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ATTACHMENT 2
APPENDIX II

RELIABILITY PROGRAM REQUIREMENTS FOR

COSMIC RAY DETECTOR EXPERIMENT (S152)

1.0 Introduction

These requirements implement the applicable portions of NPC 250-1, Reliability Program Provisions for Space System Contractors, and other MSC reliability requirements. The contractor shall develop and implement a reliability program in accordance with the requirements contained herein.

NASA reserves the right to employ independent reliability assessment contractors which will function as technical advisors to NASA in the capacity of designated NASA representatives to:

- a. Assess the system and subsystem contractors' and subcontractors' reliability program effectiveness.
- b. Assess and evaluate independently the reliability of the space system and elements thereof.

2.0 Reliability Program Plan

The contractor shall prepare a Reliability Program Plan to serve as the master planning and control document for the reliability program. This plan shall detail the approach and stepwise produce (including cost and scheduling data) by which the contractor intends to ensure compliance with the provisions of these requirements in general and the specific requirements of the contract.

In addition, the preliminary submittal of the plan shall include the following information:

- a. A description of how each reliability task shall be accomplished and by which organizational element.
- b. A Reliability Program Schedule showing completion dates of reliability tasks, major program milestones, and reliability documentation submittal dates.
- c. A complete manpower and cost assessment showing numbers of man-months applied for each month of the contract duration. These should be further broken down to show how much effort is being applied each month to each specific reliability task.

FACILITY FORM 602	N71-14053	
	(ACCESSION NUMBER)	(THRU)
	10	G-3
	(PAGES)	(CODE)
	CR-108714	29
	(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

CR-108714

The preliminary plan shall be submitted with the contractor's response to the request for proposal. The preliminary plan, with appropriate modifications directed by the NASA representative, shall be submitted for approval as the final plan.

3.0 Failure Mode, Effect, and Criticality Analyses (FMEA)

As an integral part of the early design process, the contractor shall develop projected analyses for the system to determine possible modes of failure and their effects on mission success. The primary objective of these analyses shall be to discover critical failure areas and remove susceptibility to such failures from the system. These analyses shall be a major consideration in design reviews and shall also provide an important criterion for test planning and use time (or cycles).

The contractor's FMEA effort shall have emphasis placed on defining those failure modes inherent in the equipment design, for contributing to design improvements, and for establishing requirements for testing procedures.

3.1 FMEA Reports

The FMEA report shall include the following data:

- a. Higher design level FMEA data
- b. Application of FMEA data
- c. Design and engineering data upon which the FMEA data are based.

The contractor shall submit with the FMEA report a complete set of engineering drawings, design data, and all other such data utilized in the preparation of the FMEA and required to perform a thorough review and critique of the FMEA data.

3.2 FMEA Preparation

The basic objectives of this activity shall be to identify modes of failure in the equipment that could cause severe degradation or loss of an equipment mode of operation, equipment function, and to make recommendations for an appropriate corrective action or provide justification for retaining modes of failure.* This effort will be initiated as an integral part of the early design process.

The following basic data elements shall be considered in the FMEA:

- a. Item/function identification
- b. Failure definition
- c. Failure effect

* The FMEA shall also consider hazards involved in the crew and spacecraft interfaces.

- d. Time to have effect (if applicable)
- e. Detection method (if applicable)
- f. Recommended corrective action or justification

3.3 Level of FMEA Effort

The contractor's FMEA effort shall be directed toward discerning the principal and most probable causes for degradation or failure of equipment functions. The manpower level considered necessary by the contractor for satisfying this level of effort shall be estimated in the contractor's response to the request for proposal, along with a detailed listing of the areas, materials, functions, and assemblies which are proposed to be included in the FMEA effort.

4.0 Design Review Program

The contractor shall establish and conduct a formal design review program in accordance with paragraph 7.0 of the statement of work. This review shall include a comprehensive critical audit of all pertinent aspects of the design, particularly its reliability. Participation shall be interdepartmental, including personnel from design, fabrication, reliability, quality parts application, and other areas of the contractor's organization, as well as NASA representatives (at the discretion of the cognizant NASA installation).

The contractor shall provide notification to the cognizant NASA installation or its designated representative, when so delegated, 15 days in advance of each review, as to the date, time, location, and descriptive information on the review.

Design review reports, including a listing of representation at the review, a statement of actions to be taken, and responsibility shall be provided to NASA within 15 days after the review meeting.

5.0 Failure Reporting and Correction

The contractor and subcontractors shall employ a strictly controlled system for the reporting, analysis, correction, and data feedback of all failures and malfunctions that occur. This system shall emphasize reporting and analysis of all failures and malfunctions that occur, regardless of their apparent magnitude, so that timely and appropriate evaluation, corrective and preventive action, and follow-through can be accomplished by cognizant design, fabrication, quality, and/or field personnel.

A failure is defined as the inability of a system, subsystem, component, or part to perform its required function within specified limits, under specified conditions for a specified duration.

Failure reporting to NASA MSC shall be initiated by the contractor commencing with end-item tests, such as predelivery acceptance, and continuing until the article has been delivered. The contractor shall report all failures regardless of the circumstances under which they occur.

5.1 Failure Report Submittal

The contractor shall report all failures to NASA MSC by MSC form 2174 FIAR (failure investigation analysis report). These reports shall be completed and forwarded by U. S. Airmail within 48 hours after the failure is isolated. A copy of the form shall be transmitted to the following address:

Problem Assessment Engineering, Unit 763
P. O. Box 58408
Houston, Texas 77058

A copy of the form shall be provided to the delegated resident Government agency.

Significant failures shall be reported by telephone to NASA MSC within 24 hours of occurrence to the following contact point:

NASA Problem Assessment Engineering Unit
Telephone: Area code 713 932-4511
Extension 3443 or 3440

5.2 Failure Analysis and Corrective Actions

Failure analyses and recommended corrective actions shall be submitted to MSC within 10 working days after the initial notification of the failure.

6.0 Testing and Reliability Evaluation

The contractor shall establish a testing program during the design and development process for evaluating the system reliability and the performance characteristics of the equipment under actual/simulated mission conditions.

In general, testing should be directed toward assessing the performance capability of the hardware toward identification of potential failures which are not revealed in design reviews and reliability analyses. Tests shall be planned using statistical design of experiment techniques, insofar as practicable, and shall be conducted under levels of environmental stress and for periods of time appropriate to the purpose of the test. Tests should be designed to accomplish the following:

- a. Verify design performance including reliability and life expectancy

b. Identify unexpected interactions among components

c. Identify failure modes, reflecting design weaknesses and defects in materials, workmanship, and quality control

6.1 Preparation of Testing Data

The contractor shall prepare a separate test plan, test procedure, and test report for each test in its testing program and shall review and approve those generated as a part of test programs of subcontractors and suppliers. All test plans and procedures shall be subject to NASA review. As a minimum, these documents shall include the following:

a. Test plan shall state test objectives, the test item, number of specimens to be tested, environmental and performance conditions, testing time or cycles, allowable maintenance, logging requirements, manner of analysis and utilization of test results, disposition of test specimens, retest requirements, and definition of failure.

b. Test procedures shall prescribe steps to be accomplished in detail and sequence, test equipment to be used and calibration requirements, layout and interconnection of equipment, and safety practices (for equipment and personnel) to be observed.

c. Test reports shall reference the test procedure used and shall include the pertinent test plan as an appendix. Formal reports of each test shall be issued as early as practicable following completion of testing.

The qualification test plan and qualification test reports shall be submitted to NASA MSC for review and approval as Type I document. Prior to testing, the test plan shall be approved by NASA MSC.

7.0 Limited Life Program

The contractor shall identify those components whose operating or calendar life is such that there is a possibility of performance degradation during the expected use span of the components. Replacement or refurbishment points shall be established which assure adequate remaining life for the components. Equipment logs shall be maintained for all time/cycle sensitive components. Entries shall be complete and self-explanatory and shall include, but not be limited to, the following:

a. Material name

b. Material number

c. Date of manufacture

d. Life limit

The contractor shall submit a proposed list of time/cycle sensitive components to NASA.

8.0 Materials Program

The contractor shall, as a general policy, select materials for the system on the basis of proven qualification of each material for its application(s). Every effort shall be made to select items already qualified to pertinent specifications and to use the minimum practicable number of styles of each generic type. Specifications covering protective packaging requirements shall be prepared, where applicable. All such materials specifications shall be available to the cognizant NASA installation for review.

8.1 Nonmetallic Materials Program

Nonmetallic materials used in the experiments equipment shall meet the flammability and outgassing requirements of MSC-PA-D-67-13.

The contractor shall establish, at its installation, cognizant materials engineers who will be responsible for reviewing materials problems and formulating and submitting deviation requests to NASA. The contractor shall prepare a Nonmetallic Materials List for submittal to and approval by NASA MSC.

The contractor shall not perform nonmetallic materials flammability outgassing testing.

9.0 NASA Materials Application Problems

The contractor shall establish a program for problem reporting utilizing NASA materials quality and application problem ALERTS (MSC form 863) to perform the following tasks:

a. On receipt of a problem ALERT from NASA MSC, the contractor shall initiate the immediate investigation for usage and significance of the problem item identified by the ALERT in its in-house program and in that of its subcontractors and suppliers.

b. Subsequent to the start of acceptance testing, when investigation discloses known or suspected usage of the problem item identified in the problem ALERT, unsatisfactory condition report (FIAR) shall be issued against each element of program equipment having such usage. The FIAR shall be resolved and closed out in conformance to established program procedures.

c. The contractor shall provide a documented response on each ALERT investigation and resolution to NASA MSC contracting officer within 30 days of receipt of ALERT with copies to the ALERT coordinator (MSC 1E). Beginning 30 days prior to the mission FRR to which the hardware is assigned and continuing through launch, minimum-time communication-media (hand carry, telecommunications, TWX, visit, memorandum, etc.) shall be utilized for timely distribution of advance copies of ALERTS being transmitted to the contractor for immediate investigation and reply.

The response shall indicate or provide (a) conformed, suspected, or no usage of the problem item, (b) problem analysis, recommendations, or corrective action accomplished to resolve the problem, and (c) identification of issued unsatisfactory reports, as applicable.

10.0 Reliability Documentation Requirements

The contractor shall report on the progress of the reliability program and each task therein on the same schedule as the reporting of overall technical progress. The reliability report may be submitted as a separate section of the regular periodic progress report and shall include information on the following for the reliability programs of the contractor and subcontractors:

- a. Technical progress of the reliability program including significant accomplishments and milestones reached
- b. Reliability problem areas and anticipated reliability program slippages and their effects
- c. Revised schedules for work and significant program events in the succeeding reporting period
- d. Significant decisions and actions having impact on the reliability effort and their effects on the program
- e. Pertinent technical data, reports, and summaries
- f. Current manpower levels applied to reliability tasks

Reliability documentation is to be submitted as follows: one copy to the contract technical monitor, two copies to the contract designated reliability monitor, and one copy to the contracting officer.

The documentation categories for approval, review, and information are as follows:

- a. Type I - Documentation to be submitted to NASA MSC for approval
- b. Type II - Documentation to be submitted to NASA MSC for review. NASA MSC has the right to disapprove this type of document.
- c. Type III - Documentation that is maintained at the contractor's facility but which shall be available upon request by NASA MSC for information or review

RELIABILITY DOCUMENTATION SCHEDULE

<u>Document</u>	<u>Type</u>	<u>Submittal Date</u>
Reliability Program Plan	I	20 days after contract award
Monthly Reliability Progress Report	II	With monthly progress report
Design Review Reports/ Minutes	II	15 days after review meeting
FMEA	II	3 months after contract award
Qualification Test Plan and Report	I	60 days prior to test (plan) 30 days after test (report)
Nonmetallic Materials Plan, Tests, and Lists	I	30 days after contract award
Failure Reports	II	As required
Time/Cycle Sensitive Components List	II	30 days after contract award and revised as necessary
Time/Cycle Sensitive Components Equipment Logs	III	Implemented with initiation of processing of applicable components and materials