PERFORMANCE ASSURANCE IMPLEMENTATION PLAN

FOR THE SMEX-FAST SCIENCE PAYLOAD

UCB Approval: ______________________
Dr. Charles W. Carlson
Principal Investigator

GSFC Approvals: ______________________
Ronald C. Kolecki
SMEX FAM

____
Lawrence M. Hilliard
FAST Instrument Manager

____
Timothy C. Gehringer
FAST Mission Manager

____
Orlando Figueroa
SMEX Project Manager

____

Henry D. Heetderks
Project Manager
Space Sciences Laboratory
University of California, Berkeley

1. GENERAL

1.1 Basis and Scope of the Plan

The following Performance Assurance Implementation Plan (PAIP) has been prepared in response to the requirements set forth in the "Small-Class Explorer (SMEX) Program Performance Assurance Requirements for Instruments," GSFC S-740-89-993 dated May, 1989, henceforth referred to as the PAR.

1.2 General Requirements

The PI for the SMEX-FAST Science Payload will establish an organized program which will demonstrate that the design meets the functional requirements, including margins, has been manufactured properly and that it will operate properly in association with other project components. This will be accomplished by conducting analyses, tests and inspections.

The performance assurance program will encompass flight equipment, government furnished equipment (of which we expect none) and spare flight equipment. This plan will be used by the PI and all subcontractors which fabricate or test such equipment. This plan does not apply to ground support, mission operations or data analysis equipment.

This document addresses each of the ten sections of the PAR, following the format and sequence of that document.

1.3 Use of Previously Designed, Fabricated, or Flown Hardware

No previously fabricated or flown hardware will be used for this instrument. Any previously designed section of the hardware will be subject to the PA requirements of this PAIP, when the PAIP has been approved by GSFC.

1.4 Performance Assurance Status Report

The Project Manager will prepare reports as required covering performance assurance activities, any outstanding deficiencies which could adversely affect the end-item performance, and the intended corrective actions to be taken. Reporting will be part of the Project Status Report delivered to the technical officer and will cover:

1. Significant assurance problems, including a summary of any inspections and tests that failed, and subcontractors' PA problems.
2. Unresolved hazards.
3. Summary of Alerts and their dispositions.

1.5 Pass-down of PA Requirements

The PI will insure that applicable Q.A. requirements are passed down to all vendors and subcontractors which supply hardware for the SMEX-FAST Science Payload.

The PI and possibly instrument fabrication subcontractors will be procuring parts and materials for the flight instrument. Personnel responsible for performance assurance will assist in the selection of procurement sources. All available information such as performance history, receiving inspections and test results (e.g., ALERT information), will be used to assess the capability of each potential procurement source.

1.6 Applicable Documents (Appendix A)

To the extent referenced herein, applicable portions of the documents and revision levels listed in Appendix A form a part of this document.

1.7 Glossary (Appendix B)

Appendix B lists definitions that are needed for a common understanding of terms as applied in this document.

1.8 Deliverable Data Requirements (Appendix C)

Appendix C is a list of the deliverable data which is required for the FAST program. The appendix also cites when the data shall be delivered and whether it is required for approval, review, or information.

1.9 Surveillance of the Principal Investigator

The work activities and operations of the PI, subcontractors and suppliers are subject to evaluation, review, and inspection by government-designated representatives from the Project Office, the Government Inspection Agency, or an independent agency.

The PI will provide such representatives with any documents and records outlined in the PAIP, equipment and working space at UCB required by and consistent with his overview activities. Since work space at the Space Sciences Laboratory is extremely limited, UCB will need two weeks advance notice of any overview activity which requires working space. Other inspections may be unannounced.

2. ASSURANCE REVIEW REQUIREMENTS

2.1 General Requirements

The PI will support a series of system-level design reviews that are conducted by a GSFC review team. The reviews will cover all aspects of the flight hardware, ground support hardware, software and operations for which the PI has responsibility.

2.2 GSFC Flight Assurance Review Requirements

For each system-level review, the Project Manager will:

a. Organize an oral presentation of materials from the instrument development team to the GSFC review team. Preliminary copies of the viewing material will be furnished to the review team one week before the review, with a final version furnished at the time of the review.

b. Support splinter review meetings resulting from the major review.

c. Produce written responses to recommendations and action items resulting from the review.

2.3 GSFC Flight Assurance Review Program

The PI will support four design reviews:

a. A Preliminary Design Review (PDR) which is to occur when the preliminary design is completed.

b. A Critical Design Review (CDR) which occurs after breadboard testing is complete and before the bulk of the flight fabrication begins. The topics include test plans for the flight segment and results of development tests.

c. A Pre-Environmental Review (PER) which occurs prior to environmental verification of the flight instrument. It is intended to ensure that the unit is ready for testing and to evaluate the test plans.

d. A Pre-Shipment Review (PSR) which occurs prior to shipping the instrument to be integrated with the spacecraft. Its purpose is to evaluate the flight hardware performance during testing and determine the readiness of the instrument for integration with the spacecraft.

2.4 Not Applicable

2.5 System Safety

System safety status will discussed at each review.

3. PERFORMANCE VERIFICATION REQUIREMENTS

3.1 General Requirements

A Performance Verification program will be conducted to ensure that the flight hardware meets the mission requirements. The program consists of a series of functional demonstrations, analysis, physical measurements, and environmental tests which simulate the environments encountered during handling and transportation, prelaunch, launch and flight. All flight hardware will comply with the requirements of this PAIP. There will be no prototype or spare instrument.

The applicable environmental verification program is detailed in the General Environmental Verification Specification for ELV Payloads (GEVS-ELV) dated April 14, 1987.

3.1.1 System Safety Considerations

The Project Manager will coordinate the efforts of the verification program with those required by the safety program.

3.2 Documentation Requirements

The Project Manager will be responsible for managing the collection and distribution of verification documentation. This documentation will include a Verification Plan Specification, Verification Procedures, and Verification Reports.

3.2.1 Verification Plan Specification

The Verification Plan Specification will detail an array of tests, analyses and inspections which demonstrate flight unit compliance with (1) Electrical Functional requirements, (2) Structural and Mechanical requirements, (3) Vacuum and Thermal requirements, (4) Electro-Magnetic Compatibility and (5) End-to-End Compatibility requirements, as per the PAR section 3.2.1.

3.2.2 Verification Test Procedures

Verification Test Procedures will be developed for all tests conducted at the component level and above. Such procedures will be at at least a lab notebook level of formality, and will be available for inspection by appropriate GSFC personnel on request.

3.2.3 Verification Test Reports

A formal VTR sheet will be generated for each test at the component level and above. This report will show the degree to which the test objectives were met, how well the data correspond to the expected results, and any other significant findings. Copies will be delivered to GSFC within 30 days of completion of the test.

3.3 Functional Test Requirements

3.3.1 Electrical Interface Tests

Electrical interface tests will be performed as each board of the flight unit is ready to be integrated to the rest of the system. High and low impedance lines (inputs and outputs) will be checked for proper connections. Open collector or tri-stated busses on interfaces will require careful checks to be sure that multiple devices do not contend for the buss, etc. Such problems do not show up until mated with other units.

Particular attention will be focused on the power lines to the boards and the harnessing in general. Major problems can be caused by errors in these areas. Where practical, the boards may be designed to have protection against errant voltage application, buss contention and so forth. Where this approach is not feasible, external power checking (current limiting, etc.) may be used.

Documentation of such tests will be done in lab notebook format.

3.3.2 Post Integration Functional Tests

Following integration, the operation of all elements will be verified by appropriate functional testing. Appropriate stimulation and particle sources will be used for these tests. Documentation will be in laboratory notebooks which will be available for GSFC inspection.

3.4 Structural and Mechanical Requirements

3.4.1 General Requirements

Compliance with mechanical and structural requirement will be demonstrated by a series of tests and analyses. Factors of safety, interface compatibility, workmanship, and compliance with launch vehicle and range safety requirements will be demonstrated.

3.4.2 Requirements Summary

Structural and mechanical tests will be performed as specified in Table 3–1.

Compliance with the instrument requirements will be accomplished at the spacecraft level of assembly at GSFC.

3.5 Electromagnetic Compatibility (EMC) Requirements

Given the integrated nature of the FAST Spacecraft and Science Payload, the most valuable and definitive EMC testing will be that which is done at the S/C level of assembly. However, to increase confidence that the design is free of EMC problems, the testing specified in the matrix of Table 3–2 will be done as soon as possible in the payload development program. Testing will be performed on an electrically integrated assembly consisting of flight or prototype (identical in form, fit, and function as well as mechanical packaging) units of: the Central Electronics Assembly, one of the four ESA Stacks, one of the four Radial Boom Units, the CODIF, and both Magnetometers. The Axial Boom Unit will not be included since its electronics is a subset of that of the Radial Boom Unit with identical mechanical packaging. The interconnecting harness will be either the flight harness with unused connectors shielded, or a test harness made to flight-like specifications for mechanical details.

3.6 Vacuum and Thermal Requirements

3.6.1 General Requirements

A program of thermal vacuum testing will be performed by UCB to demonstrate that (1) the instrument will perform satisfactorily in space, and (2) the instrument can withstand the thermal and humidity environments expected in transportation and storage.

3.6.2 Summary of Requirements

Testing and analysis will be performed by UCB or its subcontractors on all Science Payload deliverable components as indicated in Table 3–3.

3.6.3 Detailed Requirements

A Thermal Vacuum test will be performed at the component level on each unit in the Science Payload. Multiple units may be placed in the thermal chamber as space permits.

All mechanisms will show satisfactory operation at both the high and low temperature extremes. Other components will undergo a simplified functional test while under Thermal Vacuum at both the high and low temperature extremes.

Temperature levels will be 10 degrees centigrade below the minimum operating temperature and 10 degrees above the maximum operating temperature. A total of 8 cycles will be done with a 4-hour dwell at each extreme and a transition rate of 2 hours or as limited by the chamber or heat transfer properties. The mechanism operation test will be done at least once at each temperature extreme.

3.7 End-to-End Testing

Since the Science Payload consists of a number of systems with multiple identical channels, end-to-end testing will be done on a representative payload system subset to demonstrate full compatibility between the various portions of the system.

This testing will be documented in Laboratory Notebooks which will be available for inspection by GSFC.

Table 3–1. Structural and Mechanical Environmental Requirements for FAST Science Payload Components

Component / Test Activity	Central Electr. Assmbly	ESA Stack	Radial Boom Unit	Axial Boom Unit	CODIF	Magnet-ometer Boom	Magnet-ometer
Structural Loads	—	A	A	—		T	—
Modal Analysis and Test	—	—	—	—	T	T	—
Transient Test	—	—	—	—	—	—	—
Acoustics	—	—	—	—	—	—	—
Random Vibration	T	T	T	T	T	—	T
Mechanical Shock	—	—	—	—	—	—	—
Mech. Function	—	T	T	T	T	T	—
Pressure Profile	—	—	—	—	—	—	—
Mass	T	T	T	T	T	T	T
MOI	GSFC	GSFC	GSFC	GSFC	GSFC	GSFC	GSFC

T = Test will be done by UCB prior to delivery
A = Analysis will be done by UCB prior to delivery
GSFC = Test to be done at GSFC following delivery

Table 3–2. EMC Testing Requirements for FAST Science Payload Components

Component / Test Requirements	Paragraph No. of GEVS–SE	Central Electr. Assmbly	ESA Stack	Radial Boom Unit	Axial Boom Unit	CODIF	Magnet-ometer Boom	Magnet-ometer
CE Power Leads	2.5.2.1	T	T	T	—	T	—	T
RE AC Mag Field	2.5.2.2	T	T	T	—	T	—	T
RE E-fields	2.5.2.2	T	T	T	—	T	—	T
CS Power Lines	2.5.3.1	T	—	—	—	—	—	—
CS Power Line Transients	2.5.3.1	T	—	—	—	—	—	—
RS E-field	2.5.3.2	T	T	T	—	T	—	T
RS Mag. field	2.5.3.2	T	T	T	—	T	—	T

T = Test will be done by UCB prior to delivery

Table 3–3. Vacuum, Thermal, and Humidity Requirements

Component / Test Activity	Central Electr. Assmbly	ESA Stack	Radial Boom Unit	Axial Boom Unit	CODIF	Magnet-ometer Boom	Magnet-ometer
Thermal Vacuum	T	T	T	T	T	T	T
Thermal Balance	—	—	—	—	—	—	—
Temp/Humidity I & T	—	A	A	A	A	—	—
Temp/Humidity Transport & Store	—	A	A	A	A	—	—
Leakage	—	—	—	—	—	—	—

T = Test will be done by UCB prior to delivery

A = Analysis will be done by UCB prior to delivery

4. SYSTEM SAFETY REQUIREMENTS

System Safety concerns for the SMEX-FAST Science Payload are addressed in a separate document, the "System Safety Implementation Plan for the Small Explorer (SMEX) FAST Mission Instrument," document number S–740–89–978, Revision A, dated August, 1990.

The system safety program will be compliant with the above referenced plan.

5. EEE PARTS REQUIREMENTS

5.1 General Requirements

A parts control program covering the selection, procurement, and acceptance of EEE parts used on the SMEX-FAST Science Payload will be conducted by the PI.

The UCB Project Manager is responsible for implementation of the parts control program. Parts selection and screening plans will be done by various engineers working on the project, with final approval by the PM. Parts testing, when required, will be done by engineers assigned to the project, and/or outside vendors.

5.2 Parts Selection

Parts will be preferably selected from the following sources:

1) GSFC Specification S-311-555

2) GSFC PPL-19

3) Mil-STD-975 H (except magnetic devices)

4) Micro circuits procured to Mil-M-38510

5) JANTXV Semiconductors procured to Mil-S-19500

6) Micro circuits procured to Mil-STD-883C

Parts will, for the most part, be used without additional screening beyond that included in the procurement specification. Specifications in the PPL-18 and Mil-STD-975 may be relaxed in some cases to the level of Mil-STD-883C, to make procurements consistent with the SMEX philosophy of the acceptance of limited risk.

5.3 Additional Parts

5.3.1 Magnetic Devices

Transformers and inductors will be manufactured at UCB using magnetic components purchased from Magnetic, Inc. and Ferroxcube, to commercial specifications, and Beldon Heavy Armored Polythermaleze wire, also purchased to commercial specifications. Parts and wire will be carefully visually inspected before and after winding. Units will be potted using approved materials at UCB. Correct operation of the completed units will be verified by electrical tests and measurements using the flight circuit boards or in special test beds.

5.3.2 Other Parts

Other parts, not on any of the documents listed in section 5.2 will be purchased to screening requirements consistent with at least the level of Mil-STD-883C. Part screening documents will be available for GSFC inspection on request.

5.4 Derating

All parts used on the SMEX-FAST payload will be derated to the levels of PPL-19, Appendix B, or Mil-STD-975 H, Appendix A.

5.5 EEE Parts Identification List

A master parts list of all parts used in the SMEX-FAST science payload will be maintained. This list will include, as applicable:

1) Generic part type
2) Control specification
3) Part number
4) Manufacturer
5) Where used
6) Total quantity used

The list will be delivered 30 days prior to PDR and updated at CDR and as needed until instrument delivery.

5.6 Quality Assurance

All parts will be visually inspected upon receipt at UCB and placed in bonded stores. All parts will functionally verified by a careful functional check following their installation at the circuit card level. Parts which cannot be verified in circuit may undergo product verification testing at UCB prior to board assembly.

Destructive Physical Analysis may be used on selected parts lots if needed to demonstrate lot integrity.

5.7 Radiation Hardness

A combination of intrinsic part hardness and shielding will be used to meet the 100K Rad requirement for the SMEX-FAST Mission. Shielding effectiveness will be taken as defined in Jim Watzin's memo of 2 November 1989. Parts will be divided into two classes:

1) High criticality parts – parts, the failure of which leads to a loss of all or a major portion of the science data, e.g., parts used in the processor interface.

2) Moderate criticality parts – parts, the failure of which causes the loss of a portion of the science data, e.g., parts used in the HV supply of one ESA.

High criticality parts will be baselined with 100K rads intrinsic hardness with no part less than 20K rads. Parts with less than 100K rads intrinsic hardness will be shielded with two times margin over the numbers given by the Jim Watzin memo.

Moderate criticality parts shall have a minimum intrinsic hardness of 20K rads, and will be shielded to 100K rads per the Jim Watzin memo.

Maximum use will be made of radiation tolerant design techniques, e.g., use of a large voltage swing on FET gates, allowing comfortable timing margins, and providing substantial margin in the power converters.

6. MATERIALS AND PROCESSES CONTROL REQUIREMENTS

6.1 General Requirements

The PI will implement a comprehensive program for materials and processes control.

6.2 Selection Requirements

6.2.1 Conventional Applications

Selection of materials will be based upon past experience, available data or current tests.

6.2.2 Nonconventional Applications

Use of any material which lacks aerospace experience is considered a nonconventional application. The material will be verified for the application based upon similarity, analysis, test, inspection, existing data or a combination of these methods. UCB will define the level of this verification and all information will be available for review.

6.2.3 Special Problem Areas

UCB will give special attention to problem areas such as radiation effects, stress-corrosion cracking, galvanic corrosion, hydrogen embrittlement, lubrication, contamination of cooled detectors, weld heat-effected zones and composite materials. No high strength fasteners or pressurized systems will be used.

6.2.4 Metallic Materials

Materials will be selected according to MSFC-SPEC-522B to control stress-corrosion cracking. Table I materials will be used to the maximum extent possible.

6.2.5 Non-metallic Materials

Materials will be noncombustible or self-extinguishing as much as possible. The outgassing properties of organic materials will be considered in their selection. When tested to JSC/SPR-0022A, compliant materials will have less than 1 percent total mass loss and less and 0.1 percent collected volatile condensible mass.

6.2.6 Consideration in Process Selection

Manufacturing processes will be selected so as to minimize changes to the material's properties.

6.2.7 Shelf Life Controlled Items

Polymeric materials with an uncured limited shelf life will be identified with manufacturing data and storage conditions. Regular purchases of limited shelf life materials will be planned to assure that current date code materials are always available. Use of out of date materials will be avoided.

6.3 Documentation

Documentation for materials and processes control will include:

a. Engineering Drawings for materials application

b. Inorganic Materials List (GSFC Form 18-59A or equivalent)

c. Polymeric Materials List (GSFC Form 18-59B or equivalent)

Materials lists will be submitted to the GSFC Materials Branch for approval, in accordance with Appendix C.

7. DESIGN ASSURANCE AND RELIABILITY REQUIREMENTS

7.1 General Requirements

The PI will implement a design assurance program consistent with PAR section 7.1 and SMEX Project office directives.

7.2 Design Assurance

7.2.1 Requirements

The E-Field instrument and associated test equipment will be designed to:

a. Function properly during the mission lifetime,

b. Minimize or eliminate human-induced failures,

c. Permit ease of assembly, test, fault-isolation, repair, and maintenance without compromising performance, reliability, or safety aspects.

7.2.2 Principal Investigator Support for Design Assurance

The Project Manager will ensure that:

a. Quality, reliability, safety and maintainability considerations are factored into the design,

b. The instrument can be inspected and tested,

c. The instrument can be produced,

d. The detailed design conforms to the requirements,

e. The performance, safety and interface specifications are reflected in inspection and test documentation,

f. Operations in which high quality cannot be verified by inspection alone are identified and methods are established to ensure instrument integrity.

7.2.3 Specifications, Drawings and Test Procedures

7.2.3.1 Design Specifications. UCB will develop an electrical design specification in block diagram form for the SMEX-FAST Science Payload system. Interface protocols between major blocks will be indicated on the diagram. A master mechanical layout will also be developed and maintained which will define mechanical form and fit including mounting hole patterns and connector locations for each deliverable component.

7.2.3.2 Specification, Drawing and Test Procedure Reviews. Changes to the design specifications described in section 7.2.3.1 will be reviewed by the PM and the PI.

Flight unit drawings will be reviewed by the PM (at minimum) prior to release and following any changes occurring after release.

Test procedures will be reviewed by the component responsible engineer/scientist at minimum.

7.3 Reliability Analyses

7.3.1 Failure Mode Effects and Criticality Analysis

Since the FAST Science Payload is a single string design with a number of separate sensor assemblies connected to a common interface to the spacecraft, it is expected that failure modes will fall into two categories: those in the interface which result in loss of the entire mission, and those associated with a particular sensor which results in the loss of only that channel.

To assist in the payload system design, a FMECA will be performed early in the design process. It will be done using the system electrical specification of section 7.2.3.1, and will be done in laboratory notebook format. Problem areas identified in the analysis will result in corrective action being taken by modifying the system design. The FMECA process will be performed iteratively, as required, until a satisfactory design is obtained.

Laboratory notebooks in which the FMECA is documented will be available for inspection by GSFC representatives.

7.3.2 Parts and Device Stress Analysis

Stress analysis of the digital and analog electronics will be performed by the digital and analog designers, respectively, as part of the design process.

Analysis will consider environmental stresses and reference the derating guidelines of MIL-STD-975 and/or PPL-18. It will be performed using the worst case stresses which can result from the specified performance requirements. The analysis will be updated as the design changes.

This activity will be documented in engineering notebooks which will be available for GSFC inspection.

7.3.3 Not Applicable

7.4 Limited Life Items

No limited life items have been identified in the SMEX-FAST science payload (using the definition of section 7.4 of the PAR).

In the event that such items are identified in the future, a limited life items list will be generated and submitted to GSFC.

8. QUALITY ASSURANCE REQUIREMENTS

8.1 General Requirements

The PI will establish and maintain a quality assurance program which will meet the requirements of the PAR, section 8, as modified by this document.

8.2 Support of Design Reviews

QA issues and the status of the QA program will be addressed in the reviews identified in section 2.3.

8.3 Document Change Control

Documents which specify the configuration of the mission flight hardware will be controlled via a system of drawing numbers and revision letters. Standard techniques of materials call-out from assembly drawings to lower level assemblies and piece-part drawings will define the entire payload. Master copies of all documents will be stored in a central location. A revision letter assigned to each document will be incremented each time a change is made. Revision letter changes will be tracked using an Engineering Change Order (ECO) form, and will occur only after appropriate review of the proposed document change.

The effectivity of changes will be specified on the ECO form. If effectivity requires that changes be made to existing parts, the change will be verified prior to final sign-off of the ECO. Parts will be marked or tagged with drawing numbers and revision level, and the correct revision level verified at assembly into the next higher level. A master indented drawing list will track the revision level of all parts in the Science Payload. The master indented parts list, when properly updated, will become the as-built configuration list.

8.4 Identification and Traceability

UCB will maintain a product identification and tracking system for the SMEX-FAST Science Payload. Part numbers will be provided on each sub-assembly or PWB. If sub-assemblies or assemblies are not unique, serial numbers will be used to identify them.

Mechanical parts will be serialized when they are not fully interchangeable. Significant subassemblies (such as a sensor assembly) will be serialized for traceability.

Records will be maintained to support a trace of any non-interchangeable part or material to the board or unit in which it was placed. Parts from a given manufacturer with a given lot-date-code are considered to be interchangeable. Similarly, any board or unit will be traceable backwards to the parts or materials from which it was built. Thus, if an ALERT were to identify a problem part, UCB could determine all places where the part exists in the instrument.

8.5 Procurement Controls

UCB will include the following procurement controls on all flight unit parts and materials purchases.

8.5.1 Purchased Raw Materials

Purchase orders for raw materials will include a requirement for the results of physical and chemical tests, or a certificate of compliance.

Suppliers of materials will be requested to make acceptance test results available.

8.5.2 Age Control and Limited-Life Products

Records will be kept on products having characteristics of degradation with use or age. Records will note date, when useful life was initiated, and date when life expires.

8.5.3 Inspection and Test Records

The PI will require where necessary that suppliers maintain inspection and test records. Records that are to be provided with the deliverable item will also be specified.

8.5.4 Purchase Order Review

The PI or his designate will review all purchase orders for flight articles to verify the correctness of the purchase requirements and that all applicable Q.A. requirements have been included.

8.5.5 Resubmission of Nonconforming Articles or Materials

If an article is deemed nonconforming by the contractor and returned to the supplier, the supplier will resubmit the article with evidence showing the article has been corrected, and with markings which clearly indicate that it is a "re-submitted part."

8.5.6 Government Source Inspection (GSI)

When the government elects to perform inspection at a supplier's plant, the following statement shall be shall be included in the procurement document:

"All work on this order is subject to inspection and test by the government at any time and place. The government quality representative who has been delegated NASA quality assurance functions on this procurement shall be notified immediately upon receipt of this order. The government representative shall also be notified 48 hours in advance of the time that articles or materials are ready for inspection or test."

Procurements that do not require GSI shall include the following statement:

"The government has the right to inspect any or all of the work included in this order at the supplier's plant."

8.6 Receiving Inspection

UCB will maintain a person or persons who perform receiving inspection for the SMEX-FAST Project. Upon receipt at UCB, all purchased products will undergo an inspection which includes:

(1) verification that documentation meets the requirements of the Purchase Order.

(2) verification that parts marking and packaging is consistent with the requirements of the Purchase Order.

(3) verification of correct parts count.

Parts will be handled in accordance with the Space Physics Group ESD control plan, then bagged, marked, and placed into bonded flight stores.

8.7 Fabrication Control

8.7.1 Fabrication and Assembly Flow Plan

A fabrication and assembly flow plan will be developed which outlines the manufacturing, assembly, inspection, and test steps which are required to produce the FAST Science Payload. This plan will be in engineering drawing format on one or more D-size sheets. It will be controlled as a standard drawing. A copy will be submitted to GSFC for review and comment 30 days prior to the PDR and again 30 days prior to the CDR.

8.7.2 Manufacturing Certification Log

A Certification Log will be established for each manufactured component which will travel with the item through fabrication and inspection. Operations will be done per referenced documents, or documented directly in the log book. Torque values, part serial numbers, etc. will be noted, and all entries will be signed and dated by the operator. Entries will include results of in process testing.

8.7.3 Worker Certification

All flight segment soldering and wiring will be done in accordance with NHB 5300.4 sections 3A–1, 3G, 3H, 3I, and 3J, by technicians certified and trained as required.

8.7.4 Process Control

Controls will be implemented for processes for which uniform high quality cannot be ensured by inspection alone.

8.8 ESD Control

ESD control will be accomplished by the techniques and process controls described in the Space Physics Group Electrostatic Discharge Control Plan, Revision B, dated May, 1990.

8.9 Nonconformance Control

UCB will perform nonconformance control for failures and discrepancies. (A failure is a nonconformance discovered in testing, while a discrepancy is a nonconformance discovered at other times.) UCB will track nonconformances with a Nonconformance Report which includes the following information:

a. A description of the nonconformance;

b. Analyses to determine the fundamental cause and any impacts to the rest of the flight instrument;

c. Remedial action to be taken;

d. Verification of the removal of the nonconformance;

e. Disposition of the nonconforming item.

8.9.1 Discrepancies

8.9.1.1 Documentation. Documentation of discrepancies will begin with receipt of procured materials or fabrication.

8.9.1.2 Initial Review Dispositions. Discrepant products will be reviewed by engineering personnel to decide if they should be (a) returned for rework, (b) scrapped, (c) returned to supplier, (d) submitted for MRB action. Initial reviews will be documented as described above.

8.9.1.3 Material Review Board. The MRB will review all nonconformances or instrument-level FRB closeouts resulting in MRB action.

The MRB will: determine dispositions, ensure remedial and preventive actions; verify implementation of all dispositions; and ensure accurate recoreds are maintained. MRB dispositions will specify one of the following:

(1) *Repair:* The MRB will approve repairs. Although standard repair procedures may be approved on a one-time basis, the MRB will track the number of standard repairs on a per unit basis to ensure that reliability or quality are not compromised by excessive repairs.

(2) *Use-as-is.*

(3) *Waiver:* To use or accept hardware at the spacecraft interfaces which does not meet contract requirements; this action will require GSFC Contracting Officer Approval prior to implementation.

8.9.2 Failures

8.9.2.1 Reporting. A failure report will be written for failures that affect the function of the flight segment or could compromise mission objectives. Reporting will begin with the first functional test of the fully assembled component and will continue through the flight segment.

UCB will provide the Project with copies of all failure reports.

A master file of the reports and supporting tests or analyses will be maintained at UCB for Project information.

8.9.2.2 Failure Review Board. The FRB will designate remedial action to be taken. Where an affected item is discrepant, the FRB will closeout the failure by referring it to the MRB.

The FRB will investigate failures beginning with the component level functional tests and documented at UCB. Failures at the instrument level functional tests will be documented by a Failure Report as described above. Failure reports and closeouts will be signed by the FRB chairman and submitted to the Project for final approval. Reports not dispositioned within 30 calendar days shall be considered approved.

8.9.3 Alert Information

The PI will support the Alert program by determining the relevance of each Alert submitted to UCB. If action is required, the MRB will determine the approach to resolving the problem. The status of any such action will be reported at the PDR and CDR.

8.10 Inspections and Tests

UCB will plan and implement an inspection and test program which will demonstrate that applicable requirements are met.

Inspection and in process testing will be completed prior to installation into the next level of assembly. Inspection points and in process test requirements will be documented in assembly procedures and in the manufacturing certification logs discussed above in section 8.9.

Verification of soldering to NHB 5300.4 (3A–1) will be done by NASA certified personnel other than the original operator.

The component responsible engineer will review the hardware and documentation package prior to certification of readiness for the next assembly process.

An end-item inspection will be performed on each component by the responsible engineer. It will be verified that the configuration is as specified in the master drawing list described in section 8.3, that workmanship standards have been met, and that test results are acceptable.

8.10.1 Inspection and Test Records

Inspection and test records will be included in the manufacturing certification log for each deliverable component, to show that all manufacturing operations have been performed, the objectives met, and the end item fully verified.

8.10.2 Printed Wiring Boards Inspections and Tests

Printed wiring boards shall conform to the requirements of NHB 5300.4 (3I), or Mil–P–55110, and shall be qualified by inspection and test results.

8.11 Configuration Management

The master indented drawing list described in Section 8.3 will be used to track the as-built instrument configuration listing, and to insure that it is in accordance with the current UCB–approved instrument configuration.

8.12 Metrology

The science requirement on the accuracy of the physical measurements made by FAST is ±5%. The laboratory instruments on which the accuracy of tests of the science payload made at UCB depend include DC and AC voltmeters, counters, oscilloscopes, and spectrum analyzers. Verification of the accuracy of this equipment to the necessary levels during engineering testing will be done by a combination of calibration by outside vendors and cross-checking of one unit against another.

Acceptance level testing at the component level will be done with instrumentation calibrated per Mil–STD–456624 A.

8.13 Handling, Storage, Marking, Shipping, Preservation, Labeling, and Packaging

8.13.1 Handling

No handling equipment is planned for the FAST Science Payload. In the event that a need for such equipment is identified, appropriate proof testing will be performed prior to use.

8.13.2 Marking, Labeling, Packaging

Marking, labeling and packaging will meet the intent of MIL-STD-129. Secure storage areas for the SMEX-FAST equipment will be located at UCB.

8.13.3 Shipping

Shipping of the flight units or components will be done with the appropriate accompanying documentation and handling instructions.

8.14 Government Property Control

UCB will be responsible for and will account for all property procured under the contract or provided by the government. The University property control system and standard government property transfer forms will be used to accomplish this.

8.15 End Item Acceptance

Prior to shipment of the FAST Science Payload, the Acceptance Data Package will be assembled by the Project Manager and reviewed by GSFC Q.A. for completeness prior to submission.

9. CONTAMINATION CONTROL REQUIREMENTS

Following the start of the FAST contract, the UCB project will perform a study of the contamination requirements and develop a contamination control plan for the SMEX-FAST Science Payload. This plan is expected to be similar to that currently in force on the ISTP instrument development programs at UCB.

Equipment and expertise for performing this task at the level required on FAST is already in place at the Space Sciences Laboratory.

10. SOFTWARE ASSURANCE

10.1 General

The Space Physics Group at the UCB Space Sciences Laboratory has had considerable experience in the development of real time processor-based systems for spaceflight use (including the first microprocessor system flown on a NASA satellite – ISEE-1) and computer-based ground support equipment. The group currently includes persons of considerable ability and experience in the software area. The group has developed approximately 25 such systems over the past 15 years, all of which have been delivered on schedule and have been completely successful.

It is our intent to use the same type of organization and development procedures on FAST which have proven to be successful on past programs.

No subcontracting of software development is planned; all work will be done in house by UCB personnel.

10.1.1 Applicability

This plan shall apply to instrument and GSE software developed for the FAST project at the University of California, Berkeley.

The instrument software is computer code which runs in the micro processor(s) which are a part of the flight experiment package. GSE software is that which runs in ground-based equipment and is used to collect and display data from the instrument during development at the UCB.

It is not planned that any Mission Operations software will be developed by the UCB Project. Since FAST is a single P.I. mission, Key Parameter data of the type customarily exchanged between experimenters will also not be developed.

10.2 Software Development

Software will be developed at UCB/SSL by a small team of programmers (three to four). Control is maintained by the lead programmer who is responsible for maintaining the code and incorporating all changes at a single location.

10.2.1 Responsibilities

All UCB-developed software is the responsibility of the SMEX-FAST PI. He is responsible for approving the software functional requirements, and for approving any deviations to those requirements in the software implementation. The requirements document is developed by the programming team at UCB in close consultation with the PI and other investigators and engineers. Once the requirements are approved, the programming team at Berkeley begins developing code. This team consists of a lead programmer, aided by other programmers and under the supervision of the Project Manager at Berkeley. The lead programmer is responsible for developing, maintaining, and testing the code. Any code developed by other programmers must be integrated into the flight software by the lead programmer.

The lead programmer will maintain configuration control of the code.

Acceptance testing of the software will occur at Berkeley, and will ensure that the code is thoroughly tested. To the largest extent possible, testing will be performed by personnel not responsible for the development of the code. Testing will occur in stages as successively more complete versions of the code are developed. At each major revision, a copy of the code will be sent to GSFC for evaluation.

10.3 Documentation

The instrument and GSE software will be documented by the following:

Software Requirements Document:	Describes the functional requirements on the software to a level sufficient for a programmer to implement.
Software Acceptance Test Plan:	Describes the tests to be performed on the software prior to committing it to flight PROMS.
Software Description Document:	Describes the software as implemented to a level sufficient to allow any competent programmer to maintain the code and develop additions if necessary.
Software Users Guide:	Describes the software at the interface level for the end user (scientists, operations personnel and ground software programmers).
Software History Log:	This log will include all PFRs (with dispositions), results of acceptance testing, and detailed descriptions of any modifications made by uplinked code after launch.

The lead programmer will be responsible for developing these documents and maintaining configuration control over them. This control will consist of reviewing and implementing any document changes, maintaining a revision code on all document updates, and distributing the documents for review to interested parties consisting at a minimum of the PI and Project Managers at Berkeley and GSFC.

10.4 Software Design Reviews

Three reviews of the instrument system and GSE software will be held. The reviews will consist of a presentation by the developer to a review panel appointed by the Project, with back-up material, splinter sessions, and subsequent meetings as required to resolve any issues raised. The reviews will be held coincident with, and will be a part of the FAST payload CDR (SR1), PER (SR2), and PSR (SR3) activities.

10.5 Configuration Management

Prior to software review SR2, configuration control on the software will be performed by the lead programmer, and any change requests or bug reports will be communicated to him. Before SR2, at least one preliminary release of the software will be provided to GSFC.

Following SR2, additional controls will be instituted. A software release version number will be required on all distributed revisions. This version number is to be included in the code and broadcast as part of the housekeeping, as well as being on all media and/or directories containing the code. All errors found in an official release will be documented and submitted to the lead programmer.

Prior to the beginning of acceptance testing, when the code is complete and ready to test, additional controls will be put in place. Any failures or change requests will be made to the lead programmer via the Problem/Failure Report system. The lead programmer will verify the problem and determine the cause. If the problem can be fixed without impacting the functionality of the rest of the code and does not have a serious schedule impact, he will proceed with the fix, and distribute a new revision of the code for further tests. Any instrument S/W modifications, no matter how seemingly minor, will be verified by a complete S/W acceptance test. Problems with greater impact will be submitted to a review board consisting of the lead programmer, the Berkeley Instrument Project Manager, and the PI. The lead programmer shall maintain a log book of all PFRs.

When all PFRs have been dispositioned and the final version of the code has completed acceptance testing, the code will be committed to the flight PROMs and installed into the flight hardware. From this point on, all change requests must be approved by the PI, and will only be considered for a serious problem that cannot be fixed by uplinking a software "patch" after launch. If a change is approved, the lead programmer will implement the fix and issue a new release. The new release will be submitted to a full acceptance test (to be determined by the programmer, based on the nature of the fix) before again committing to PROM.

Any code to be uplinked after launch will submitted to the same level of configuration control as was levied on the final version of the flight code, including detailed acceptance testing on breadboards prior to uplinking the code. Any significant code uplink will be accompanied by a change in the code version number which is included in the instrument housekeeping, so that ground data processing software can determine what version of the software is running.

At all stages of the software development, a system of backups will be maintained to ensure that the failure of a system or media will not destroy more than 1 day's work. In addition, a backup copy will be maintained off-site, updated periodically.

APPENDIX A. APPLICABLE DOCUMENTS

The following documents shall be applicable to this PAIP to the extent referenced herein.

Document No.	Title
GEVS–STSELV	General Environmental Verification Specification for STS and ELV Payloads, Subsystems and Components (Draft 12 April 1989)
MIL–STD–461C	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL–STD–462	Electromagnetic Interference Characteristics, Measurement of
MIL–STD–463	Military Standard Definitions and System of Units, Electromagnetic Interference and Electromagnetic Compatibility Technology
MIL–STD–1574A	System Safety Program for Space and Missile Systems
WSMCR 127–1	Western Space and Missile Center Range Safety Requirements
S–311–555	GSFC Specification, Parts Selection Guide for the Small Explorer Program
MIL–STD–975 (NASA)	NASA Standard Electrical, Electronic, and Electromechanical (EEE) Parts List
MSFC–SPEC–522B	Design Criteria for Controlling Stress Corrosion Cracking
MIL–STD–6866	Military Standard, Inspection, Liquid Penetrant, 29 November 1985
None	GSFC Materials Tips for Spacecraft Applications
TM 82275* (GSFC Mtr. No. 755–013)	Quality Features of Spacecraft Ball Bearing Systems
TM 82276* (GSFC Mtr. No. 313–003)	An Evaluation of Liquid and Grease Lubricants for Spacecraft Applications
None	Materials Selection Guide, GSFC, June 1985
N–84–26751* (NASA RP–1124)	Outgassing Data for Selecting Spacecraft Materials
NHB 8060.1B	Flammability, Odor, and Outgassing Requirements and Test Procedures for Materials in Environments that Support Combustion
MSFC–HDBK 527 Rev. C, JSC 09604, Rev. C	Materials Selection List for Space Hardware Systems

(continued)

Document No.	Title
NHB 5300.4 (3A–1)	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
DOD–HDBK–263	Electrostatic Discharge Handbook for Protection of Electrical and Electronic Parts
DOD–STD–1686	Electrostatic Discharge Program for Protection of Electrical and Electronic Parts
MIL–P–55110	General Specification for Printed Wiring Boards
MIL–STD–45662	Calibration System Requirements

APPENDIX B: GLOSSARY

Acceptance Tests: The process that demonstrates that hardware is acceptable for flight. It also serves as a quality control screen to detect deficiencies and normally to provide the basis for delivery for an item under the terms of a contract.

Assembly: A functional subdivision of a component, consisting of parts and subassemblies that perform functions necessary for the operation of the component as a whole. Examples are a power amplifier and a gyroscope.

Audit: A review of the contractor's of subcontractor's documentation or hardware to verify that it complies with project requirements.

Catastrophic: A potential failure effect which would result in complete loss of an item of hardware or a mission or result in serious injury to personnel, e.g., loss of ability to recover science data would be catastrophic to an instrument mission.

Critical: A potential failure effect which would result in a significant (as defined by the Project) performance degradation of an item of hardware or a mission.

Collected Volatile Condensable Material (CVCM): The quantity of outgassed matter from a test specimen that condenses on a collector maintained at a specific constant temperature for a specified time.

Component: A functional subdivision of a subsystem and generally a self-contained combination of items performing a function necessary for the subsystem's operation. Examples are transmitter, gyro package, actuator, motor, battery.

Configuration: The functional and physical characteristics of parts, assemblies, equipment of systems, or any combination of these which are capable of fulfilling the fit, form and functional requirements defined by performance specifications and engineering drawings.

Configuration Control: The systematic evaluation, coordination, and formal approval/disapproval of proposed changes and the implementation of all approved changes to the design and production of an item, the configuration of which has been formally approved by the contractor or by the purchaser, or both.

Configuration Management: The systematic control and evaluation of all changes to baseline documentation and subsequent changes to that documentation which define the original scope of effort to be accomplished (contract and reference documentation) and the systematic control, identification, and status accounting and verification of all configuration items.

Derating: The reduction of the rating of a device to improve reliability or to permit operation at high ambient temperatures.

Design Specification: Generic designation for a specification which describes function and physical requirements for an article, usually at the component level or higher levels of assembly. In its initial form, the design specification is a statement of functional requirements with only general coverage of physical test requirements. The design specification evolves through the project life cycle to reflect progressive refinement in performance, design, configuration, and test requirements. In many project the end-item specifications serve all the purpose of design specifications for the contract and items. Design specifications provide the basis for technical and engineering management control.

Designated Representative: An individual (such as a NASA plant representative), firm (such as assessment contractor), Department of Defense (DOD) plant representative, or other Government representative designated and authorized by NASA to perform a specific function of NASA. As related to the contractor's effort, this may include evaluation, assessment, design review participation, and review/approval of certain documents of actions.

Destructive Physical Analysis (DPA): An internal destructive examination of a finished part or device to assess design, workmanship, assembly, and any other processing associated with fabrication of the part.

Discrepancy: See Nonconformance.

Effectivity: The point (in configuration evolution) at which a change or action becomes applicable to the hardware or software.

Electromagnetic Compatibility: The condition that prevails when various electronic devices are performing their functions according to according to design in a common electromagnetic environment.

Electromagnetic Interference (EMI): Electromagnetic energy which interrupts, obstructs, or otherwise degrades or limits the effective performance of electrical equipment.

Electromagnetic Susceptibility: Undesired response by a component, subsystem, or system to conducted or radiated electromagnetic emissions.

End-to-End Test: Test performed on the integrated ground and flight system, including all elements of the payload, its control, communications, and data processing to demonstrate that the entire system is operating in a manner to fulfill all mission requirements and objectives.

Failure: See Nonconformance.

Failure Modes, Effects, and Criticality Analysis (FMECA): Study of a system and working interrelationship or its elements to determine ways in which failures can occur (failure modes), effects of each potential failure on the system elements in which it occurs and on other system elements, and the probable overall consequences (critically) of each failure mode on the success of the system's mission. Criticalities are usually assigned by categories, each category being defined in terms of a specified degree of loss of mission objectives or degradation of crew safety.

Functional Tests: The operation of a unit in accordance with a defined operational procedure to determine whether performance is within the specified requirements.

Hardware: Physical items of equipment. As used in this document, there are two major categories of hardware as follows:

1. *Nonflight Hardware:* Development hardware not intended to fly, hardware of flight design but found to be of unsuitable quality for flight use, or hardware intended for use on the ground.

2. *Flight Hardware:* hardware to be used operationally in space. It includes flight instruments (experiments) and/or spacecraft hardware.

Inspection: The process of measuring, examining, gaging, or otherwise comparing an article or service with specified requirements.

Instrument A subsystem consisting of sensors and associated hardware for making measurements or observations in space. The flying portion of a flight experiment.

Margin: The amount by which hardware capability exceeds requirements.

Monitor: To keep track of the progress of a performance assurance activity: the monitor need not be present at the scene during the entire course of the activity, but he will review resulting data or other associated documentation.

Nonconformance: A condition of any hardware, software, material, or service in which one or more characteristics do not conform to requirements. As applied in quality assurance, nonconformances fall into two categories–discrepancies and failures. A discrepancy is a departure from specification that is detected during inspection of process control testing, etc., while the hardware or software is not functioning or operating. A failure is a departure from specification that is discovered in the functioning or operation of the hardware or software.

Part: A hardware element that is not normally subject to further subdivision or disassembly without destruction of designed use.

Performance Verification: Determination by test, analysis, or a combination of the two that the spacecraft can operate as intended in particular mission; this includes being satisfied that the design of the spacecraft of element has been accepted as true to the design and ready for flight operations.

Qualification: The process of demonstrating that a given design and manufacturing approach will produce hardware that will meet all performance specifications when subjected to defined conditions more severe that those expected to occur during its intended use.

Redundancy (of design): The use of more than one independent means of accomplishing a given function.

Repair: The article is to be modified by established (customer approved where required) standard repairs or specific repair instructions which are designed to make the article suitable for use, but which will result in a departure from original specifications.

Rework: Return for completion of operations (complete to drawing). The article is to be reprocessed to conform to the original specifications or drawings.

Similarity, Verification By: A procedure of comparing an item verified. Configuration, test, data, application, and environment should be evaluated. It should be determined that design differences are insignificant, environmental stress will not be greater in the new application, and that manufacturer and manufacturing methods are the same.

Single Point Failure: A single element of hardware the failure of which would result in loss of mission objectives or the hardware, as defined for the specific application or project for which a single point failure analysis is performed.

Spacecraft: An integrated assemblage of subsystems designed to perform a specified mission in space.

Subassembly: A Subdivision of an assembly, Examples are wire harness and leaded printed circuit boards.

Subsystem: A functional subdivision of a spacecraft consisting of two or more components, Examples are attitude control, electrical power subsystems, electrical power subsystems, and instruments.

Temperature Cycles: A transition from some initial temperature condition to temperature stabilization at one extreme and then to temperature stabilization at the opposite extreme and returning to the initial temperature condition.

Temperature Stabilization: The condition that exists when the rate of change of temperatures has decreased to the point where the test item may be expected to remain within the specified test tolerance for the necessary duration of where further change is considered acceptable.

Thermal Balance Test: A test conducted to verify the adequacy of the thermal design and the capability of the thermal control system to maintain thermal condition within established mission limits.

Total Mass Loss (TML): Total mass of material outgassed from a specimen that is maintained at a specified constant temperature and operating pressure for a specific time.

Verification: See Performance Verification.

Vibroacoustics: An environment induced by high-intensity acoustic noise associated with various segments of the flight profile; it manifest itself throughout the payload in the form of directly transmitted acoustic excitation and as structure-borne random vibration excitation.

Witness: A personal, on-the-scene observation of a performance assurance activity with the purpose of verifying compliance with project requirements. (see Monitor).

APPENDIX C. DELIVERABLE DATA AND GSFC RESPONSE DATA REQUIREMENTS

The purpose of the data requirements is to define the following data, which GSFC requires for performing its assigned management functions, and for ensuring the orderly flow of information between a contractor and other organizations.

Paragraph Number	Description	Type	Scheduled Delivery
1.2	Performance Assurance Implementation Plan	I	Preliminary 60 days after receipt of Preliminary PAR
		A	Update 60 days after contract award
2.2	Data for GSFC Reviews		
	Copies of the Material to be Presented at the Review	I	Beginning of review meeting
3.2.1	Verification Plan Specification	I	Preliminary with PDR
		A	Final at time of GSFC CDR
3.2.3	Verification Reports	R	Within 30 days following completion of test
4.0, 4.2	Inputs to SSIP	R	At PDR
4.0, 4.3	Inputs to SDP	R	Preliminary 60 days prior to CDR
		R	Final 45 days prior to FRR
4.4.1	Checklist Inputs	R	90 days after PDR
4.4.2	Hazard Report Inputs	R	30 days prior to GSFC reviews
		A	45 days prior to FRR
4.4.3	Hazard Control Procedures	A	45 days prior to FRR
4.5	Verification Activity Summary Report	R	At spacecraft PER
		A	45 days prior to FRR
4.7	Waivers	A	As determined necessary
5.5	EEE Parts Identification List	I	30 days before developer PDR
		I	Update 30 days before developer CDR
6.2.6	Data Supporting Use of Out-of-Date Materials	A	30 days prior to the use of such materials

(continued)

Paragraph Number	Description	Type	Scheduled Delivery
6.3	Materials and Processes List	R	30 days before developer PDR
		A	Update 30 days before developer CDR
7.4	Limited-Life List	R	30 days prior to developer CDR
8.7	Fabrication and Assembly Flow Plan	R R	30 days prior to developer PDR 30 days prior to developer CDR
8.9.1	Failure Reporting –Information (MR form)	I	Orally within 3 working days
	–Failure Analysis Proposed Corrective Action	I	Orally
	–Final Close-Out Information	A	Completion of Required Actions
8.14	Acceptance Data Package For Each End-Item Comprising:	A	At time of deliver or end item
	–As Built Configuration List in Accordance with Paragraph 8.11		
	–List of Parts use in the Hardware, in accordance with Paragraph 5.5		
	–List of Material & Processes used used in the Hardware in accordance with Paragraph 6.3		
	–Test Log Book including Total Operating Time and Cycle Records		
	–List of Open Items with Reason for Items Being Open		
	–Listing and Status of all Identified Limited-Life Items		
	–Results of the Final Comprehensive Performance Test		
10.2	Software Test Plan	R	At CDR

A – GSFC approval required.

R – GSFC reviews and may comment within 30 days; developer may continue work unless comment requires him to stop.

I – Information only.

SMALL EXPLORER (SMEX) DOCUMENTATION CONTROL FORM

ACTION CODE	NAME	MAIL CODE
	B. ADAMS	743.3
	A. AHMAD	711.1
	R. ALEMAN	740.4
	D. BAKER	690
	D. BETZ	740.4
	M. BLAU	743.3
	T. BUDNEY	745
	J. BYRD	740.4
	J. CATENA	740.4
	G. CHIN	693.1
	J. CHITWOOD	727.2
	C. CLAGETT	745.1
	G. COLON	740.4
✓	SMEX CM	740.4
	G. COOPER	743.1
	H. CULVER	711.1
✓	B. FAFAUL	311.1
✓	O. FIGUEROA	740.4
	J. FIORA	740.4
	M. FLANEGAN	735.2
	T. FLATLEY	733.3
	J. GALLEHER/HEI	740.4
✓	T. GEHRINGER	740.4
	D. GILMAN/NASA HQ	SZD
	T. GRUNER	745.2
	K. HERSEY	727.1
✓	L. HILLIARD	740.4
	H. HOFFMAN	712
	R. HOLLENHORST	740.4
	T. HUBER	700
	T. JACOBS	743.2
	K. JENKINS	302.A
✓	R. KOLECKI	740.4
	F. JONES	750.2
	G. KAMBOURIS	301
	K. KEADLE-CALVERT	743.1
	J. KELLOGG	741.2
	R. KICHAK	711
	R. KOZON/BFEC	740.4
	D. KRUEGER	730
	K. LABEL	735.2
	G. LIGHTSEY	712.3
	J. LYONS	711.2
	H. MALDONADO	727.2
	L. MALKIN/UNISYS	740.4
	L. MATAOSKY	470
	B. McALISTER	743.3
	S. MEYERS	741
	P. MULE	750.2
	W. NAGEL	740.4
	D. NGUYEN	732.3
	Q. NGUYEN	743.2
	D. OLNEY	745.1
	R. PATSCHKE	743.3
	V. PELTZ/UNISYS	740
	R. PFAFF	696
	W. POWELL	822
	J. POWNELL	743
	H. PRICE	700
	G. RAKOW	743.3
	J. ROACH	741.2
	G. ROSANOVA	741.3
	P. SALERNO	740.4
	R. SCHNURR	745.2
	R. SCOTT	741.1
	E. SEN	732.3
	A. SHERMAN	700
	D. SHREWSBERRY	740
	SMEXFOT	740.4
	B. SMITH	735.2
	G. SNEIDERMAN	741.3
	M. STEINER	743.3
	J. STEPHENS	733.3
	R. STONE	743
	S. STRAKA	732.4
	L. TANT	LaRC
	M. TOOLEY	743.3
	M. WALKER	745.1
	J. WATZIN	740.4
	R. WEAVER	740
	R. WHITLEY	735.3
	N. WILKINSON	740.4
	J. WOLFGANG	704
	M. WRIGHT	743.3

NUMBER OF ENCLOSURES OR ATTACHMENTS INCLUDED 1

SUBJECT: FAST PAIP 3 January 1991

FAST-QA-001

A - Coordinator of Action - Will prepare response to SMEX Project Office

Attn:______ By:______

S - Supporting Action - Will submit comments and/or information to coordinator of action by______

√ - Information

R - Retain

COMMENTS:______

Distributed by: [signature] Date: 3/25/91

3/1/91