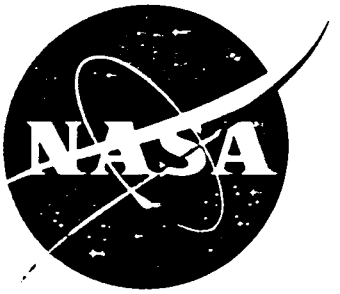

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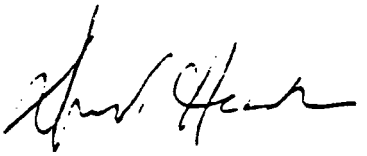
GODDARD SPACE FLIGHT CENTER

PROJECT MANAGER'S HANDBOOK

FOREWORD

This handbook sets forth the practices and procedures to be followed in carrying out all scientific, applications, and launch vehicle projects at the Goddard Space Flight Center. This document reflects GSFC policy and experience, and should be followed unless exceptions are appropriate in the view of the Project Manager. Project Plans will delineate those areas where there are exceptions from this handbook.



Donald P. Hearth
Deputy Director

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PART 1

INTRODUCTION

1.1 SCOPE AND APPLICABILITY

The Project Manager's Handbook of practices and procedures defines the primary guidelines to be followed in carrying out all scientific, applications, or launch-vehicle projects of the Goddard Space Flight Center (GSFC).

The policies stated herein should be followed unless exceptions are deemed necessary by the Project Manager. Such exceptions will be delineated in the Project Plans.

This document consists of eight basic parts:

1. Project Management (Part 2)
2. Systems Tests (Part 3)
3. Operational Requirements (Part 4)
4. Project Reviews (Part 5)
5. Reliability and Quality Assurance (Part 6)
6. Data Utilization and Management (Part 7)
7. Procurement (Part 8)
8. Financial Management (Part 9)

1.2 ORIGINATION AND REVISION

Any GSFC employee may originate a request for preparation of new procedures or review of existing procedures by writing to the Deputy Director of Projects, who will serve as chairman of a permanent committee for project practices and procedures. The committee will consist of representatives from the Systems Reliability Directorate, the Missions and Data Operations Directorate, the Space and Earth Sciences Directorate, the Network Directorate, the Space Applications and Technology Directorate, and the Administration and Management

Directorate. Revisions must have the approval of the Deputy Director of GSFC.

1.3 AUTHORIZATION

The Director, GSFC, has authorized publication of this handbook. After initial release, the Office of the Director will approve additional or revised procedures.

1.4 DISTRIBUTION

The Project Manager's Handbook, normally distributed to branch heads and above, will be issued to any individual whose request has the approval of his Division Chief or Project Manager. Copies of the handbook are available from the Management Support Branch, Code 233, X5341.

PART 2

PROJECT MANAGEMENT

2.1 INTRODUCTION

At GSFC, the Project Manager is the highest line official solely concerned with a particular project. After a project is formally approved, he is the final authority for saying "yes" to a critical proposition. For example, in launch operation, many officials can properly say "no" to the firing, but the Project Manager must be completely satisfied before the button is pushed. Goddard invests full responsibility for mission success in the Project Manager. Within the confines of established policies and procedures, full authority and accountability go with this responsibility. However, because each Project Manager is concerned primarily with his own project, the equitable distribution of available resources is a function of Center general management. GSFC policy is to house basic project personnel together, where practical.

2.2 PROJECT PLANNING

It is the policy of NASA that the implementation of major research and development projects will be done on the basis of plans and analyses that define the effort to be accomplished. This policy is set forth in NMI 7121.1 (presently being updated) and GHB-7121.3, GSFC Project Planning Handbook. (See also: Management Study of NASA Acquisition Process dated June 1971, Letter to Distribution from Deputy Administrator dated June 9, 1971, Subj: NASA Acquisition Study Report). It should be remembered that the concept of Phased Project Planning requires that a Project or Study Manager take the time to plan the effort such that the mission objectives can be accomplished for the minimum expenditure of Government resources. This requires then that a Project Plan (PP) (see para. 2.2.3) be formulated and approved prior to the initiation of significant project effort. This plan then becomes a control document and is in essence the "contract" between GSFC and Headquarters for the scope of effort outlined.

2.2.1 GSFC Implementation of Project Planning

GHB 7121.3 prescirbes detail format for Project Plans, and the following describes briefly how this effort is implemented at GSFC.

The GSFC effort will usually be accomplished in two phases, rather than the four phases in superseded NHB 7121.2. The phases now are: (1) Feasibility and Systems Definition, (2) Execution. The output of Feasibility and Systems Definition will, in many instances, be used to justify Congressional approval of development funds. Thus, it is essential that this redefined first phase activity be expanded somewhat so that various programmatic options are developed in depth. This will permit a more reliable estimate of scope, cost, and schedule for new projects. It is important also that this effort be in concert with the Congressional and Office of Management and Budget approval cycles in order to eliminate "dead time" while awaiting for approvals.

Where sufficient resources are available, it is desirable to conduct the Feasibility and Systems Definition phase (including Systems Design) in-house and then go directly into a single competition for the selection of the Execution phase contractor.

In those cases where the Feasibility and Systems Definition activity has provided a firm understanding of project objectives and requirements, but has identified many system options and thus too great an effort for in-house support, a competition should be initiated for multiple contractors to perform the Systems Design. Subsequently a single contractor will be selected for the Execution from the Systems Design effort contractors.

2.2.2 Initiation of New Project activities

GHB 7121.3 describes the documentation and procedures required when a new activity — which might become a full project — is started at GSFC.

Projects conducted at the Center will generally be conducted in a number of sequential steps and, in general, will be preceded by a preliminary study of limited scope (known as a Candidate Study Effort) which can be conducted in any organizational entity at the Center.

2.2.2.1 Candidate Study Effort. A preliminary study will be conducted and include mission identification with the scientific or application objectives, alternative approaches, and a preliminary engineering assessment. The preliminary study will be concluded with a report and presentation to the Office of the Director recommending whether or not the study should be extended into Feasibility and Systems Definition.

2.2.2.2 Study Management System. With an affirmative decision by the Deputy Center Director, a Study Manager and Study Scientist will be appointed and the Feasibility and Systems Definition activities will be initiated in accordance with GHB 7121.3.

In general, the Study Manager will conduct the Feasibility Study, produce an Analytical Report at the completion of the Feasibility activity. Where there is an affirmative decision for continuation of the effort, the Study Manager will continue with Systems Definition and prepare a Project Plan in accord with the timing and guidelines sanctioned by the Deputy Center Director.

2.2.2.3 Project Plan for the Next Phase. With an affirmative decision by Center and Headquarters elements to proceed into System Definition, the Study Manager will initiate these activities. As early as feasible during the System Definition activities the Projects Directorate, or other responsible Directorate will recommend to the Management Council a Project Manager for the Execution effort.

2.2.3 Project Plan

In a research and development (R&D) environment the executives who manage aerospace programs are consistently confronted with the need to encourage creativity while maintaining a degree of control; therefore, the need arises to provide visibility to management on imminent issues, requirements, and actions. The NASA vehicle for the conveyance of this information is the Project Plan. That management document constitutes the Project Manager's charter as well as GSFC's comprehensive master plan for accomplishing the effort. The Project Plan is approved by the Center Director and submitted to Headquarters. Once approved and signed by Headquarters, it becomes the basic working agreement with the Center. The plan describes, in specific terms, the technical, financial, procurement, and management arrangements identified with any one or all of the phases. The Project Plan also includes a clear assignment of managerial responsibility, authority, and statements of funding, manpower, facilities and support which the field installation is furnishing to the project. Project Plans must be coordinated with all cognizant offices and should be reviewed for necessary updating to reflect any major changes in the project.

The scientific, technical, managerial and administrative substance in Project Plans must be approved by the GSFC Deputy Director for all steps prior to submission to NASA Headquarters. Those approvals must be obtained prior to the release of resources and before the significant start of operations described in the Project Plan for a particular study or project phase; thus, the Project Plan is part of a planning system and a sequential function in the life cycle of a project.

As established in NASA Management Instruction 7120.1 (presently being revised), each project is responsible for preparing, and modifying, as substantive changes occur, a Project Plan.

Implementation of the concept at GSFC involves the following steps:

A. New Project Ideas — Candidate Study Effort that surfaces ideas and concepts within the Center that could culminate in development of a spaceflight system (described in GHB 7121.3)

B. GSFC Study Management System; comprising two efforts of the first phase identified as Feasibility and Systems Definition (described in GHB 7121.3)

C. Project Management System; comprising the Execution phase which includes detailed design and development (also described in GHB 7121.3)

The resident Program Support Specialist will arrange for administrative inputs and working assistance with the Technical Information Division and the Program Support Division.

2.3 FUNCTIONS AND AUTHORITIES OF PROGRAM MANAGERS AND PROJECT MANAGERS

Appendix A, of this Handbook, was generated by the Office of Space Science (OSS) when it was combined with the Office of Applications and known as OSSA. It contains guidelines for the functions and authorities of Program Managers and Project Managers. OSSA prepared these guidelines with Center participation to provide a clear understanding of the relative role of Program Managers at Headquarters and the Project Managers at field centers. It is assumed that the same intent and definitions are applicable to OA.

2.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section does not prescribe detailed project organizational structures; but Appendix B does indicate, in general, a project organization that is used on most GSFC projects in Code 400. The smaller, in-house projects located in the Explorer Project Office and International Projects Office (Code 700) are usually structured on a similar basis. Although the following sections are outlined by titles, emphasis is on responsibilities that must be assigned as applicable. The scope and size of a particular project may require, or make it desirable, to assign more than one specific responsibility outlined here to a single individual. The PP should illustrate individual project organizational structures showing responsibilities and line authority. Official approval of such organizations derives from approval of the PP.

2.4.1 Overall Management Responsibility

GSFC is assigned project management responsibility under the overall direction of the Associate Administrator OSS or OA. In addition to project management responsibility, GSFC may be assigned systems-management responsibility for systems such as spacecraft, experiments, tracking and data-acquisition system, or Delta launch-vehicle system.

2.4.2 Project Manager

The appropriate Director of — nominates and the Center Director's office approves the Project Manager. If the project has "Division" status, Headquarters must concur in the appointment. The Project Manager is responsible for assuring the performance of all functions necessary for management of the project. In particular, he is responsible for projectwide planning and evaluation, systems engineering and design, systems integration, test, reliability and quality assurance, scheduling, budgetary and financial planning, technical monitoring of contracts, and project reporting. He has full authority to carry out these functions, subject to limitations established by the Director's Office, GSFC. He also coordinates project requirements with other activities of the Center as well as keeping the Headquarters Program Manager apprised of project status (see Appendix A). The Project Manager discharges his responsibilities with the assistance and support of individuals and organizations assigned either administratively or functionally to the project management organization.

2.4.3 Project Scientist

The appropriate Director of —, usually Space and Earth Sciences or Space Applications and Technology Directorates, nominates and the GSFC Director approves the selection of the Project Scientist. The Project Scientist is responsible for assuring coordination between and satisfactory accomplishment of the scientific objectives of the mission and its individual experiments. He participates in the formation of the specific mission objectives; reviews the implementation of individual experiments to ensure that their objectives are consistent with the proposal upon which the selection was based; reviews the spacecraft weight, power, space, the telemetry assignments among experiments, operating plans, data acquisition and processing requirements all to ensure that the total system plan is consistent with the overall mission objectives. He provides leadership in assuring that the experiment data are effectively used and the scientific results of the mission are expeditiously produced. The project scientist evaluates all impacts on the scientific productivity of the project and provides scientific guidance to the Project Manager and others involved in the program.

2.4.4 Principal Investigator

The Project Plan will list the experiments to be performed on each spacecraft. Experiments may be primarily scientifically, technologically, or applications oriented. The appropriate Associate Administrator selects all scientific experiments and their associated principal investigators.

The Principal Investigator (PI) is responsible for assuring that the objectives of the experiment are met, managing the experiment, publishing the results of the experiment, and submitting the experiment data to the National Space Science Data Center (NSSDC) in a form usable by other experienced investigators in the field.

2.4.5 Deputy Project Manager

The Deputy Project Manager, when the position is required, is selected by the Project Manager and his Director of —. Approval by the Center Director's office is required. The Deputy Project Manager is the alter-ego of the Project Manager and as such may act for the Project Manager with respect to all the Project Manager's responsibilities.

2.4.6 Assistant Project Manager

The Project Manager selects with the concurrence of his Director of —, and the Center Director approves the Assistant Project Manager. The Assistant Project Manager represents the Project Manager on all matters with the Project Manager's cognizance to the extent authorized and assigned by the Project Manager. As directed by the Project Manager, he may from time to time devote full time to critical problems, assist in negotiating major contracts, etc. The position of Assistant Project Manager is optional with the Project Manager.

2.4.7 Project Coordinator

The Project Coordinator is responsible to the Project Manager for coordinating the activities of the various individuals and organizations involved in the project. Duties and line of authority shall be defined by the Project Manager.

2.4.8 Systems Managers

Each Systems Manager is responsible to the Project Manager for ensuring timely accomplishment of technical, procurement, budgetary, planning, and other actions necessary to design, develop, fabricate, integrate, test, and deliver or operate a particular system. In addition, the Systems Manager must

resolve coordination problems arising between his system and other systems. Each Systems Manager is responsible for keeping the Project Manager fully informed of all actions taken in support of the project.

2.4.8.1 Spacecraft Systems Manager. The Spacecraft Systems Manager is responsible for the design, integration, and test of the complete spacecraft being adequate to give high confidence in mission success. Subsequent to launch he is responsible for evaluating and reporting the spacecraft performance. He is also responsible for integrating the experiments. The Spacecraft Systems Manager has prime responsibility for spacecraft development and procurement. He may carry out this responsibility through a number of subsystem-development and flight-hardware contracts with private industry.

2.4.8.2 Experiment Systems Manager. The Experiment Systems Manager monitors the progress of the experimenters to assure compliance with performance, schedule, and cost requirements. If applicable, he serves as Technical Officer of all contracts with the experimenters. He coordinates interface problems with the other Systems Managers and the Project Scientist (see para. 2.4.3).

2.4.8.3 Mission Operations System Manager (MOSM). The MOSM is responsible to and normally administratively assigned to the Project Manager for all flight mission support and operations. This includes validating, and generating project requirements, assuring adequate resources are committed and overviewing the implementation by the OTDA elements. He must have a complete, detailed knowledge of the spacecraft including experiments and its operations, capabilities, and limitations. The MOSM is responsible for preparing the operations plan, beginning with the first elements of that plan as soon as the Project Manager approves it, and for refining and detailing the plan throughout the life of the project. With the assistance of the Mission Support Manager and the Network Support Manager the MOSM will supervise, instruct, train, conduct simulations with, and exercise the operations team to establish and assure a performance capability consistent with the mission requirements. The MOSM ensures that all equipment supplied by the project or experimenters for installation at any network station conforms to the General Specifications for Network Equipment Design and Construction, and is provided with the necessary spare parts, manuals, and training.

2.4.8.4 Mission Support Manager (MSM). The MSM (Code 500) is the primary contact for the Mission & Data Operations Directorate (M&DOD) activities in

support of the project. He is responsible to the MOSM for accepting and assisting in the generation of project requirements, committing M&DOD resources, and implementing M&DOD support. He is responsible for preparing the M&DOD inputs to the NASA support plan and the publication of the coordinated plan. He is the prime contact for the Network Support Manager concerning M&DOD National Directorate (ND) operational interfaces in support of the mission.

2.4.8.5 Network Support Manager. The Network Support Manager (Code 800) is responsible to the Mission Operations Systems Manager for all network support to the project. He is responsible for accepting and assisting in the generation of project requirements and obtaining the commitment of network resources. He is responsible for the committed network resources, preparation of the Network Support Plan, including the launch vehicle tracking and data systems requirements, implementing network operational support plans, and readiness testing. He is the prime contact for the Mission Support Manager concerning ND/M&DOD operational interfaces in support of the mission.

2.4.8.6 Launch-Vehicle Systems Manager. Although another center may be assigned systems-management responsibility for the launch-vehicle system, being adequate to support the mission, the Launch-Vehicle Systems Manager is responsible for technical, procurement, budgetary, planning and scheduling, and other actions necessary for designing, developing, fabricating, testing, modifying, launching, and tracking the launch vehicle through injection into the transfer ellipse. This responsibility includes launch-vehicle systems engineering, i.e., assuring the integrity of the launch vehicle and the engineering compatibility of the launch vehicle and the spacecraft.

2.4.8.7 Test and Evaluation Support Manager. For each project, the T&E Division will assign an individual to support the Project Manager on all test matters. The Support Manager advises the Project Manager on test requirements, prepares or reviews the spacecraft test specification for approval of the Project Manager, coordinates the test program, and reviews test results. The Support Manager's duties also include liaison with the T&E Division on technical, manpower, and fiscal matters.

2.4.8.8 Quality Assurance Support Manager. For each project, a Quality Assurance Support Manager from the Quality Assurance Division, Systems Reliability Directorate, shall be assigned responsibility for assisting the Project Manager in the project reliability and quality assurance effort. He also provides liaison with the Quality Assurance Division on manpower and fiscal matters.

Specific responsibilities of the Quality Assurance Support Manager on the project staff are identified in Part 6, para. 6.2

2.4.9 Technical Staff

The scope and size of the technical staff will depend on the size, type, and management approach of each particular project. Personnel, such as subsystem engineers, will in general be assigned from the Space Applications & Technology Directorate (Code 700). There must be an engineer responsible for each spacecraft subsystem.

2.4.10 Project Administrative and Management Staff

Personnel from the Administration and Management (A&M) Directorate shall support each project in the area of procurement, scheduling (PERT), and financial analyses. The degree and scope of this support will depend on the size and requirements of the project. The A&M staff will be housed with the project when practical. A typical staff shall include:

A. A business representative, serving as a "single interface" for all A&M Directorate support to the project, who will be administratively responsible for resident functional A&M staff activities.

B. A Procurement Officer, either the Contracting Officer or his representative, who will act as contract negotiator and manager for the project. He shall be responsible for the timely accomplishment of all procurement activities, and shall give assistance and advise on source-selection justification, type of contract, negotiations. fees, etc.

C. Personnel to perform project-schedule analyses, using program evaluation and review technique (PERT), MICS, and other scheduling techniques.

D. Financial Analysts, who shall be responsible for cost analyses, budget compilations, cost accounting, etc.

2.4.11 Project Systems Engineer

Each Project Manager shall name by direct and specific assignment to a particular individual (perhaps himself) the responsibilities of systems engineering.

This includes not only system design but the assurance that all interfaces are adequately specified and reviewed. These interfaces shall include not only those between the spacecraft and experiment systems but also those between the complete observatory or satellite and the launch vehicle, ground complexes, and operational requirements. Specific responsibilities and authorities of this position depend upon the individual project organizational structure. This position is a staff function to the Project Manager.

2.4.12 Integration and Test Engineer

An Integration and Test Engineer may be assigned for each flight mission. The scope of this position will depend on the method of project implementation; i.e., in-house integration and test, or contractor integration and test. This function may be assigned to the Spacecraft Manager. The Integration and Test Engineer shall be responsible for the preparation of plans and procedures for the final assembly, integration, and flight acceptance test of the spacecraft system plus experiments, and for the execution of those plans and procedures.

2.4.13 Configuration-Management Officer

The Project Manager shall designate a Configuration-Management Officer (perhaps himself) for the project. GMI 8040.1 states the responsibilities of this position.

2.4.14 Systems Safety Officer

The Project Manager shall designate a Systems Safety Officer (perhaps himself) to implement a Systems Safety Plan (see 2.12.20 and Appendix C).

2.4.15 Documentation-Management Officer

The Project Manager shall designate a Documentation-Management Officer (perhaps himself). Paragraph 2.10 states the responsibilities of this position.

2.4.16 Environmental Committee

At his discretion, the Project Manager may establish a Project Environmental Committee; appointment of such a committee is highly desirable in all large projects.

Responsibilities of this committee should include assessment of requirements for environmental testing (ref. General Environmental Test Specification S-320-G-1), approval of environmental test specifications, and coordination and

evaluation of facilities and tests necessary for project requirements. The environmental committee will evaluate results and will certify that results meet the specifications and that the test program is adequate to meet the mission objectives.

2.5 MANAGEMENT INFORMATION SYSTEMS

2.5.1 Management Information and Control System (MICS)

As required by NASA Handbook 2340.2, November 1966, projects must submit monthly reports designed to:

A. Keep management at all levels informed on the status of the project.

B. Define responsibilities for accomplishment and approvals at all levels.

C. Interrelate the technical, schedule, and cost aspects of the project.

D. Provide the Project Manager with an opportunity for assessing the status of the project.

E. Provide a mechanism for identification of decisions that are required and for positive feedback of decisions made.

The monthly Project Managers' Report (PMR's) provide internal reporting within the Center, as well as the official Center report to Headquarters. The structure of the MICS, by level of detail, provides meaningful data for management purposes throughout the organization. The Project Manager must use the Level 2 MICS data for an oral briefing to Center management on the project status and on the content of the report submitted to Headquarters.

Appropriate elements of the Program Support Division, will provide assistance in the techniques of preparing the PMR's, if needed.

2.5.2 Work Breakdown Structure

The Work Breakdown Structure (WBS) is a basic management tool which is used to systematically subdivide discrete blocks of work. A WBS, when properly structured, can provide for: relating the specifications to the end item; identifying controllable work packages for estimating resources; budgeting and pricing; work assignment and authorization and reporting.

It is a product-oriented family tree composed of hardware, software, services, and other work tasks, which result from systems engineering and management planning processes, and which completely defines the program/project. A WBS displays and defines the products to be developed and relates the tasks to be accomplished to each other and to the end product.

The structure represents how the work will be managed by the Project Office and the contractor and is made up of work blocks arranged by level. Blocks of related and consistent work effort form a branch of the structure. Each block is sub-divided into smaller elements down to a control point which represents the lowest level of controlled effort, by the project. A WBS handbook has been written at GSFC (GHB 7120.1; dated August 1971, Subject: Handbook for Preparation and Implementation of Work Breakdown Structures).

2.5.3 Program Evaluation and Review Technique (PERT)

Basic elements of any scheduling system are:

A. Initial planning

B. Correlation of the interrelationship of project activities

C. Periodic reports on the status of the plans

D. Identification of critical paths of activity

E. Assistance in reprogramming project activities when necessary, through its ability to simulate potential solutions to problems.

The size and complexity of project activities dictate whether the scheduling activity can be covered by "bar charts" or whether machine processing and the programmed logic of PERT will be required. Where appropriate, consideration should be given to the relationship of the scheduling matrix with the WBS as there should be a continuity between all reporting requirements.

The scheduling technique that a contractor has implemented should be reviewed for acceptance before any other technique is imposed. Only if it is reasonably sure the contractor does have qualified personnel to properly implement PERT and is required by the project, should GSFC impose it on a contractor. Otherwise, PERT will only be a reporting system not a planning system. Assistance in developing a PERT system is available from the Program Support Division. Implementation and maintenance support is available from the applicable Program Support Representative.

2.5.4 Contractor Financial Management Report (533)

Contractors must submit financial reports on all cost-plus contracts in excess of $100,000. Cost contracts of a lesser value may also require financial reports. (Fixed-price contracts with cost incentives can require 533's also.)

Financial data are used as follows:

a. The contractor must develop a time-phased cost plan and must report against that plan.

b. The data serve as a basis for developing funding requirements for budget preparation.

c. The data help to monitor contract progress by identifying manpower application and material commitment.

d. The WBS subdivides the contract into manageable units which enhances resource planning and control and permits detail work flow analysis.

e. The data serve a warning system for detecting potential cost overruns.

f. The data assist in pricing of future buys.

NASA Handbook 9501.2A, October 1971, provides additional details on the use of contractor financial reports. The Program Support Division, will assist Project Managers in making financial reports and in analyzing data received.

Again there should be a correlation with the WBS for consistency and continuity.

2.5.5 PERT and Companion Cost

Many techniques can be used to interrelate and correlate schedule and cost data received, ranging from PERT cost (a technique used by the Department of Defense (DOD) in costing out all activities included in a PERT network) to a simple comparison that total technical effort is_____percent complete and total costs are_____percent expended.

NASA has selected PERT-Companion Cost for developing a system that provides a common framework for both cost and schedule reporting. The total PERT network is structured into "fragnets" (fragments of a network) which clearly

identify a unit of work that also becomes a basis for collection of costs. On a meaningful segment of the project activity schedule; therefore, cost can be reviewed on a common and meaningful basis.

Regardless of the reporting technique finally selected, the common work-breakdown structure should be understood and used in initial project planning because proper structuring can enhance the ability to assign responsibilities and to select levels of detail for reporting requirements. These concepts and techniques appear in the NASA PERT and Companion Cost System Handbook, October 1962. Additional assistance is available from the Program Support Division.

2.5.6 Project Operating Plans

NASA Headquarters requires submission of the Project Operating Plans (POP) in July and February. The July submission coincides with GSFC's grass roots budget and updates GSFC's operating plan for the current fiscal year. The February submission coincides with GSFC's mid-year update and provides the budget information of the Congressional submission for the next fiscal year and approval of revisions for the second half of the current fiscal year. It also provides the Office of Management and Budget (OMB) with a preliminary look at subsequent FY requirements.

The project must review its funding requirements by fiscal year and for project completion, as well as for the type of procurement envisioned and the estimated date of availability of the procurement request. These data must be realistic, because compliance with the submitted POP becomes the measurement of the effectiveness of the project's management of its resources.

The monthly Level 1 Headquarters Management Report constitutes a continuing update of the latest Headquarters POP data. The current estimate, contained in a GSFC Project Manager's PMR, is an information-only assessment of the validity of the current POP.

The subject is discussed at greater length in Procurement (Part 8) and Financial Management (Part 9). Information and support in preparing the POP are provided by Program Support Division.

2.5.7 Business Data Reports

Information on the project's resource status is available from reports issued on a periodic basis by the Business Data Branch, Program Support Division. Funding status information on current budget allocations, resource commitments,

obligations, and disbursement status is also available, as are detailed project manpower application data. A machine-reporting register prepared by the Business Data Branch constitutes a complete list of report frequency and availability. Assistance in interpreting and analyzing these reports is available from the Program Support Division.

2.5.8 Director's Weekly Reports

Each project should submit a weekly report to the Director. The objects of this report are:

A. A means for Project Managers, Division, Laboratory, and Office Chiefs to communicate problems and major happenings directly and openly with Center Management.

B. An updating of information (such as computer usage, special events, X-document reports, etc.) of general interest to Center Management and to other elements of the Center.

Guidelines for the report are as follows:

Directors Weekly Report

A. A concise summary of —

1. Major and important happenings.

2. Problems that cannot be resolved at the Division level.

3. Controversial items — do not hide them under the rug. Get them out in the open where management can deal with them.

B. Reports are to be provided by each Division/Laboratory Chief and Project Manager, and certain office heads. The report is to reflect his personal message.

C. Each report should be one page in length, with a two-page limit. Flag problems — do not try to explain them in detail.

D. Weekly reports are encouraged. Reports are expected at least once a month. Negative reports should be submitted if there are no major problems and/or happenings.

E. Functional and project offices may report on the same item if both the functional Division Chief and the Project Manager have personal messages on that item.

These reports are intended for information and communication and do not necessarily reflect official Center position.

2.6 FUNCTIONAL SUPPORT

2.6.1 Purpose

All administrative and technical support requirements supplied by functional Directorates should be clearly defined and estimated to effectively plan the most efficient use of the Center's resources and to ensure a complete understanding between the project and the functional area.

2.6.2 Applicability

This section shall apply to all organizational elements providing significant amounts of functional support to the project and to in-house experimenters. (For the Mission and Data Operations and Networks Directorates, this section refers to additional support beyond that specified in the Support Instrumentation Requirements Document, paragraph 2.8.4.4.)

2.6.3 Memoranda of Agreement

Memoranda of Agreement for functional support shall be used unless a Project Manager decides to the contrary. They shall be prepared in the following manner.

Prior to the release of the guidelines for semi-annual project involvement in manpower POPs (grass roots and mark-up) the Project Manager (PM) or Principal Investigator (PI) shall prepare or update a statement of support requirements for each Division from which support is required, and forward it to the pertinent Division Chiefs. This statement must be consistent with or modifications to other official agreements, particularly the Project Plan and the SIRD (see para. 2.12.15). It should also include the Project Manager's latest assessment of critical dates which affect planning requirements. The Division Chiefs through discussions with each Project Manager or Principal Investigator shall estimate the manpower required to be responsive to the Project Manager's statement.

If, after assimilating all the inputs from the PM/PI, the Division Chief finds that he has sufficient resources to support all projects, he and the Project Managers sign memoranda of agreement in the format of Appendix E which shall include a designation of both the man-years as well as the identification by name of those key individuals deemed essential for performance of the task. In dealing with Code 800 (Networks Directorate) all Memoranda of Agreement shall be between the Project and the Networks Directorate, Requirements and Plans Office. If the Division Chief has insufficient manpower to support all projects, he provides a memorandum to his Director of- which (a) validates the requirements, (b) reports the critical skill shortage, and (c) indicates the impact on his organization if required to support at the desired level. Copies of these memoranda are supplied to the appropriate Director of- in which the project or experiment is located.

At the same time, the appropriate Project Manager will prepare a memorandum for his Director of — which (a) validates the requirement and (b) indicates the impact on the project of support at the level proposed by the functional Division Chief. Copies of these memoranda are supplied to the appropriate functional Director of —. Resolution should be attempted by the Directors of — prior to the Director's manpower review. It is expected that critical shortages and the impact of such shortages as well as agreed upon requirements will be identified through this process at the Director's review of the manpower POP for eventual resolution.

Substantive changes in requirements between the POP exercises shall be handled in exactly the same manner as described above.

Between POP's the PM/PI and the Division Chiefs have collective responsibility for testing the validity of the estimates in executing the requirements — was the estimate too high or too low so that manpower usage can become increasingly effective through each succeeding POP. The PM/PI will be expected to track the actual vs the estimates at the MICS reviews.

2.6.4 Management Responsibility

It is the intent of Center management:

A. To apply adequate technical expertise to the Center's flight projects and,

B. To involve the functional managers (Branch and Division Chiefs) in the review of their personnel's efforts on flight projects.

The relative responsibility of the Project Manager and the Division Chief varies with the nature of the task:

- For tasks accomplished at the functional location the Division Chief has the responsibility for supervision and execution. The Project Manager, in this case, only reviews the technical and fiscal progress of the task, as well as the manpower expended.

- For tasks requiring full time, collocation of functional personnel with the project, the Project Manager is responsible for the day-to-day supervision of the functional personnel unless specified to the contrary in the Memoranda of Agreement. The administrative responsibility must be shared between the functional division and the project. It is expected that the PM/PI will advise the functional supervisor on the performance of those functional personnel residing with the project. However, the Division Chief is responsible for periodic reviews of the adequacy of the technical performance of their co-located personnel. Differences of judgment between the project and functional personnel can and should be appealed with the burden on the Project Manager and the functional Division Chiefs to resolve such differences if possible.

- In those cases where one functional man is assigned only part time to a project or splits his time between two projects, the functional chief's responsibilities are greater. It is his responsibility to supervise the time spent in the applicable areas and resolve any conflicts arising from concurrent project requirements.

2.7 INTER-CENTER SUPPORT

When project goals can best be attained by using the capabilities, equipment, or other resources of an installation other than GSFC, the Office of the Director will, at the request of the Project Manager, initiate each new request for such support.

2.7.1 Project Manager's Responsibility

The Project Manager will submit requests for inter-Center support to the Office of the Director with complete detailed justification. The justification shall include each of the following, if applicable:

a. Type of support (e.g., name of test or type of analysis to be conducted, or equipment to be used)

b. If similar support is available at GSFC, why request is desirable.

c. Funding limitations/resources

d. Dates requested

e. Consequences if support is not received

f. Other pertinent factors

After the request has been approved, the Project Manager will provide liaison with the other installation.

2.7.2 Request for GSFC Support

Requests by other centers or Headquarters for GSFC support will be channeled through the Director's office.

2.8 INTERFACE DOCUMENTATION

2.8.1 Purpose

To provide a medium of communication among agencies, experimenters, and individuals responsible for the various interfaces in a project, a system shall be established for documenting and updating all interfaces.

2.8.2 Applicability

The requirement for interface documentation applies to all GSFC projects.

2.8.3 Responsibility

The Project Manager shall be responsible for establishing and updating a system for interface documentation. The Project Manager may delegate this responsibility

to another individual such as the Project Documentation Manager. Formal sign-off procedures for each document must be established.

2.8.4 Scope

Interface documents shall specify all interface items required to adequately define the integration and operation of:

a. Spacecraft subsystems and experiments

b. Spacecraft and launch vehicle

c. Spacecraft and special ground-support equipment

d. Tracking and data-acquisition support (Support Instrumentation Requirements Document)

e. Launch vehicle, mission requirements, and launch range

f. Spacecraft and launch site

g. Spacecraft-to-ground Interface Control Document

2.8.4.1 Spacecraft Systems, Subsystems and Experiments. Interface documents shall specify all interface items required to define the complete integration of all spacecraft systems, subsystems, and experiments, including;

a. Method of installation

b. Electrical input and output characteristics

c. Thermal (environmental)

d. External mechanical constraints on configuration

e. Power

f. Special test equipment

g. Mechanical and electrical operating restraints

2.8.4.2 Spacecraft and Vehicle. Each launch vehicle (Delta, Atlas-Agena, Titan, Atlas-Centaur, Thor-Agena, and Scout) has interface documentation which is

required of a spacecraft project. These documents control the mechanical, electrical, and operational interfaces for these vehicles. A spacecraft constraints document for the Delta vehicle defines the interfaces of the vehicle and spacecraft, in general. To augment this, a vehicle/spacecraft integration and documentation schedule lists the detailed interface information which must be exchanged by the spacecraft and the vehicle projects.

For Agena, a mission requirements and restraints document sets forth the Agena restraints. An interface planning and scheduling document serves as the interface control medium for the spacecraft and vehicle.

For Centaur, an interface control document serves as interface control.

For Scout, the GSFC mission interface data book serves as the interface control document.

2.8.4.3 Spacecraft and Special Ground Service. This documentation shall specify all interface items between the spacecraft (including experiments) and the ground-support equipment (GSE), including project-unique ground stations and project-unique equipment at existing ground stations. Typically, it includes electrical and mechanical input and output characteristics, operational restraints, and computer hardware and software interfaces.

2.8.4.4 Tracking and Data-Acquisition Support. The Support Instrumentation Requirements Document (SIRD) serves to document and submit requirements for support according to NASA Management Instruction 5430.1A, Sept. 12, 1969. The implementation plan to the SIRD is the NASA Support Plan (NSP). Center approval and concurrence procedure is given in Appendix D.

2.8.4.5 Launch Vehicle, Mission Requirements, and Launch Range. NASA Management Instruction 8430.1A, Sept. 12, 1969, lists the documentation for requirements and responses for the national ranges. The Program Requirements Document (PRD) describes requirements for support and the Program Support Plan (PSP) outlines plans for meeting the requirements.

2.8.4.6 Spacecraft and Launch Site. The PRD shall outline requirements for spacecraft support at the launch site (such as space, clean-room facilities, power, air conditioning, and personnel facilities).

2.8.4.7 Spacecraft-to-Ground Interface. The Spacecraft-to-Ground Interface Control Document defines the electrical interface between the spacecraft and the network. This document will be prepared by the Networks Directorate in consonance with the project during the project system design phase. Any

subsequent changes will require the joint concurrence of the Networks Directorate and the project. Component and subsystem tests will be performed to verify compliance with this document. These tests will be performed on engineering models early in the spacecraft implementation schedule. The Interface Control Document will utilize the Aerospace Data Systems Standards as a guideline in establishing the interface between the spacecraft/launch vehicles, and the network.

2.9 CONFIGURATION MANAGEMENT

2.9.1 Policy

GSFC policy is to use Configuration Management Procedures (GMI 8040.1) on all GSFC satellite and satellite-orbiting vehicle projects, including unique support equipment and experiments.

2.9.2 Definition

Configuration management is defined as the identification, documentation, accounting, systematic technical evaluation, and approval of changes to all end-items of hardware (down to the black-box level) and software (down to the subroutine level).

2.9.3 Summary of GMI 8040.1

This instruction defines, and indicates requirements for, a configuration control board, configured article list, and configuration freeze date. Exhibit 1 shows the format for submitting changes to higher management. Exhibit 2 is an example of a configuration control board directive indicating the scope and authority of the Configuration Control Board and other elements of the documentation required for both the configured article list and the configuration accounting and identification system.

2.10 DOCUMENTATION MANAGEMENT SYSTEM

2.10.1 Objectives

Objectives of the GSFC Documentation Management System are:

a. To assure that required documentation is generated for both technical and administrative management

b. To assure that adequate procedures are used for controlling report redundancy and superfluous distribution

c. To systematically administer documentation from identification of requirement through acquisition, storage, and use

d. To evaluate the quality of documents by assessing their adequacy for intended use

e. To provide within the project a central source of information (documents and data availability) for maximum use

f. To analyze on a Center-wide basis the effectiveness of the total documentation process — identification, acquisition, distribution, and storage

2.10.2 Applicability

The provisions of the Documentation Management System apply to all GSFC projects and include contractor documents and formal documents generated within the Center.

2.10.3 Responsibilities

The Project Manager will appoint a Project Documentation Manager responsible for establishing and maintaining the formal Project Documentation Management System. The Project Documentation Manager will:

a. Establish all policies and procedures within the framework of this instruction to implement the system in the individual projects

b. Approve all project work statements for documentation requirements

c. Develop the distribution list for all project documents

d. Review documents received for quality, timeliness, and conformity to GSFC Specification S-250-P-1, January 1967, and any additional project instruction

e. Maintain the status records of documentation (including all reports required, frequency of issues, distribution of documents, and estimated cost per issue)

f. Maintain current library file of required project documents

g. Submit a documentation inventory report (Figure 2-1) to the Chief, Technical Information Division, on July 1 and January 1. (This report should include all significant scientific and technical papers published by the project and experimenters.) Send to the GSFC Library a copy of each document listed on the inventory report.

2.11 FLIGHT MISSION OBJECTIVES AND SUCCESS CRITERIA

Statements of objectives for individual missions are to be consistent with mission objectives established by formal NASA Headquarters documentation, such as Project Approval Documents (PAD). Such statements are the only set of words that may be used as "Mission Objectives" in all project documentation.

Approved objectives statements will be included in initial guideline instructions from OSSA for implementation of each project, and will be incorporated into the Project Plan and PAD verbatim. These statements should be established in an iterative manner between GSFC and OSSA. The final statement requires the approval of the GSFC Deputy Director. Mission performance will be rated as "successful" or "unsuccessful" by AA/OSSA, based upon achievement of primary mission objectives. It is recognized that, in almost all cases, valuable additional information is obtained if the mission exceeds this success criteria; i.e., the primary mission objectives. Every effort should be made to maximize the return from each mission consistent with the resources available.

The wording of the mission objectives statement should be simple and concise and should reflect the true project goals and maturity. As indicated above, the mission objectives should be established and agreed to by GSFC and OSSA early in the implementation cycle. If, during implementation, circumstances dictate a basic change in plans, the mission objectives statement should be examined to determine if a change in wording is required. Such changes require the approval of the GSFC Deputy Director and the AA/OSSA.

Approximately one year before launch, the GSFC Project Manager and the OSSA Program Manager should review the mission objectives statement and either certify to GSFC and OSSA management that the statement is valid or recommend appropriate changes.

Exceptions by the Project Manager to PAD mission objectives can be accommodated by negotiation with the appropriate Program Office, and subsequent PAD updating should a change be approved.

In every case, the Division Director will schedule a specific review of mission objectives about one year prior to launch readiness. The Project Manager will

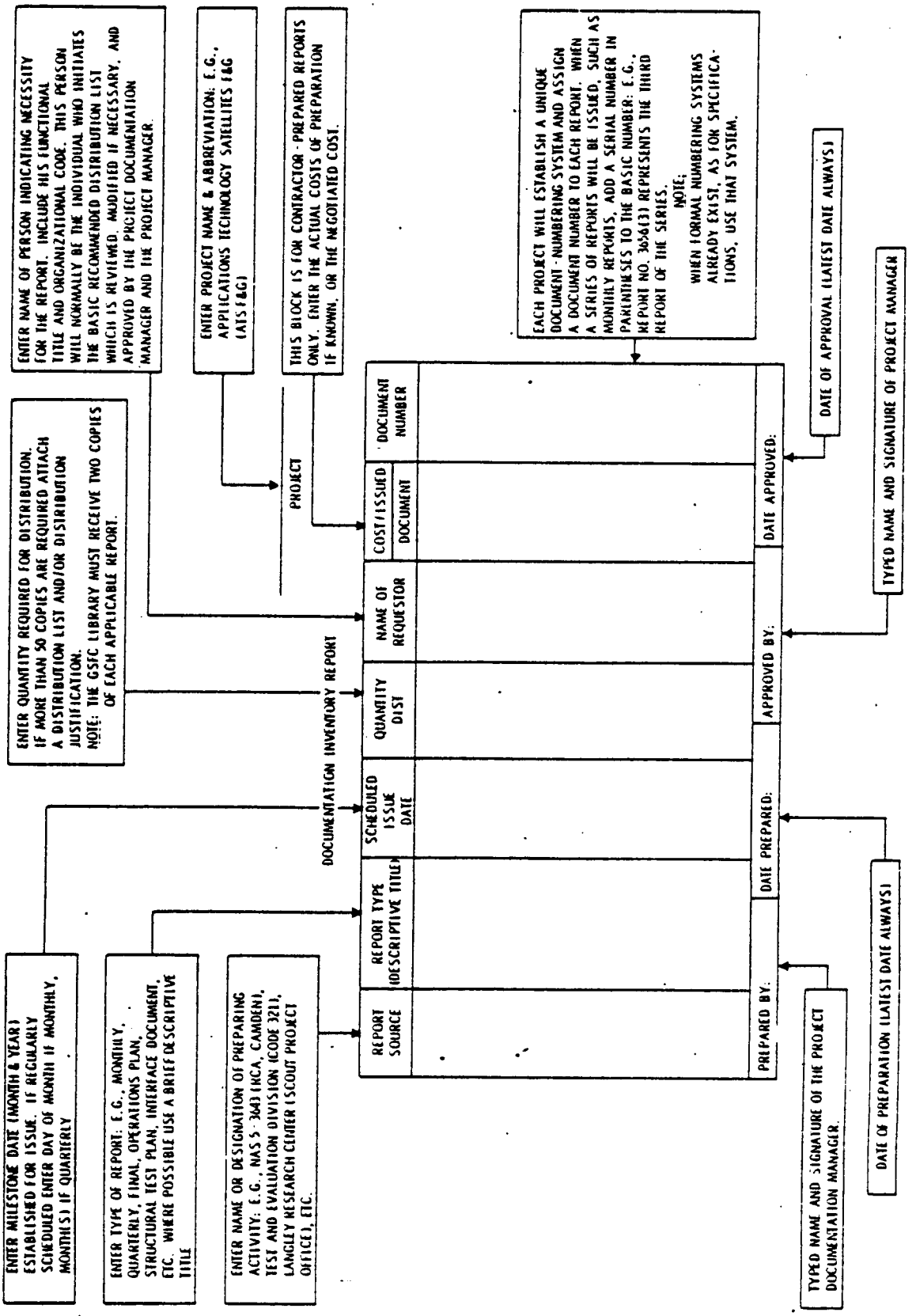


Figure 2-1. Documentation Inventory Report

display such a milestone on Level 2 milestone charts prepared for PMR submittal to Headquarters.

2.12 APPLICABLE INSTRUCTIONS AND GUIDELINES

The following briefs of instructions and guidelines state the general content of each as it relates to project management. If itemized, specific responsibilities of the Project Manager will appear in the brief.

The intent is not to answer all questions that may arise nor to duplicate detailed procedures, but to refer the Project Manager to a source that can help prevent or solve his problems.

2.12.1 Planning and Implementation of NASA Projects (NMI 7120.1, presently being revised)

a. Summary of the overall NASA planning structure including long-range, intermediate range, and current planning

b. Policies and procedures for initiating a project, project approval, project implementation, and organization for project management

c. Procedures for actions following project approval, including revisions to approval documents

d. Procedure for resolving disagreement between a Project Manager in one center and a System Manager in another center

e. Project Manager's responsibility: direct responsibility for project execution

2.12.2 GSFC Project Planning Handbook (GHB 7121.3, April 1972)

These guidelines provide guidance for understanding and using the preferred Goddard project-planning concept.

2.12.3 NASA Quality and Reliability Publications

NASA quality and reliability publications contain general guidelines which apply to many situations. Each guideline or publication must be implemented to the extent required for accomplishing project activities (see para. 6.6).

2.12.4 GSFC Malfunction Reporting Procedure (GMI 5310.1A)

a. Applicability. This procedure is required for all flight projects.

b. General Content. The means of reporting and documenting deficiency data on materials, parts, components, subassemblies, assemblies, subsystems, systems, processes, and procedures.

c. Project Manager's Responsibility. The Project Manager shall have the overall responsibility for malfunction reporting on his project.

2.12.5 GSFC Engineering Standards Design Manual (X-Document 673-64-1)

a. General Content. Practices and procedures to be followed by engineering and drafting personnel in the preparation, revision, and release of engineering drawings.

b. Project Manager's Responsibility. These standards should be used with those for procurement of items, procurement source control, and field modifications.

2.12.6 NASA Design Criteria, NASA Policy Directive 8070.1, August 17, 1967

Design Criteria Monographs are to be regarded as guides to design and not as NASA requirements except as may be specified in formal project specifications. These monographs are published in four technological areas — Environment; Structures; Guidance and Control; and Chemical Propulsion. Project Managers should consider citation of these monographs where applicable as references in GSFC contractor specifications. The criteria documents published as of this date are as follows:

a. Environmental Criteria:

SP-8005 — Solar Electromagnetic Radiation, revised May 1971.

SP-8010 — Models of Mars Atmosphere (1967), under revision.

SP-8011 — Models of Venus Atmosphere (1968), under revision.

SP-8013 — Meteoroid Environment Model (1969) (Near-Earth to Lunar Surface), March 1969.

SP-8017 — Magnetic Fields — Earth and Extraterrestrial, March 1969.

SP-8020 — Mars Surface Models (1968), May 1969.

SP-8021 — Models of Earth's Atmosphere (120 to 1000 km), under revision.

SP-8023 — Lunar Surface Models, May 1969.

SP-8037 — Assessment and Control of Spacecraft Magnetic Fields, September 1970.

SP-8038 — Meteoroid Environment Model — 1970 (Interplanetary and Planetary), October 1970.

SP-8049 — The Earth's Ionosphere, October 1970.

b. Structural Criteria:

SP-8001 — Buffeting During Launch and Exit, May 1964.

SP-8002 — Flight-Loads Measurements During Launch and Exit, December 1964.

SP-8003 — Flutter, Buzz and Divergence, July 1964.

SP-8004 — Panel Flutter, May 1965.

SP-8006 — Local Steady Aerodynamic Loads During Launch and Exit, May 1965.

SP-8007 — Buckling of Thin-Walled Circular Cylinders, revised August 1968.

SP-8008 — Prelaunch Ground Wind Loads, November 1965.

SP-8009 — Propellant Slosh Loads, August 1968.

SP-8012 — Natural Vibration Modal Analysis, September 1968.

SP-8014 — Entry Thermal Protection, August 1968.

SP-8019 — Buckling of Thin-Walled Truncated Cones, September 1968.

SP-8029 — Aerodynamic and Rocket-Exhaust Heating During Launch and Ascent, May 1969..

SP-8031 — Slosh Supression, May 1969.

SP-8032 — Buckling of Thin-Walled Doubly Curved Shells, August 1969.

SP-8035 — Wind Loads During Ascent, October 1969.

SP-8040 — Fracture Control of Metallic Pressure Vessels, May 1970.

SP-8046 — Landing Impact Attenuation for Non-Surface-Planning Landers, March 1970.

c. Guidance and Control Criteria:

SP-8015 — Guidance and Navigation for Entry Vehicles, November 1968.

SP-8016 — Effects of Structural Flexibility on Spacecraft Control Systems, April 1969.

SP-8018 — Spacecraft Magnetic Torques, March 1969.

SP-8024 — Spacecraft Gravitational Torques, May 1969.

SP-8026 — Spacecraft Star Trackers, July 1970.

SP-8027 — Spacecraft Radiation Torques, October 1969.

SP-8028 — Entry Vehicle Control, November 1969.

SP-8033 — Spacecraft Earth Horizon Sensors, December 1969.

SP-8034 — Spacecraft Mass Expulsion Torques, December 1969.

SP-8036 — Effects of Structural Flexibility on Launch Vehicle Control Systems, February 1970.

d. Chemical Propulsion Criteria:

SP-8025 — Solid Rocket Metal Motor Cases, April 1970.

2.12.7 Aerospace Data Systems Standards (X-Document 520-63-2 as modified)

a. Applicability. The GSFC Aerospace Data Systems (ADS) Standards apply to all projects using the GSFC Network or the GSFC data handling and processing facilities, and to all projects managed by GSFC. They are binding unless specific waivers are requested and granted.

b. General Content. The standards govern interfaces between major parts of aerospace data systems; i.e.:

- Telemetry
- Command
- Tracking
- Communications
- Data Processing
- Associated Systems

They impose constraints or boundary conditions at the interface and establish minimum acceptable levels of performance which the user may expect through conformance to the Standards.

c. Project Manager's Responsibility. GMI 8070.1 (establishing the authority of the Data Systems Requirements Committee and the Aerospace Data Systems Standards) requires that each Project Manager assure conformance to the standards if feasible. If conformance is not feasible, a waiver for each deviation for each mission is required. Procedures for obtaining waivers are outlined in the introduction to the Aerospace Data Systems Standards (X-520-63-2). It is recommended

that the standards be cited as applicable documents in procurement actions whenever appropriate.

2.12.8 Experiments Specifications (Dr. Townsend memo, October 14, 1966)

a. General Content

(1) Project Manager's right to concur in all final Goddard and outside experiment specifications

(2) Procedure to be followed if experimenters and Project Managers fail to agree on any part of the experiment specifications

b. Project Manager's Responsibility. To immediately refer to higher authority for resolution any disagreement concerning experiment specifications.

2.12.9 Reliability and Quality Assurance Guidelines for Experiments (Dr. Townsend memo, October 14, 1966)

a. General Content. Policy is that the project organization must maintain cognizance of the reliability and quality-assurance aspects of experiments without removing these aspects from the experimenter's basic responsibility.

b. Project Manager's Responsibility. Inform Goddard management of any matter on which, in the Project Manager's judgment, a major compromise is being made. Ensure that appropriate Goddard elements advise experimenters concerning:

(1) Any pitfalls that might jeopardize their scientific or technological objectives

(2) The sensor, its calibration, and specifically selection of component parts, fabrication techniques, circuit reliability assessments, subsystem testing, and handling

2.12.10 Tips To Experimenters (published by Quality Assurance Division, Systems Reliability Directorate)

Tips to Experimenters describes some of the accumulated experiences encountered in preparing spacecraft for flight during the early years. Most of the items discussed were observed first-hand at GSFC. The chief objective of this publication is to prevent the recurrence of problems observed.

a. General Content

(1) Considerations in experiment design

(2) Hardware procurement; contracting for quality assurance

(3) Inspection and fabrication techniques

(4) Testing and experiments

b. Project Manager's Application. This publication contains useful information for implementing the policy on advice to experimenters (see para. 2.12.11).

2.12.11 NASA Complementary Manuals

Complementary manuals are the basic NASA references in the functional areas of personnel, financial management, and procurement. Although other guidelines exist, the major publications are:

a. NASA Procurement Regulation (NHB 5101.2)

b. NASA Financial Management Manual

c. Procedures for Contractor Reporting of Correlated Cost and Performance Data (NHB 9501.2A, October 1971)

d. A Guide to Initiating Procurement Requests (GHB 5150.1C)

2.12.12 NASA Contract-Administration Publications

The NPC-400 series of NASA publications set forth basic contract-administration guidelines in specialties of this functional area.

2.12.12.1 NASA Policy and Procedures for Use of Contracts for Nonpersonal Services (NPC-401). This publication is used in conjunction with NASA Procurement Regulation (NHB 5100.2). It does not apply to contracts for consultants and experts covered by existing regulations.

2.12.12.2 NASA Source Evaluation Board Manual (NPC-402). Establishes requirements for all NASA management and technical personnel involved in source-evaluation processes for major competitively negotiated contracts as follows:

a. The basic policy requiring use of source-evaluation boards for competitively negotiated processes

b. Regulations for establishing source-evaluation boards

c. Procedures which govern the evaluation and selection of contractors for performance of NASA's major competitively negotiated contracts

2.12.13 Budget Execution and Review at the Goddard Space Flight Center (X-Document 210-67-80)

a. General Content. Documentation of the system used at GSFC for reviewing and executing its detailed operating budget, including the application of computer technology to the process; describes both the overall NASA budgetary process and the GSFC system.

b. Project Manager's Responsibility. To participate in the preparation, review, and execution of the budget for the project.

2.12.14 Funds Control at GSFC (X-Document 210-67-353)

This document describes the system used at GSFC for ensuring funds control at job-order, project-appropriation, fiscal-year, and total Center level. It describes both the overall NASA system and the GSFC system.

2.12.15 Documentation of Tracking and Data Acquisition Support for NASA Unmanned Space Flight Projects (NMI 8430.1A, September 12. 1969)

a. General Content. A common means of delineating project support requirements and of planning the necessary facilities to meet such requirements (see Appendix D and para. 4.3.1).

b. Project Manager's Responsibility

(1) To prepare the Support Instrumentation Requirements Document (SIRD)

(2) To initiate, through the Launch-Vehicle Systems Manager, the preparation of the Program Requirements Document (PRD)

2.12.16 Management Procedures for Automatic Processing Equipment (NHB 2410.1A)

General Content — Establishes policies, procedures. and guidelines for the acquisition and management of automatic data processing equipment.

These regulations apply to all ADP (computer-related) equipment systems, components, or attachments, for whatever use, and whether purchased or rented, by NASA or by a contractor or subcontractor, for a new installation or for a modification or reassignment. A special path of review and approval is required before the acquisition of such equipment. This includes a NASA Headquarters approval of the individual action in most cases. An ADP Acquisition Plan must be prepared, including a technical Feasibility Study, for approval prior to issuance of an RFP by NASA or a contractor for any item of ADP equipment. For competitive procurement the RFP and specifications must be reviewed, a technical panel established, evaluation criteria defined, and the final selection made in accordance with GSFC ADP procedures.

A brief definition of the range of equipment designated as ADP is given in paragraph 8.5.2, but determination of the category must be made by NASA ADP management. The designated official for ADP matters at GSFC is the Assistant Director of Mission and Data Operations (Center Automatic Data Processing). Code 502. Procurement of ADP equipment by GSFC is assigned to the Procurement Division, Network and Data Systems Branch, Section C (Code 244.3).

Specifications for Phase B, C, and D contracts must include the GSFC ADP procedural requirements in anticipation of possible inclusion of ADP equipment for such uses as integration and test, simulation, displays, recording, control centers, or telemetry processing. Specific guidelines must be given to the contractor, particularly when the contractor is involved in total system design and pricing. GSFC project personnel (or consultants) should be assigned to study and coordinate all project ADP use areas, and to maintain contact with Code 502.

2.12.17 Systems Safety (NHB 1700.1 (V3) 3/6/70)

a. Outline of techniques that are useful in the planning, implementation, and administration of a system safety program (also see NHB 1700.1 (V1) entitled "Basic Safety Requirements," July 1969).

b. It is the policy of this Center to have a System Safety Plan for all flight projects. The implication of NHB 1700.1 (V3) is that system safety assess the risk associated with space flight hardware systems with a purpose of avoidance of injury to people and property loss regardless

of cause and this policy extends to post-launch operations. At GSFC it is the policy on unmanned flights to concentrate our attention on the avoidance of injury to people. Therefore, Systems Safety is defined as those engineering and management practices and procedures necessary to avoid personnel injury and property loss to the maximum extent practical. Systems Safety includes the protection through launch of flight hardware from loss or damage from extrinsic factors, but does NOT include property loss or damage to flight hardware due to internal component malfunctioning. The latter is considered a design reliability, and/or quality responsibility.

Systems Safety does not extend into post-launch operations. Appendix C gives an outline of a model Systems Safety Plan. This outline should be used to the extent applicable on all projects. It should be noted that it is not the intent to duplicate existing document with a "systems safety" cover on it.

c. Project Manager's Responsibilities. To implement a Systems Safety program. It should be noted that advise and consultation can be obtained from the Health and Safety Engineering Office in the drafting and implementation of the Systems Safety Plan. Each Systems Safety Plan shall be approved prior to implementation by the cognizant Director of —.

2.12.18 Photographic Coverage

The Project Manager will ensure that required photographic coverage of project activities is recorded for technical and administrative documentation purposes. In addition to in-house coverage, this includes suitable requirements in contracts to meet project needs. The GSFC Photographic Section will provide consultative support, as required, in formulating contractual requirements and prescribing photographic specifications.

2.12.19 General Specifications for Network Equipment Design and Construction

a. General Contents. Establishes policies, procedures, standard interfaces, and guidelines for design, construction, and installation of equipment in a network station.

b. Project Manager's Responsibility. The Project Manager shall have the responsibility for the conformance of project supplied ground station equipment with the General Specifications for Network Equipment Design and Construction.

2.12.20 Indexes to NASA and GSFC Management Instructions

a. The table of contents to the GSFC Management manual, published quarterly and distributed to manual holders, contains a listing of the complete GSFC issuance system.

b. Table of Contents of NASA Management Issuances, NHB 1410.4 series, lists all NASA issuances.

2.13 INTERNATIONAL COOPERATIVE PROJECT MANAGEMENT

The international activities of the National Aeronautics and Space Administration are planned to demonstrate the peaceful purposes of space research and exploration by the United States, to provide opportunities for the participation of scientists and agencies of other countries in the task of increasing man's understanding and use of his spatial environment, and to support operating requirements for the launching and observation of space vehicles and craft. Because of their very nature (initiation, execution, etc.), international cooperative projects are managed in a manner slightly different from their domestic counterparts. Proposals for cooperative satellite projects are generally initiated by the foreign country as a result of preliminary discussions between their representatives and NASA Headquarters personnel. The foreign proposal is reviewed by appropriate NASA Centers and a technical/scientific evaluation is submitted to NASA Headquarters. If the proposal satisfies the standard NASA guidelines, i.e., civilian agency, specific project, scientific or applications validity, mutual interest, and open availability of results, then a Memorandum of Understanding is prepared by NASA Headquarters and signed by the Administrator and his foreign counterpart. The project management responsibility is then assigned to a NASA Center (sixteen have been assigned to GSFC and one to LeRC).

In general, NASA is responsible for providing the launch vehicle, support by the T&DA facilities, one or more U.S. experiments, spacecraft advice, and unique test facilities. The foreign country generally provides the spacecraft, the majority of the scientific experiments and most of the data processing. Therefore, the principal project management efforts on an international project are directed towards insuring on behalf of the United States that the various Centers responsible for the three areas of NASA responsibilities (spacecraft advice/experiments, launch vehicle, T&DA) perform satisfactorily within the written words and spirit of the Memorandum of Understanding. This generally results in active management of the U.S. effort and directing the passive advice and counsel provided on the foreign effort (usually limited to a general surveillance of the foreign effort, culminating in a joint flight-worthiness approval of its efforts).

In all cooperative projects the principal mechanism for coordination and information exchange and transfer is the Joint Working Group (JWG). This group is co-chaired by the U.S. and foreign project managers and consists of working representatives of each system and major subsystem. It usually meets semi-annually in alternate countries and exerts a major influence on the successful execution of an international cooperative project.

Formal reviews are held during the life of an international project by a design review team composed principally of technical experts from the Project Management Center and co-chaired by a representative from the Systems Reliability Directorate and his foreign counterpart. These reviews are similar in function as those described in Part 5.

2.14 EXPERIMENTS

2.14.1 Experiment Selection

Space flight experiments are selected and approved by NASA Headquarters based upon a proposal submitted in response to a specific solicitation in Opportunities for Participation in Space Flight Investigations, NHB 8030.1A. Proposals define objectives, the technical plan for the achievement of these objectives, management plan, program scope, and cost. (For GSFC proposals, see GMI 8030.2 dated October 14, 1970.) As part of the experiment selection process, Project Managers will review the proposed experiments in order to assess mutual compatibility, ability of the spacecraft to accommodate the individual instruments, and instrument complement, and realism of the management plan including cost. Results of this review are provided to NASA Headquarters prior to final selection of the experiment complement for the given mission.

2.14.2 Project Experiment Requirements

The Project Manager shall establish project requirements and schedule milestones for all experiments. These shall include:

a. Delivery dates for prototype and flight experiments

b. Interface documentation requirements

c. Environmental and integration test requirements

d. Configuration management

e. Reliability and quality assurance

f. Progress reporting

g. Interface liaison with spacecraft contractor

h. Design reviews

Through formal and informal means, the Project Manager shall monitor the progress of the experiment effort.

The establishment of uniform requirements upon all experimenters, both in-house and out-of-house, is necessary for the conduct of a successful space flight program. These requirements are implemented as follows:

a. GSFC Experiments. A Memorandum of Agreement, if deemed necessary by the Project Manager, between the Project Manager and the in-house experimenter forms the basis for project requirements. This agreement shall include total budget and manpower requirements by fiscal year in addition to requirements listed in paragraph 2.14.2.

b. Out-of-House Experiments. Project requirements listed above plus total experimenter program costs through launch are agreed to in the formal contractual document between GSFC and the experimenter's institution. The data reduction and analysis phases of the experiment program are discussed in Part 7 of this handbook and are called-out specifically in the contractual agreement between the project and investigator.

c. Foreign Experiments. The official agreement with foreign experiments is handled by NASA Headquarters. The details of project requirements are handled by mutual agreement between the Project Manager and the Foreign Investigator.

2.14.3 Application Experiments

The term "experiments" when applied to some application projects, such as ERTS has a different connotation than when applied to the scientific projects. It refers primarily to the analysis and interpretation of the data and not to the sensor hardware per se. Thus, in contrast to the classical role of the Principal Investigator, these investigators are essentially "Guest Observers."

In general, the requirement for the sensors and the format of the data output are generated by means of working groups representing the experimenters, (guest observers) who will ultimately make use of the data and project personnel. It is

the responsibility of the Project Scientists to chair the working group and to see that these requirements are generated early in the program.

Once the requirements are established, the Project and the Technical Officer are responsible for the procurement of the sensor hardware and any ground equipment necessary to present to the experimenters the sensor output in a usable format. The Technical Officers for the sensors will in general be provided by the Earth Observations Systems and Systems Engineering Division and assigned to the project.

PART 3

SYSTEM TESTS

3.1 PHILOSOPHY

Because spacecraft are not only "one-shot" but are also "one-of-a-kind," statistical approaches to testing developed for mass production of consumer goods and weapons are not applicable. Actual flight hardware must be exposed to a reasonable simulation of the expected operating environment to assure a high probability of successful performance in space.

The six objectives of the spacecraft test program are:

a. To verify that system, subsystem, and component designs meet performance requirements

b. To verify that particular hardware samples meet performance requirements

c. To eliminate defects in material and workmanship

d. To discover unexpected interactions between subassemblies, particularly when the system is exposed to environmental stress

e. To verify that ground-support and data-processing equipment are compatible with the spacecraft (see para. 4.4)

f. To train spacecraft operations and data-processing personnel

3.2 BASIC CONCEPTS OF SYSTEM TESTING

GSFC has endorsed the full-system test approach, in which the entire system is tested under conditions as realistic as possible. Systems tests generally fall into one of two categories:

a. Functional tests to establish that each subsystem is doing its designated job in conjunction with the other spacecraft subsystems. This category includes calibrations which consist of actually calibrating any spacecraft sensors or instrumentation, as well as establishing a

performance baseline with which the spacecraft can be compared throughout the environmental test phase.

b. Compatibility testing, considered here in its broadest sense, refers to all testing directed primarily toward evaluation of the various spacecraft interfaces. This category includes electromagnetic compatibility (EMC) assessments and electromagnetic interference (EMI) evaluations, as well as magnetic moment determinations.

EMC and EMI measurements are necessary to ensure that the spacecraft electrical and electronic equipment operate satisfactorily not only as independent systems but also in conjunction with the launch vehicle and ground support equipment, and in the proximity of launch range equipment. In short, the spacecraft should not be adversely affected by electromagnetic interference reaching it from any external sources. Conversely, the spacecraft itself should not be a source of interfering signals which might adversely affect its own operation, vehicle operation, other spacecraft, or ground monitoring and control equipment. Because of the criticality of spacecraft functions whose operation is dependent upon electro-explosive devices (deployment, separation, etc.), the susceptibility of these devices to interfering signals should be of particular concern.

To determine mechanical compatibility of the spacecraft with the launch vehicle and aerodynamic fairing, matchmates may be advisable.

Components and subsystems of the spacecraft communications and data subsystems shall receive preliminary compatibility testing as early in the implementation schedule as possible — preferably on the engineering model — in order to minimize the potential impact on the ground support elements.

Finally, the flight spacecraft shall be tested with the ground-support and data-processing equipment, personnel, and procedures that will be used to operate the spacecraft in orbit.

3.3 SYSTEM TESTING

System testing is performed at GSFC or monitored at contractors' facilities by the project with the aid of the Test and Evaluation and the Quality Assurance Division of the Systems Reliability Directorate.

3.3.1 Environmental Test

These tests determine the ability of components, subsystems, and the entire spacecraft to withstand environmental rigors that may be experienced before and during launch, and during orbital operation. The tests may be conducted at any or all levels of assembly, but are required at the spacecraft level. The severity and duration of the tests are related to the purpose of the tests as indicated below. At times it is difficult to distinguish between functional testing and environmental testing, particularly when a specific environmental, e.g., high vacuum, is required for the performance of a functional test (see para. 3.4).

3.3.1.1 Flight Acceptance Testing. All flight hardware is ground-tested in the expected flight environment. The hardware is exposed to simulated loading conditions produced by temperature, pressure (vacuum), and vibration during the launch and the orbital phases of the flight. Functional tests appropriate to the conditions simulated are conducted. Test levels are chosen such that, in theory, there is one chance in twenty of their being exceeded in flight.

3.3.1.2 Qualification Testing. A prototype model (i.e., the actual flight configuration) is exposed to an environment intended to produce loading conditions and stresses in excess of those expected in flight. The purpose of prototype testing is to ensure a margin in the design to provide for uncertainties in areas such as analyses, materials, and workmanship. For qualification, test levels are chosen such that, again in theory, there is one chance in one hundred of their being exceeded in flight.

3.3.1.3 Proto-Flight Testing. As programs mature, cases arise of spacecraft based primarily on previously flown hardware but somewhat different in design and performance. In these cases a prototype spacecraft may not be required. Flight acceptance and qualification testing are combined and performed on the flight spacecraft. The amount of qualification testing required is made consistent with the magnitude of the hardware changes.

While the establishment of test levels is defined above in terms of overall risk, the paucity of applicable data makes this task one which does not yield exact numerical values.

3.3.2 Subsystem Testing

The full-systems test approach does not eliminate the desirability, or in some cases the necessity, of black-box and subsystem qualification and acceptance testing. Several inherent limitations of systems testing are best overcome by testing at the subsystem or black-box level:

a. If only systems tests are run, marginal conditions existing at subsystem or black-box interfaces may remain undetected. Only information on the input/output characteristics of the individual black boxes can establish the presence of adequate control margins.

b. Systems tests seldom run long enough to detect wear-out problems. Wherever a fatigue or wear-out potential exists (chiefly in electromechanical devices), the "life" characteristics should be investigated on a component or subassembly basis. Great care must be taken to assure that the sample is truly representative of the flight hardware.

c. After a spacecraft is completely assembled, devices may no longer be realistically operable during systems testing. In some cases this occurs because the spacecraft cannot be operated in all possible orbital modes on the ground, primarily because the orbital environment cannot be precisely simulated. Maximum assurance that devices are still working after systems testing must be obtained without invalidating test results by extensive spacecraft disassembly. In some cases, such as the power subsystems, comprehensive testing may be the best way to gain confidence in the ability of that subsystem to perform satisfactorily in all its anticipated operating modes.

d. Because systems testing is costly, judicious testing of individual black boxes and/or subsystems should be accomplished before final assembly and full-systems testing. A conscious compromise is necessary between complete black-box and early systems testing. Black-box testing provides a hedge against failures of these elements in the full-systems test, while the early systems test verifies the basic design and uncovers systems problems.

3.3.3 Experiment Testing

Where an experiment is one of many in a spacecraft, and where its failure will not endanger the mission requirements, it may be treated the same as a subsystem (see above). Where an experiment is essential to the accomplishment of the mission or costs $2,000,000 (approx) or more, the mandatory testing program called out in the General Environmental Specifications will be required before assembly into the spacecraft. In cases when two models of the experiment are available, one can be used for qualification and one for flight acceptance. In cases where constraints permit only one experiment to be made, it must be subjected to protoflight level tests at the experiment and spacecraft (observatory where applicable) configuration levels.

3.4 GENERAL ENVIRONMENTAL TEST SPECIFICATIONS

A single document, General Environmental Test Specification for Spacecraft and Components, S-320-G-1, describes the environmental and functional tests anticipated for GSFC spacecraft. The tests, generally common to all spacecraft, are presented in the main body. The appendices contain the structural dynamic test levels that are appropriate for the launch vehicle being used.

Mandatory tests are listed in paragraphs 1.6.4 and 1.6.5 of the general test specification and careful consideration should be given to other tests listed in those paragraphs and in paragraph 1.6.6 on the basis of spacecraft design and mission. The test program is not rigid but provides for alternate methods for satisfying test requirements, including the mandatory tests. Deviation from mandatory tests, or the recommended alternate, requires prior approval from the Director of Systems Reliability as well as the cognizant Director of —. The general test specification serves as a model in format and as a source document in content for the writing of particular test specifications for individual projects.

3.5 DETAILED ENVIRONMENTAL SPECIFICATIONS AND TEST PLANS

Detailed requirements for environmental tests for a specific project appear in specifications and plans developed for that project and issued by the Project Manager. The scope of the project's effort will appear in the reliability assurance program plan; approval of that plan means approval of the scope of the test effort. The Project Manager calls principally on his Test Support Manager (para. 2.2.8.7) for preparing detailed specifications and plans.

3.5.1 Environmental Test Specifications

The Project Manager is responsible for approving project specifications that define requirements and levels for spacecraft tests and plans. These specifications shall reflect the basic requirements and intent of the General Environmental Test Specification for Spacecraft and Components using launch environments dictated by the particular launch vehicle.

Environmental testing shall be conducted in accordance with the terms of an approved Environmental Test Plan. This plan shall relate the objectives, philosophies, test requirements, management schemes, and schedules which apply to the program.

PART 4

OPERATIONAL REQUIRMENTS

4.1 GENERAL

The operational requirements covered by this section are principally those which come under the program responsibility of the Office of Tracking and Data Acquisition, NASA Headquarters, and are concerned with the on-orbit support to flight missions. The basic policies and procedures for establishing, documenting, and controlling requirements for tracking and data-acquisition (T&DA) support of unmanned missions are outlined in NMI 8430.1A dated September 12, 1969.

It is the Project Manager's responsibility to ensure timely submission of operational requirements for implementation by T&DA support organizations. These requirements involve engineering and operations in the major areas of network(s), control centers, communications, orbit determination, support computing (attitude determination, launch window and lifetime analyses, etc.), and data processing. These areas have been defined as a result of recognition of the operational elements common to project support, the scope and nature of those elements, the identification of the networks and associated facilities as a NASA and a national resource, and the manner in which these large common user facilities are controlled and funded. This functionally organized T&DA support is frequently different from that provided to flight projects by many other organizational elements at GSFC. The efforts involved do not deal with any single specific part of the satellite per se but, for the most part, the policies, procedures, practices, rules, etc., under which the mission will be operated. The result is specific instructions, procedures, etc. for the operation of the major ground facilities for each mission in a multimission environment.

It is axiomatic that as much as possible of the technical capability required for each new mission should be available from existing capability by simple addition, reallocation or redefinition. The recognition and identification of the truly mission unique requirements and the determination of those items that can be or will be supported from existing capabilities, whether hardware, software, or procedure, is a most important and difficult task. It must be accomplished expeditiously in order to permit initiation of design and development of the truly unique items and to allow for the adjustment and testing of the established way of operating. That part of the support drawn essentially intact from existing capabilities cannot be considered experimental and dedicated. Only that truly unique to a mission can be placed in that category. Even then, as such items

are proven and incorporated into standing capability, they become part of the resources each following new mission may draw upon. In this manner, each new operation contributes to the development and improvement of ground operations and ground systems.

4.2 INTERFACES

4.2.1 Studies and New Project Activities

The development of operational requirements is an iterative, interactive, process involving the four principal steps of (1) operational concepts, (2) requirements definition, (3) support definition and commitment, and (4) mission operations planning. These steps roughly correspond to the sequence of project events. The first two steps are important and essential activities and should be consciously and explicitly executed in-line and in-balance with all other aspects of the mission (i.e. — science, spacecraft, launch vehicle, etc.). It is important that each feel the influence of the requirements and constraints of all other areas as early as possible in the definition and development of the mission, in order to avoid significant and unnecessary discrepancies between mission parameters and ground capabilities and/or constraints in flight mission operations. This is especially true for the first mission of a series where precedence has not been established nor experience gained. These steps are normally executed by the Study Manager and his assigned staff. At this time the definition of the operational requirements is necessarily not detailed or precise because Systems Definition has not been reached. One of the first actions by the Project Manager should be a review of the results of the studies and the preparation of the Support Instrumentation Requirements Document (SIRD) required under NMI 8430.1A. This document and its counterpart, the NASA Support Plan (NSP), should be completed well before the end of the Systems Definition. These formal documents are intended to be periodically reviewed and revised as the system design, development, and planning proceed. To accomplish this, the Project Manager should establish a Missions Operations Planning Group, chaired by the Mission Operations Systems Manager (MOSM) and consisting of the Mission Support Manager and the Network Support Manager, representatives for each experiment, representatives for the spacecraft and major subsystems, and others from both the project staff and support areas to ensure adequate coverage.

4.2.2 T&DA Support

The execution of the third and fourth steps are the responsibility of the Project Manager and are accomplished in parallel with the other principal elements of

the mission. The objective in these steps is to prepare specific and detail plans for the day-to-day, orbit-to-orbit, flight operations and is done by the MOSM and the Mission Operations Staff (MOS). These requirements should define overall functions and performance including each support area. This definition cannot consist of simple demands for specific equipments by model number or name, however, this type of detail must be recognized as the "lingua franca" of the business. The members and participants of the MOS from the support areas must be prepared and capable of providing detailed information about the facilities: what each consists of; what each will consist of; how they function individually and collectively; etc. Once established, the requirements and commitments must remain reasonably fixed.

Functional support in the T&DA program areas is provided by the Mission and Data Operations Directorate (M&DOD) and the Network Directorate (ND). There are two principal points of interface. The Mission Support Manager from the M&DOD is responsible (see para. 2.2.8.4) for the control centers, support computing, data processing, non-real time operational orbit determination, and definitive or precisive orbit determination for the mission. The Network Support Manager (see para. 2.2.8.5) is responsible to the MOSM for obtaining commitments for network, communications, and real-time orbit determination.

A project support cadre is established in the M&DO Directorate and consists of a member of each supporting element as necessary. In the Networks Directorate an "Ad Hoc" Committee is formed and chaired by the NSM to ensure full network support. These groups are expected to prepare specific plans for the utilization of technical resources in support of the project and identify any real discrepancies. Each member is responsible for the technical matters in his area, and is expected to participate as required as a full member of the group, and in close liaison with the designated project personnel. The commitment of resources are established and approved through normal functional channels. Within the scope of this agreement, the cadre member is free to exercise his technical judgment and is expected to operate in the best interests of the project and the Directorate. He cannot commit additional resources without the concurrence of his line supervisors. He is expected to identify promptly any problems that occur or which he anticipates will occur in such areas as scheduling and use of facilities; operational policies, practices and/or procedures; new requirements; etc. He is expected to provide M&DO management a thorough knowledge of the project and its requirements, bring to its attention any problem areas, offer an opinion as to a possible solution and alternates, and provide estimates of impact as appropriate. There are established functional groups in each division for each element of operations and the cadre member is given substantial freedom to use the services, skills, and knowledge of these groups.

4.2.3 Mission Support Manager (MSM) and Network Support Manager (NSM)

The Mission Support (para. 2.4.8.4) and Network Support Manager (para. 2.4.8.5) are expected to have an acquaintance with operations in all areas they represent. The utilization of technical capability of the M&DO cadre, and the other support personnel and the resources they represent are, to a great extent, dependent upon the practices and desires of the project management. At times, the MSM and the NSM are used as a single point of contact by the Mission Operations Systems Manager (MOSM) and at other times full interplay with all support personnel is exercised. No restriction is placed by management other than that outlined above. The M&DO cadre is considered an integral part of the project team, and is expected to participate to the fullest extent possible in the project operations by providing substantial knowledge and skill in ground operations.

4.2.4 Frequency Authorization

The Radio Frequency Management Manual (formerly NPC 102-1, presently being revised) sets forth the procedures covering management requirements for the control of radio frequencies for NASA. These procedures are adhered to by all NASA frequency users and Field Installation Frequency Managers.

NMI 1138.6 assigns the authority for management of radio frequencies for NASA to the Associate Administrator, OTDA, NASA Headquarters.

The Radio Frequency Management Manual (NPC-102-1) will be issued under the authority of NMI 2570.2A, which establishes the policy and responsibilities in radio frequency management.

The following NMI's outline additional NASA policies involving frequency management:

NMI 2570.2A — Sets forth the policy and responsibilities for management of NASA radio frequency requirements and states NASA policy regarding the control of radio frequency transmission from space vehicles under NASA cognizance, and incorporates in the NASA Management Manual the "Manual of Regulations and Procedures for Radio Frequency Management of the Office of Telecommunications Policy."

NMI 5104.2 — Establishes the NASA policy for ensuring that no equipment radiating radio frequency energy is acquired prior to obtaining frequency support for its operation.

NMI 1052.25 Establishes procedures relative to the coordination of frequencies in NASA projects requiring range support.

NMI 1052.111 NASA-DOD Memorandum of Understanding provides for air/space-ground telemetering in the 225 to 260-MHz band.

The above policy documents contain explicit constraints on project management, such as, the requirement that a NASA Frequency Authorization (license) be obtained prior to the procurement of a transmitter. It is important that the Project Manager identify frequency requirements for the project on a mission-by-mission basis as early as possible and submit a Frequency Application (NASA Form 566) to the GSFC Frequency Manager in order to avoid unnecessary delays.

4.3 DOCUMENTATION

4.3.1 SIRD/NSP

The SIRD is NASA Form 987 revised and dated January 1965. The elements covered by this document can be categorized as follows:

- Mission description and support information
- Mission technical parameters
- Requirements:

  Information flow

  Orbit determination accuracy

  Telemetry data acquisition

  Ground command

  Support computing

  Communications

  Data processing

It is important that the requirements be statements of functional and performance specifications rather than equipment specifications so that the assessment of existing and planned capability can be useful and meaningful. The NSP is a page-for-page reply to the SIRD and as such is not carried as a NASA form. Revisions to both documents are controlled and wherever possible should be on

a single page basis. GSFC forms and procedures are given in Appendix D of this handbook. Memoranda and "understandings" play a role in the interplay and dynamics of support preparation, however, they do not and cannot replace or eliminate the formal, approved (Center and Headquarters) statement of requirements that these documents represent.

Study/Project managers should plan and schedule the issuance of an initial SIRD (Support Instrumentation Requirements Document) concurrent with the Project Plan. This first SIRD should meet the minimum requirements established in the SIRD preparation instructions and contain the new and continuing requirements placed by the Tracking and Data activities of the project. It is attached to the Project Plan and sent to OSS or OA, as appropriate for approval purposes, and after their action, it is sent by the program office(s) to OTDA for information, review and commitment of support and future resources. Additionally, GSFC sends OTDA information copies of the project plan and SIRD concurrent with the transmittal of the same documents to the OSS or OA program approving office.

4.3.2 Operations Plans

As preparation for flight mission operations progresses, and the requirements and technical data become firm, an operations plan and procedures are prepared. This is in reality a set of coordinated, overlapping, documents prepared by the individual(s) responsible for the conduct of operations in the principle project and functional support organizations for each identifiable functional operational element of support.

4.3.2.1 Mission Operations Plan (MOP). The MOP is the governing document covering the mission specific plans and procedures for each mission. As such, it relies heavily on the related documents prepared for the T&DA support facilities outlined below. It should reference these documents and only duplicate their content where necessary for complete understanding of the expected reader. All aspects and phases of flight mission operations should be covered from the point of view of the MOSM. The MOP is prepared by the MOS with the assistance of the support elements and approved by the Project Manager. It should be published at least 90 days prior to the expected launch date of the mission.

4.3.2.2 M&DO Operations Plan (OPPLAN). The M&DO OPPLAN is a summary document covering the coordinating, interfacing Mission and Data Operations support operations and activities. It relies heavily on both the MOP and support element documents including the NOSP (para. 4.3.2.3), and should duplicate the material contained therein only where necessary for complete understanding. Where operations of a support element are sufficiently routine or simple, the

appropriate section in the OPPLAN may suffice. The M&DO OPPLAN is prepared by the MSM and the support cadre, with the assistance of the operational elements and approved jointly by the Project Manager and the Associate Director of Mission Operations, Mission and Data Operations Directorate. It should be published at least 60 days prior to the expected launch date of the mission.

4.3.2.3 Network Operations Support Plan (NOSP). The NOSP is the governing document which directs the network during support of a specific mission. NOSP's are prepared for each mission and define the station configuration and operational procedures along with project peculiar items as derived from mission requirements. The NOSP is prepared by the Network Support Manager and will nominally be published 60 days prior to the expected launch date of the mission.

4.3.2.4 Major Facilities Operations Plans (MFOP). Each of the operating, mutliple user facilities (i.e., Network, Communications, Support Computing, Orbit Determination, Control Center, and Data Processing) prepare specific explicit control procedures for providing support to each mission while guaranteeing continued support to their other users. In preparation for the mission under consideration, the interfaces, conflicts, and influences of all missions expected to be supported concurrently are analyzed, tested, and discussed and agreements reached in the context of each facility. Items of importance in one are often of no or little direct concern in another, but secondary effects sometimes reflect throughout the system. The MFOP's express these agreements and define the actions to be taken in as many circumstances as practical. The previous document — M&DO OPPLAN — is in part a summary of these effects and constraints for the purpose of overall understanding and consistency. These documents rely upon the detailed procedures existing and specially developed or modified in each operating element as well as the MOP. Minimum duplication between all of these documents should be the rule, and only material needed for the understanding of the expected reader/user should be included and references made to all other operations and reference documents as appropriate. The MFOP's are prepared by the operating organizational element and approved by the responsible functional supervisor. These documents should be prepared as early as possible so that the impact of the expected operations can be understood and tested. In any event, the final documents should be published no later than 60 days prior to the expected launch date of the mission to which they apply.

4.3.2.5 Network Operating Procedures (NOP), Pass Support Requests, Post Pass Reports, Etc. These documents, and there are many, are explicit, detailed directions to the sub-elements of each operating facility. They are prepared by the operating line management according to the policies and practices established. They are intended to provide for the orderly acceptance of specific requirements, execution of delegated authority, and reporting of results for both line and project

management. The various operations plans may specify the detailed requirements for these documents. They are prepared as required and necessary as the operations are executed.

4.4 SIMULATIONS AND TESTS

As preparations for flight mission operations progress, the operating elements conduct individual and cooperative tests, simulations, analyses, and assessments to validate technical capabilities, support commitments, and operating policies and procedures; and to identify problem areas and required changes. The results are continuously fed back into the system for consideration and action. The objective is to enter actual flight operations with the necessary certified capability and full understanding and evaluation of constraints and effects on all missions to be supported concurrently consistent with the priorities, objectives, and current status of each and the center and agency programs (see para. 3.1).

4.4.1 Equipment and Subsystem Tests

These tests are conducted throughout the mission preparation or pre-flight phase to determine technical capability such as receive threshold, bit error rate, format compatibility, etc. These tests are performed by the support elements and culminate in system and subsystem certification.

4.4.2 System Tests and Simulations

These tests and simulations are started somewhat after the previous tests mentioned and use certified or conditionally certified segments of the system to enlarge upon the scope of technical certification and to introduce the expected time dynamics of the mission. They are typically cooperative or joint exercises between operating elements and include the appropriate interfaces. They culminate in system simulation as realistic as practical, such as network data flow, command execution, etc., but do not deal directly in mission contingencies or full system interaction; since the objective is to validate and certify the capability to support any given support phase and the interactions, interrelationships, and effects unique or peculiar thereto. These tests and simulations are the responsibility of the operating elements, however, the Mission Operations Staff (MOS) should participate and cooperate in these activities. They should be completed 3 to 6 months before the expected launch date.

4.4.3 Mission Simulations

These simulations are the final exercises intended to fully show flight readiness from a ground operations/ground system point of view. As such, they should

culminate in operations involving full mission time dynamics for a period of time sufficient to allow all significant normal situations and conditions to occur, and mission contingencies to a reasonable practical extent consistent with mission objectives, anticipated inter-mission constraints and conflicts, and resources. Mission simulations shall involve all participating elements and operating personne (project and support elements) including all shifts where applicable. They are the responsibility of the MOSM and the MOS and shall be conducted for a period of 90 to 120 days before the expected launch. A minimum of two full simulations will be carried out — one approximately 30 days before launch and one 3 to 7 days before launch.

4.4.4 Compatibility Tests

These tests are intended to verify mission technical parameters where they relate to the interface with the operational ground system. They are designed to establish feasibility of the intended ground operational support configurations and to evaluate areas of potential support difficulty. They also verify compliance with the Spacecraft-to-Ground Performance Interface Control Document and with the GSFC Aerospace Data Systems Standards (see para. 2.12.10).

These tests are not design validation or proof tests of either the spacecraft or ground equipment; but, they are a thorough evaluation of the degree to which support requirements can be met when the spacecraft and ground equipment, each meeting their respective performance specifications, are interfaced.

The tests will be conducted by the Networks Directorate using standard ground support equipment and flight hardware to the maximum extent possible. A separate compatibility verification test is required for each spacecraft in a multiple-launch program. The test results will be the primary basis on which the Director of Networks and the Director of Mission and Data Operations will verify full compatibility or identify interface limitations. Compatibility verification tests will be conducted as early in the program as possible after the flight spacecraft tracking, telemetry, and command subsystems are finalized. The compatibility verification tests must be completed prior to the Network Readiness Test (NRT).

PART 5

PROJECT REVIEWS

5.1 PROJECT MANAGER'S REVIEWS

The Project Manager shall formally review and document the status of the hardware at times coincident with the key milestones in the design and development of the items. These Project Manager reviews will, in general, focus on the spacecraft subsystems. Reviews are recommended for components and black boxes of subsystems that are either unique or particularly vital to the mission.

The Project Manager shall review experiments, launch-vehicle system, and ground-support and operational equipment. He should invite the Systems Review Office to participate in these reviews.

The primary objective of these reviews is to evaluate the design and performance of the subsystem or component. They also provide an opportunity to evaluate and update the interface specifications.

5.2 GSFC DESIGN REVIEW PROGRAM

5.2.1 Definition

The GSFC design review program is composed of a series of systematic, technically-oriented and documented evaluations of a project by a team of specialists not directly involved with the project. The design is administered by the Systems Reliability Directorate.

5.2.2 Purpose

The purpose of the design review program is to enhance the probability of success of GSFC spacecraft and launch-vehicle missions.

5.2.3 Implementation

GMI 8010.1 prescribes policies and general procedures of the design review program. In summary, it requires each project to undergo a series of reviews by a team of technical specialists selected on a GSFC-wide basis. The number of reviews required depends on the specific mission and on considerations such as mission complexity and number of previous flights. A new project will probably undergo a design review program as follows:

a. Conceptual Design Review. This review, keyed to the end of the study phase, will evaluate the preliminary design and design approaches which resulted from the study.

b. Detail Design Review. This review usually takes place after the design is frozen and before assembly begins. Emphasis is on the implementation of the design approaches which result from the study and the plans for the systems and prototype testing.

c. Flight Qualification Review. This review takes place after qualification testing of the prototype, or before acceptance testing if no prototype is used. The primary purpose of this review is to determine the qualification status of the hardware and to evaluate flight-acceptance test plans.

d. Flight Readiness Review. This review usually takes place before the flight spacecraft is shipped to the range, and emphasis should be on the performance of the flight spacecraft during acceptance testing.

e. Flight Operations Review. This review, keyed to the availability of a flight operations plan, will evaluate the plan for orbital operations and the interface between the flight spacecraft and the ground-support equipment. This review is often combined with the Flight Readiness Review.

In addition, to the foregoing reviews, the review team will include on its agenda safety aspects of flight systems.

5.3 TRACKING AND DATA SYSTEMS READINESS REVIEWS

Several reviews of the project's tracking and data systems will be conducted before each flight. The primary purpose of these reviews is to determine the state of readiness of supporting personnel and systems for the impending flight. The Project Manager should normally use these reviews to fulfill his requirements for establishing the readiness of tracking and data systems.

5.4 MISSION FAILURE INVESTIGATIONS

NASA Management Instruction 8621.1 states that NASA's policy is to investigate and document the causes of all major mission failures.

If serious in-orbit or operational failures occur in GSFC missions, the Director, GSFC, may conduct, at his discretion or at the request of the cognizant Headquarters Program Office, independent investigations to determine causes and make recommendations (see GMI 8621.1, dated June 28, 1971).

5.5 MISSION EVALUATION REVIEW

On some projects there has been a review after the spacecraft has been in orbit for an appreciable period to assess its performance. For some projects this review has only covered experiments, while for others all the spacecraft subsystems have been reviewed. Reviews, as complete as practical, provide information on how to conduct future projects and are encouraged.

PART 6

RELIABILITY AND QUALITY ASSURANCE

6.1 RELIABILITY

Key factors emphasized in GSFC's reliability program are:

a. Reliability considerations in original design

b. Quality assurance

c. Design reviews (see Part 5)

d. Systems testing (see Part 3)

The Project Plans for the individual projects describe in some detail the project and supporting functional organizations which implement the reliability program. At GSFC, the term "reliability" is considered to be design-oriented; it is Center policy to place responsibility for the design on the same group from start to finish. Accordingly, on large projects, the reliability engineers on project staffs report administratively to the Projects Directorate.

Discipline control in the area of reliability is sometimes achieved by using a reliability contractor who is independent of the company which produces project hardware. These contractors have worked primarily in reliability assessment with the project reliability engineer directing the work. When there is no reliability engineer, this responsibility rests directly with the project engineering staff, with support from Quality Assurance Support Managers and Test and Evaluation Support Managers assigned by the Systems Reliability Directorate. The effectiveness of the overall program of design, testing, reliability, and quality assurance activities is periodically reviewed and judged in a series of formal design reviews administered by the Systems Reliability Directorate (Part 5). Technical review teams, as independent as possible of the indirect project staff, conduct these reviews. This review program serves as primary discipline for the overall reliability program at GSFC.

Individual members of the Systems Reliability Directorate serve as consultants on the reliability and quality assurance program in their areas of competence. The Systems Reliability Directorate prepares the required policies and management instructions.

6.2 QUALITY ENGINEERING

At GSFC, quality assurance is administered by the Quality Assurance Division which guides, counsels and assists the project in this field. A Quality Assurance Support Manager is co-located and assigned directly to the Project Manager's staff to assist in project-related matters that affect quality assurance, such as:

a. Developing appropriate quality and reliability requirements

b. Reviewing purchase requisitions, procurement plans, contractor proposals, and contracts to ensure the inclusion of proper quality and reliability requirements

c. Surveying prospective contractors' plants to ensure that they are capable of producing hardware of a specified quality level

d. Arranging for Government monitoring of contractors' quality programs by delegation to other agencies or by NASA/GSFC personnel as appropriate

e. Evaluating contractor quality program plans and recommending approval or disapproval

f. Inspecting or arranging for Government inspection of hardware from a technical and design-intent perspective

g. Maintaining control of the specified configuration

h. Ensuring the establishment and operation of an effective parts program

i. Arranging for performance of failure analysis work

j. Closing out malfunction and corrective action reports

All quality-assurance policy and procedural matters, which impact other NASA Centers, NASA Headquarters, or Government inspection agencies, are coordinated by the Project Quality Assurance Support Manager through the Quality Assurance Division Office.

6.3 MALFUNCTION REPORTING (Failure Reporting)

GSFC policy is to use a uniform malfunction reporting system for all GSFC spacecraft projects. GSFC Management Instruction 5310.1A describes this system and the procedures to be followed.

This reporting procedure shall be used for all prototype and flight hardware on all spacecraft projects. Malfunction reporting shall begin with the first functional test of an assembly (subassembly if it exists) and continue throughout the mission until spacecraft power is turned off. Hardware level, not contractor level, shall define the starting point for reporting. Malfunction reports shall be submitted on GSFC Malfunction Report Form (GSFC 4-2, June 1970) and shall be closed out by the Project Manager. GSFC Specification for Contractor Malfunction Reporting, S-312-P-1, shall be used on GSFC contracted programs.

6.4 PARTS PROGRAM

6.4.1 Preferred Parts Lists and Parts Selection Policy

It is GSFC policy to use reliable electrical, electronic, mechanical, and electromechanical parts in all launch vehicle, spacecraft, and experiment efforts that the Center manages. To accomplish this end, the use of the GSFC Preferred Parts List (PPL) has been made mandatory as described in GSFC Management Instruction 5330.5.

6.4.2 Scope

The GSFC PPL must be used on all flight and prototype launch vehicles, spacecraft, and experiments of new design. The PPL may be required on equipment of existing design and critical ground support equipment at the option of the Project Manager. Non-PPL parts may be used in they are approved in accordance with GMI 5330.5.

6.4.3 PPL Contents and Distribution

The GSFC PPL, updated on an "as-needed" basis, lists recommended parts and their respective procurement specifications. Each part listed has a history either of satisfactory qualification testing or of extensive past usage in GSFC flight programs. The appendix of the GSFC PPL contains nominal screening tests and derating for electronic parts. Additional parts information appears in the document, Application Noted for Preferred Parts and Materials, Volume 1, February 1967.

The PPL may be distributed to NASA contractors and foreign experimenters on NASA programs or to the Project Manager of International Cooperating Programs.

6.4.4 Non-PPL Procurement

Many procurement and screening specifications, that were written locally, are available for the procurement of parts such as nonmagnetic connectors, relays, diodes, and microcircuits. Specifications for unique project procurements may be developed upon request for the purchase of electronic parts and materials. The Quality Assurance Support Manager assigned to the project will be familiar with the procedures on initiating these procurements.

6.4.5 Inspection and Test

The GSFC Project Manager may use the facilities and manpower of the Inspection Section for the performance of electrical, electro-mechanical, and mechanical inspection of parts and assemblies to ensure compliance with the requirements of the procurement specification. In addition, screening and evaluation tests can be performed by this organization on both planned and emergency basis.

6.4.6 Failed Parts Analysis

The Project Manager may use the facilities and manpower of the Failure Analysis Section to perform analyses and evaluation of failed parts and components. He is encouraged to do so.

6.5 NASA RELIABILITY AND QUALITY ASSURANCE PUBLICATIONS

NASA has developed and published a series of reliability and quality assurance publications setting forth stringent requirements for space program procurements from research and development concepts to space operations. These publications implement NASA policies and should be utilized to the extent necessary for hardware procurements as contractor, subcontractor, and Government agency control documents.

Official NASA policy and detailed procedure for implementing these NASA publications are set forth in NASA Procurement Regulation NHB 5100.2, Part 1, Subpart 50, "Integration of Quality Requirements in NASA Procurements," and Part 1, Subpart 51, "Integration of Reliability Requirements into NASA Procurements".

The present NASA publications relevant to quality assurance and reliability functions are as follows:

a. NHB 5300.4(1B), "Quality Program Provisions for Aeronautical and Space System Contractors," April 1969. This publication sets forth broad quality system requirements for prime contractor quality programs necessary to ensure that flight equipment and associated ground support equipment meet the quality requirements of the program. Complete implementation of this document requires control from initiation of design to operational use; however, variations in detailed control elements should be tailored to the circumstances of individual procurements.

b. NHB 5300.4(1C), "Inspection System Provision for Suppliers of Space Materials, Parts, Components, and Services," April 1962. This publication sets forth the minimum requirements for subcontractors' or suppliers' inspection systems for those suppliers operating below the system level (i.e., suppliers of materials, parts, and components, including certain classes of "off-the-shelf" items).

c. NHB 5300.4(2B), "Quality Assurance Provisions for Government Agencies," June 1964. This publication is for use by Government agency quality assurance and inspection representatives at contractors' plants who perform quality assurance (including inspection functions as delegated by NASA installations.

d. NHB 5300.4(1A), "Reliability Program Provisions for Aeronautical and Space System Contractors," April 1970. This publication establishes general guidelines for designing reliability into space hardware and preventing degradation of design reliability during the succeeding steps from fabrication to end use. The document requires the contractor to develop a reliability program plan for submission.

e. NHB 5300.4(3A), "Requirements for Soldered Electrical Connections," May 1968. This publication provides specific guidelines and procedures for effective control of soldering operations to obtain confidence in the reliability of soldered electrical connections for NASA space systems, including ground support equipment. A companion document NASA SP-5002, "Soldering Electrical Connections" offers approved techniques for space flight hardware.

f. "Tips to Experimenters," A candidly written booklet, describes a great deal of accumulated trouble experienced with space hardware and highlights these problem areas.

g. Quality Assurance Brief. A monthly issuance of the Parts Branch, Quality Assurance Division, discusses current parts problems, alerts, failed part analyses completed, and recently published parts specifications which have come to their attention during the month. These publications are widely distributed to both GSFC personnel and approved NASA contractors and experimenters, including foreign experimenters in cooperating NASA programs.

PART 7

DATA UTILIZATION AND MANAGEMENT

7.1 EXPERIMENT DATA ANALYSIS, UTILIZATION, AND REPORTING

The Project Plan describes the complement of experiments to be carried on each spacecraft. Experiments may be primarily scientifically, technologically, or applications-oriented.

7.2 PRINCIPAL INVESTIGATOR

A Principal Investigator should be assigned to each experiment. He is normally selected by the Associate Administrator for Space Science and Applications (see para. 2.4.4). The Principal Investigator is responsible for assuring that the experiment's objectives are met, for managing the experiment properly, for publishing the results of the experiment, and for submitting the experiment data to the National Space Science Data Center (NSSDC) in a form that other experienced investigators in the field can use.

7.3 FUNDING

The project will fund the Principal Investigator so that he can meet his responsibilities (para. 7.2). Funding will normally cover the period from experiment approval to submission of data to the NSSDC. The project will not fund the Principal Investigators for data analysis after the data are in the NSSDC without specific approval by the Office of the Director. The data will normally be submitted to the NSSDC within two (2) years of the date they are taken.

7.4 DATA USE

The Principal Investigator will receive processed data or recovered material from an experiment as soon as possible after they are received. He will have sole use of these data or materials for a period which he and the Associate Administrator for Space Science and Applications will decide upon before launch. He will submit the experiment data to the NSSDC at the end of this period.

7.5 DATA REQUIREMENTS REVIEW COMMITTEE

The GSFC Data Requirements Review Committee has been established by the Director to review and approve for him the requirements for data reception and processing, including telemetry, orbit and attitude data, established by each GSFC flight project. Reviews are carried out at various stages of the project as follows:

a. Pre-launch. At least one year before the launch readiness date, a review shall be held of the requirements for post-launch data reception and processing.

b. Immediate post-launch. Between launch and 6 months, a review shall be held of the requirements and results of the data reception and processing operations.

c. Periodic post-launch. At approximately 1-year intervals, reviews shall be held of the requirements and results of each project's data reception and processing operations. At the discretion of the Committee, the 1-year interval may be modified as desired.

At all post-launch reviews, spacecraft status, scientific output, and the prospects for the continued production of worthwhile science will be reviewed. The Committee has the authority on behalf of the Director to modify the requirements levied by the project on functional support elements of the Center. The Chairman of the GSFC Data Requirements Review Committee must concur on all SIRD revisions.

7.6 HEADQUARTERS REVIEWS

Approval for the continuation of satellite operations is given by Headquarters. Concerning those satellites under the direction of the Physics and Astronomy Program Office at Headquarters, before the expiration of such approval, each space science satellite will be reviewed by the Headquarters Director of Physics and Astronomy Programs to determine whether continued spacecraft operation is desirable. These reviews are expected to be held no more frequently than annually. The review will be organized and prepared for Headquarters by the Data Requirements Review Committee. In it, the Project Manager will be expected to provide the statement of spacecraft status and prospects for continued satisfactory operation. The Project Scientist will be expected to review the scientific output of the spacecraft and its prospects for continued production of good science, and the Data Requirements Review Committee will

address the question of the requirements levied by the mission on Center facilities.

7.7 NASA POLICY DOCUMENTS

Additional information on this subject appears in the following documents:

a. Memo for Record, Goddard/NASA Headquarters Responsibilities Concerning Data Analysis Items, Revision 1 (by Dr. G. F. Pieper, December 9, 1965)

b. Policy Concerning Data Obtained from Space Science Flight Experimenters (NPD 8030.3, January 7, 1967)

c. GSFC Announcement No. 1310, April 29, 1970, Subject: Data Requirements Review Committee

d. Memorandum for Project Managers, Project Scientists from Chairman, Data Requirements Review Committee, October 7, 1970, Subj: Reviews for Headquarters of Operating Space Science Satellites

PART 8

PROCUREMENT

8.1 PROCUREMENT FUNCTIONS AND ORGANIZATION

The functional statement in the GSFC Organizational Manual is that the Procurement Division "...organizes and directs (the) procurement functions and related activities in support of the Goddard Space Flight Center and its assigned responsibilities in space science and applications, rocketry, and tracking and data acquisition." Implicit in this rather encompassing statement is the quality of the procurement by contractual means. Note that required services or material can be procured otherwise than by contract. Some examples are:

a. Federal Standard Requisition Issuance Procedure (FEDSTRIP) administered by the GSFC Property Branch, for chemicals, hand-tools, paper, etc.

b. Military Standard Requisition Issuance Procedure (MILSTRIP) administered by the GSFC Property Branch, for vacuum tubes, resistors, transformers, etc.

c. Goddard Store Stock Systems (property disposal) administered by the GSFC Property Branch, for excess property of NASA Centers or Government agencies

d. Consultant services obtained through temporary civil-service appointments arranged by the Placement Branch of the Manpower Utilization Division

The Procurement Division's Facilities support Branch (FSB), located in building 16, through its organized functions provides essential hardware support to the institutional facilities of this Center and its research programs. Materials, supplies, and equipment typically required by a small municipality or fairly large manufacturing operations are purchased from a wide variety of sources. All Center requirements for off-the-shelf type items are purchased by this Branch, and normally any hardware not otherwise acquired through major flight programs. Generally, procurement of a service nature are acquired through other Branches of the Division.

Figure 8-1 is an organization chart of the Procurement Division.

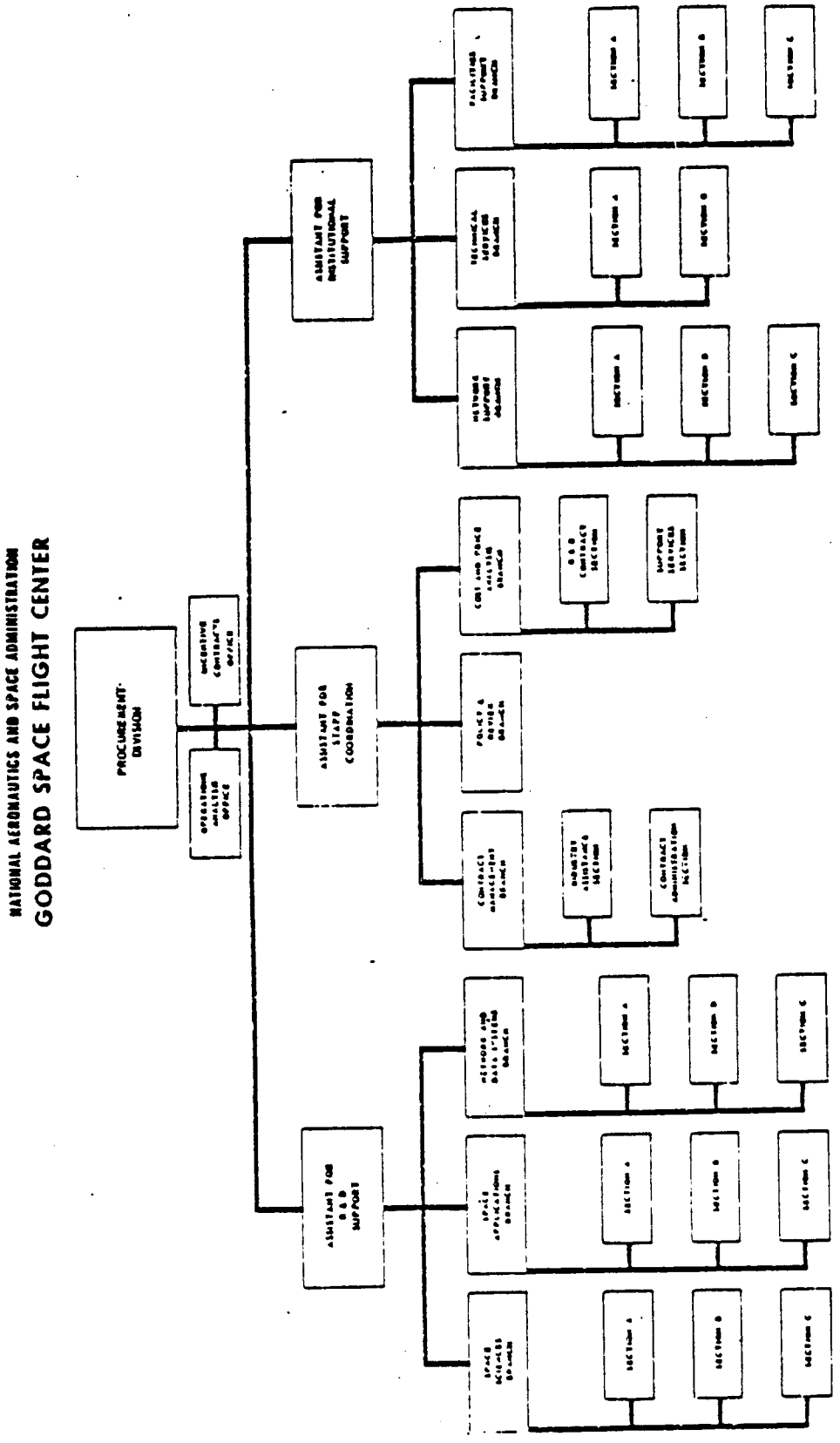


Figure 8–1. Procurement Division Organization Chart

8.2 PROCUREMENT RELATIONSHIPS

A Contracting Officer is the final signatory authority on all contractual documents issued by the Center and is the only person authorized to contractually bind the agency. Many constraints are placed upon the exercise of that authority. The usual initial effort after establishment of the requirement is the preparation of a determination and finding setting forth facts and circumstances to establish that formal advertising is not practicable. The Contracting Officer must interface with the personnel of several other divisions and offices (e.g., the Project Support Representative (business rep), Financial Analyst, Technical Representative, and the Office of Chief Counsel). On most all large center projects the Procurement Division, through the cognizance Negotiation Branch, assigns a Contracting Officer to the project to furnish detailed assistance and provide coordination on procurement related matters i.e., noncompetitive justifications, establishment of a procurement action schedule, evaluation of existing and required facilities, statement of work, and technical data for reprocurement.

Moreover, a number of functional interfaces must be coordinated. For fiscal matters there is the Financial Management Division. Contract documents and other legal matters are concurred in by the Office of Chief Counsel. The Office of Patent Counsel will advise on matters relating to patents, technical data and copyright, and prepare special contract provisions where appropriate. The Transportation Branch assists in packing and crating, methods of shipment, cost of transportation, etc. The Quality Engineering Branch of the Quality Assurance Division provides early assistance to the Purchase Request Initiator by the recommendations of realistic quality requirements, and reviews the Negotiator's Procurement Plan for appropriate technical application of the NASA Quality publication to be included in the solicitation and contractual documents. The Policy and Review Branch reviews each document for compliance with overall procurement policy. The Manpower Utilization Division reviews NPC 401 justifications involving nonpersonal services to ensure compliance with applicable directives and laws. The Health and Safety Engineering Office advises on inclusion of clauses covering special health or safety problems. The Technology Utilization Office advises on the "New Technology Clause," which is mandatory for research and development contracts in excess of $1,000,000 and in contracts of lesser dollar amounts where significant advances in the state of the art are anticipated.

To avoid delays in procurement actions, the Contracting Officer should attend early project planning sessions to assure that document requirements are fully explored. Because many people make up the team and it is necessary to move quickly, early coordination with all interested parties is essential.

8.3 PROCUREMENT CYCLE AND LEAD TIMES

The procurement cycle is the total elapsed time from the initiation of a project (by formally submitting a project approval document) until the hardware is delivered and the contract is complete. In many cases, this cycle covers several years. The term "procurement administrative lead time" is frequently confused with the term "procurement cycle." Lead time refers to the span between the receipt of a Procurement Request (PR) by the Procurement Division and the issuance of a signed contractual document. The following is a list of the steps in a sample "procurement cycle" of a new competitive procurement of $2,500,000 from receipt of the PR to contract award and distribution.

Actions required in a typical $2,500,000 competitive procurement are:

a. Go-Ahead to Request for Proposals (RFP)

(1) Headquarters program go-ahead
(2) Draft of work statement and specifications
(3) In-house estimate begins
(4) Procurement request received
(5) Determination and findings written
(6) Procurement plan prepared
(7) GSFC counsel comments
(8) RFP preparation started
(9) Preliminary source list prepared
(10) SEB and tech committee nominations requested
(11) SEB and bus committee nominations forwarded
(12) Proc. plan review GSFC mgmt.
(13) D&F approved by Hdqts. — proc. plan approved by Hdqts.
(14) SEB tech and bus comm. established
(15) SEB approved by Hdqts.
(16) Technical specifications complete
(17) Approval of specifications
(18) RFP complete and SEB approved

(19) GSFC estimate complete

(20) To chairman SEB

(21) Preparation of tech and bus eval criteria

(22) SEB approves eval criteria

(23) SEB approves source list and RFP release

(24) Final editing and printing

(25) RPF mailed and synopsized

b. RFP to Selection

(1) Preproposal conference held

(2) Proposed received

(3) Proposals separated into bus. and tech.

(4) Technical evaluation begins

(5) Business evaluation begins

(6) Price analysis begins

(7) Preliminary technical, bus eval and comparative price analysis complete

(8) Tech and bus comm. chairman make prelim. presentation to source evaluation board (SEB)

(9) SEB preliminary presentation to GSFC mgmt.

(10) Selection of serious contenders

(11) Preparation of critique for orals

(12) Preparation of questions to offerors

(13) Review of questions by SEB

(14) Contractor responses to questions

(15) Orals complete

(16) final technical evaluation

(17) Final business evaluation

(18) Final BMC-TAC presentation to SEB

(19) SEB first presentation to GSFC

(20) Review by Director A&M

(21) SEB final presentation to GSFC

(22) SEB presents to NASA administrator Hdqts.

(23) Source selection

(24) Prepare statement of source selection (GSFC)

(25) Sign off of statement by Administrator

(26) Preparation of OPA release

(27) Hdqts approval of release

(28) TWX's to all offerors

c. Selection to Award

(1) Price analysis requested

(2) Price analysis received

(3) Preparation of prenegotiation plan

(4) Prenegotiation plan approved

(5) Start negotiations

(6) Complete negotiations

(7) Prepare memo of negotiations

(8) Draft contract and prepare file

(9) Policy and regulation review

(10) Legal office review

(11) Changes and preparation for transmittal

(12) To contractor for signature

(13) Signed contract returned

(14) GSFC review of any changes

(15) Forward contract to Hdqts.

(16) Hdqts review and approval

(17) Award synopized

(18) Contract distributed

NASA Procurement Regulation (NHB 5100.2) establishes approval levels for various contractual matters to be performed at Field Installations. For GSFC, this level is generally established at $2,500,000 - above which NASA Headquarters approval is necessary.

Figure 8-2 is the current procurement administrative lead time usually necessary for a specific requirement. Lead time standards are also included in the GSFC publication, Procurement Request Handbook, GHB 5150.1C.

Because various Acts of Congress require many of the steps shown previously it is difficult to shorten the time cycle. However, the lead-time cycle can be shortened by influencing action in several key areas:

a. Ensure that procurement request packages are complete (i.e., specifications, required justifications, or approvals)

b. Exercise active control over the technical evaluation being conducted within the project and, where possible, appoint someone to monitor the overall effort

c. Schedule requirements realistically and use emergency procurement action when necessary

d. Most important, promote early coordination among the Technical Representative, the Negotiator, the Financial Analyst, and the Project Support Business Representative

A number of open-end contracts already exist which may be used to speed up the placement of contract coverage:

Quick-reaction work-order contracts

a. Contracts for Off-Site Engineering Design Supporting Fabrication and Associated Technical Writing Services (see GMI 5104-1B)

b. Contracts for Off-Site Fabrication Services (GMI 5104.3)

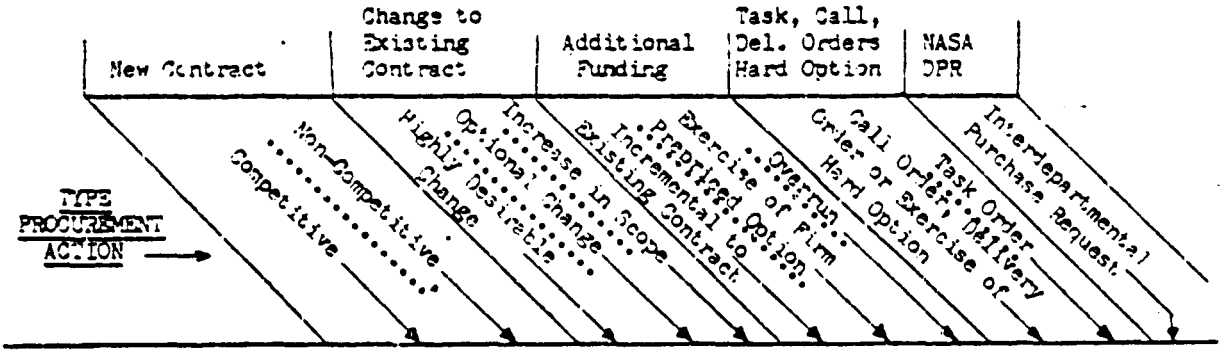
c. Off-Site Computer Programming and Systems Analysis. These contracts provide for performance of off-Center requirements in: orbit determination; ground system operations; satellite control; and scientific data processing (see GMI 5104.1B as revised). The Technical Services Branch will assist in the use of these contracts.

8.4 PREPROCUREMENT REQUEST STAGE

This section covers the procurement cycle from the time initiator begins routing the PR through his own management, financial management, other groups

PROCUREMENT ADMINISTRATIVE LEAD TIME

PROCESSING TIMES IN MONTHS FROM RECEIPT OF COMPLETE, APPROVED PR PACKAGE UNTIL ISSUANCE OF OBLIGATING INSTRUMENT



Type Procurement Action Code	1A	1B	2A	2B	2C	3A	3B	3C	4A	4B	5
CONTRACT TYPES											
REGULAR/NON-PERSONAL SERVICES											
$2.5M and over	9	7	1	6	7	1	2	3	1	N/A	2
$1.0M to $2.5M	7	5	1	5	5	1	2	3	1	N/A	2
$100K to $1.0M	6	5	1	5	5	1	1	2	1	2	2
$2.5K to $100K	4	3	1	3	3	1	1	1	1	1	2
$ 0 to $2.5K	1	1	1	1	1	1	1	1	1	1	2

NOTE: a. As far as dollar levels are concerned, base your choice of lead time upon the total estimated cost of the procurement and not upon the PR value.

b. Should you need a lead time for a contract type not mentioned above, such as: Construction, Architechture & Engineering Services, Leases, or Automatic Data Processing Equipment Contracts, contact procurement branch personnel.

c. Use only the type procurement action codes found above.

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Figure 8-2. Procurement Administrative Lead Time

necessary because of any special approvals, the Property Branch for certification of nonavailability from stock, and Center management when the dollars involved warrant it, until the Procurement Division receives it for processing. The preplanning and control of PR's during their early life is a vital element of a responsive, successful project procurement program.

8.4.1 Budget Planning

The Project Operating Plan (POP) is a valuable tool for procurement planning. Requirements should be carefully planned, not only as to their technical content but also as to the availability of a complete package: procurement request, specification, work statement, and any required justification. If availability data and type of procurement action are accurately forecast and expressed in the POP, the Procurement Division can, in coordination with the project, plan contractor go-ahead dates.

The POP is used as a measurement of the fiscal responsibility of the project in planning and using its resources, and the Procurement Division's ability to efficiently contract the technical requirements of the Center. Unless the POP is carefully planned, documented, and coordinated, the project and procurement cannot meet their goals.

8.4.2 Processing Procurement Requests Within the Project

The central recording of PR's within a project is strongly recommended to promote accuracy as well as control.

8.4.3 Initiating Procurement Requests

The Project Manager should be familiar with the Procurement Requests Handbook, GHB 5150.1C, to supervise the assembly of the PR package. If time permits, he should discuss with the assigned negotiator the detail of the PR before starting the papers through the approval cycle.

The specification is the most important part of a procurement package. An inadequate specification will delay the procurement.

Things to watch for include:

a. Each contract schedule must include a list of deliverable items. To avoid redundancy and conflicting language, the specification should contain technical descriptions of line items only, and should omit references to quantities.

b. The package should include provisions for preservation and packaging. NHB 6000.1 or Military specifications on this subject can be referenced for the necessary coverage.

c. Specifications should conform to GSFC Specification Manual TID-1, August 1964, which contains an excellent checklist for reviewing the document.

Each R&D procurement over twenty-five ($25,000) dollars requires a valid in-house estimate, that may be prepared in accordance with the guidelines set forth in GHB 5150.1C, para. 2-4, as revised. The estimate is required for several purposes, one of which is to evaluate prospective offerors' proposals when adequate experience or competition is lacking.

GMI 5310.2A (para. 2-34) establishes the policy that all PR's for material, supplies, and equipment intended for space flight use will be reviewed by Quality Assurance Division personnel to assure that adequate reliability and quality requirements are included commensurate with program needs, the intended application of the item, and NASA and GSFC policy. Quality Assurance Division personnel will, when requested, assist the PR initiator in developing R&QA requirements for all spaceflight hardware procurements, ensuring the compatibility of these requirements with the needs and intended use of the equipment.

8.4.4 Funding of Special Procurement Requests

Special PR's include planning PR's and blanket PR's. Planning PR's (planning stubs, as they are frequently called) are used to minimize the impact of fiscal constraints by allowing concurrent processing of the procurement action while the funding problem is being resolved. They are used primarily when fiscal constraints are present but will be alleviated.

The negotiator, upon receiving a planning procurement request, begins the procurement process by the accumulation and preparation of required documentation such as: the source list, small business coordination, procurement plan, and request for proposal. Except in unusual circumstances such as critical program schedules, and invitation for bids, request for proposals are not issued until there is a certification that funds are available. However, the cognizant negotiation branch head may authorize (with the approval of the Director of Admin & mgmt) all actions necessary up to the point of contract award, where program authority has been issued, and he has further assurance that funds will be provided.

To the Project Manager, planning PR's are effective weapons against fiscal constraint. Planning PR's should be used for large procurements which require

extensive administrative planning and work which, if carried on while the funding problem is being overcome, can lessen procurement lead time.

The blanket PR provides a source of funds within the Procurement Division for mandatory immediate changes, pursuant to GHB 5104.2A (paragraph 7.7). The advantage is that the individual PR's go directly to the negotiator who draws the necessary funds from the blanket PR already processed. A new blanket PR is issued when the available balance is exhausted. Because they will be obligated as a series of actions over a prolonged period, blanket PR's must be handled carefully in the Project Operating Plan.

8.4.5 Keeping Track of Procurement Requests

Various Automatic Data Processing (ADP) reports issued by the Business Data Branch may be useful in keeping track of PR's. Project Managers and PR Initiators receive copies of these reports regularly. Among the most important are:

a. Report 1051A — Status of Procurement Request in initiating Division sequence, and within Divisions, by PR number (bi-weekly)

b. Report 1233A — Status of PR's in fiscal year/program-project/PCN sequence (bi-weekly)

Information contained in these reports includes:

Buyer	Description
Procurement control number	Type PR (routine/emergency/planning/ oblig. authority)
Job order number	Date PR received
Budget line item	Type procurement action
Fiscal year of funds	Next milestone due
Commitment dollars	No. of days hence
	Milestone is due or is late

8.5 PRECONTRACT STAGE

This section deals with procurement administrative lead time, which begins when the Procurement Division receives the procurement request and ends with the award of the contract.

8.5.1 Types of Contracts

The proper business environment requires the selection of the appropriate type of contract. The objective is to negotiate a type of contract and a price that includes reasonable contractor risk, and provides the Government a means of achieving maximum technical return from the dollars being invested. During the preparation of the procurement plan the Contract Negotiator with the assistance of the Project Manager makes some preliminary decision on what type of contract that will be specified within the solicitation document. Technical input must consider matching the nature of the requirement with the ability of the Government to describe the end-product required. Generally, the spectrum from basic research to production in the requirements end, affords an opportunity to choose from a range of standard cost-reimbursement contracts to firm fixed price.

The GSFC practice is to utilize a firm fixed-price and/or an incentive type contract to the extent feasible and practicable. If the Contract Negotiator and the Project Manager (or his representative) believe that there are possibilities for incentive contracting they should secure the advice of the Special Assistant for Incentive Contracting early in the planning stages of the procurement process.

8.5.2 Procurement Plans

The NASA Procurement Regulation, NHB 5100.2 (formerly NPC 400), 3.852, describes procurement plans in detail. A procurement plan outlines the method by which the Contracting Officer expects to accomplish the procurement task. The procurement plan must be approved before a request for proposal can be issued.

The procurement plan is also a means of justifying a particular approach and of obtaining management approval of the proposed action. Usually, procurement plans are required when a contract estimate exceeds $100,000. Procurement plans are particularly significant to the Project Manager because of the administrative processing time required for coordination.

The Procurement Officer (Procurement Division Chief) approves plans for amounts up to $1,000,000; the Installation Director approves those over $1,000,000; the Associate Administrator for Organization and Management approves those of $2,500,000 and above. It now takes approximately 30 days to process a plan from receipt of the PR to approval by the Associate Administrator. For more information, refer to "Contents of the Procurement Plan," NHB 5100.2, part 3.852-3.

A Computer-Acquisition Plan, a special version of the Procurement Plan, is required for any acquisition by the project, prime contractor or any sub-contractor of:

a. Any electronic digital computer, regardless of use, and any peripheral or auxiliary equipment used with it or in support of it.

b. Punched-card electric accounting machines.

c. Data-transmission or communications equipment selected and acquired solely or primarily for use with an electronic digital computer.

The requirements set forth in NASA Handbook 2410.1A, "Management Procedures for Automatic Data Processing Equipment (ADPE)," are mandatory for NASA Headquarters, field installations, and NASA-owned contractor-operated facilities. The Procurement Division's Procurement Instruction, 210-71, provides a listing of regulatory material affecting ADPE acquisition plans.

8.5.3 Determination and Findings (D&F's)

A fundamental distinction must be made in any discussion about Government procurement which has a particular application in reference to D&F's. It is axiomatic that in non-Government fields, the business official proceeds to do whatever he is not prohibited from doing by law. The Government official, however, can do only what he is expressly authorized to do.

Basic legislation on Government procurement states that all contracts shall be let by the formally advertised bid method. In the research and development (R&D) environment, this policy seems particularly restrictive. The original legislation was passed shortly after the Civil War because of Congressional reaction to a number of scandals involving nepotism and graft in the purchase of war materials. For a long time thereafter, the Government bought almost everything by formal advertising. Over the years, as things became more complex and less defined, certain exceptions were made to the basic law: for example, the first exception was legislated to solve the problem of procuring services and supplies quickly in time of a national emergency declared by Congress. Since that time, sixteen exceptions have been added to the list. Therefore, a negotiator must have an approved D&F citing one of the exceptions before he can negotiate a contract.

When it falls within the authority of the Contracting Officer, a D&F does not generally present a time problem. However, for an R&D contract, estimated at over $100,000, the law expressly states that the Administrator or Deputy Administrator of NASA must approve the D&F. The administration lead time for this process will be 4 to 6 weeks or more. When GSFC authority can review and approve the D&F, the process will usually be less than 1 week.

8.5.4 Request for Proposals, Request for Quotations, and Invitations for Bids

8.5.4.1 Request for Proposals (RFP's). RFP's are formal documents sent to prospective contractors by a Contracting Officer to provide information they need to prepare a proposal, and solicit from them information that procurement and technical personnel need to evaluate the proposals. A RFP is used for a negotiated procurement and is particularly appropriate for R&D situations. RFP's result in both price or cost proposals and technical proposals. The RFP is particularly sensitive because it establishes the format for these proposals which can greatly aid evaluation, analysis, and comparison. Their strength and weakness stem from the same characteristic — flexibility. One of the problems is proper emphasis to the prospective offerors that contractual requirements must be conformed to and all mandatory requirements complied with; the more complicated the "scope-of-work" the more possibilities exist that the negotiated contract may not faithfully reflect all terms and conditions contemplated. Nevertheless, RFP's are appropriate in a true R&D situation.

A preproposal conference is sometimes held with industry after the RFP is released, in order to provide explanation by the Government and permit industry in open session to request clarification of any part of the RFP they do not understand. This conference, if held, is not less than ten (10) days after release of the RFP in order to enable prospective contractors adequate time to analyze its contents.

8.5.4.2 Request for Quotations (RFQ's). RFQ's are informal means of obtaining price and delivery information, and their use is usually confined to small purchases, the aggregate amount of which does not exceed $2,500. The buyer or negotiator may use a standard form to request a quotation or may telephone the vendor to obtain the quotation and place the order at the same time, subject to an approved Purchase Order being forwarded and accepted. However, RFQ's are also used for Solicitations for Information or Planning Purposes under certain circumstances regardless of the dollar amount of the contemplated procurement. The NASA Procurement Regulation (NHB 5100.2), 1.309 reads as follows: "It is the general policy of the NASA to solicit bids, proposals or quotations only where there is a definite intention to award a contract or purchase order. However, in some cases solicitation for informational or planning purposes may be justified...Request for quotations may be issued for informational or planning purposes only with prior approval of the Procurement Officer. In such cases, the request for quotation shall clearly state its purpose and, in addition, the following statement in capital letters shall be placed on the face of the request. "The Government does not intend to award a contract on the basis of this Request for Quotation, or otherwise pay for the information solicited." The uncontrolled use of RFQ's would impose a considerable hardship on industry,

and place the Government in a position to be justifiably critized. Goddard has adhered strictly to the NASA policy on the matter of RFQ's; therefore, none are to be utilized except with the prior approval of the Procurement Officer.

8.5.4.3 Invitations for Bids (IFB's). IFB's are used when the sealed-bid method of procurement can be utilized. Very definitive specifications are required. One of their distinct advantages is the speed with which large amounts of orders may be placed. GSFC experience has been to use the IFB primarily for large quantities of developed items, off-the-shelf equipment and supplies, construction of facilities, or standard commercial services such as printing. Technical discrepancies must be kept to a minimum in order to avoid official protests when the contract award is made.

A less restrictive sealed-bid procedure is two-step formal advertising. The first step resembles RFP negotiation. First-step proposals are submitted without reference to cost; an evaluation ensues which, from a technical point of view, either eliminates the proposal as completely unacceptable, determines that the proposal does not meet the government's minimum requirement but may be revised, or determines that the proposal is fully acceptable as submitted. Discussions are generally held with contractors whose proposals may be corrected by suitable revision.

In a two step formal advertisement, after each technical proposal is declared either acceptable or unacceptable, the second step begins. Each acceptable proposer submits a sealed bid incorporating the technical aspects of his first-step proposal. The contract is then awarded on the basis of price only. This usually follows closely upon receipt of the bids, and delays occur only for a pre-award survey when doubt exists as to the capacity of the contractor. When only one acceptable proposer remains after the technical evaluations, the procedure must be converted to a negotiated procurement as described previously. This does not mean that proposals are resolicited, but that the procurement is negotiated from the point at which the technical evaluation are complete.

8.5.5 Technical Evaluations

Initial judgments must be based on technical merit only, without reference to cost information. Cost tradeoffs will be made later. All RFP's must include a work breakdown statement to correlate the technical and business evaluation, and a statement covering special technical capabilities which offerors must possess. Technical evaluation of the proposals shall be based upon the criteria contained in the request by the "Source Evaluation Board Manual," the GMI on "Evaluation and Selection Policies and Procedures," and the "NASA Procurement Regulation," NHB 5100.2, 2.503-1(c) and 3.804-2. As a minimum, each evaluation should consider the following:

a. Contractor's understanding of the scope of the work, as shown by the proposed scientific and technical approach

b. Availability and competence of experienced engineering, scientific, or other technical personnel

c. Availability of necessary research, test, and production facilities

d. Experience of pertinent novel ideas in the specific branch of science or technology involved

e. Contractor's willingness to devote his resources to the proposed work with appropriate diligence

f. Contractor's proposed method of achieving the required reliability

NASA Handbook NHB 5100.2, 3.804-2(b), states: "In research and development contracting, awards should usually be made to those companies that have the highest competence in the specific field of science or technology involved, although awards should not be made on the basis of research and development capabilities that exceed those needed for the successful performance of the work." Reduced to its essentials, technical evaluation of an offeror's technical proposal results in ranking proposals according to their merit and acceptability. At this point there is a marriage of the technical proposal with the business proposal; the first step may simply be the setting forth of the technical score and to categorize the several offerors' proposals as acceptable or unacceptable. At this point selection of a contractor is weighted heavily by merit of technical competence when compared with the Government's stated minimum requirement. To be remembered, however, is the above regulatory admonishment to always be observed against "never buying more than is needed." Consistent with this rule is the basic policy of NASA to procure supplies and services from responsible sources at fair and reasonable prices, calculated to result in the lowest ultimate overall cost to the Government. Therefore, once having decided one offeror has technical superiority over another and that certain advantages will be obtained by the Government, all other things being equal, a contract award can only be made to an offeror that has a higher price if there is something tangible to be gained in the trade-offs. Unless an award can be made without any discussion with any competitor in negotiated procurement, it is necessary to hold written or oral discussions with all contractors whose proposals are in the "competitive range" (those proposers whose technical scores and price/cost factors give them a reasonable chance of winning the competition). The purpose of these discussions are to point out the uncertainties and ambiguities in the proposal in order that the offeror may support or clarify his proposal and thus enable the Government

to more effectively evaluate the proposal. Following oral discussions all offerors, with whom discussions were held, are given the opportunity to submit revisions to their proposal which will clarify or support their original proposals. (See Procurement Regulation Directive No. 70-15 dated 12/1/70.)

The prospective contractor comes to the "orals" with the advance understanding that he will be interrogated with regards to certain parts of his proposal, and that the Government will provide him with an opportunity to amplify his proposal, and demonstrate his depth of understanding of the Government's requirement and the company's ability to provide it.

See the GSFC publication entitled "GSFC Source Evaluation Board Handbook - July 1971."

8.5.6 Analysis of Labor, Hours, Materials, etc.

The number of labor hours required to perform a job and the span of time over which these hours will be applied, are factors that assist in determining whether or not the company has an understanding of the job. Also, the list of materials and equipment, including Government-Furnished Equipment (GFE), are important and both labor hours and materials will measurably assist in the technical evaluation. However, aside from that, a technical analysis considers the quantities in relation to each task proposed by the offerors or their subcontractor, and compares these and other elements with the Government's estimates, other offeror's proposals, and historical information, if available. Technical analysis occurs usually in the later phases of technical evaluation when it is certain, or fairly certain, which prospective contractors will be in the competitive range. Some type of technical analysis is usually required even on noncompetitive procurements.

A good technical analysis will cover the following points and comment on areas which require further clarification, explanation, or revision:

- Man-hours or man-months by category of labor
- Premium time
- Materials and purchased parts
- Special equipment
- Special testing
- Special tooling
- Computer use

- Subcontracts
- Travel expense
- Transportation: Number of persons travelling, and number of trips from where to where
- Per diem: Number of persons and number of days
- Car rental: Number of days and estimated mileage
- Other direct costs
- Consultants
- Freight

Comments are not required on labor, overhead, and G&A rates, because the price analyst will review and recommend the rates that make up the Government's position. The price analyst is also responsible for using the technical analysis and rate data to assist the negotiator in establishing the negotiation objective.

8.5.7 Business Management Evaluations

Business management evaluations produce a go/no-go type of result. The evaluation determines whether or not the areas evaluated are acceptable for the proposed contract and relative merit is not a strong factor.

Factors evaluated are generally as follows:

a. qualifications of the people who will administer the contract for the company

b. Effectiveness of the systems to be used for cost control, schedule control and progress reporting

c. Overall resources available for the contract, such as number of professional and technicians available, backlog of work for key facilities, and funds available vs those required

d. Previous experience with the company with regard to meeting commitments and being responsive

Business evaluations are not scored, but are generally given an adjective rating such as "fair", "good" or "superior."

8.5.8 Preaward Surveys and Fact Finding

Before an award is made, it is sometimes necessary to conduct a survey of a prospective contractor's capability to perform under the terms of the proposed contract. This survey is useful to evaluate the prospective contractor's financial capability and workload capacity. The preaward survey may be accomplished by use of (1) data on hand, (2) data from another Government agency or commercial source, (3) an on-site inspection of plant and facilities to be used for performance of the proposed contract, or (4) any combination of the above. Preaward surveys are sometimes conducted by Source Evaluation Board Members; the Contracting Officer with the assistance of financial and technical personnel; other NASA installations; a military department; or Defense Contract Administration activity as may be appropriate for a particular procurement.

8.5.9 Selection of Successful Proposers

When Source Evaluation Board procedures are utilized a source selection statement is prepared, and signed by the Source Selection Official for initiation of final contract negotiations with one or more proposers. Similarly, though less formal, procedures apply in competitive selections between $100K and $1,000K (see GMI 5150.8). Successful proposers in other negotiated contracts of $100K or less are selected with less formality, and the selection factors are noted within the "background" section of prenegotiation plans. In addition, one of the following procedures are usually followed:

a. A separate selection statement is not usually prepared and approved if the contractor to whom the award is to be made has the highest technical rating and the lowest cost/price proposal. The Contracting Officer usually makes the required decision and documents the selection within the summary of negotiation.

b. The Technical Evaluation Report, when approved and signed by the appropriate Technical Representative, serves as the basis for the selection statement provided it includes a recommendation for an award, and is concurred in by the Contracting Officer, or other higher procurement head or supervisor.

c. In sole source situations the Justification for Noncompetitive Procurement serves as the selection statement when properly signed and concurred in by appropriate authority. The negotiator usually places a memorandum in the file to indicate that the situation with respect to sole source has not changed from receipt of the Procurement Request to award of the contract.

8.5.10 Prenegotiation Plans

A prenegotiation plan draws upon all information and facts developed during the evaluation process and establishes a firm negotiation position with respect to each segment of the contractor's proposal. Prenegotiation plans are required for all procurements over $10,000 and must be approved at the following levels:

- $10,000 to $100,000 — Procurement Section Head
- $100,000 to $500,000 — Procurement Branch Head
- $500,000 to $1,000,000 — Procurement Division Chief
- $1,000,000 and over — Procurement Division Chief with the concurrence of the Director A&M

The technical representative is usually requested to review, concur in, or comment upon prenegotiation plans over $500,000. Incentive arrangements included in prenegotiation plans must be approved by the NASA Director of Procurement when the proposed contract exceeds $2.5 million except when approval authority has been delegated to GSFC under the Master Buy Plan Procedures (see para. 8.3, above).

8.5.11 Negotiations

No matter how carefully the negotiation position was developed, a negotiator will achieve or fail to achieve his objective at the conference table on the basis of the way in which he presents his case. Principles which should guide all members of the negotiation team are:

First, the contract negotiator, as lead member should be regarded as captain of the team and he will present the Government's position, or designate a "member of the team" to speak in support of the agreed position as reflected in the prenegotiation plan, as the various points to be discussed come under consideration. Other members must support the preagreed position. At no time should the company negotiator be allowed to feel that the Government's position does not accurately reflect the true feelings of all the team members. A member who feels he must take issue with the position during formal negotiations should ask for a recess and do it in private.

The GSFC contract negotiator should ascertain from the company negotiator the extent of his authority to bind the company, as it is futile to reach agreements that will later be set aside.

Negotiation constitutes give and take, consideration of the opposition argument, and compromise. Where the Government's position is well founded, firmness is

appropriate and one should not hesitate to break off negotiations when disagreeing on a key point. When the disagreement concerns a nonessential point, defer the discussion and proceed to the next point. As the opposing positions move closer, the points of earlier disagreement usually diminish in significance. In all fairness to the company negotiator, if he inquires he should be advised that if the amount negotiated exceeds GSFC authority, the amount and other terms will require ratification by Headquarters authority.

Occasionally, the agenda for the negotiation is established prior to the conference when it appears that such a procedure may be necessary to conduct the necessary business within a specified time frame. However, the agenda when established is rather general in order that the Government does not divulge its position with regards to the total matters it may wish to consider. Discussions with contractor personnel should be businesslike, and only one member of the Government's team should speak at a time.

Generally, it is appropriate for the contract negotiator to call a prenegotiation meeting of the GSFC negotiation team to brief the members on the Government's position, and to inform them in general just how he intends to approach the discussions with the prospective contractor. If such a prenegotiation meeting has not been called by two (2) days prior to the scheduled conference, and the Technical Officer believes that a meeting should be held, he should inform the assigned contract negotiator, or the cognizant Procurement Branch Head.

8.5.12 Award

After negotiations are concluded, the contract must be written in final form, reviewed, and forwarded to the contractor for signature. If the contractor objects to some portion of the document, negotiations may have to resume. If the Director of Procurement at NASA Headquarters must approve the contract (contracts of $2.5 million or more and not delegated under the Master Buy Plan - see para. 8.3 above), changes and further negotiations may still be required. The Headquarter's review will take approximately 15 days. If the contractor takes no exception and Headquarters review is not required, the document will be distributed upon signature of the Contracting Officer, usually shortly after it is returned to the Center.

8.5.13 Source Evaluation Boards

This subject is adequately explained in the following documents:

a. Source Evaluation Boards, Advisory Committees, Negotiation Teams, and Consultants (GMI 1152.1C)

b. NASA Source Evaluation Board Manual (NPC-402, August 1964)

c. GSFC Source Evaluation Board Handbook, July 1971

Because of the sensitive nature of source evaluation in general, and the applicability of the principles used in formal boards to lesser procurements, the foregoing documents are suggested reading for the Project Manager.

8.6 POSTCONTRACT STAGE

The postcontract stage of the procurement cycle spans the period from award of the contract through delivery of the hardware or services and successful completion of all related items of work. This period continues until the contractor is paid in full and the contract file is closed out.

8.6.1 Change Order Procedure

Contract Modification Handbook, GHB 5104.2A, Oct. 70, describes the procedure for amending contract specifications to reflect necessary changes in the technical approach. This handbook defines mandatory, mandatory immediate, highly desirable, and optional changes, and tells how to implement each.

8.6.2 Technical Direction

Technical direction is a means whereby a contractor is instructed to pursue a particular line of endeavor within the existing scope of the contract. (See "Scope of Work" in GHB 5104.2A "Contract Modifications Handbook", for a definition of the term "scope".) If properly used, this procedure will eliminate many contractor claims for so-called "implied changes" (i.e., claims for increased cost or time because of inadvertent or informal out-of-scope changes). Because these claims for adjustment are not discovered until after the fact, all direction must be accomplished in writing and the contractor must acknowledge that either (a) the direction is within the current scope and will not entail additional time and money, or (b) he cannot accept the new work without a formal change order. In any event, both parties will know exactly where they stand at all times. Technical Directions, GMI 5150.5, contains guidance for use of this procedure.

8.6.3 Contract Management

The Department of Defense has established the Defense Contract Administration Service (DCAS) with a wide network of field offices to perform various functions of contract management including quality assurance specialists resident at or

assigned to contractor and supplier plants to perform Government quality assurance functions. NASA has an agreement with DOD for use of these field offices, and has established a policy to make maximum use of the contract-administration services and related field-support capabilities of DOD. It forbids the assignment of NASA personnel to a plant site to perform contract-administration services without justification to the Institutional Director and Director of Procurement. The directive lists the functions to be delegated and, generally, the functions to be retained (see NASA PR 51-310). Many agencies become involved in enforcing statutory provisions (e.g., Department of Labor for compliance with Davis Bacon, Walsh Healy, and Service Contract Act, the Health and Safety Act of 1970, and the Equal Employment Opportunity Program).

Other provisions of the contract can be enforced by DOD field offices, which are usually under the Defense Contract Administration Services of the Defense Supply Agency. A limited number are under the Department of Air Force and Navy. A Defense Contract Audit Agency is widely used in gathering negotiation data and auditing cost-reimbursable contracts and fixed-price contracts which involve progress payments.

After the award of a contract, the Contract Management Branch of the GSFC Procurement Division reviews the contract in coordination with the Project Manager and prepares the necessary letters to DOD field offices delegating functions which include contract administration, property administration, production surveillance, quality control, security, health and safety, small business monitoring, engineering, and audit. It arranges for any necessary post-award conference with the DOD field offices which is encouraged by NASA and mandatory for all contracts over 5 million dollars. It is to the interest of the Project Manager or the Technical Officer to participate in such conference.

Contract administration includes purchase system surveys, price analysis, rate approvals, subcontract approval, monitoring of make-or-purchase procedures, and salaries and wage approval.

DOD quality assurance specialists perform in-plant quality assurance functions in support of projects as assigned by the quality assurance attachment to the delegation letter. This attachment is prepared at the direction of the Project Manager by the Quality Engineer assigned to the project. Specific tasks which may be assigned to the DOD quality assurance specialist include: quality surveys, monitoring of contractor and supplier quality programs and inspection systems, workmanship inspections, material review board representation, monitoring of tests, quality status reporting, and acceptance of contract items.

The Property Administrator monitors the contractor's control of Government property. A Technical Officer should ship property to the contractor with appropriate documentation to the Property Administrator, in order to ensure that it is received under a control system and recorded as Government inventory. The Property Administrator can be helpful in ensuring proper use of GSFC property on the GSFC contract.

The auditor verifies the contractor's costs and helps to maintain regularity of a contractor's books of accounts.

DOD staff engineers have proven useful because of their experience with design drawings and material review boards. When these engineers are available in a plant, advantage can be taken of their talents on the spot and they can save many project trips.

The Contract Management Branch has available for consultation, staff counterparts for administration of contracts, property, and production surveillance. The Branch is also the focal point for receiving complaints concerning the performance of DOD activities with respect to GSFC contracts.

8.6.4 Quality Assurance

Three phases of quality assurance (a planned and systematic pattern of actions necessary for providing adequate confidence in the satisfactory performance of end items) govern procurement actions, and the Project Manager is responsible for all three. The initial phase, the quality-engineering function, covers building quality standards, characteristics, design features, and production processes into the requirements of the end item. The second phase, quality control, is the management function of overseeing production of an item to conform to quality standards. The third phase is the inspection of the end item by examination and test to determine its conformity to requirements.

A quality engineer from the Quality Assurance Division will assist the Project Manager in the foregoing activities.

8.6.5 Expediting Work Under NASA Prime Contracts and Subcontracts

Work under NASA contracts can be expedited in various ways: if a subcontractor fails to deliver a part on time, the Defense Material System Program of Priorities is sometimes helpful. This will not work, however, if the delay is caused by the

pre-emption of project work by a higher DOD priority. Help may also be obtained through the Defense Contract Administration Service group assigned to the particular contract (see para. 8.6.3, Contract Management). A limited expediting capability exists within the Contract Management Branch of the Procurement Division. Whatever is done, the Project Support Representative and the Project Negotiator must be aware of the difficulty.

8.6.6 Receiving and Acceptance

This function is handled in several ways. Two points should be emphasized because of their impact on the successful administration of the contract:

a. First, where acceptance takes place within the project, it should be done promptly. Completed Receiving and Inspection Reports should be processed expeditiously in accordance with GMI 4520.1A and returned to the Property and Supply Branch for distribution.

b. Secondly, the negotiator should be informed if an item is not acceptable or is accepted under a waiver or deviation. Therefore, familiarize yourself with the provisions of GMI 4520.1A on the procedure to be followed in rejecting an item or accepting an item which does not meet the contractual requirements to protect the Government's interests.

If there is any doubt as to what action should be taken in regard to either a delinquent or deficient delivery, contact the Senior Project Negotiator or Contracting Officer.

Parts, materials, and electrical instruments ordered for project use may be tested and inspected by the Incoming Inspection Facility managed by GSFC's Quality Assurance Division.

8.6.7 Invoices and Payment

Timely payment to vendors is an important aspect of contract administration. Be sure that your project has an active means of controlling its part in the payment cycle.

8.7 SPECIAL AREAS OF INTEREST

This section includes references to, or discussion of, specialized procurement topics of particular interest to the Project Manager.

8.7.1 Relationships with Industry

This subject is covered in Standards of Conduct for NASA Employees, NHB 1900.1A, October 1967. A more detailed discussion from a contracting point of view appears in NASA Procurement Regulation NHB 5100.2, Part 1, and the pamphlet on conduct. All Government personnel are required to maintain the highest standards of conduct in connection with dealings on behalf of the Government, and must conduct themselves in such a manner to avoid criticism or discredit to NASA or the Government. If the Project Office receives any inquiries from any prospective contractors regarding RFP's or proposed procurements, their inquiries should be diverted to the assigned negotiator. During the course of evaluation proceedings, whether or not a Source Evaluation Board is utilized, NASA personnel participating in any way in evaluating proposals shall not reveal any information concerning the evaluation under way to anyone who is not also participating in the same evaluation proceedings.

8.7.2 Unsolicited Proposals

Procedure for Handling Unsolicited Proposals Received by GSFC, GHB 5150.2B, May 1972, sets forth the policy and procedures for handling unsolicited proposals.

8.7.3 Contracts for Nonpersonal Services

When it has been determined that contracting for services is proper and essential, it is imperative that requirements for either new contracts, or extensions to existing contracts, be initiated at the earliest possible date. A review of the Justification for Nonpersonal Services, the need for a staffing plan, and a Cost Comparison study, takes considerable processing time. The policy and procedures relating to support service contracts are set forth in NASA Document NPC 401 and GHB 5150.1,C.

8.7.4 Summary

This part of the Project Manager's Handbook is not the last word on matters of procurement; it merely assembles information and points out some important areas for consideration. Changes in language, practice, and interpretation as to what can be done are a way of life. If you have a unique procurement problem, ask procurement personnel to discuss it and assist in the matter.

PART 9

FINANCIAL MANAGEMENT

9.1 NASA FUNDING POLICY - DIRECT TO PROJECT

To the maximum extent possible, all charges will be made directly to a research and development project. This also applies to general purpose equipment if the initial need for the equipment is to fulfill a research and development requirement.

Salaries and travel expenses of Goddard employees, rental of business information automatic data processing equipment, and cost of telephones, water, electric, etc., are chargeable to an annual Research and Program Management (overhead) allotment.

9.2 TECHNICAL AND BUSINESS RESPONSIBILITY

The Project Manager is responsible for the business management of his project, including the review, approval, or disapproval of all dollar, civil service and contractor personal support manpower budgets submitted as part of the Center's semiannual grass-roots budget call for financing of support of his project. If the Project Manager disapproves dollar or manpower budgets for work to be performed on his project, he must prepare a memorandum to the Division Chief affected, with copy to the Chief, Financial Management Division (FMD), of all revisions made to the budgets. Changes to the grass-roots budgets will not be made without such memoranda. The Chief, FMD, will be responsible for determining whether the affected Division Chief concurs in the change. If the Division Chief does not concur, then the Chief, FMD, is responsible for bringing the problem to the attention of the appropriate Directors of —. Any problems they cannot resolve will be brought to the attention of the Director.

9.3 PROJECT APPROVAL DOCUMENT (PAD)

A PAD is written authorization, signed by the Deputy Administrator. This document is submitted annually by the Associate Administrator to cover on-going activity and authorizes NASA Centers to apply resources to new projects after approval by the Deputy Administrator. This document in summary form covers specific project objectives, technical plans, major support interfaces, procurements, launch schedules, resources, management, and NASA Headquarter's controlled items.

The PAD summarizes the results of previous flight missions and mission objectives for spacecraft to be launched. It also specifies the Center responsible for project management, the number of spacecraft, the type of booster, and the current approved plan for dollars and manpower.

9.4 RESOURCES AUTHORITY WARRANT (Form 506)

The resources authority warrant is the official dollar authorization to the field center by individual projects, which allows the Financial Management Division to certify that funds are available at the Center for project requirements. After the Financial Management Division has certified funds, the Procurement Division, Experimental Fabrication and Engineering Division, and Management Services and Supply Division, are authorized to contractually obligate the United States Government for materials and services ordered by the project.

In essence, a Form 506 represents a deposit to a job order which allows commitment and obligation of Government funds.

9.5 SUBAUTHORIZATIONS

The subauthorization is the official document with which NASA field centers finance services requested by one field Center of another NASA Center. A subauthorization transfers Form 506 and allotment dollars to the Center for the services requested. Because it is NASA policy that work cannot begin without a Form 506, the NASA Center, from which services are requested, must receive a subauthorization before beginning the effort.

The NASA Center receiving the subauthorization is responsible for funds control and reporting for the services rendered. However, the policy of Headquarters is that the Center with project management responsibility for a project must budget for the total project in its Project Operating Plan.

9.6 REIMBURSABLES

Reimbursable effort is defined as work performed for any Government or field center, other than NASA. Work cannot commence until NASA Headquarters issues a resources authority warrant, Form 506 (reimbursable). Normally, other Government agencies request GSFC services by purchase order or contractual agreements. If GSFC agrees to the request, Headquarters is requested

to issue the Form 506 authority and allotment authorization. Upon receipt of these, procurement requests may be initiated subject to Financial Management Division certification that funds are available. GSFC cannot subauthorize any portion of a resource authorization received for a reimbursable order.

The Project Manager is responsible for assuring that all expense attributed to reimbursable effort is charged to the resources authority warrant. This includes all costs for purchases for material or services, Civil Service manpower, travel, facility usage, and overhead expenses when applicable.

9.6.1 Trust Funds

Trust fund agreements are cooperative agreements between NASA and foreign entities for procurement or furnishing by NASA of materials and services which are funded by deposits to trust fund accounts. Trust fund deposits are fiscal resources held by the Federal Government for the benefit of specific individuals or classes of individuals as distinguished from the general public. In administering these resources, the Government acts as a trustee and is limited in the capacity to the actions authorized by the specific trust agreement.

9.7 BUDGET DEVELOPMENT AND REVIEW

9.7.1 Budget Structure

NASA has one of the simplest appropriation (budget) structures in the Federal Government in that NASA uses only three appropriation titles as contrasted with other agencies which have as many as 70 appropriation titles. The three NASA appropriation accounts are Research and Development, Construction of Facilities, and Research and Program Management.

a. The Research and Development Appropriation finances the purchase of materials, contractual services, R&D transportation costs, equipment, test and evaluation, and technical information support required in direct support of flight projects, basic research, and operations of the tracking networks. This appropriation is not limited by Congressional action as to life duration, i.e., funds are available until expended. However, NASA has the option of establishing expiration dates for field centers' use of these funds.

b. The Construction of Facilities Appropriation finances the design, construction, purchase of equipment, modernization of facilities, and advance design of facilities planned for future authorizations. All construction

involving new structures wherein the costs exceed $10,000 and modifications to existing structures costing in excess of $25,000 are financed by this appropriation. C of F funds are not limited by Congressional action as to life duration. However, NASA has the option of establishing expiration dates for field centers' use of these funds.

c. The Research and Program Management Appropriation finances the personnel-related cost of NASA such as salaries, overtime, travel, transportation, rentals of equipment, administrative communications, utilities, printing, and other housekeeping operations not specifically associated with a direct research project. This appropriation is an annual appropriation, i.e., authority to obligate these funds automatically terminates on June 30 and any residual funds are lost to NASA.

9.7.2 Budget Cycle

Headquarters requires field installations to submit semiannual POP's in a format prescribed by the Institutional Director. Goddard utilizes the "grass-roots" concept of budgeting which may be defined as a process in which all levels of management are given an opportunity to make known manpower and funding requirements considered necessary to continue functional support and approved research projects. Further, it affords each level of management an opportunity to propose new effort which should be initiated and the part in which they wish to participate. The major milestones involved in the budget cycle are shown in the milestone schedule (Figure 9-1). As shown on the milestone schedule, the timing for preparation of the "grass-roots" budget and submission of updated POP's may be related to the following requirements:

POP Submission to NASA Headquarters	Requirement
July 30	Initial grass roots estimates for inclusion in the budget submission to Congress for the next fiscal year and updates the current fiscal year.
February 15	Budget update of Congressional submission for next fiscal year and approval of the revisions for the second half of the current fiscal year. Additionally, a preliminary look at subsequent FY requirements if provided.

The Government's fiscal year is the 12-month period from July 1 to June 30.

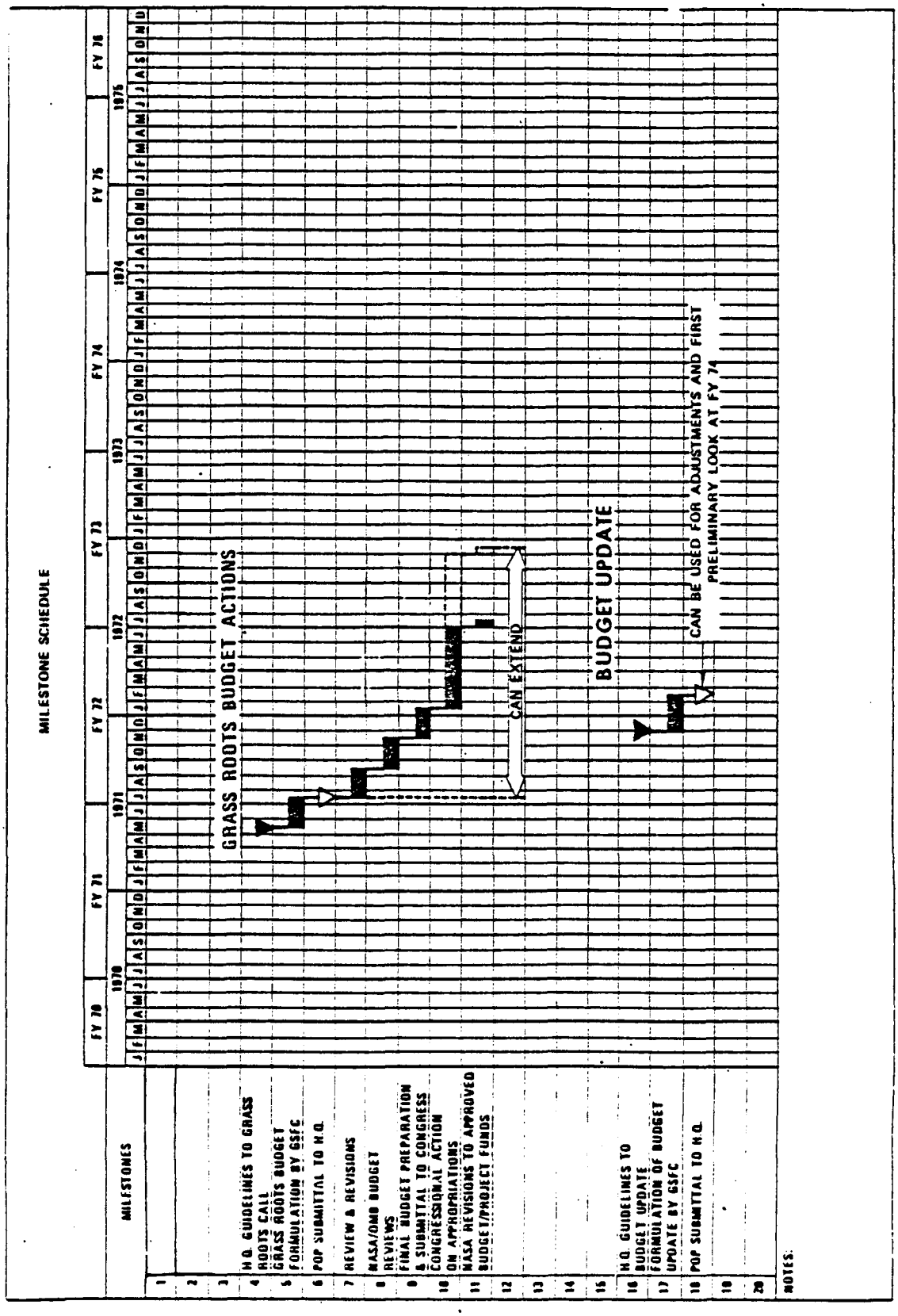


Figure 9-1. Manpower Budgeting Milestones

9.7.3 Budget Estimating-Dollars

A very critical element in the budget process is the problem associated with the initial estimates of the total cost of a new project and the time-phasing of resource requirements by fiscal year. There are various types of data available for use in estimating the costs of new projects. Cost data are available for completed and on-going projects, and actual costs for similar systems or subsystems may be used for costing purposes. Estimates may also be prepared based on projections of contractor manpower required to design, fabricate, and test the spacecraft, experiments, and associated ground support equipment. A very useful tool in the pricing of new projects is the technique of "cost modeling."

Briefly, the "cost models" represent a mathematical technique, which relates technical or engineering parameters to systems, subsystems, and total project cost. Through the careful selecting of parameters which can be identified in the early stages of program development (i.e., number of watts of power used, weight of the data handling and communications subsystem, etc.) and by utilizing regression analysis, it is possible to measure the relationship between cost and such factors as complexity, size, and quantity. Occasionally, the models are developed from limited data bases and may reflect a certain management philosophy or mode of operation. In those cases where deviations are apparent, adjustments are made to the total estimated cost..

Once the total project cost has been established, spending profiles are prepared which relate program start and length to fiscal year funding requirements. A typical funding profile is a function of the total project length in that the percentage of contractor spending in any given year will vary when the length of the project is either extended or shortened.

Through the utilization of available cost data and sophisticated estimating techniques, the reliability of cost estimates for new projects is improving.

For on-going projects, the contractor's monthly financial management reports should be consulted and evaluated in assessing future R&D budget requirements. The financial management reports provide forecast costs on work covered contractually, but the cost of future work not under contract must be estimated, on a lesser scale, much the same way that effort is assessed for new projects.

It should be noted here that budgets are to be prepared, to the extent practicable, on an "accrued-cost" basis. That is, the increment of funding requested each fiscal year for cost reimbursable contracts is limited to the funds required to cover estimated costs for materials actually consumed or services rendered to accomplish contractual work for the fiscal year. This approach allows incremental

funding of contracts each fiscal year as opposed to fully funding cost reimbursable contracts at the total negotiated value at the time of award.

An Allowance for Program Adjustment (APA) (a sum reserved to meet unforeseen cost growth) is to be established for each major flight project. The amount of reserve will involve the individual circumstances of each project and will consider such things as schedule status, technical difficulty, etc.

Proposed new-start projects should also consider cost growth factors such as labor union agreements and their impact on labor costs. This is important because development, fabrication, and flight operations involve several years and we do not have contractor proposals which anticipate these factors for estimating and pricing purposes.

The Office of Manpower and Budget (OMB) prescribes that five-year estimates should be based on projections of cost (in constant dollars at prices existing at the time estimates are prepared) which (1) are not intended to predict future economic conditions, and (2) do not reflect possible changes in the scope of quality of the program which might result from experience gained in actual practice.

Notwithstanding these instructions, GSFC is conducting a study to determine what impact cost inflationary factors have had on the cost of several of our major flight projects. Supplementary guidelines on this item will be provided at a later time.

9.7.4 Manpower

GSFC takes a modified "grass-roots" approach to the development of manpower POP's. First, manpower data are collected on a requirements basis. This is accomplished by the line organization developing a requirements plan for the on-going commitments. The line organization, the so-called grass roots of the organization, develops a requirements plan for the on-going commitments. These inputs are then iterated and reviewed through the line management, then by the project people in the Center who are responsible for the project being supported to be sure that the line organization fully understands the task for which it is responsible and to eliminate double budgeting and the like. Out of this comes a set of "requirements." Center management then goes through a decision making cycle after these data are collected and understood where the requirements are balanced against the constraints the Center has placed upon it, programmatic limitations, R&PM dollars, Center ceiling, etc. From this process attempt is now made to balance the risk of cutting any of this requirement down and try to make judgments on whether these cuts represent "acceptable" risks.

The manpower POP generally follows this decision cycle and normally comes out in August. The basic plan is put together once a year, through the line organization, and is documented in a Program Operating Plan and is updated at least on 6 month centers. Individual project agreements are documented by Memorandum of Agreement (see para. 2.6.3).

9.7.5 Level of Detail

As stated above, the grass roots budget estimates are generally prepared at the second level of line management, the branches. The branches submit individual "job-order" estimates for the various projects, and the total of all applicable job-order estimates becomes the total project budget. The individual job-order estimates for the R&D budget must be submitted in considerable detail; in fact, each procurement costing $15,000 or more must be described and the month the commitment and obligation of funds are expected must be stated. The detail required is as follows:

(a.) Technical description of job order

(b.) Routine materials

(c.) Technical information support services

(d.) Transportation

(e.) Fabrication services

(f.) Contract support services on-site

(g.) Contract support services off-site

(h.) Major procurements

(i.) Automatic data processing equipment purchase

(j.) Civil service manpower requirements

(k.) Technical Representative name and telephone number

(l.) Business Representative name and telephone number

All job order budget items are also assigned job order numbers. The Center's job order structure is basically the same as the standard NASA system.

9.7.6 Management Reviews

The job order budget reviews are very extensive with the following levels of Center management involved in the review cycle:

- Budget Office
- First Level Line Management
- Project Managers
- Directors of —
- Director

Upon completion of management reviews, the job order budgets are incorporated into the prescribed POP format and Budget Analysts coordinate the Center submission of the POP with NASA Headquarters. It is emphasized that the budget submission covers the entire life of each project, and is detailed as to spacecraft, experiments, and ground operations and that all estimates of major procurements are time-phased and that all contracts having expenditure projections of $1,000,000 or more during the fiscal period are included in the budget submission (POP) as separate line items.

9.8 PROGRAM OPERATING PLANS

The Program Operating Plan (POP) is the key to the budget system. Prior to formal implementation, each project must have a financial and Performance Plan or Project Plan which covers the entire life of the project. The formal device for initiating and updating resource and funding requirements, and against which, progress and status is compared, is the POP. The POP's are time-phased budgets which are updated twice annually and show detailed 5-year forecasts of funding requirements for each project.

The objectives of the POP system are generally to provide NASA management with a basis to:

a. Prepare agency estimates for various phases of the budget formulation and execution process.

b. Issue resource authorizations and allotments.

c. Evaluate financial performance and status against planned rates of operating activity.

The value of the POP system is also to standardize the submission from the various NASA field installations of basic financial resource planning data for each of the three NASA appropriations discussed.

9.8.1 Program Offices' Use of POP's

The Program Office reviews the POP's to ascertain progress, workload, adherence to schedules, and ability to provide the requested funds to the projects. The POP is then consolidated with POP's of other centers which perform work for the same Program Office. The consolidated POP becomes the Program Office's official budget request to the Administrator.

9.8.2 Administrator's Use of POP's

The Administrator uses the information contained in the POP's to:

a. Approve budgets of Program Offices for the current year.

b. Grant Program Office the program authority (funding) for executing its POP.

c. Request funding authority from the Office of Management and Budget (OMB); this funding represents a portion of the previously approved NASA budget.

d. Review the budget for the next fiscal year with the OMB.

e. Evaluate performance of Program Offices by comparing actual commitments and obligations with those stated in the POP to determine if full funding of the Program Office is required. Conversely, the Program Offices use this technique on their field centers and the field centers use it on their project managers and procurement staffs.

9.9 CONTINUING RESOLUTION

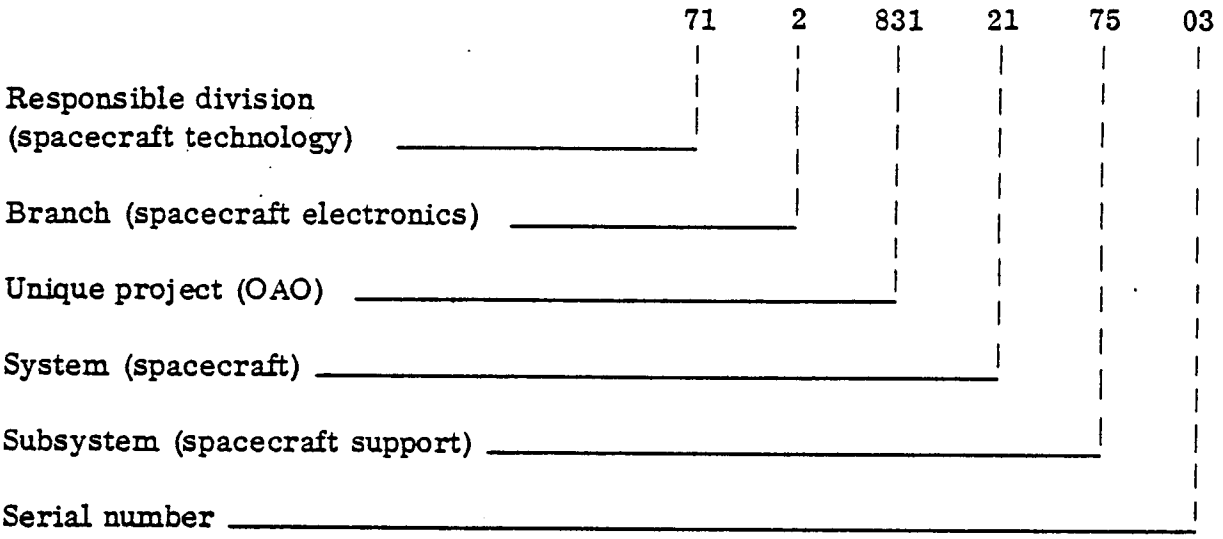
A continuing resolution is an agreement passed by both the Senate and the House of Representatives allowing Federal agencies to continue in operation beyond June 30. This resolution is required when the appropriation act has not been passed and funds are not legally available to finance Government operations. For example, most appropriations for the salaries of Government personnel expire each June 30; an appropriation or continuing resolution provides for personnel salaries beyond that date.

Under a continuing resolution, all activities authorized on June 30 can continue in operation. Nothing new can be started until Congress acts and the President signs the NASA appropriation.

9.10 GSFC'S JOB-ORDER STRUCTURE

GSFC's job-order structure is basically the NASA-wide coding structure. The only difference is that GSFC uses the 3-digit organization code (division and branch) as a prefix to the NASA system, and uses digits 9 and 10 to further detail the subsystems.

GSFC's job-order structure for ART/SRT is identical to the Headquarter's system, except for the use of digits 1 through 3, responsible division and branch. For example:



9.11 APPROVAL LEVELS FOR PROCUREMENT REQUEST AND INTERNAL REPROGRAMMINGS

Procurement requests and internal reprogrammings within a project may be approved at the following levels:

Branch Heads	Under $25,000.00
Division Chiefs/Project Managers	$25,000.00 to $100,000.00
Directors of –	$100,000.00 to $1,000,000.00
Director/Deputy Director/ Associate Director	$1,000,000.00 and over

9.12 REPROGRAMMING (EXTERNAL-HEADQUARTERS)

Project Managers cannot reprogram funds between projects (i.e., OAO versus OGO).

All reprogrammings between projects, regardless of dollar amount, can be approved only by the Headquarters Program Office on the basis of a written request from the Center Director.

9.13 COMMITMENTS

Commitments are firm administrative reservations of funds based on firm requisitions, procurement requests, authorizations to execute contracts, or other authorized evidence which authorizes the creation of obligations without further recourse to the official responsible for certifying that funds are available.

GSFC's commitment policy is as follows:

a. Commitments shall not be incurred in excess of available program authority. To ensure that funds are available, all commitment transactions must be submitted to the Financial Management Division (Accounting Branch) for funds certification before submission to the Procurement Division.

b. Commitments shall be recorded promptly against allotments, subauthorizations, or other subdivision of funds.

c. Availability of funds shall be determined before a commitment is incurred.

d. Commitment accounts and documents shall be maintained in the Accounting Branch of the Financial Management Division.

9.14 OBLIGATIONS

In general, obligations are incurred when orders are placed, contracts are awarded, or services are received which require disbursement of money.

9.15 ACCRUED COST

Accruals are total costs incurred by contractors for services rendered or materials delivered in support of a contract. Accruals do not include purchase orders issued by a contractor for services or materials that he has not received.

9.16 UNCOSTED OBLIGATIONS (FORWARD FUNDING)

The difference between the total funded value of a contract and the actual accruals under that contract is referred to as uncosted obligation.

9.17 ENCUMBERED FUNDS

Encumbered funds are the sum of the following elements:

a. That portion of total project funds presently offset by bonafide disbursements, vouchers for disbursements, and/or accrued costs.

b. Funds which have been transferred to another Government entity and may not be withdrawn or reduced by the unilateral action of the Project Manager.

c. Obligations to fixed-price prime contracts or fixed-price subcontracts expected to be accrued or disbursed within the reported year.

d. Those funds that are directed by Center management and may not be reduced or withdrawn except by appeal to Center management, such as T&E and computer-operation prorate charges.

9.18 DISBURSEMENTS

A disbursement is the actual issuance of a check by the U.S. Treasury for payment of services rendered or material received. Accrued costs under a contract always exceed disbursement until final payment is made.

9.19 TEST AND EVALUATION DIVISION AND QUALITY ASSURANCE DIVISION FUNDING

It is Goddard policy that the cost of operating the Center's Test and Evaluation (T&E) and Quality Assurance (QA) Divisions will be borne by the research and development program.

The annual operating budgets are initiated by these divisions on the basis of projected requirements. The budgets are reviewed at a Director's staff meeting with all Directors of — present and are approved by the Office of the Director. Test and Evaluation manpower planned for each project is based on known requirements and past experience, and is reviewed by each Project Manager.

Each project bears the same percentage of the total T&E annual operating budget as the percentage its planned manpower is of the total manpower available in each division for direct flight-program support. Each project bears the same percentage of the total QA annual operating budget as the percentage of their budget dollars in relation to the total R&D budget dollars.

After Center management approves the annual operating budget and the Project Manager agrees to the manpower assignment, a fixed project cost is established which cannot be changed. As they become available through Form 506 authority, these funds are used to establish an R&D carrier account which is expended as needed by the T&E and QA Divisions in accordance with the approved plan.

This funding process does not include the cost of major procurements by T&E and QA Divisions for unique requirements of a project. Each Division determines these needs and negotiates for funds directly with the Project Manager. When approved, the funds are identified as a separate line-item entry in the project's operating budget.

9.20 SPACE AND EARTH SCIENCES (SES) DIRECTORATE COMPUTER FUNDING

GSFC policy dictates that the cost of operating SES computers at GSFC be borne by the several R&D flight projects. Costs will be shared by the Physics and Astronomy and Space Applications Projects as well as the Delta Project.

Items covered under SES computer support are:

a. Supplies – Paper, cards, cabinets, pool magnetic tapes, etc.

b. Operations – Computer operators, keypunch operators, tape librarian, plotter operators, EAM operators, and dispatchers.

c. Systems programming – Maintenance and enhancement of the software operating system and general-purpose library subroutines.

d. Machine maintenance

Project-peculiar computer support (e.g., special programming) will continue to be budgeted under the project. Certain rentals of the SES computers are funded from Research and Program Management funds. The Goddard Institute for Space Studies (GISS) computer activities (including rentals) are funded from R&D funds separately. They are not included in the policy stated above. The

contribution of each project is based on the percentage of its total individual budget to the total budget of each program area.

After Center management approves the total dollars required, the budget SES computer support becomes a fixed assessment to the project. The Office of the Director of SES manages the computer program.

9.21 FABRICATION CHARGES

To order services from the Experimental Fabrication and Engineering Division, the originator completes a work order and forwards it to the Fabrication Division. Estimates of the hours a task will require are made; the hourly rate is applied to determine the cost. The Fabrication Division then forwards the request (work load record form) including dollar estimates to the Financial Management Division (Accounting Branch) for funds certification. If funds are available under the cited job order and Form 506, the Financial Management Division agent will certify that funds are available and will return the work load record form to the Fabrication Division. If funds are not available, the workload record form will be returned to the originator.

Under no circumstances may the Fabrication Division perform work without a certification that funds are available for reimbursing the Fabrication Division.

9.22 PROJECT JOB ORDER STATUS REPORTS

The Financial Management Dvision through the Business Data Branch provides the Project Manager with various reports that reflects both budgetary and actual commitment, obligation, disbursement, and accrued cost experience. These reports are listed in the GSFC Machine Reporting Register, published periodically by the Business Data Branch of the Program Support Division. Copies are available by request.

These reports reflect the official accounting records for GSFC at a particular time and may be used for reports or statistical data.

APPENDIX A

FUNCTIONS AND AUTHORITIES OF PROGRAM MANAGERS AND PROJECT MANAGERS ON OFFICE OF SPACE SCIENCE AND APPLICATIONS FLIGHT PROGRAMS

APPENDIX A

FUNCTIONS AND AUTHORITIES OF PROGRAM MANAGERS AND PROJECT MANAGERS ON OFFICE OF SPACE SCIENCE AND APPLICATIONS FLIGHT PROGRAMS

Project Managers are the senior NASA line officials exclusively responsible for the execution of their projects within Headquarters and Center prescribed guidelines and controls. Program Managers are the senior NASA staff officials exclusively responsible for developing and administering the Headquarter's guidelines and controls.

Program Managers

1. The Program Manager is the senior NASA Headquarters staff official exclusively concerned with the projects which compose his program.

2. The Program Manager is responsible for assuring the effective overall general management of his program. He is the focal point of all NASA Headquarter's activity bearing directly on those projects which compose his program. He is responsible for developing and administering the Headquarters guidelines and controls under which those projects are conducted. He will carry out these responsibilities within his delegated authority.

3. The Program Manager's specific functions include, but are not limited to the following:

   a. Developing and/or updating, in collaboration with other participants, an overall plan for implementation of his program, including:

      (1) Objectives

      (2) Missions

      (3) System concept

      (4) Experiments

      (5) Schedules

      (6) Funding

      (7) Manpower

      (8) Organization

(9) Procurement arrangements

(10) Interfaces among centers, agencies, experimenters, and contractors

(11) Facilities

(12) Reporting and review

(13) Controls

b. Preparation of the necessary material to represent the program to NASA management, and making such representations as appropriate.

c. Budgeting for the program.

d. Reviewing and concurring on the Project Plans prior to approval and release to the executing centers.

e. Reviewing, assessing, and reporting of the effectiveness of the Center's execution of the project, including management of contractors.

f. Administering OSSA guidelines and controls for the project, including evaluation of proposed changes in configuration, contracts, costs, schedules, objectives, performance, mission profiles, etc., and preparing necessary Headquarters actions.

g. Identifying and defining solutions or alternate courses of action, when major problems arise in the course of the program.

h. Developing a close working relationship with Center management officials, especially the Project Manager. Auditing the Center's assessment of project activity to maintain a real-time "feel" for the project operations and for the state of health of the project.

i. Assisting Center management in every way possible to facilitate their execution of the project. Expediting Headquarter's actions in support of the project.

j. Preparing, with Center support as required, all staff papers required in Headquarters in support of the program, including:

(1) Project proposals

(2) Project approval documents

(3) Briefing memoranda

(4) Program management reports (after analysis of project management reports from the centers)

(5) Correspondence and directives

(6) Congressional backup statements

(7) Budget material

(8) Mission status reports

(9) Other

k. Taking whatever additional initiative he deems necessary, within organizational structure and guidelines, to ensure the successful completion of his program.

Project Managers

1. The Project Manager is the senior NASA line official exclusively concerned with the execution of his project.

2. The Project Manager is responsible for the effective day-to-day management of his project. He is the focal point of all Center and field activity bearing directly on his project. He is responsible for directing the execution of his project within guidelines and controls established by NASA Headquarters and his Center management. He will carry out these responsibilities within his delegated authority and otherwise in the name of the Center Assistant Director for Projects or the Center Director.

3. The Project Manager's specific functions include, but are not limited to, the following:

   a. Developing and/or updating the Project Plan, which specifies the plans for execution of all elements of the project, including:

      (1) Objectives

      (2) Technical plan, including systems concepts

      (3) Reliability and quality assurance provisions

      (4) Management plan

      (5) Management reporting

      (6) Documentation management

      (7) Procurement arrangements

      (8) Configuration and change control

      (9) Schedules

(10) Resource requirements

(11) Coordinated operations plan

(12) Experiment integration

(13) Data handling

(14) Facilities

b. Executing this plan in adherence to its provisions.

(1) Coordinating the activities of all elements of the project to ensure effective performance in the execution of their responsibilities.

c. Organizing and supervising his Center Project Office which directs the execution of this plan.

(1) Training the members of his organization

d. Directing and/or coordinating as applicable, the supporting elements within his Center and other Centers which support the project, including:

(1) Design, fabrication, test, and operation of in-house hardware

(2) Tracking and data system

(3) Launch vehicle system

(4) Launch operations

(5) Other

e. Directing and/or coordinating, as applicable, supporting activities within other agencies of the Federal Government.

f. Directing contractor effort on his project, (through Contracting Officer if required):

(1) Directly for those contractors where his project holds the contract

(2) Indirectly, as necessary, for the contractors of supporting organizations

g. Preparation and dissemination of working agreements.

h. Establishment of working groups and coordination committees. Supporting design review groups and failure analysis groups, established by Center and Headquarters, etc., as required.

i. Preparation of specifications.

j. Review of changes and approval within his authority.

k. Preparation of necessary documentation in support of his project.

l. Providing other necessary support to Center management.

m. Keeping Center management and the Headquarter's Program Manager fully apprised of the status of his project, particularly with regard to adherence to:

(1) Schedules

(2) Funding

(3) Performance

n. Preparation of accurate and complete Project Management Reports.

o. Maintaining a close working relationship with the Headquarters Program Manager for his project.

p. Identifying, devising, and executing effective solutions to management and technical problems which arise during the course of his project.

q. Seeking the assistance of higher management authority in a timely manner when necessary to achieve the objectives of the project.

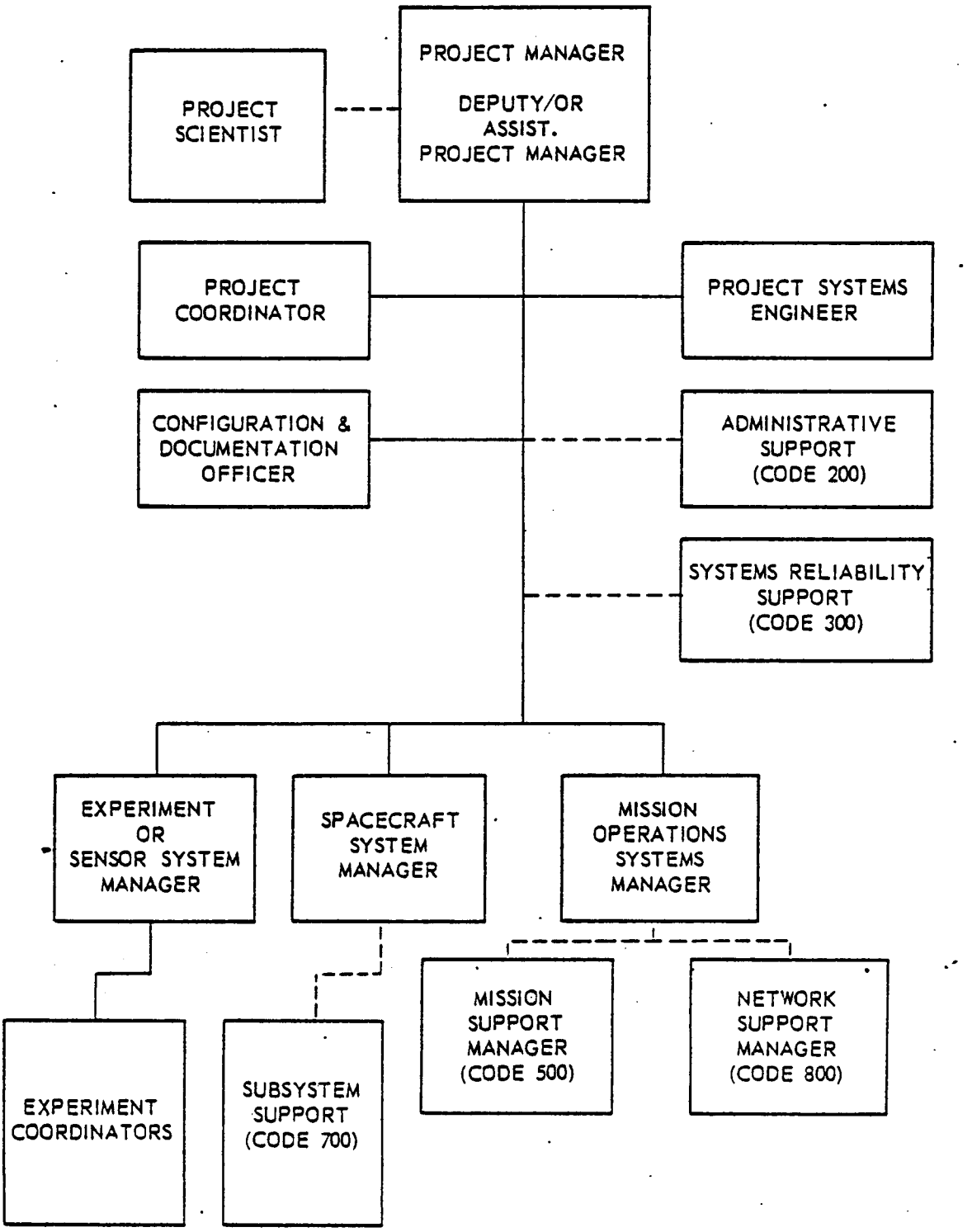
r. Taking whatever additional initiative he deems necessary, within organizational structure and guidelines, to assure the successful completion of his project.

APPENDIX B

GENERALIZED PROJECT ORGANIZATION

APPENDIX B

GENERALIZED PROJECT ORGANIZATION



APPENDIX C

OUTLINE OF MODEL SYSTEMS SAFETY PLAN

CONTENTS

APPENDIX C

OUTLINE OF MODEL SYSTEMS SAFETY PLAN

1.0 GENERAL

1.1 Introduction

Identify the project and state the mission to which the Systems Safety Plan applies. Describe briefly the spacecraft, its payload, and the ground system involved. Identify the launch vehicle and the launch facility to be employed.

1.2 Scope and Purpose

State the major systems, subsystems, experiments, facilities, ground equipment, and operations to be included in the Safety Plans. Indicate the participation by other NASA centers, Government agencies, and whether contractors and subcontractors will be involved. Conclude with "the purpose of this plan is to provide in a single document the total_____Project Safety Program requirements and to show the agency, center, and contractor responsibilities for implementation of these requirements."

1.3 Definitions

Under this paragraph define the safety team used in the plan. Examples are given below. Of particular interest is definition of "systems safety" to be used by the Projects Directorate, GSFC. This definition clearly differentiates between extrinsic factors which subject flight hardware to hazards, and intrinsic factors resulting in component or subsystem malfunction. The latter one to be considered a design, reliability and/or quality responsibilities rather than safety responsibilities.

Recommended safety terminology:

a. Safety — Freedom from chance of injury or loss to personnel, equipment, or property.

b. System safety – Systems safety is defined as those engineering and management practices and procedures necessary to avoid personnel injury and property loss to the maximum extent practical. Systems safety includes the protection through launch of flight hardware from loss or damage from extrinsic factors, but does not include property loss or

damage to flight hardware due to internal component malfunctioning. The latter is considered a design, reliability, and/or quality responsibility.

c. Accident prevention — Methods and procedures used to eliminate the causes which lead, or could lead, to an accident.

d. Hazard — The presence of a potential risk situation caused by an unsafe act or condition.

e. Risk — The chance of injury or loss to personnel, equipment, or property.

f. Major damage — damage to equipment which results in major system degradation or loss.

g. Major system degradation — A condition which results in one or more of the following:

(1) Jeopardized achievement of an operation or performance of a mission; or delay beyond acceptable time limits.

(2) Inadvertent system activation.

1.4 Application and Implementation

State to whom the plan is applicable and that this plan represents the safety requirements planned for inclusion in contract work statements and System Safety Plans from other Government organizations and contractors for Project X. The planned implementation for each phase of the project may be outlined here.

1.5 Applicable Documents

List applicable NASA documents, project, and program documents and make a statement of their applicability. Reference documents may be listed here or in an appendix.

Examples are:

a. Applicable Documents — The following documents, of the latest approved issue, form a part of this specification to the extent described herein.

b. Program Documents

Project Configuration Management Plan

c. NASA Documents

- NHB 1700.1, Vol. I NASA Safety Manual, Basic Safety Requirements.
- NHB 1700.1, Vol. III — System Safety
- NMI 7100.4 Authorization and Control of Research and Development Programs, Projects, other Activities, and Sources Related thereto.

d. Air Force Documents

AFETRM - 127 - 1 Range Safety Manual, Vol. I, Air Force Eastern Test Range Manual, January 1, 1969

e. U.S. Army Documents

- WSMR Range Users Handbook dated 1 May 1967 and Revision I dated 1 December 1967

f. Reference Documents

A list of reference documents is contained in Appendix A.

2.0 SAFETY ORGANIZATION AND RESPONSIBILITIES

In this section of the plan, describe the safety organizations and the responsibilities for the GSFC project and associated contractors, the launch vehicle project, the range, and other activities when involved. Use organizational charts where appropriate and identify personnel where possible.

2.1 GSFC Organization and Responsibilities

The Project Safety Officer should be named, his position in the project organization delineated, and his responsibility as the overall systems safety focal point established.

The assignment of responsibilities to the other NASA installations for the launch vehicle and launch site (range) safety programs should be specified.

The responsibilities of GSFC experimenters for in-house developed hardware should be covered.

The relationship to the GSFC Health and Safety Engineering Office should be established concerning the Industrial Safety responsibilities under Clause 86 of NASA PR 1.5204.

2.2 Contractor Organization and Responsibilities

This section of the Safety Plan should include a chart of the prime contractors organization showing the relationship of the systems safety function. The safety responsibilities of the prime contractor at all sites should be stated. Indicate the prime contractor's responsibility for implementing safety requirements on critical subcontracts.

Also include the safety provisions to be applied to institutional and industrial experimenters under prime contract to GSFC for the development and delivery of flight hardware.

3.0 SAFETY PROGRAM REQUIREMENTS

3.1 Safety Plans

Note other organizations such as the prime contractors, critical subcontractors, NASA Centers, the range, etc., which will be responsible for developing and implementing safety plans in support of the Project Safety Plan. Describe the format to which the plans will be submitted. The plans should reflect the requirements of paragraphs 3.2 through 3.5 below.

3.2 Safety Criteria and Precedence

Hazard categories and the precedence for reducing or eliminating hazards are illustrated in Appendix I and II. The Project Safety Officer should consider modification of these general concepts to develop guidelines particularly applicable to his project.

3.3 Systems Safety Analysis Tasks

This section should clearly establish the scope of the safety analysis to be performed under the Systems Safety definition provided in 1.3-b above. Consideration should be given to methodical examination and review of hardware designs, test plans and procedures, and operating practices for the purpose of identifying and controlling hazards.

3.3.1 Preliminary Analyses

Preliminary analyses should be conducted early in the program to provide a comprehensive, qualitative analysis of the system/subsystem/equipment in its intended operating environment for detecting and defining

its potential hazards. Such information should be used in the development of safety criteria to be included in the performance/design specification. Consideration should be given to at least the following areas:

a. Isolation of energy sources.

b. Fuels and propellants: characteristics, hazard levels and quality/distance constraints; handling, storage, and transportation safety features; compatibility factors, etc.

c. Proposed system environmental constraints.

d. Use of explosive devices and their hazard constraints.

e. Compatibility of materials.

f. Effect of transient current, electromagnetic radiation, and ionizing radiation. Design of controls to prevent inadvertent activation of initiation circuits.

g. Use of pressure vessels and associated piping.

h. Documentation for safe operation and maintenance of the system.

i. Training and certification pertaining to safe operation and maintenance of the system.

j. Fire sources and protection.

k. Equipment layout and lighting requirements and their safety implications in manual system.

l. Nuclear and isotope power sources or experiments.

m. System interactions.

n. Long-term storage.

o. Break-off mechanisms.

p. Despin mechanisms.

q. Appendages (antennas, booms, solar paddles, etc.).

r. Solar cells.

3.3.2 Detailed Analyses

The preliminary analyses for hazard identification initiated early in the program should be expanded in depth in the Definition and Design Phases. These analyses are to include the systems and subsystems

equipment and their interfaces. Catastrophic hazards shall be eliminated or controlled. Nuclear systems will meet a negligible hazard category unless a waiver is granted.

3.3.3 Operating Analyses

Analyses should be conducted to determine safety requirements for personnel, procedures, and equipment used in installation, maintenance, support, testing, operations, and training. Results of these analyses shall provide the basis for: (1) design changes, where feasible, to eliminate hazards or provide safety devices, safeguards, etc.; (2) inputs to the warning, caution, and emergency procedures section of test operating and maintenance procedures and instructions; (3) identification of a hazardous period time span and actions required if such hazards occur; and (4) special procedures for servicing, handling, storage, and transportation.

3.4 Industrial and Public Safety

The System Safety Program shall include coordination with the GSFC Health and Safety Engineering Office to ensure an effective and integrated total Safety Program.

3.5 Design Review

A review of the Safety Program shall be presented to the NASA/GSFC Design Review Team as a part of the Center's formal Design Review Program. Additional Safety Program Reviews, if required, shall be conducted as directed by the Project Manager.

4.0 SYSTEMS SAFETY MONITORING AND CONTROL

4.1 Safety Program Schedule

In this section provide a master schedule for integrating the activities to be accomplished in the overall Project Safety Plan. Identify approval dates for the plans, the analyses, reviews, and audits and other events as applicable.

4.2 Mishap Reporting

All significant mishaps shall be investigated, utilizing applicable procedures, for causes and system safety implications. The findings, conclusions, and

recommendations shall be documented and submitted to the appropriate organizations for disposition. The contractor shall be prepared to provide technical assistance to boards investigating mishaps which occur within his jurisdiction. A copy of all mishaps reports shall be sent to the GSFC Health and Safety Engineering Officer for disposition. The contractor shall be prepared to provide technical assistance to boards investigating mishaps which occur within his jurisdiction.

4.3 Safety Monitoring

Observation of designated hazardous/dangerous operations will be accomplished as necessary to ensure adherence to safety principles and compliance with safety requirements and checklists. Normally, the degree of monitoring necessary (spot-check, full time monitoring, etc.) will vary depending upon such factors as: the nature of the operation; the history/experience; the quality of technical data available; the personnel involved and the type of facilities available. Other factors may also be decisive and the degree of monitoring required should be periodically evaluated as the state-of-the-art progresses.

4.4 Safety Audits

Each project will audit prime contractors' safety performance. The prime contractors will audit their own conformance to safety requirements and the performance of their subcontractors and suppliers, as required. These audits will evaluate the degree of conformance to the established safety requirements. Requirements audited will also include safety requirements specified in design, manufacturing, test, and operational specifications.

4.5 Waiver Procedures

Areas of noncompliance with the project's established safety requirements must be referred to the Project Manager for review and approval. Describe the procedures to be followed in obtaining waivers.

4.6 Reporting and Documentation

In this section identify all documents, and the responsible organizations, to be prepared in support of the Project Safety Plan. Further, identify those documents, prepared under other project functions that support or become an integral part of the plan by reference. Describe the central source files for project safety documentation.

ATTACHMENT I — APPENDIX C

HAZARD LEVEL CATEGORIES

A. Safety Catastrophic

Condition(s) such that environment, personnel error, design characteristics, procedural deficiencies, or subsystem or component malfunction will cause subsequent death or multiple injuries to personnel.

B. Safety Critical

Condition(s) such that environment, personnel error, design characteristics, procedural deficiencies, or subsystem or component malfunction will cause personnel injury, or will result in a hazard requiring immediate corrective action for personnel.

C. Safety Marginal

Condition(s) such that environment, personnel error, design characteristics, procedural deficiencies, or subsystem failure or component malfunction that can be counteracted or controlled without any injury to personnel.

D. Safety Negligible

Condition(s) such that personnel error, design characteristics, procedural deficiencies, or subsystem failure or component malfunction will not result in personnel injury.

ATTACHMENT II — APPENDIX C

SYSTEM SAFETY PRECEDENCE

A. Design for Minimum Hazard

The major effort throughout the design phases shall be to ensure inherent safety through the selection of appropriate design features as fail safe, redundancy, and increased ultimate safety factor.

B. Safety Devices

Known hazards which cannot be eliminated through design selection shall be reduced to the acceptable level through the use of appropriate safety devices as part of the system, subsystem or equipment, e.g., shorting plugs on squibs, safe and arm devices.

C. Warning Devices

Where it is not possible to preclude the existence or occurrence of a known hazard, devices shall be employed for the timely detection of the condition and the generation of an adequate warning signal. Warning signals and their application shall be designed to minimize the probability of wrong signals or of improper personnel reaction to the signals, e.g., N_2 H_4 leak detectors.

D. Special Procedures

Where it is not possible to reduce the magnitude of an existing or potential hazard through design, or the use of safety and warning devices, special procedures shall be developed to counter hazardous conditions for enhancement of personnel safety. Precautionary notations shall be standardized in accordance with the direction of the procuring activity.

E. Residual Hazards

Residential hazards for which safety or warning devices and special procedures cannot be developed or provided for counteracting the hazard shall be specifically identified to safety and program management. Continuation of effort to eliminate or reduce such hazards shall be accomplished throughout the program by maintaining awareness of new safety technology

or devices being developed and their application to the residual hazards. Justification for the retention of residual hazards shall be documented.

APPENDIX D

SUPPORT INSTRUMENTATION REQUIREMENTS DOCUMENT (SIRD)

APPENDIX D

SUPPORT INSTRUMENTATION REQUIREMENTS DOCUMENT (SIRD)

RELEASE PROCEDURES

1. The SIRD (or revisions) is prepared by the Project Office in conjunction with the NSM and MSM for the project. (For all revisions, a new page 010 will be prepared. Page 030 will be revised to reflect those pages affected by the revision.)

2. Copies are provided to the NSM and MSM for concurrence within their respective directorates.

3. Informal Network Directorate, and Mission and Data Operations Directorate concurrence is received and any changes incorporated.

4. The Project Manager signs page 010 (in the case of a revision the Project Manager also initials the "validate" block(s) on page 030 for the correct revision).

5. Copies of the SIRD memorandum are prepared (see sample memorandum).

6. A memorandum from the Office of the Director to the appropriate Headquarters Associate Administrator, is prepared. This memo must contain a statement that ND and MDOD concurrence has been received (see attached sample). The route slip requests the Office of the Director to sign the SIRD memorandum, page 010 and to forward the entire package. The routing of the memo is from Project Manager to the appropriate Directorate office to the Directors of Networks and Mission and Data Operations; then to the Office of the Director. In addition, revisions are routed through Dr. George F. Pieper, Code 600, to the Office of the Director (see attachment sample).

7. The documents attached to the memo consist of three copies of the SIRD plus the original of page 010. (All the rest of the originals are retained by the project office.)

Study/Project managers should plan and schedule the issuance of an initial SIRD (Support Instrumentation Requirements Document) concurrent with the Project Plan. This first SIRD should meet the minimum requirements established in the SIRD preparation instructions and contain the new and

continuing requirements placed by the Tracking and Data activities of the project. It is attached to the Project Plan and sent to OSS or OA, as appropriate for approval purposes, and after their action, it is sent by the program office(s) to OTDA for information, review, and commitment of support and future resources. Additionally, GSFC sends OTDA information copies of the project plan and SIRD concurrent with the transmittal of the same documents to the OSS or OA program approving office.

a. The sequence of events subsequent to the Projects Directorate release of the SIRD or revision are as follows:

(1) The package is routed as per the routing slip.

(2) The Office of the Director signs the memorandum and page 010 of the SIRD and forwards the package to the Associate Administrator, OSS or OA.

(3) The Associate Administrator, OSS or OA, signs page 010 and forwards the package to the Office of Tracking and Data Acquisition (OTDA).

(4) OTDA approves the SIRD and signs page 010.

(5) OTDA reproduces page 010 and attaches a copy to each SIRD set. One copy of the SIRD, attached to the memorandum authorizing its use, is forwarded to GSFC.

(6) A copy of the SIRD and authority for use is sent to the Headquarters Program Office in OSS or OA along with original of page 010.

(7) OSS or OA returns page 010 to the Project Office at GSFC for retention.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

SAMPLE

SIRD (or Revision) Memorandum

TO: NASA Headquarters
Attention: Office of Space Science and Applications
Dr. John E. Naugle

FROM: Office of the Director

SUBJECT: ATS-F&G Support Instrumentation Requirements Document (SIRD), (Revision Number _____).

The subject document (revision) is forwarded herewith for approval and transmittal forward to the Office of Tracking and Data Acquisition for their review.

The document defines the support requirements for the ATS-F&G launch and subsequent flight operations. It was prepared by the ATS Project staff in cooperation with the ATS Network Operations Manager and Mission Support Manager and has been reviewed by the cognizant Tracking and Data Systems personnel.

(Brief narrative description of the change and reason for it.)

Please return original Page 010 "Approval" to the ATS Project Office, GSFC, Attention: G. Bullock.

Enclosures
Three copies of the ATS-F&G SIRD (Revision)
Original page 010 "Approval" page

GB:lh (8/18/70)
ATS Project, Code 460

cc: Dr. G. F. Pieper, Code 600, with 1 copy of SIRD (Revision)
J. R. Burke, NASA HQ, with 1 copy of SIRD (Revision)
H. L. Gerwin, Code 460, with 1 copy of SIRD (Revision)
R. R. Nersesian, Code 513, with 10 copies of SIRD (Revision)

APPENDIX E

EXAMPLES OF MEMORANDA OF AGREEMENT

POP 70-4

CIVIL SERVICE MANPOWER
OAO SUPPORT
PROJECT SUPPORT BRANCH (263)

	FY 71	FY 72	FY 73	FY 74	FY 75
COLOCATED PERSONNEL	BIGIO ROSS EYSTER } 5.0MY DAVIS MEYERLE	BIGIO ROSS EYSTER } 2.9MY DAVIS MEYERLE	1.2MY	0.0	0.0
BRANCH TASKS	• GENERAL BUSINESS • FINANCIAL • SCHEDULE SUPPORT	SAME AS FY 71			
BRANCH PERSONNEL (MAN YEARS)	0.0	0.0	0.0	0.0	0.0
TOTAL MANYEARS	5.0	2.9	1.2	0.0	0.0

FRANK J. HEDDINGER, BRANCH HEAD

JOSEPH PURCELL, PROJECT MANAGER

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POP 70-4
CIVIL SERVICE MANPOWER
OAO SUPPORT
QUALITY ASSURANCE DIVISION (310)

	FY 71	FY 72	FY 73	FY 74	FY 75
COLOCATED MANPOWER	GUNSHINAN ROTHENBURG FALK)4.0 LONG NAVY INSP.)3.0	GUNSHINAN ROTHENBURG FALK)2.0 LONG *NAVY INSP.)0.5	0.0	0.0	0.0
DIVISION TASKS	• FAILURE ANALYSIS. • INSTRUMENT CALIBRATION FOR I&T CREW • MR DATA • CONSULTATION ON PART SELECTION.	SAME AS FY 71	0.0	0.0	0.0
DIVISION PERSONNEL (MAN YEARS)	1.6	1.2	0.0	0.0	0.0
TOTAL MAN YEARS	5.6	3.2	0.0	0.0	0.0

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*CIVIL SERVICE REPLACEMENTS FOR NAVY INSPECTORS REQUIRED AT AUGUST 31, 1971.

RUSSELL E. DORRELL, DIVISION CHIEF

JOSEPH PURCELL, PROJECT MANAGER

POP 70-4
CIVIL SERVICE MANPOWER
OAO SUPPORT
TEST AND EVALUATION DIVISION (320)

FISCAL YEAR	FY 71						FY 72					
BRANCH	321	322	324	325	326	328	321	322	324	325	326	328
COLOCATED (BUILDING 5)												
ALVORD					0.4							
MILLMAN					1.0						0.5	
DIVISON TASKS												
OAO-B S/C	0.3	1.2	0.2	0.6	0.8	1.2						
OAO-B EXPERIMENT					0.2							
OAO-C S/C	3.3	5.4	4.0	3.1	0.7	1.1	1.3	2.5	4.5	0.5	1.0	0.2
OAO-C EXPERIMENT	2.3	1.7	5.9	6.8	1.2	___	___	___	___	0.6	0.5	___
TOTALS (MY)	5,9	8.3	10.1 (41.6* MYs)	10.5	4.3	2.3	1.3	2.5	4.5 (11.6 MYs)	1.1	2.0	0.2

*INCLUDES 0.2 in 320 on committee actions

William H Meyer
WILLIAM H. MEYER, T&E SUPPORT MANAGER

Joseph Purcell
JOSEPH PURCELL, PROJECT MANAGER

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POP 70-4
CIVIL SERVICE MANPOWER
OAO SUPPORT
SPACE POWER TECHNOLOGY BRANCH (761)

	FY 71	FY 72	FY 73	FY 74	FY 75
COLOCATED PERSONNEL	FAIRBANKS}2.0 HUSICH OTHER	FAIRBANKS }1.5 OTHER	FAIRBANKS}0.2	0.0	0.0
BRANCH TASKS	• FLIGHT BATTERIES PRODUCTION AND TEST SUPPORT. • ARRAYS AUDIT INSPECTION. • CRANE (NAD) CELL TESTING. • CELL VERIFICATION TESTING. • RADIATION EFFECTS TESTING. • POWER CONDITIONING EQUIPMENT REVIEW. • BRANCH CLERK TYPIST.	SAME AS FY 71	CELL TESTING TO SUPPORT FLIGHT.	0.0	0.0
BRANCH PERSONNEL (MAN YEARS)	5.2	1.7	0.3	0.0	0.0
TOTAL MANYEARS	7.2	3.2	0.5	0.0	0.0

Charles M MacKenzie
CHARLES M. MACKENZIE, BRANCH HEAD

Joseph Purcell
JOSEPH PURCELL, PROJECT MANAGER

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