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VOLUME II
PROGRAM PLAN

PART I-A, Technical Administration Documents

NCS-211A

For SNP-1, Contract Year 1963

26 November 1962

MASTER

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PART I-A, TECHNICAL ADMINISTRATION DOCUMENTS

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1. TASK TITLE: REACTOR SUBASSEMBLY

2. PURPOSE AND OBJECTIVES:

The preimary contribution of LRP to this task is to provide the technical management and liaison with WANL for the LRP supplied NRX hardware required by the NRX test program-principally the pressure vessel, nozzle, instrumentation and certain non-nuclear plumbing. In addition, designs for all equipment unique to the NRX-A test series, design review and fabrication of that equipment are included in this subtask. This includes coordination of all NRX-A hardware design and fabrication to ensure proper integration of the system at NRDS.

3. RELATED WORK AND BACKGROUND:

The work to be performed under this task is directly related to, and is a continuation of preliminary design efforts conducted during Contract Year 1963. It is further related to, and dependent on, the experimental work performed under the cognizance of LASL.

4. DESCRIPTION OF WORK PROGRAM:

In fullfillment of this subtask, the policy and procedural requirements necessary to fulfill subtasks 2.6, 4.1, 4.2, 4.3, and 4.4 will be borne by this subtask.

4.0 The sub-subtasks of this subtask are:

- 1.3.0 Engine Integration and Technical Management
- 1.3.1 Mechanical Design
- 1.3.2 Thermal and Fluid Flow Analysis
- 1.3.3 Nuclear Design and Radiation Analysis
- 1.3.4 Control System Design and Testing
- 1.3.5 Fuel Element Fabrication and Process Development
- 1.3.6^{plc} Non-Nuclear Subsystem Parts, Fabrication and Processes
- 1.3.8 Nuclear Subsystem Development Test Plan and Operation
- 1.3.9 Reactor Models and Mockups

Of these, LRP will contribute to sub-subtasks 1.3.0 and 1.3.6 during Contract Year 1963.

4.1 Sub-Subtasks 1.3.0 - Engine Integration & Technical Management Administration

In fulfillment of this subtask, the policy and procedural requirements necessary to fulfill subtasks 2.6, 4.1, 4.2, 4.3 and 4.4 will be borne by this subtask.

a. Engineering

(1) Liaison with WANL, SNPO-C, and LASL and with the technical management responsible for the design and development of all hardware indicated below will continue through this period to guarantee the accurate integration of all hardware at NRDS as discussed below.

(a) Three NRX titanium pressure vessels will be shipped to NRDS on 1 June, 17 August and 16 November 1963, and three NRX nozzles will be shipped 26 June, 17 August and 16 November 1963 for NRX-A1, A2, and A3 test respectively. One NRX aluminium pressure vessel will be available 5 April 1963 in order to provide backup for the titanium pressure vessel program. One set of aluminium pressings and one spare NRX nozzle will be available in order to support a change in the NRX program. Westinghouse reflector and core assembly will be shipped directed to NRDS where they will be mated with the pressure vessel and nozzle.

(b) Design and fabrication of the above items will occur under subtask 1.4 and will be made available to this sub-subtask for NRX-A1, A2 and A3 test.

(c) All of the NRX-A series instrumentation will be developed under subtask 2.4 and provided in June 1963 to sub-subtask 1.3.6 for the NRX-A test series. REON, Dept. 737, is responsible for the maintenance of the NRX interface drawings. These drawings are binding on all participants and represent the official configuration and tolerances for the interfaces. Engineering liaison between LRP and REON will be provided to facilitate preparation of these drawings.

b. Fabrication

Not Applicable

c. Testing

Not Applicable

4.2 Sub-Subtask 1.3.6 - Non-Nuclear Subsystem Parts. Fabrication and Processes.

Administration

a. Engineering

(1) A special pump discharge line unique to the NRX-A test series will be designed under this sub-subtask.

(2) Detail fabrication drawings for the discharge line to be used on NRX-A1 will be released 1 February 1963.

b. Fabrication

(1) A total of three special pump discharge lines to be used on NRX-A1, A2 and A3 shall be fabricated and shipped to NRDS 26 June, 17 August and 16 November 1963.

S/T 1.3 - REACTOR SUBASSEMBLY

S/S/T 1.3.0 ENGINE INTEGR. + TECH MANAGEMENT

M/P REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
014400	9546	1.3.0	START NRX-A LIAISON	6S	100162
014401	9546	1.3.0	COMPLETE NRX-A LIAISON	6S	093063
014402	9546	1.3.0	RECEIVE NRX-A1 INTERFACE CRITERIA	6S	120362
014403	9546	1.3.0	RECEIVE NRX-A2 INTERFACE CRITERIA	6S	021563
014404	9546	1.3.0	RECEIVE NRX-A3 INTERFACE CRITERIA	6S	051563
014405	9546	1.3.0	SHIP NRX-A1 PRESSURE VESSEL INSTRUMENTATION & SPECIAL PLUMBING TO NRDS	6S	060163
014406	9546	1.3.0	SHIP NRX-A1 NOZZLE TO NRDS	6S	062663
014407	9546	1.3.0	SHIP NRX-A2 PRESSURE VESSEL, NOZZLE, INSTRUMENTATION, AND SPECIAL PLUMBING TO NRDS.	6S	081763
014408	9546	1.3.0	SHIP NRX-A3 PRESSURE VESSEL, NOZZLE, INSTRUMENTATION AND SPECIAL PLUMBING TO NRDS.	6S	111663

LRP NERVA PROPOSED LEVEL SIX MILEPOSTS CY 63

S/T 1.3 REACTOR SUB ASSEMBLY S/S/T 1.3.6 NON NUCLEAR SUB PARTS

M/P NO	REV NO	DEPT CONT ITEM	DESCRIPTION	CD	DATE
014800	9647	136	RELEASE DETAIL FAB DWG OF NRX-A1 SPECIAL PLUMBING	6S	020163
014801	9647	136	COMPLETE FAB OF NRX-A1 SPECIAL PLUMBING	6S	052563
014802	9647	136	RELEASE DETAIL FAB DWG OF NRX-A2 SPECIAL PLUMBING	6S	041563
014863	9647	136	COMPLETE FAB OF NRX-A2 SPECIAL PLUMBING	6S	081063
014804	9647	136	RELEASE DETAIL FAB DWG OF NRX-A3 SPECIAL PLUMBING	6S	071563
014805	9647	136	COMPLETE FAB OF NRX-A3 SPECIAL PLUMBING	6S	111363

SUBTASK 1.3

Difference in Contract Mileposts

1. P.V. Interface gages are shipped under S/Task 1.1.
2. & can not be correct, because the components (P.V., Nozzle, Instrum. and Special Plumbing) will not be shipped to NRDS until 1 June 63, 17 Aug 63, and 16 November 1963.

1. TASK TITLE: REMOTE HANDLING SYSTEM

2. PURPOSE AND OBJECTIVES:

The purpose of this subtask is to identify, design, and develop remote handling equipment necessary to satisfy the functional requirements of the NERVA engine non-nuclear components throughout their development program. This effort encompasses:

- a. Remote tools required to assemble and disassemble the NERVA non-nuclear engine in the Hot Engine Disassembly Bay at NRDS.
- b. All remote equipment required to handle, inspect and disassemble the NERVA non-nuclear subassemblies and components in the Engine Component Disassembly Cell and Post Mortem Hot Cells at NRDS.

3. RELATED WORK AND BACKGROUND

Previous LRP experience in the remote handling field is primarily the effort conducted during Contract Year 1962.

The status at the end of Contract Year 1962 was as follows:

- a. The preliminary remote assembly-disassembly procedures for the engine subassemblies and major components completed.
- b. The remote handling portion of the Ground Support Equipment Design Criteria Specification completed.
- c. The preliminary end item specification for Rocket Engine Remote Tool Kit completed.
- d. The preliminary Operating Ground Equipment Section (OGES) of the Support Equipment System Plan completed.
- e. The preliminary Provisioning Data Sheets completed.

4. DESCRIPTION OF WORK PROGRAM

In fulfillment of this subtask, the policy and procedural requirements necessary to fulfill subtasks 2.6, 4.1, 4.2, 4.3, and 4.4. will be borne by this subtask.

4.0 The sub-subtasks of this subtask are:

2.1.0 - Contractor In-Plant Equipment

2.1.1 - SIE Experiment Equipment

2.1.2 - SIE Reactor Equipment

2.1.3 - NRX

2.1.5 - E Engine Equipment

2.1.6 - Engine Installation Vehicle

2.1.7 - Facilities Support Equipment

2.1.8 - Test Stand Equipment

2.1.9 - Launch Operations

The only sub-subtask that LRP contributes to during this Contract Year is 2.1.5 - "E" Engine Equipment

4.1 Sub-Subtask 2.1.5 - "E" Engine Equipment

a. Engineering

(1) The portion of the Support Equipment System Plan pertaining to the remote handling system, and consisting of the Operation Ground Equipment (OGES), will be completed in final form and released.

(2) The preparation of final end-item specifications for remote handling equipment required in support of the NERVA program will be completed.

(3) The final procedures for remote assembly-disassembly of the NERVA engine subassemblies and components will be prepared.

(4) Preparation of final Provisioning Data sheets for remote handling equipment will be completed.

(5) Design efforts on all remote handling equipment required for support of the "E" engine will be initiated.

b. Fabrication

No fabrication of remote handling GSE will be performed during this period.

c. Testing

No testing on remote handling GSE will be conducted during this period.

LRP NERVA LEVEL SIX MILEPOSTS CY 63 - NCS-211A

S/T 2.1 - REMOTE HANDLING EQUIPMENT S/S/T 2.1.5 - E-ENGINE EQUIPMENT

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
022500		9632	215	START DESIGN LAYOUT OF REMOTE HANDLING EQUIPMENT	4S	120362
022450		9632	215	COMP PRELIMINARY END-ITEM SPECIFICATIONS	6S	033163
022520		9632	215	START DESIGN REVIEW REMOTE HANDLING EQUIPMENT	6S	062863
022590		9632	215	COMP FINAL SUPPORT EQUIPMENT SYSTEM PLAN	6S	093063
022570		9632	215	COMP FINAL PROVISIONING DATA LIST	6S	093063
022550		9632	215	COMP FINAL END-ITEM SPECIFICATIONS	6S	093063

1. TASK TITLE: GSE CHECKOUT AND TEST

2. PURPOSE AND OBJECTIVES:

To identify, design, and develop the checkout and test system required for support of the NERVA non-nuclear engine and its sub-assemblies in the following areas:

- 2.1 - LRP complex
- 2.2 - E-MAD receiving inspection
- 2.3 - E-MAD cold area
- 2.4 - NRDS test stands
- 2.5 - NRDS control points

3. RELATED WORK AND BACKGROUND

Previous LRP experience in this area of effort includes design and development of similar equipment for chemical rocket engines and work performed during Contract Year 1962. Mileposts are shown on Page 2.2-(5).

At the end of Contract Year 1962, the following work had been accomplished.

- a. The checkout and test portion of the GSE design criteria specification.
- b. A preliminary Operating Ground Equipment Section (OGES) of the support equipment system plan, which includes:
 - (1) The functional flow analysis in the LRP and NRDS complexes.
 - (2) All scheduled engine, facility and personnel requirements in the LRP and NRDS complexes.
 - (3) Identification of end items of checkout and test equipment.

The preliminary Maintenance Ground Equipment Section (MGES) portion of support equipment system plan pertaining to the checkout and test system was 30% complete. This portion consists of:

- a. A functional analysis of systems and components which require maintenance
- b. Recommendations for the levels of maintenance to be performed.
- c. The checkout and test equipment necessary to support such maintenance.

4. DESCRIPTION OF WORK PROGRAM

In fulfillment of this subtask, the policy and procedural requirements necessary to fulfill subtasks 2.6, 4.1, 4.2, 4.3 and 4.4 will be borne by this subtask.

4.0 The sub-subtasks of Subtask 2.2 are:

2.2.0 - Contractor In-Plant Equipment

2.2.1 - SIE Experiment Equipment

2.2.3 - NRX

2.2.5 - "E" Engine Equipment

2.2.6 - Checkout and Control Trailer

2.2.8 - Test Stand Equipment

2.2.9 - Launch Operation Equipment

The only sub-subtask that LRP contributes to during this contract year is 2.2.5 - "E" Engine Equipment.

4.1 Sub-Subtask 2.2.5 - "E" Engine Equipment

a. Engineering

The accomplishments during the Contract Year 1963 will include the following:

- (1) That portion of the support equipment system plan, consisting of the Operating Ground Equipment Section (OGES), pertaining to checkout and test equipment will be completed in final form and released.
- (2) Completion of the preparation of GSE end item specifications for those items of checkout and test equipment required in support of the "E" Engines.
- (3) The design efforts on the following checkout and test equipment, which were started during Contract Year 1962, will be completed.
 - (a) Engine Manual Pressure Test Kit
 - (b) Thrust Chamber Closure
 - (c) Leak Detector Kit
 - (d) TPA Manual Pressure Test Kit
- (4) Initiation of design efforts on the remaining GSE checkout and test items defined as a result of the support equipment system plan.
- (5) Completion of preparation of the Final Provisioning Data sheets.

b. Fabrication

There will be no fabrication in this contract period.

c. Testing

There will be no testing during this contract period.

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SUBTASK 2.2 - GSE CHECKOUT AND TEST SUB-SUBTASK 2.2.5 - CONTRACT IN-PLANT EQUIP

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
023300		9632	225	START DESIGN LAYOUT CHECKOUT & TEST EQUIPMENT	4S	121562
023320		9632	225	START DESIGN REVIEW CHECKOUT & TEST EQUIPMENT	6S	030963
023250		9632	225	COMPLETE PRE END-ITEM SPECIFICATIONS	6S	032463
023390		9632	225	COMPLETE FINAL SUPPORT EQUIPMENT SYSTEM PLAN	6S	093063
023370		9632	225	COMPLETE FINAL PROVISIONING DATA LIST	6S	093063
023350		9632	225	COMPLETE FINAL END ITEM SPECIFICATIONS	6S	093063

1. TASK TITLE: GSE LOGISTICS

2. PURPOSE AND OBJECTIVES:

The objective of this task is to identify, design, and develop a logistics system which includes service, handling, maintenance, and transport equipment to support the NERVA non-nuclear engine and its subassemblies in the following areas:

LRP Complex

Transportation from LRP to NRDS

E-MAD Receiving Inspection

E-MAD Warehouse

E-MAD Cold Bay

3. RELATED WORK OR BACKGROUND:

Previous LRP experience includes design and development of similar equipment for chemical rocket engines and work performed during Contract Year 1962 on the NERVA program.

At the end of Contract Year 1962, the following work has been accomplished:

a. Completion of the logistic system portion of the GSE design criteria specification.

b. Completion of the preliminary Operating Ground Equipment Section (OGES) of the support system plan which includes:

(1) The scheduled functional flow analysis in the LRP and NRDS complexes and the transport between these areas.

(2) All scheduled engine, facility and requirements in the LRP and NRDS complexes.

(3) Identification of end items of logistics equipment.

c. Completion of the preliminary Maintenance Ground Equipment Section (MGES) of the Support Equipment System Plan consisting of the following:

(1) A functional analysis of systems and components which will require maintenance and recommendations for the level of maintenance to be performed.

(2) Identification of the logistics equipment required to support such maintenance.

d. Completion of the preliminary design of those end items of the logistics equipment required in support of the cold-flow development system test program.

e. Completion of the preliminary provisioning data sheets.

4. DESCRIPTION OF WORK PROGRAM

In fulfillment of this subtask, the policy and procedural requirements necessary to fulfill subtasks 2.6, 4.1, 4.2, 4.3 and 4.4 will be borne by this subtask.

4.0 The sub-subtasks of Subtask 2.3 are:

2.3.0 - Contractor In-Plant Equipment

2.3.1 - SIE Experiment Equipment

2.3.2 - SIE Reactor Experiment

2.3.3 - NRX

2.3.5 - "E" Engine Equipment

2.3.7 - Facilities Support Equipment

2.3.8 - Test Stand Equipment

2.3.9 - Launch operations equipment

The only sub-subtask to which LRP contributes during this contract year is 2.3.5 - "E" Engine Equipment.

4.1 Sub-Subtask 2.3.5 - "E" Engine Equipment

a. Engineering

Accomplishments during Contract Year 1963 will include:

- (1) Preparation and release of that portion of the Support Equipment System Plan pertaining to the GSE logistics equipment and consisting of the Operating Ground Equipment Section (OGES).
- (2) Preparation and release of final end-item specifications for logistics equipment required in support of the "E" Engines.
- (3) Design of the following logistics equipment:
 - (a) Container, Nozzle
 - (b) Manual Tool Kit, Rocket Engine
 - (c) Manual Tool Kit, Turbopump
 - (d) Sling, Multiple Use
 - (e) Stand, Assembly and Maintenance, TPA
 - (f) Sling, Nozzle
 - (g) Sling, Upper Thrust Structure
 - (h) Sling, Lower Thrust Structure
 - (i) Sling, Pressure Vessel
 - (j) Stand, Upper Thrust Structure
 - (k) Stand, Lower Thrust Structure
 - (l) Sling, Pressure Vessel Head

- (m) Sling, Reflector
- (n) Sling, Top Shield
- (o) Assembly Platform R & E
- (p) Stand, Adapter Ring - Engine
- (q) Stand, Adapter Handling

(4) Initiation of design efforts on the remaining GSE logistics items defined as a result of the Support Equipment System Plan.

(5) Preparation of final provisioning data sheets

b. Fabrication

(1) Fabrication will be completed on those items of logistics equipment identified in a.(3) above.

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S/T 2.3 - GSE LOGISTIC HANDLING S/S/T 2.3.5 - CONTRACT IN-PLANT EQUIPMENT

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
0224420		9632	235	COMP PREL END ITEM SPECS OF EQUIP FOR NRX-A	6S	103062
0224430		9632	235	COMP DES LAYOUT OF GSE FOR CFDTS INCLUDES DETAIL DWG	6S	013163
024450		9632	235	COMP DES REVIEW OF GSE FOR CFDTS INCLUDES DWG CHECK & RELEASE	4S	022863
024440		9632	235	COMP DES LAYOUT OF GSE FOR NRX-A INCLUDES DETAIL DWG	6S	022863
024480		9632	235	COMP PREL END ITEM SPECS OF EQUIP FOR E-ENGINES	6S	033163
024460		9632	235	COMP DES REVIEW OF GSE FOR NRX-A INCLUDES DWG CHECK AND RELEASE	6S	033163
024470		9632	235	START DESIGN LAYOUT OF GSE FOR E-ENGINES	4S	040163
024500		9632	235	COMP FAB OF GSE FOR CFDTS	4S	041563
024520		9632	235	COMP DELIVERY OF GSE FOR CFDTS	4S	052463
024510		9632	235	COMP FAB OF GSE FOR NRX-A	6S	061563
024490		9632	235	START DESIGN REVIEW OF GSE FOR E-ENGINES	6S	070163
024485		9632	235	START R & D TEST OF GSE	6S	070163
024530		9632	235	COMPLETE DELIVERY OF GSE FOR NRX-A	6S	072063
024590		9632	235	COMPLETE FINAL SUPPORT EQUIP SYSTEM PLAN	6S	093063
024570		9632	235	COMPLETE FINAL PROVISIONING DATA LIST	6S	093063
024550		9632	235	COMPLETE FINAL END ITEM SPECIFICATIONS	6S	093063

2.3-(5)

MILEPOSTS FOR 2.3

	<u>Title</u>	<u>New Date</u>
6.	CFDTS (GSE) Design Completed	2/28/63
7.	CFDTS (GSE) Fabrication Completed	4/15/63
8.	CFDTS (GSE) Delivery Completed	5/24/63

The above dates are consistent with the June 1963 CFDTS Fabrication Start and August 1963 Test Date

Number 8. - Changed from Acceptance Test Completed to Delivery Completed as the equipment is used in-house and no acceptance tests are involved.

HOT BLEED CYCLE PROPOSAL DATED 10-19-62

REV. 211A 11-26-62

[illegible]

1. TASK TITLE: RELIABILITY AND QUALITY CONTROL

2. PURPOSE AND OBJECTIVES:

To conduct a planned Reliability Program to ensure that the NERVA engine, subsystems, components, and related support equipment meet the required reliability objectives. To implement the applicable provisions of NPC 200-2 and 200-3, as interpreted by NERVA Operations Policy and Procedure Statement (NOPPS) IV-B1, and to assure control of the quality of the program effort and project hardware to the requisite level.

3. RELATED WORK AND BACKGROUND:

The reliability task is an integral part of the engine development program. The reliability programs that have been conducted during other engine development programs, along with the reliability program that was developed during the past contract periods, provide experience that will permit accomplishment of the work program described below. During this contract period the requirements of NPC 200-2 will be partially integrated into the program. The NOPPS IV-B1 outlines these requirements, required interpretations, and the time phasing to be used in this contract period to partially comply with NPC 200-2.

4. DESCRIPTION OF THE WORK PROGRAM:

4.0 The two sub-sub-tasks are 2.6.1 - Reliability and 2.6.2 - Quality Control.

The programs described herein are applicable from 1 October 1962 through 31 March 1963. LRP will submit a program plan for REON approval by 1 January 1963, which will cover the period from 1 April 1963 through 30 September 1963.

4.1 Sub-Sub-Task 2.6.1 - Reliability

Administration

In fulfillment of this sub-sub-task, the policy and procedural requirements necessary to sub-tasks 4.1, 4.2, 4.3, and 4.4 will be borne by this sub-sub-task.

a. Engineering

(1) Integration and Technical Management

Technical management of the reliability effort will be provided by the LRP Reliability Organization. This effort will include preparation and maintenance of mile-post computer programs, preparation and maintenance of specific work statements defining the tasks to be performed, monitoring the reliability program status, preparation of monthly progress reports and coordination of the technical requirements and accomplishments with other LRP departments.

(2) Design Review

Design criteria for the NERVA engine and support systems, which is recorded, maintained, and distributed by the Nuclear Engine Department on a current basis, will be studied for reliability application. Design Information Lists (DIL) will be prepared as a result of the study to summarize the design criteria for each significant component. The DIL includes performance and environmental summaries that are significant to reliability, relative failure potential (RFP) calculations to establish probability of failure, and modes of failure analysis (MOFA)

with associated causes and corrective action. The DIL will be distributed, with appropriate reports, to cognizant design engineering departments and revised as necessary. Component designs subject to review activity are indicated by the PERT milestone chart for this sub-sub-task.

(3) Design of Experiments and Test Plan Evaluation

Test plans will be reviewed as applicable and recommendations made concerning reliability requirements. The estimated number, type, and sequence of tests will be indicated as applicable. Statistical design of experiment techniques will be used and ground rules for predeclaration and classification of tests will be determined as needed. Component test plans subject to this evaluation are indicated by the milestone chart for this sub-sub-task.

(4) Apportionment

The reliability goal for the E-3 engine was apportioned among the various components as a part of the effort applied during the Phase 1 activity (10 July 1961 through 10 January 1962) and re-evaluated in August 1962. This apportionment will be amended in December 1962 and August 1963, on the basis of existing design and test results. Reliability goals and growth curves for the engine and subsystems will be maintained as applicable.

(5) Data Processing

- (a) Summary data of test results will be provided by departments cognizant of the item tested and will be

stored by the Planning Part Number (PPN) of the highest level of assembly tested. Summary Data Sheets will be available at LRP five days after the test. Storage of data will be by manual methods, with computer storage and retrieval to be instituted as test data volume may require. This summary data sheet will include test identification, equipment buildup record, with applicable planning part numbers, AGC part numbers and serial numbers, test objectives, measured environmental and performance conditions, malfunction and failure data, and will reference Quality Control data as may apply. Subsidiary records for each PPN will be maintained as derived from the summary data of test results, and will include the following information:

- 1 AGC Part Number
- 2 Serial Number
- 3 Operating Time and/or Cycles
- 4 Test Number
- 5 Notation of whether the data is applicable for reliability assessment.
- 6 Reference to malfunction-failure data, trouble investigation reports, and corrective action as may be documented and distributed to the Reliability organization.

(b) Evaluation of failure and trouble investigations will be made to determine the results of corrective action and that appropriate records are maintained. Significant reliability problem areas will be monitored to determine the corrective action taken and the effectiveness of the corrective action.

(c) Material for a Reliability Data Book, indexed by PPN, will be developed and the following information will be distributed to cognizant organizations:

- 1 Design Information Lists (DIL)
- 2 Mode of Failure Analysis (MOFA)
- 3 Relative Failure Potential Calculations (RFPC)
- 4 Curves of apportioned reliability goals and assessed reliability, with the assessment method(s) identified.
- 5 Tabulations of test results and failure data, with applicable cross references.
- 6 Apportionment Functional Diagram as an appendix.
- 7 A schedule of availability of the above data by PPN.
- 8 A listing and reference to descriptions of applicable reliability techniques utilized, including methods of assessing reliability, as an appendix.

(6) Analysis of Test Results

Analysis of test results and malfunction data for the engineering and statistical assessment of reliability will be made, with comparison made as applicable to design review

criteria and reliability goals. Curves of assessed reliability will be maintained with identification of the method(s) used in assessing that reliability. As indicated by the milepost chart for this sub-task, reliability assessments are scheduled at six month intervals as a minimum.

b. Fabrication

There will be no fabrication or tooling work performed under this sub-sub-task.

c. Testing

There will be no testing performed under this sub-sub-task.

4.2 Sub-Sub-Task 2.6.2 - Quality Control Engineering

a. Engineering

- (1) The required administration and planning of the Quality Control Program, appropriate to the non-nuclear engine assembly and Aerospace Ground Equipment (AGE), will be provided. This includes the Quality Control Engineering functions, and applicable supervision of the Quality Control Inspection activities. Overall budgets and costing for the inspection function of the Quality Control Program (as differentiated from Quality Control Engineering) are included in the overall fabrication budget. Fabrication unit costs include inspection costs, and actual inspection charges are made against the items inspected. The Quality Control Program Plan for the Contract Year 1963 (October 1962 through March 1963) is included as Appendix A.

Milepost computer programs will be maintained for the sub-sub-task, with scheduled and random audits as required to assure quality program implementation.

(2) Standards Development

Standards for quality procedures, inspection instructions, and inspection standards will be maintained and developed as required. Overall LRP quality requirements will be analyzed as required in establishing NERVA Program Standards for quality.

(3) Design Review

Drawings, specifications and related documents will be reviewed as required for quality. Standard and special processes are included here.

(4) Liaison

Effective liaison will be maintained between the quality organization and other applicable NERVA program organizations, including vendors, that effect product quality. Effectiveness is to be measured and maintained by early recognition of quality problems and supporting corrective action.

(5) Data Analysis

Data pertinent to product quality will be kept under current analysis as required to detect and evaluate immediate and potential quality problems. Pertinent data includes purchasing, vendors, receiving, shops, laboratories and

test area. Statistical control and analysis will be provided on a periodic or special basis as required.

(6) Internal Reporting

Summary monthly reports will be provided as required to describe the quality control activities and to provide input to the contractual monthly letter report. Special reports, with supporting analysis as appropriate, will be made as required by problems concerning quality. Data and details of quality engineering, audit, and inspection functions will be available and traceable to support the findings of summary and special reports, including troubles, failures, and discrepancies.

(7) Engineering Tests

Quality control of non-nuclear engine and AGE equipment tested, recording of test results, and maintenance of logs and records as appropriate to the requesting engineering documents and test requests will be maintained. Trouble, failure, and discrepancy records will be maintained as required.

(8) Inspection Planning

Activities of Inspection Planning will include purchasing, vendors, receiving, shops, laboratories, and the test area. The detail of planning will be adequate to assure that the items procured, fabricated, assembled or tested, will conform to the originating drawings and specifications.

b. Fabrication

There is no fabrication under this sub-sub-task.

c. Testing

There is no testing under this sub-sub-task, other than that associated with the function of equipment inspection.

TITLE: QUALITY CONTROL PROGRAM PLAN FOR CONTRACT YEAR 1963 - FOR NERVA
NON-NUCLEAR ENGINE ASSEMBLY

I. INTRODUCTION (Section 1)

The current LRP Quality Control Program Plan will be continued. This program is in accordance with AGC LRP Quality Control Activity Level (Q-CAL) III, Quality Control Instruction 1-3-1, and as detailed in applicable portions of AGC Quality Control Procedures (QCP), AGC LRP Quality Control Instructions (QCI), and AGC LRP Quality Control Standards (QCS) manuals. Those applicable portions of the current issue of the QCP, QCI, and QCS manuals are included in this program plan by reference. These manuals, as information copies and current as of 27 April 1962 were forwarded through REON to the customer organization (Reference Letter, R. W. Schroeder from W. C. House, dated 27 April 1962, L329). This program will conform to NASA Quality Publication NPC 200-2 and 200-3, as considered applicable to this stage of maturity of the NERVA program, and as defined in NOPPS IV-B1. This applicability to NPC 200-2 and 200-3, as to detail requirements and as to correlation of AGC Q-CAL III, is described in the following paragraphs. These paragraphs are cross referenced to similar paragraphs in NPC 200-2 (April 1962 edition), That cross reference being noted in brackets after each paragraph heading. Cross reference to NPC 200-3 (April 1962 edition) is noted in the appropriate text (Paragraph V). The reliability program complements, but does not duplicate this quality control program. This quality control program and its various documents of implementation will be available for information review as may be required at timely intervals. Revision to the

scope of work, as outlined in this plan, would be considered as a contract and cost change.

II. BASIC REQUIREMENTS (Section 2)

A. Quality Program Documentation

Quality Control documents to be submitted for approval, review, or information will be as described in sub-paragraphs 1 and 2 below. These documents are considered adequate for this stage of maturity of the program.

1. Documents Submitted for Approval and Review

This program plan for Contract Year 1963 (October 1962 through March 1963) constitutes the documents that will be submitted for approval and review. As the program matures, it is anticipated that additional applicable detailed technical documents may be submitted for approval.

2. Documents Submitted for Information

The monthly informal letter reports will include a current status report of the results of implementing this program plan, and will be submitted for information. This will include summary results of receiving, shop, laboratory, and test area inspection; will identify equipment inspected or for which inspection has been waived; indicate equipment found discrepant, category of discrepancy, the cause and corrective action taken; applicable budget and cost data, applicable milestone data and appropriate narrative description. The QCP, QCI, and QCS

manuals already provided, Paragraph 1A above, are for information only and will not be automatically kept current. The changes that are (may be) made in those manuals are considered an internal LRP matter, and no provisions are included for correlating these changes with operations outside of the LRP organization structure.

B. Change Control

1. Present systems provide control of drawings, specifications, planning, inspection procedures, procurement documents and fabrication directives at point of use. Revisions of these existing systems are made on a current basis to meet changing program needs, with obsolete documents purged from the system. In addition to applicable portions of the QCP, QCI, and QCS manuals, the AGC LRP Drafting Room Manual (DRM) applies here. All drawings will be to Type 1, as defined in the AGC LRP DRM.
2. The effectivity point of each change is clearly defined and controlled after a design is established at the prototype level. During development of an experimental design, changes and their documentation are the responsibility of the cognizant engineer.

III. MANAGEMENT (Section 3)

A. Planning and Quality Program Plan Submission

This program plan represents the scope of quality control work and activity to be undertaken during this contract period. The applicable detailed methods of implementing this plan to NOPPS IV-B1

requirements and to Q-CAL III, are shown in the AGC LRP QCP, AGC LRP QCI, and AGC LRP QCS. These quality control documents are on file with the customer organization (See Paragraph 1A above.) Appropriate reviews and discussions for information will be held as required, however, no documents are proposed for submittal other than this program plan for approval, the monthly reports for information, and the referenced QCP, QCI, and QCS manuals for information.

B. Organization

Policy for Quality Control is established by the REON office of Product Assurance for the NERVA program, under the overall direction of the AGC Vice President for Nuclear Rocket Systems, and is expressed in NERVA Operations Policy and Procedure Statements (NOPPS). Implementation of the NOPPS is by project directive (PD) from REON to the LRP NERVA Rocket Operations Division, who then issue an appropriate LRP PD to execute the work. The responsibility for executing the quality work rests with the Quality Control Organization Manager. Various phases of quality work may be delegated and performed outside of the specific quality organization, but responsibility remains vested in the Quality Control Organization Manager.

IV. DESIGN AND DEVELOPMENT CONTROL (Section 4)

A. Drawing and Specification Review

Design review of drawings, specifications and technical documents by Quality Control will be performed concurrent with release for

fabrication or use. All drawings are to be AGC LRP Type 1 configuration and include detailed drawing review procedures that are available for analysis as may be required. The design review includes, but is not limited to, a check for applicable preferred or qualified parts, materials, procedures, and classification of characteristics.

B. Qualification Tests

Qualification tests, related procedures, planning, and lists of parts and qualification status lists, will be provided as the program matures beyond this contract period.

C. Identification

Engineering, fabrication, purchasing, and quality control documents currently provide identification of all serialized and critical non-serialized equipment, material and parts to the extent deemed practical for this stage of the program. Present serialization utilizes the seven-digit system in use throughout the LRP.

V. CONTROL OF CONTRACTOR PROCURED MATERIAL (Section 5)

The procedures for control of subcontracted materials, parts, components, and services will continue to provide the elements described in sub-paragraphs (a) and (b) below, and the proposed level of compliance with NPC 200-3 is limited to those provisions.

A. Selection of Procurement Sources (Vendors)

Selection of vendors from an approved source list is based on vendor history and on-site evaluations. This includes a currently

maintained rating system based on weighing of classification of characteristics and defects.

B. Procurement Documents and Inspection

Procurement documents will continue to be reviewed for quality provisions to be incumbent on the supplier, and for criteria to be used in acceptance inspection as is applicable for this contract period. The AGC LRP Quality Control Standard for suppliers, QCS H-1-3, is used to establish the standard requirements for subcontractor quality programs. Requirements for age control, identification and packaging, inspection records, and chemical, physical, functional, destructive, and non-destructive tests are included here. Special processes are given additional documentation as required. Source inspection will be performed as applicable. Assistance, monitoring, and audit of subcontractor quality control activities will be rendered as required. Suppliers of proprietary designs and components will provide detailed drawings of those items, with applicable manufacturing process and quality control procedures. Acceptance of items at receiving inspection will be controlled by inspection of the item in accordance with the provisions of procurement documents noted above, the Q. C. Planning, and the reports of the Supplier Quality Engineering Group. Records of receiving inspection results will continue to be maintained by contract number and by part number, correlated with the purchase document, and summary reports and analysis provided on a monthly basis. Identity of

inspected items with applicable records is established by traveler tags and data packets, strip marking, and applicable lot number systems. Rejected material is documented as to cause, segregated as applicable, and feedback to the supplier and engineering organization maintained. Appropriate interface gages and test equipment calibration standards are maintained for interplant and subcontractor use. Systems, procedures, and records for the above functions are available for inspection and review as required.

VI. CONTROL OF GOVERNMENT FURNISHED PROPERTY (GFP) (Section 6)

Upon receipt, GFP will be inspected to the extent practical to detect damage in transit and for accountability. Procedures for protection, periodic inspections, storage surveillance, and functional tests before installation will continue in use. The supplying agency of GFP will be advised of any defects that are found to exist upon receipt of that property, and required corrective action indicated.

VII. CONTROL OF CONTRACTOR-FABRICATED ARTICLES (Section 7)

A. Inspection and Test Planning

Inspection and test planning procedures will be continued and progressively developed as required to meet the maturing needs of the program. These procedures and associated records are considered adequate for assuring that the as-built equipment will meet the requirements of the originating engineering drawing and specification documents and include fabrication, processing, assembly, and handling and transport provisions. The applicable characteristics to be measured or observed, with acceptable tolerances, are defined by the

inspection planning and travel with the equipment as it is being fabricated, processed, assembled, and tested.

B. Inspection and Test Performance

Quality Control of testing of major subsystems, engine simulators, and engine will continue to be delegated to the Test Division Organization. Quality Control of applicable laboratory testing will be under the quality control organization. Actual inspection and records evolved will follow the appropriate planning discussed below.

C. In-Process Inspection

Inspection operations are organized and controlled as a result of standard procedures and planning to provide verification of in-process fabrication and processing at points that will provide adequate effectiveness.

D. End Item Tests and Final Inspection

End item test and final inspection is considered applicable to program phases beyond the term of this contract period. However, items provided for use external to AGC LRP will be supported by appropriate logs of equipment buildup and inspection records.

E. Fabrication Control

Equipment and material undergoing fabrication is identified and controlled under present systems. Nonconforming items are identified and withheld from normal channels by hold-tag and bond room control until purged from the system or accepted for conditional as-is-use over the signature of the cognizant engineer. Age/time/cycle/clean

sensitive items will be controlled as specified on the engineering drawings or in applicable specifications. Standard and special tooling and machines are periodically audited for tolerance and maintenance records.

F. Process Control

Standard and special process control procedures will continue in use and be developed progressively as required to establish and maintain requirements for certification in accordance with applicable drawings and specifications.

VIII. NON-CONFORMING MATERIAL (Section 8)

Non-conforming material is segregated into controlled-access bond rooms and held for disposition by engineering and quality control representatives. Non-conforming material records are available for review as required.

IX. INSPECTION, MEASURING AND TEST EQUIPMENT (Section 9)

A. Calibration (Facilities and Standards)

Inspection, measuring and test equipment are calibrated at scheduled intervals against certified standards which have known relationships to National Standards and such calibration is extended as required to document and control the calibration and accuracy of tools, gages, jigs, and fixtures.

B. Evaluation, Maintenance and Control

Standard commercial equipment and special test equipment are periodically evaluated for accuracy, tolerance, and completeness of related records. Critical items are maintained on a controlled

basis. These evaluation procedures and their results are available as required for review.

C. Written Procedures

Written procedures will continue in use for the control of inspection, measuring and test equipment. Periodic revisions of these procedures will be issued as required to meet various program requirements.

X. INSPECTION STAMPS (Section 10)

Systems in use for issue and control of inspection stamps will be continued. These stamps provide indication of equipment of material quality status, inspection station, and identity of the inspector. Traveler tags are used when stamping the article is not practical.

XI. PRESERVATION, PACKAGING, HANDLING, STORAGE AND SHIPPING (Section 11)

Written procedures will be prepared for preservation, packaging, handling, storage, and shipping as applicable to this contract period, and will be reviewed by Quality Control prior to their implementation.

XII. STATISTICAL PLANNING, ANALYSIS, AND QUALITY CONTROL (Section 12)

A. Statistical Analysis and Test Planning

Test planning and analysis of test results of functional tests are reviewed for applicable statistical applications. This work is performed by the Reliability organization.

B. Sampling Plans

Sampling plans, as may be used for quality control applications, are in accordance with applicable military standards. Alternate

sampling plans will be used as indicated by engineering judgement and the nature of the program requirements for this contract.

C. Statistical Quality Control Charts

Statistical quality control charts will be used where they provide an effective aid to quality problem definition and solution. Current usage involves receiving inspection and development shops.

XIII. TRAINING AND CERTIFICATION OF PERSONNEL (Section 13)

A. Training

Existing training and re-training programs will be applied as required to quality control and other personnel who may have an effect upon, or who are responsible for, the maintenance and determination of quality.

B. Certification

Personnel responsible for controlling standard and special processes, or for performing fabrication, assembly and inspection operations of a specialized nature, will continue to be trained and certified in accordance with the quality levels applicable to this contract period. Examples of typical certification include weld, X-ray, cleaning, dye penetrant, and ultrasonic.

XIV. DATA REPORTING AND CORRECTIVE ACTION (Section 14)

A. Data Reporting

The collection, processing, analyzing and dissemination of trouble, failure, and quality data to responsible departments is the responsibility of the Quality Control and Reliability organizations. Functional test results are supplied to the reliability

organization by cognizant engineers for processing, analysis, and reporting of applicable reliability applications. Handling of reliability and quality data is by both manual and automated methods, with increasing use of automated methods anticipated as the program matures beyond this contract period. Applicable portions of the Quality-Reliability Report (QRR) is included here.

B. Monthly Quality Status Report

The informal monthly letter reports will include appropriate narrative discussion and summary technical data on quality control status with analysis as may be required for clarity and interpretation.

C. Laboratory and Experimental Data

Laboratory and experimental data will continue to be kept on file in the laboratories and various engineering organization files and are traceable to related equipment and procedures for reference and review as required.

D. Quality Data

Records of inspection and tests performed in fabrication, process, and assembly will continue to be maintained and are available for reference and review as required.

E. Narrative End Item Report

Narrative end item reports and operational data will be prepared for end items, as may be appropriate beyond this contract period.

F. Corrective Action

Corrective action procedures will continue to feed back information on troubles, malfunctions, and failures, to engineering, procurement, reliability, quality control, fabrication, and supplier organizations, so that appropriate corrective action can be taken. Responsibilities for corrective action rests with the various organizations involved, and are monitored by the Quality Control and Reliability organizations. Corrective action on suppliers, and in-house fabrication, process and assembly problems will continue to be handled by the Quality Control organization. Corrective action follow-up on functional test and performance failure will be monitored by the Reliability organization. Summarized information on significant troubles, malfunctions, failures, and corrective action problems will be included in the informal monthly letter report. Deficient or failed articles will be available for examination as may be required.

XV. AUDIT OF QUALITY PROGRAM PERFORMANCE (Section 15)

Quality Control will continue to perform audits of quality program procedures, inspections, tests, and other areas that have an effect upon quality standards. Periodic reports of audit results will be available as required.

A. Audit Reports and Corrective Action

Results of audits and appropriate recommendations for corrective action will continue to be submitted to management. Summaries of

quality program performance audits and corrective and preventative actions taken will be included as applicable in the informal monthly letter report.

B. Fabrication

There will be no fabrication or tooling under this sub-sub-task.

D. Testing

Testing under this sub-sub-task is limited to the inspection procedures involved in the execution of the various Quality Control functions.

NCS - 211A LRP NERVA PROPOSED LEVEL SIX MILEPOSTS CY 63 ISSUED 111562
S/T 2.6 - RELIABILITY + QUALITY ASSURANCE S/S/T 2.6.1 - RELIABILITY

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
026543		8520	261	COMP DES REVIEW PRESSURE VESSEL ASSY	6S	082063
026798		8520	261	START TEST DATA ANALYSIS GEN II MOD I SIMULATOR	6S	120162
026406		8520	261	START TEST DATA ANALYSIS TANK SHUT-OFF VALVE ASSY	6S	012663
026797		8520	261	COMPLETE TEST DATA ANALYSIS GEN II MOD I SIMULATOR	6S	020163
026795		8520	261	COMPLETE TEST ANALYSIS GEN II MOD IB SIMULATOR	6S	052963
026796		8520	261	START TEST DATA ANALYSIS GEN II MOD IB SIMULATOR	6S	022863
026504		8520	261	START TEST DATA ANALYSIS RCDV CONF 2 DEV TESTING	6S	012863
026576		8520	261	START TEST DATA ANALYSIS TPCV CONF 2	6S	050863
026680		8520	261	COMPLETE TEST PLAN EVALUATION GEN II MOD IB SIMULATOR DEVELOPMENT TEST PROGRAM	6S	012763
026513		8520	261	COMP FAILURE INVESTIGATION & CORRECTIVE ACTION	6S	093063
026512		8520	261	START FAILURE INVESTIGATION & CORRECTIVE ACTION	6C	101062
026510		8520	261	START DATA PROCESSING	6C	100162
026405		8530	261	START RELIABILITY PROGRAM PLAN	6C	111562
026410		8530	261	COMPLETE RELIABILITY PROGRAM PLAN	6S	123162

NCS - 211A LRP NERVA PROPOSED LEVEL SIX MILEPOSTS CY 63 ISSUED 11562
S/T 2.6 - RELIABILITY + QUALITY ASSURANCE S/S/T 2.6.1 - RELIABILITY

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
026677		8520	261	START ENGINE RELIABILITY ASSESSMENTS	6S	070163
026673		8520	261	START REAPPORTIONMENT OF RELIABILITY GOALS	6S	120162
026674		8520	261	COMPLETE REAPPORTIONMENT OF RELIABILITY GOALS	6S	010163
026676		8520	261	COMPLETE FIRST ENGINE RELIABILITY GOAL APPORTIONMENT	6S	081563
026675		8520	261	START REAPPORTIONMENT GOALS	6S	071563
026678		8520	261	COMPLETE ENGINE RELIABILITY ASSESSMENTS	6S	083063
026790		8520	261	COMP TEST PLAN EVALUATION TCA STRUCTURAL EVAL TESTING	6S	010763
026784		8520	261	COMP TEST DATA ANALYSIS THRUST STRUCTURE TEST NO. 1	6S	031563
026786		8520	261	START TEST DATA ANALYSIS NOZZLE	6S	070163
026785		8520	261	COMPLETE TEST DATA ANALYSIS NOZZLE	6S	093063
026792		8520	261	START TEST DATA ANALYSIS COLD FLOW DEVEL TEST SYSTEM	6S	080863
026511		8520	261	COMPLETE DATA PROCESSING	6S	093063
026789		8520	261	START TEST DATA ANALYSIS TCA DYNAMIC TESTING	6S	071563
026443		8520	261	COMPLETE DESIGN REVIEW SKIRT	6S	041563

NCS - 211A LRP NERVA PROPOSED LEVEL SIX MILEPOSTS CY 63 ISSUED 111562
S/T 2.6 - RELIABILITY + QUALITY ASSURANCE S/S/T 2.6.1 - RELIABILITY

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
026530		8520	261	COMP DESIGN REVIEW SHUTOFF VALVES PSS EXP.	6S	060163
026479		8520	261	COMP DESIGN REVIEW RELIEF VALVES PSS	6S	080163
026459		8520	261	START DESIGN REVIEW GIMBAL	6C	101562
026462		8520	261	COMP DESIGN REVIEW GIMBAL	6C	113062
026442		8520	261	START DESIGN REVIEW SKIRT	6S	020663
026481		8520	261	COMP DESIGN REVIEW CHECK VALVES PSS EXP	6S	060163
026480		8520	261	COMP DESIGN REVIEW REGULATIONS PSS EXP	6S	080163
026495		8520	261	COMP DESIGN REVIEW THRUST CHAMBER ASSY	6S	030163
026781		8530	261	PUBLISH FIRST INDEX FOR RELIABILITY DATA BOOK	6S	020163
026782		8530	261	PUBLISH SECOND INDEX FOR RELIABILITY DATA BOOK	6S	083063

NCS - 211A LRP NERVA PROPOSED LEVEL SIX MILEPOSTS CY 63 ISSUED 111563

S/T 2.6 - RELIABILITY + QUALITY ASSURANCE S/S/T 2.6.1 - RELIABILITY

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
026769		8520	261	COMPLETE TEST PLAN EVALUATION CFDTs TEST PLAN	6S	071563
026770		8520	261	START TEST DATA ANALYSIS PURGE AND EMERGENCY COOLDOWN CKV'S	6S	081463
026771		8520	261	COMPLETE TEST PLAN EVALUATION TCA DYNAMIC TESTING	6S	062263
026772		8520	261	START DESIGN REVIEW HOT BLEED NOZZLE	6S	020763
026773		8520	261	COMPLETE DESIGN REVIEW HOT BLEED NOZZLE	6S	031263
026774		8520	261	START DESIGN REVIEW BLOCK II GIMBAL ASSY	6S	080563
026775		8520	261	COMPLETE DESIGN REVIEW BLOCK II GIMBAL ASSY	6S	091563
026776		8520	261	START TEST DATA ANALYSIS GIMBAL LAB TESTS	6S	031563
026777		8520	261	COMPLETE TEST DATA ANALYSIS GIMBAL LAB TESTS	6S	090563
026778		8520	261	COMPLETE TEST PLAN EVALUATION HARNESS COMPONENTS	6S	072363
026779		8520	261	COMPLETE DESIGN REVIEW PSS FILTER	6S	070163
026780		8520	261	COMPLETE TEST DATA ANALYSIS THRUST STRUCTURE TEST NO. 2	6S	062263
		8520	261	START REVIEW NERVA PROGRAM MATERIALS PROPERTIES DATA BOOK	6C	110862
		8520	261	COMPLETE REVIEW NERVA PROGRAM MATERIALS PROPERTIES DATA BOOK	6C	111562

NCS - 211A LRP NERVA PROGRAM LEVEL SIX MILEPOSTS CY 63 ISSUED 11 15 62 REV 02

S/T 2.6 RELIABILITY + QUALITY ASSURANCE S/S/T 2.6.2 QUALITY CONTROL

<u>M/P</u> <u>NO.</u>	<u>REV</u> <u>NO.</u>	<u>DEPT.</u>	<u>CONT</u> <u>ITEM</u>	<u>DESCRIPTION</u>	<u>CD</u>	<u>DATE</u>
034827	02	8425	262	COMPLETE INITIAL APPROVAL SUPPLIERS QC & SPECIAL PROCESS PROCEDURES	6C	101562
034828	02	8405	262	COMPLETE INITIAL TRAINING PROGRAM DESCRIPTION	6C	103062
034851	01	8460	262	COMPLETE SYSTEM FOR QC USE PACKAGING AND HANDLING MANUAL	6S	103062
034890	00	8410	262	COMPLETE MONTHLY STATUS REPORT OCTOBER 62	6C	103062
034867	01	8415	262	COMPLETE ESTABLISHMENT OF DOCUMENT CHANGE CONTROL IN SHOPS AND FOR QC PLANNING	6S	110162
034891	00	8410	262	COMPLETE MONTHLY STATUS REPORT NOVEMBER 62	6S	113062
034862	01	8470	262	COMPLETE SYSTEM TO REPORT NERVA DATA IN RECEIVING AND SHOP	6S	120162
034842	01	8455	262	COMPLETE SPEC REVIEW GSE END ITEM TASK 2.1.5	6S	123062
034892	00	8410	262	COMPLETE MONTHLY STATUS REPORT DECEMBER 62	6S	123062
034820	01	8470	262	COMPLETE INSTALLATION OF SERIALIZATION AND LOT CONTROL SYSTEM	6S	010163
034888	01	8410	262	COMPLETE REVISED PROGRAM PLAN FOR LAST HALF CY 63	6S	010163
034815	01	8410	262	COMPLETE FIRST QUARTERLY AUDIT REPORT	6S	011563
034894	00	8410	262	COMPLETE MONTHLY STATUS REPORT JANUARY 63	6S	013063
034895	00	8410	262	COMPLETE MONTHLY STATUS REPORT FEBRUARY 63	6S	022863
034824	02	8470	262	COMPLETE 90% OF OPERATING PROCEDURES FOR QC INSPECTION AND QC ENGINEERING	6S	033063
034896	00	8410	262	COMPLETE MONTHLY STATUS REPORT MARCH 63	6S	033163
034814	01	8410	262	COMPLETE CY 1964 AND 1965 PROGRAM PLAN AND COST STUDY	6S	040163

NCS - 211A IRP NERVA PROGRAM LEVEL SIX MILEPOSTS CY 63 ISSUED 11 15 62 REV 02

S/T 2.6 RELIABILITY - QUALITY ASSURANCE S/S/T 2.6.2 QUALITY CONTROL

<u>M/P</u> <u>NO.</u>	<u>REV</u> <u>NO.</u>	<u>DEPT.</u>	<u>CONT</u> <u>ITEM</u>	<u>DESCRIPTION</u>	<u>CD</u>	<u>DATE</u>
034889	01	8410	262	START IMPLEMENTATION OF PROGRAM PLAN FOR LAST HALF CY 63	6S	040163
034897	00	8410	262	COMPLETE MONTHLY STATUS REPORT APRIL 63	6S	043063
034898	00	8410	262	COMPLETE MONTHLY STATUS REPORT MAY 63	6S	053063
034899	00	8410	262	COMPLETE MONTHLY STATUS REPORT JUNE 63	6S	063063
034900	00	8410	262	COMPLETE MONTHLY STATUS REPORT JULY 63	6S	073063
034825	01	8460	262	COMPLETE APPROVAL OF 90% OF CONTAMINATION CONTROL PROCEDURES	6S	080163
034831	01	8455	262	COMPLETE DESIGN REVIEW E-1 ENGINE LONG LEAD ITEM	6S	081563
034901	00	8410	262	COMPLETE MONTHLY STATUS REPORT AUG 63	6S	083063
034902	00	8410	262	COMPLETE MONTHLY STATUS REPORT SEPT 63	6S	093063
034843	01	8455	262	COMPLETE SPEC REVIEW GSE END ITEM TASK 2.2.5	6S	093063
034844	01	8455	262	COMPLETE SPEC REVIEW GSE END ITEM TASK 2.3.5	6S	093063

1. TASK TITLE: TRAINING

2. PURPOSE AND OBJECTIVES:

The purpose of the NERVA Training Program is to provide an efficient means of qualifying the required number of selected individuals necessary for support of the NERVA Program.

3. RELATED WORK AND BACKGROUND:

The related work and background are consistent with information previously developed in Phase I and Contract Year 1962. Formal training will be provided by a qualified training staff consisting of engineering personnel with experience in rocket propulsion systems and training program management. This staff has extensive experience in the preparation and conduct of technical courses for design, fabrication and test personnel. Members of the present staff participated in the preparation of Proposal No.-61004. This staff is presently engaged in engineer and technician training on the Titan II Missile System, Contract AF 04(647)-521. Previous to this, the staff conducted training programs on the Titan I Missile System, Contract AF 04(647)-49.

4. DESCRIPTION OF WORK PROGRAM:

4.0 The sub-subtasks of this subtask are:

2.8.0 - Technical Management

2.8.1 - Training Analysis

2.8.2 - Training Supervision

2.8.3 - Training Preparation

2.8.4 - Training Presentation

2.8.5 - Training Aids

2.8.6 - Training Equipment

The only applicable sub-subtask for LRP during this contract period is 2.8.1.

4.1 Sub-Subtask 2.8.1 - Training Analysis

a. Engineering

(1) During Contract Year 1963, LRP NERVA Training will consist of training analysis and training program planning. Specific course preparation may be possible. Also, LRP will support the REON Job-Task Analysis Program.

b. Fabrication

This section is not applicable.

c. Testing

This section is not applicable.

LRP NERVA LEVEL SIX MILEPOSTS CY 63

S/T 2.8 S/S/T 2.8.1 Training Analysis

M/P NO	REV NO	DEPT	CONT ITEM	DESCRIPTION	CD	DATE
ENGINEERING						
027200		8980	281	START GATHER DATA FOR TRAINING ANALYSIS	6S	100162
027210		8980	281	START DETERMINE OBJECTIVES OF SPECIFIC COURSES TO BE PREPARED	6S	120162
027215		8980	281	START PLAN SPECIFIC COURSES	6S	010163

1. TASK TITLE: PROGRAM PLANNING AND CONTROLS

2. PURPOSE AND OBJECTIVES

To provide PERT networks and reports at Level 6 for use in program management at LRP and to provide data on Level 6 events for use by REON in the total program networks.

3. RELATED WORK AND BACKGROUND

During Contract Year 1962, networks at Level 4 were established for the proposed program defined by Report 2300. Subsequent revisions in keeping with the program redirection to the Hot Bleed Cycle Engine were initiated during the first month of Contract Year 1963. The definitions of "level" of events established during Contract Year 1962, which are applicable to LRP, are as follows:

- a. Level 4 - LRP events which are reported to SNPO (contract NTAD events).
- b. Level 5 - Summary of major LRP events.
- c. Level 6 - Operating level of LRP networks. Used by LRP and REON for program management (LRP NTAD events).

4. DESCRIPTION OF WORK

4.1 Program Planning and Controls

a. Engineering

(1) Although it is recognized that planning for the program is not final, SNPO-C requires that PERT analysis and reporting on the program be initiated immediately. It is further required that the analysis and reporting be based on the program defined by the planning networks in AGC Report 2300,

with revisions as required to maintain currency. Program revisions at the level shown in the reporting networks must be coordinated with REON.

(2) Networks (activities and events) will be shown and reported in detail for Contract Year 1963 and in less detail for Contract Year 1964. For the work initiated in Contract Year 1964 but logical completion of which occurs in Contract Year 1965, enough detail will be shown to permit the tie in to the Engine Development Schedule (0.0) Network, at the earliest Contract Year 1965 date or the introduction of the first flight type component into the engine development stream (0.0) which ever is later.

(3) Test series as illustrated by the Component-Subassembly Test Schedule prepared for cost studies shall be included as discrete activities at Level 6.

(4) LRP shall submit the following information by TWX every two weeks beginning 10-29-62 on approved REON networks.

(a) List of completed events during the reporting period including event numbers, activity description, and completion dates.

(b) List of events expected to be, but not completed during the report period; new expected completion dates; brief explanation of cause of delay; and effect of delay.

(c) Addition or deletion of events or activities together with event numbers, activity descriptions and activity time estimates.

(d) Revisions in activity time estimates. LRP shall utilize the NASA-PERT (Langley) or the Aerojet PERT program. No requirements for data exchange other than those specified above exist.

1. TASK TITLE: FISCAL CONTROLS

2. PURPOSE AND OBJECTIVES

The purpose of this task is to provide fiscal controls for the overall non-nuclear component development program.

3. RELATED WORK AND BACKGROUND

Several IBM programs are presently being utilized to compile and process cost data into the format desired for LRP management. These programs are continuously being revised as new methods of data presentation are developed.

4. DESCRIPTION OF WORK PROGRAM

Engineering

- a. A work order release plan shall be established to provide cost data identification by contract sub-subtask, complex. In addition, the release plan shall identify significant components and activities of supporting functions.
- b. NERVA cost data shall be processed and distributed in accordance with Enclosure (1).
- c. Processing of budget, cost study and actual-budget comparison data shall be included in this task. All Accounting Department data processing shall be charged to the normal overhead account.
- d. Analysis of cost data for inclusion in the monthly report shall be included in the applicable development subtask.
- e. Processing of work authorization documentation shall be included in this task.

f. Development of improved data handling and analysis techniques shall be included in this task.

FINANCIAL STATUS REPORTS

Enclosure (1)
5 October 1962

4.2

DESCRIPTION	LEVEL OF REPORTING	** DISTRIBUTION			
		ACCTG.	LRP PROGRAM DEPT.	NERVA OPERATIONS 9400	OTHER
WEEKLY REPORTS					
Accounting Reports (Incremental)					
Labor Distribution (Hours Only)	Charging Dept., W.O. Release	X			Charging Department
Charging Department Report	Charging Dept., W.O. Release	X	X		Charging Department
Division Managers Report	Contract, Charging Dept., W.O. Release	X	X		Division Managers
Material Distribution Report	W.O. Release, Purchase Order	X	X	X	
Cost Transfer Report	W.O. Release, Transfer Voucher	X	X	X	
Work Order Cost Report (Cum totals at W.O., Plant, Contract level)	W.O. Release	X	X	X	W.O. 4X,5X - 9590
Responsible Department Cost Report	Resp. Dept., W.O. Release, Charging Dept.	X	X		W.O. 6X,7X - 8745
Contract Commitment Report (Incr. and Cum.)	Contract	X		X	8745 & Resp. Dept.
Uncommitted Requisitions (Current outstanding req's)	W.O. Release, Requisition Number			X	9590
NERVA Operations Reports					
Contract Cost Summaries (Graphical)	Budget vs Commitment at Contract Level			X	9545
MONTHLY REPORTS					
Accounting Reports (Cumulative)					
Labor Distribution (Hours Only)	Charging Dept., W.O. Release	X			Charging Department
Charging Department Report	Charging Dept., W.O. Release	X	X		Charging Department
Division Managers Report	Contract, Charging Dept., W.O. Release	X	X		Division Managers
Work Order Cost Report	W.O. Release	X	X	X	W.O. 4X,5X - 9590
Responsible Department Cost Report	Resp. Dept., W.O. Release, Charging Dept.	X	X		W.O. 6X,7X - 8745
Contract Item Cost Report	Subtask, Sub-subtask, Complex, W.O. Release, Charging Department (Booked Cost), Summary with open balance.	X	X	X	Responsible Department
NERVA Operations Reports					
Comparison Budget with Commitments (Historical Monthly comparison, incremental and cumulative with variance and percentage in total dollars)	Task, Subtask, Sub-subtask, Complex			X	Project Engineers, REON
Budgets - 744					
Task Budgets	Subtask, Sub-subtask, Complex, W.O. Release			X	Project Engineers, REON
Responsible Department Budget	Resp. Dept., Charging Dept., W.O. Release			X	Responsible Department
Work Order Release Budget	W.O. Release			X	9545
Division Budget	Division, Department			X	Division Managers

* Accounting Reports are by cost element, hours, material, overhead, etc.

** Azusa Accounting Distribution: 1. All Azusa cognizant work order detail costs on weekly basis

2. Schedule 5 (book costs) report on all work items

3. Special NERVA weekly tape (Azusa format, Commitments, weekly increments)

4. Contract Item Booked Cost Tape Monthly with subitem summary including open commitments.

1. TASK TITLE: TECHNICAL REPORTS

2. PURPOSE AND OBJECTIVES

To provide monthly progress reports, quarterly motion picture film strips and special technical reports describing LRP activities.

3. RELATED WORK AND BACKGROUND

Previous contracts at the Liquid Rocket Plant have included stringent technical report requirements. The experience gained on these programs and Contract Year 1962 of the NERVA program will be utilized in the preparation of the NERVA technical reports. A well established documentary film organization is available to provide the quarterly motion picture film strips.

4. DESCRIPTION OF THE WORK PROGRAM

4.0 There are no sub-subtasks of this subtask.

4.1 Sub-Subtask 4.3 - Technical Reports

a. Engineering

- (1) A weekly TWX report will be made before the close of work each Tuesday stating as briefly as possible the significant technical events occurring during the previous Wednesday through Tuesday. These weekly reports will cover significant tests conducted, test results delivery of important equipment, equipment failures, etc. The information will be presented in such a way as to be unclassified. The weekly TWX will be addressed to the Program Controls Manager - REON.
- (2) Prepare, and submit monthly, fifteen copies of an informal progress report to the NERVA Operations Office. These will be due seven days after the monthly reporting period.

(3) Prepare and submit quarterly motion picture film strips depicting hardware, assembly, testing accomplishments and other significant progress events leading themselves to visual presentation.

(4) Special reports will be prepared, as requested, concerning technical progress or related matters not covered in the regularly scheduled reports.

b. Fabrication

Not applicable.

c. Testing

Not Applicable.

1. TASK TITLE: DATA SYSTEM

2. PURPOSE AND OBJECTIVES:

To provide a system of control for pertinent data on the NERVA program.

3. RELATED WORK AND BACKGROUND

The accumulation and dissemination of technical data has been in process on other programs in the Liquid Rocket Plant. Experience gained and procedures for data control that have been evolved will be utilized for the NERVA Data System.

4. DESCRIPTION OF THE WORK PROGRAM

4.0 There are no sub-subtasks for this subtask.

4.1 Subtask 4.1 - Data System

a. Engineering

(1) A Central Data System will be established for the compilation of NERVA Data relating to reliability, test results and drawing release information, including records of engineering orders, drawing changes and effectivity.

REON will establish the system requirements and procedures and LRP will assist in implementing the established procedures.

(2) Pertinent data will be forwarded to REON for processing, recording and presentation. (Reproducible copies of blue-prints, and documents, as required, will also be forwarded).

b. Fabrication

Not applicable.

c. Testing

Not applicable.

1. CONTRACT YEAR 1962 CARRYOVER EFFORT

Special Test Equipment, Test Stand G-7, required in support of the NERVA Component Test Program.

Contract Year 1962 Carryover Effort consists of those items of STE not completed during Contract Year 1962 and requiring completion as part of the Contract Year 1963 effort. Active engineering design, procurement, fabrication, and installation has been initiated on all items listed.

1.0 The continued Sub-Sub-Tasks of this Sub-Task are:

5.7.1 Test Zone G Mechanical STE

Complete fabrication and installation of high speed bearing test fixture.

5.7.2 Test Zone G Instrumentation and Control STE

Complete instrumentation system modification to accommodate high speed bearing test fixture.

LRP NERVA PROPOSED LEVEL SIX MILEPOSTS

CY 63

ISSUED 11-62

CONTRACT YEAR 1962 CARRY-OVER EFFORT

NCS-211A

S/T 5.7 - LRP - TEST ZONE G

TEST ZONE G MECHANICAL STE

MP NO	DEPT.	CONT. ITEM	DESCRIPTION	CD	DATE
0046-90	8745	5.7.1	COMPLETE FAB AND INSTALL OF HIGH SPEED BEARING TEST FIXTURE	6 S	12-01-62
TEST ZONE G INSTRUMENTATION AND CONTROL STE					
91	8745	5.7.2	COMPLETE INSTRUMENTATION SYSTEM MODIFICATIONS TO ACCOMMODATE BEARING TEST FIXTURE	6 S	12-15-62

1. CONTRACT YEAR 1962 CARRYOVER EFFORT

Special Test Equipment - Temperature Laboratory, Building 3308, LRP.

Contract Year 1962 Carryover Effort consists of those items of STE not completed during Contract Year 1962 and requiring completion as part of the Contract Year 1963 effort. Active engineering design, procurement, fabrication, and installation has been initiated on all items listed.

1.0 The continued Sub-Sub-Task of this Sub-Task is:

5.8.2 Building 3308 - Temperature Laboratory, Instrumentation
and Control STE

Complete fabrication, installation, and activation of
special temperature sensor calibration cryostat.

LRP NERVA PROPOSED LEVEL SIX MILEPOSTS

CY 63
NCS-211A

ISSUED 11-62

CONTRACT YEAR 1962 CARRY-OVER EFFORT

S/T 5.8 - LRP - TEMPERATURE LABORATORY

MP NO	DEPT.	CONT. ITEM	DESCRIPTION	CD	DATE
			TEMPERATURE LABORATORY, INSTRUMENTATION AND CONTROL STE		
0047-90	8745	5.8.2	COMPLETE FAB, INSTALL, AND ACTIVATION OF SPECIAL TEMPERATURE SENSOR CALIBRATION CRYOSTAT	6S	3-30-63

1. CONTRACT YEAR 1962 CARRYOVER EFFORT

Other Government Property - Test Zone H - LRP

Contract Year 1962 Carryover Effort consists of those items of OGP not completed during Contract Year 1962 and requiring completion as part of the Contract Year 1963 effort. Active engineering design, procurement, fabrication, and installation has been initiated on all items listed.

1.0 The continued Sub-Sub-Task of this Sub-Task is:

6.1.1 Test Zone H Mechanical - O.G.P.

Complete design, fabrication, installation, and activation of a 82,000 SCFH, 5,000 psig, 30 HP, LN₂ pump and vaporizer unit.

LRP NERVA PROPOSED LEVEL SIX MILEPOSTS

CY 63

ISSUED 11-62

CONTRACT YEAR 1962 CARRY-OVER EFFORT

NCS-211A

S/T 6.1 - LRP - TEST ZONE H

MP NO	DEPT.	CONT. ITEM	DESCRIPTION	CD	DATE
			TEST ZONE H MECHANICAL, O.G.P.		
0049-90	8745	6.1.1	COMPLETE FAB AND INSTALL OF LN ₂ PUMP AND VAPORIZER UNIT	6S	2-15-63