

Lyndon B. Johnson Space Center
Houston, Texas
77058

Reply to Attn of

DE5/1-77/27

JAN 10 1977

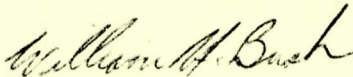
TO: Distribution

FROM: DE5/Chairman, Mission Management Board

SUBJECT: SMD III Schedule

One of the major objectives of the SMD III activity is to develop a realistic schedule at the onset and adhere to that schedule with strong discipline. In the SMD III Development Plan, control milestones were established for this purpose. We are rapidly approaching the first two controlled milestones. These are respectively the ARC Preshipment Review and the JSC Experiment Readiness Review. Definition of these reviews is on page 9.4 of the development plan. These will be the final reviews of experiment and OTR hardware in the Spacelab racks prior to installation in the mockup. Currently the ARC review is scheduled for February 1-2 at ARC, and the JSC review is scheduled for February 8 at JSC.

Accordingly, all experiment and OTR hardware should be in final phases of preparation, science verification, checkout, crew task training and rack integration. The review on February 8 should assess this degree of readiness by inspection of documentation and hardware and by certification by the individual project engineers and investigators. Experiments that are not at this state of readiness at that time will be subject to deletion from the test.



William H. Bush

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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REPLY TO
ATTN OF:

January 19, 1977

Subject: Life Sciences Spacelab Mission Development
Test III, DE-SMD-III-053

The enclosed pages contain changes approved by the Mission Management Board. Please incorporate these pages into your current document and discard all old copy.

A handwritten signature in cursive script, reading "William H. Bush, Jr.".

W. H. Bush, Jr.
MMB Chairman

REVISIONS

REV. SYM	DESCRIPTION	DATE	APPROVED
A	<p><u>Substitute</u> pages:<i>iii</i>, <i>vii</i>, 1-1, 4-3, 4-4, 4-5, 5-1, 5-2, 6-1, 7-1, 7-2 (fig. 7-1), 7-3, 7-4, 8-1, 8-2 (fig. 8-1), 8-4, 9-1, 9-2 (fig. 9-1) 9-9 (fig. 9-3), and Distribution List.</p> <p><u>Add</u> new pages: 4-6, 8-3 (fig. 8-2), and letter.</p>	1/19/77	W. H. Bush, Jr. SMD-III, MMS Chairman

ACRONYMS AND ABBREVIATIONS

A/G	Air-to-ground
AOS/LOS	Acquisition of signal/loss of signal
ARC	Ames Research Center
BESS	Biomedical Experiments Scientific Satellite
BOP	Baseline Operations Plan
CORE	Common Operational Research Equipment
DSAD	Data Systems and Analyses Directorate
ERT	Experiment Review Team
ESA	European Space Agency
FOD	Flight Operations Directorate
G.m.t.	Greenwich mean time
GSE	Ground Support Equipment
ICD	Interface Control Document
JSC	Johnson Space Center
LSD	Life Sciences Directorate
LSPDF	Life Sciences Payloads Development Facility
MMB	Mission Management Board
NASA	National Aeronautics and Space Administration
OTR	Operational Test Requirement
PET	Preliminary Evaluation Team
PI	Principal Investigator
POCC	Payload Operations Control Center
RECP	Request for Engineering Change Proposal
SMA	Science Monitoring Area
SMD-III	Spacelab Mission Development - Test III
SMS	Spacelab Mission Simulation
STS	Space Transportation System
TCA	Test Control Area
TDRSS	Tracking and Data Relay Satellite System
TOT	Test Operations Team
TRRB	Test Readiness and Review Board
TV	Television

1.0 INTRODUCTION

The third Spacelab Mission Development Test (SMD-III), to be conducted in mid 1977, is a continuation of the Life Sciences Payloads Development effort outlined in the *Spacelab Mission Simulation Program Plan* (DA-SMS-001).

Maximum benefit was derived from the experience gained during the previous Spacelab mission simulations (SMS's) in formulating this Development Plan. Spacelab Mission Development Test III features Ames Research Center (ARC) participation, extensive use of animals, adherence to as many zero-g constraints as feasible and program implementation in accordance with a realistic premission timeline. Updated operational concepts including inter-Center science management will provide experiment development experience and an early identification of Payload Operations Control Center (POCC) interface requirements. The Life Sciences payloads facility improvements for SMD-III include upgraded data, communications, and television systems.

This plan provides participants with authoritative information on the objectives, management, documentation, and schedules associated with SMD-III.

Support to the development of this plan and the subsequent assembly and preparation of this document was provided by The Boeing Company under NASA Contract NAS 9-14937.

NOTE: The title Spacelab Mission Simulation (SMS), used during SMS-I and SMS-II, has been changed to Spacelab Mission Development (SMD) to more accurately reflect the scope of these activities.

4.1.2 Spacelab Mockup (Continued)

- The lighting and air-conditioning systems have been integrated to provide the proper number of lights and lighting levels. Lighting fixtures are alternated with air-conditioning registers. Controls for the lights are placed inside the mockup to simulate Spacelab lighting control.
- An overhead stowage arrangement is provided to create a one-g storage capability which simulates the zero-g overhead stowage and underfloor routing of cables and plumbing.
- The floor has been segmented into sections similar to Spacelab. The racks are bolted to these segments to develop the integrated floor/rack segments. These segments are being used to evaluate Levels III and IV integration. Level IV integration is experiment to rack; level III integration is rack to floor.

The Spacelab development test unit is connected to the Orbiter mockup by a six-foot long simulated tunnel.

4.1.3 Ground Support Equipment (GSE) Area

A room adjacent to the test units will be designated as the GSE area and contains support equipment, *i.e.*, vacuum pumps, gas supplies, *et cetera*, as required by various experiment and operational systems in the test.

4.2 CONTROL AREAS

Control areas for SMD-III consist of a Test Control Area and a Science Monitoring Area, both located in building 36, at JSC.

4.2.1 Test Control Area

The Test Control Area, located in room 1010, simulates the activities of a Mission Control Center Flight Control Room. The Test Facility Engineering position will be manned by the LSD. The Test Director, Payloads Officer, and Flight Activities Officer positions will be manned by FOD personnel. Currently, baseline operations concepts are being utilized and evaluated by test team members. Console positions that will be located in this area are the Test Director, Payloads Officer, Flight Activities

Officer, Safety Officer, Test Facility Engineer, Television Officer, and a Simulation Supervisor.

4.2.2 Science Monitoring Area

The implementation of a Science Monitoring Area (SMA) will be a Life Sciences concept to develop and evaluate the use of a POCC to monitor experiment data during both in-house integrated testing of experiments and orbital flight. This concept eliminates reconfiguration of portions of the facility between Life Sciences flights, thus facilitating the extremely short turnaround predicted for Shuttle flights. The SMA will be located in room 1005, remote from the Test Control Area and will provide a valid simulation of remote experiment monitoring. "Downlinked" scientific and engineering data will be displayed on consoles provided for a Mission Science Manager, PI's, Experiment Coordinating Engineers, Medical Officer, and a Data Manager.

4.2.3 Remote Payloads Monitoring Facility

For the SMD-III seven-day simulated mission preparation and conduct, an area at ARC will be designated and implemented as a Remote Payloads Monitoring Facility. In this facility some of the designated ARC PI's will be able to communicate with the SMD-III Science Management Area personnel, follow the test progress, and by special communication circuits talk directly to the onboard crewmen.

4.2.4. Clinical Medicine Monitoring Station

Medical monitoring of SMD-III activities by representatives of the JSC Clinical Medicine Branch will be conducted by the Chief Test Support Physician assisted by other Test Support Physicans (on-call). This monitory activity will be accomplished from two locations:

- a. The physician's station in the SMA where the physician's review appropriate physiological data. Medical communication in this area is provided by air-to-ground loops (A/G) and downlink TV will assist the physicians in evaluating crew health status.

- b. A clinical Medicine Monitoring Console located in JSC building 8, room 128. This console provides a black and white display of Spacelab TV downlink with G.m.t. Simulated AOS/LOS is accomplished under controls from the SMD-III test control area. Communications from this console is via a black phone to the test area or black phone patched into the A/G loop. A medical private line to the crewmen is provided by the black phone (with restricted number).

4.3 SUPPORT AREAS

Support accommodations will utilize the existing Life Sciences Bioengineering Laboratory in building 36 to perform individual experiment interface and acceptance testing prior to integration. Various handling fixtures are being evaluated during Level III experiment integration, subsequent checkout, and successive integration of racks into the Spacelab mockup. Room 1009 of building 36 will be used as a buildup area to perform Level IV integration of experiments into racks. In addition, postintegration testing of experiment hardware is accomplished in this area.

4.3.1 Animal Holding Facility

An animal holding and preparation facility is implemented for SMD-III at JSC. This facility will be used as a receiving station for incoming animal test specimens. The animals will be cared for in this facility during pre- and post-test periods. During the actual simulated mission, the animal specimens will be housed in the Spacelab mockup in building 36.

4.3.2 Data Management

A new data system, being developed for SMD-III, will provide an airborne interface similar to the Spacelab system for experiment digital and analog data inputs. A digital downlink feeds a ground data system which drives SMA displays, strip charts, and printers, as well as records data on digital or analog magnetic tape. Further definition of this system is contained in the *SMD-III Data Management Plan*, DE-SMD-III-061.

During integrated testing and mission simulations the data system will be operated by the LSD and supporting contractor personnel to provide data for both resident and visiting investigators, as well as to supply an inter-Center data link to ARC. Transfer rates and formats are contingent on the ARC-supplied interface and transfer line.

4.3.3 The Communications System used during SMS-II is being up-graded to provide for inter-Center communications between JSC and ARC. Two talk/monitor loops will be provided to ARC, *i.e.*, the Science co-ordination ground loop and the Spacelab A/G loop.

5.0 TEST OPERATIONS SUMMARY

The SMD-III will be conducted in the Spacelab Mission Test Facility which includes partial mockups of the Orbiter, Spacelab, and tunnel. This facility is located in the high bay area of building 36. The test is planned to simulate the operations of a Life Sciences Payloads Spacelab Mission of one week's duration.

5.1 MANNING

A three member crew, assigned as Mission Specialist and two Payloads Specialists, will be supported by a Test Operations Team (TOT) during the seven-day test run. The TOT provides the ground support or mission control operations. Ground support consoles located adjacent to the Test Area and the Science Monitoring Area within building 36 will be manned by the appropriate flight control and experiment control personnel.

5.2 FLIGHT PLANNING

A Crew Activity Plan, developed by FOD for the test, will be used by the crew to perform orderly execution of the experiments. The Plan contains all activities presently scheduled for the Shuttle Program. Crew Activity Plan changes as well as contingency operations will be handled the same as during an actual mission.

All activities are planned to duplicate a Space Shuttle Mission as closely as possible. The flight crew-to-ground communications will be operated to simulate the two Tracking and Data Relay Satellite System (TDRSS) operations, *i.e.*, air-to-ground coverage approximately 90 percent of the time. The crew's daily activity will be a one-shift operation of approximately 12 hours. The ground support team will operate on a three-shift schedule to provide necessary support.

Data from the experiments, where applicable, will be reviewed in real-time during network coverage times, and also will be stored for downlink and playback at a later time.

5.2 FLIGHT PLANNING (Continued)

Experiments chosen to provide a cross-section of Life Sciences areas that represent typical Spacelab biomedical payloads, will give ground support personnel diverse experience in monitoring such experiments.

SMD-III operations should allow further definition of requirements, hardware, and techniques to be used in the development of the actual orbital Life Sciences Spacelab missions.

A flight planning integrated schedule containing both LSD control milestones and the FOD activities required to support this test date will be provided by FOD. This schedule will be maintained by FOD and revised as necessary during the test buildup. However, an all-out effort will be made to meet each of the major milestones.

One of the FOD objectives for SMD-III is the development of an integrated schedule for the preflight planning activities necessary to support a Life Sciences Spacelab flight. To properly evaluate this objective, it is imperative that the major LSD development milestones be maintained.

5.3 SAFETY PLAN

Safety protocols require certain minimum standards for manned tests in possible hazardous environments. The facility, Orbiter and payload mockup, demonstration hardware, and related support equipment, must conform to safety codes defined in the JSC Safety Manual. All experiment systems must be functionally checked during the pretest preparation phase. A hazard analysis to insure safety of personnel and to prevent damage to equipment is being accomplished. A manned dry run will be required to identify operational problems and to evaluate procedures. A Test Readiness and Review Board (TRRB) will review all aspects of readiness and safety before transition is made into the Test Performance Phase.

6.0 EXPERIMENT DEVELOPMENT AND IMPLEMENTATION

Each of the SMD-III experiments will be developed by one of three implementation routes depending upon the experiment source, the location of the experiment development, and the center having the integration responsibility. These experiments are grouped in accordance with the following three implementation routes.

Group A - ARC experiments developed and integrated at ARC.

Group B - ARC experiments developed at ARC and integrated at JSC.

Group C - JSC experiments developed and integrated at JSC.

Detailed information on SMD-III Experiments and OTR's is contained in the SMD-III *Detailed Experiment/OTR Objectives and Requirements* (DE-SMD-III-062).

7.0 ORGANIZATION AND MANAGEMENT

7.1 TEST MANAGEMENT

SMD-III will be conducted under the joint auspices of JSC and ARC with JSC performing the Lead Center functions. The management organizations for directing SMD-III activities at these two Centers are shown in figure 7-1.

The Life Sciences Inter-Center Review Board will be responsible for the overall direction and management of the SMD-III test; the planning, development and implementation will be carried out and directed by the MMB Executive Committee. The SMD-III MMB, under the direction of the Executive Committee Chairman, will be responsible for translating mission requirements into specific implementation plans, establishing schedules, providing configuration control, and managing documentation. Membership of the MMB Executive Committee is as follows:

Chairman - W. H. Bush, Jr.
JSC Science Manager - J. A. Rummel, Ph. D.
ARC Project Manager - W. E. Berry
ARC Science Manager - P. X. Callahan, Ph. D.

7.1.1 Johnson Space Center Responsibilities

The JSC Life Science Directorate will be responsible for the overall conduct of the SMD-III test simulation. Specifically, they will be responsible for the mission functions listed below and defined in the supporting documentation listed in Section 8.0.

- To implement SMD-III test facility and supporting ground station.
- To perform Level III and higher integration of the mission payload at JSC.
- To perform Level IV and higher integration of all experiments at JSC.
- To provide documentation per section 8.0.
- To conduct mission planning and operations.

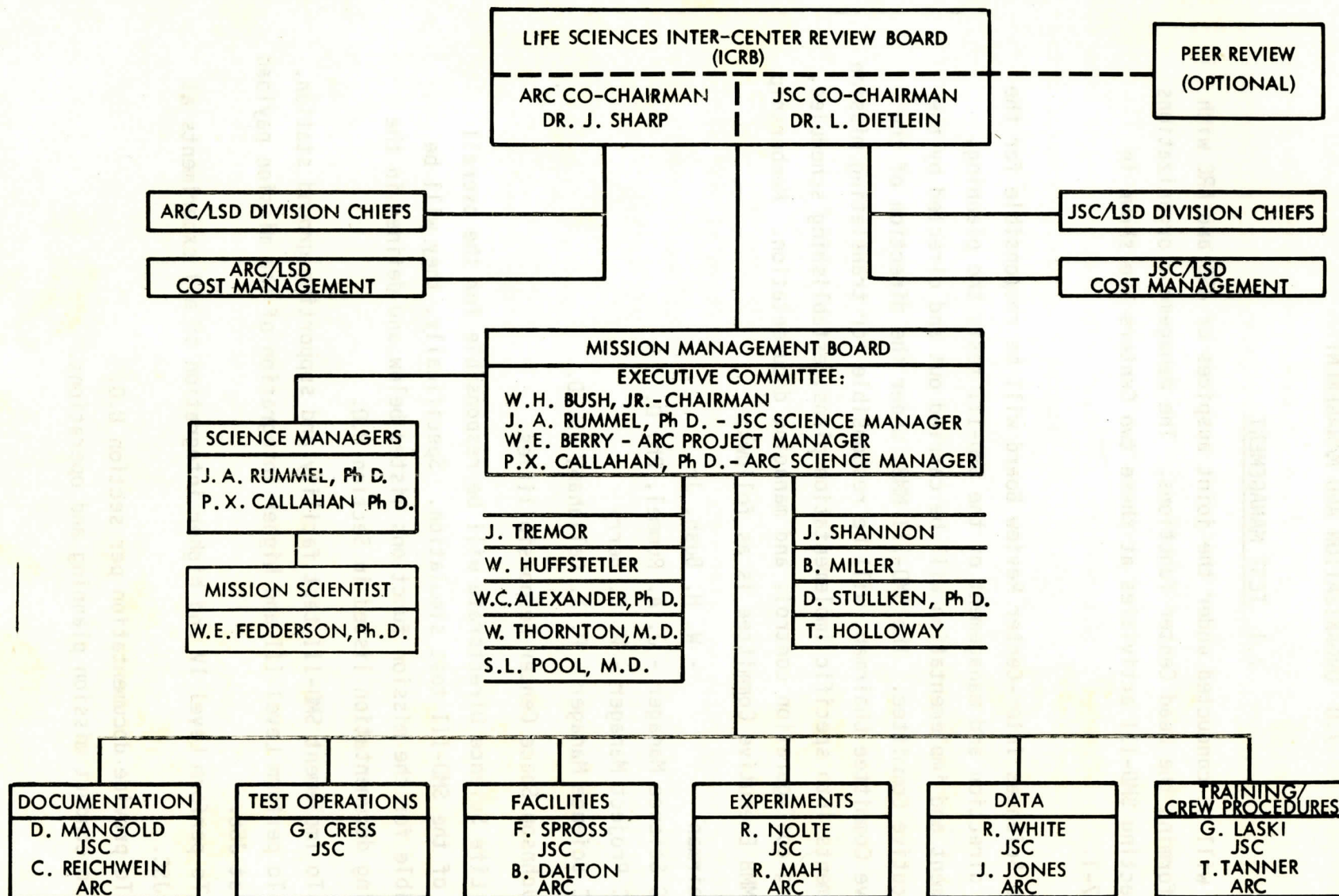


Figure 7-1. SMD-III management organization.

7.1.1 Johnson Space Center Responsibilities (Continued)

- ° To implement test units and CORE equipment which include:
 - CORE and experiment section floor segments,
 - floor segment ground support equipment,
 - Spacelab equivalent racks (Bud Radio),
 - onboard refrigerators and freezers,
 - microbiological incubators, and
 - centrifuge (refrigerated - 2000-g).
- ° To design, develop, fabricate and test all human experiments.
- ° To perform data handling and dissemination.
- ° To develop crew procedures and timelines.

7.1.2 Ames Research Center Responsibilities

The ARC Life Science Directorate will be responsible for providing both human and biological experiments for the test. Their responsibilities will include the following functions:

- ° To design, develop, fabricate and test all selected biological experiments.
- ° To perform Level IV integration at ARC of all biological experiments to the JSC-provided floor segments and racks.
- ° To provide Principal Investigator and engineering support to Level III and higher integration as well as the actual simulation.
- ° To provide one prime and one backup Payload Specialist.
- ° To implement payload hardware which includes:
 - two primate unit specimen holding facilities (2 double racks),
 - two rodent unit specimen holding facilities (2 single racks),
 - one each BESS-type primate (single) and rat (12 specimens) transporters,
 - one surgical bench (1 double rack),
 - six racks integrated with biological experiments,
 - all biological experiment peculiar hardware and special ground support equipment, and
 - human experiment peculiar hardware as described in the experiment interface documents.

7.1.2 Ames Research Center Responsibilities (Continued)

- ° To provide all flight, flight backup and ground control animals.
- ° To provide Principal Investigator support for ARC experiments.
- ° To provide experiment procedures and descriptive documentation.
- ° To man Remote Payload Monitoring Facility and the Science Monitoring Area.

7.2 EXPERIMENT SELECTION

7.2.1 Format

Details of the experiment selection process are depicted in figure 7-2. The general format of experiment proposals should conform to appendix A of Document NHB8030.6, July 1974, *Guidelines for Acquisition of Investigations*. Since this is the present National Aeronautics and Space Administration (NASA) policy and will be the format utilized for all Spacelab experiment proposals, it was requested that all SMD-III experiment proposals submitted use this guideline, format, and fact sheets. "Operational" investigations or studies should be proposed in an OTR format.

Animal experiments will be submitted to ARC and human experiments and OTR's to JSC. JSC and ARC will organize an Experiment Review Team (ERT) to review, accept/reject, and prioritize their cognizant proposals. As an example, at JSC each branch of the Biomedical Research and Operations Division will select two members for the ERT. These individuals plus two members of the Life Sciences Experiments Working Group (DB6) will review all applicable (human) experiments (ARC and JSC) and OTR's for overall compliance with SMD-III scientific goals.

Selected experiments from both Centers will be submitted to the Mission Management Board Chairman. A Preliminary Evaluation Team (PET) consisting of representatives from JSC and ARC will evaluate the experiments

8.0 DOCUMENTATION REQUIREMENTS

This section establishes SMD-III documentation requirements including responsibility for the development of the documents and the levels of approval required. As Lead Center, JSC has overall responsibility for SMD-III documentation. ARC will provide inputs to science-oriented documentation and will review and approve documents which impact their participation in the test.

The documents identified in figure 8-1 are considered to be of minimum program Level I; they contain requirements for planning, developing, implementing, and reporting various test program elements. (A documentation schedule will be shown in paragraph 9.3 of section 9.0 at a later date.) The organization of SMD-III documentation is shown in Figure 8.2.

Rev. A, 1/19/77

8-2

<u>Document</u>	<u>NASA Responsible Person</u>	<u>Contractor Support Required</u>	<u>ARC Inputs Required</u>	<u>Approvals</u>
SMS Program Plan (Update)	W. H. Bush, Jr.	Boeing	-	JSC LSD Director
SMD-III Detailed EXP/OTR Objectives and Requirements	J. A. Rummel, Ph. D.	Boeing	Yes	MMB Chairman
Animal Health Assurance Plan	R. A. Hoffman, D.V.M.	TI*	Yes	LS IRB
SMD-III Medical Support Plan	S. L. Pool, M.D.	-	-	JSC LSD Director
SMD-III Development Plan	F. R. Spross	Boeing	Yes	LS IRB
Payload Implementation Document	F. R. Spross/R. W. Nolte	Boeing	Yes	MMB Chairman
SMD-III Data Management Plan	R. C. White	AFC/MMC [†]	Yes	MMB Chairman
Design Packages	Each Hardware Coordinator	-	Yes	MMB Chairman
Stowage List	F. R. Spross/R. W. Nolte	GE	Yes	N/R
Close-out Photos	F. R. Spross	GE	Yes	N/R
Crew Activity Plan	J. L. Garner	-	Yes	N/R
Crew Procedures and Malfunctions	C. F. Sawin, Ph. D.	Boeing	Yes	N/R
Flight Rules	G. H. Cress	-	Yes	LS IRB
Console Handbook/Test Procedures/Logistics	G. H. Cress	-	-	N/R
Training Plan	G. Laski	-	Yes	N/R
Safety Plan	R. J. Miller	-	Yes	MMB Chairman
Space Transportation System Flight Operations Development Plan	G. H. Cress	-	-	N/R
Report	F. R. Spross	Boeing	Yes	LS IRB
Spacelab Microbial Contamination Control	G. R. Taylor, Ph. D.	-	Yes	LS IRB

*TI = Technology Incorporated
[†]AFC = Aeronutronic Ford Corp.

MMC - Martin Marietta Corp.
 IRB - Inter-Center Review Board

Figure 8-1. SMD-III documentation list.

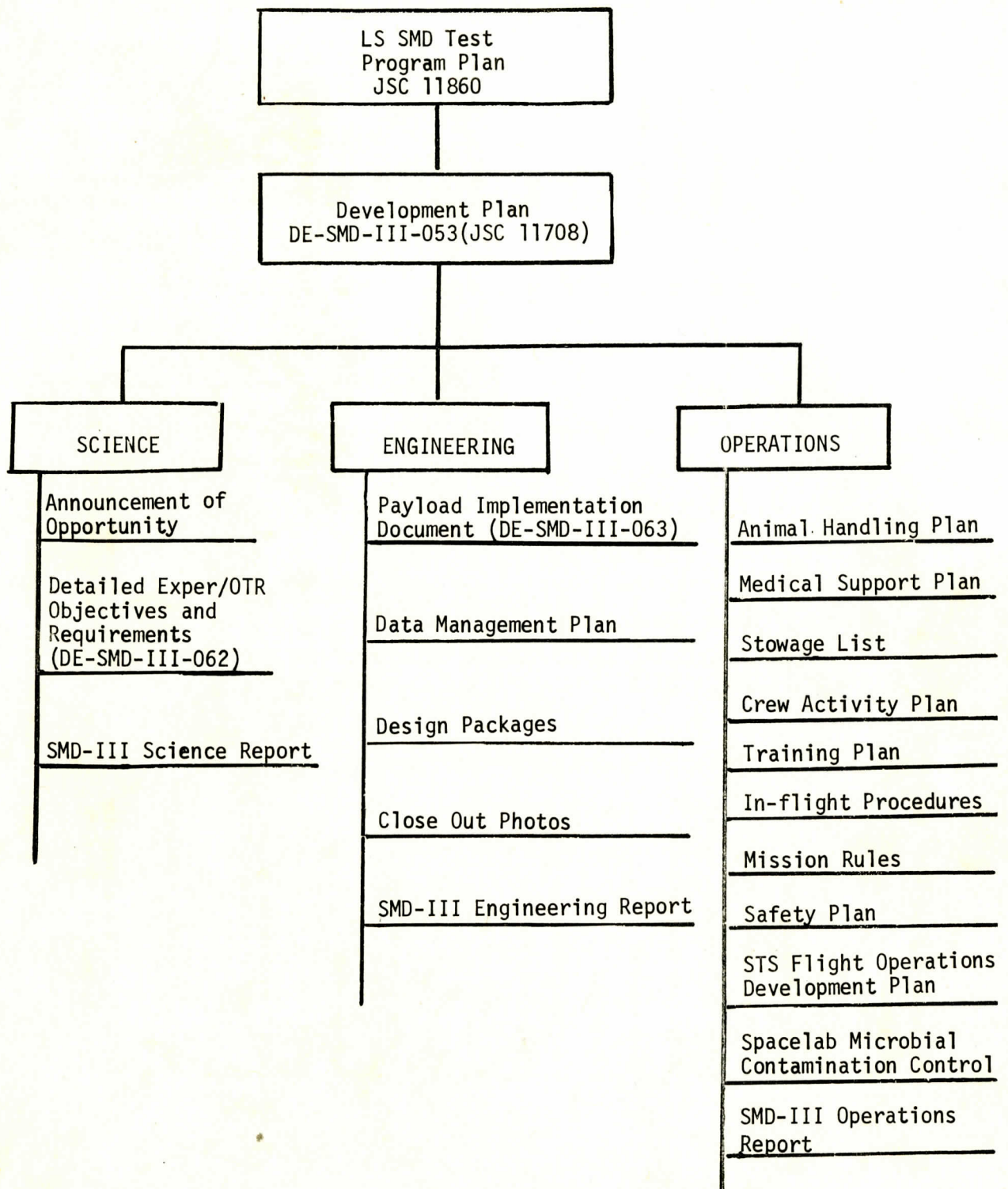


Figure 8-2. SMD-III Documentation Tree.

9.0 DETAILED SCHEDULES

SMD-III detailed schedules include:

- SMD-III Master Schedule
- SMD-III ARC Internal Schedule
- SMD-III JSC Documentation Schedule

To meet the March 1977 test date, the following experiment selection process schedule has been established and should be adhered to:

- Experiment/OTR proposal submittal/resubmittal in proper format to ERT - August 6, 1976.
- ERT review and submittal to MMB - August 31, 1976.
- MMB review and submittal to PET.
- PET review and recommendation to MMB - September 7, 1976.
- MMB recommendation of final payload to Inter-Center Review Board - October 14, 1976.
- Inter-Center Review Board final approval and go-ahead - October 19, 1976.

9.1 SMD-III MASTER SCHEDULE

The Master Schedule (fig. 9-1) presents a chronology of major activities to be accomplished during the preparation, integration and operational phases of SMD-III. This schedule contains JSC, ARC and KSC milestones. The KSC associated activities are for reference only to facilitate JSC mission planning and time-line development and as such will not be actually accomplished at KSC during SMD-III.

A description of each line item on the Master Schedule is contained in table 9-1.

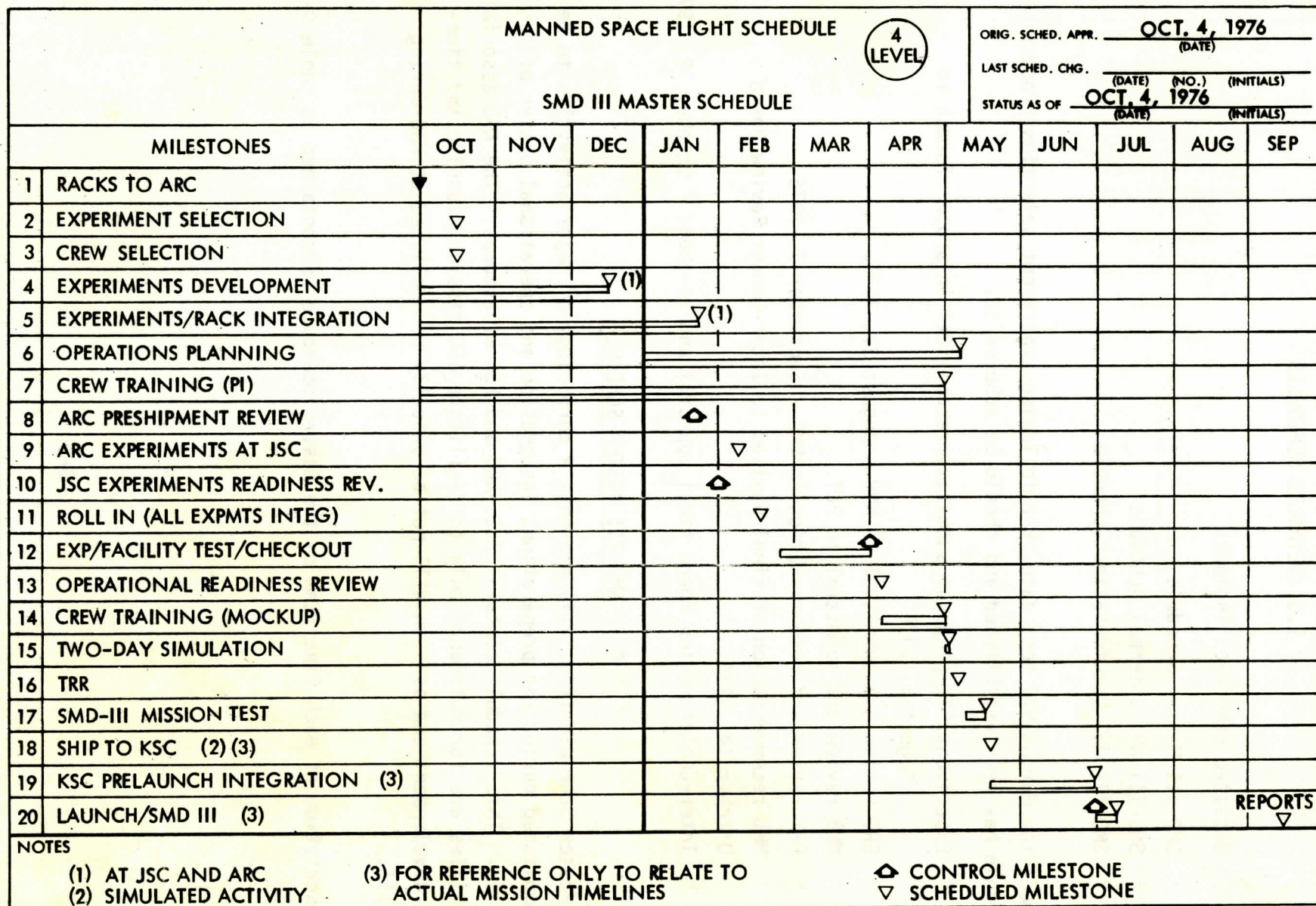


Figure 9-1. SMD-III Master Schedule.

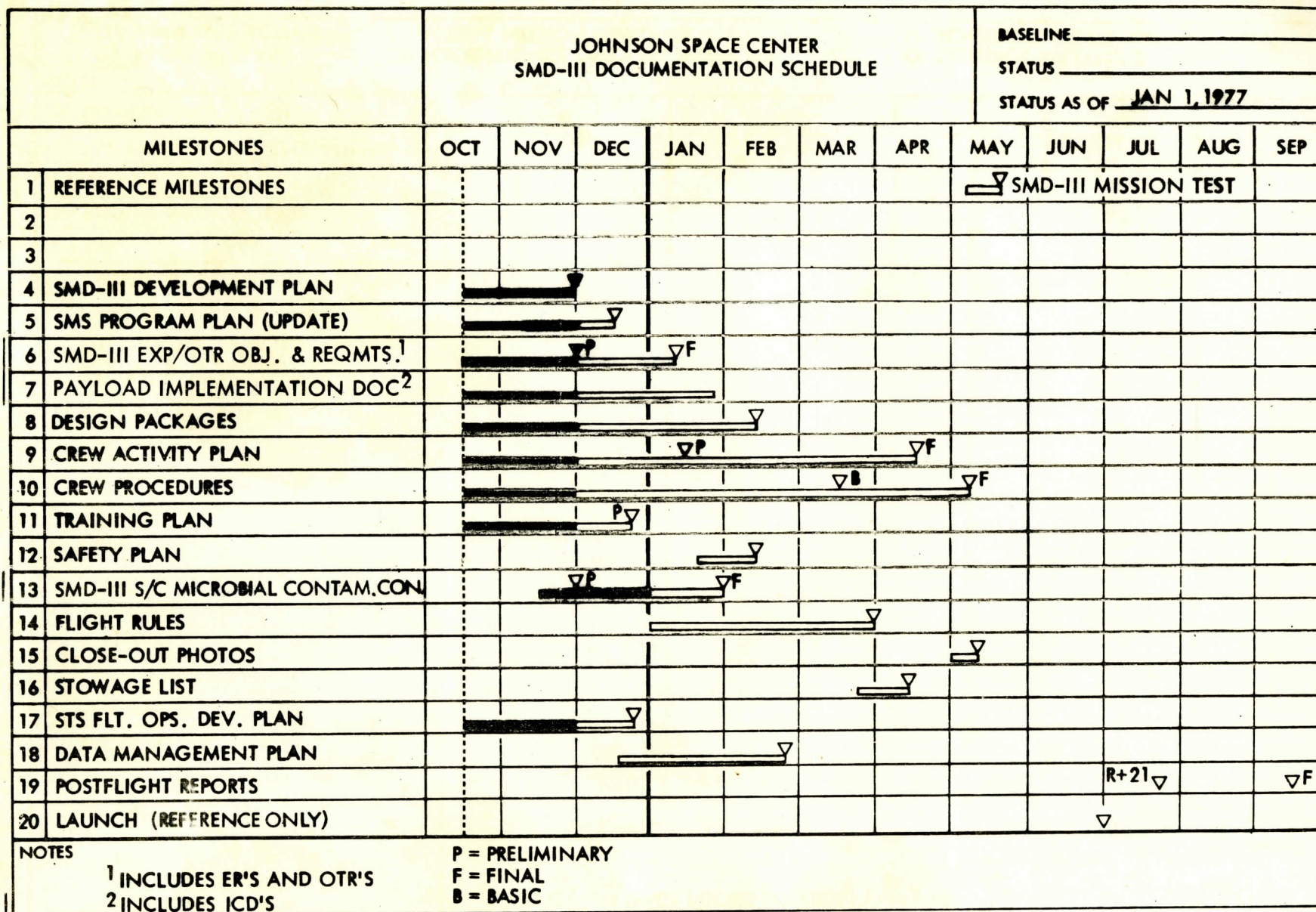


Figure 9-3. JSC documentation schedule.

NASA-JSC

9-9

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