S-PRIME THERMIONIC SPACE NUCLEAR

POWER SYSTEM DESIGN AND TECHNOLOGY

DEMONSTRATION

S-PRIME THERMIONIC SPACE NUCLEAR POWER SYSTEM QUALITY ASSURANCE PROGRAM PLAN

DOE CONTRACT AC03-92-SF19138

ROCKWELL INTERNATIONAL CORPORATION
Rocketdyne Division

DISCLAIMER

Rockwell International
Rocketdyne Division

SUPPORTING DOCUMENT

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ABSTRACT

This document describes the Quality Assurance Program for the S-PRIME Thermionic Program Design and Technology Demonstration Phase I & II. This QAPP satisfies the requirements delineated in the Department of Energy Order 5700,6C the Quality requirements for this Project.

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REV	SUMMARY OF CHANGE	APPROVALS AND DATE
A	Page 1 Revised mail address and total numbers of pages. Page 14 Para 1.3, Authorities: added stop work authorities. Added para 1.5 Plannning, Scheduling, and Cost Control. Page 17 and 18 Added Record Retention Requirement Table 1 Page 20 Para 6.1.2: Replace "of" with "or" in title. Page 22 Para 7.1.1: corrected last sentence ..... "Evaluation and Re-evaluation was "re-evaluation re-evaluation" ..... Page 24 Added para 8.1.5, Test Plans and renumber para 8.1.6 Page 27 Quality Assurance Program Implementation Methodologies was Deliverables. Para 11.1: revised to add ..... "and any other manual/ or procedures used to implement the requirements of this QAPP"..... Page 28 Revised objective evidence to read evidence of quality. Page 31 Appendix A-2 was completely revised to add all Rocketdyne project procedures.	R D Rogers 2/25/93 2/25/93 2/25/93 Rel Date: 2-25-93

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INTRODUCTION

This Quality Assurance Program Plan (QAPP)describes how the Thermionic Space Nuclear Power System Design and Technology Demonstration Project addresses the Quality Assurance requirements delineated in DOE Order 5700.6C and the Thermionic Program Management Plan 214PMP000001. The Quality Assurance Program is based on the following fundamental principles, which Rocketdyne endorses and the QA Project Manager and Program Manager shall enforce:

a) Quality Achievement is a continuing responsibility of line organization at all levels. Quality Assurance is recognized as an interdisciplinary function involving many organizational components and shall not be regarded as the sole domain of any single quality assurance group. Achieving quality is the responsibility of people throughout the organization from the top executive to workers, including designers, scientists, engineers, welders, inspectors, researchers, operators, craftsman and auditors.

b) The Quality Assurance organization through the effective overview of work, gives additional assurance that specified requirements are met. This is accomplished by performing oversite activities such as audits, surveillances, inspections and assessment of activities affecting quality. All work affecting quality shall be performed in accordance with approved instructions and procedures.

c) Risk is the fundamental consideration in determining to what extent the Quality Assurance Plan should be applied to items and processes. Risk is a quantitative and/or qualitative expression of possible loss which considers both the probability of event occurrence causing harm or loss and the consequences of that event. The degree of application of the Quality Assurance Plan, shall be accomplished through the use of "graded" quality assurance. The plans shall provide for quality categories based on safety, reliability and minimizing risk.

d) Action is based on facts and analysis, customer driven quality, strong quality leadership and continuous improvement.

SCOPE

This Quality Assurance Program Plan has been prepared to delineate the requirements governing the QA Program for the Thermionic Space Nuclear Power System Design and Technology Demonstration (hereafter the S-PRIME Program) and defines the Quality Assurance requirements governing activities affecting quality of all program participants unless specifically stated otherwise herein. These requirements are applicable to analysis, design, procurement, fabrication, handling, construction, installation, inspection, testing and maintenance of all structures, systems, components and facilities utilized in support of the program. This Quality Assurance Program Plan incorporates applicable quality assurance program requirements from DOE Order 5700.6C (8-21-91). As the implementing document only this QAPP needs to be cited for S-PRIME quality assurance programmatic requirements. The S-PRIME Quality Assurance Program Plan is organized such that at the beginning of each section the DOE 5700.6C that criteria the section is to address is delineated in italics under the heading requirements.

Each program participant shall establish and implement an effective quality assurance program meeting the requirement of the S-PRIME Thermionic Space Nuclear Power System Quality Assurance Program Plan. Each program participant's QA Program may be implemented by the use of existing procedures, plans, and instructions as appropriate for their involvement in the program.

At Rocketdyne the following Policies and Procedures will make up the Quality Program. The Rocketdyne Operating Policies (ROP); the Quality Assurance Operating Procedures (QAOP); the Rocketdyne Quality Assurance Manual (QAM); and the Advanced Power Engineering Management Procedures (EMP) shall be invoked as required to implement the Rocketdyne S-PRIME QA Program Plan. If existing plans, procedures, and instruction are not adequate, then additional ones shall be developed and implemented.

REFERENCE DOCUMENTS

1. DOE Order 5700.6C dated 8-21-91 Quality Assurance.

2. ASME/NQA-2 Quality Assurance Requirements for Nuclear Facility Applications.

1.0 PROGRAM MANAGEMENT

REQUIREMENT Organizations shall develop, implement, and maintain a written Quality Assurance program. The QAP shall describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing adequacy of work. The QAP shall describe the management system, including planning, scheduling, and cost control considerations.

1.1 Organization

Rocketdyne Division within the Rockwell International Aerospace Operation Organization is chartered to conduct business in the areas of rocket propulsion systems, directed energy systems, power conversion systems, and power generating systems. Within Rocketdyne's Advanced Programs organization, the Advanced Space Power Programs group will be responsible for performance of the S-PRIME contract work. Dr. J.C. Mills, Director, will also serve as Program Manager on this program. Figure 1 shows the relationship of the Rocketdyne Division to the Rockwell corporate structure, and Figures 2 and 3 show the reporting relationship for Dr. Mills.

Rocketdyne has formed a project organization and team division of responsibilities to achieve all the objectives of the S-PRIME program effort. The program organization is shown in Figure 4, and S-PRIME responsibilities, by team member, are summarized in Figure 5. Figure 8 shows the quality assurance organization structure. The Quality Assurance organization reports to the Rocketdyne Vice President of Quality Assurance and System Safety and is matrixed to the Program Manager for program direction and guidance. This is essential to independently and effectively assure product quality.

1.2 Responsibilities

The responsibilities for each of the key components and the end items in the effort are delineated with lines of accountability clearly established. As seen in Figure 4, the program design work is coordinated through the chief project engineer with designated lead individuals responsible for each major S-PRIME subsystem. Safety, reliability, and quality assurance are kept separate from the design development effort to ensure the independence needed for effective oversight and program integration of these attributes.

Primary responsibility for each WBS element has been assigned to an individual who has single point accountability for performance of that WBS

element. That individual is responsible for coordinating his work with the interfacing WBS elements and to determine and report the work status, cost status, and schedule status to the program manager. Figures 6 and 7 show the Responsibility Assignment Matrices developed for Phases 1 and 2.

As seen in Figure 5, which summarizes team member responsibilities, Rocketdyne will perform overall systems engineering and payload integration activities, including lead responsibility for such system level efforts as reliability, survivability, feasibility, development risk, and aerospace safety. Rocketdyne also has specific design responsibility for the shield assembly, the drives for the reflector and safety control, the heat rejection system and power conditioning.

General Atomics (GA) will have the design responsibility for the two major design areas of the system, namely, the reactor and the thermionic fuel element (TFE) power conversion system. GA will also have responsibility for nuclear safety (i.e., design analyses to demonstrate subcriticality in all credible accidents) and operability (e.g., startup and shutdown). Thermo Trex Technology Corporation (TTC) will assist the development of a non-nuclear acceptance testing strategy and a manufacturing assessment for the TFEs, and will also be responsible for the cesium reservoir design for the TFE. Rasor Associates Incorporated (RAI) will provide thermionic modeling and performance evaluation to support the GA power conversion system effort and will spearhead some of the critical component testing with the thermionic converters. POD Associates will support Rocketdyne in the survivability task effort by assisting in the design and technology assessments and performing selective detailed analyses (e.g., hydrocode, shock wave). Teledyne Energy Systems, will provide assistance in the nuclear risk analysis arena to support both the S-PRIME design evolution and Phase 2 PSAR.

Military satellite suppliers, TRW, Martin-Marietta, Lockheed and Rockwell Space Systems Division will examine how the S-PRIME would integrate with and benefit military applications being explored. Their participation during the conceptual and preliminary design phases will assure inclusion of features/attributes that an end user would rate as attractive, desirable and/or enabling. Furthermore, their participation will assist in defining a meaningful flight experiment during the flight planning task in Phase 1.

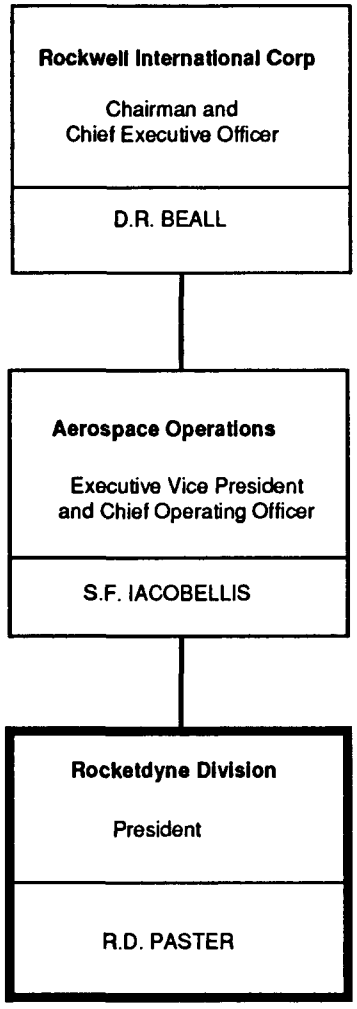


Figure 1. Relationship of the Rocketdyne Division to the Rockwell Corporate Structure

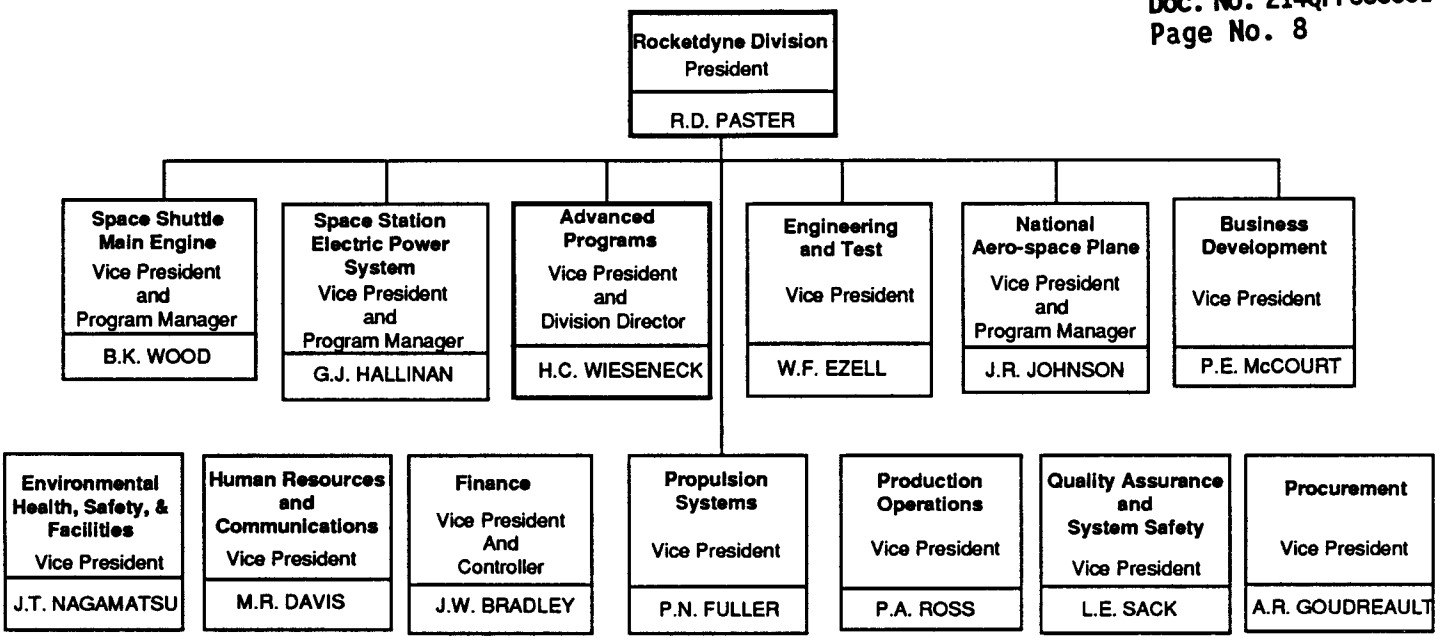


Figure 2. Relationship of Proposed S-PRIME Program to Rocketdyne Division

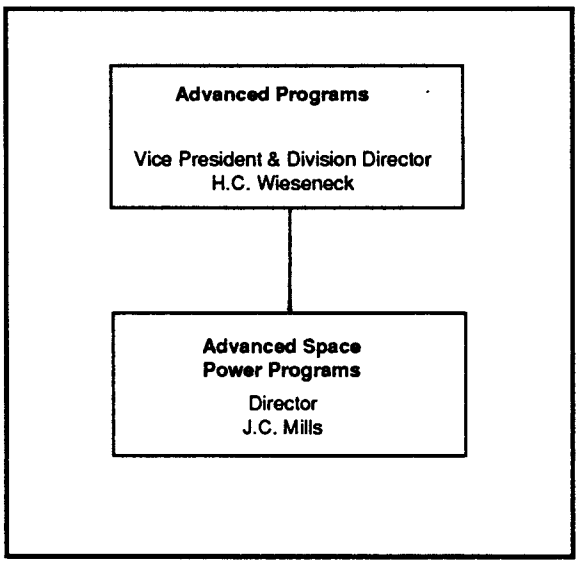


Figure 3. Relationship of S-PRIME Program Manager to Rocketdyne Advanced Programs Organization

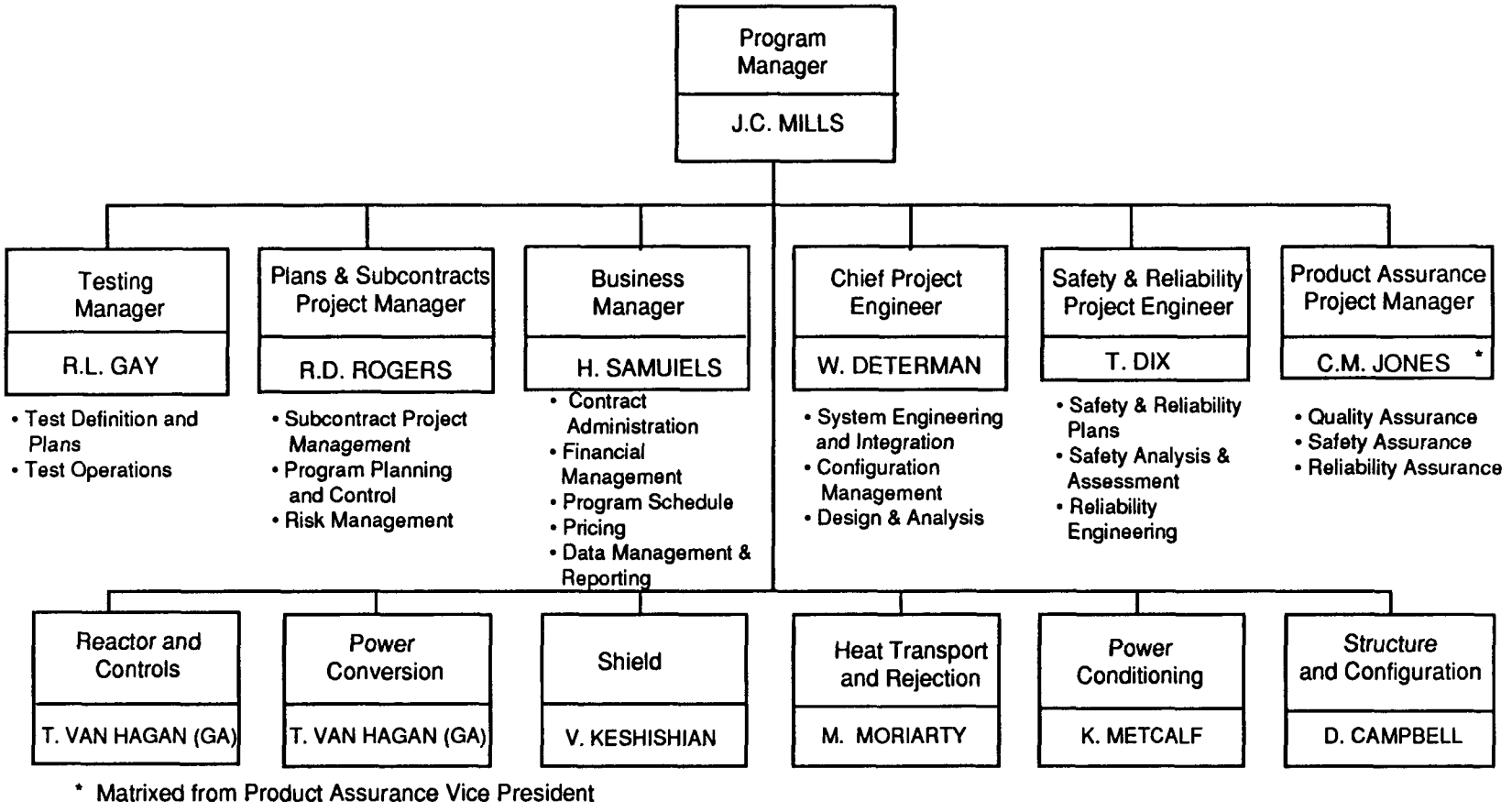


FIGURE 4. S-PRIME Program Organization

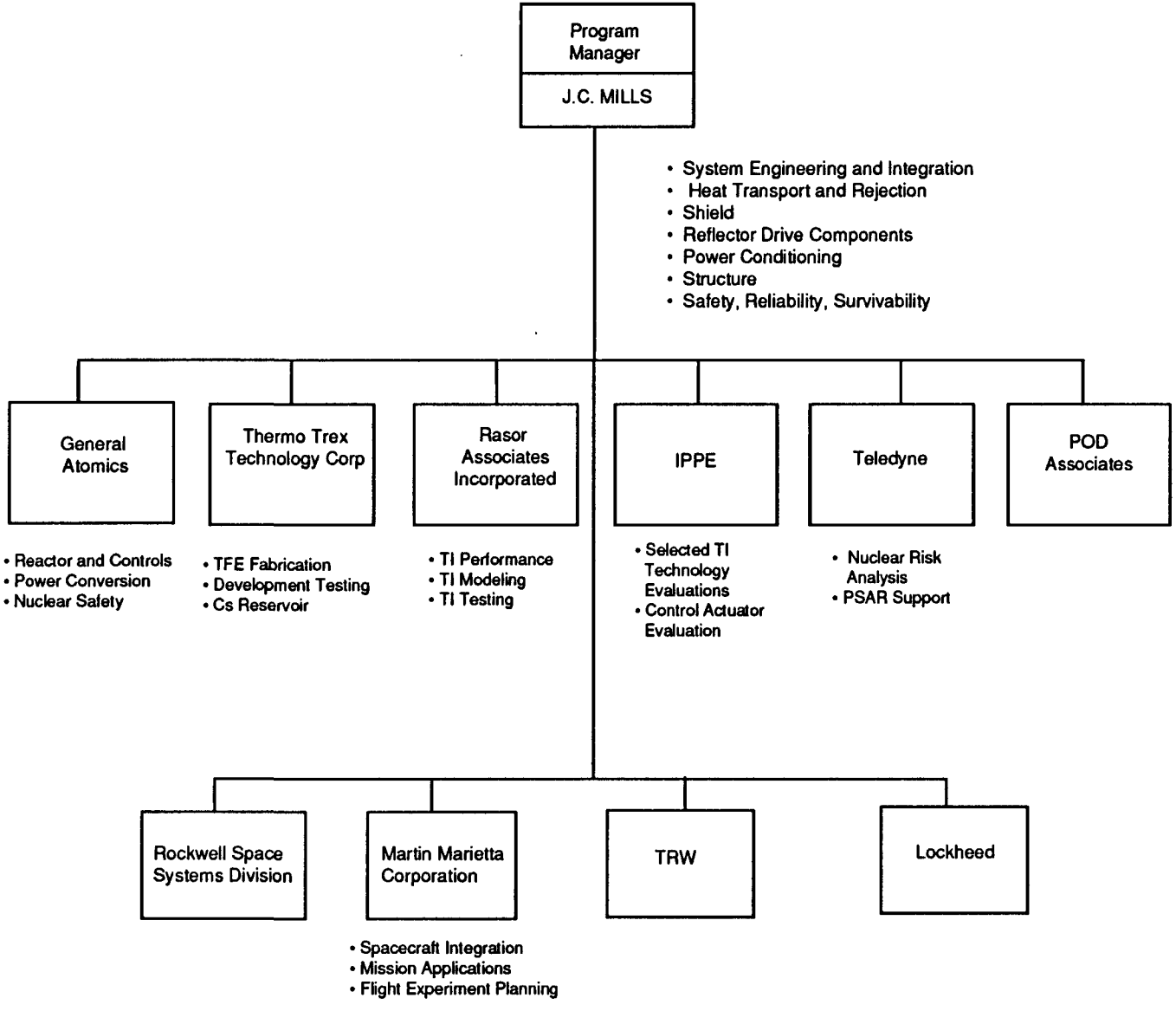
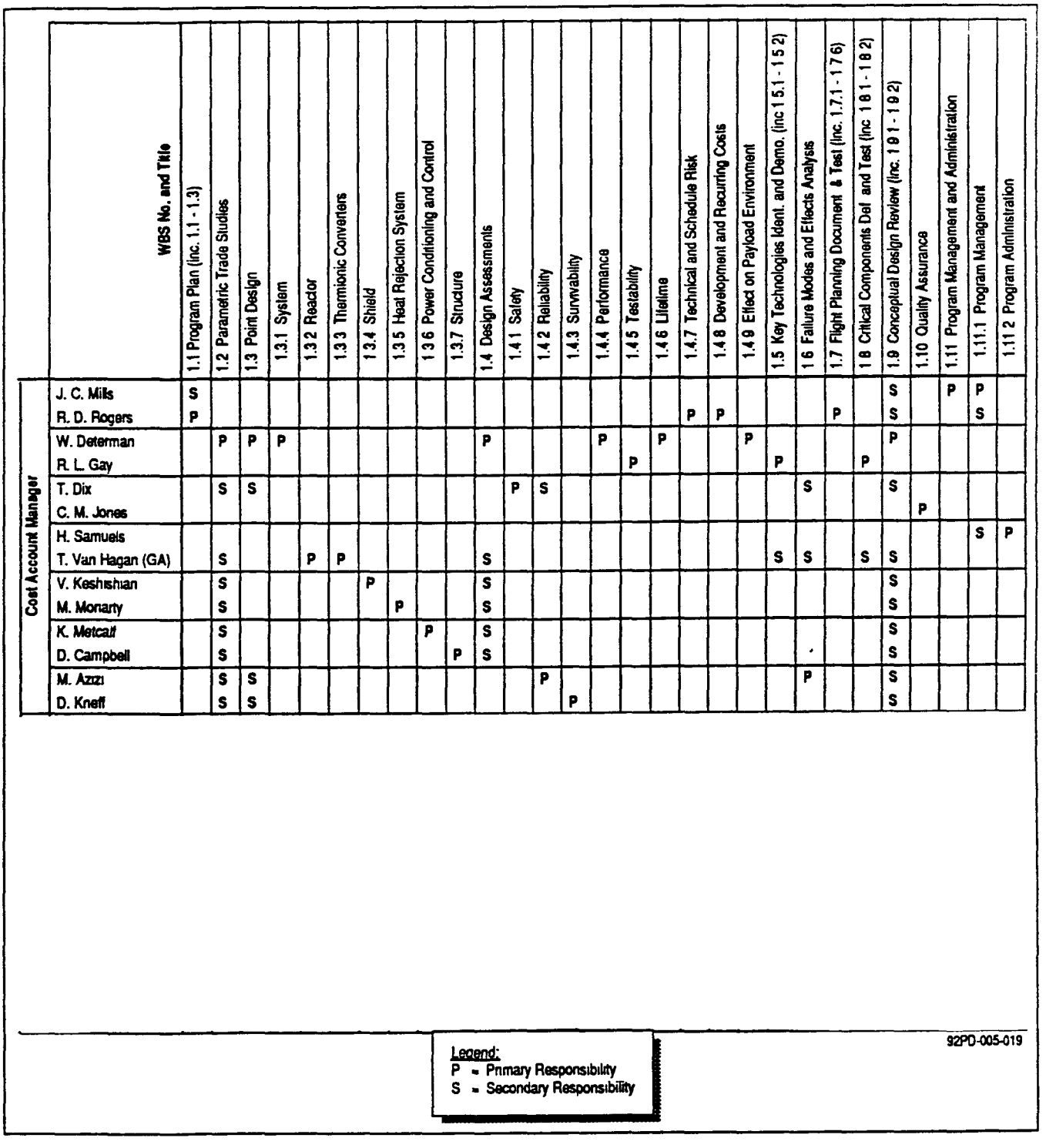


FIGURE 5. S-PRIME Team Responsibilities



Cost Account Manager	WBS No. and Title	1.1 Program Plan (inc. 1.1 - 1.3)	1.2 Parametric Trade Studies	1.3 Point Design	1.3.1 System	1.3.2 Reactor	1.3.3 Thermionic Converters	1.3.4 Shield	1.3.5 Heat Rejection System	1.3.6 Power Conditioning and Control	1.3.7 Structure	1.4 Design Assessments	1.4.1 Safety	1.4.2 Reliability	1.4.3 Survivability	1.4.4 Performance	1.4.5 Testability	1.4.6 Lifetime	1.4.7 Technical and Schedule Risk	1.4.8 Development and Recurring Costs	1.4.9 Effect on Payload Environment	1.5 Key Technologies Ident. and Demo. (inc 1.5.1 - 1.5.2)	1.6 Failure Modes and Effects Analysis	1.7 Flight Planning Document & Test (inc. 1.7.1 - 1.7.6)	1.8 Critical Components Del and Test (inc 1.8.1 - 1.8.2)	1.9 Conceptual Design Review (inc. 1.9.1 - 1.9.2)	1.10 Quality Assurance	1.11 Program Management and Administration	1.11.1 Program Management	1.11.2 Program Administration
	J. C. Mills	S																								S			P	P
	R. D. Rogers	P																	P	P				P		S			S	
	W. Determan		P	P	P							P				P		P			P					P			P	
	R. L. Gay																P					P			P					
	T. Dix		S	S									P	S									S			S				
	C. M. Jones																										P			
	H. Samuels																											S	P	
	T. Van Hagan (GA)		S			P	P					S										S	S		S	S				
	V. Keshishian		S					P				S														S				
	M. Monarty		S						P			S														S				
	K. Metcalf		S							P		S														S				
	D. Campbell		S								P	S														S				
	M. Azizi		S	S										P									P			S				
	D. Kneff		S	S											P											S				

Legend:
P = Primary Responsibility
S = Secondary Responsibility

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Figure 6 Responsibility Assignment Matrix - Phase 1

WBS Manager	WBS No. and Title	2.1 Program Plan Update	2.2 Preliminary Design	2.2.1 System	2.2.2 Reactor	2.2.3 Thermionic Converters	2.2.4 Shield	2.2.5 Heat Rejection System	2.2.6 Power Conditioning and Control	2.2.7 Structure	2.3 Critical Components Demonstration	2.4 Design Assessments	2.4.1 Safety	2.4.2 Reliability	2.4.3 Survivability	2.4.4 Performance	2.4.5 Testability	2.4.6 Lifetime	2.4.7 Technical and Schedule Risk	2.4.8 Development and Recurring Costs	2.4.9 Effect on Payload Environment	2.5 Draft Preliminary Safety Analysis Report	2.6 Preliminary Design Review	2.7 Quality Assurance	2.8 Program Management and Administration	2.8.1 Program Management	2.8.2 Program Administration
	J. C. Mills	S																					S		P	P	
	R. D. Rogers	P																	P	P			S			S	
	W. Determan		P	P								P				P		P			P		P				
	R. L. Gay										P						P										
	T. Dix		S										P	S								P	S				
	C. M. Jones																							P			
	H. Samuels																									S	P
	T. Van Hagan (GA)				P	P						S										S	S				
	V. Keshishian						P					S											S				
	M. Moriarty							P				S											S				
	K. Metcalf								P			S											S				
	D. Campbell									P		S											S				
	M. Azizi		S											P									S				
	D. Kneff		S												P								S				

Legend:
P = Primary Responsibility
S = Secondary Responsibility

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Figure 7. Responsibility Assignment Matrix - Phase 2

S-Prime Quality Assurance Organization Structure

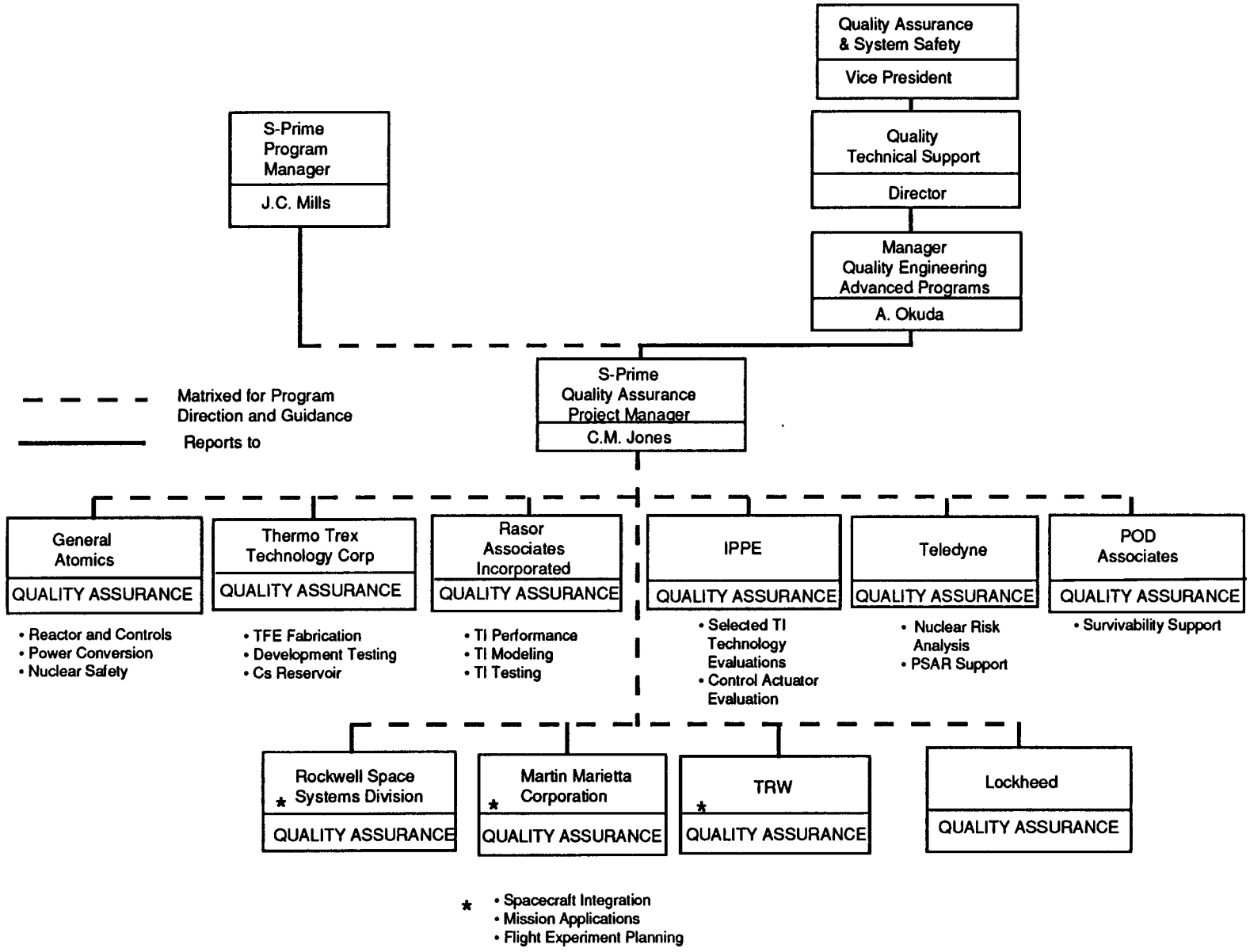

FIGURE 8

1.3 Authorities

The project organization shown in Figure 4 and discussed in Section 1.1 is a matrix organization wherein the program manager, who reports directly to the Vice President for Advanced Programs, has total responsibility and accountability for project success. Programmatic support is provided by individuals representing various functional departments and having functional responsibility to maintain technical excellence and administrative control on the project. Programmatically, the individuals shown in Figure 4 are responsible to and report to the respective organizations. For Quality Assurance on the S-PRIME Program, this relationship is reflected in Figure 4 which shows the Product Assurance Project Manager being programmatically responsible for quality, safety, and reliability assurance and in Figure 8 which shows the Quality Assurance organization. Structured in this manner, product assurance can be kept separate from design development activities thus ensuring the independence needed for effective oversight. The Quality Assurance Project Manager and QE has the authority to stop work. The criteria for stopping work include, but are not limited to the following nonconforming work or item; unapproved practices, repetitively ineffective corrective action, unsafe work, work of inadequate quality, and continued work will produce or conceal results that are not in accordance with the requirements of this QAPD. Method for lifting stop work shall be defined in the procedures for stop work.

1.4 Communications

The free, continuous, and unimpeded flow of quality assurance communications, both horizontally and vertically within organizations, as well as among the participants, is essential. The free exchange of information between responsible individuals is also essential to the timely execution of quality assurance responsibilities. To promote the flow of communications and to assure positive attention to quality problems from design through system testing, lines of communication will be established as follows:

Formalized communications shall flow according to established organizational arrangements and as defined in the Project Management Plan.

1.5 Planning, Scheduling and Cost Control

The S-Prime Program Planning, Scheduling and Cost Control shall be performed in accordance with the procedures defined in the Program Management Plan 214PMP000001. The top level planning, scheduling and budgeting of work is accomplished by key project management personnel.

The results of planning, scheduling and budgeting are documented in organization charts, work breakdown structures and work plans. Detail planning is done by the Cost Account Manager responsible for each work breakdown structure cost account. Subcontractors will utilize their own procedures to control their work and provide complete, accurate, and timely reporting of their progress to Rocketdyne in a format compatible with requirements of the Program Management Plan 214PMP000001.

2.0 PERSONNEL TRAINING AND QUALIFICATION

REQUIREMENT Personnel shall be trained and qualified to ensure they are capable of performing their assigned work. Personnel shall be provided continuing training to enure that job proficiency is maintained.

2.1 Training

Training and qualification shall be documented for all personnel performing quality affecting activities. Training and/or qualification shall be conducted prior to performing quality affecting activities. Training requirements for S-PRIME personnel performing quality affecting activities shall be determined by the Line Management directly responsible for the activity. Training and qualification procedures will describe how training and qualification shall be implemented for the S-PRIME project at each program participant facility.

2.2 Qualification of Personnel

Each program participant will establish a personnel qualification program which identifies personnel qualification needs for those individuals who are authorized to accept materials, products, processes or systems by required inspection and tests; establishes qualification requirements; and conducts activities which will fulfill the requirements.

The need for requalification will be assessed at least every (18) eighteen months.

Each program participant shall produce and maintain current a list which identifies the job types for which qualification requirements have been established.

As a minimum the training program shall provide indoctrination for key personnel covering the technical objective of the program and quality assurance program requirements. Key personnel shall include the Program Manager, Project Managers, Engineering and Design, Quality Assurance, Purchasing, Manufacturing and Test Personnel.

3.0 QUALITY IMPROVEMENT

REQUIREMENT. The organization shall establish and implement processes to detect and prevent quality problems and to ensure quality improvement. Items and processes that do not meet established requirements shall be identified, controlled, and corrected. Correction shall include identifying the cause of problems and preventing recurrence. Item reliability, process implementation, and other quality-related information shall be reviewed and the data analyzed to identify items and processes needing improvement.

3.1 Quality Improvement

Each program participant shall identify, document, evaluate, segregate, and disposition nonconforming items and shall notify affected parties in accordance with their respective nonconformance procedures which shall comply with the requirements of this section. Nonconformances which potentially impact others shall be forwarded to the Rocketdyne S-PRIME QA Project Manager for processing in accordance with Rocketdyne Procedures. Nonconforming items dispositioned "use as is" or "repair" shall be technically justified and are subject to design control measures commensurate with the original design.

3.2. Corrective and Preventive Action

Each program participant shall establish a system for determining and preventing the cause of conditions affecting quality and quality problems for items and services that do not meet established requirements. The cause of the condition shall be determined and corrective action taken to preclude recurrence. Quality information such as Audit Reports, Inspection Reports, Surveillance Reports, Nonconformance Reports, Corrective Action Reports, Item Reliability, Process Implementation and other quality related documents shall be analyzed to identify quality, items and processes needing improvement. Process analysis shall be performed in a manner and at a frequency that shall provide for prompt identification and improvement of quality related problems.

4.0 DOCUMENTS AND RECORDS

REQUIREMENT Documents shall be prepared, reviewed, approved, issued, used and revised to prescribe processes, specify requirements, or establish design. Records shall be specified, prepared, reviewed, approved, and maintained.

4.1 Records

Records that furnish documentary evidence of quality shall be specified, prepared, and maintained. See Table 1 below for record retention requirements.

Records shall be legible, identifiable, and retrievable.

Records shall be protected against damage, deterioration or loss. Requirements and responsibilities for records transmittal, distribution, retention, maintenance and disposition shall be documented in procedures. Quality records shall include but are not limited to the results of inspections, tests, audits, surveillances performance and material analysis. The records shall also include as appropriate data such as qualifications of personnel, procedures and equipment and other documentation required by contract or regulation. The quality assurance records shall be traceable to the item and/or purchase order they support.

TABLE 1
RECORDS RETENTION REQUIREMENTS

Type of Record	Retention of Original [a]
Design documents, e.g. design drawings, calculations, specifications, computer programs, reports, test, plans etc.	5 years
Program directives, plans, schedules, memos, letters, transmittals, status letter reports, TELEXs, telecon records, etc., that contain programmatic or technical information.	1 year
Quality Assurance program document, QA audit records (includes audits of subcontractors, and suppliers).	1 year
Nonconformance reports, suppliers' disposition requests,	5 years
Laboratory notebooks containing description/results of laboratory experiments, R&D work (including supplemental information, such as charts, diagrams, sketches).	5 years
Materials test reports, analyses, test data, and inspection records for material	5 years
Inspection records of all components. Test reports, and acceptance test records	5 years
Fabrication records including completed travelers, special process procedures and NDE reports.	5 years

[a] After completion of project.

NOTE: 5700.6C states retention is per the General Records Schedule or DOE 1324.2A.

4.2 Documents

The QAPP for S-PRIME shall be submitted to DOE for review and approval as required by contract and DOE Order 5700.6C (dated 8-21-91). Specifications, drawings, technical reports, procurement documents process procedures shall be approved at the management level commensurate with their importance to quality. The adequacy of these approvals shall be verified through audits, surveillances and assessments.

5.0 WORK PROCESSES

REQUIREMENTS *Work shall be performed to established technical standards and administrative controls. Work shall be performed under controlled conditions using approved instructions, procedures, or other appropriate means. Items shall be identified and controlled to ensure their proper use. Items shall be maintained to prevent their damage, loss, or deterioration. Equipment used for process monitoring or data collection shall be calibrated and maintained.*

5.1 Work Processes

Activities affecting quality shall be prescribed and performed in accordance with documented instruction, procedures and drawings, instruction, procedures, and drawings shall be appropriate to the circumstances and shall be prepared and authorized by the line management overseeing the activities. Instruction, procedures and drawings shall include or reference acceptance criteria to determine if the prescribed activity has been satisfactorily accomplished. Each program participant shall conduct reviews, audits and surveillances to determine compliance with requirement. Instructions, procedures, and drawings shall be periodically reviewed by the issuing organization to assure that they are kept current with applicable standards and DOE orders. The minimum frequency of review shall be determined by each program participant and documented in their QA program.

Training, Line Managers shall ensure that personnel working under their supervision are provided the training, resources and administrative support required to accomplish assigned tasks.

5.1.1 Identification and Control of Items. Processes shall be established and implemented to identify, control, and maintain items.

Identification of items should be maintained to ensure appropriate traceability.

Processes should be established and implemented to control consumables and items with limited shelf life, prevent the use of incorrect or defective items, and control samples.

5.1.2 Handling, Storing, and Shipping. A process shall be established and implemented to control the handling, storage, shipping, cleaning, and preservation of items to prevent damage, loss, or deterioration.

Marking and labeling of items should be maintained throughout packaging, shipping, handling, and storage. Marking and labeling should provide information to identify items and provide instructions or special controls to preserve items' integrity. Requirements for off-site transportation should be established and implemented.

Special protective measures (such as containers, shock absorbers, accelerometers, inert gas atmospheres, and specific temperature and moisture levels) should be specified and provided when required to maintain acceptable quality.

6.0 DESIGN

REQUIREMENT Items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Design work, including changes, shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by individuals or groups other than those who performed the work. Verification and validation work shall be completed before approval and implementation of the design.

6.1 Design Controls

Program participants shall develop and implement design control activities that define design inputs, design interfaces, design adequacy, design changes and file changes are properly defined, controlled and verified.

6.1.1 Safety review A safety review group shall review the designs to assure that project requirements are met within the scope of the program participants assigned task.

6.1.2 Design Deficiency or Design Errors Design deficiency and design error control shall be developed and implemented. Design

deficiencies and design errors shall be documented and corrective action shall be taken. Design deficiency and design error control shall be achieved in accordance with approved procedures.

6.1.3 Interfaces Measures shall be established for identifying and controlling design interfaces and coordinating among program participants the review, approval, release, distribution and revisions of documents involving design interfaces.

6.1.4 Design Review Each program participant shall develop and implement design verification methods that include but are not limited to design review, alternate calculation and qualification testing.

6.4.1.1 Design Review Schedules shall be established in accordance with the Program Management Plan. Each design review shall be documented in a report in accordance with the program participant approved procedures.

6.1.5 Configuration Control Each program participant shall develop and implement procedures to assure that design documents accurately reflect configuration requirements.

6.1.6 Software Controls Each program participant shall control the development, use and verification of computer software in accordance with ASME NQA2a 1990 part 2.7.

6.1.7 Design Change Changes affecting the final design, filed changes, modifications, and nonconforming item dispositioned use as is, or repair, shall be justified and are controlled by measures commensurate with those applied to the original design.

6.1.8 Design Records Each program participant shall maintain records which provide evidence that the Phase I & II design was properly accomplished. Design records should include final design output, its revision and calculations, analyses and computer programs. (See Table 1 for retention requirements).

7.0 PROCUREMENT

REQUIREMENT The organization shall ensure that procured items and services meet established requirements and perform as specified. Prospective suppliers shall be evaluated and selected on the basis of specified criteria. The organization shall ensure that approved suppliers can continue to provide acceptable items and services.

7.1 Procurement

Each program participant shall control the procurement of items and services to assure conformance with specified requirements. Such control shall provide for source evaluation and selection, evaluation of objective evidence of quality furnished by the supplier. Source inspection, audit, and examination of items or services upon delivery or completion, as appropriate for the items or service.

7.1.1 Approved Vendors List Each program participant shall maintain a list of qualified suppliers. The list shall include the supplier's name, address, product or service provided, the quality requirement use in evaluation, as well as the method, and date of evaluation and re-evaluation at least every 18 months.

7.1.2 Supplier QA Requirements Each program participant shall require their suppliers to have a Quality Assurance Program which meets the applicable requirements or DOE Order 5700.6C and shall monitor the supplier performance as defined in this QAPP.

7.1.3 Procurement Document Control Program participants shall delineate the applicable design and other requirements necessary to assure adequate quality in drawings, specifications, procedures and other documents which constitute the requirements for procurement of items and services. This shall include acceptance criteria for items and services.

7.1.4 Fraudulent Material or Services Program participants shall develop procedures for the detection of and to prevent use of fraudulent material. Each program participant is responsible for imposing this requirement on its suppliers in cases where there are indications that suppliers knowingly supplied items and/or services of substandard quality. This information should be forwarded to the DOE Office of the Inspector General.

8.0 INSPECTION AND ACCEPTANCE TESTING

REQUIREMENT Inspection and acceptance testing of specified items and processes shall be conducted using established acceptance and performance criteria. Equipment used for inspections and tests shall be calibrated and maintained.

8.1 Inspection and Acceptance Testing

Quality affecting activities shall be performed in accordance with documented instructions, procedures and drawings, instruction, procedures

and documents shall be prepared and approved by the line management overseeing the activity. They shall include appropriate acceptance criteria applicable to determine if the prescribed activity has been satisfactorily accomplished.

8.1.1 Inspections Program participants shall establish measures to assure that inspections are controlled, planned and executed. Requirements and characteristics to be inspected shall be specified. The inspection method and the inspection results shall be documented. Inspection shall be performed by personnel other than those performing the work or directly supervising the work being inspected. When acceptance criteria are not met, deficiencies shall be resolved and reinspection shall occur as required by the QAPP and the program participants procedures.

8.1.2 Testing and Acceptance Testing Program participants shall establish measures to assure that testing is controlled, planned and executed. Tests required to collect data shall be planned, documented and evaluated. Potential sources of uncertainty or effort shall be identified in test plans and procedures where applicable.

Acceptance testing of items shall be performed by a designated organization to demonstrate that the item will perform satisfactorily in service. Test shall be accomplished in accordance with written and controlled procedures. The organization responsible for the design of an item shall define the test requirement, inspection requirements and acceptance criteria for that item and shall document these requirements in specifications, instructions or plans.

8.1.3 Inspection and Test Status The status of inspections, test and operations shall be identified either on the item or in documents traceable to the item. Status indicators shall be used to preclude the inadvertent use of uninspected, untested or nonconforming items. The authority for application and removal of status labels, tags or markings shall be specified in procedures or instructions.

8.1.4 Test Procedures. Shall include the following:

1) Instructions and prerequisites required to perform the test.

2) Completeness and accuracy of data requirements.

3) Required test equipment.

4) Acceptance criteria.

5) Inspection hold points

6) Test article configuration.

8.1.5 Test Plans Test plans describe how the test requirements will be met. At least one test plan is required for each critical component test. Test plans are prepared by the program supporting organization assigned responsibility for performing the test. Test plans are numbered in accordance with the supporting organization's procedures, will include the organization's name and address, subcontract and contract numbers, and titled to indicate the type of test and the item to be tested. Test plans shall include a table of contents and typically will list the following sections.

1) Objectives
2) Description of Test
3) Expected Results
4) Data
5) Safety
6) Waste Minimization and Management
7) Quality Assurance
8) References

Appendix as required

When authorized by the program manager, a design review shall be conducted by the supporting organization prior to initiation of testing. Test plans, when initially released or on subsequent revisions, shall be approved in accordance with the Release Plan of Action.

8.1.6 Measuring and Test Equipment Program participants shall establish measures to assure that tools, gages, instruments and other measuring and test equipment are adequately controlled. Measuring and test equipment shall be calibrated at specified intervals and adjusted to maintain accuracy within specified limits. Monitoring and data collection equipment shall be of the accuracy and type suitable for the intended use. Calibration or measuring and test equipment shall be traceable to National Standards or known physical constants. Calibration procedures shall require that calibration standards have an equal or greater accuracy than the equipment being calibrated, unless limited by the state of the art

if nationally recognized standards exist, calibration standards shall be traceable to such standards. Out-of-tolerance equipment shall be tagged and segregated and not used until it has been recalibrated. The acceptability of items or processes measured, inspected or tested with out-of-tolerance devices shall be determined.

9.0 MANAGEMENT ASSESSMENT

REQUIREMENT Management at all levels shall periodically assess the integrated quality assurance program and its performance. Problems that hinder the organization from achieving its objectives shall be identified and corrected.

9.1 Management Assessment

Each program participant shall establish a process for management assessment of the effectiveness of the S-PRIME quality program at least annually. The review shall evaluate the adequacy and effectiveness of at least the following program aspects:

a) The Quality Assurance Program.

b) Planning and Procedural Controls.

c) The Corrective Action System.

d) Organizational Structure and Staffing.

10.0 INDEPENDENT ASSESSMENT

REQUIREMENT Planned and periodic independent assessments shall be conducted to measure item quality and process effectiveness and to promote improvement. The organization performing independent assessments shall have sufficient authority and freedom from the line organization to carry out its responsibilities. Persons conducting independent assessments shall be technically qualified and knowledgeable in the areas assessed.

10.1 Independent Assessment

Each program participant shall establish a surveillances program. Surveillances shall be conducted to assess the quality of activities and processes and to promote improvement. Surveillances shall be planned and scheduled and performed by the Quality Assurance Department. Surveillance shall be performed by personnel who are knowledgeable in the area of the

surveillance and are not directly responsible for the activities under surveillance. Surveillances shall be performed to accomplish the following:

a) Monitor work in progress.

b) Document compliance or noncompliance with requirements and procedures.

c) Identify actual and potential problems and deviations. Identify opportunities for improvement.

d) Promote prompt corrective action by cognizant management responsible for performing the work;

e) Provide management information on activities under surveillance and

f) Verify timely implementation of corrective action.

Responses to assessment surveillances shall include as applicable action to correct the deficiency; cause identification; action to prevent recurrence; lessons learned and action taken for improvement.

11.0 QUALITY ASSURANCE PROGRAM IMPLEMENTATION METHODOLOGIES

The QAPP, para 11.2 requires each Rocketdyne Subcontraactor to develop a matrix of procedures that would be used in implementing the QAPP. The matrices shall be submitted to Rocketdyne for review and approval. Each program participant shall submit controlled copies of their Quality Assurance Manual and any other manuals and/or procedures used to implement the requirements of the QAPP per 11.1. Each program participant purchase order shall state: "Rocketdyne will prepare the Quality Assurance Program Plan specifically for the S-PRIME project which will provide quality requirements for the entire project. The Quality Assurance Plan will meet the requirements of DOE Order 5700.6C and will provide supplemental/additional requirements for those specified in the supplier Quality Assurance manual. The Quality Assurance Program Plan will become the governing Quality Assurance document for the project. The Quality Assurance Program Plan will be submitted for approval 30 days after effective date of award. A Supplier Evaluation will be scheduled and conducted after approval of the Quality Assurance Program Plan and implementation of the plan by the program participants.

Rocketdyne shall submit copies of the manuals and/or documents listed in the Rocketdyne matrix shown in Appendix A-2 for DOE review and approval. The matrix format in Appendix A-2 is an example that should be followed in the development of the required matrices.

11.1 Supplier Quality Assurance Manual

Each program participant shall submit a controlled copy of their Quality Assurance Manual and any other manuals/or procedures used to implement the requirements of this QAPP, to Rocketdyne's S-PRIME QA Project Manager for retention.

11.2 Procedure Matrix

Each program participant shall develop a matrix of procedures used or developed to implement this Quality Assurance Program Plan. The matrix shall be submitted for review and approval by Rocketdyne. Once approved, the matrices of each program participant will be added to the QAPP as Appendix A2.

12.0 QUALITY LEVEL CLASSIFICATION

12.1 Quality Categories

The purpose of this section is to define the methodology and provide guidelines for developing a graded QA program for the S-PRIME project. Assigning quality categories for the S-PRIME project must address the appropriate management control described in the S-PRIME Quality Assurance Program Plan. The quality categories shall be commensurate with the purpose and importance of the item and/or processes to meeting S-PRIME Safety and Mission requirement. Risk is the fundamental consideration in determining to what extent the Quality Assurance Program Plan is applied to items and processes. Risk is a quantitative and/or qualitative expression of possible loss which considers both the probability of event occurrence causing harm or loss and the consequences of that event. Criteria, such as consequences of failure, probability of failure, data generation function, complexity or uniqueness of design or fabrication, special controls, ability to demonstrate functional compliance, quality history, degree of standardization, impact on the environment, and impact on schedule or cost or both should be considered in determining risk. Program participant should use proven risk-related information of both qualitative and quantitative nature where available. Organizations should be cautioned to not use risk analysis to mitigate the importance of accomplishing work (e.g., equipment maintenance) which, when not performed, tends to have a long term negative affect on the achievement of the organization's objectives. Risk-related information includes current Safety Analysis Reports (SAR's), accident analyses, environmental impact reports, probabilistic risk assessments (PRA's), operating safety reviews, or other appropriate studies and information.

APPENDIX A-1

KEY TERMINOLOGY

Acceptance Criteria -- Specified limits placed on characteristics of an item, process, or service defined in codes, standards, or other requirement documents.

Audit -- A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with surveillance of inspection activities performed for the sole purpose of process control or product acceptance.

Certificate of Conformance-- A document signed by an authorized individual certifying the degree to which items or services meet specified requirements.

Certification of Personnel -- The act of competent authority in verifying that required training has been completed and specified knowledge and proficiency has been demonstrated. Certification shall be in writing with backup data for training and proficiency demonstration.

Corrective Action -- Measures taken to rectify conditions adverse to quality and, where necessary, to preclude repetition. Not to be mistaken for remedial action which is rectification of specific conditions found adverse to quality.

Characteristic -- Any property or attribute of an item, process, or service that is distinct, describable, and measurable.

Condition Adverse to Quality -- An all inclusive term used in reference to any of the following: failures, malfunctions, deficiencies, defective items, and nonconformances.

Deviation -- A before-the-fact departure from a procedure, drawing, or specification requirement.

Evidence of Quality -- Any documented statement of fact, other information, or record, either quantitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests which can be verified.

Inspector -- A person who performs inspection activities to verify conformance to specific requirements.

Inspection -- Examination or measurement to verify whether an item or activity conforms to specified requirements.

Internal Audit -- An audit of those portions of an organization's quality assurance program retained under its direct control and within its organizational structure.

Item -- An all inclusive term used in place of any of the following: assembly, component, equipment, material, module, part, structure, subassembly, subsystem, system, or unit.

Measuring and Test Equipment (M&TE) -- Devices or systems used to calibrate, measure, gage, test, or inspect in order to control or to acquire data to verify conformance to specified requirements.

Nonconformance -- After-the-fact failures of hardware or operational and ground support firmware and software to meet drawing or specification requirements.

Class I Nonconformances are those which adversely affect safety, performance, reliability, interchangeability, or interface characteristics. Class II Nonconformances are those not Class I.

Procedure -- A document that specifies or describes how an activity is to be performed.

Procurement Document -- Purchase requisitions or purchase orders.

Purchaser -- The organization responsible for establishment of procurement requirements for issuance, administration, or both, of procurement documents.

Qualified Procedures -- An approved procedure that has been demonstrated to meet the specified requirements for its intended purpose.

Quality Assurance (QA) -- All those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service.

Quality Assurance Program -- The written set of policies, procedures, practices, and instructions that implement the contractual quality assurance program requirements.

Quality Control -- That aspect of quality assurance associated with the physical determination of product characteristics for comparison with requirements to establish acceptability. Quality control is broader than inspection in that it included such actions as statistical process control and process qualification and monitoring.

Quality Assurance Record -- A completed document that furnishes evidence of the quality of items and/or activities affecting quality.

Quality Affecting Activities -- An activity which results in or influences the quality, safety or reliability in the production of an item or a quality affecting document.

Quality Affecting Document -- A programmatic or implementing document (e.g., plans, specifications, procedures or drawing) which directs activities which affect the quality, safety or reliability of the item produced.

Receiving -- Taking delivery of an item at a designated location.

Repair -- The process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still does not conform to the original requirement.

Rework -- The process of restoring a nonconforming characteristic to acceptability as defined in drawings or specifications.

Special Processes -- Processes such as welding, brazing, soldering, nondestructive inspection, bonding, coating, heat treating, and cleaning where quality acceptance is largely dependent upon qualifications of personnel, equipment, and procedures.

Subcontract -- A purchase order or participant interdivisional job orders to provide services and supplies.

Service -- The performance of activities such as design, fabrication, inspection, nondestructive examination, repair, or installation.

Surveillance -- The act of monitoring or observing to verify whether an item or activity conforms to specified requirements.

Traceability -- The ability to trace the history, application, or location of and like items or activities by means of recorded identification.

Use-as-is -- A disposition permitted for a nonconforming item when it can be established that the item is satisfactory for its intended use.

Verification -- The act of reviewing, inspecting, testing, checking, auditing, or otherwise determining and documenting whether items, processes, services, or documents conform to specified requirements.

QUALITY ASSURANCE PROGRAM PLAN SECTION		ROP	QAOP PUB.NO. 578-D-5	EMP	S-PRIME PROGRAM BULLETINS	OTHER DOCUMENTS
1.0	PROGRAM MANAGEMENT	A-500	N1.01			214PMP000001 214QPP000001
1.1	ORGANIZATION		N1.01			214PMP000001 214QPP000001
1.2	RESPONSIBILITIES		N1.01			214PMP000001 214QPP000001
1.3	AUTHORITIES		N1.01,N10.00& N14.00			214PMP000001 214QPP000001
1.4	COMMUNICATIONS					214PMP000001 214QPP000001
2.0	PERSONNEL TRAINING AND QUALIFICATION	E-530	N1.24			214QPP000001
2.1	TRAINING		N1.24			
2.2	QUALIFICATION OF PERSONNEL		N1.05,N6.02, N7.02			
3.0	QUALITY IMPROVEMENT		N14.01	3 -68		
3.1	QUALITY IMPROVEMENT					
3.2	CORRECTIVE AND PREVENTIVE ACTION		N14.00			
4.0	DOCUMENT AND RECORDS	A-512,J-500.2	N13.00	3-24		214RPA000001
4.1	RECORDS		N13.04,N13.05, N9.00			
4.2	DOCUMENTS		N2.02	3-25-18,3-5, 3-26-7		214RPA000001

QUALITY ASSURANCE PROGRAM PLAN SECTION		ROP	QAOP PUB.NO. 578-D-5	EMP	S-PRIME PROGRAM BULLETINS	OTHER DOCUMENTS
5.0	WORK PROCESSES	A-512,J-500.0	N6.03,N6.04,N2.02 ,N6.00,N6.05, N6.01	1-1		214RPA000001
5.1.1	IDENTIFICATION AND CONTROL OF ITEMS		N3.00,N4.01,N4.02 ,N4.03,N5.00, N6.00	3-28,4-3,4-4,4-8,4-5,4-6,4-7,3-29		
6.0	DESIGN	A-500,A-542,A-512,A-577	ALL SEC.2	ALL OF SEC.3, 5-3,5-17		
6.1	DESIGN CONTROLS		N2.01,N2.02	ALL OF SEC. 3,4-7,5-3		
6.1.1	SAFETY REVIEW		N2.02	3-67		
6.1.2	DESIGN DEFICIENCY OR ERRORS		N10.00,N14.00, N2.01	5-16,3-21.1		
6.1.3	INTERFACES			3-22		
6.1.4	DESIGN REVIEW		N2.01	5-03,3-21		
6.1.5	CONFIGURATION CONTROL		N2.04,N2.05	3-50		
6.1.6	SOFTWARE CONTROL		N10.00,N14.00, N2.02	3-63,3-70		
6.1.7	DESIGN CHANGES		SEC. 2	3-21,3-35		214RPA000001
6.1.8	DESIGN RECORDS		SEC. 13	3-05,3-40		
7.0	PROCUREMENT	G-503	ALL SEC.4			
7.1.1	APPROVED VENDORS LIST		N4.01			
7.1.2	SUPPLIER QA REQUIREMENTS		N4.04,	3-64		214RPA000001
7.1.3	PROCUREMENT DOCUMENT CONTROL		N4.00,NB2.02	3-64,3-69		
7.1.4	FRAUDULENT MATERIALS OR SERVICE		N10.00,N4.04, N4.03,N14.00	5-16		

QUALITY ASSURANCE PROGRAM PLAN SECTION		ROP	QAOP PUB.NO. 578-D-5	EMP	S-PRIME PROGRAM BULLETINS	OTHER DOCUMENTS
8.0	INSPECTION AND ACCEPTANCE TESTING		SEC.'S 5&7			
8.1.1	INSPECTIONS		N5.00,N3.01			
8.1.2	TESTING AND ACCEPTANCE TESTING		N3.01,N7.00			
8.1.3	INSPECTION AND TEST STATUS		N9.00			
8.1.4	TEST PROCEDURES		N5.00,N13.04, N1.22,N2.02	4-02,4-03,4-05, 4-07,4-08		
8.1.5	MEASURING AND TEST EQUIPMENT		SEC. 3			
9.0	MANAGEMENT ASSESSMENT		N14.01			214PMP000001, 214QPP000001
10.0	INDEPENDENT ASSESSMENT		N14.01			214PMP000001, 214QPP000001