FLIGHT EXPERIMENT DEVELOPMENT PROJECT PLAN

Space & Life Sciences Directorate

Draft: 20 December, 1999

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center

Houston, Texas

FLIGHT EXPERIMENT DEVELOPMENT PROJECT

Biomedical Research and Countermeasures Program

Human Space Life Sciences Programs Office

PROJECT PLAN

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DATE

ACRONYMS

AO	Announcement of Opportunity
ARC	Ames Research Center
BRC	Biomedical Research and Countermeasures Program
CCB	Configuration Control Board
CDR	Critical Design Review
CEVP	Countermeasures Evaluation and Validation Project
DSO	Detailed Supplementary Objective
DTO	Development Test Objective
ECM	Engineering, Cost, and Management Review
ED	Experiment Document
EP	Equivalent Personnel
ERR	Experiment Requirements Review
FACB	Flight Activities Control Board
FEDP	Flight Experiment Development Project
FTSOD	Flight Test and Supplementary Objectives Document
FTE	Full-Time Equivalent
HEDS	Human Exploration and Development of Space
HLS	Human Life Sciences
HRF	Human Research Facility
HRMRB	Human Research Multi-Lateral Review Board
HSLSPO	Human Space Life Sciences Programs Office
ICB	Integration Control Board
IRB	Institutional Review Board
JSC	Johnson Space Center
KSC	Kennedy Space Center
LSFEP	Life Sciences Flight Experiment Program
LSD	Life Sciences Division; Code UL
MSDCCB	Medical Sciences Configuration Control Board
NASDA	National Space Development Agency
NOA	New Obligation Authority
NRA	NASA Research Announcement
OLMSA	Office of Life and Microgravity Sciences and Applications; Code U
PI	Principal Investigator
PDR	Preliminary Design Review
PMR	Project Management Report
SLSD	Space and Life Sciences Directorate
TCR	Technical Cost Review

CHANGE LOG

REVISION	EFFECTIVE DATE	DESCRIPTION
Baseline	11/02/2000	Original Document

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this document is to set forth the primary goals of the Flight Experiment Development Project (FEDP) and to describe project activities in terms that are applicable to all platforms and payloads supported by FEDP.

1.1 Project Identification

The Human Space Life Sciences Programs Office (HSLSPO) is an office established within the Space and Life Sciences Directorate (SLSD) at Johnson Space Center (JSC). HSLSPO is charged with the oversight of three "human element" programs, one of which is the Biomedical Research and Countermeasures Program (BRC). The BRC Program was developed in response to requirements outlined in the HSLSPO Lead Center Management Plan dated January 1997. The JSC FEDP is one of the projects under the guidance of BRC Program.

1.2 Overview

One of NASA's primary responsibilities is to understand and mitigate the deleterious effects of space flight on human health, well being, and performance. Specifically, the Strategic Plan for NASA's Human Exploration and Development of Space (HEDS) Enterprise outlines a number of goals and objectives, one of which is to:

> ***"Develop biomedical knowledge and technologies to maintain human health and performance in space".***

A critical component of fulfilling these responsibilities is to provide for the flight of relevant biomedical experiments. These experiments seek to elucidate the physiological and psychological adaptations that occur in response to the space flight environment. In order to design countermeasures against the deleterious effects of microgravity on the human body, NASA must first gather a foundation of physiological and psychological data upon which such countermeasures can be based.

Within the BRC Program, the FEDP is charged with implementing, managing, and supporting those biomedical investigations that require access to space. Figure 1 depicts how the JSC programmatic and project elements are aligned with the overall HEDS Enterprise.

2.0 OBJECTIVES

2.1 Objectives

Consistent with the BRC Program objectives, the primary objective of the FEDP is to define, develop, and conduct investigations in space. These investigations shall utilize the unique microgravity environment for the advance of science conducted both in space and on Earth.

The goal of the FEDP is to furnish experiment Principal Investigators (PIs) with the requisite resources and management support for flying human life sciences (HLS) experiments on any of the available orbital platforms. The FEDP is actively involved in the solicitation, selection, definition, development, and flight of these experiments. Life sciences investigations are assigned as Detailed Supplementary Objectives (DSOs) or Development Test Objectives (DTOs) dependent upon the experiment resource requirements and the availability of flight opportunities.

2.2 Performance

The primary indicator of performance is considered to be the successful design, development, and flight of human biomedical investigations in space.

3.0 CUSTOMER DEFINITION AND ADVOCACY

The principal customers of the FEDP are NASA Headquarters, the Office of Life and Microgravity Sciences and Applications Life Sciences Division (OLMSA Code UL). The experiment PIs managed by the FEDP are the primary focus for research implementation. NASA spaceflight crewmembers ultimately benefit from the accomplishments of the program. Experiment PIs are drawn from academic institutions, government laboratories, private enterprise organizations, as well as foreign academic and private institutions. The transfer of technologies and approaches for commercial utilization represents an additional, possibly significant, source of beneficiaries.

The customer advocacy process shall be implemented and managed by Headquarters Code U. Because experiment PIs are the direct customers of FEDP, the project promotes customer advocacy directly via annual customer surveys. These surveys solicit feedback on FEDP performance and customer satisfaction.

4.0 PROJECT AUTHORITY

The FEDP is the programmatic successor to the JSC Field Center organizational arm (project office) established by the NASA Headquarters Life Sciences Flight Experiments Program (LSFEP) in 1979. The JSC Field Center was chartered to manage the definition, development, and flight of human biomedical experiments selected for flight on the Space Shuttle and its associated in-flight laboratories and resources.

JSC is designated as the Lead Center for the FEDP, while Ames Research Center (ARC) and Kennedy Space Center (KSC) are the two FEDP Supporting Centers. Significant interfaces, in addition to these Lead and Supporting Centers designations, are described in Section 5.2.

5.0 MANAGEMENT

The FEDP manages the HLS flight experiment component of the BRC. The BRC structure and its program and center relationships are shown in Figure 1 below.

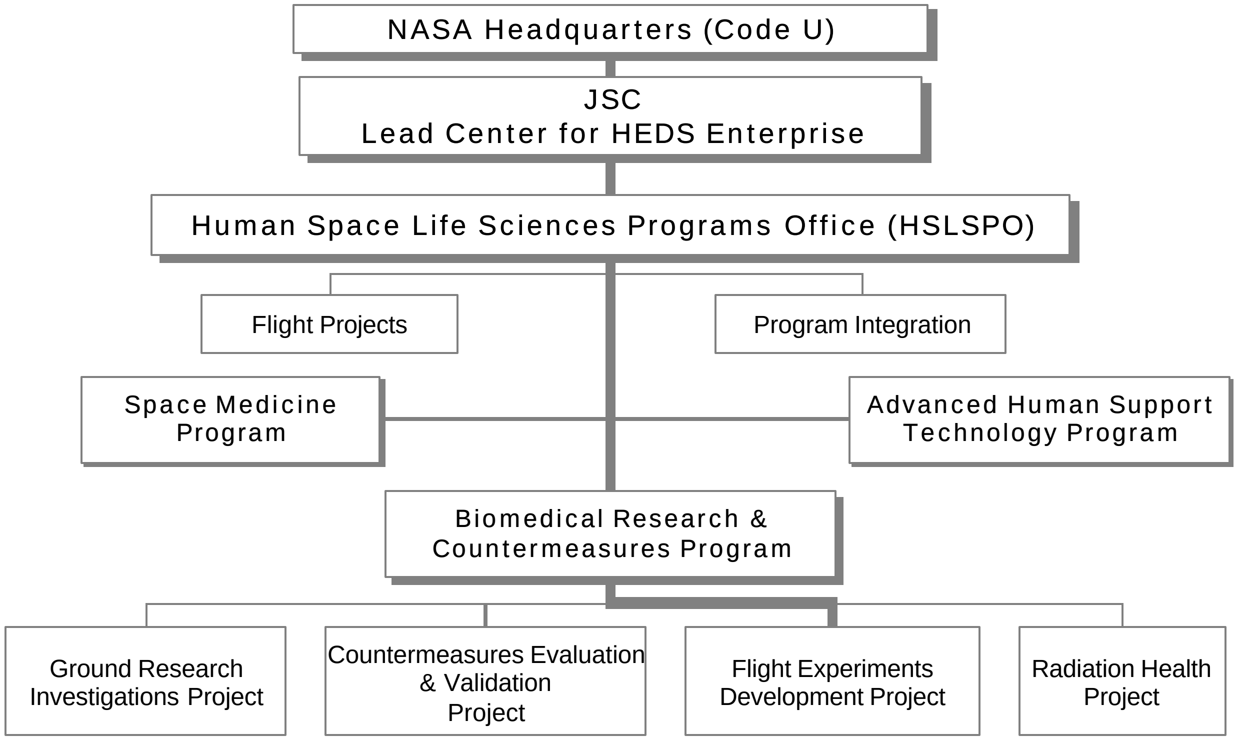


Figure 1. The FEDP relationship to the BRC Program and HSLSPO, as well as its alignment with the HEDS Enterprise, are shown.

5.1 Project Management Structure

Management of the FEDP is assigned to the Flight Research Management Branch in the Flight Projects Division of the JSC Space and Life Sciences Directorate. The Chief, Flight Research Management Branch, serves as the manager of the FEDP and reports to the BRC Program Manager.

5.2 Significant Interfaces

In order to provide access to flight resources for the selected experiments, the FEDP relies upon a number of intra- and inter-agency relationships that include:

- other NASA Centers,
- other governmental organizations,
- international partner space agencies, and
- Space Shuttle Program and the International Space Station Program offices.

These interfaces and the functions of specific elements are also considered in the BRC Program Plan.

6.0 TECHNICAL SUMMARY

6.1 Experiment Acquisition and Processing

Flight experiments are selected, developed, and flown in accordance with the process shown in Figure 2 below.

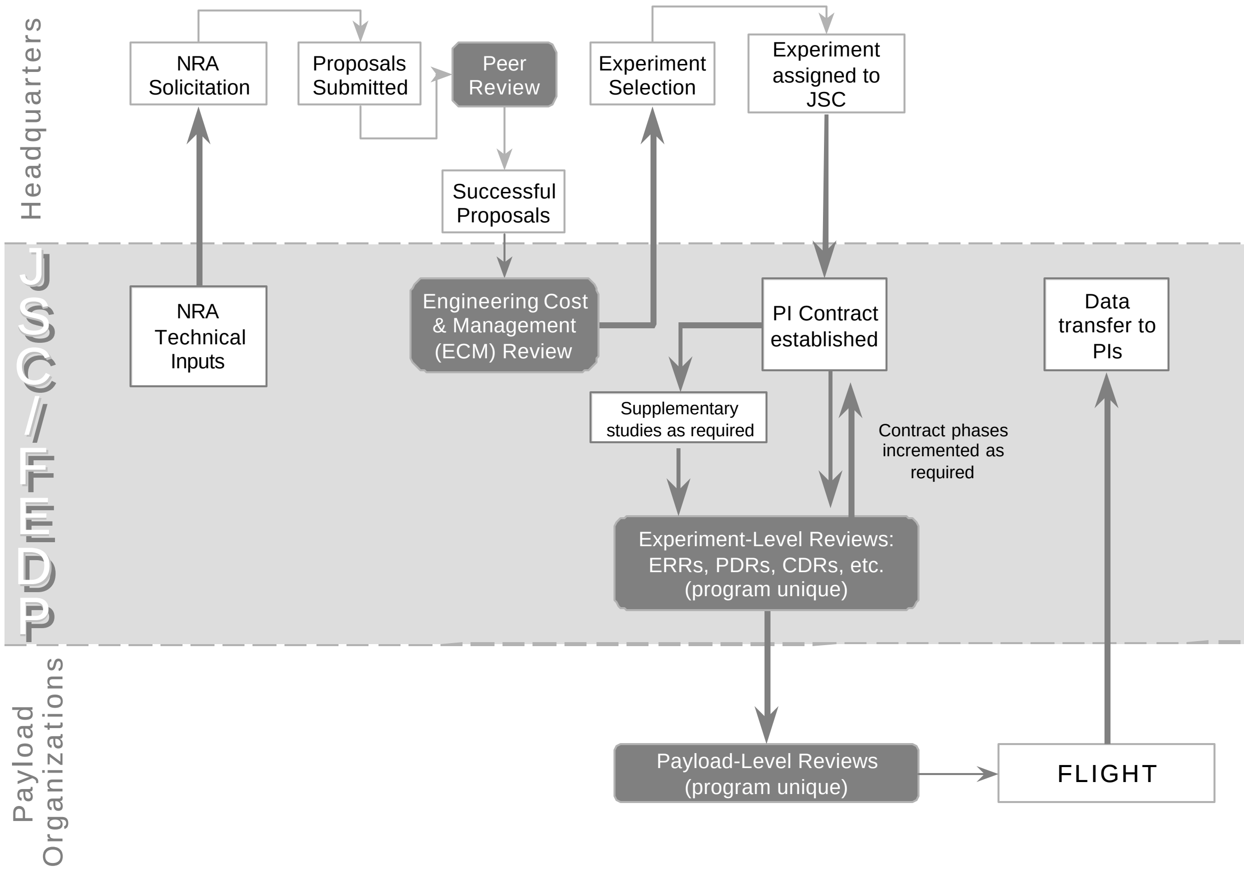


Figure 2. The FEDP process for selection, definition, and flight of experiments includes reviews performed by Headquarters Code U, JSC/SF, and the appropriate payload organizations. (ERR: Experiment Requirements Review; PDR: Preliminary Design Review; CDR: Critical Design Review)

As depicted, the FEDP assists NASA Headquarters with the preparation of solicitation materials, such as the NASA Research Announcement (NRA) and associated documents, by providing technical inputs. Each scientific proposal is subjected to a process of scientific peer review, after which the FEDP provides Headquarters with an implementation feasibility assessment known as the Engineering, Cost, and Management (ECM) review. This review serves as a critical component of selection decisions. Once a human biomedical research proposal has been selected, Headquarters assigns the FEDP responsibility for further defining implementation requirements and completing the development process that culminates in the flight of the experiment. Experiments developed by FEDP to be performed on ISS may utilize equipment and flight resources provided by the Human Research Facility (HRF). Investigations that are performed on Shuttle such as DSO/DTOs generally utilize investigation-specific hardware and/or flight kits.

The experiment development process and the role of the FEDP are delineated in more detail in Figure 3. This flowchart portrays the sequence of activities undertaken and products provided by the PIs and the FEDP as the experiments move through the experiment development process. No timetable or schedule is given, since the precise timing of the phases can vary with the particular flight platform and the complexity of the experiment. For very simple experiments, some steps in the process may be truncated or eliminated, thereby shortening the overall schedule. When an experiment is assigned to the category of DSO or DTO, it is processed into the Flight Test and Supplementary Objectives Document

(FTSOD). Requirements for experiment implementation, including hardware, spaceflight resources, flight timelines, and data products, are defined in the Experiment Document (ED).

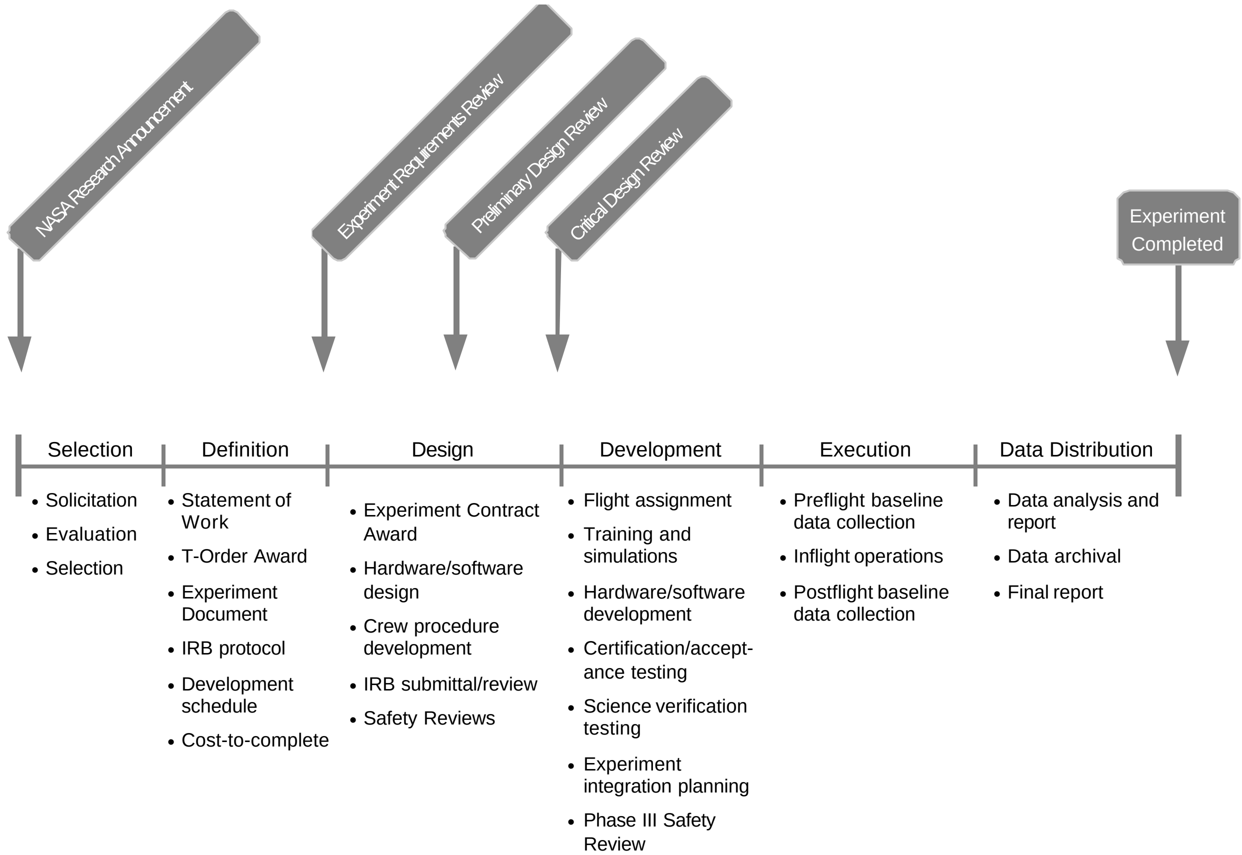


Figure 3. The process by which FEPD experiments progress towards flight is shown in this idealized flow.

The list of experiments and DSOs currently being managed in the FEDP may be found in Appendix A (updated periodically). This list includes experiments that are in all phases of experiment maturation, from definition to postflight reporting.

6.2 Experiment Manifesting and Management

6.2.1 Flight Manifesting

Figure 4 illustrates the process by which FEDP-managed experiments are assigned to specific flights. In addition to FEDP experiments, HSLSPO oversees several other program elements, including the DSO and Countermeasure Evaluation and Validation Project (CEVP) components as shown. These elements are described in detail in the CEVP Project Plan. Some FEDP experiments may be proposed for flight implementation as DSOs, which requires approval through the Medical Science Division Configuration Control Board (MSDCCB) and the Space Shuttle Integration Control Board (ICB).

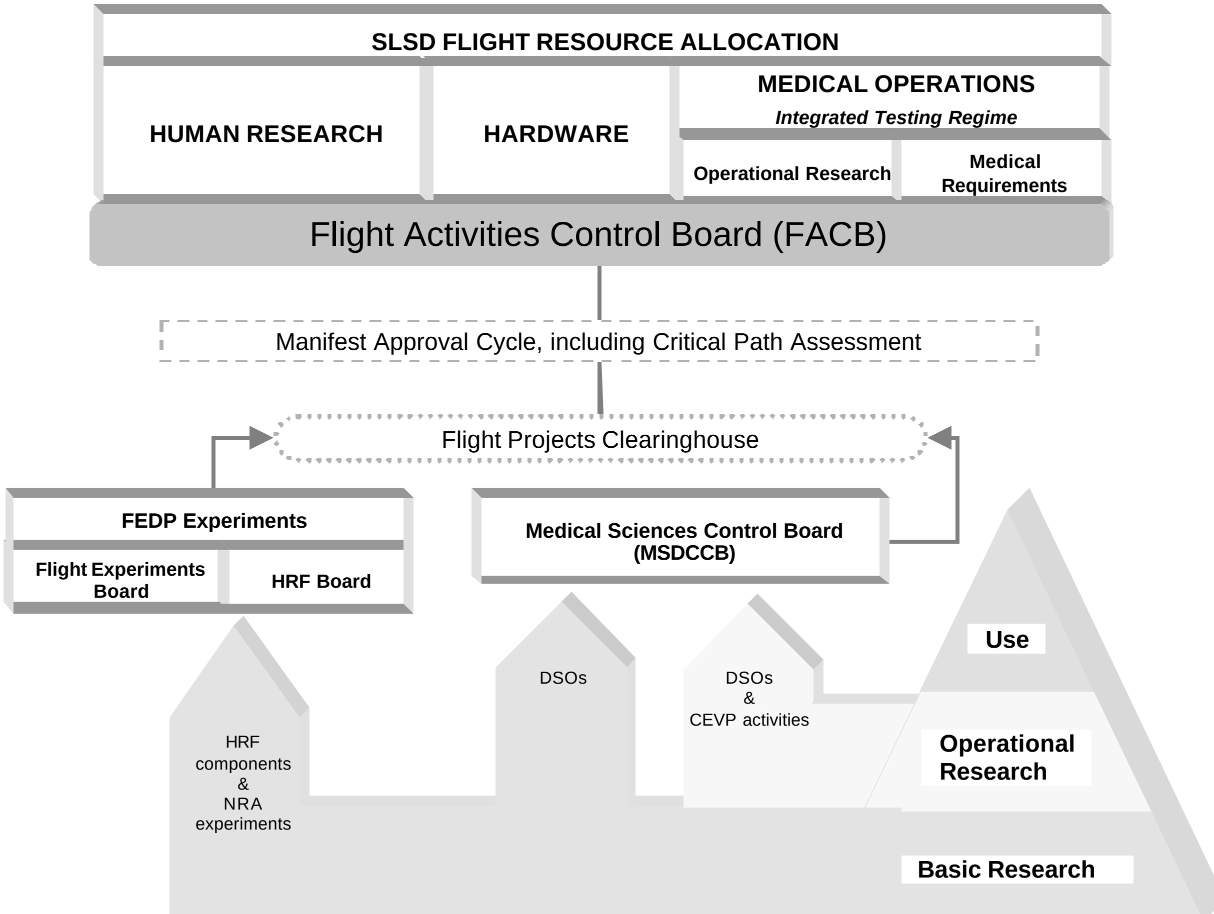


Figure 4. FEDP and HSLSPO management of experiment flight assignment and SLSD flight resource allocation.

In brief, as each STS mission or ISS increment opportunity arises, the JSC elements that "own" potential flight candidates meet as the Flight Projects Clearinghouse to review:

1) available flight resources associated with the flight,
2) element flight activities that are or will be ready to fly in time to take advantage of the flight opportunity,
3) flight resource requirements necessary to perform the activities, and
4) program element priorities.

The Clearinghouse produces an agreed-upon set of flight activities that can be accommodated by the available flight resources and that represent an appropriate distribution of those resources between the program elements. These activities are also assessed within the context of the HSLSPO Critical Path Roadmap for human research to ensure that the proposed flight activities are relevant to the overall scientific goals of the BRC Program.

Subsequent to the Clearinghouse and Critical Path determinations, the flight activities package is subjected to a more rigorous technical review by a team of representatives selected from each HSLSPO element. This review of the package examines in detail the flight resources required to assure that the necessary vehicle/crew resources are available on the projected flight(s) and to further verify that the elements are operationally compatible but not duplicative.

Following completion of this second review, the final package is provided to the BRC Program Manager for final signature, and then presented to the SLSD Flight Activities Control Board (FACB) for the final SLSD manifest decision.

6.2.2 Science Management

Programmatic review and manifest approval of FEDP-managed experiments is a multi-step process. As depicted in Figure 2, the initial selection for definition approval resides with Headquarters Life Sciences Division (LSD; Code UL), which utilizes BRC Program recommendations. At the completion of the experiment definition phase, the FEDP coordinates with the BRC Program Manager to recommend that experiments either be selected for follow-on development/flight or be deselected from the program. The recommendation "decision packages" are prepared by the FEDP and the BRC Program Manager and forwarded to Headquarters for final decision.

Following selection for development and flight, flight manifest planning for the experiments is the responsibility of the FEDP/BRC. The BRC Program Manager is charged with formally recommending assignment of experiments to specific flights, based upon completion of the previously described Clearinghouse, Critical Path, and resource assessment processes.

Experiments may be removed from the program for several reasons. Lack of developmental progress, changes in budgetary and flight resources, and changes in program priority can result in the removal of experiments from specific flights (demanifestation) or from the flight program entirely (deselection). The process of removing experiments can be initiated by recommendations from the FEDP (experiment-driven criteria), the BRC Program Manager (programmatic considerations), or by the Project or Increment Scientist assigned to the mission. Regardless of the source, the deselect recommendation must be reviewed and approved by the BRC Program Manager. The BRC Program Manager will assure that all other avenues of keeping the experiment in the program have been considered before recommending deselection.

An experiment recommended for deselection must be approved by NASA Headquarters Code U, while recommendations for demanifesting require concurrence only from the JSC FACB. In the latter case, alternate flight assignments will be assessed through the approval cycle described above and in Figure 4.

Once an experiment enters the flight preparation phase—usually considered to be the initiation of crew training—changes to experiment implementation, including such details as crew training/baseline data collection schedules, inflight data collection schedules etc., can be approved by the Project Scientist/HLS Increment Scientist assigned to the flight. These changes do not require additional approval or concurrence as long as the basic experiment goals and objectives are not compromised. The BRC Program Manager and FACB should be apprised of any significant adjustments to inflight implementation of the experiments, such that both the BRC and FEDP can assess whether any additional flight opportunities might be required to fulfill the scientific objectives of the experiment.

6.3 Facility Requirements

The FEDP is dependent upon the Telescience Support Center at JSC and the baseline data collection facilities at JSC, KSC, DFRC, and Russia (Star City). These facilities are critical to accomplishing the necessary preflight, inflight, and postflight activities associated with conducting the experiments. The FEDP also requires use of the JSC KC-135 aircraft for supporting ground studies critical to the proper development of certain flight experiments. Additional JSC facilities are used for training and testing activities.

7.0 PROJECT SCHEDULES

The near-term experiment flight schedules are shown in Appendix A.

8.0 RESOURCES

Funding levels for fiscal years 2000 through 2004 are provided in Appendix B, Table 1. The FEDP currently requires a minimum of 12 Civil Service personnel. Civil servant workforce guidelines for fiscal years 2000 through 2004 are provided in Appendix B, Table 2.

9.0 CONTROLS

Changes to financial resources required by the FEDP are controlled by the HSLSPO Manager via the BRC Program Manager.

Flight assignment of experiments is approved by the BRC Program Manager and controlled by the JSC FACB.

Experiment requirements are controlled by the flight experiment Configuration Control Board (CCB) using an incrementally baselined ED. DSOs are controlled by the FTSOD, a Space Shuttle Program document.

10.0 IMPLEMENTATION APPROACH

In addition to the FEDP civil servant workforce, the primary support contractor for the FEDP is through the JSC SEAT contract with the Lockheed-Martin Corporation.

11.0 ACQUISITION SUMMARY

For the FEDP, procurement items are the experiments that have been solicited through the Headquarters Code UL procurement sources: Announcements of Opportunity (AO) and annual international NRAs.

Non-governmental, domestic U.S. investigations are managed by contract with JSC and are under the technical management of the Flight Research Management Branch. Government laboratory investigators and foreign-national investigators are managed according to the technical agreement found in the ED and are also managed by the Flight Research Management Branch. The management of foreign national investigations (ESA, CSA, CNES, DLR, and NASDA) is covered by international agreements between NASA and the national space agencies or other responsible governmental units.

12.0 PROJECT DEPENDENCIES

ARC and KSC provide experiments as well as experiment management for some FEDP activities. As noted above, numerous international space agencies contribute investigations to the FEDP via international agreements.

13.0 AGREEMENTS

The following NASA documents and agreements are the foundation of FEDP authority and activities:

- LSFEP Program Plan (1979)
- NASA Headquarters agreements with international partners for experiment management and implementation
- Human Research Multilateral Review Board (HRMRB) charter
- IRB charter
- HSLSPO Program Plan and JSC Lead Center Implementation Plan
- BRC Program Plan

14.0 PERFORMANCE ASSURANCE

Experiment performance is safeguarded through a series of design reviews and by performance verification testing.

A series of design reviews (ERR, PDR, CDR) provide for the controlled, incremental maturation of experiment requirements and execution that is defined in the Experiment Document and overseen by the Flight Research Management Branch CCB. These reviews assure that the requirements for experiment implementation are consistent with the known and projected project, program, and spacecraft resources and constraints.

The verification testing (science verification tests) assures that the complete experiment system, including equipment, procedures, ground monitoring systems, and training regimen provide high-quality experiment data as defined by the investigator and NASA in the ED and/or FTSOD.

15.0 RISK MANAGEMENT

The FEDP will track issues and risks in the monthly Project Management Report (PMR) provided to the HSLSPO Program Manager (see Section 18) and to HSLSPO during SLSD Technical Cost Reviews. Principal Investigator institutions are contractually obligated to provide the FEDP with monthly financial reports (JSC Form 533).

16.0 SAFETY

Flight experiments managed by the FEDP are reviewed and approved by the JSC Institutional Review Board (IRB) for safe and ethical conduct of human experiments on the Shuttle and ISS. Operating guidelines for the JSC IRB are found in JSC 20483 (Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations). Experiments that are scheduled for flight on the ISS are also reviewed and approved for flight by the HRMRB.

Experiment hardware utilized both on the ground at NASA facilities and on-orbit must meet all safety requirements defined, reviewed, and approved by the JSC Payload Safety Panel and by the ground safety review teams at appropriate NASA sites.

17.0 TECHNOLOGY ASSESSMENT

Experiment requirements for new flight hardware are routinely assessed with respect to current and planned technology within the ability of those technologies to meet the requisite performance, cost and schedule requirements of the experiments and flight program.

18.0 REVIEWS

FEDP technical, cost, and schedule performance is assessed via quarterly Space and Life Sciences Technical Cost Reviews (TCR) and by HSLSPO management reviews. FEDP project status is reported to both local JSC organizations and to NASA Headquarters via a monthly PMR that is published by the Flight Experiments Management Branch. Monthly status teleconferences are conducted with HSLSPO personnel and Headquarters Code UL.

19.0 TAILORING

Environmental impact assessments and commercialization plans are not applicable to the project.

20.0 CHANGE LOG

The change log for the FEDP Plan is located on page 4 of this document.

APPENDIX A: EXPERIMENT LISTS AND SCHEDULES

Table 1. Experiments under FEDP management as of 09/99.

PRIMARY INVESTIGATOR	SOLICITATION	AFFILIATION	EXPERIMENT TITLE	PROJECT	FLIGHT ASSIGNMENT
Badhwar, G.D., Ph.D.	93-OLMSA-07	JSC	Organ Dose Measurement Using the Phantom Torso	radiation	ISS
Berthoz, A., Ph.D. ***	96-OLMSA-01	College de France Paris, France	Human Orientation and Sensory Motor Coordination in Microgravity	biomedical	ISS
Cavanagh, P.R., Ph.D.	96-HEDS-4/5	Pennsylvania State University	Foot Reaction Forces During Spaceflight	HF	ISS
Cerretelli, Paolo, M.D., Ph.D. ***'	96-HEDS-04	Universita di Milano, Italy	Effect of Spaceflight on Human Skeletal Muscle Force per Cross-sectional Area	biomedical	ISS
Clement, G., Ph.D. ***	96-HEDS-04/05	Universite Paul Sabatier, Toulouse, France	Eye Movements and Motion Perception Induced by Off-Axis Rotation at Small Angles of Tilt After Spaceflight	biomedical	STS/ISS
Ferrando, A.A., Ph.D.	95-OLMSA-01	Shriners Burn Institute, Galveston, TX	Protein Turnover During Spaceflight	JSC	STS-95/107
Fitts, R.H., Ph.D.	96-HEDS-4/5	Marquette University	Effect of Prolonged Spaceflight on Human Skeletal Muscle	biomedical	ISS
Gabrielsen, A., M.D. ***		Danish Aerospace Medical Center	Peripheral Cardiovascular Reflexes In Humans During Spaceflight Microgravity	biomedical	ISS
Gabrielsen, A., M.D. ***	96-HEDS-04/05	Danish Aerospace Medical Center	Effects of Microgravity on the Peripheral Subcutaneous Veno-Arteriolar Reflex in Humans	biomedical	ISS
Greenleaf, J.E., Ph.D. (Co-I)	96-HEDS-4/5	ARC	Cardiovascular, Endocrine, and Renal Variables of Fluid Volume Control in Humans during Spaceflight	biomedical	ISS
Harm, D.L., Ph.D.	96-OLMSA-01	JSC	Bioavailability and Performance Effects of Promethazine During Spaceflight	biomedical	DSO
Kanas, N., M.D.	96-OLMSA-01	Veterans Administration SF	Crew Member and Crew-ground Interactions During International Space Station Missions	biomedical	ISS
Lang, T.F., Ph.D.	96-HEDS-4/5	UCSF	Sub-regional Assessment of Bone Loss...	biomedical	ISS
McGinnis, M.R., Ph.D.	96-OLMSA-01	University of Texas	Spaceflight Effects on Fungal Growth, Metabolism, and Sensitivity to Antifungal Drugs	environmental	STS-107
Norsk, Peter ***	96-HEDS-4/5	Natl Research Hospital	Cardiovascular, Endocrine, and Renal Variables of Fluid Volume	biomedical	ISS

		Tagensvej, Denmark	Control in Humans during Spaceflight		
Oman, C.M., Ph.D.	96-OLMSA-01	MIT	Human Orientation and Sensory Motor Coordination in Microgravity	biomedical	ISS
Pierson, D.L., Ph.D.	96-OLMSA-01	JSC	Flight Induced Changes in Immune Defenses	biomedical	DSO
Pierson, D.L., Ph.D.	96-OLMSA-01	JSC	Incidence of Latent Virus Shedding During Spaceflight	biomedical	DSO
Putcha, L., D.L., Ph.D.	96-OLMSA-01	JSC	Gastrointestinal Function During Extended Duration Spaceflight	biomedical	DSO
Pyle, B.H., D.L., Ph.D.	96-HEDS-4/5	Montana State University	Bacterial Physiology and Virulence on Earth and in Microgravity	ARC-environmental	
Reitz, G.F., Ph.D. ***	96-HEDS-04/05	DLR Institute of Aerospace Medicine	Dosimetric Mapping	environmental	ISS
Reschke, M.F., Ph.D.	96-HEDS-4/5	JSC	Visual-Vestibular Mediated Gaze and Head-Eye Control in Altered Gravitoinertial Environments	biomedical	ISS
Schweickart, R.W., Ph.D.	93-OLMSA-07	Boeing, TX	Effects of Microgravity on Microbial Physiology	environmental	STS-107
Smith, S.M., Ph.D.	96-HEDS-4/5	JSC	Calcium Kinetics During Spaceflight	biomedical	STS/ISS
Tesch, P.A., Ph.D. ***	96-HEDS-04/05	Huddinge University, Sweden	Effects of Resistance Training Using Flywheel Technology on Size and Function of Unloaded Skeletal Muscle	JSC	STS
Thomson, I., M.E. ***	96-HEDS-04	Thomson & Nielson Electronics, CAN	A Study of Radiation Doses Experienced by Astronauts in EVA	JSC	ISS
Watt, D.G.D., M.D., Ph.D. ***	96-HEDS-04/05	McGill University, Canada	Effects of Altered Gravity on Spinal Cord Excitability	biomedical	ISS
West, J., M.D., Ph.D.	96-HEDS-4/5	UCSD	The Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function	biomedical	ISS
Whitson, P.A., Ph.D.	96-OLMSA-01	JSC	Renal Stone Risk During Space Flight...	JSC	STS-107
Yelle, J.M., M.S.	96-OLMSA-01	JSC	Individual Susceptibility to Post-spaceflight Orthostatic Intolerance...	JSC	DSO
Smith, S.M., Ph.D.	98-HEDS-02	JSC	Iron Absorption and Metabolism During Spaceflight	JSC	ISS
Stein, T. Peter, Ph.D.	98-HEDS-02	University of Medicine and Dentistry, New Jersey	Protein and Energy Status During Long Spaceflight	JSC	ISS
Brady, Joseph, Ph.D.	98-13OSSAIML-2	Institute for Behavioral Resources, Johns Hopkins	Stability & Precision of Human Performance During Spaceflight	JSC	STS-91
Blomqvist, C. Gunnar, MD	93-OLMSA-01	Univ. Texas Southwest Medical Center	Integration of Neural Cardiovascular Control in Space	JSC	STS-90

Cohen, Bernard, MD	93-OLMSA-01	Mount Sinai School of Medicine	Spatial Orientation of the Vestibulo-ocular Reflex	JSC	STS-90
Eckberg, Dwain, MD	93-OLMSA-01	Virginia Commonwealth Univ	Autonomic Neuroplasticity in Weightlessness	JSC	STS-90
Robertson, David, MD	93-OLMSA-01	Vanderbilt University, Memphis, TN	Autonomic Neurophysiology in Microgravity	JSC	STS-90
Oman, C.M., Ph.D.	93-OLMSA-01	Mass. Institute of Technology, Cambridge, MA	Role of Visual Cues in Spatial Orientation	JSC	STS-90
Czeisler, Charles, MD	93-OLMSA-01	Brigham and Women's Hospital, Harvard U.	Clinical Trial of Melatonin as Hypnotic for Neurolab Crew	JSC	STS-90/95
West, J., M.D., Ph.D.	93-OLMSA-01	U. C. San Diego	Sleep and Respiration in Microgravity	JSC	STS-90
Bloomberg, Jacob, Ph.D.	98-HEDS-02	JSC	Promoting Sensorimotor Response Generalizability: A Countermeasure to……	JSC	ISS
Czeisler, Charles, MD	98-HEDS-02	Brigham and Women's Hospital, Harvard U.	Sleep-wake Actigraphy Monitoring During Space Flight	JSC	STS-107
Bock, Otmar, Ph.D. ***	98-HEDS-02	German Sport Univ.	Adaptation of Motor Skills to Microgravity	JSC	ISS
Bock, Otmar, Ph.D. ***	93-OLMSA-01	German Sport Univ.	Visuo-motor Coordination During Space Flight	JSC	STS-90
Baisch, Friedhelm, MD ***	93-OLMSA-01	DLR Institute of Aerospace Medicine	Artificial Neural Networks & Cardiovascular Regulation	JSC	STS-90
Clement, G., Ph.D. ***	93-OLMSA-01	CNES/MEDES, Toulouse, France	Visual-Otolithic Interactions in Microgravity	JSC	STS-90
Berthoz, A., Ph.D. ***	93-OLMSA-01	CNRS/College de France, Paris, France	Frames of Reference & Internal Models	JSC	STS-90
Hughson, Richard, Ph.D. ***	98-HEDS-02	Univ. of Waterloo, Canada	Autonomic Nervous System Regulation of Cardiovascular Control on ISS	JSC	ISS
Barrett, Alan, Ph.D.	98-HEDS-02	Univ. Texas Medical Branch, Galveston, TX	Space Flight-Induced Reactivation of Latent Epstein-Barr Virus	JSC	ISS
Tesch, P.A., Ph.D. ***	98-HEDS-02	Huddinge University, Sweden	Efffects of Resistance Training, Using Fly-wheel Technology, on Size and Function of Skeletal Muscle in Crew Stationed in Space	JSC	ISS
Gabrielsen, A., M.D. ***	98-HEDS-02	Danish Aerospace Medical Center	Does Sodium and Fluid Volume Repletion in Humans Normalize Cardiovascular Responses to LBNP During Spaceflight	JSC	ISS
LeBlanc, A. Ph.D. (Co-I)	96-HEDS-4/5	Baylor College of Medicine, Houston, TX	Effect of Spaceflight on Human Skeletal Muscle Force per Cross-sectional Area	JSC	ISS

Costill, D. , Ph.D. (Co-I)	96-HEDS-4/5	Indiana University, Bloomington, IN	Effect of Spaceflight on Human Skeletal Muscle Force per Cross-sectional Area	JSC	ISS
Trappe, S. Ph.D. (Co-I)	96-HEDS-4/5	Ball State University, Muncie, IN	Effect of Spaceflight on Human Skeletal Muscle Force per Cross-sectional Area	JSC	ISS
Fitts, R.H., Ph.D.	84-AO-13-20	Marquette University, Milwaukee, WI	Effect of Weightlessness on Human Single Muscle Fiber Function	JSC	STS-78
LeBlanc, A. Ph.D. (Co-I)	94-OLMSA-01	Baylor College of Medicine, Houston, TX	Magnetic Resonance Imaging after Exposure to Microgravity	JSC	NASA/Mir
Good, E. MD	98-HEDS-02	Neurology Consultants	The Role of Intracranial Pressure in Space Adaptation Syndrome	JSC	ISS
Palmer, P.T. Ph.D.	94-OLMSA-01	San Francisco State University	Analysis of Volatile Organic Compounds on Mir Station	JSC	NASA/Mir
Stein, T. Peter, Ph.D.	94-OLMSA-01	University of Medicine and Dentistry, New Jersey	Protein Metabolism During Long Duration Spaceflight	JSC	NASA/Mir
Monk, T. Ph.D.	94-OLMSA-01	University of Pittsburg	Human Circadian Rhythms and Sleep in Space	JSC	NASA/Mir
Blomqvist, C. Gunnar, MD	94-OLMSA-01	University of Texas Southwest Medical School	Adaptive Changes in Cardiovascular Control at Microgravity	JSC	NASA/Mir
Eckberg, Dwain, MD	94-OLMSA-01	McGuire Research Institute	Autonomic Mechanisms During Prolonged Weightlessness	JSC	NASA/Mir
Hobson, A. MD	94-OLMSA-01	Massachusetts Mental Health Research Corp.	Sleep and Vestibular Adaptation	JSC	NASA/Mir
Clarke, A. Ph.D. ***	98-HEDS-02	Freie Universitat Berlin	The Influence of Prolonged Microgravity on the Orientation of Listing's Plane and on the unilateral Otolith-ocular Response	JSC	ISS
Hirasaki, E. Ph.D. ***	98-HEDS-02	Osaka University	Effect of Spaceflight on Eye-head-trunk Coordination Strategies During Locomotion	JSC	ISS
Paloski, W. Ph.D.	98-HEDS-02	NASA/JSC	Spatial Reorientation of Sensorimotor Balance Control in Altered Gravity	JSC	ISS

*** Foreign national PI

Figure 2. ISS Manifest Plan.

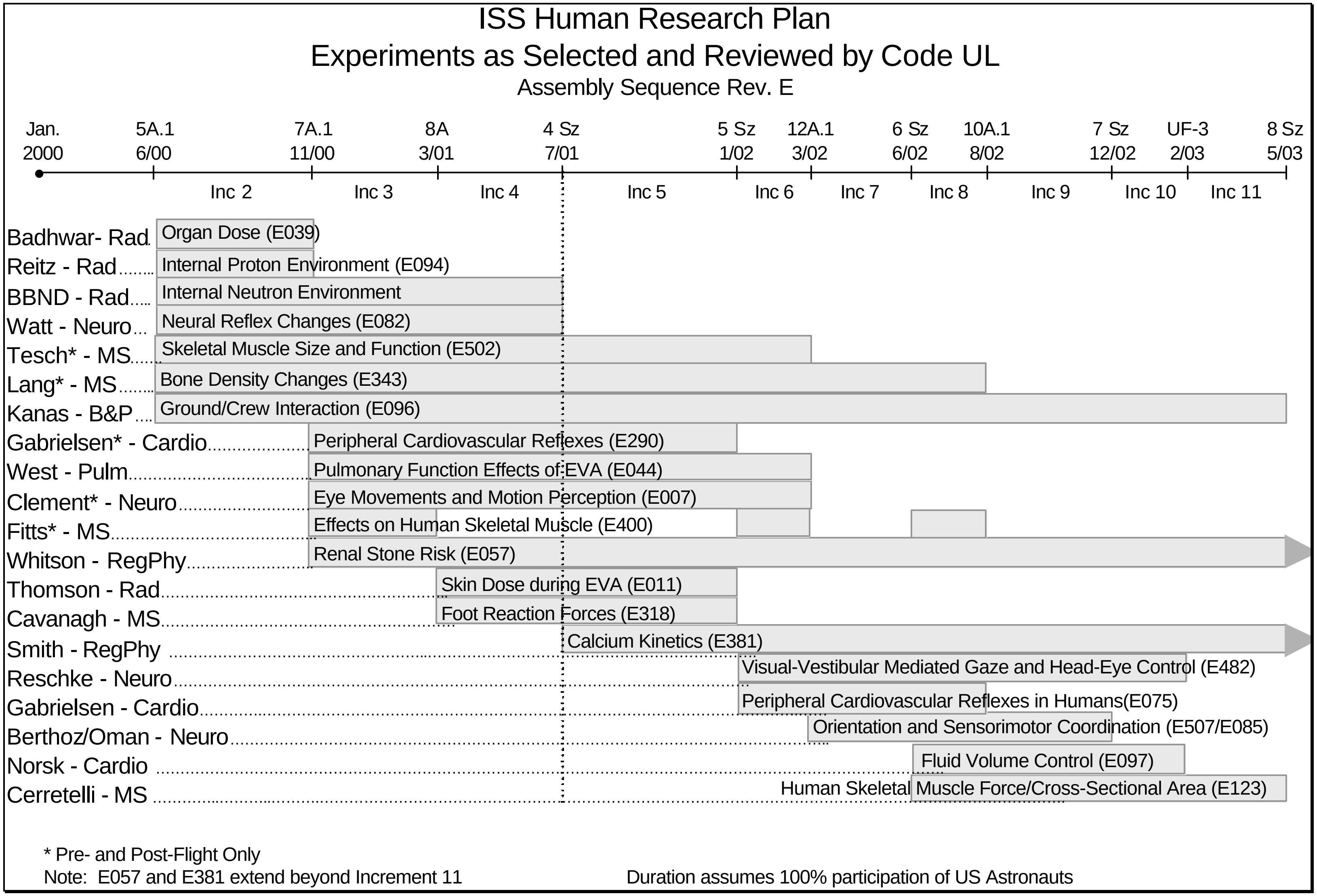
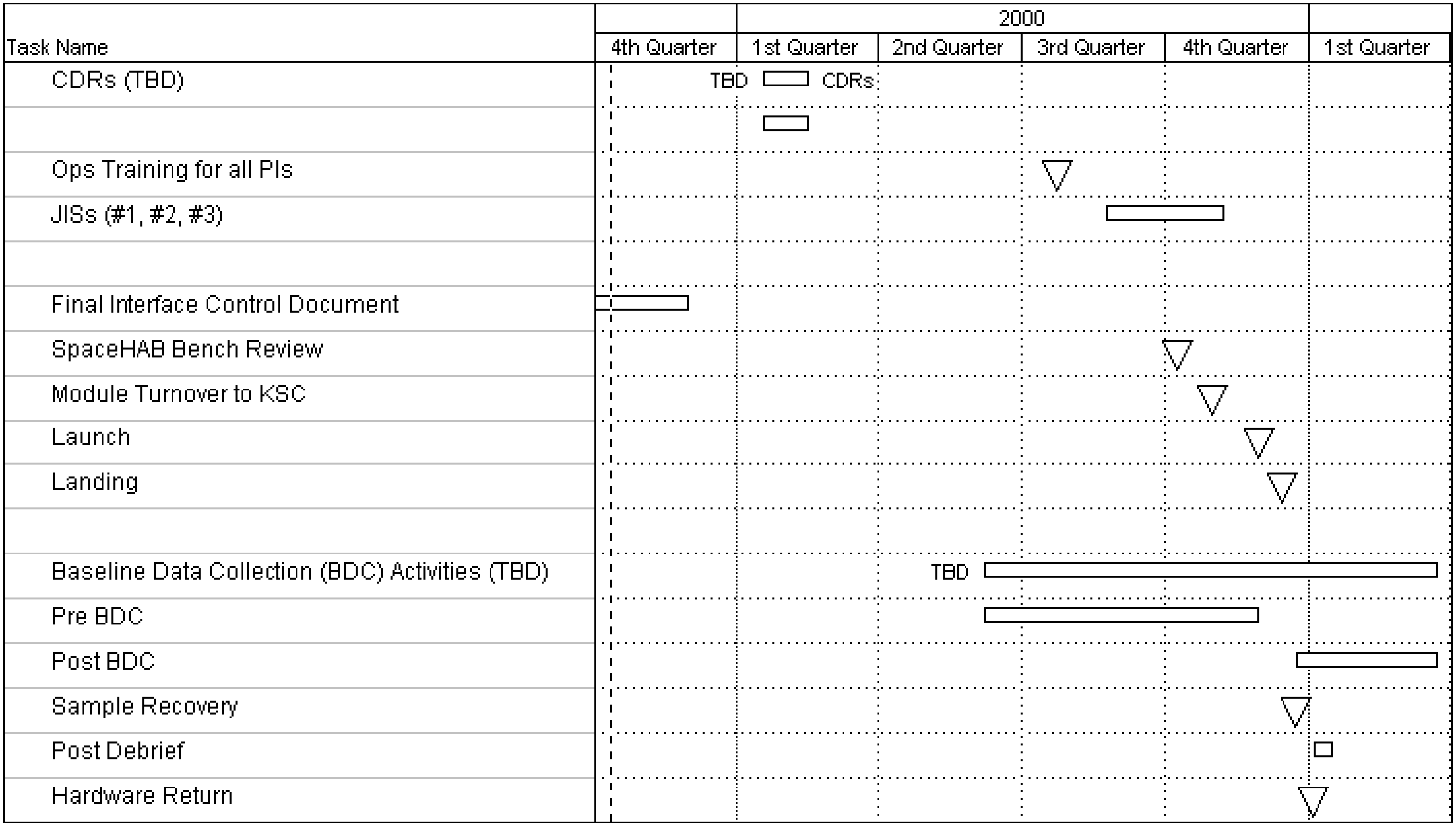


Figure 3. STS-107 Development Schedule.



CDR: Critical Design Review

JIS: Joint Integration Simulation

APPENDIX B: FINANCIAL AND INSTITUTIONAL REQUIREMENTS

Table 1. FEDP Financial Resources in NOA ($ M) for FY 00-04.

POP-99 GUIDELINES					
	FY00	**FY01**	**FY02**	**FY03**	**FY04**
FEDP Total	10.8	10.7	11.5	10.8	11.1
ARC	0.4	-	-	-	-
JSC	10.1	10.4	11.2	10.4	10.7
KSC	0.3	0.3	0.3	0.4	0.4

Table 2. FEDP Workforce Resources for FY 00-04.

POP-99 GUIDELINES					
	FY00	**FY01**	**FY02**	**FY03**	**FY04**
FEDP Total	12	12	12	12	12
Civil Servants (FTE)	12	12	12	12	12
Support Contractor (EP)	0	0	0	0	0