



HIGH ENERGY SOLAR SPECTROSCOPIC IMAGER

**PERFORMANCE ASSURANCE REQUIREMENTS
FOR THE HESSI PROJECT**

Contract Number: NAS5-98033

UCB Approvals:

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Source : HESSI Contract 4/1/98 ATTACHMENT G



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1. FLIGHT ASSURANCE REQUIREMENTS

1.1 GENERAL GUIDELINES

1.1.1 Overview

The Principal Investigator shall be responsible for all aspects of the mission, including Safety, Reliability, and Quality Assurance (SR&QA). Unlike previous Small Explorer Missions, NASA Headquarters has not imposed a payload classification per NMI 8070.1A, thus allowing Principal Investigators to tailor their SR&QA program in accordance with ISO 9001 series standards. This approach allows the use of existing and proven processes, procedures, and methodologies

The Product Assurance (PA) requirements for the program recognize a wide variation in complexity, size, and technology for the mission which can affect program risks and costs. In addition, the capabilities of investigators and their partners and subcontractors vary widely. For those organizations with established SR&QA processes and a record of success in space flight, the PA requirements for the Small Explorer program should be considerably reduced from that of the past. For those organizations which do not have established SR&QA processes for space flight hardware, NASA is providing in this attachment a set of guidelines which supplement the more general standards of ISO 9001. It is recommended that the Principal Investigator consider all aspects of the mission when developing a comprehensive PA program. The effort to plan and invest from the beginning in quality design and problem prevention should not be underestimated, as its value in terms of reducing overall cost has been demonstrated.

It is the responsibility of the Principal Investigator to plan and implement a comprehensive SR&QA program for all flight hardware, software, and Ground Support Equipment (GSE). This responsibility extends to all of the Principal Investigator's subcontracts and suppliers. Only limited PA insight is planned by the Goddard Space Flight Center (GSFC) Explorers Project and will be focused primarily on those activities that contribute most to product integrity. Deliverable documentation will be significantly reduced, provided the Principal Investigator maintains an adequate internal record keeping system that provides the necessary traceability for a program of this magnitude. The GSFC Explorers Project will support and participate with the Principal Investigator in assuring that the SR&QA program being implemented is valid, complete, and effective. Likewise, the GSFC Explorers Project is prepared to assist the Principal Investigator in any aspect of PA



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and to be the focus for ready and regular access to the GSFC's flight assurance expertise.

Previous Small Explorer missions have been predominately single string systems, with emphasis on simplicity of design and cost control. Rigorous and disciplined systems engineering, combined with the prevention of problems by using high quality parts and materials and using high standards of workmanship, have allowed a limited reliability and quality assurance program, guarded by the test program, to achieve adequate reliability for a low cost. It is recommended that the Principal Investigator consider similar approaches that envelope all aspects of the mission development. A philosophy based on quick design and development, followed by an extensive test and repair program, has been shown to be the most expensive and unreliable approach.

An agreement between the Principal Investigator and the GSFC Explorers Project office on the quality assurance, reviews, safety, design assurance and verification system to be implemented will be required prior to the confirmation of the mission.

2. QUALITY ASSURANCE

2.1 Quality System

During Phase B, the Principal Investigator shall define and implement a quality system based on ANSI/ASQC Q9001-1994, which shall be documented in a Performance Assurance Implementation Plan. The GSFC Explorers Project Office will review the quality system and provide the Principal Investigator with an assessment and recommendations.

2.2 Workmanship Standards

Workmanship requirements are a critical part of preventing reliability and quality problems. The Principal investigator is encouraged to use their own workmanship standards, provided they meet the following minimum NASA guidelines:

NHB 5300.4 (3A-2)	Requirements for Soldered Electrical Connections
NHB 5300.4 (3G)	Requirements for Interconnecting Cables, Harnesses, and Wiring
NHB 5300.4 (3H)	Requirements for Crimping and Wire Wrap
NHB 5300.4 (3I)	Requirements for Printed Wiring Boards
NHB 5300.4 (3J)	Requirements for Conformal Coating and Staking of Printed Wiring Boards and Electronic Assemblies
NHB 5300.4 (3K)	Design Requirements for Rigid Printed Wiring Boards and Assemblies
NHB 5300.4 (3L)	Electrostatic Discharge Requirements



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2.3 Product Assurance Audits and Reporting

Assurance Status Reports shall be part of the regular, monthly reporting by the Principal Investigator to the GSFC Explorers Project Office and shall summarize the status of all assurance activities and report on any discrepancies (including corrective actions) that could affect the performance of the investigation.

During all phases of the mission, NASA must be able to assess the reliability of the mission and understand how the Principal Investigator is resolving problems. In order to do this, the Principal Investigator shall document and report failures to the GSFC Explorers Project Office beginning with initial power-up of any flight component or assembly (including critical GSE). Reporting shall continue until successful closure by the Principal Investigator's Failure Review Board (FRB).

In order to ensure that the quality system is working the way it is intended to, the Principal Investigator shall plan and conduct audits of his/her internal PA systems and those of his/her subcontractors and suppliers, examining documentation (processes, procedures, analyses, reports, etc.), operations and products. The Principal Investigator shall generate and maintain an audit report for each audit. A summary of all audit findings shall be included in the monthly report.

The work activities and operations of the Principal Investigator's team, including subcontractors and suppliers, may be evaluated, surveyed, or otherwise inspected by designated representatives from the GSFC Explorers Project Office, the Government Inspection Agency (GIA), or an independent assurance contractor. The GSFC Explorers Project Office may delegate appropriate responsibilities and authority in letters of delegation (LOD)

3. REVIEWS

The Principal Investigator is encouraged to focus resources from the beginning and throughout the mission development phase on engineering working-level reviews (peer reviews) to identify and resolve concerns prior to formal, system level reviews. The Principal Investigator's quality system shall track and close-out all actions items identified during these peer reviews to ensure that issues are resolved promptly at the lowest levels and before system level reviews. A list of action items/closures for each peer review shall be maintained by the Principal Investigator's quality system and made available during system level reviews. Any open action items from any peer reviews shall be addressed at the system level reviews.



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Upon request, the GSFC Explorers Project Office will supply technical expertise as required for participation in the areas undergoing detailed engineering reviews.

Unlike the many informal engineering peer reviews that will occur during the project life cycles, there are two semiformal reviews focusing on requirements and the mission concept and five formal, system level reviews that will concentrate on critical systems and end-to-end mission level technical safety, reliability, flight operations, ground operations, and programmatic issues. If warranted, additional formal reviews may be required for unusually complex areas such as safety and/or flight and ground operations. The following represent the semiformal and formal reviews expected under this program. (Formal reviews are required.)

- * Requirements Review (Semiformal)
- * Concept Review (Semiformal)
- * Preliminary Design Review (Formal)/Confirmation Review
- * Critical Design Review (Formal)
- * Pre-Environmental Review (Formal)
- * Pre-Ship Review (Formal)
- * Flight Readiness Review (Formal)

Semiformal and formal reviews shall be chaired by the Principal Investigator's organization with copies of the presentation materials provided to the Small Explorer Project Office for information. It is the Principal Investigator's responsibility to address all concerns and action items identified during these reviews.

Independent reviews, including a Confirmation Review, shall also be conducted. An independent review of the investigation's readiness to proceed will be conducted before being authorized to spend more than 25 percent of the total NASA commitment for Phases A/B/C/D. Results of this Confirmation Review and a decision to proceed (or not) will be rendered within 30 days of the review. This decision will be based upon review of the Phase B results, and evidence of satisfactory technical, cost and schedule performance. These reviews will be coordinated with the Principal Investigator so that they coincide with other reviews. It is the Principal Investigator's responsibility to address all concerns and action items identified during these reviews.



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4. SAFETY

The Principal Investigator is responsible for the overall safety of the mission, from start of development through launch activities. In fulfilling this responsibility, the Principal Investigator shall define an overall safety program for documenting hazard analyses, hazard reports, operations hazards analyses, and the safety data package. A preliminary assessment shall be provided at the time of the preliminary design review. The GSFC Explorers Project Office will provide the necessary interfaces with the GSFC testing facility (if applicable), and the launch vehicle and/or range safety points of contact (if applicable).

The Contractor may access the following website for guidance in planning an approach to meet these requirements:

<http://arioch.gsfc.nasa.gov/302/safety/systy.html>

4.1 General

The Principal Investigator shall plan and implement a system safety program that accomplishes the following:

Identifies and controls hazards to personnel facilities, support equipment, and the flight system during all stages of the mission development. The program shall address hazards in the flight hardware, associated software, ground support equipment, and support facilities.

Meets the system safety requirements stated in the applicable launch site safety regulation (EWRR 127-1 for the Eastern or Western Range) and the mission System Safety Implementation Plan (SSIP).

Meets the baseline industrial safety requirements of the institutions as well as any special contractually imposed mission unique obligations.

The GSFC Explorers Project Office will provide assistance, as necessary to assure that the Safety Plan meets the requirements established above. The Principal Investigator shall give the GSFC Explorers Project Office a description of the system down to the subsystem level, and a preliminary assessment of the system's compliance with the requirements of this section.



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The Principal Investigator shall submit, in accordance with a schedule in the contract, all ground operations procedures to be used at GSFC facilities, other integration facilities or the launch site for review and approval. All hazardous operations, as well as the procedures to control them, shall be identified and highlighted. All launch site procedures shall comply with the applicable launch site safety regulations.

When a specific safety requirement cannot be met, the Principal Investigator shall provide the GSFC Explorers Project Office with an associated safety noncompliance request that identifies the hazard and shows the rationale for approval of such a noncompliance, as defined in the applicable launch site safety regulation.

4.2 Safety Data Package

The Principal Investigator shall submit a safety data package consistent with the design maturity of the mission at each of the independent reviews, up to and including the Pre-Ship Review (PSR) and the Flight Readiness Review (FRR). The contents of each package shall be consistent with the requirements of the applicable launch vehicle and launch site

4.3 Launch Site Safety Plan

The Principal Investigator shall submit a Payload Organization launch Site Safety Plan consistent with the launch site requirements for review and approval by the GSFC Explorers Project Office. The details of the plan and submittal milestones is dependent on the selected launch site safety regulations.

4.4 Orbital Debris Plan

The Principal Investigator shall submit an Orbital Debris Plan for review by the GSFC Explorers Project Office. The plan shall include an environmental impact assessment of the spacecraft debris.



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5. DESIGN ASSURANCE

5.1 *Electrical, Electromechanical, and Electronic (EEE) Parts*

The Principal Investigator shall implement an appropriate EEE parts program consistent with the scope of a Small Explorer mission. Previous Small Explorer missions have utilized parts programs that provided early and frequent interaction between the design team and performance assurance personnel to ensure reliable EEE parts while at the same time maintaining a cost effective parts program. The GSFC Explorers Project Office recommends that the Principal Investigator consider a similar approach with the parts program.

As a guideline, EEE parts should be selected and processed in accordance with GSFC 311 - INST-001, "Instructions for EEE Parts Selection Screening, and Qualification" for Grade 3 quality parts level, or an internal procedure that meets these standards.

The Principal Investigator is responsible for verifying that any part used in the mission is flight worthy and is not affected by any GIDEP Alert throughout the mission development cycle.

A preliminary EEE parts list shall be provided for informational purposes during the preliminary design review.

5.2 *Materials*

The Principal Investigator shall implement a materials and processes control program beginning with the start of Phase B. The Principal Investigator shall maintain lists and usage records for inorganic and metallic, polymeric, lubricants, and processes.

A preliminary materials list shall be provided for informational purposes during the preliminary design review.

5.3 *Reliability*

Early in the program's preliminary design phase, the Principal Investigator shall identify specific reliability concerns and the steps being taken to mitigate them. As a minimum, the Principal Investigator shall conduct a Failure Mode and Effect Analysis to a sufficient depth so that mission critical failures are identified and dealt with effectively.



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It is strongly recommended that the Principal Investigator accumulate several hundred hours of error-free operation at the observatory prior to the start of environmental testing.

5.4 Contamination

The Principal Investigator shall plan and implement a contamination control program consistent with the requirements of the mission. The plan shall address all aspects of contamination control throughout the mission including transportation and launch site processing. The contamination control plan shall be made available to the GSFC Explorers Project Office if requested.

5.5 Software

The Principal Investigator shall employ a structured program for the development of flight and ground software. The program must address appropriate development life cycle phases such as requirement analysis, design, code, and unit test, integration and build test, performance verification, and maintenance. All code produced shall be structured, error-free, properly documented, and maintainable.

6. VERIFICATION

The Principal Investigator shall conduct a verification program to ensure that the spacecraft and instrument(s) meet the specific mission requirements. It is recommended that the Principal Investigator use the Goddard Space Flight Center's General Environmental Verification Specification for STS and ELV Payloads, Subsystems, and Components (GEVS-SE), available from the GSFC Explorers Project Office, as a tool and a model to prepare the mission verification plan and specification.

The Principal Investigator shall prepare and submit adequate verification documentation including a verification matrix, environmental test matrix and verification procedures to the GSFC Explorers Project Office for review.

The Principal Investigator shall prepare an acceptance data package available for review upon the Government's request and shall include lists for the materials and parts used to build the spacecraft, in addition to validation and verification.