESSING	(18)	18	18	17	1	10	3	10
SPACE COMMUNICATIONS	(8)	8	8	8	1	8	5	8
OSTA PAYLOADS	(85)	85	85	77	50	72	47	72
OAST PAYLOADS	(26)	0	26	5	0	23	0	26
TOTAL	(111)	85	111	82	50	95	47	98

These two volumes - Volume I, "OSTA Payload Planning Data Summary" and Volume II, "OSTA Payload Planning Data" - are addended to this report.

5.2 COMPUTER DECKS

In addition to the books and data matrices mentioned above, all format data have been entered into a computer bank for input into NASA/MSFC mission planning program.

The data for 82 OSTA payloads for which data are available were keypunched in a format suitable for entry into the MIPS data base. These data were entered into the MIPS data base and the cards are also delivered as backup data.

The MIPS data duplicate the printed data exactly except for the following constraints:

1. Any data item is either always numeric or always alphanumeric. The only exception to this occurs because MIPS initializes storage to (TBD). Therefore any item for which no data were entered will contain (TBD). In a few cases for which a narrative explanation was used in a numeric data item, the narrative was placed with the notes.

2. MIPS is limited to a maximum of 20 cards per data item. In two cases this required changes in the notes section.

3. Cross references between data items and notes are contained in four additional data items rather than in the notes themselves.

4. An additional data item is used for a list of data items that were estimated by TBE.

5. An additional data item is used for the cognizant NASA center abbreviation.

6. Alphanumeric data items are entered in multiples of 54 characters, so formated that displays of 54 characters per line are easily readable.

The MIPS data base can be updated by entering new data which will overwrite old data. This method was used to enter changes to the data. Therefore the order of cards in the card deck is significant if the data are reloaded. A list of the card deck (approximately 10,000 cards) is delivered with the deck.

Suggested page formats for computer display of the data in a form similar to the printed data were also delivered. These are suitable for a 58 line per page 121 character per line, and incorporate the constraints listed above.

APPENDIX A. PAYLOAD DESCRIPTIONS

SUMMARY DATA ON INVESTIGATIONS/INSTRUMENTS IN THE 1980-83 OSTA FLIGHT REQUIREMENTS MODEL

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Adaptive Multibeam Phased Array	CN-16-S	AMPA	Demonstrate the possibility of low power point-to-point communications. Active/passive microwave system operating on 1.5 GHz and 1.6 GHz frequencies.
Large Deployable Antenna Shuttle Experiment	CN-07-S	LDASE	Demonstrate technical feasibility of large deployable mesh antennas and measure antenna performance by making mechanical RF measurements in space under actual operating conditions.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Shuttle Geodynamics Ranging System	ED-15-S	SGRS	Measurement of 1 to 5 centimeter level earth crustal motions, and phenomena of dilatancy and plate motion which will help understand solid earth dynamics and earthquake events. SGRS is a frequency doubled Nd:YAG system that will generate signal pulses. Photoemissive detectors will monitor transmission and reception. High speed digital and analog electronics will measure time-of-flight. Retroreflector targets will be viewed.
Shuttle/Tethered Satellite (Operational)	ED-13-S	TETHER	Applications involving deployment of science payload, requiring low altitude performing magnetic mapping, and plasma physics. Also to deploy science payload away from the orbiter to avoid orbiter induced environment including contamination and EMI. It is a tether system with closed loop controls capable of supporting a payload module suspended from the shuttle bay.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Large Format Camera	ER-02-S	LFC	It is a film camera system which operates in the visible and near-IR portion of the spectrum and will provide precision, wide area, high resolution, steroscopic and cartographic/imagery of the earth's land masses, coastal shoals, and shallows. Its primary objective is remote sensing of the land resources.
Shuttle Imaging Radar-A	ER-14-S	SIR-A	Evaluate the applicability of spaceborne imaging radars for geological mapping, mineral and petroleum exploration, and fault mapping. A synthetic aperture imaging radar that operates at 1275 MHz.
Shuttle Multispectral Infrared Radiometer	ER-12-S	SMIRR	To obtain 10-channel radiometric data from a significant sample of geological units world-wide in the spectral region of 0.5 to 2.4 μm to determine (a) spectral bands for geological mapping use, (b) correlation between radiance measured from orbit and reflectance obtained through field instruments, (c) value of the spectral bands chosen in the separation of lithologic units (d) effect of variable atmospheric absorption on the radiance value.
Ocean Color Experiment	ER-13-S	OCE	Mapping of open ocean phytoplankton on a global basis to evaluate the ecology of marine algae. This mapping will be done with a 8-channel scanning radiometer which will receive reflected solar radiation from a 12.7 cm Dall-Kirkham telescope scanning a 90° field.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTION/PURPOSE/DESCRIPTION
Shuttle Imaging Radar-B	ER-15-S	SRI-B	Understanding the radar signature of geological surfaces, measurement of soil moisture, and identify crops on a global basis. Thereby develop the basis for application of spaceborne radar imagers for earth resources study. SIR-B consists of a single frequency, dual polarization, L-band synthetic aperture radar, control/display, on-board processor, and support equipment.
Passive Microwave	ER-16-S	PASS MICRO	Study development and evolution of storm systems, map ice boundaries in lakes and oceans, determine sea surface temperature, determine soil moisture, investigate possibility of measuring subsurface features. Reflector antenna, 10 radiometers. Rotating shaft data encoder, data processing unit, data recorder.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Composite Stratospheric Test on Spacelab	EQ-19-S	COMP STRAT	Measure stratospheric profile of O_3, NO_2, N_2O_4, HNO_3, halogens, and aerosols. Compare data from instruments with common view angle but different spectral range. The payload consists of HALOE, SER, LIMS, ATMOS, LACATE, SOSU, MFR, HIRS.
Atmospheric Trace Molecules	EQ-01-S	ATMOS	To determine concentration profile of known and newly discovered molecular species through stratospheric altitudes (20-80 km) at a vertical resolution of 2 km, by viewing sun through stratosphere. The instrument consists of three parts (a) the optical sensor mounted in Spacelab airlock, (b) the electronics mounted in the standard rack, and (c) gas bottle inside module.
Halogen Occultation Experiment	EQ-02-S	HALOE	To measure stratospheric profiles of Halogens. Equipment used will be an Extinction Radiometer which will work in 8 spectral bands in the range 2 to 11 μm.
Solar Extinction Radiometer	EQ-10-S	SER	Measure stratospheric profiles of ozone and aerosols. This is an extinction radiometer working in 6 bands between 0.38 and 1.0 μm and will view sun at horizon.
Advanced Limb Infrared Monitoring of Stratosphere	EQ-03-S	LIMS	Measure stratospheric profile of constituent species and aerosol using a scanning spectral radiometer working in 6 bands between 6.1 and 17.5 μm. The instrument will view earth's limb.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Standard Ozone Sounding Unit	EQ-06-S	SOSU	Measure solar irradiance in 12 spectral bands between 160 and 400 μm to map vertical and spatial ozone distribution. Equipment will be a spectral radiometer working in the ultraviolet region of the spectrum.
Composite Tropospheric	EQ-24-S	COMP TROP	Measure the temperature and humidity profile of troposphere. Also to measure the atmospheric, CO, CO_2, CH_4, SO_2, N_2O, NH_3, and O_3. The payload consists of CIMATS, VTPR, THIR, and MAPS.
Correlation Interferometric Measurement of Atmospheric Trace Species	EQ-14-S	CIMATS	Provide measurements of vertical burden of the atmospheric species CO, CH_4, SO_2, N_2O, NH_3, etc., in the spectral ranges of 2 to 3 μm and 4 to 9 μm.
Measurement of Air Pollution	EQ-23-S	MAPS	Determine the global distribution of tropospheric CO as a function of latitude, longitude, and season, and to observe the extent of interhemispheric air mass transport in the troposphere. MAPS is a gas filter correlation infrared radiometer analyzer, which looks at the earth to collect the energy emitted.
Temperature Humidity Infrared Radiometer	EQ-25-S	THIR	Measure cloud cover and temperatures of the cloud tops, land, and ocean surfaces. Also measure moisture content of the upper troposphere and stratosphere, and location of jet streams and frontal systems.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Temperature Humidity Infrared Radiometer	EQ-25-S	THIR	It is a two-channel scanning radiometer designed to measure earth radiation. The two channels are 6.7 and 11.5 μm. THIR consists of an optical sensor and an electronics module.
Vertical Temperature Profile Radiometer	EQ-26-S	VTPR	To measure the vertical profile of the atmospheric temperature and humidity and distribution of CO_2 using a radiometer.
Shuttle Atmospheric Lidar	EQ-28-S	SAL	To measure vertical, horizontal, and temporal extent of aerosols and cirrus clouds by elastic backscattering technique. Consists of Nd-YAG, dye or CO_2 laser transmitting and receiving system which will use nadir-viewing and limb-scanning for data collection. Includes 1.0 meter class telescope and control electronics.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Space Processing Application - Module	SP-36-S	SPA-M	Research on bio-separation by electrophoresis and effect of low gravity. Static and continuous flow electrophoresis units, centrifuge, UV detector, fraction collection unit, supply and storage tanks. Fluid phenomena system, "shadow box."
Space Processing Application - Pallet	SP-37-S	SPA-P	Research on materials processing involving crystal growth, metallurgy, glass forming, alloy forming, liquid phase sintering, etc. Equipment used will include gradient and isothermal furnaces, a crystal growing facility, an acoustic levitator, and a splat cooling device.
Materials Experiments Assembly	SP-40-S	MEA	To provide, as early as possible, precursory data for the materials processing in space and testing of automated space processing concept. This will provide an early shuttle experiment capability in materials processing in space that will not be limited by the capability of SPAR. MEA consists of isothermal and gradient furnaces, single-axis levitator, a latex reaction chamber, and own power supply. These equipments will be automatically programmed and controlled by micro-processor. Data will be recorded on recorder.
Molecular Wake Shield Facility	SP-39-S	MWS	To provide a scientifically beneficial ultra-high vacuum facility to accomplish a wide variety of scientific experiments like purification, transport, epitaxy, etc., that will need the highly clean environment offered by MWS. Experiment types include vapor deposition, metal purification, and molecular beam epitaxy. It is a 3 m diameter hemispherical shell which can either be shuttle or power module attached, or free flyer.

PAYLOAD NAME	CODE NO.	ACRONYM	OBJECTIVE/PURPOSE/DESCRIPTION
Active Cavity Radiometer	WC-02-S	ACR	Measurement of total solar irradiance with state-of-the-art accuracy and precision to determine the magnitude and direction of possible variations in the output of total solar optical energy. This information is useful for earth's climatology and behavior of sun. Continuous operation. Payload specialist used for on/off only.
Atmospheric Cloud Physics Laboratory	WC-01-S	ACPL	The primary goal of the ACPL is to develop and provide for the scientific community a unique multipurpose laboratory facility for conducting atmospheric cloud physics research that will complement and/or supplement cloud physics research on earth, and significantly increase the level of knowledge of atmospheric cloud microphysical processes. One double and one single rack mounted facility consisting of experiment chamber, aerosol generator, etc. Real-time payload specialist support needed.

PAYLOAD REQUIREMENTS

NAME	PRESSURIZED VOLUME (m^3)	PALLET AREA (m^2)	WEIGHT (kg)	POWER (W) SB/OPE/PEAK	POINTING (deg)	ALTITUDE/ INCLINATION (km/deg)	VIEWING REQUIREMENTS
AMPA	0.93	7.8	423	300/750/800	1.0	400/57	Total angular coverage of ±70° with IFOV of 5°.
LDASE	1.3	Requires two pallets	1483	40/204/395	0.5	400/Any	Space viewing to obtain variation in sun illumination.
SGRS	0.25	0.47	216	50/500/500	0.0047	400/50	Line-of-sight elevation from ground target to shuttle should exceed 20°.
TETHER (Operational)	0.017	5.22	705	0/121/1128	±0.5	190-210/Any	NA
LFC	0.43	1.57	439	192/262/700	±2	222/57	Earth viewing with sun elevation angle from 10 to 90°.
SIR-A	TBD	0.34	280	/900/	±2	200/40	Earth viewing in a direction 50° off. Nadir with a FOV of 6°.
SMIRR	0	0.53	86	53/ 82/120	±5	280/57	Center of FOV 15° away from sun with sun elevation angle between 0-90°. IFOV * 360 ur.
OCE	0.33	0.92	124	50/180/192	±5	280/38	Earth viewing with FOV of 0.2° and scan of ±45°.
SIR-B	1.9	~9	~800	100/2000/TBD	2.5	225/57	View angle selectable 15, 47, 60° from nadir.
PASS MICRO	0.06	9.3	984	TBD/930/NA	TBD	340/55	Total angular coverage of 160° cross track and 17° along track with a FOV between 0.09-17.0°. The viewing is nadir.
COMP STRAT	1.56	>1.0	451	78/527/697	0.5 max.	200/Any	Nadir, limb, sun at sunrise/ sunset through limb.
ATMOS	1.0	0	195	30/335/435	±5	Any/Any	FOV of 10°, sun centered during sunrise and sunset.
HALOE	0	0.32	37	8/ 40/70	1.0	200/57	Solar view at horizon IFOV of 0.2° x 0.4°.
SER	TBD	TBD	35	16/ 32/38	0.5	Any/Any	
LIMS	0	0.42	68	11.5/110/120	0.01	500/90	Total angular coverage of +6°, -5° elevation, +45° azimuth.
SOSU	0.002	0.14	20	4/10/24	1.0	<500/Any	Nadir viewing with instantaneous FOV of 6°.
COMP TROP		2.098	147	TBD/328/TBD	TBD	Any/TBD	Nadir.
CIMATS	0	0.63	100	100/160/TBD	0.008	Any/Any	Nadir viewing with angular coverage of 7° or 2° with a FOV of 7°.
MAPS	0.0015	0.562	80	TBD/95/130	±5	Any/Any	Nadir viewing with FOV of 2.2°.
THIR	NA	0.09	9.1	TBD/7.5/TBD		Any/TBD	Nadir.
VTPR		0.125	14.0	TBD/25/TBD			
ATMOS LIDAR	0.127	1.6	122	150/700/700 dc 100/600/600 ac	±2	280/50-20	Nadir viewing and limb scanning. FOV of 0.057.
SPA-M	3.4	NA	1345	TBD/2000/TBD	NA	NA	NA
SPA-P	NA	TBD	3000	TBD/4300/TBD	NA	NA	NA
MEA	NA	1.86	909	0/0/0	NA	NA	NA
MWS	TBD	TBD	3543	TBD	±1° along velocity vector	200-500/NA	NA
ACR	NA	0.12	28	10/10/13	±2.5	200/NA	FOV of 8°, sun centered.
ACPL	2.65	NA	550	0/591/814	NA	>200/NA	No viewing requirements.

APPENDIX B. PAYLOAD MODEL REQUIREMENTS

SUMMARY DATA ON OSTA AND OAST INVESTIGATIONS/INSTRUMENTS CONSIDERED IN THE 1980-85 OSTA PAYLOAD MODEL

RESOURCES OBSERVATIONS

Identification	Objective	Target	Sortie Mission: Pallet Area (%)	Sortie Mission: Rack Volume (%)	Free Flyer: Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
Shuttle Imaging Radar-A (SIR-A)	Antenna for studies in geology and oceanography.	All land masses	OFT-2		-	480	200, 70	Earth, 0.25 deg	800	
Measurement of Air Pollution from Satellite	Measures carbon monoxide concentration in the troposphere and its distribution.	Earth	OFT-2		-	80	any, any	Nadir, orbiter pointing adequate	95	Continuous operation preferred
Ocean Color Experiment (OCE)	To map distribution of chlorophyll-A bearing phytoplankton in the open ocean.	Cloud-free, open ocean	OFT-2	-	-	124	280, 38	Nadir, orbiter pointing adequate	180	
Feature Identification and Locating Expt. (FILE)	Remote sensing of earth resources using video and color IR imagery.	Land masses	OFT-2			20	160/480, any	Nadir, orbiter pointing adequate	40	
Large Format Camera (LFC)	Photography of earth's surface for cartography and renewable resources analysis.	All land masses especially CONUS	12	-	-	439	200/250, High KSC inclination	Nadir, orbiter pointing adequate	262	Needs, velocity and altitude information real time
Shuttle Imaging Radar-B (SIR-B)	Mineral and petroleum exploration and water resources studies.	CONUS, South and Central America, Africa	75	100	-	808	225, High KSC inclination	Nadir, orbiter pointing adequate	2000	Deployed antenna
Shuttle Imaging Radar-C (SIR-C)	Vegetation identification, mineral and petroleum exploration and water resources studies.	CONUS, South and Central America, Africa	75	100	-	1000	325, High KSC inclination	Nadir, orbiter pointing adequate	3500	Deployed antenna

RESOURCES OBSERVATIONS (CONCLUDED)

Identification	Objective	Target	Sortie Mission Pallet Area (%)	Sortie Mission Rack Volume (%)	Free Flyer Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
Passive Microwave	Microwave imaging of earth for meteorology, geophysics, ship routing, etc.	Earth	100	10	-	984	340, High KSC Inclination	Nadir, orbiter pointing adequate	930	
Tethered Magnetometer	To deploy payload away from orbiter environment to map true magnetic field.	None	100		-	705	200, any	Nadir, orbiter pointing adequate	121	Control in aft flight deck
Shuttle Goed. Ranging Sys. (SGRS)	Measure cm level motions on earth's surface to predict earthquake.	San Andreas Fault, CA	Very small	28	-	216	400, High KSC inclination	Nadir, 0.005°	500	Pointing system provided
STEREOSAT	Stereoscopic imaging of land masses for exploration geology and cartography.	Earth	-		11	3545	580, 97.7 (VAFB launch)	Space, orbiter pointing adequate	100	AEM data used
GRAVSAT	Improved earth's gravitational yield mapping.	None	-	-	11	4500	300, Polar	Space, orbiter pointing adequate	-	Program at very early stage
Adv. Geologic Mapping Sat.	Land mass mapping for geological studies and resource observations.	Earth	-	-	11	3545	580, 97.7 (VAFB launch)	Space, orbiter pointing adequate	100	Stereosat data used
Thermosat	Map thermal inertia of earth's surface for use in geological and agricultural studies.	All land masses	-	-	25	3000	700, 98 (VAFB launch)	Space, orbiter pointing adequate	-	Assume MMS
Multispectral Linear Array + Bus (MLA)	Earth imaging for earth resources studies.	All land masses	-	-	25	3000	700, 98 (VAFB launch sun synchronous)	Nadir, orbiter pointing adequate	75	Assume MMS BUS

ENVIRONMENTAL OBSERVATIONS

Identification	Objective	Target	Sortie Mission: Pallet Area (%)	Sortie Mission: Rack Volume (%)	Free Flyer: Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
Halogen Occultation Experiment (HALOE)	Measure stratospheric profiles of halogens and their inter-actions with ozone.	Solar occultation through limb	40	-	-	37	200, High KSC inclination	Nadir, orbiter pointing adequate	40	
Atmospheric Trace Molecules Observed by Spectroscopy (ATMOS)	Measure infrared spectrum of the stratosphere to determine the abundance and vertical profile of trace species.	Solar occultation	-	170	-	195	any, any	Solar occultation through limb. Orbiter pointing adequate	335	Instrument uses scientific airlock
Measurement of Air Pollution From Satellites (MAPS)	Measure carbon monox-ide concentration in troposphere and its distribution. Also observe interhem-ispheric air mass transport.	Earth	50	10	-	80	any, any	Nadir, orbiter pointing adequate	95	Needs coordinate surface and airborne observation
Atmospheric Cloud Physics Laboratory (ACPL)	Conduct cloud micro-physics research for better weather pre-diction. One double and one single rack mounted equipment.	Low-g	-	300	-	550	>200, any	any, any	591	
Pallet Equivalents	Environmental observation using atmospheric scanning.	Earth	100	-	-	TBD	TBD	TBD	TBD	
Earth Radiation Budget Satellite-A (ERBS-A)	Measure earth radiation budget and distribution of startospheric compo-nents for studies of climate. IY, SAGE, and ERBI.	Earth	-	-	15	2000	600, High KSC inclination	Space, orbiter pointing adequate	400	

ENVIRONMENTAL OBSERVATIONS (CONCLUDED)

Identification	Objective	Target	Sortie Mission		Free Flyer	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
			Pallet Area (%)	Rack Volume (%)	Bay Length (%)					
GOES	Provide day and night cloud cover, earth radiance, and space environment data. A spin stabilized cylindrical spacecraft.	Earth and its atmosphere	-	-	13	660	Geosynchronous with 1° inclination	Space, N/A	150	Data from NSSDC Sept. 1977 very preliminary
Seasat follow-on	Global observation of ocean surface conditions. Upper stage will be used for orbit insertion.	Earth	-	-	77	10,000	700, 87 (VAFB launch)	Space, N/A	200	Program in planning stage only
System 85	Weather monitoring and prediction. Four satellites - 2 polar, 2 geosync. work together.	Earth	-	-	12 each	500-1500 each	Goesynchronous and polar	Space, N/A	200	Program in very early planning stage
STORMSAT	Improved detection and forecasting of severe storm. MMS mounted payload. IUS will be used for orbit.	Earth	-	-	63	5550	Geosynchronous	Space, N/A	600	
ICESAT	Global observation of ice budget and ice movement. Upper stage will be used.	Earth	-	-	77	10,000	700, 87 (VAFB launch)	Space, N/A	200	Seasat follow-on data use
COASTSAT	Global coastal zone observation. Upper stage will be used.	Earth	-	-	77	10,000	700, 87 (VAFB launch)	Space, N/A	200	Seasat follow-on data use

MATERIALS PROCESSING

Identification	Objective	Target	Sortie Mission: Pallet Area (%)	Sortie Mission: Rack Volume (%)	Free Flyer: Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
Materials Experiment Assembly (MEA)	Provide testing of automated space processing concept, facility, and early materials processing data.	Low-g	17	-	-	909	any, any	any, any	None	
Pallet	Facility for preparation of improved materials using containerless technique.	Low-g	100		-		any, any	any, any	—	
Module	Facility for improved processing of bio-materials, metallic and semiconducting materials.	Low-g		400 to 600	-		any, any	any, any		

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SPACE COMMUNICATIONS

Identification	Objective	Target	Sortie Mission		Free Flyer	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation, Pointing (deg)	Operational Power From Shuttle (W)	Other
			Pallet Area (%)	Rack Volume (%)	Bay Length (%)					
Adaptive Multi-beam Antenna Experiment AMPA CN-16-S	Operate in space orbit a communications phased array capable of producing multiple simultaneous transmit and recieve beams as an electronically steerable antenna	Earth stations	69	100	-	423	400, High KSC inclination	Nadir, orbiter pointing adequate	750	
Wideband 30/20	Provide a wideband uplink and downlink from a geostationary satellite for point to point exchange of information within the U.S.	Wideband Communication Ground Stations in the U.S.	-	-	60	18,220	Geosynchronous	Space	-	
Narrow Band Antenna	Perform structural tests of a paraboloid antenna capable of automatic unfurling and refurling from the orbiter.	Four sun illumination angles and RF beacon	200	150	-	1483	any, any	Space and RF beacon in near proximity to orbiter, orbiter pointing adequate	20	Star tracker used to measure pointing angle
Narrow Band System Test	Verify the operation of a large antenna for use later as a free flyer.	Mobile and fixed ground stations on earth	263	150	-	2300	any, any	Nadir, orbiter pointing adequate	5000	
Narrow Band Comm Satellite	Provide a Multibeam Communications Satellite capable of relaying messages from earth transceivers.	Geographic sectors in the U.S.	-	-	72	4142.8	Geosynchronous	Space	-	A solar electric propulsion engine is used to move the satellite from low earth orbit to a geosyn. position.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY PAYLOADS

Identification	Objective	Target	Sortie Mission Pallet Area (%)	Sortie Mission Rack Volume (%)	Free Flyer Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation Pointing (deg)	Operational Power From Shuttle (W)	Other
Drop Dynamics Module (DDM)	Measure figures of free floating liquid drops under rotational or vibrational excitation.	Low-g	-	200	-	309	any, any	any, any	660	Acceleration limits apply
Induced Environment Contamination Monitor (IECM)	Measure gaseous and particulate contaminants in shuttle environment.	None	10	-	-	363	any, any	any, any	300	Continuous operation preferred
Laser Heterodyne Spectrometer (LHS)	Measure trace atmospheric species with passive optical heterodyne receiver.	Sun	18	3	-	133	300, High KSC inclination	Solar occultation through limb, 0.125	1000	Pointing system provided
SEP Solar Array	Demonstrate solar array technology for solar electric propulsion.	Sun	75	2	-	300	any, any	Sun, orbiter pointing adequate	TBD	Deployed wing
Thermal Canister Experiment (TCE)	Demonstrate heat pipe thermal control system in a space environment.	None	15	-	-	250	any, any	any, any	100	
Semiconductor Mat. Growth in Low-G Environment (O-G SMG)	To grow semiconductor crystals by three methods in a low-g environment.	Low-g	TBD	-	-	TBD	any, any	any, any	TBD	Acceleration limits TBD
Microwave Radiometer Technology Experiment (MRTE)	To make meteorological measurements with a passive microwave heterodyne radiometer.	Oceans, north and south galactic poles	100	2	-	300	250, 80-90 (VAFB launch)	Nadir and space, orbiter pointing adequate	230	Antenna scanned in yz-plane

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY PAYLOADS (CONTINUED)

Identification	Objective	Target	Sortie Mission: Pallet Area (%)	Sortie Mission: Rack Volume (%)	Free Flyer: Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation Pointing (deg)	Operational Power From Shuttle (W)	Other
Modular Instrument Pointing Technology Laboratory (MIPTL)	To provide test bed for pointing and control technology development.	Earth, Solar, stellar	TBD	TBD	-	TBD	any, any	TBD	TBD	
Propulsion Contamination Effects Module (PCEM)	Measure rocket engine plume characteristics in space environment.	None	37	-	-	500-1000	any, any	any, any	100-200	
Superfluid Helium Experiment (SFHE)	Investigate thermal and dynamic properties of superfluid He in zero gravity.	Low-g	10	-	-	250	any, any	any, any	60	Acceleration $<10^{-4}$ g required
Feature Identification and Locating Experiment (FILE)	Demonstrate FILE capabilities for remote sensing of earth resources.	Earth	4	-	-	34	300, any	Nadir, TBD	24	Pointing system provided
ASPS Gimbal System (AGS)	To provide a stable platform to meet general use pointing requirements.	Governed by expt.	35	-	-	303	TBD	TBD	320	
Ion Thruster Character (ITC)	Obtain particle transport data.	None	3	-	-	43	any, any	any, any	205	
Cryogenic Fluid Management Experiment (CFME)	Demonstrate subcritical cryogen orbital storage and transfer.	None	25	-	-	162	any, any	any, any	TBD	
NASA End-to-End Data System DDS (NEEDS-DDS)	Demonstrate digital data reduction system for general experiment support.	None	-	TBD	-	TBD	any, any	any, any	TBD	Interfaces with other payloads

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY PAYLOADS (CONCLUDED)

Identification	Objective	Target	Sortie Mission Pallet Area (%)	Sortie Mission Rack Volume (%)	Free Flyer Bay Length (%)	Payload Weight (kg)	Operational Altitude (km), Inclination (deg)	Shuttle Orientation Pointing (deg)	Operational Power From Shuttle (W)	Other
Solar Cell Calibration Facility (SCCF)	Measure performance of solar cells in a space environment	Sun	3	-	-	34	any, any	Sun, orbiter pointing adequate	24	Pointing within 2° of sun required
Two-Phase Heat Transfer (2ΦHT)	To provide facility for fluid mechanics and heat transfer experiments in low-g environment.	None	-	125	-	580	any, any	any, any	TBD	
Gallium Arsenide Solar Cell Test (GASCT)	Test GaAs solar cells for radiation/temperature damage in space environment.	Sun		-	TBD	TBD	any, any		TBD	Program dormant
Combustion Experiment Facility (CEF)	Provide facility for low-g combustion process experiments.	Low-g	28	200	-	981	any, any	any, any	908	Acceleration $<10^{-4}$ g required
Geophysical Fluid Flow Cell (GFFC)	Conduct fundamental convective fluid flow experiments in zero gravity.	Low-g	-	35	-	60	any, any	any, any	103	Acceleration $<10^{-3}$ g required
Tribological Experiments in Zero Gravity (TEZG)	Examine static and dynamic behavior of liquid lubricants in zero gravity.	Low-g	-	11	-	58	any, any	any, any	54	Acceleration $<10^{-3}$ g required
Shuttle SAR Processing Experiment (SSPE)	Demonstrate capability to meet data processing requirements for space-based synthetic aperture radar.	Earth	-	100	-	100	TBD	TBD	1,100	Will interface with radar transceiver of another payload
MESA Low-G Accelerometer (MLGA)	Evaluate Spacelab 2 orbital environment and calibrate MESA.	Low-g	0.7	-	-	8	any, any	any, any	20	Acceleration $<10^{-2}$ g required

APPENDIX C. SUMMARY DATA FOR QUICK REFERENCE

SUMMARY DATA ON ALL INVESTIGATIONS/INSTRUMENTS IN THE OSTA ACTIVE INVENTORY

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EARTH RESOURCES PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Shuttle Imaging Radar-A (SIR-A) ER-14-S	Single frequency, synthetic aperture radar for geologic and oceanographic. Observations at microwave frequency.	Nadir viewing, low orbit. Pallet mounted antenna occupies half of 3 1/3 pallets. Tape recorder and optical recorder in module. High power. Payload specialist familiar with radar. Location and orientation data needed real time.	In development on OFT-2. Desires flights in 1982-83.
Large Format Camera (LFC) ER-02-S	Photographic camera for mapping geological exploration and renewable resources analysis.	Nadir viewing, low orbit. Occupies 1/2 pallet. Low power. Minimal attention from payload specialist. Stellar view required at least once per flight.	In development. Will be ready to fly in 1980. May be on SL-3, 1981.
Thematic Mapper (TM) ER-03-S	High spatial resolution, visible and infrared multispectral scanner for geological, agricultural, and water resources studies. Filter spectrometer, mechanical scanner.	Nadir viewing, medium altitude orbit. High inclination preferred. Pallet mounted. Small, low power instrument. Minimal payload specialist duties.	In development on Landsat-D. Possible flights after 1981.
Shuttle Multispectral Infrared Radiometer (SMIRR) ER-12-S	Infrared, filter radiometer for geologic mapping.	Nadir viewing, low orbit. High inclination preferred. Pallet mounted. Small, low power instrument. Minimal payload specialist duties.	Definition studies on OFT-2. Desires annual flights beginning 1980.
Ocean Color Experiment (OCE) ER-13-S	Visible light scanner to map distribution of microscopic marine life. Multichannel grating spectrometer.	Nadir viewing, low orbit. Low inclination. Pallet mounted. Small, low power instrument. Minimal payload specialist duties.	Existing airborne instrument modified for OFT-2. Desires annual flights beginning 1980.
Shuttle Imaging Radar-B (SIR-B) ER-15-S	Single Frequency, synthetic aperture radar for vegetation identification, water resources studies, mineral and petroleum exploration. Complementary to SIR-A. Later addition of second frequency converts this to SIR-C.	Earth viewing, low altitude, high inclination orbit. Full pallet, high power. Antennae deploy across orbiter. Payload specialist operates instrument.	Planning. Proposing 1980 new start. Could be ready for flight in 1983.
Shuttle Imaging Radar-C (SIR-C) ER-17-S	Two frequency, synthetic aperture radar for vegetation identification, water resources studies, mineral and petroleum exploration. Complementary to SIR-A.	Earth viewing, low altitude, high inclination orbit. Full pallet, very high power. Three antennae deploy across orbiter. Payload specialist operates instrument.	Planning. Proposing 1980 new start. Could be ready for flight in 1983.
Multispectral Linear Array Imaging System (MLA) ER-05-S	High spatial resolution, visible and infrared multispectral radiometer for earth resources studies. Electronic, not mechanical scanning.	Nadir viewing, polar sun synchronous orbit preferred. Small, low power instrument. Minimal payload specialist duties.	Laboratory version exists. In development for Landsat-D'. Could be ready for flight in 1983.
Passive Microwave Imager (PASS MICRO) ER-16-S	High spatial resolution, multifrequency microwave radiometer for meteorological, geophysical, water resources and polar studies.	Nadir viewing, low altitude, high inclination orbit. Full pallet. High power.	Planning. May be ready for flight in 1983.

EARTH RESOURCES PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Landsat D' ER-09-A	Continues Landsat series of earth resources observations with improved sensors.	Polar orbit, satellite to go to sun synchronous orbit. Full pallet.	Definition studies. Back-up unit for Landsat D. Will fly on shuttle in 1982 if Landsat D is successful.
High Resolution Microwave Imager (HRMI) ER-18-S	Ten frequency, high resolution scanning passive microwave radiometer for meteorological, geophysical, water resources and polar studies.	Nadir viewing, low altitude, high inclination orbit. Full pallet. Moderate power.	Definition studies. Could be ready by 1983. Planned for free flyer after shuttle tests.
Synchronous Earth Observatory Satellite (SEOS) ER-02-A	High spatial resolution earth sensing satellite for applications in earth resources, meteorology, pollution and disaster warning.	Launch vehicle - Titan III-E Too heavy to reach geosynchronous orbit from shuttle.	Planning. May be ready for flight after 1990.
Soil Moisture Radiometer (Fixed Parabolic) (SMR) ER-07-A	Microwave radiometer to determine feasibility of soil moisture measurement from space for crop yield prediction, watershed management and climate studies.	Large payload, 1/4 of bay length, carried on MMS which has its own cradle. Polar orbit preferred, other high inclinations acceptable.	Planning. Could be ready for flight in 1982.
Soil Moisture Radiometer (Phased Array) (SMR) ER-08-A	Dual frequency microwave radiometer to make soil moisture measurements for crop yield predictions, watershed management and climate studies.	Large payload, 60% of bay length, carried on MMS which has its own cradle. Polar orbit preferred, other high inclinations acceptable.	Planning. Could be ready for flight in 1985.
Advanced Heat Capacity Mapping Mission (Adv HCMM) ER-03-A	High spatial resolution, visible and infrared scanner for geological and agricultural applications.	Planned for expendable launch vehicle. Sun synchronous orbit.	Initial planning, no schedules set.

EARTH RESOURCES

SPECIAL CONSIDERATIONS	PAYLOAD ACRONYM
HIGH POWER	SIR-B
FIELD OF VIEW OBSTRUCTION	SIR-B
PAYLOAD BAY ENVELOPE CONSTRAINT	SIR-B
MASS OR VOLUME	SEOS, SMR, SIR-A
DATA RATE	TM
ORBIT RESTRICTIONS	LFC

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EARTH DYNAMICS PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Shuttle Geodynamics Ranging System (SGRS) ED-10-S	Earth motion study for earthquake prediction. The sensor is a combination of laser transmitter and telescope receiver.	Earth orientation with high shuttle altitude. Launch with high KSC inclination. Medium power consumption. Will occupy very small pallet and module volume.	Definition study only. Plans to fly in 1982.
Geomagnetic Field Measurement-Tethered System (GFM/TS) ED-13-S	Facility to deploy science payload away from orbiter environment. The sensor is a magnetometer.	Earth orientation with low shuttle altitude. No specific inclination. Low power consumption. Will occupy moderate pallet volume.	Definition study only. Plans to fly in 1983.
Laser Altimeter/Profilometer Experiment (LAP) ED-06-S	Ocean current mapping, oil spill and pollution, and marine studies. The sensor is a combination of laser transmitter and receiver.	Earth orientation with no specific altitude and inclination. Will occupy small pallet volume. High power consumption.	AAFE. Plans to fly in 1981.
Satellite Altimeter Land Profiling (SALP) ED-14-S	Information to terrain mapping satellite altimeter design. The sensor is a radar.	Earth orientation with high shuttle altitude. Launch with high KSC inclination. Low power consumption. Will occupy very small pallet and module volume.	Hardware exists. Plans to fly in 1981.
Gravity Field Satellite (GRAVSAT) ED-04-A	Improved earth's gravitational field mapping. The sensor is satellite with accelerometers.	Low shuttle altitude with high VAFB launch inclination. Payload will occupy large bay volume.	Study under planning. Planning to fly in 1984.
Vector Magnetometer Satellite (MAGSAT-B) ED-05-A	Update of earth's magnetic field. The sensors are magnetometers.	High shuttle altitude with high VAFB launch inclination.	Study under planning. Planning to fly in 1984.
Global Surveyor Satellite (GSS) ED-10-A			

EARTH DYNAMICS

SPECIAL CONSIDERATION	PAYLOAD ACRONYM
ALTITUDE	GFM/TS

WEATHER AND CLIMATE PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Atmospheric Cloud Physics Laboratory (ACPL) WC-01-S	Facility for atmospheric cloud research to better predict the weather. The sensor is a combination of nucleation chamber, aerosol generator, and saturator. Camera and particle counter are used as data collection devices.	This experiment does not require specific altitude, inclination, or orientation. It requires low and stable "g-level." The experiment will occupy one double rack. Low power consumption.	The payload hardware is in development and is scheduled to fly in 1981.
Active Cavity Radiometer (ACR) WC-02-S	Total solar optical irradiance outside the terrestrial atmosphere. The sensor used is an optical radiometer. Solid state detectors are used as data probes.	The experiment desires low shuttle orbit with no specific inclination, and requires solar orientation. The equipment is on the pallet occupying very small area. Very low power consumption.	The payload definition study only. The payload is in existence and is scheduled to fly in 1980.
Advanced Meteorological Temperature Sounder (AMTS) WC-07-S	Development of all weather sounder for atmospheric temperature of humidity profiling. The sensor is a spectrometer. Cooled solid state detectors are used as data gathering devices.	The experiment desires medium shuttle orbit with inclination suitable for KSC launch. Requires a nadir orientation. It occupies very small pallet volume. Lower power consumption.	Plans to have first flight in 1982.
Solar Irradiance Monitor (SIM) WC-18-S	Monitoring of solar total irradiance over a 22 year magnetic reversal cycle of sun. The sensor is a radiometer.	Solar orientation with no specific altitude and inclination. Will occupy very small pallet volume. Low power consumption.	Hardware exists. Plans to fly in 1979.
Microwave Pressure Sounder (MPS) WC-19-S	Atmospheric Pressure at the surface of the Earth for meteorological studies. The sensor is a combination of microwave antenna transmitter f receiver.	Nadir orientation with low altitude. Will occupy very small pallet volume. Low power consumption.	Definition study only. Plans to fly in 1982.
Calibration Facility (CF) WC-16-S	Spacelab mounted calibration instrument for calibration of instruments on free flying payloads.		
Lidar Temperature Sensor (LTS) WC-12-S	Temperature profiling of troposphere. The sensor is a combination of laser transmitter and receiver.	Nadir orientation with low orbit and inclination adequate for KSC or VAFB launch. Will occupy small pallet volume. High power consumption.	Definition study only. Plans to have first flight in 1981.
Lidar Pressure Sensor (LPS) WC-11-S	Pressure profiling of troposphere. The sensor is a combination of laser transmitter and receiver.	Nadir orientation with low orbit and inclination adequate for KSC or VAFB launch. Will occupy small pallet volume. High power consumption.	Definition study only. Plans to have first flight in 1981.
Cloud Climatology Experiment (CCE) WC-08-S	Global cloud mapping for meteorology. The sensor consists of telescope. Cooled solid state detectors will gather data.	Nadir orientation with no specific altitude and inclination. Will occupy small pallet volume. Moderate power requirement.	Hardware exists. Plans to fly in 1981.

WEATHER AND CLIMATE PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Shuttle Microwave Instrument Technology Experiment (SMITE) WC-20-S			
Shuttle Atmospheric Lidar (SAL) WC-13-S	Tropospheric and stratospheric water, atomic species, and pollutant flow study for weather. The sensor is a combination of laser transmitter and telescopic detector.	Nadir orientation with very low altitude and KSC launch inclination. Will occupy moderate pallet volume. High power consumption.	Definition study only. First flight planned in 1984.
Spaceborne Meteorological Radar (SMR) WC-03-S	Three-dimensional precipitation data for natural disaster prediction. The sensor is a microwave antenna transmitter and receiver.	Nadir orientation with low shuttle altitude. Will occupy moderate pallet volume. High power consumption.	Definition study only. First flight planned in 1985.
Earth Radiation Budget Satellite-A (ERBS-A) WC-03-A	Earth radiation budget data to understand climate. The sensors are optical radiometers and spectrometer.	Moderate shuttle altitude with KSC launch inclination will occupy large pallet volume. Medium power requirement.	Definition study only. Plans to fly in 1982-83-
Advanced Climsat Observation System (ACOS) WC-04-A	Long range weather and climate prediction. Sensors not defined - probably radiometer type.	Shuttle altitude and inclination TBD. Large payload weight. Power consumption not defined.	Definition study only. Plans to fly in 1984.
System 85 Operational Satellite - Polar (85-P) WC-05-A	Weather satellite for climatology and water budget. Sensors not defined.	Shuttle altitude and inclination TBD. Large payload weight. Power consumption not known.	Planning study only. First flight planned in 1985.
System 85 Operational Satellite - Geosynchronous (85-G) WC-06-A	Weather satellite for climatology. Sensors not defined.	Shuttle altitude and inclination TBD. Moderate payload weight. Power TBD.	
Geosynchronous R&D Weather Satellite (Geosyn R&D) WC-07-A			

WEATHER AND CLIMATE

SPECIAL CONSIDERATIONS	PAYLOAD ACRONYM
VOLUME	SAL
POWER	LPS
	LTS
	SAL
	SMR
LOW-G	ACPL

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ENVIRONMENTAL QUALITY PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Atmospheric Trace Molecules Observed by Spectroscopy - Airlock Version (ATMOS-A) EQ-01-S	Measures stratospheric distribution of atmospheric trace species. High resolution, infrared interferometer spectrometer.	Solar occultation viewing, any altitude, high inclination preferred. Solar and cold space views required. Small, low power, scientific airlock mounted. Payload specialist may install and remove from airlock.	In development on SL-1, 1980.
Halogen Occultation Experiment (HALOE) EQ-02-S	Measures stratospheric profiles of halogens and other gases important to ozone chemistry. Combination filter and gas filter correlation, infrared spectrometer.	Solar occultation viewing. Low altitude, high inclination orbit. Solar view required, cold space view desired. Small, low power, pallet mounted. Payload specialist duties minimal.	In development. Can be ready for flight in 1980. On ERBS-A (1982).
Limb Infrared Monitor of the Stratosphere (LIMS) EQ-03-S	Measures temperature and density profiles through stratosphere of gases important in ozone chemistry. Infrared filter radiometer.	Limb viewing, low to medium altitude, high inclination orbit preferred. Small, low power, pallet mounted. Payload specialist duties minimal.	Existing hardware. Can be ready to fly in 1980.
Measurement of Air Pollution form Shuttle (MAPS) EQ-23-S	Measures distribution and movement of carbon monoxide in troposphere. Gas filter correlation, infrared radiometer.	Nadir viewing, low to medium altitude, low inclination orbit preferred. Small, low power, pallet mounted. Payload specialist duties minimal.	Existing hardware on OFT-2
Standard Ozone Sounding Unit (SOSU) EQ-06-S	Measures vertical distribution of ozone to calibrate ozone monitors on free flyers and to supplement coverage of free flyers. Combination ultraviolet filter photometer and grating spectrometer.	Nadir viewing. Low altitude, any inclination orbit. Small, low power, pallet mounted. Payload specialist duties minimal.	Existing hardware available for flight 1981.
Temperature Humidity Infrared Radiometer (THIR) EQ-25-S	Measures water content of troposphere and stratosphere, temperatures of clouds and images cloud cover. Scanning infrared filter radiometer.	Nadir viewing, any altitude and inclination orbit. Small, low power, pallet mounted. Payload specialist duties minimal.	Existing instruments are in use on NIMBUS satellites.
Vertical Temperature Profile Radiometer (VTPR) EQ-26-S	Measures vertical profile of atmospheric temperature, humidity and carbon dioxide. Scanning infrared filter radiometer.	Nadir viewing, any orbit. Small, low power, pallet mounted. Payload specialist duties minimal.	Existing instruments belong to NOAA.
Laser Absorption Spectrometer (LAS) EQ-08-S	Measures atmospheric trace gases by absorption of laser beam reflected from earth's surface. Uses one meter diameter telescope.	Nadir viewing, low altitude, high inclination orbit. Large, medium power, pallet mounted. Payload specialist duties minimal.	Definition studies. Airborne instrument exists. Ready for flight 1982.

ENVIRONMENTAL QUALITY PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Correlation Interferometric Measurement of Atmospheric Trace Species (CIMATS) EQ-14-S	Measures vertical distribution of atmospheric trace species. Infrared interferometer radiometer.	Nadir and/or solar occultation viewing. Any orbit acceptable. Small, low power, pallet mounted. Automated operation or ground control.	Existing AAFE instrument.
Solar Extinction Radiometer (SER) EQ-10-S	Measures aerosol and ozone distribution in atmosphere. Grating spectrometer.	Solar occultation viewing. Any altitude, high inclination orbit. Small, low power, pallet mounted. Payload specialist duties minimal.	Definition studies.
Stratospheric Aerosol and Gas Experiment (SAGE) EQ-29-S	Measures aerosol and ozone distribution in atmosphere. Grating spectrometer.	Solar occultation viewing. Medium altitude, high inclination orbit. Small, low power, pallet mounted. Payload specialist duties minimal.	In development. On AEM-B (1979) and ERBS-A (1982) Could be ready for flight in 1980.
Shuttle Atmospheric Lidar (SAL) EQ-28-S	Study transport, dissipation, excitation and chemistry of upper atmosphere. Laser and 1.0 meter class telescope.	Nadir viewing. Low altitude, high inclination orbit. Large, high power, pallet mounted.	Definition studies ready for flight in 1983.
Composite Stratospheric Package (COMP STRAT) EQ-19-S	Compare results of stratospheric measurements by instruments with different spectral ranges. No new instruments.	Determined by instruments being compared.	Planning.
Composite Troposheric Package (COMP TROP) EQ-24-S	Measure concentration and distribution of atmospheric constituents. Integrated package consisting of CIMATS. VTPR, THIR and MAPS.	Nadir and solar occultation viewing. Cold space calibration view required. Medium size, medium power, pallet mounted.	Planning. Could be ready for flight 1983.
Laser Heterodyne Spectrometer (LHS) EQ-30-S	Measures atmospheric profiles of trace species. Infrared heterodyne spectrometer.	Solar occultation viewing. Low to medium altitude, high inclination orbit. Medium size, medium power, pallet mounted.	In development. Airborne AAFE instrument exists.
Atmospheric Trace Molecules Observed by Spectroscopy - Pallet Version (ATMOS-P) EQ-31-S	Measures stratospheric distribution of atmospheric trace species. High resolution, infrared interferometer spectrometer.	Solar occultation viewing, any altitude, high inclination preferred. Solar and cold space views required. Small, low power, pallet mounted. Desires payload specialist to photograph mirage if occurs during observation.	In development for SL-3, 1981.
Earth Radiation Budget Satellite-A (ERBS-A) EQ-02-A	Measures earth radiation balance and distribution of aerosols, halogens and ozone for climate studies. Includes SAGE, HALOE and ERBI on AEM or MMS spacecraft.	High inclination orbit. Full pallet size, may use own cradle. Development needed. Medium power.	Definition studies. Planned for flight after NOAA-F (1982).

ENVIRONMENTAL QUALITY

SPECIAL CONSIDERATIONS	PAYLOAD ACRONYM
HIGH POWER	SAL
VAPOR CONTAMINATION	ATMOS, HALOE, LIMS, LAS, CIMATS, COMP STRAT, MAPS, COMP TROP, THIR, VTPR, LHS, SAL
ORBIT RESTRICTIONS	SOSU
ASCENT AND DESCENT POWER	LIMS, THIR

OCEAN CONDITION PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Ocean Wave Spectrum Measurement (OWSM) OC-01-S	Ocean dynamics and condition.		
Ocean Applications Laboratory (OAL) OC-02-S	Ocean conditions, marine biology, and dynamics.		Idea only.
Seasat Follow-on OC-03-A	Global observations of ocean surface conditions. Various active and passive sensors.	High shuttle altitude with high VAFB launch inclination. Will occupy very large bay volume.	In planning stage. Plans to fly in 1983.
Coastal Monitoring Project (CMP) OC-05-A	Monitoring of ice, environment, biocontent, and transport condition.	High shuttle altitude with high VAFB launch inclination. Will occupy very high bay volume.	In planning stage. Plans to fly in 1985.

OCEAN CONDITION

SPECIAL CONSIDERATION	PAYLOAD ACRONYM
VOLUME	SEASAT FOLLOW-ON
	CMP

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MATERIALS PROCESSING PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Materials Processing Furnace System (MPFS) SP-41-S	To grow high perfection crystals for nuclear detectors.	Stable "low-g" only. Low power consumption. Will occupy part of a single rack in the module.	Payload in development state. Scheduled to fly in 1981.
Acoustic Lavitation Processing Module (ALPM) SP-42-S	Facility for containerless processing of materials. Sensor is an acoustic lavitator.	Stable "low-g" only. Moderate power consumption. Will occupy a double rack volume.	Payload in development state. Scheduled to fly in 1981.
Cell Aggregation Module (CAM) SP-43-S	Intercellular attraction force and size relation to specific disease. Sensor is a viscometer with camera as the data gathering device.	Stable "low-g" only. Will occupy part of a single rack.	Payload in development state. Scheduled to fly in 1981.
Multipurpose Fluid Phenomena Facility (MFPF) SP-44-S	Study fluid phenomena important for space processing. Sensors are optical. Camera will gather most of the data.	Stable "low-g" only. Will occupy one double rack.	Payload in development state. Scheduled to fly in 1981.
Polymer Particle Growth Module (PPGM) SP-45-S	Gravity effect on seeded emulsion polymerization. The sensor is a reaction chamber.	Stable "low-g" only. Will occupy part of a single rack. Low power consumption.	Definition study only. Scheduled to fly in 1981.
Vapor Crystal Growth Module (VCGM) SP-46-S	Production facility for growing crystals using vapor transport. Sensor is a high temperature furnace.	Stable "low-g" only.	Imagination only.
Materials Experiment Assembly (MEA) SP-40-S	Materials processing and automated space processing facility concept. Sensors are furnances, lavitator, and reaction chamber.	Stable "low-g" only. Will occupy small pallet volume. No power required.	Payload under development. Scheduled to fly in 1980.
Analytical Float Zone System (AFZS) SP-47-S	Gravity effects on molten zones that are important for space processing. Sensor is a furnace. Camera will gather part of the data.	Stable "low-g" only. Will occupy part of a double rack. High power requirement.	Definition study only. Scheduled to fly in 1981.
Floating Zone Crystal Growth System (FZCGS) SP-48-S	Materials processing and purification using the floating zone technique. Sensor is a high temperature furnace.	Stable "low-g" only.	Idea exists.
Bioprocessing System (BPS) SP-49-S	Process information on space cell - culture system. The sensor is a reaction chamber.	Stable "low-g" only. Will occupy a small portion of a single rack. Low power requirement.	Definition study only. Plans to fly in 1981.
Leased Industrial Materials Experiment Assembly (LIMEA) SP-50-S	Facility to process various types of materials which are of industrial importance.	Stable "low-g" only.	Idea exists only.

MATERIALS PROCESSING PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Electromagnetic Containerless Processing System (ECPS) SP-51-S	Facility to produce high purity materials by contactless technique. Sensor is a electromagnetic furnace.	Stable "low-g" only.	Definition only. FY81 new start.
Cell Separation System (CSS) SP-52-S	Purification and fractionation of biological cells for production. The sensor is a electrophoretic chamber.	Stable "low-g" only. Will occupy part of a single rack. Moderate power consumption.	Definition only.
Polymer Production Facility (PPF) SP-53-S	Facility for the production of polymers of various types. The sensor are reactive chambers.	Stable "low-g" only.	Idea only. FY83 new start.
Molecular Wake Shield (MWS) SP-39-S	Facility with ultrahigh vacuum for ultraclean material production. Sensors likely to be furnaces.	Stable "low-g" only. Will occupy a large shuttle bay volume.	Definition study only. Plans to fly in 1984.
Glass Shell Processing System (GSPS) SP-54-S	Facility for containerless processing of glassy materials. Sensor is a lavitating device.	Stable "low-g" only.	Definition only.
Foamed Solid System (FSS) SP-55-S	Facility for production of metal and non-metal foams for industrial use. The sensors will be furnaces.	Stable "low-g" only.	Very vague idea only.
Counter Current Distribution System (CCDS) SP-56-S	Facility for separation and purification of biomaterials. The sensor will be a counter current chamber.	Stable "low-g" only.	Idea only with some demonstration.

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SPACE COMMUNICATIONS PAYLOAD DESCRIPTION

PAYLOAD NAME (ACRONYM)	SCIENCE OBJECTIVE AND TYPE OF SENSOR USED	SHUTTLE ACCOMMODATION	PAYLOAD DEVELOPMENT STATUS
Adaptive Multibeam Antenna Experiment AMPA CN-16-S	Operate in space orbit a communications phased array capable of producing multiple simultaneous transmit and receive beams as an electronically steerable antenna (± 70° circular).	Single pallet and a full vertical rack, earth orbit pointing in the nadir direction	Contract for payload to be awarded in Sept. 1978
Large Deployable Antenna CN-07-S	Demonstrate and measure a 30 meter diameter mesh antenna that can be automatically unfurled and refurled in space.	Two forward pallets and 1.5 racks in low earth orbit pointing into space.	Development of special instrumentation
Millimeter Wave communication experiment CN-09-S	Evaluate advanced millimeter wave communications techniques for space applications and measure propagation effects through a wide variety of atmospheric conditions.	Single pallet and 1/5 rack in low earth orbit bay toward nadir.	Definition studies ready to start hardware development
Microwave Interferometer Navigation and Tracking Aid CN-12-S	Measure the performance of a spaceborne (low earth orbit) microwave interferometer for locating the position of multiple microwave signal sources.	Center pallet and 1/2 rack	Planning
Orbiting Standards Platform CN-24-S	Develop satellite techniques capable of calibrating broadband radio measurements from remote earth and space sources.	Single pallet and rack operating in low earth orbit.	Definition study
Public Service Communications Payload CN-05-A	Demonstrate the technology needed to implement satellite to mobile transceiver communications. Use an approach that makes use of already developed hardware and provides a future test source for a subsequent satellite with higher capacity.	≈ 1/2 shuttle cargo length transported to an intermediate orbit before being placed into geostationary orbit.	Planning
Coastal Zone Monitoring Satellite CN-09-A	Provide a satellite capable of making accurate position measurements on cooperative fishing and tanker vessels operating near and within the 200 n.mi. coastline of conus using a precision RF interometer.	Two pallets transported to an intermediate orbit before being placed into geostationary orbit.	Planning
Hazard Warning/ Communication Satellite CN-10-A	Provide additional "daily business" communications for the national weather service and to enlarge their diaster warning capabilities on a cost effective basis.	Two pallets transported to an intermediate orbit before being placed into a geostationary orbit.	Definition Studies

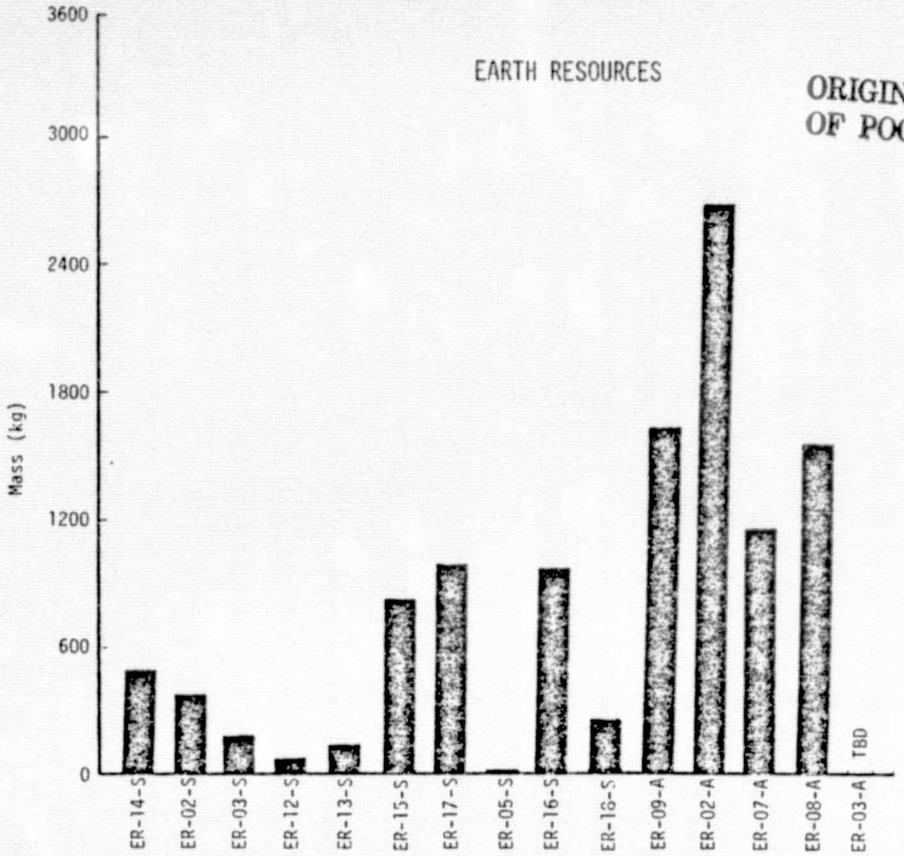
SPACE COMMUNICATIONS PAYLOADS

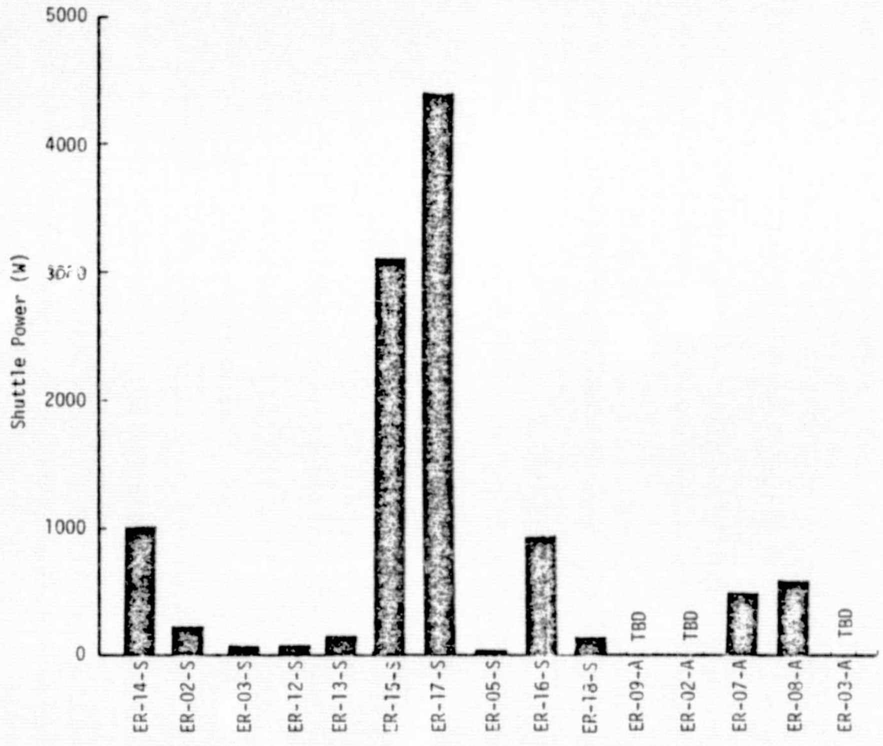
SPECIAL CONSIDERATION	PAYLOAD ACRONYM
LOW ACCELERATION ENVIRONMENT	LDASE MINTA
FIELD OF VIEW OBSTRUCTION OF CARGO BAY	LDASE
PAYLOAD BAY CONSTRAINT	LDASE MINTA

APPENDIX D. PERTINENT PARAMETER BAR CHARTS

COMPARISONS OF MASS, POWER, ORBIT, AND INCLINATION REQUIREMENTS
OF ALL THE INVESTIGATIONS/INSTRUMENTS
IN THE ACTIVE OSTA INVENTORY

EARTH RESOURCES





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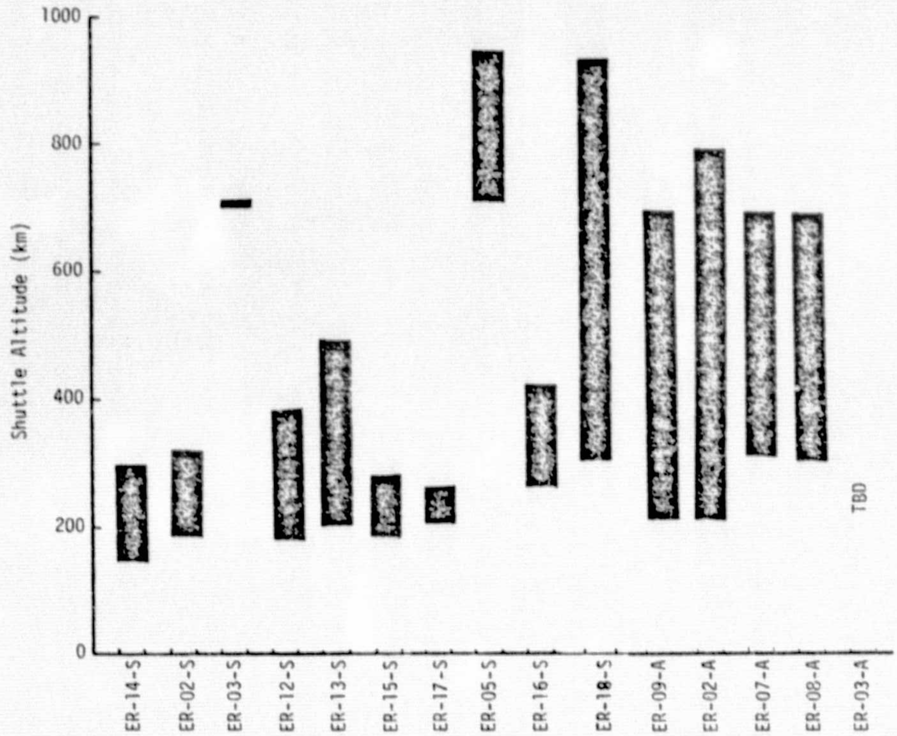

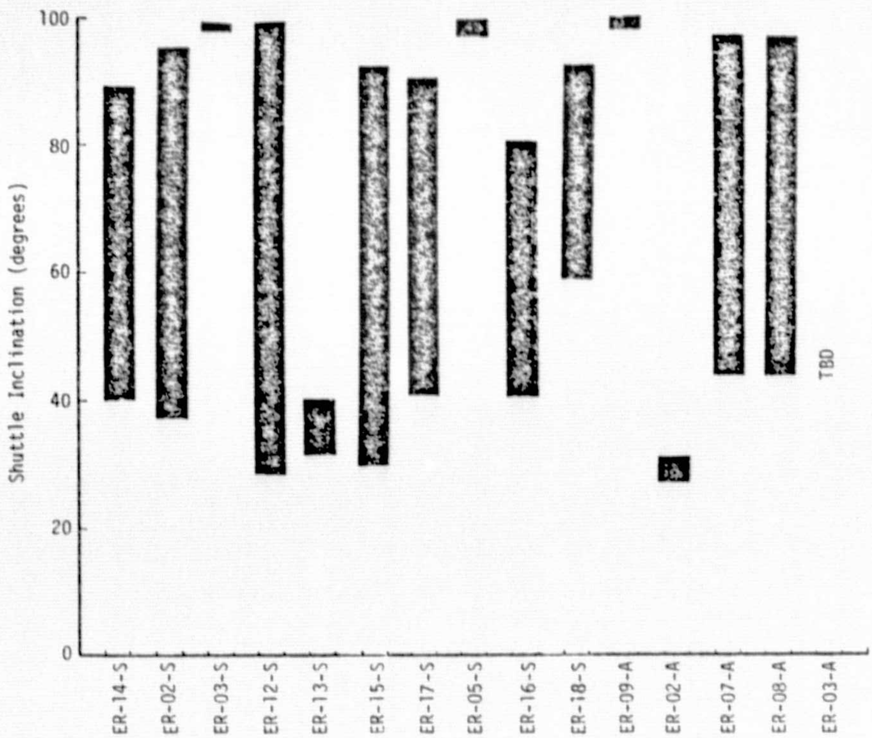

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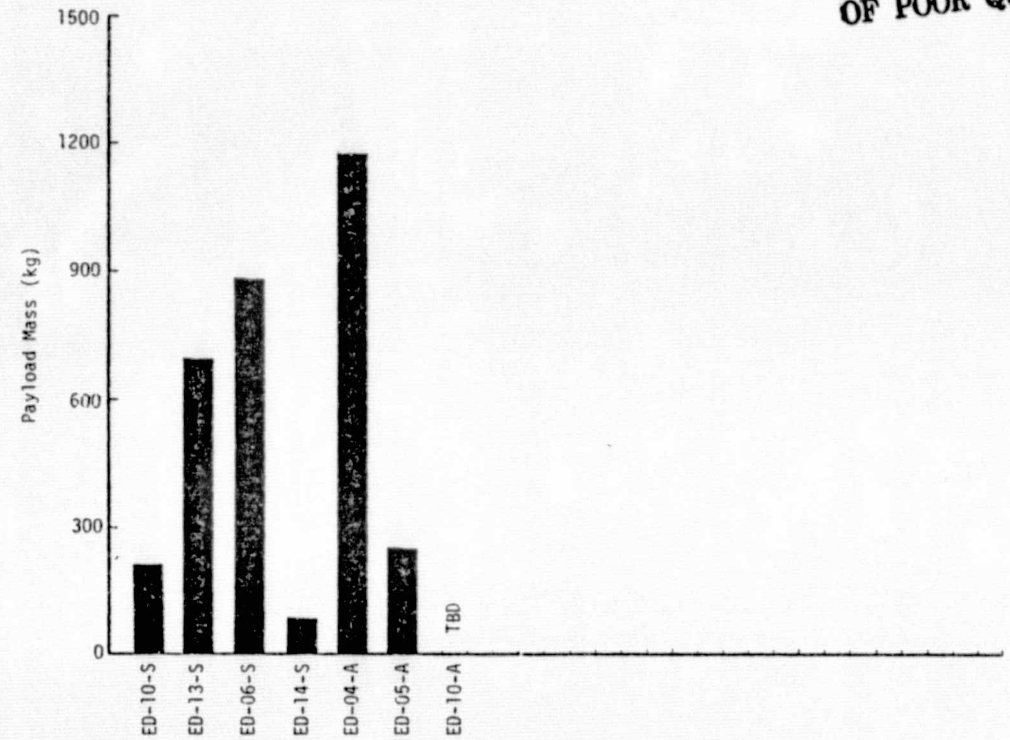

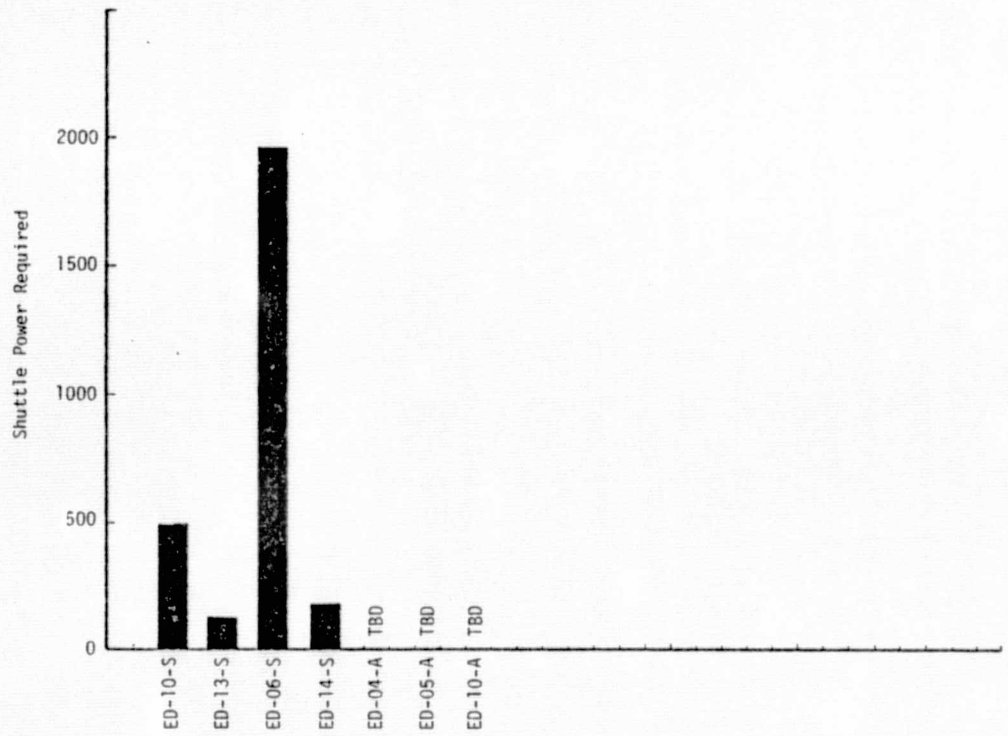

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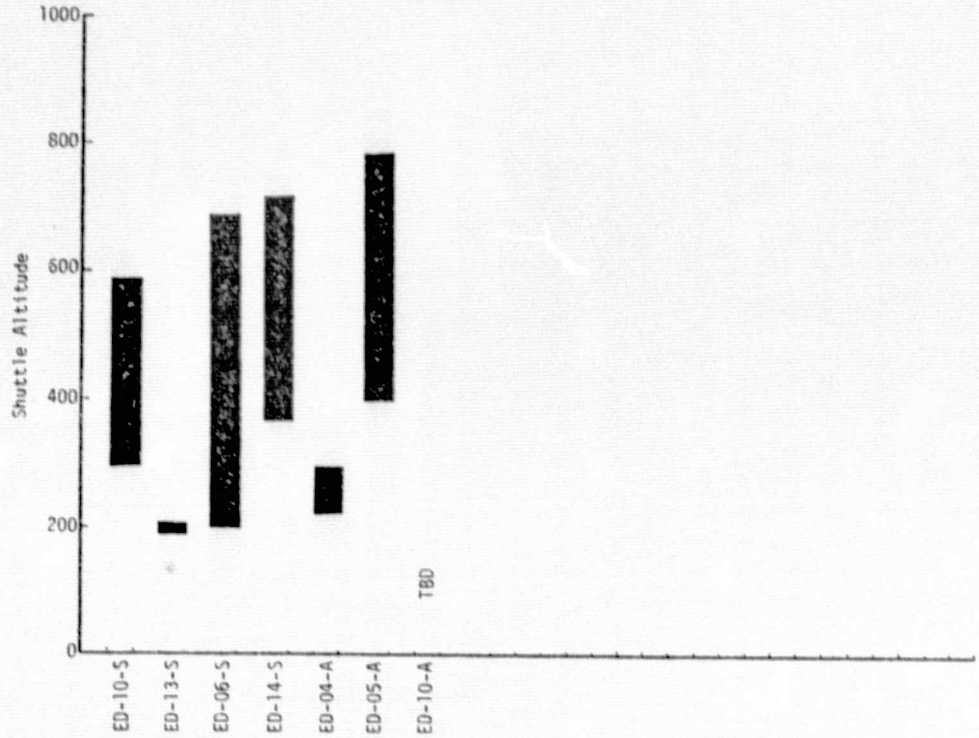

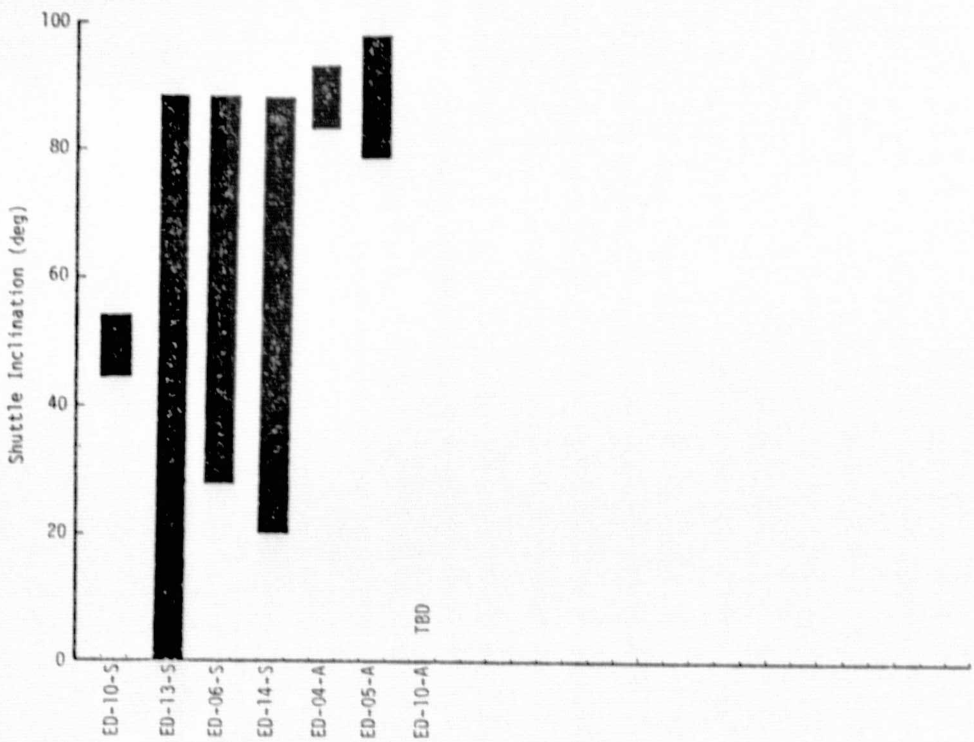

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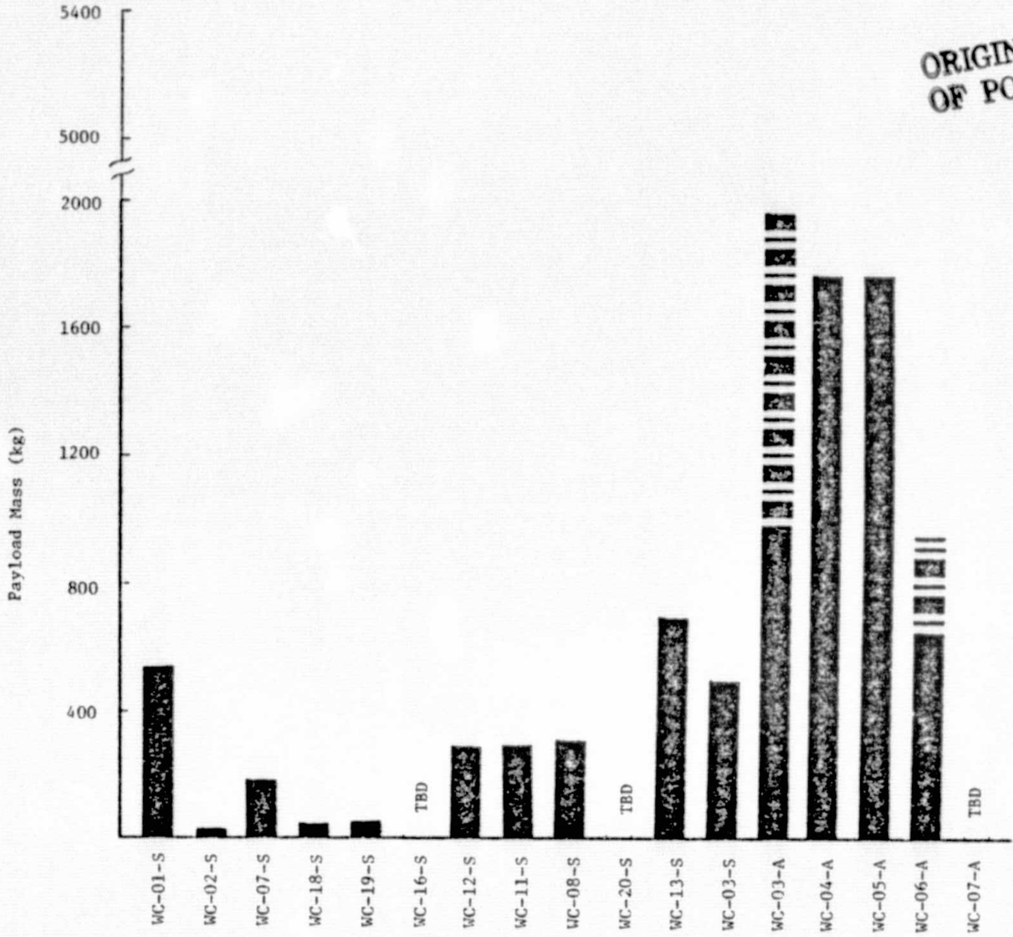

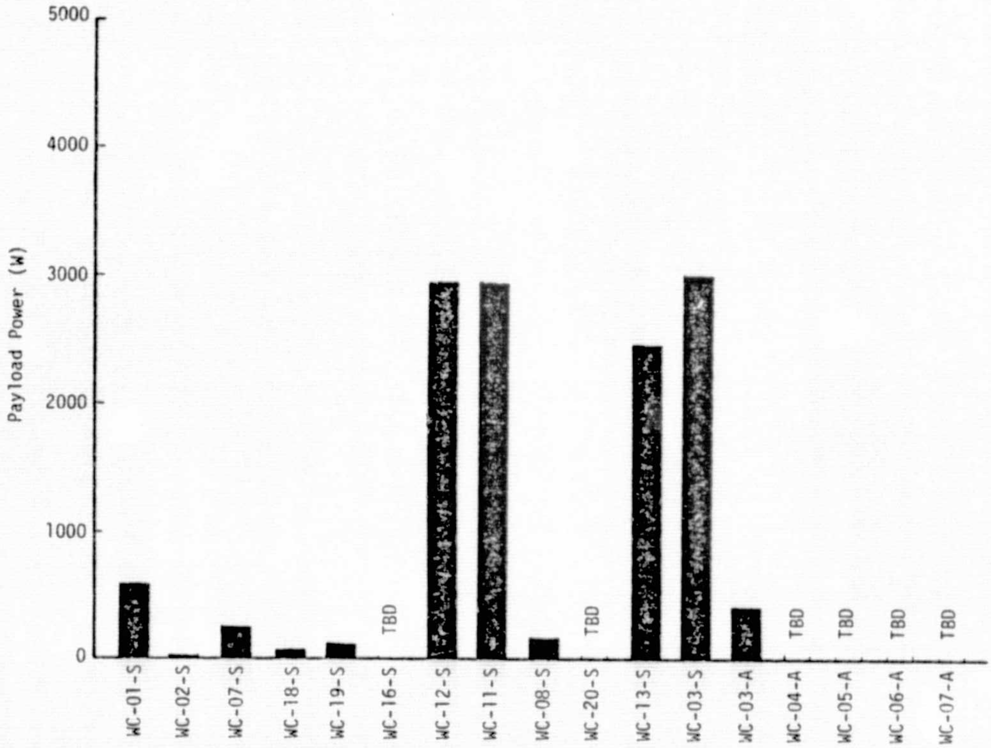

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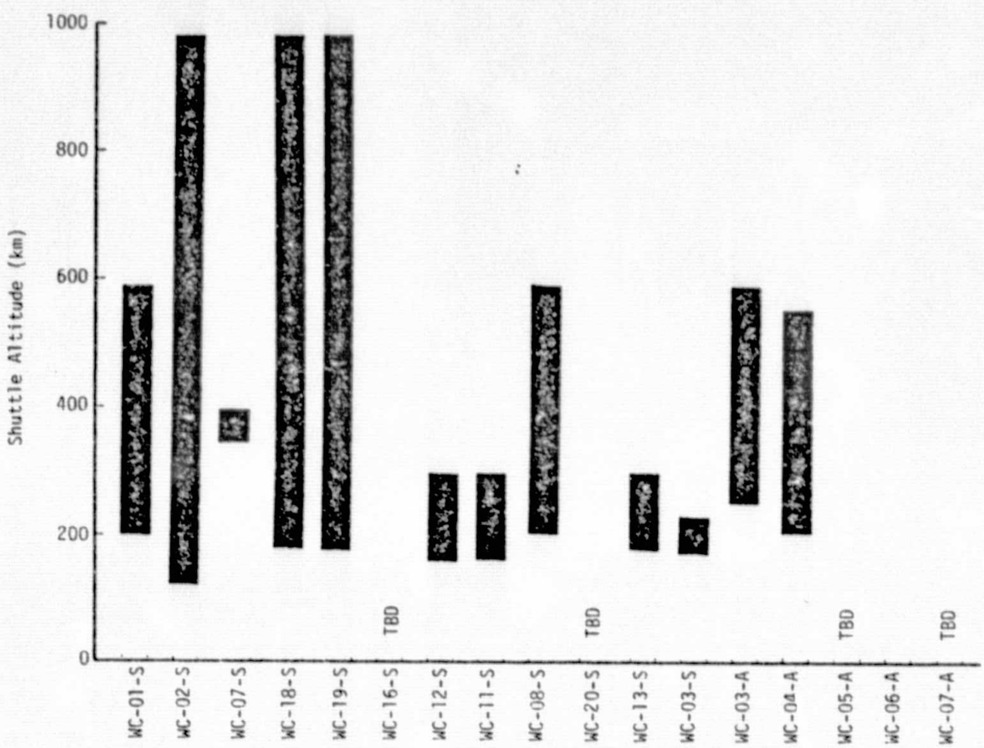

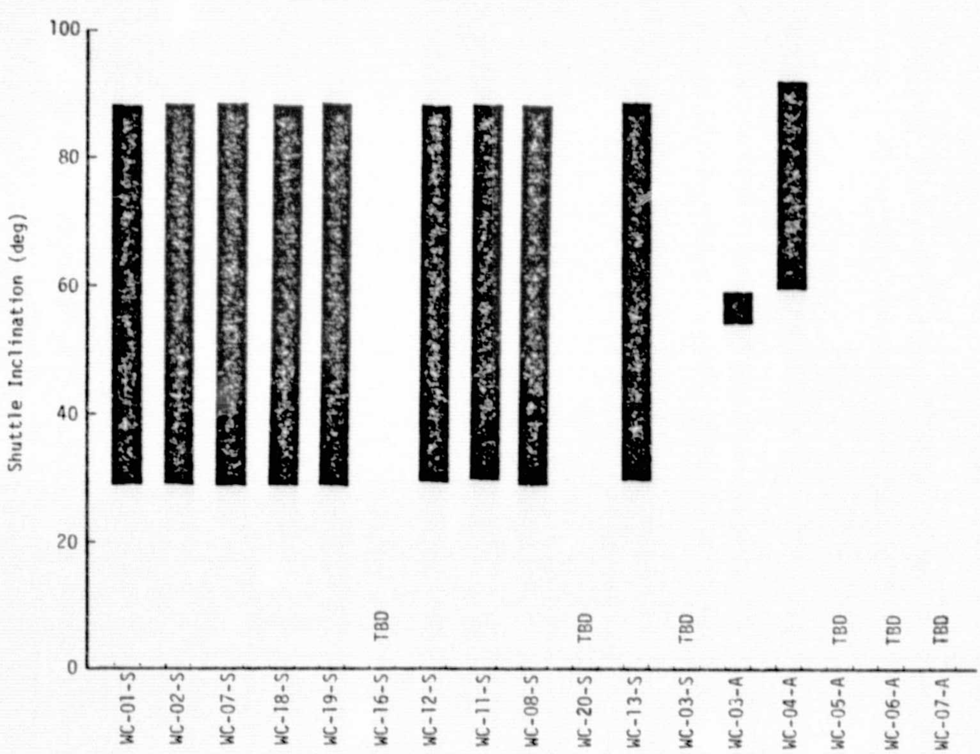

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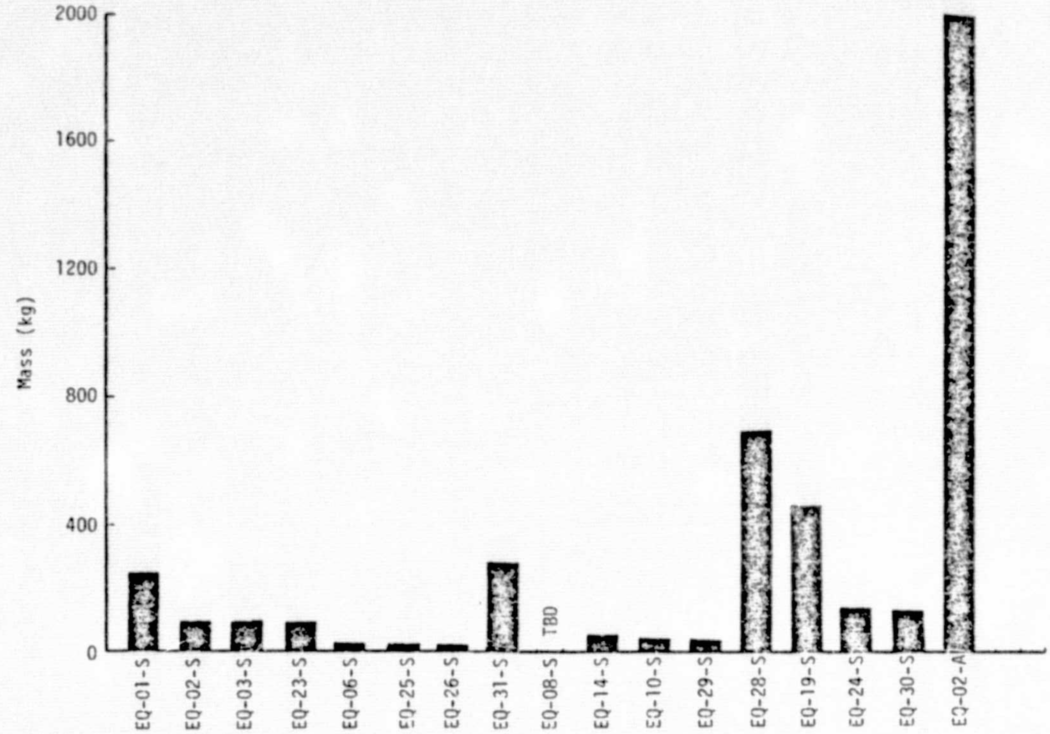

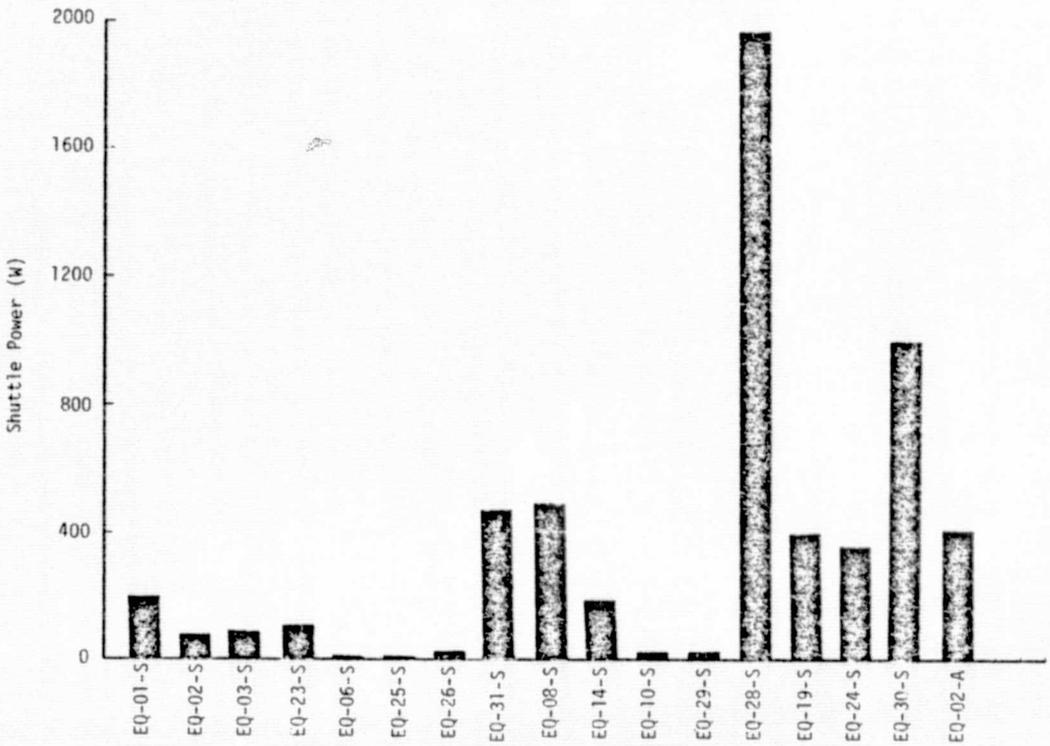

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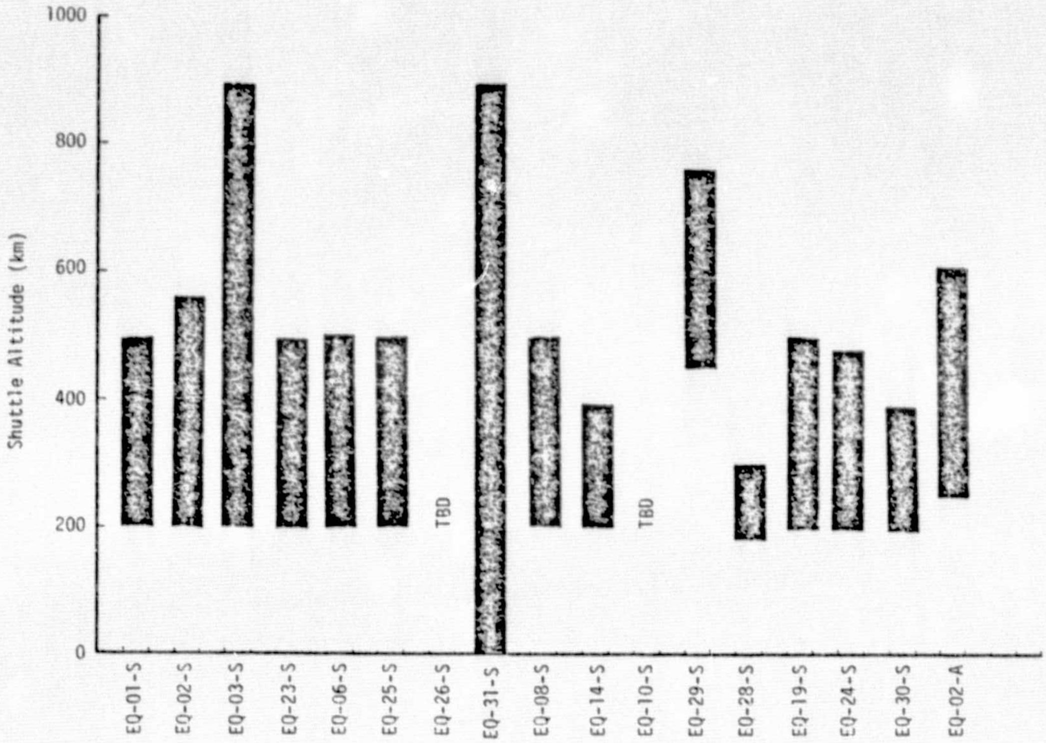
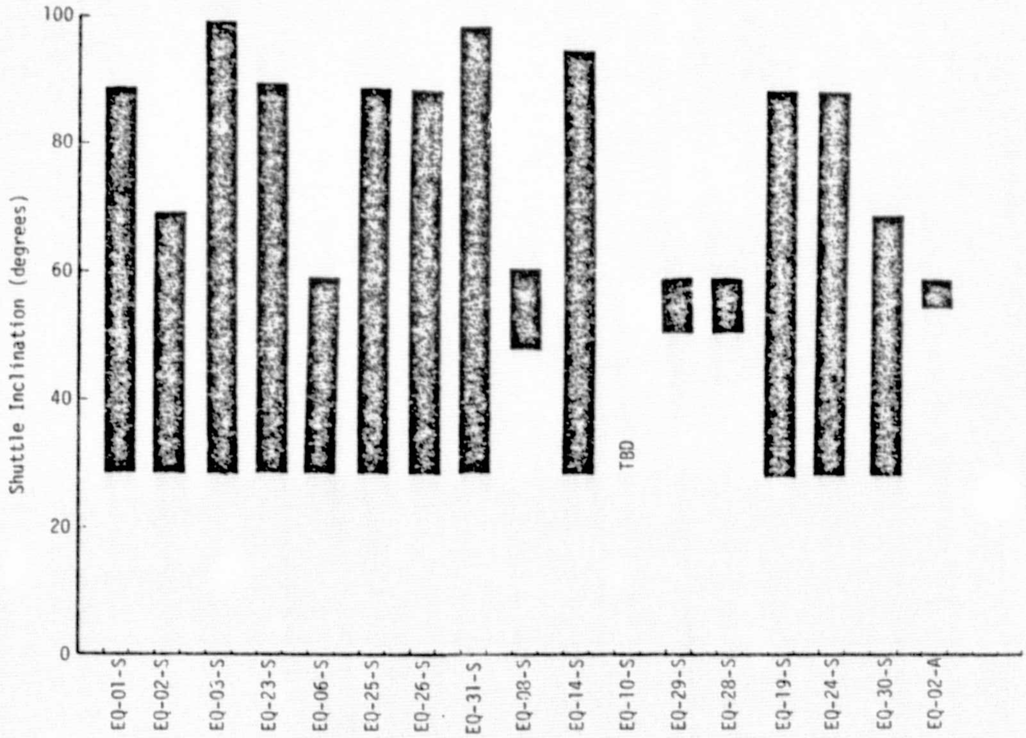
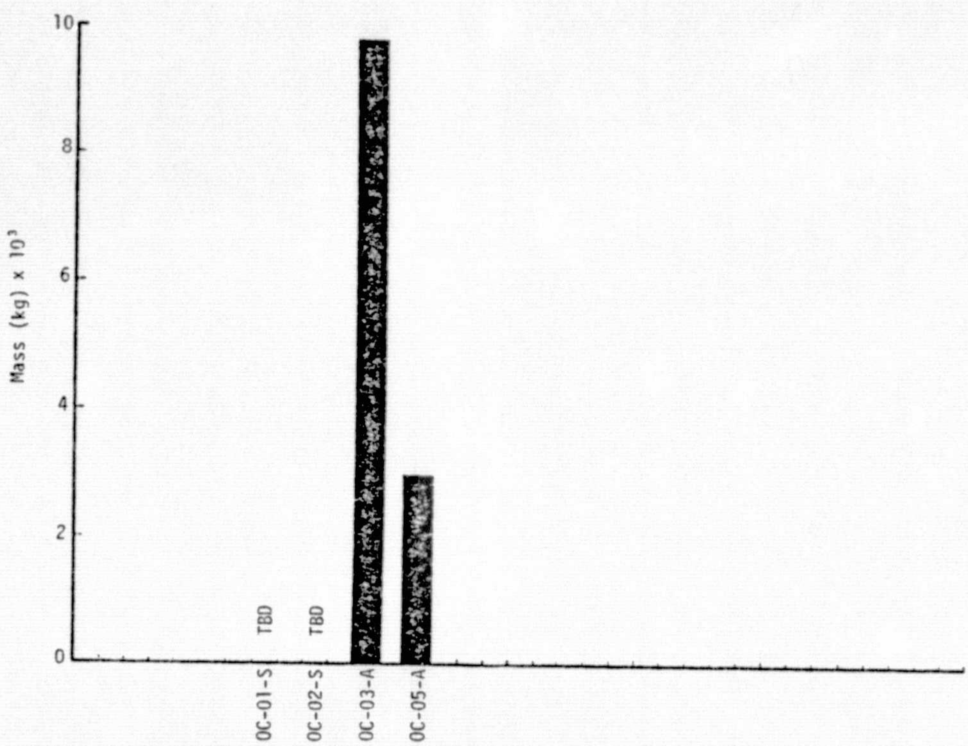
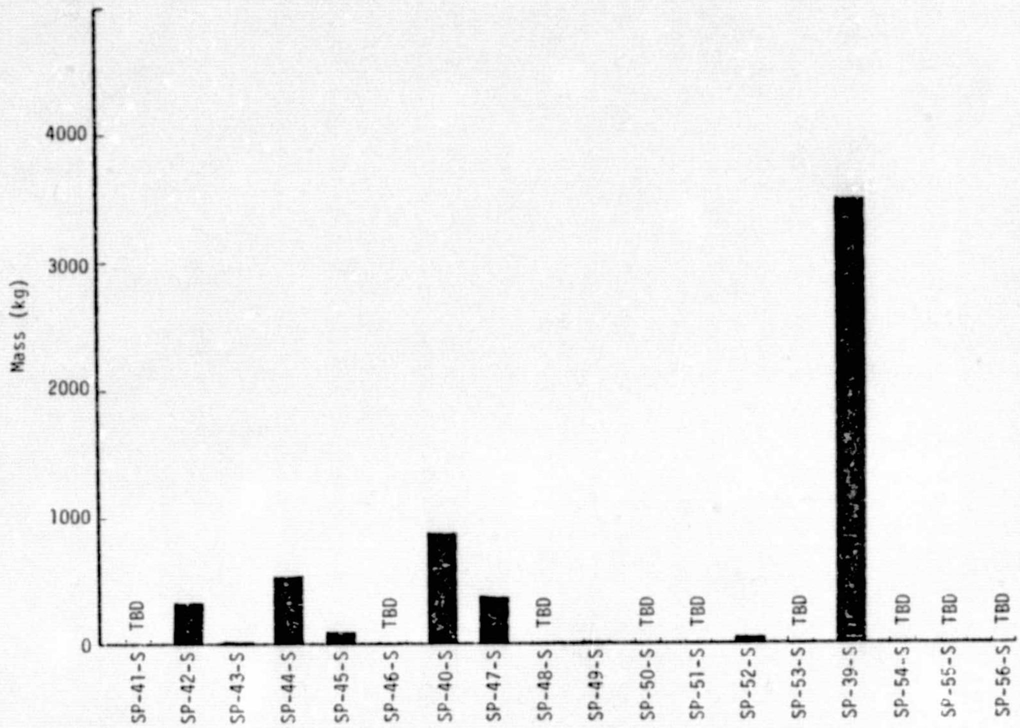


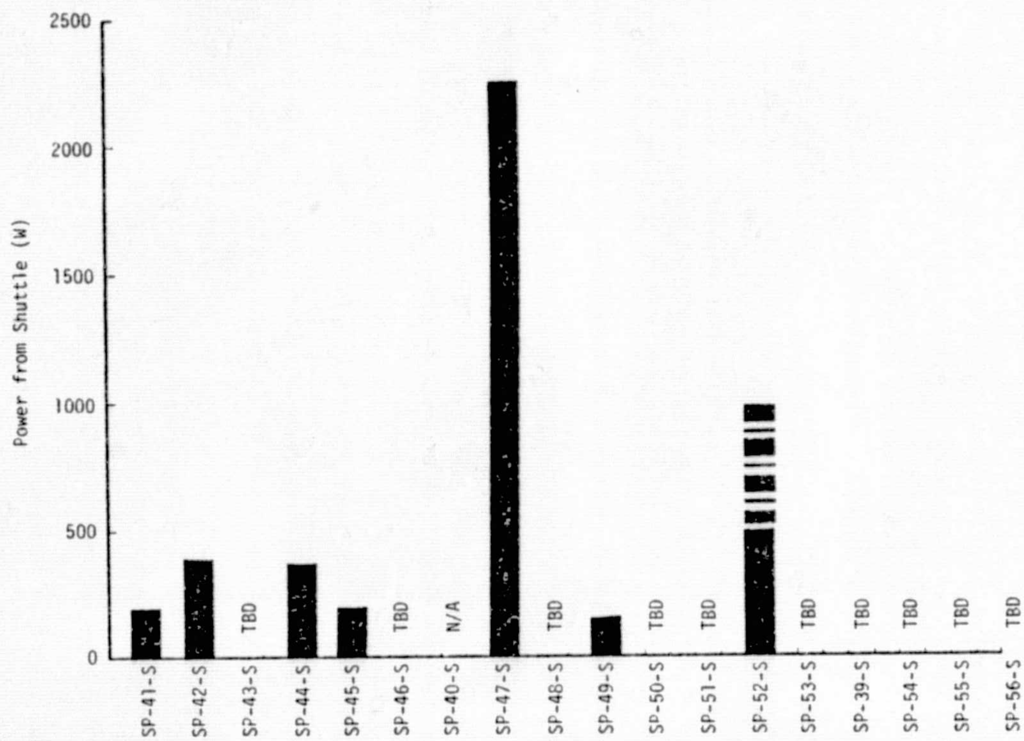


OCEAN CONDITIONS



MATERIALS PROCESSING





SPACE COMMUNICATIONS

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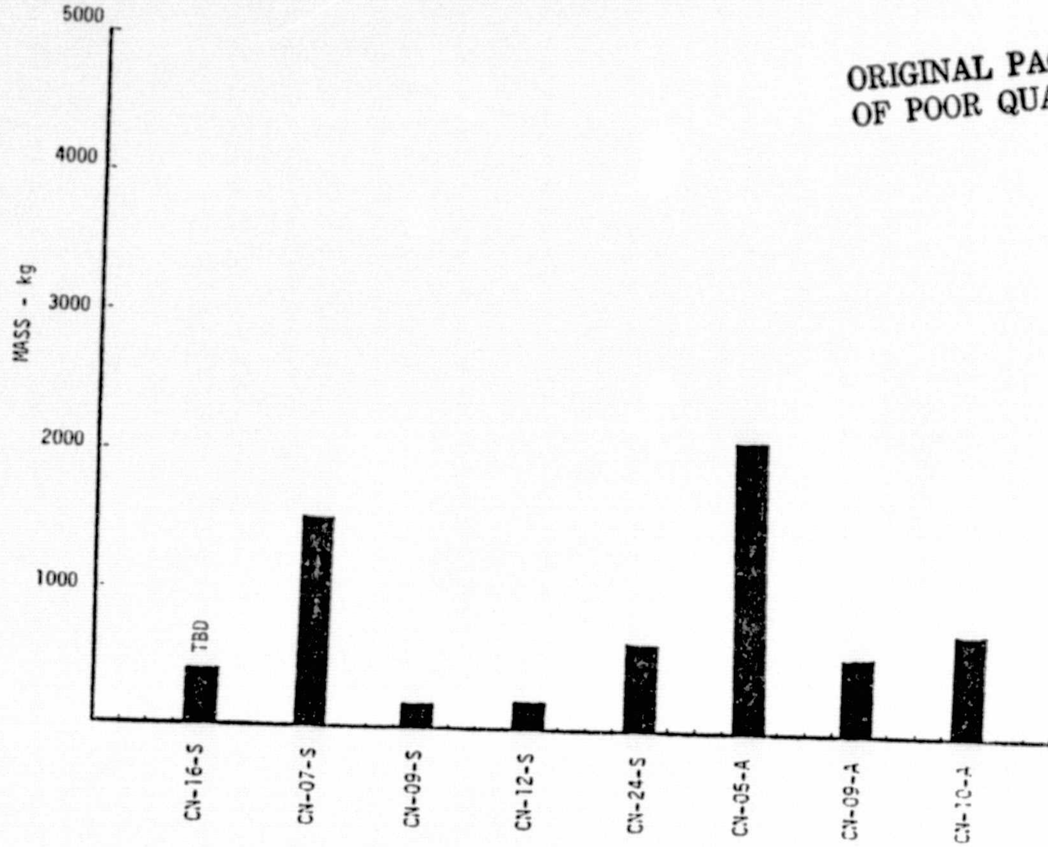

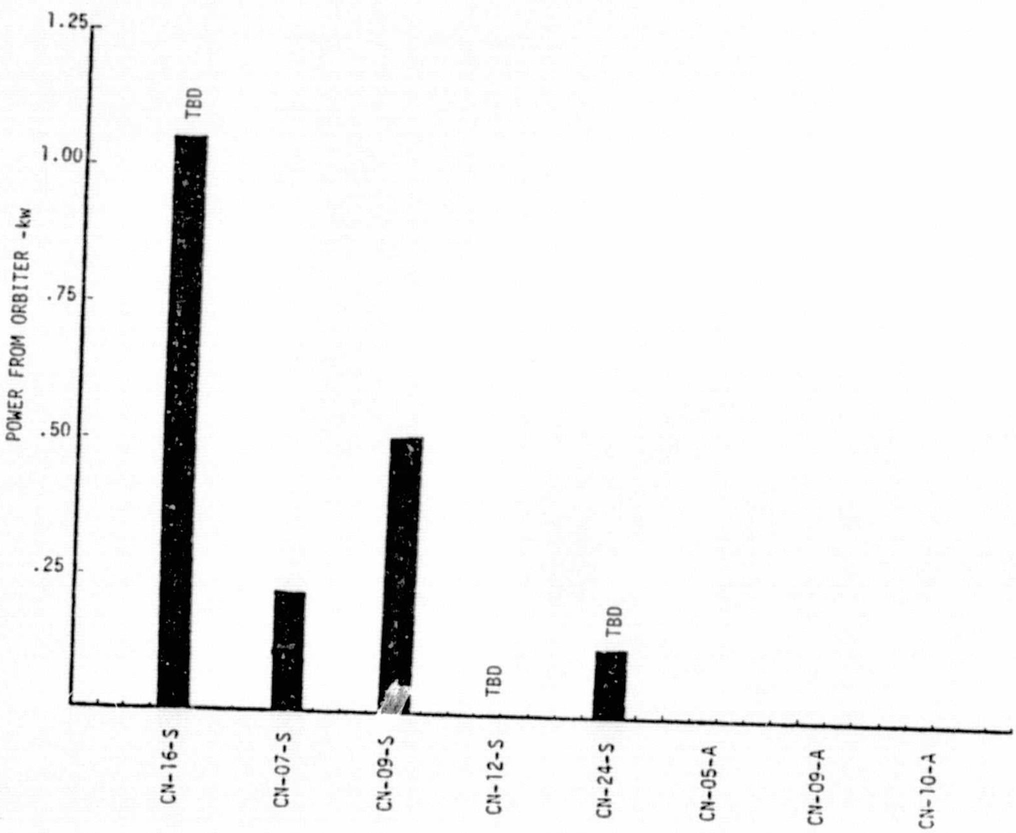

SPACE COMMUNICATIONS