REON

ROCKET ENGINE OPERATIONS - NUCLEAR

PROGRAM ACCOMPLISHMENTS - CONTRACT YEAR 1963

VOLUME II

RN-S-0014

30 OCTOBER 1963

SPACE NUCLEAR PROPULSION OFFICE
CONTRACT SNP-1

Questions & Answers in back of book. 12/16/63 Jm

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*corrected
12/16/63
KMN*

AEROJET-GENERAL CORPORATION

765:726
GLR:se

2 December 1963

Space Nuclear Propulsion Office - Cleveland Extension
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland 35, Ohio

Attention: R. W. Schroeder, Chief

Subject: Supplement to Report RN-S-0014 -- Program Accomplishments -
Contract Year 1963

Gentlemen:

During the CY 1963 Contract status presentation at Cleveland, 30-31 October 1963, it was agreed that Aerojet would record and submit questions and answers given in the course of the conference. In addition, some items were omitted from the printed report. Accordingly, submitted as Enclosures (1), (2) and (3), are errata, omitted narrative material, and recorded questions and answers, respectively. It is requested that these be inserted into copies of Report RN-S-0014 which were previously delivered to you.

Very truly yours,

AEROJET-GENERAL CORPORATION

G. L. Ryland
G. L. Ryland

Manager of Contracts
Rocket Engine Operations - Nuclear

Enclosure:

- (1) Errata Sheet to Report RN-S-0014
- (2) Supplement to Report RN-S-0014 *in front of section D*
- (3) Questions and Answers *in back of book.*

ERRATA SHEET TO REPORT RN-S-0014

Correct the SNP-1 Cost Summary Chart in Section D of Volume II, as follows:

CY 1963 PLANT STATUS

Line "AGC"	Column 3 - Change 31,085,440 to read 31,085,485.
	Column 4 - Change (2,954,083) to read (2,954,038).
	Column 6 - Change 32,902,422 to read 32,902,465.
	Column 7 - Change (770,092) to read (770,049).
Line "WANL"	Column 3 - Change 33,233,078 to read 33,233,035.
	Column 4 - Change (724,061) to read (724,104).
	Column 6 - Change 36,078,147 to read 36,078,104.
	Column 7 - Change (722,695) to read (722,738).
Line "Bendix"	Column 3 - Change 1,477,327 to read 1,477,325.
	Column 4 - Change (39,056) to read (39,058).

CY 63 STATUS

Line "Actual CY 63"	Column 3 - Change 13,349,692 to read 73,349,692.

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**AEROJET
GENERAL**

Classification cancelled (or changed to)
by authority of DOC
in H.F.C. TIC, date SEP 2 1961 - 2 d35

**PROGRAM ACCOMPLISHMENTS - CONTRACT YEAR 1963
VOLUME II**

RN-S-0014

30 OCTOBER 1963

SPACE NUCLEAR PROPULSION OFFICE
CONTRACT SNP-1

ROCKET ENGINE OPERATIONS - NUCLEAR

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- B. CALENDAR YEAR 1963 PROGRAM OBJECTIVES
- C. TASK ACCOMPLISHMENTS
(Subtasks 1.1 through 2.4)

Volume II

- C. TASK ACCOMPLISHMENTS
(Subtasks 2.6 through 6.2)
- D. SUMMARY
- E. ESTIMATE TO COMPLETE CY 1963 WORK

S/T 2.6- PRESENTATION CHARTS CY63

2.6.1 RELIABILITY PROGRAM ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL*
2-2.6.1	PREPARE A DETAILED RELIABILITY PROGRAM PLAN & SUBMIT TO SNPO-C PRIOR TO FEB 28, 1963, FOR APPROVAL	1. RELIABILITY PLANS SUBMITTED TO SNPO-C 2. REVISED RELIABILITY PLANS SUBMITTED TO SNPO-C
2.6.1 (a)	REVIEW PREVIOUSLY APPORTIONED RELIABILITY GOALS & UPDATE AS REQUIRED & SUBMIT TO SNPO-C FOR REVIEW	3. APPORTIONMENT - HOT BLEED ENGINE 4. REVISED APPORTIONMENT - HOT BLEED ENGINE COMPLETED
2.6.1 (b)	REVIEW DWGS., SPECS., & OTHER PERTINENT DOCUMENTATION DURING PERIOD FOR RELIABILITY REQ'TS & PREPARE MODES OF FAILURE ANAL.	5. DESIGN REVIEWS & MOFA COMPLETED
2.6.1 (c)	REVIEW TEST PLANS & TEST PROGRAMS FOR RELIABILITY REQUIREMENTS	6. COMPLETED-RELIABILITY DATA BOOK
2.6.1 (d)	ANALYZE TEST RESULTS & TEST FAILURES AND MONITOR FOR CORRECTIVE ACTION	7. COMPLETED-RELIABILITY DATA BOOK
2.6.1 (e)	COLLECT & ANALYZE RELIABILITY DATA AND RECORD RELIABILITY INFORMATION	8. RELIABILITY DATA HAS BEEN COLLECTED & ANALYZED COMPLETED
13-3.3 (a)	IMPLEMENT A SUPPLEMENTARY EFFORT TO MONITOR & MAINTAIN SURVEILLANCE OF THE RELIABILITY ACTIVITY OF EG & G	9. EG & G RELIABILITY PLAN HAS BEEN APPROVED 10. CRITICAL ITEMS LIST PREPARED

* EVIDENCE OF COMPLETION IS SHOWN IN DOCUMENTATION LIST INCLUDED IN HANDOUT

ROCKET ENGINE OPERATIONS

S/T 2.6 PRESENTATION CHART CY '63

2.6.1. RELIABILITY PROGRAM ACCOMPLISHMENTS

W/S
REFERENCE

PLANNED

ACTUAL *

MISC ACCOMPLISHMENTS

11. NPC 250-1 INCORPORATED IN RELIABILITY PROGRAM PLAN
12. MATHEMATICAL MODEL FOR SIMULATION AND PREDICTION OF THE RELIABILITY OF THE NERVA ENGINE
13. RELIABILITY ANALYSES REPORTS HAVE BEEN PREPARED
14. MATHEMATICAL MODELS DEVELOPED FOR RELIABILITY PREDICTION OF NON-NUCLEAR ASSEMBLIES AND COMPONENTS

* EVIDENCE OF COMPLETION IS SHOWN IN DOCUMENTATION LIST INCLUDED IN HANDOUT

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 2.6 PRESENTATION CHART CY '63

2.6.2 QUALITY ASSURANCE PROGRAM ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL *
2-2.6.2(a)	CONDUCT A QA PROGRAM IN ACCORD- ANCE WITH NPC 200-2 AND 200-3 AS INTERPRETED BY NOPPS IV . B.1 DURING PERIOD 1 OCTOBER 1962 THROUGH 31 MARCH 1963	1. QA PROGRAMS STARTED 2. INSTRUCTIONS PREPARED FOR & QA PROGRAM PLAN 3. REON R&QA PLAN SUBMITTED 4. MTGS. WITH AGC & SUBCONTRACTOR PLANTS 5. R&QA PROGRAM PLANS SUBMITTED FOR LRP, WANL, AMF, BENDIX 6. ESTABLISHED PROD. ASSURANCE DIVISION 15 MARCH 1963 7. MONITORED R&QA PERFORMANCE 8. REVIEWED QA PLANS W SNPO-C 9. COORDINATED REVISIONS WITH RESPECTIVE PLANTS 10. REVISED QA PLANS SUBMITTED TO SNPO-C 11. ESTABLISHED FIELD SURVEILLANCE OFFICES 12. REVISED REON R&QA PROGRAM PLAN 13. ORIENTATION & INTRODUCTION PROGRAM 14. QA IMPLEMENTATION SCHEDULE ESTABLISHED 15. PREPARED R&QA PROGRAM PLAN FOR NTO 16. NRX-A1 FACTORY TEST PLAN & PROCEDURES 17. IMPLEMENTATION OF R&QA ACTIVITIES 18. ESTABLISHED COMPREHENSIVE AUDIT SYSTEM.
2.6.2 (b)	EFFECTIVE 1 APRIL 1963, CONDUCT A R&QA PROGRAM IN ACCORD- ANCE WITH NPC 200-2 AND 200-3 AS INTERPRETED BY REON R&QA PROGRAM PLAN, REPORT #2487	
13-3.3(a)	MONITOR QA ACTIVITIES OF EG & G	19. EG & QA PLAN REVIEWED

* EVIDENCE OF COMPLETION IS SHOWN IN DOCUMENTATION LIST INCLUDED IN HANDOUT

SUBTASK 2.6 - ACCOMPLISHMENTS CY 1963

Purpose and Objective

The overall objective of Subtask 2.6 was to ensure that the subsystems, components and related support equipment designed and built during CY 1963 achieved the required reliability and quality.

There are over 100 significant program activities which directly affect product reliability or quality and for which the Reliability and Quality Assurance organization has primary or associate responsibility. The Reliability and Quality Assurance supervisory and engineering input to these activities are supported by Subtask 2.6. The accomplishments under Subtask 2.6 probably could be demonstrated most effectively by presenting the status and problems associated with the implementation of each of these activities. Also, I am sure the presentation of slides or charts illustrating some of the more significant accomplishments in these activities, such as reliability apportionment diagrams, growth curves, prediction models, etc., would be of interest. However, allotted time for this presentation will not permit detailed discussion of each of the reliability and quality assurance activities, although I will be glad to provide any information desired on specific items of interest. Reliability and quality methods, charts, graphs, etc., are available in the plans, data books, reports and other documentation which have been submitted to the SNPO-C Reliability and Quality Assurance group.

My presentation will be based on the flip charts which include the program objectives, and a very brief statement of actual accomplishment of these objectives. Program plans, data books, reports and other documentation bearing evidence of completion of these accomplishments is given in the bibliography included in the handout. Also, a copy of this narrative report and the Milestone Chart for 2.6 is given, showing completion of all milestones during 1963. I will briefly expand on the accomplishments in order to explain their significance.

A Reliability Program Plan, REON Report No. 2487, was submitted to SNPO-C for approval in February, 1963. Reliability Program Plans were prepared also by LRP, WANL, AMF, and Bendix and submitted to SNPO-C for review. These plans were reviewed by Lewis Research Center - Reliability, SNPO-C, and REON - Product Assurance Division. Comments resulting from these reviews have been incorporated into revised editions of the plans.

2-2.6.1(a)

A complete apportionment of reliability - based on actual or calculated failure rate data and assuming 80% reliability for the E-7 engine test - was prepared during the previous Contract Year for the heated-bleed engine. This apportionment was revised to meet the configuration of the hot bleed engine and was included in Report No. 2469, Volume 1. The latter has been reassessed and revised to update and to include all additional reliability information and will be included in Report No. 2487, Revision (a).

2-2.6.1(b)

All designs - specifications, drawings, standards - have been reviewed by Reliability as released. Modes of failure analyses - giving mode, cause, effect and probability of failure and the corrective action required - was prepared on all critical assemblies, subassemblies or components. Results of design reviews and modes of failure analyses are reported in the LRP Reliability Data Book and WANL technical reports.

2-2.6.1(c)

All test plans and test programs published during the Contract Year have been reviewed by Reliability Engineering, and the reliability input has been included in the final plans. Reliability test plan reviews appear in the LRP Reliability Data Book and in WANL technical reports.

2-2.6.1(d)

Test results have been analyzed by Reliability Engineering. All test failures have been analyzed and failure reports and corrective action reports have been issued in accordance with the failure reporting corrective action system developed in each plant. Failure reports are filed in the Reliability Data Book, and summaries of failures and corrective action appear in the Reliability and Quality Assurance supplement to the Informal Monthly Progress Letters.

2-2.6.1(e)

All pertinent reliability data generated during the Contract Year have been collected, maintained, analyzed and reported in accordance with the data system established in each plant. Summary data required for the reliability assessment of the NERVA engine is collected, maintained, analyzed and reported by the REON Product Assurance Division.

~~2.6-3(a)~~

In accordance with C.O. No. 1 for Mod 8, a Reliability Program Plan has been prepared by EG&G for the ETS-1 I&C equipment and approved by REON and SNPO-C. However, this program is limited to critical items. A critical item is defined as an item the failure of which would:

- (1) Adversely affect the safety of personnel.
- (2) Result in significant loss of test data.
- (3) Result in facility or engine damage that would cause excessive schedule delay.

A critical items list has been prepared by REON Engineering and Product Assurance and transmitted to SNPO-C for approval.

In addition to the above, other reliability accomplishments include the following:

(a) REON Reliability Program Plan, Report No. 2487, is being revised to incorporate the applicable requirements of NPC 250-1, which is to be incorporated into the 2.6 Work Statement for Contract Year 1964. Target date for the issue of revision (a) to this plan is 15 November 1963.

(b) A system for the simulation and prediction of the reliability of the NERVA engine is under development. This system involves the establishment of mission phases, environmental and operating conditions for each phase, time sequenced events required for mission success, specific hardware associated with each event, a mathematical model for assessing, reliability, including redundancy available, and a Monte Carlo computer program for reliability simulation. This system will be included in revision (a) to REON Report No. 2487.

(c) Numerous statistical studies have been made for use in the reliability analysis of nuclear and non-nuclear components. Examples of the studies made during the Contract Year are given in the documentation list.

(d) Mathematical models have been developed for computing the reliability of all non-nuclear components and assemblies of the NERVA engine. These models are in the Reliability Data Book and will be used for reliability assessments as reliability data is generated.

2-2.6.2(a)

Prior to 1 October 1962, a quality control program was conducted in all AGC and subcontractor plants, in accordance with local quality control manuals and guidelines established by REON. This program met most of the requirements of NPC 2002- except that the level of quality control applied to experimental, test and ground support equipment was left up to the cognizant design or test engineer.

On October 1962, NPC 200-2 was included in the Work Statement. It was agreed by REON and SNPO-C that the quality program during the period 1 October 1962 through 31 March 1963 would be limited to those NPC 200-2 requirements as interpreted by NOPPS IV-B1. The latter document limited the program to approximately the program in effect during CY 1962. It was further agreed that during this period a quality program plan would be prepared, to be effective 1 April 1963, which would extend all applicable provisions of NPC 200-2 and NPC 200-3 to all NERVA hardware including experimental, STE, GSE, and to all tiers of suppliers. This was a momentous decision, as it extended the quality control coverage to experimental laboratories, development machine shops, test areas, facility and tool design and certain suppliers which previously had not been subjected to this level of control. This created a serious indoctrination and training requirement in the extended areas and a serious staffing problem for the Quality Control Departments.

In order to comply with the above requirements, NOPPS IV-B1 was revised and negotiated with SNPO-C. Elaborate instructions for preparing definitive quality program plans were issued to all AGC and subcontractor plants. Numerous meetings, conferences and communications were required to obtain plans from the several plants and to obtain agreement of plant managements.

The REON Reliability and Quality Assurance Program Plan, Report No. 2487, incorporating program plans for LRP, WANL, AMF and Bendix were submitted to SNPO-C on schedule prior to 28 February 1963. A Product Assurance Division was established in REON in March 1963 to establish and monitor the NERVA Reliability and Quality Assurance Program in accordance with this plan. Considerable effort was expended to get all plants in shape to implement the program plan.

2-2.6.2(b)

The plans, submitted above, were reviewed with SNPO-C. In general, they were found to be satisfactory except for areas requiring further clarification and certain compromises which were not acceptable. Desired changes were negotiated with plants concerned, and Revision (a) of the LRP, WANL, AMF and Bendix Plans were resubmitted for SNPO-C review. The revisions have been found satisfactory, with the exception of minor editorial comments, except for the WANL Plan which still has a few items of omission and a few items requiring change or clarification. WANL has been notified of changes required. Now that the plans for the AGC and subcontractor plants have been substantially finalized, the REON Reliability and Quality Assurance Plan is being revised to incorporate any significant changes that have been agreed to and to directly incorporate all Reliability and Quality Assurance contractual program requirements. This will be submitted to SNPO-C for final approval on 15 November 1963.

No matter how adequate the plan, no improvement in quality will result unless every person affected by the plan understands it and follows it. Consequently, the second phase of a Reliability and Quality Assurance program is the orientation and indoctrination of personnel affected. The Reliability and Quality Assurance Program affects almost everyone on the NERVA program, and so this is a herculean task. Plans have been distributed widely, and considerable effort has been spent in determining that pertinent personnel are informed as required regarding the provisions, methods, systems, procedures, etc. included in the plan.

The third step in a Reliability and Quality Assurance Plan is the implementation of the designated activities. Since the plan went into effect on 1 April 1963, it could not be expected that each of the 100 activities could be fully implemented and 100% effective immediately. Each activity was appraised in each plant and implementation schedules were obtained for those items requiring implementation.

Field surveillance offices were established at WANL and LRP.

The present status of implementation might be summarized as follows: almost all of the 100 required activities have been implemented to some degree in every plant. The majority of these items have been implemented to a satisfactory

level in each plant. Some of these items have been satisfactorily implemented for certain types of hardware, but not for others. The weakest hardware areas are still the special test and ground support equipment and experimental hardware made in development labs and shops. Probably the most vulnerable area in this category in all plants has to do with specifications. Existing Industrial and Government specifications and standards are not definitive to the extent that they can be used for the acceptance or rejection of hardware on a black-or-white basis. These specifications have been previously used, expecting that with certified processes, certified operators and certified inspectors, technical judgement would be used in those areas that required further interpretation and that any questionable areas would be covered by proper Material Review Board actions. If specifications are required to be completely definitive, either excessive time must be spent in the review of each procurement package or there must be a complete set of definitive specifications written specifically for the NERVA program. In order that the review of procurement packages be implemented fully and effectively, criteria as to the degree of definitiveness of specifications will have to be evolved.

An audit system has been prepared through which the effectiveness, completeness, efficiency, conformance to policy and status of corrective action will be determined on a current basis for each of the 100 reliability and quality assurance activities in each plant on a current basis. This system will also provide a numerical rating for the implementation of reliability and quality assurance activities for each plant and the overall program.

A Reliability and Quality Assurance Program Plan for the NERVA Test Operations at NRDS has been prepared and will be submitted to SNPO-C for review by 15 November 1963. Also, a factory test plan which designates the control points during the assembly of the NRX A-1 test at NRDS and the inspection procedures for each control point has been prepared and submitted for review.

13-3.3(a)

Several EG&G Quality Control plans have been reviewed and comments submitted to EG&G and SNPO-C. The last plan submitted to EG&G is somewhat improved, but is not complete and lacks definition of detailed procedures.

Summary

In summary, during Contract Year 1963, we have developed Reliability and Quality Assurance Program Plans which are substantially complete and satisfactory. Personnel have been oriented and indoctrinated as to the requirement and provisions of these plans to a large extent. Most of the reliability and quality assurance activities have been implemented to a satisfactory level. Remaining action is to extend the coverage and to improve the effectiveness and the efficiency of these activities. This will be accomplished by a comprehensive audit-corrective action system.

SUBTASK 2.6 - BIBLIOGRAPHY

- 1.a. REON Report #2487 - REON Reliability and Quality Assurance Program Plan, February 1963
- b. LRP Report #2469 - R & QA NERVA Program, Vol. 1 (Reliability Program Plan), February 1963
- c. WANL Report #WANL-TNR-088 - WANL R & QA Program Plan, NERVA Nuclear Subsystem, 31 January 1963
- d. AMF Atomics Report - R & QA Program Plan, NERVA Remote Handling System, 6 February 1963
- e. Bendix Report #BPAD 49-9 - The Bendix NERVA Program, R & QA Program Plan, 8 February 1963
- 2.a. REON Report #2487, Revision A - REON Reliability and Quality Assurance Program Plan (to be published 15 November 1963)
- b. LRP Report #2469, Revision A - R & QA NERVA Program, Vol. I (Reliability Program Plan), (to be published 15 November 1963)
- c. WANL Report #WANL-TNR-088, Revision A - WANL R & QA Program Plan, NERVA Nuclear Subsystem, 24 June 1963
- d. AMF Atomics Report, Rev. 1 - R & QA Program Plan, NERVA Remote Handling System, 22 August 1963
- e. Bendix Report #BPAD 49-9, Revision B - The Bendix NERVA Program, R & QA Program Plan (Reliability), 30 August 1963
3. Exhibit IV-1 - LRP R & QA Program Plan, Volume 1, February 1963
4. Exhibit in REON Report #2487, Revision A - REON R & QA Program Plan, (to be published 15 November 1963)
- 5.a. R & QA Supplements to REON Informal Monthly Progress Letters No. 22 through 27 for NERVA Program, April through September 1963
- b. LRP NERVA Reliability Data Book (continuous)
- c. REON Report _____ (as yet unpublished) corresponding to REON TM 739-63-103 Report on Actuator Evaluation dtd 10/10/63.
- d. WANL Report #WANL-TNR-085 - Failure Mode Analysis Summary, NERVA NRX-A Reactor, 3 March 1963
- e. WANL Report #WANL-TNR-081 - Failure Mode Analysis Summary, NERVA Control Drum Actuator Proposed by General Electric (Model AG-14), 15 January 1963
- f. WANL Report #WANL-TNR-082 - Failure Mode Analysis Summary, NERVA Control Drum Actuator Proposed by Bendix (Model ND-D1), 15 January 1963

Document List - 2.6.1 Reliability Program (continued)

- 6.a. R & QA Supplements to REON Informal Monthly Progress Letters No. 22 through 27 for NERVA Program, April through September 1963
  - b. LRP NERVA Reliability Data Book (continuous)
  - c. WANL Report #WANL-TNR-095 - NRX-A Component Test Program, 16 April 1963
  - d. WANL Report #WANL-TNR-097 - NRX-A1 Test Plan, Revision 1, May 1963
- 7.a. R & QA Supplements to REON Informal Monthly Progress Letters No. 22 through 27 for NERVA Program, April through September 1963
  - b. LRP NERVA Reliability Data Book (continuous)
  - c. Bendix Report #BPAD 863-4-15022R - Turbine Power Control Valve Actuator System (Model NT-B4), June 1963
- 8.a. R & QA Supplements to REON Informal Monthly Progress Letters No. 22 through 27 for NERVA Program, April through September 1963
  - b. LRP NERVA Reliability Data Book (Continuous)
  - c. Bendix Report #BPAD 49-14995R - Statistical Distribution for Reliability Prediction, 1 July 1963
  - d. AGC Report #2258 - Reliability Concepts, Vol. I of Reliability Handbook, April 1962
  - e. AGC Report #CRA62-2 - Reliability Methods, Vol II of Reliability Handbook (Corporate)
- 9.a. EG&G Report File No. 02-001-01 - R & QA Program Plan, 19 August 1963
  - b. EG&G Report File No. 02-001-12 - R & QA Program Plan, 29 August 1963
- 10. Ltr. from W D Stinnett to R W Schrader dtd 6 September 1963, Subject: Critical Item List, R & QA Program, ETS-1 I & C, L741:0302, Subtask 3.3
- 11. REON Report #2487, Rev. A - REON R & QA Program Plan (to be published 15 November 1963)
- 12. REON Report #2487, Rev. A - REON R & QA Program Plan (to be published 15 November 1963)
- 13.a. REON Memo 736:0184 - Statistical Tolerance Study of the B-4 Fuel Element With Respect to the Cross-Sectional Area of the Core, 29 March 1963
  - b. REON Memo 736:0167 - Statistical Tolerance Study of the B-4 Fuel Element, 12 March 1963
  - c. REON Memo 736:0208 - Study of Using Undersize Fuel Elements for a Portion of the Core, 23 May 1963
  - d. REON Memo 736:0232 - Reliability Comparison of Relay vs Solid State Circuitry for Malfunction Cameras, 7 August 1963

Document List - 2.6.1 Reliability Program (continued)

- 13.e. REON Memo 736:0203 - Reliability Comparison Between Two Anti-Criticality Destruct Systems, 14 May 1963
- i. REON Memo 736:0212 - Reliability Study "Evaluation and Comparison of Attitude Control System for Spacecraft With NERVA Engines, 3 June 1963
- 14. LRP NERVA Reliability Data Book (continuous)

Document List - 2.6.2 Quality Assurance Program

- 1. NOPPS IV-B1 - NERVA-NASA Quality Provisions NPC 200-2 and NPC 200-3 dated 17 July 1962
- 2.a. NERVA Project Directive #149 - NERVA R & QA Program Cost Study, Contract Task 2.6, dtd 13 December 1962
  - b. Enclosure 1 of P.D. 149 - NOPPS IV-B1, Revision (a) - NERVA NASA Quality Provisions (NPC 200-2 and NPC 200-3) dated 15 November 1962
  - c. Enclosure 2 of P.D. 149 - NOPPS IV-A1, Revision (a) - NERVA Reliability and Quality Assurance Program, dtd 7 December 1962
  - d. Enclosure 3 of P.D. 149 - Quality Assurance Program Plan Outline
- 3. REON Report #2487 - REON R & QA Program Plan, February 1963
- 4. Minutes of Meetings, Letters to Subcontractors, etc.
- 5.a. LRP Report #2469 - R & QA NERVA Program, Vol. II (Quality Assurance) Feb. 1963
  - b. WANL Report #WANL-TNR-088 - WANL R & QA Program Plan, 31 January 1963
  - c. Bendix Report #BPAD 49-9 - The Bendix NERVA Program, R & QA Program Plan, 8 February 1963
  - d. AMF Atomics Report - R & QA Program Plan, NERVA Remote Handling System 6 February 1963
- 6. Ltr. from W C House to Corporate Offices and Staff, Plant and Division Managers, Department Heads, Supervisors - All Plants, dtd 15 March 1963, re: Establishment of REON Product Assurance Division
- 7. Minutes of Technical Direction Meetings, Trip Reports & Other Correspondence
- 8.a. Various Review Meeting Reports
  - b. Program Plan Checklists
- 9. Letters to Plants from REON Subcontracts Division, Minutes of Meetings, and Technical Direction Meetings
- 10.a. LRP Report #2469, Vol. II, Rev. A - R & QA NERVA Program (Quality Assurance Program Plan), April 1963

Document List - 2.6.2 Quality Assurance Program (continued)

- 10.b. WANL Report #WANL-TNR-088, Rev. A - WANL R & QA Program Plan, NERVA Nuclear Subsystem, 24 June 1963
  - c. Bendix Report #BPAD 49-9, Rev. A - R & QA Program Plan (Quality Assurance), 30 August 1963
  - d. AMF Atomics Report - R & QA Program Plan, Revision 1, 22 August 1963
- 11.a. Ltr. from V R Miller to H F Faught, dtd 17 May 1963, 760:3511, Subject: Subcontract NP-1 - REON Reliability and Quality Assurance Office at WANL
  - b. Correspondence, Management Meetings, Technical Direction Meetings, and Organization Manuals
- 12. REON Report #2487, Rev. A - REON R & QA Program Plan (to be published 15 November 1963)
- 13. Management Meetings, Seminars, Technical Direction Meetings, Project Directives, Training Manuals, Procedures and Correspondence
- 14. Implementation Dates Indicated on Program Element Chart for Each Plant Contained in R & QA Plans
- 15. Nevada Test Operations R & QA Program Plan to be published 15 November 1963
- 16. NRX-A1 Factory Test Plan - Procedures L-1 through L-4, L-8 through L-11, L-13, W-5 through W-7, W-12, W-14, N-15 through N-33, 23 June 1963
- 17.a. Reliability Data Books
  - b. Reports (Reliability, Corrective Action, Audits, Survey, Quality Control)
  - c. Documentation (Design, Procurement, Fabrication, Quality Control)
  - d. Project Directives and Correspondence
- 18.a. REON Report #2487, Rev. A - REON R & QA Program Plan (to be published 15 November 1963)
  - b. AGC Quality Control Instruction Manual
  - c. AGC Corporate Quality Control Policies & Procedures Manual
  - d. AGC Corporate Quality Control Standards Manual
- 19.a. EG&G Report File No. 02-B01-18 - R & QA Plan, 1 October 1963
  - b. AGC Ltr. from D L Dewing to J W Dutli, 720:LL73, dtd 22 October 1963, re: EG&G QA Program Plan

SCHEDULES AND MILESTONES
CONTRACT YEAR 1963
TASK ITEM 2.6

⬆ SCHEDULED MILESTONE

◇ RESCHEDULED MILESTONE

◊ RESCHEDULED TO CY 64

⬆ MILESTONE ACHIEVEMENT

◆ RESCHEDULED MILESTONE ACHIEVEMENT

S/T 2.7 SAFETY

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
<u>SITE OPERATION</u>			
2-2.7 A 1	(1) PROVIDE NRDS SAFETY PROCEDURES AND REGULATIONS	COMPLETE FOR CY 63	1. AGC REPORT NO. 2636-SS MATERIALS CONTROL MANUAL 2. NERVA OPERATIONAL SAFETY PROGRAM- NOPPS 1-A9 3. NRDS HEALTH AND SAFETY INSTR. MANUAL RN-HSM-0001 4. TRAINING DOCUMENTS 5. MEDICAL PROGRAM PLAN
	(2) PROVIDE A SAFETY STAFF FOR NRDS	COMPLETE FOR CY 63	NRDS SAFETY STAFF OR- GANIZATION OF 7-PROF. PER- SONNEL -3 WANL., 4 AGC

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 2.7 SAFETY

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-2.7 A	(3) REVIEW AND EVALUATE NRDS TEST AND OPERATIONS PROCEDURES	COMPLETE FOR CY 63	
	(4) COMPLIANCE WITH GOVERNMENTAL REGULATORY AND CONTRACTUAL REQUIREMENTS AT NRDS	COMPLETE FOR CY 63	SEE BIBLIOGRAPHY MATERIAL CONTROL NERVA OPERATIONAL SAFETY PROGRAM NOPPS I-A9
DESIGN SAFETY			
2-2.7 B	(1) REPRESENTATION ON ROVER FLIGHT SAFETY PANEL	COMPLETE FOR CY 63	PARTICIPATION IN ALL 3 RFSP MEET'GS.
	(2) ASSURE SAFETY IN DESIGN, MANUFACTURE, HAN- DLING, SHIPPING AND ASSEMBLY OF COMPONENTS	COMPLETE FOR CY 63	AGC RPT. NO. 2636-SS MAT'LS. CONTROL/RPT. NO. 765:610-SS MAT'LS. ACCOUNTABILITY PROC'S, MANUAL

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 2.7 SAFETY

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-2.7 B (CONT)	(3) INCORPORATION OF SAFETY FEATURES IN NERVA ENGINE TESTS	COMPLETE FOR CY63	AGC REPORT NO.2316- OPERATIONAL SAFETY EVALUATION OF ETS-I
	(4) REVIEW OF ENGINE DESIGN FROM STANDPOINT OF (2) AND (3) ABOVE	COMPLETE FOR CY 63	AGC REPORT NO.2316 OPERATIONAL SAFETY EVALUATION OF ETS-I
	(5) ASSIST AND PROVIDE DATA TO TEST AND LAUNCH SITE OPERATIONS AND RIFT CONTRACTOR	COMPLETE FOR CY 63	PARTICIPATION IN RFSP MEETINGS - AGC REPORT NO.2421- INITIAL AND REVISED

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 2.7 SAFETY

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-2.7 B(CONT)	(6) PROVIDE DESIGN REQUIREMENTS FOR AND REVIEW OF SAFETY AND DESTRUCT SYSTEMS AND COMPONENTS	COMPLETE FOR CY 63	AGC REPORT 2421- NOV. 62 -AGC REPORT 2421 (REVISION) AUG 63
	(7) PREPARE AND REVIEW ALL REQUIRED HAZARDS AND SAFETY EVALUATION AND REPORTS	COMPLETE FOR CY 63	
	(8) PROVIDE REQUIRED INCIDENT REPORTS, EVALUATIONS, REVIEWS AND CORRECTIVE ACTION	COMPLETE FOR CY 63	NARF GTR FIRE INCIDENT-FZK-164 DTD 14 JUNE 1963
	(9) PROVIDE DATA FOR AND DESIGN REVIEW OF FACILITIES AND EQUIPMENT	COMPLETE FOR CY 63	

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 2.7 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

To assure the maximum protection to operations personnel and the general public in the design, fabrication, and testing of the NERVA engine and its components, and to provide maximum protection to facilities and equipment consistent with the foregoing and with program objectives.

During the 1963 Contract Year, Subtask 2.7 encompassed the entire field of safety including operational, design and flight safety problems. By its very nature such a program is, generally speaking, not productive of hardware and technical report documents, but rather consists of review and approval or modification of designs and procedures, and recognition and correction of operational hazards to assure the minimization of danger to personnel and damage to property. The Safety Program consists of three phases: (1) operational safety related to the entire NERVA Program including the safety aspects associated with engineering, manufacturing, assembly and test operations at the various plants; (2) the design safety of facilities and the engine with its related handling and service equipment; and (3) the safety of projected flight operations.

In all of these areas, the Aerojet accomplishment has been significant. We have complied with all of the objectives set forth in the contractual work statement and, with one exception, have met the milestones set forth in our program within the reasonable limits of possible accomplishment. For purpose of this discussion, the work statement as set forth in the 1963 Revised Program Plan - RN 63002 will be reviewed and accomplishment and significant progress under each item will be briefly discussed.

Under Item (A) of the Work Statement for Subtask 2.7, Site Operation, four objectives are set forth.

2-2.7-A(1)

All essential site operation procedures required during Contract Year 63 were prepared. The preparation of detailed procedures related to safety aspects of assembly and operation of specific reactors, and the conduct of specific tests was initiated. However, the delay in the reactor test schedule precluded the completion of detailed procedures. The work statement was geared to the

provision of safety procedures in accordance with the overall program status, and in this context our program is current and contracted work is completed.

Basic safety policies, instructions and procedures related to the control of nuclear materials, the operational safety program, necessary medical arrangements and safety training were prepared and are listed in the bibliography.

2-2.7-A(2)

A safety staff of seven people (4 AGC - 3 WANL) has been organized for the Nevada test station operation and is currently functioning as called for in the work statement.

2-2.7-A(3)

All test operations procedures have been reviewed, evaluated and modified as necessary to comply with sound safety practice and contractual requirements. These reviews were documented in the form of internal memoranda to the originating organizations. Examples of this documentation are listed in the bibliography.

2-2.7-A(4)

Designs of facilities and subsystems were reviewed for compliance with regulations and functional safety requirements through consultation with SNPO-Nevada and SNPO-Cleveland. Preliminary arrangements have been worked out to provide for appropriate supervision, review, and control by these organizations. Arrangements have been made for the utilization of the services of SNPO-Nevada and the Support Services Contractor, and procedural manuals for the control and management of source and special nuclear materials have been prepared. An overall program for the continued assurance of compliance with all regulatory and contractual requirements has been prepared. A listing of the principle documents applicable to this activity is set forth in the bibliography.

Under Item (B) of the Work Statement for Subtask 2.7, Design Safety, nine objectives are set forth.

2-2.7-B(1)

Formal membership on the Rover Flight Safety Panel has been maintained and in addition, the resources of various related activities, particularly to

the design of destruct systems and countermeasures, have been provided to the Rover Flight Safety Panel during Contract Year 1963. Formal presentations were made by AGC at three of the scheduled meetings during this contract period.

2-2.7-B(2)

Under this activity, the proposed procedures for shipment and handling of fuels and core materials and design of handling facilities have been reviewed and the necessary corrective actions taken to ensure the safety of these operations. Fuel storage facilities and special equipment for handling radioactive components and materials were evaluated. Safety criteria pertaining to siting and to radioactive materials handling requirements for the NRDS Radioactive Materials Handling, Decontamination, and Storage Complex were developed. The operational support plan for NRX-A2 was reviewed. The review of the assembly, shipping and criticality testing of the NRX reactor was initiated. Some of the internal documents resulting from these activities are listed in the bibliography.

2-2.7-B(3)

In CY 1963 this activity consisted primarily of the review of ETS-1 operational requirements and the preliminary procedures for its operation. Detailed procedures for engine test operations at NRDS were not available for review during this contract period. Internal documentation which resulted from this effort is contained in the bibliography.

2-2.7-B(4)

The details of the NERVA engine design have not progressed to the point where a rigorous examination of engine components from the standpoint of safety would be possible. The engine specifications have been examined from the standpoint of safety in normal and abnormal operation, particularly as related to the engine tests in the ETS-1 Complex. Pertinent documentation is included in the bibliography.

2-2.7-B(5)

A significant portion of the effort required under this element of the work program grows out of the Source Term Program and the data which will be produced thereunder. The major portion of this activity is conducted under the

Westinghouse subcontract. Arrangements were made during CY 1963 to provide available data derived from this activity directly to the participating agency in the NERVA Program, including the Rover Flight Safety Panel and the RIFT Contractor. Detailed descriptions of the NERVA engine system and pertinent data for use in safety analysis and planning were presented to the Rover Flight Safety Panel and documented in the Rift Safety Review Program reports, AGC Report No. 2421 and AGC Report No. 2421 (Revised).

2-2.7-B(6)

Preliminary and general design requirements for safety, destruct, and countermeasure systems have been generated throughout the contract year as guidance for the development activities in reactor destruct systems and anti-criticality poison mechanisms. Detailed design information and data on the NERVA engine and the RIFT stage were supplied to Westinghouse in March (772:H&S: 055-Conf) to enable the conceptual design of the in-flight poison system to proceed. The design of destruct components has not progressed to the point where a review from the standpoint of reliability and performance would be meaningful. It was planned during Contract Year 1963 to provide a report on the design requirements for safety and destruct systems for the NERVA engine. This planned activity was not completed and has been deferred to CY 1964.

2-2.7-B(7)

Preliminary due to the slippage in the NRX-A reactor test schedule, the preparation and review of the NRX-A Safety Analysis Report was delayed to CY 1964. A significant effort was involved in the coordination and establishment of the content and format for the NRX-A Safety Analysis Report and supporting documentation. Partial redirection by SNPO-C of the effort initiated early in the contract year (reference: SNPO-C letter NNO:DS of 15 May and 10 July 1963) caused additional coordination effort on this task that was not anticipated and resulted in further delays in the preparation of the draft material for the NRX-A Safety Analysis Report.

The shipping container design and the preliminary draft of the Shipping Safety Analysis Report was reviewed with Westinghouse in December 1962. As a result of this review, major design changes were incorporated into the shipping

container design and major revision to the Shipping Safety Analysis Report was initiated. The Assembly and Shipping Safety Analysis Reports were completed by Westinghouse by the close of the contract year and are currently under review by REON.

The NRX-A Disassembly Operations Safety Analysis Report was delayed by slippage in the reactor schedule as noted above and will not be available until CY 1964. REON review of this report will be performed as draft material becomes available.

The critical facility safety analysis report covering activities at WANEF was completed by Westinghouse at the end of the contract year and is currently under review by REON.

2-2.7-B(8)

Fortunately, there was a minimum of accident and incident situations requiring report and corrective action during CY 1963. However, our investigation committee prepared a report on the 1962 LRP fire. A major review was undertaken relating to the fire and damage at the NARF-GTR and incident reporting requirements for the development of the propellant feed system were evaluated. Pertinent documentation to this effort is contained in the bibliography.

2-2.7-B(9)

A major part of the effort of the safety staff was properly devoted to this activity during the contract year and over forty safety evaluation and review reports were prepared in support of the facility design and review of the functional safety of facilities and equipment operation. These reviews covered all aspects of the facility and operational design with principal concern directed at the adequacy of shielding and nuclear materials handling problems. Shielding requirements were established for equipment and facilities. Decontamination requirements in support of the exhaust duct design were provided and data were developed with respect to expected levels of fission-product plateout contamination. Radiation monitoring instrumentation systems for E-MAD and ETS-1 facilities were reviewed and appropriate modifications accomplished. Design data were provided for the location and design of the radioactive materials storage and disposal areas.

Although considerable work remains to be done in the review of operational and handling procedures as a result of facility and support equipment reviews during CY 63, there is real assurance that the facilities and equipment as now existing or designed can be safely operated. Documents prepared in support of this activity are listed in the bibliography.

SUBTASK 2.7 - BIBLIOGRAPHY

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SCHEDULES AND MILESTONES

CONTRACT YEAR 1963

TASK ITEM 2.7

DATE:

↑ SCHEDULED MILESTONE

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SCHEDULES AND MILESTONES
CONTRACT YEAR 1963
TASK ITEM 2.7

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TASK ITEM 2.7

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CONFIDENTIAL

SUBTASK 2.8 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

The objective of this subtask was to initiate specialized indoctrination and familiarization to wualify appropriate personnel for assignment and performance of operations in support of the NERVA program.

Accomplishments

Staffing was maintained at four engineers throughout CY 1963 for implementing the training effort at NRDS and providing direction, review and integration of all NERVA training activity within participating Aerojet Divisions and with subcontractors. During the contract year, the following items were accomplished.

1. Assisted WANL in the preparation of operator job descriptions for the Test Cell "A" Control Point and of certain other positions at E-MAD based on R-MAD operational experience. Assistance was also provided in performing job task analysis and the subsequent establishment of a preliminary detailed operators' Qualification Program.
2. Prepared psychomotor testing procedures entitled "Psychomotor Study" to aid in the selection of "remote handling" operators at E-MAD. This procedure is also applicable for selecting new hires at R-MAD or at any facility utilizing remote handling equipment.
3. Completed a "Selector and Screening Study Manual" for the purpose of determining the screening process required in selecting operators for "remote handling" equipment at E-MAD or any other facility, such as R-MAD or ETS-1, which does or will utilize remote handling techniques.
4. During the final quarter of CY 1963, a government-furnished training trailer was established supplied with standard sudio-visual equipment, for conducting lectures and office space for the training staff members. In addition, the preparation of visual training aids was initiated to permit effective dissemination of course presentations.

5. Prepared a "Test Cell 'A' Indoctrination" manual which was used during the final quarter of CY 1963 for three groups of trainees totaling 28 enrollees. The course is of 8 days duration, or 48 hours, and covers the various process systems including radiological safety. The large majority of trainees who completed this course were assigned to Test Cell "A" operations.

6. Initiated preliminary assembly of training materials for courses in nuclear physics, cryogenics, and general NRDS indoctrination of new employees, which will continue into CY 1964.

7. Prepared a preliminary list of recommended training mockups of engine hardware for future NERVA training programs.

8. Established a NERVA Training Plan accepted by SNPO-C for CY 1964 and also reviewed and recommended revisions to the preliminary training program submitted by Aermican Machine and Foundry for E-MAD Operations in CY 1964.

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Test Cell "A" Indoctrination Course Syllabus

Test Cell "A" Indoctrination Course

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Presentation.

SCHEDULES AND MILESTONES

CONTRACT YEAR 1963

TASK ITEM 2.8

DATE:

SCHEDULED MILESTONE

MILESTONE ACHIEVEMENT

RESCHEDULED MILESTONE

RESCHEDULED MILESTONE ACHIEVEMENT

RESCHEDULED TO CY 64

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SCHEDULES AND MILESTONES
CONTRACT YEAR 1963
TASK ITEM 2.8

TRAINING	1962												1963											
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER									
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CRYOGENICS																								
23. START TRAINING STANDARDS															↑									
24. COMPLETE TRAINING STANDARDS															↑									
25. START SYLLABUS																								
26. COMPLETE SYLLABUS																								
27. START STUDY GUIDES/VISUAL AIDS															↑									
28. COMPLETE STUDY GUIDES/VISUAL AIDS															↑									
29. START INSTRUCTOR LESSON PLANS																								
30. COMPLETE INSTRUCTOR LESSON PLANS																								
31. START PRESENTATIONS																								
32. COMPLETE PRESENTATIONS																								
HEALTH AND SAFETY																								
33. START TRAINING STANDARDS															↑									
34. COMPLETE TRAINING STANDARDS															↑									
35. START SYLLABUS																								
36. COMPLETE SYLLABUS																								
37. START STUDY GUIDES/VISUAL AIDS															↑									
38. COMPLETE STUDY GUIDES/VISUAL AIDS																								
39. START INSTRUCTOR LESSON PLANS															↑									
40. COMPLETE INSTRUCTOR LESSON PLANS																								
41. START PRESENTATIONS																								
42. COMPLETE PRESENTATIONS																								
43. ON-THE-JOB AND FACTORY TRAINING																								
44. PERSONNEL QUALIFICATION PROCEDURES															↑									

DATE:

◇ SCHEDULED MILESTONE

▲ MILESTONE ACHIEVEMENT

◇ RESCHEDULED MILESTONE

◆ RESCHEDULED MILESTONE ACHIEVEMENT

◇ RESCHEDULED TO CY 64

Sheet 2 of 2

SUBTASK 2.9 ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

The objective of this task was to provide LASL with technical assistance at Los Alamos and NRDS in areas related to rocket propulsion.

Accomplishment

The level of engineering personnel assignment was that which was mutually agreeable to both REON and SNPO-C. During the first quarter of CY 1963, four AGC engineers were assigned to LASL at NRDS and three engineers at Los Alamos. Personnel at NRDS participated in KIWI reactor and test car assembly, disassembly and hot cell operations while those at Los Alamos participated in reactor analysis reports, instrumentation, data evaluation and control system and component design analysis.

During the third quarter of CY 1963, LASL support at NRDS was phased out so that during the final quarter of CY 1963 support was only provided at Los Alamos and consisted of three engineers. The four engineers at NRDS were integrated into the NRX organization.

S/T 3.0 GENERAL SUPPORT FACILITIES

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-3.0-(1) SUPPORT TO SNPO-C	(a) CONDUCT AND REPORT MISC. TECH STUDIES AS REQUESTED	COMPLETED. AIRSTRIP ANALYSIS AUX TEST STAND STUDY AND NRDS TEL. REQMTS. TAB	LTR. 720:571 DTD 11/8/62 AGC. REPORT # 2433 DTD 12/28/62 LTR 741:0065 DTD 1/8/63
	(b) PROVIDE AS REQ'D UPDATED REQUIREMENTS	PERFORMED	
2-3.0-(2) DOCUMENT REVIEW	(a) PERFORM REVIEWS PER SNPO-C REQUESTS	(a) REVIEWED PRELIM. DRAWINGS & REPORTS (b) REVIEW PRH	AGC TWX DTD 10/17/62 LTR 780:0110 DTD 5/21/63
2-3.0-(3) PROGRAM REQMTS. DOCUMENT	(a) PREPARE AND ISSUE PRD DURING CONTRACT YEAR	(a) SUBMITTED FIRST ISSUE (b) SUBMITTED FIRST QUARTERLY REVISION	AGC REPORT #2578 DTD 6/25/63 AGC REPORT #2578 REV. 1 DTD 10/1/63
SPECIAL REQUEST SNPO-W	ASSIST IN EVALUATION OF EXISTING NTO FACILITIES FOR USE IN NUCLEAR ROCKET PROGRAMS	COMPLETED	GOVERNMENT TRIP REPORT

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

TASK 3 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objectives

The objective of the Task 3 Series (less S/T 3) are in general to provide technical assistance to SNPO-C as required in establishing NRDS Facility requirements and facility criteria, perform design reviews of the AE designs, monitor as requested the procurement and installation/construction, review and/or supply activation plans and advise or assist SNPO-C in the facility acceptance of the facility item from the contractor.

It is to be noted that all of these S/T were negotiated at a level of effort basis and that the performance of the required work was dependent on the basic REON Facilities group being assigned on various S/T's as the work load demanded with some peak loads being handled by AETRON in certain areas.

Conclusion

In conclusion, all milestones, reviews, work requests, criteria, studies have been completed in a timely manner which aided SNPO-C to continue creation of the NRDS facilities for the NRX and Engine development programs.

SUBTASK 3.0 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. Conduct and Report on Miscellaneous Technical Studies

(1) REON reviewed the Lockheed Aircraft Corporation "Survey of Proposed Airport at Jackass Flats, Nevada." A comparative analysis of the Lockheed plan versus a previously submitted (during CY 62) REON plan, was completed and submitted to SNPO-W in L720:571 on 8 November 1962. Conclusions reached was that an airfield was required at NRDS.

(2) A study of requirements and development of criteria for alternate methods of testing an E-Engine at NRDS was instigated per SNPO-C letter dated 11-20-62. Subtask 3.0 in conjunction with Subtask 3.2 completed and issued REON Report No. 2433 on 12-28-62.

(3) A tabulation of telephone stations and extensions was made of the Direct Line and Dial Telephone Subsystems survey ETS-1 Complex as requested by SNPO-C letter FDB:CEF dated 1 August 1962. Results of this tabulation were transmitted to SNPO-C (in REON L741:0065 1-8-63).

b. Update Requirements

(1) No requests were received to update requirements for general support facilities; however, updating was achieved via the PRD reporting.

2. Document Review

a. Perform reviews per SNPO-C requests:

(1) A review of 6 preliminary drawings of the NRDS Support Area Plan was made at the request of SNPO-N (letter 9 October). Comments on these drawings were sent to SNPO-C by TWX on 17 October 1962 (refer to Bibliography). Significant problems were identified and a meeting was requested to discuss these problems which has not yet been scheduled.

(2) Comments resulting from a REON review of the NRDS-SOP were compiled and transmitted to NRDS Operations Division for inclusion with their submittal at the request of NTO. (to SNPO-C - TWX 8 May 1963).

3. Program Requirement Document

a. Program Requirements Handbook (PRH)

(1) The Program Requirements Handbook - preliminary - (PRH) issued by SNPO-N which provided the guidelines for the preparation of Program Requirements Documents (PRD) was reviewed and comments were submitted to SNPO-C (L780:0110) (Refer to Bibliography).

b. Program Requirements Document (PRD):

(1) The development and publication of a Program Requirements Document (PRD) was accomplished and the first issue of AGC Report No. 2578 was made in June 1963 (Refer to Bibliography). The first quarterly revision has been completed and is to be published during October 1963.

4. Special Request SNPO-W

a. Evaluation Study: :

(1) As required by SNPO, REON assisted in the evaluation of existing NTO facilities for use in the Nuclear Rocket Program (L741:MO564) (refer to Bibliography). This inspection tour involved evaluation of the PLUTO facilities at Area 401, NTS. The conclusion of recommendations of this meeting were to be documented in SNPO-W trip report.

Conclusion

All SNPO-C requests and direction were completed on a timely and satisfactory basis.

SUBTASK 3.0 - BIBLIOGRAPHY

<u>ITEM</u>	<u>REFERENCE</u>	<u>SUBJECT</u>	<u>ORIGINATOR/ADDRESSEE</u>
Ltr.	10-9-62	Preliminary Master Plan for NRDS	Huff, SNPO-N to REON
TWX	10-17-62	Preliminary Master Plan for NRDS	House to Schroeder
Ltr.	720:571:ACJ: gb- 11-3-62	Airstrip at Jackass Flats, Nevada	House to Finger
Ltr.	11-27-62	NRDS Communications	Schroeder to House
Report	No. 2433 12-62	Auxiliary Static Test Facility Study	
Ltr.	1-8-63	NRDS Communications	Stinnett to Schroeder
Ltr.	2-26-63	Program Requirements Handbook	Dickson, SNPO-N-REON
TWX	5-10-63	Program Requirements Document	Ryland to Schroeder
Ltr.	5-21-63	Comments on Program Requirements Handbook	House to Schroeder
Report	No. 2578 6-63	Program Requirements Document	
Ltr.	6-25-63	Program Requirements Document for NRDS	Ryland to Schroeder
Ltr.	7-26-63	Utilization of Pluto Facilities in Nuclear Rocket Program	H.B.Johnson/W.R.Slivka to Finger

S/T 3.1 NERVA EXHAUST SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE A. ENGINEERING-	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.1 (1)	EVALUATE SUBSCALE ETS-1 NES EJECTOR SYSTEMS FOR 25:1 AREA RATIO ENGINE NOZZLE (PAGE II-A-30)	COMPLETED	REPORT NO. 2679 REPORT NO. 2678
2-3.1 (2)	NES R&D PROGRAM TO ESTABLISH PRIMARY & SECONDARY PERFORMANCE FOR ETS-1 & ETS-2 (PAGE II-A-30)	COMPLETED	REPORT NO. 2679 REPORT NO. 2680
2-3.1 A (1)	NES DUCT MECHANICAL DESIGN SUPPORT OF SCALE MODEL PROGRAM (PAGE II-A-30)	COMPLETED	REPORT NO. 2699
2-3.1 (3) & 2-3.1 A (2)	NES DUCT PRELIMINARY DESIGN, DRAWINGS & SPECIFICATIONS (PAGE II-A-30)	COMPLETED	REPORT NO. 2630
2-3.1 A (3)	SELECT NES PURGE SAFETY SYSTEM (PAGE II-A-30)	COMPLETED	CHANGE ORDER NO. 1, MOD. 8, RN-63013 AGC SPEC 10193

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 3.1 NERVA EXHAUST SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.1A (4)	NES INTEGRATION, PROVIDE TECHNICAL DATA FOR (PAGE II-A-30) (a.) INSTALLATION, REMOVAL, INSPECTION & DISPOSAL CRITERIA (b.) INTERFACE CONTROL (c.) ACCEPTANCE TEST PLAN (d.) OPERATIONAL CRITERIA (e.) MAINTENANCE, SERVICE & SUPPLY (f.) MALFUNCTION ANALYSIS (g.) CONTAMINATION ANALYSIS	COMPLETED	NDC 69, NDC 69, MEMO 793 :M:0080 793 :M:0078 793 :M:0079 793 :M:0079 793 :M:0067 793 :M:0069 793 :M:0076
13-31a(2)	ENGINEERING SUPPORT OF STEAM GEN- ERATOR PROCUREMENT, TEST PLAN & FACILITY MODS (PAGE II- 6)	PERFORMED	CHANGE ORDER NO. 1, MOD 8, RN 63013 MEMO 791:M0031

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 3.1 NERVA EXHAUST SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
13-31 a (2) CONT			MEMO 790:M0131 MEETING 13 SEPT. 1963 SNPO-C & REON LETTER 741:0311 MEMO 791:M00 34
13-3.1 a (3)	ENGINEERING SUPPORT OF INSTRUMENT- ATION & CONTROL (I&C) FOR STEAM SYSTEM (PAGE II-6)	PERFORMED	MEMO 29365 (I&C TRAILER) MEMO 791M00 34 STATUS REPORTS 1&2
13-3.1 a(4)	SUBSCALE THERMAL CYCLE TEST PROGRAM PLAN (PAGE II-6)	COMPLETED	TWX SNPO-C TO REON TEST PLAN.

REON - ROCKET ENGINE OPERATIONS - NUCLEAR

S/T 3.1 NERVA EXHAUST SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE B. FABRICATION	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2.3.1.B	FABRICATION OF DUCT COOLANT PASSAGE TEST SPECIMENS (PAGE II A-31)	COMPLETED	REPORT NO. 2668
13.3.1.a(1)	PROCUREMENT OF STEAM GENERATOR SYSTEM (PAGE II-6)	COMPLETED	P.O. NO. NP.000254
13.-3.1.a(4)	FABRICATION OF THERMAL CYCLE TEST SPECIMENS (a) DELTA CHAMBER MOD.	COMPLETED	P/N 2-088180-IS/N A.42
	(b) UNCOOLED TEST SPECIMEN	COMPLETED	P.O. NO. 363778
	(c) COOLED TEST SPECIMEN (PAGE II-6)	COMPLETED	P.O. NO. 363778

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 3.I NERVA EXHAUST SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
C. TESTING			
2-3.I.C (1)	CONDUCT STRUCTURAL TEST OF COOLANT PASSAGE TEST SPECIMENS (PAGE II A-31)	COMPLETED	REPORT NO. 2668
2-3.I.C (2)	CONDUCT 1/4 SCALE NES FACILITY SEAL TEST PROGRAM (PAGE II A-31)	COMPLETED	REPORT NO. 2700
13-3.I a(4)	CONDUCT UNCOOLED SPECIMEN TEST	COMPLETED	MEMO 790:MO148

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.1 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

Conduct scale model tests which will provide information to develop design criteria and perform preliminary design of the NERVA Exhaust System (NES) configuration with safety purge for ETS-1, prepare criteria for the ETS-2 systems. These criteria and preliminary designs will be supported by studies of the operational and safety aspects of the NES. Technical direction and assistance will be provided for and during the final design and procurement of the duct and purge gas systems. Limited testing to support and/or verify the preliminary design will also be provided.

2 - 3.1 (1)

1. Scale model tests were performed to aid in the selection of the NES ETS-1 duct configuration. In order to provide sufficient data to enable selection of the most favorable configuration, eight scale models were designed, fabricated, and subjected to hot gas testing to ascertain their aerodynamic performance, heat transfer rates, and operational characteristics. The selected configuration designated the SST-2 duct geometry, a configuration with a heat flux at the elbow of 2.6 Btu/in. sec. When utilized with the secondary injector safety purge, the NES allows the E engine 25:1 nozzle to flow full when the chamber pressure makes approximately 230 psig. However, the NES for ETS-1 does not permit engine gimbaling or altitude simulation firing startup or shutdown.

2. Report No. 2678

The selected configuration (SST-2) was further tested to determine safety purge requirements and operational behavior, such as heat rates, distribution, and the simulation of actual testing sequences. The results of the above two testing programs provided design criteria to the NES ETS-1 duct preliminary design.

2 - 3.1 (2)

To establish primary and secondary performance for ETS-1, ETS-2 Facilities (Report No. 2680).

In order to predict the behavior of secondary fluid and cell pressure and to establish the secondary ejector flow requirements during the reference engine operating cycle, an analytical model was developed and scale models were tested to verify the model. This testing program confirmed the predicted behavior and interaction of the major components which comprise the exhaust system.

2 - 3.1 A (1)

In support of the Subscale Heat Transfer Testing Program, a conceptual design effort was performed to establish basic design concepts which served as the basis for the preliminary design of the NES duct for ETS-1. Several design approaches for the duct were generated and evaluated. As a result of the effort basic decisions made were:

1. Selection of the coolant channel configurations for each duct section
2. Establishment of basic fabrication techniques for development during the preliminary design
3. Selection of 347 SS as the construction material.

2 - 3.1 (3) and 2 - 3.1 A (2)

A preliminary design of the ETS-1 NERVA Exhaust System (NES) duct, designated SST-2 Subsonic Turn Configuration, was completed in the fulfillment of Milestone No. 7 of Subtask 3.1 as defined in RN 63002. Analysis of flows, stresses, and temperatures have been performed to verify the adequacy of this design and to establish the actual configuration. Detailed calculations and backup analysis, along with the design description, has provided sufficient information to complete the preliminary design and permit proceeding with the final design. Support analysis included in the preliminary design concludes that the design is adequate and fulfills the NES ETS-1 program goals.

The major products of the preliminary design were the drawings and related specifications for the NES duct.

Analyses in support of the designs and specifications were made in the following areas

1. Design
2. Heat Transfer

3. Water System
4. Stress
5. Fabrication
6. I&C

2 - 3.1 A (3)

An economic evaluation of the possible safety purge systems for ETS-1 was made. Based upon this evaluation and data obtained from the scale model test program, a decision was made in coordination with SNPO-C to provide a steam safety purge system for ETS-1. Detailed requirements for a steam generator system were established and an equipment specification was prepared and issued.

2 - 3.1 A (4)

The NES Integration effort was specifically aimed toward providing the definitive data and criteria to permit the orderly integration of the several NES subsystems and to describe the overall performance band of the operational NES. The technical data and studies developed under this portion of the 3.1 Subtask considered such activities as handling, installation and removal at the test site; minimum acceptable standards for operational readiness; the operational sequence of events for startup and shutdown of the NES. Additionally, a preliminary malfunction analysis of the NES was performed to define probable modes of failure. This information will serve to establish necessary remedial procedures and to define an initial spare parts component list. Studies were also conducted to estimate the fission product plate-out to the NES duct inner wall and to formulate candidate processes of the deposited fission products.

13 - 3.1 a (2)

A list of potential steam generator suppliers was established and requests for quotations from three prospective subcontractors were solicited. Proposals were received and a detailed evaluation performed. Visits were made to each company to inspect methods of fabrication and test facilities. A subcontractor was selected and a recommendation submitted to SNPO-C.

Coordination meetings with SNPO-C and REON were held and a visit to the test site at NRDS was made to select the site location for the steam generator. Steam generator interface control drawing 093119 and facilities requirements were prepared and issued. The basic steam generator development test program was defined and discussed with SNPO-C.

13 - 3.1 a (3)

It was not expected that the facility I&C would be operational by the time of the steam generator development test period. Therefore, an interim instrumentation system was deemed necessary. The design for such a system has been initiated. Two (2) surplus Army fire control trailers (GFE) obtained on loan basis, have been integrated into the design. The trailers have been stripped of their original electronic equipment and are being refurbished to install the instrumentation, signal conditioning, recording and controls equipment. Procurement of material for the instrumentation system has been initiated. Preliminary tabulations defining measurement points and transducer requirements have been made.

13 - 3.1 a (4)

A test program was initiated utilizing a Delta Thrust Chamber and subscale specimens of the ETS-1 duct. Four uncooled specimens were used to determine the representative heat transfer profile. One tubular coolant passage cross-section specimen and one rectangular coolant passage cross-section specimen each of cylindrical ejector cross-section are in process of fabrication to be tested in evaluating the combined mechanical and thermal stress loads as a verification of the preliminary design studies.

This testing was accomplished by firing the Delta rocket engine into instrumented scale model specimens. A test program plan describing the testing sequence was completed.

2 - 3.1 B

Sample coolant channels, for possible use in the design of the ETS-1 primary and secondary portion of the NES exhaust duct, were fabricated. Five specimens were constructed for this test program, three tensile specimens and two burst specimens.

13 - 3.1 a (1)

Approval of the recommended steam generator subcontractor was received from SNPO-C and procurement was initiated. P.O. Number N.P. 000254 was issued to the Thiokol Chemical Corporation for design, fabrication, and testing of the steam generator units.

13 - 3.1 a (4)

1. Delta Thrust Chamber Modifications

A Delta Thrust Chamber (Ser. No. A.42) was purchased and modified for acceptance of the test specimens.

2. Uncooled Test Specimens

In order to simulate actual heat transfer conditions, verification of the heat transfer rates were required. Four uncooled test specimens were fabricated for testing in order to obtain representative heat transfer profiles.

3. Cooled Test Specimen

The fabrication of the cooled simulated duct specimens for subsequent testing was initiated in CY 1963. This specimen has coolant passages and manifolds similar to that of the final ETS-1 NES duct.

2 - 3.1 C (1)

Five sample coolant channel specimens were structurally tested. Burst and tensile testing was conducted using these specimens, and results indicated the structural capability of the coolant channel design was adequate.

2 - 3.1 C (2)

A 1/4 scale NES seal test program was conducted to evaluate three types of metallic seals and to determine the types that are best suited for use in the design of the ETS-1 NES duct. Results indicated that a double, aluminum "Conoseal," backed by an inert gas buffer zone, will provide satisfactory sealing and safety for the NES duct operation. However, the test indicated that the present Conoseal design was unsuitable for repeated use. This report marks the completion of Item 4.3a, task 3.1 of Program Plan, RN 63002, Vol. I of Contract SNP-1.

13 - 3.1 a (4)

Five firings at various durations up to 15 seconds were performed on the uncooled specimens to obtain a representative heat flux profile.

Conclusion

1. The work statement objectives were met.
2. All thirteen milestones scheduled in Subtask 3.1, as defined in both RN 63002 and RN 63013 (Change Order 1) were completed in CY 1963.
3. All hardware demands were completed on schedule in compliance with the updated program plan.
4. All scheduled testing was conducted and completed on schedule.
5. The objectives of this subtask have been accomplished such that final design of the NES can proceed during CY 1964.

SUBTASK 3.1 - BIBLIOGRAPHY

REPORTS

<u>Number</u>	<u>Title</u>
2679	Analytical & Experimental Evaluation of 90° Subsonic Turn Ejector System for Use at ETS-1
2678	ETS-1, NES Performance & Design Criteria
2680	Experimental Evaluation of Secondary Pumping Systems for ETS-2
2699	NES Conceptual Design, September 1963
2630	NES Duct Preliminary Design Report & Appendix, September 1963
AGC-10193	Equip. Spec.-Gen. System, Steam, for NERVA Exhaust System at ETS-1
NDC 69	Installation & Removal, NES Exhaust Duct at ETS-1, Procedure for
2668	Structural Integrity Test, August, 1963
2700	ETS-1 Sub-scale Seal Test Program, October, 1963
	Thermal Cycle Test Plan, September 1963
2474	AGC-2 ETS-1 NES Preliminary Design Report
	NES Duct Sub-scale Thermal Stress Structural Test Plan, September 1963

RECON MEMOS

<u>Number</u>	<u>Subject</u>
793:MO080	Acceptance Test Plan for NES Duct - ETS-1 dtd 10/27/63
793:MO078	Sequence of Operation, NES, ETS-1 dtd 10/26/63
793:MO079	NES Preliminary Malfunction Analysis dtd 10/27/63
793:MO069	NES Decontamination Report dtd 10/18/63
793:MO067	Proposed Addition to NRI-A2, Operational Support Plan for Nozzle Contamination Analysis dtd 10/18/63

NumberSubject

793:MO075   Review of NRX-A2 Test Plan dtd 10/30/63

793:MO076   Proposed Revisions to NRX-A2 Test Plan for Nozzle Contamination
Analysis dtd 10/23/63

741:LO311   Interface, ETS-1 NES Steam Generator dtd 10/30/63

790:MO131   ETS-1 Facility Requirements dtd 10/9/63

791:MO031   Trip Report SNPO-REON Steam Generator System dtd 6/13/63

791:MO042   Trip Report - GFE, Inst. Trailers for SGS Development dtd 10/3/63

AGC   Status Report 1 & 2 dtd 8/2/63 and 8/26/63 - SGS

SNPO   Minutes of Meeting REON -SNPO dtd 10/13/63 - SGS

TNX   SNPO to REON dtd 8/8/63 - Schroeder to House "Initiate Thermal
Cycle Test Program"

790:MO148   Monthly Progress Report Thermal Cycle Test Program dtd 10/1/63

Receiving Memo   Spare Trailer Van (SGS Instrumentation) S/W 55

791:MO034   Steam Generator System Procurement dtd 7/10/63

PURCHASE ORDERSNumberSubject

N.P. 000254   Design, Fabrication, Inspection and Test completes SGS (Thickol)

P/N 2 - 088180-1   Delta Chamber Fabrication Modification
S/N A.42

363778   Thermal Cycle Test Specimens

RECON
ROCKET ENGINE
OPERATIONS - NUCLEAR
AEROJET-GENERAL

EXHAUST SYSTEM DEVELOPMENT PROGRAM	1962												1963											
	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER									
	6 13 20 27 3 10 17 24	1 8 15 22 29 5 12 19 26 2 9 16 23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24 31 7 14 21 28 5 12 19 26 2 9 16 23 30 7 14 21 28																						
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1. COMPLETE SUPPORTING TESTS FOR AGC 2 CONFIGURATION DUCT				▲																				
2. COMPLETE PRELIMINARY DESIGN OF AGC 2 NES				▲																				
3. DETERMINE PRIMARY EJECTOR CONFIGURATION						▲																		
4. OPERATION OF NES DEFINED-SCALE MODEL TESTS FOR ETS-1								↑		◇		◇	◆											
5. INITIATE PRELIMINARY DESIGN ON DUCT								↑	◆															
6. COMPLETE SUB-SCALE STRUCTURE TEST PROGRAM												▲												
7. COMPLETE NES PRELIMINARY DESIGN & SUBMIT TO SNPO-C													▲	▲										
8. CY 1963 R & D SCALE MODEL TESTS COMPLETE													▲	▲										
9. START DESIGN, PORTABLE I&C SYSTEM FOR STEAM GENERATOR DEVELOPMENT TESTS												▲												
10. ISSUE P/O, STEAM GENERATOR EQUIPMENT, ETS-1 (NES)												↑	▲											
11. START ENGINEERING EFFORT IN SUPPORT OF STEAM GENERATOR SYSTEM TEST PLANS & MODS.												▲	◇											
12. START SUBSCALE THERMAL CYC. PROGRAM													▲											
13. GFE INSTRUMENTATION TRAILERS AT AGC-AZUSA.												↑	▲											

TEST STATUS

9-30-63

TASK ITEM 3.1.8

TASK TITLE Sub-scale Thermal Cycle Test Program

COMPONENT OR SUBASSEMBLY	CONFIGURATION NO. OR SERIES	TEST OBJECTIVE	FACILITY	NUMBER OF TESTS		REMARKS
				EST.	ACTUAL	
Sub-scale Duct	Uncooled Cylindrical	Establish Heat Flux Profile	Azusa	2	5	
Sub-scale Duct	Uncooled Rectangular	Establish Heat Flux Profile	Azusa	2	0*	*Memo 746:B.10:458 An agreement with SNPO-C to eliminate the rectangular uncooled specimen and associated tests and add three additional cylindrical test specimens
Delta Thrust Chamber	Exit Area Ratio Approx. 4	Checkout Chamber Performance	Azusa	1	2	

S/T 3.2 TEST STAND ETS-I

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.2 (1) SUPPORT TO SNPO-C	(a) PRODUCE SCHEMATICS AND DWG-S FOR CONTROL SYSTEMS. PROCESS SYSTEMS AS REQUIRED	(a) PERFORMED	(a) AGC DWG NOS. 091035, 091036, 091257, 091258
	(b) PRODUCE, REVISE, EXPAND OPERATING PROCEDURES	(b) PERFORMED	(b) L740:0035 DTD 10/17/62
	(c) PROVIDE ACTIVATION PLANNING AS REQUESTED	(c) PERFORMED	(c) L741:0158 DTD 5/1/63
2-3.2 (1) REVIEW TEST STAND DESIGN	(a) DESIGN REVIEW	(a) PERFORMED	(a) L741:0109 DTD 3/11/63
	(b) CONDUCT STUDIES TO IDENTIFY TEST STAND MODS TO ACCEPT ENGINE/NES	(b) PERFORMED	(b) AGC REPORT #2506 DTD 6/63
	(c) PERFORM SYSTEM ANALYSIS AS REQUIRED	(c) PERFORMED	(c) AGC REPORT #2506 ADDENDUM DTD 6/18/63
2-3.2 (1) DESIGN CRITERIA	DEFINE ENGINE/FACILITY INTERFACES AND DEVELOP CRITERIA AS REQUIRED	PERFORMED	NDC-65 DTD 9/19/63 L741:0309 DTD 9/19/63 AGC DWG #091762 AGC REPORT #2433 DTD 12/28/62

SUBTASK 3.2 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. REON produced drawings of the test stand process and utility flow schematics. AGC Drawing Nos. 091035, 091036, 091257, 091258 were released to NTO for review and comment including a layout of the control systems composite flow schematics. One set of these schematics was transmitted to EG&G through S/Task 3.3 for use in designing the I&C wiring and control consoles.

b. As a continuing function Subtask 3.2 periodically reviewed, revised and expanded ETS-1 operating procedures and countdown schedules. One revision of these procedures and schedules were incorporated as an addendum into REON Report 2506, dated June 1963.

REON also supplied various preliminary checkout procedures for Test Stand and Process Systems (ref. REON L740:0035 dated 10-12-62).

Construction contractor prepared checkout procedures for various ETS-1 systems were also reviewed and commented on as the procedures became available. Comments on these procedures were returned to NRDS for action through the NERVA Test Organization.

c. Activation planning was accomplished as requested by SNPO-C. PERT data, periodically received from SNPO-C was reviewed and incorporated into REON working charts. At specific SNPO-C request (Ltr PPO/PSR dated 4-5-63) a bi-weekly reporting system was implemented by Subtask 3.2 for the ETS-1 program (Ref. REON L741:0158 5-1-63).

2. Design Review of Modifications and Deficiencies

a. Aetron Report No. 2408A, "Preliminary Design for Additions to ETS-1," was received and reviewed as requested by SNPO-C. Comments as to operational and safety adequacy of the contents of this report were prepared and forwarded to SNPO-C (Ref. REON Letter L741:0109, dated 3-11-63).

Specifications and drawings for the ETS-1 fire protection system, and for specific facility additions and modifications were reviewed as a separate package and again as part of the revised facility modification package. Comments were submitted to SNPO-C each time in REON letters L741:0109 dated 3/11/63 and L741:0253 dated 7/26/63.

Field review, verification and correction of the test stand process and utility flow schematics was completed during this report period. Drawings of individual system schematics were initiated and completed.

Subtask 3.2 also participated in reviews of certain I&C design packages in support of Subtask 3.3. Effort was provided in developing control room, control console and facility/graphic display layouts. The I&C construction bid package material such as tunnel modifications, cable tray installation, etc. were reviewed (REON letter 741:508 dated 4/12/63).

b. REON Report No. 2506, "Mandatory Facility Additions, Engine Test Stand No. 1 at NRDS," and Addendum, "ETS-1 Fluid Requirements," was completed and submitted to SNPO-C in June 1963. The report included data on the operational requirements of the NERVA engine. The Static Test Complex Utilization Plan and ETS-1 Functional Requirements. The mandatory additions and modifications of the test stand were divided into the following categories:

- (1) Major Contracts and Bid Packages
- (2) Major Mods of Addendums required from program changes requiring an A&E effort
- (3) Systems associated with engine development
- (4) Facility mods accomplished as part of activation.

A special preliminary engineering study requested by SNPO-C (Ltr PPO/RWS dated 11/20/62) was conducted to consider alternate facilities for NERVA engine testing which are not dependent on the NERVA exhaust system. The results of this study, which considered several alternate methods including upward firing were submitted in REON Report No. 2433. Coordinated efforts in subtask 3.0 and 3.6 were involved. Alternate test facilities were considered feasible.

c. REON conducted a study to assess the feasibility of topping the ETS-1 test run tank in order to achieve an extended run time capability. This study, which included both a flow analysis and a thermodynamic feasibility analysis, was conducted to provide guidelines for ETS-1 I&C system design, and to assess the capability of the facility in supporting various test objectives. It was concluded that significant facility modifications were mandatory before ETS-1 could be utilized for test runs of longer duration than the present run tank is capable of sustaining. Results of this study were submitted to SNPO-C in REON L741:0234 dated 6-26-63.

Another typical study conducted by REON was the LH₂ engine cooldown facility requirements study, which was initiated when revised engine cooldown data became available in late April 1963. The results of this study were included as addendum to REON Report 2506 wherein cooldown facilities were defined and preliminary conceptual design of the LH₂ and LN₂ systems included.

Assistance was provided in generation of an Operational Safety Hazards Study REON Report No. 2316.

Additionally, preliminary data was developed to illustrate the feasibility of performing maintenance on a "hot" NERVA engine on the test stand and the facility support requirements associated with limited engine removal. This data is presently being used to supplement the "On Stand Maintenance" study currently being conducted by REON under subtask 2.1.

3. Define Engine/Facility Interfaces and Develop Criteria as Required

Considerable effort was expended by Subtask 3.2 in defining, analyzing ETS-1 interfaces and producing and maintaining interface control drawings. Typical results of these actions are as follows:

Production of Design Criteria for LH₂ Propellant Feed Line Assy, REON NDC-50, dated 10-15-62, of criteria for "Top Shield Penetration ETS-1 Engine Compartment NDC-63 dated 6-28-63 were completed and submitted to SNPO-C. Criteria was generated from October 1962 until December 1962 for the NERVA Exhaust Duct System, which was later used in REON Report 2474.

Assistance in the production of preliminary criteria for the ETS-1 Thrust Structure and Thrust Structure to Engine Adapter was given to Subtask 1.1.

Subtask 3.2 assisted in establishing all NES-Facility interfaces and produced a preliminary interface drawing REON No. 093118. This drawing has been used as a guide in establishing exhaust duct requirements. All NES Design Criteria has been reviewed as it affects the operation and functional capability of the ETS-1 facility.

Another Drawing, No. 091762, was produced to further identify ETS-1 facility and process system interfaces. This drawing included the Cool-down Compartment Purge interfaces, the interfaces for the disconnect for the gas back pressure actuator and the I&C engine harness systems.

Further, a topical study of the ETS-1/ETS-2 Facility Control Interface was conducted at the direction of SNPO-C TWX 506 dated 8-9-63. This study presented methods of utilizing facilities for both ETS-1 and ETS-2 and determined that only minimum changes to the I&C system and the existing storage facilities must be made to allow common and simultaneous usage of both test stands. The results of this study were submitted to SNPO-C by REON L741:0309 dated 9-19-63.

Conclusions

The effort expended under Subtask 3.2 during CY 1963 has expedited preparations for activation of the ETS-1 facility and greatly aided SNPO-C in the identification of additional requirements, needed for new internal planning and budgeting.

SUBTASK 3.2 - BIBLIOGRAPHY

CORRESPONDENCE TO AND FROM REON

DATE	TO	FROM	TWX NO.	LETTER NO.	SUBJECT
10-17-62	SNPO-C	REON		L740:0035	Checkout Procedures for Test Stand and Process Systems.
10-31-62	SNPO-C	REON		L741:0045	Area Warning System Summary
12-5-62	REON	NASA LRC-C		0321142	ETS-1 Supersonic Turn Configuration NES
12-20-62	REON	SNPO-C		Draft to House	Exhasut System Actions.
1-10-63	REON	NASA S.M.		2343	Cryogenic Storage Capacities for ETS-1
1-22-63	SNPO-C	REON		L741:0080	Proposed ETS-1 Facility Modifications.
1-25-63	SNPO-C	REON	740-6179		Revision to AGC Report 2409.
2-11-63	REON	SNPO-C		None	Preliminary Design for Addition to ETS-1
2-13-63	SNPO-C	REON	741-5263		2409 Revision Report
2-18-63	REON	SNPO-C		FDG:ETM	Nitrogen Gas Purge of Instrument Boxes ETS-1
2-19-63	REON	SNPO-C		TSB:AL/CEF FDG:EM	Electrical Hazard Classification of ETS-1

CORRESPONDENCE TO AND FROM REON

DATE	TO	FROM	TWX NO.	LETTER NO.	SUBJECT
3-11-63	SNFO-C	REON		L741:0109	REON Comments on Report No. 2408 A "Preliminary Design for Additions to ETS-1."
4-3-63	REON	SNFO-C	1539		ETS-1 Piping
4-5-63	REON	SNFO-C		ppo-per	Preliminary ETS-1 Facility Network
4-10-63	SNFO-C	REON		L740:0008	Preliminary Facilities Instrumentation and Control
4-12-63	SNFO-C	REON		741-508	Addition of Blast Valve to ETS-1 Tunnel
4-30-63	REON		TSS/AL/CEV 301629Z		Addition of Blast Valve to ETS-1 Tunnell
5-1-63	SNFO-C	REON		L741:0158	Return of Preliminary ETS-1 Facility Network Copy
5-9-63	REON		TSS/AL/CEV 071756Z		ETS-1 I&C System, Vessel AS-Built Brawing
5-21-63	REON		TF&OB/BJB 211759Z		ETS-1 Gas System
5-22-63	REON	SNFO-C	TF&CB/BJB P 222052Z		ETS-1 Process Water System Tests
5-22-63	REON	SNFO-C	PT&OB/BJB P 222057Z		Activation of ETS-1 Process Water System
5-24-63	REON		FDG/CJL 232249Z		Testing Diesel-Generator

CORRESPONDENCE TO AND FROM REON

DATE	TO	FROM	TWX NO.	LETTER NO.	SUBJECT
5-24-63	REON	NASA LRC-C	FDG/OJL 232245Z		ETS-1 Diesel-Generator Performance Data
6-4-63	SNFO-C	REON		L740-0023	AGC/Sacto Safety Procedure No. 3 Pressurized Equipment
5-31-63	SNFO-C	Aetron		810:254	ETS-1 Engineering Work Incompleted
6-7-63	REON	SNFO-C	741:059		ETS-1 Facility Addition and Modification
6-10-63	REON	SNFO-C		FDG-HBS	ETS-1 Facility Additions & Modifications Required by NERVA Engine Program Changes (meeting minutes of 5-29-63 at SNFO-C)
6-12-63	REON	NASA LRC-C	TFO/BJB 122103Z		Test Specification Process Water System
6-14-63	REON	NASA LRC-C	TFO/BJB 141812Z		Test Specification Diesel Generator
6-26-63	SNFO-C	REON		L741:0234	ETS-1 Run Tank Topping Study
7-12-63	SNFO-C	REON		L741:0251	NDC-65, NERVA Design Criteria
7-12-63	REON	SNFO-C	TFO/BJB RL22103Z		Process Water System ETS-1 Calibration Test Specification
7-23-63	SNFO-C	REON	6179		ETS-1 Water Process
7-26-63	SNFO-C	REON		L741:0253	Review of ETS-1 Fire Protection Systems & Facility Additions and Modifications

CORRESPONDENCE TO AND FROM REON

DATE	TO	FROM	TWX NO.	LETTER NO.	SUBJECT
7-29-63	REON	SNPO-C	TSB/AL 291544Z		ETS-2 Facility Control
7-29-63	SNPO-C	REON		790:L0008	Rev. ETS-1 Water System Calibration Test Specification
8-7-63	REON	SNPO-C		FDG-HBS	NERVA Design Criteria NDC-65 Penetrations, Top Shield, ETS-1 Engine Compartment
8-7-63	REON	SNPO-C		None	AGC Report No. 2502, ETS-2 Criteria
8-9-63	SNPO-C	REON	506		ETS-2 Facility Control
8-13-63	REON	SNPO-C	TBS/AL R131354Z		ETS-2 Facilities Control
8-15-63	REON	SNPO-C	TP&OB/WCM 15/1817Z		Process Water System Calibration Test Specification
8-16-63	REON	SNPO-C		FDG-HBS	Drawing No. 081762 ETS-1 Test Stand Flow Schematic (Preliminary)
8-16-63	REON	SNPO-C	PFO/PSR 16 2049Z		ETS-1 Facility Schedule
9-19-63	SNPO-C	REON		L741:0309	Transmittal of Topical Study on ETS-1/ ETS-2 Facility Control Interface Scope Study
9-26-63	SNPO-C	REON		L741:0298	Revision of NERVA Design Criteria NDC-65, Penetrations, Top Shield ETS-1 Engine Compartment

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CORRESPONDENCE TO AND FROM REON

DATE	TO	FROM	TWX NO.	LETTER NO.	SUBJECT
9-26-63	SNFO-C	REON		L741:0040	ETS-1 Fire Protection System Package Construction Specification
9-27-63	SNFO-C	REON		L741:0323	SNFO-C Comments Concerning AGC Drawing No. 091762 "ETS-1 Test Stand Flow Schematic (Preliminary)"
9-30-63	SNFO-C	REON		L741:0316	ETS-1 NERVA Exhaust System Steam Generator Interface

S/T 3.3 ETS-I INSTRUMENTATION & CONTROLS

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-3.3(I) SUPPORT TO SNPO-C	(a) PROVIDE AS REQUESTED CRITERIA, EVALUATIONS, REQUIREMENTS, JUSTIFICATION	(a) PERFORMED	(a) SEE BIBLIOGRAPHY L741:0081 DTD 1/23/63 L741:0123 DTD 5/23/63 L741:0213 DTD 6/13/63
2-3.3(I) PROVIDE O'ALL PRELIM. DESIGN	SUBMIT OPDP DURING CONTRACT YEAR	COMPLETED	AGC REPORT #2410 DTD 11/19/62
2-3.3(I) TECHNICAL LIASON	MAINTAIN TECHNICAL LIASON WITH SNPO-C AND I & C CONTRACTOR	PERFORMED	REON RESIDENT REPRES. AT A & E SEE BIBLIOGRAPHY
2-3.3(I) ENGINEER- ING RESPONSIBILITY WITH	MAINTAIN TECHNICAL COGNIZANCE OF INTERFACES I & C DESIGN	PERFORMED	SEE BIBLIOGRAPHY L741:591 DTD 7/29/63
2-3.3(I) OVERALL ENGINEERING SURVEILLANCE	REVIEW FACILITY MODIFICATION DESIGNS, MONITOR INSTALLATION AND CHECKOUT AS REQUIRED	PERFORMED	SEE BIBLIOGRAPHY L741:0205 DTD 6/10/63

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 3.3 ETS-I INSTRUMENTATION & CONTROLS

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-3.3 (1) TECHNICAL DIRECTION TO I & C CONTRACTOR	PROVIDE AS REQUIRED CRITERIA CLARIFICATION, DETAILED REQUIREMENTS AND DESIGN REVIEW SERVICES	PERFORMED	SEE BIBLIOGRAPHY L 741: 0104 DTD 2/20/63 L 741:0173 DTD 5/2/63
13-3.3(1) RELIABILITY AND QUALITY ASSURANCE	ASSIST SNPO-C IN THE INITIATION AND INTEGRATION OF AN RQA PROGRAM WITH I & C CONTRACTOR	COMPLETED	L 741:028 DTD 8/26/63

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.3 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 3-1.

Accomplishments

1. Support to SNPO-C

a. Criteria

Special studies were conducted to define approximately 83 criteria and/or criteria clarifications as requested by SNPO-C. These have been reported in various letters and TWX's (see Bibliography). Typically, these were; electrical hazards definition (741:0081, 23 January 1963 to SNPO-C), emergency coolant flow measurement pipe spool design criteria (L741:0123, 24 April 1963 to SNPO-C), facility operations and control systems (L741:0082, 23 January 1963 to SNPO-C), safety alarm and warning systems (L741:0045, 31 October 1963 to SNPO-C), radio frequency communications system (L741:0074, 16 January 1963 to SNPO-C), facility modifications (L741:0080, 22 January 1963 to SNPO-C). As a consequence of these studies some technical direction to EG&G resulted.

b. Technical Evaluations

Approximately 10 special technical evaluations were performed as requested by SNPO-C. Typical examples were the evaluation of the new LASL time code resulting in technical direction to EG&G transmitted by Addendum No. 6 (REON letter L741:0149 dated 22 April 1963), technical evaluation of digital data system proposals (REON letter L741:0126, 29 March 1963), performance investigation of 32 track FM magnetic tape recorders provided information needed for incorporation of these units in the ETS-1 I&C design (L741:0289, 21 August 1963 to SNPO-C). Use of heated reference junctions rather than thermocouple reference wells at ETS-1 resulted in a change in the EGG design of these systems (L741:0272, 6 August 1963).

c. Technical Requirements

Certain special requirements and definitions were submitted to SNPO-C as requested. Typically, these were the ETS-1 and ETS-2 Electrical Power Generation and Distribution Requirements (L741:0299, 23 September 1963), this study resulted in clarification of criteria and was utilized in subsequent direction of EGG effort, ETS-1 I&C Phase II Drawing Lists and Procurement Specifications were produced to assist in describing the magnitude of the EG&G Phase II effort required and define the approval/review responsibilities.

d. Justification of Technical Direction

REON at the request of SNPO-C Justified certain Technical Direction which has been given to EG&G. Typical examples listed in the Bibliography are: (1) use of individual power supplies (minutes of I&C meeting No. 11, 14 June 1963); (2) Modification of Meteorological Subsystem (TWX Msg. 314, 7 June 1963 to SNPO-C); (3) Duct and Shield Monitor (Addendum 8, Letter 741:0213, 13 June 1963 to SNPO-C). This information provided to SNPO-C the basis for REON technical directives to EG&G.

e. Program Management Assistance to SNPO-C

Management assistance was provided in the formulation of contract documents Addendum 3-8 noted in Bibliography for use in contractual direction of EG&G. These documents were incorporated in the EG&G contract and implemented by technical direction from REON.

2. Overall Preliminary Design

The Overall Preliminary Design Package was submitted as defined in the W/S and TAD. REON was requested to submit the OPDP for use during I&C contract negotiations on 27 November 1962. REON complied by submitting the OPDP as AGC Report 2410 on 19 November 1962.

3. Technical Liaison

REON provided technical liaison with the I&C contractor by assignment of a representative at the I&C contractor's plant in Boston during

various phases of the design effort and by technical review meetings and field surveys. Approximately 102 man-days were expended during this period. This was exclusive of the liaison provided in design reviews of facility modifications associated with I&C requirements.

4. Engineering Responsibility

REON maintained engineering responsibility by continuous technical direction and appropriate liaison with the I&C contractor and for the coordination of interfaces of other systems with the I&C system. Participation in periodic Remote Engine Control meetings, Test Stand Interface committee meetings and review of various facility design packages such as Fire Protection System, Shield Design, Tunnel Blast Valve, etc., were conducted. Typical interface information was prepared and was subsequently submitted as technical direction and/or information to the I&C Contractor was (1) Fire Protection Control requirements (REON letter L741:591, 29 July to EG&G); (2) Signal Interfaces for REC (L741:0160, 26 April 1963 to EG&G); (3) Shield Interface (L741:0130, 1 April 1963 to EG&G).

5. Overall Engineering Surveillance

REON performed design reviews and submitted comments regarding the I&C contractor direction of the facility modification construction bid packages. REON has received 33 documents, 288 drawings, including revised drawings, and has attended 28 design review meetings relative to I&C influenced facility modifications. Examples of the submittals with review comments are REON letters (L741:0008 dated 6 June 1963), and (L741:0205 dated 10 June 1963), regarding the Facility Modification Criteria, T.V. and Photo Systems and Building Modifications respectively. The results of these reviews have been incorporated in the Construction Bid Packages under REON technical direction.

Although monitoring of installations and checkouts is required, no effort was expended in this area due to program status of the design in CY 1963. It is anticipated that all monitoring of installations and checkouts will be conducted in CY 1964.

6. Provide Technical Direction to the I&C Contractor

REON performed design reviews of the I&C contractor submittals and submitted reviews and technical direction to the I&C contractor. During this period approximately 76 documents and 650 drawings were reviewed and commented on. In addition REON participated in 18 design review meetings and 22 official I&C meetings involved in technical direction and program planning.

REON prepared specific technical direction to EG&G resulting in revised system requirements, design and review, definition of and special studies as noted in Section 1. All of the T.D. actions are noted in the Bibliography. An example of this T.D. is presented by REON letter L741:0173 dated 2 May 1963 defining communication station locations.

Other examples of Technical Direction are illustrated by REON letter (L741:0104 dated 20 February 1963) which defines comments to be incorporated in the design of ETS-1/ETS-2 control center as specifically directed by SNPO-C.

During the reporting period, 290 letters and TWX's were received from EG&G and REON submitted 108 TWX's and 91 letters to EG&G involving technical direction. These actions are noted in the Bibliography.

7. Reliability and Quality Assurance

(Change Order No. 1 to Mod No. 8 (RN-63013))

This change order established the requirements for REON to provide R&QA surveillance of the overall ETS-1 I&C program.

REON reviewed and submitted comments on the EG&G Reliability and Quality Assurance Plan. This information was transmitted in REON letter 720:RQA:L004 to SNPO-C on 9 April 1963. REON submitted technical direction document to SNPO-C for review and approval for R&QA Program Plan in L741:0278 dated 16 August 1963. A recommended Critical Item List for inclusion in the plan was submitted to SNPO-C in REON letter L741:0302 dated 6 September 1963).1

During this period (last quarter) REON submitted a total of 4 TWX's and letters to SNPO-C and 6 TWX's and letters to EG&G regarding this program. In addition REON participated in two I&C R&QA meetings.

As a result of this REON activity a partially acceptable plan has been received by SNPO-C/REON from EG&G. Some elements of this plan, however, require resolution by SNPO-C before a complete plan can be derived and implemented by REON technical direction to EG&G.

Conclusion

In conclusion, and as noted by the extensive bibliography, significant detailed direction was required to secure a design package acceptable to SNPO-C/REON. Redirection of EG&G as noted in Addendum 7 dated 24 July 1963, has resulted in the production of a design package that conforms to the objectives presented during meeting No. 8 (26 April 1963). It is expected that this package will be acceptable to SNPO-C/REON with only minor revisions.

SUBTASK 3.3 - BIBLIOGRAPHY

TWX

CORRESPONDENCE TO SNPO-C

<u>TWX No.</u>	<u>Date</u>	<u>Subject</u>
	10-17-62	Separate ETS-2 Control Room
	10-30-62	Control Room Concept
	11-21-62	I&C Completion Schedule
	11-21-62	I&C System Schedule
	11-27-62	Facility I&C System Reqd. Completion
	12-17-62	Review Agenda for Technical Direction Meeting with EG&G
	12-17-62	I&C System Completion Schedule
	12-27-62	Facilities Modification Assignment and Costs

FWX

CORRESPONDENCE TO SNPO-C

FWX No.	Date	Subject
188	1-4-63	I & C Technical Information
	1-8-63	I & C Technical Information
	1-11-63	RECON I & C System Design Review Schedule
	1-11-63	SNPO-C FWX Messages SM 114 and SM 017
	1-15-63	ETS-1 I & C Criteria - Facility Modification and Facility Operations and Control System
	1-16-63	Telecon between A. Lovoff and D. Limbacher, 15 Jan 63
	1-16-63	SNPO-C FWX Messages SM 114 and SM 017
	1-17-63	Telecon Lovoff/Limbacher, 1-17-63 Re: Clarification Submittals on Facility Modification and Facility Control System
	1-31-63	Nitrogen Gas Purge of Instrument Boxes, ETS-1
	2-6-63	Telecon 5 February 1963
	2-6-63	Telecon Limbacher/Zaremba to Lovoff 31 January 1963
	2-11-63	RECON Ltr. L741:0082, dtd 23 Jan 63, Subj: Facility Operations and Control System, Encl. No. 3
	2-11-63	Telecon 5 February 1963 (Task 3.3) Limbacher to Lovoff
	2-26-63	ETS-1 I & C Electrical Hazards Classifications
	3-4-63	ETS-1 I & C Electrical Hazards Classifications
888	3-21-63	ETS-1 I & C System Location of TV Stations 9, 10 & 11
886	3-21-63	ETS-1 I & C System Revised Dwgs.
	3-27-63	Facilities Storage Vessels - As-Built Dwgs.
520	4-12-63	Addition of Blast Valve to ETS-1 Tunnel
785	4-19-63	Facilities Control Storage Vessels Level

CORRESPONDENCE TO SNPO-C

TWX No.	Date	Subject
787	4-19-63	ETS-1/ETS-2 Timing System
282	5-8-63	Comments on Digital System Work Statement
366	5-9-63	ETS-1 I & C System, Addendum No. 4 & 5
456	5-11-63	ETS-1 Diesel Generator Performance Data
927	5-22-63	Comments on Work Statement and Functional Specs (Rev.B) Digital Data System
	5-27-63	ETS-1 I & C System Vessel As-Built Dwg.
314	6-7-63	ETS-1 I & C Meteorological Tower
508	6-13-63	ETS-1 I & C System As-Built Dwg.
	6-20-63	ETS-1 I & C Preliminary Design Revised Schedule
1133	6-28-63	Telecon Lovoff SNPO-C to Limbacher RECON dtd 28 Jun 63
016	7-1-63	Duct and Shield Monitors
581	7-3-63	ETS-1 I & C Design Package Review
586	7-10-63	TWX Msg. SNPO-C to RECON dtd 3 July, Subj: ETS-1 I & C Package Review Meeting
689	7-16-63	Telecon SNPO-C (Lovoff) to RECON (Carton, Limbacher), 15 Jul 63
429	8-13-63	Attachment 3A to SNPO-C Letter to E G & G dtd 24 Jul 63
601	8-15-63	Location of Terminal Boxes for Steam Generator Wire and E G & G Interface Point
553	8-15-63	Preparation of Material for ETS-1 I & C "Construction Bid Package"
594	8-16-63	ETS-1/ETS-2 I & C Cable Engrg Estimated Requirements
593	8-16-63	Recorders for Radiation Monitoring Subsystem
592	8-16-63	ETS-1 I & C Design Package Revision Schedule

CORRESPONDENCE TO SNPO-C

TWX No.	Date	Subject
590	8-16-63	G. E. Electrical Drawings
756	8-21-63	Calibration Steps for Frequency Channels, ETS-1
026	9-3-63	SNPO-C TWX to REON, dtd 26 Aug 63, Sugj: ETS-1 I & C Wide Band Recording System
0103	9-4-63	Location of Steam Generators, ETS-1
311	9-10-63	SNPO-C to REON TWX, dtd 22 Aug 63, Subj: ETS-1 I & C Power Distribution
0384	9-11-63	Telecon Farrar (SNPO-C)/D.Limbacher (REON), ETS-1 I & C Design Agreements
822	9-18-63	ETS-1 Digital Data System Work Statement
1060	9-26-63	REON/EG&G Bi-Weekly Action Item List No. 4 dtd 9/20/63, Item No. 11
1221	9-30-63	ETS-1 TV System Lighting Requirements for Station 9, 10 and 11

TWX

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

TWX No.	Date	Subject
845	12-28-62	Technical Direction Procedures
	1-7-63	Technical Direction Meeting of 27 December 1962
299	1-8-63	I & C Technical Information
335	1-8-63	Changes & Clarification of Technical Direction Procedures.
333	1-8-63	E G & G TWX No. 3129, dtd 1/4/6
334	1-8-63	Action Item No. 16 I & C Meeting No. 3, Polarization of Control and Indicating Circuits
332	1-8-63	I & C Technical Information Changes
395	1-9-63	OPDP Reproducibles
633	1-15-63	Comments on Minutes of ETS-1 I & C Meetings 2 and 3
652	1-16-63	E G & G Rep. No. 1183-3B
	2-2-63	TV Functional Spec. Review Comments
	2-4-63	Drawings for Data Acquisition System
	2-4-63	REON I & C System Design Revised Schedule
187	2-6-63	REON I & C System Design Review
	2-8-63	I & C Technical Review Meeting
945	2-25-63	Dwg. ICC-079A, OPDP, Page 587
974	2-25-63	Resolution of On-Off Indications
999	2-25-63	Analog Recording System
998	2-26-63	Verification of Cable Requirement E.C. & R E C
1128	2-28-63	Action Item No. 14, Minutes of I & C Meeting No. 3
270	3-6-63	Comments on Minutes of I & C Meeting No. 7.

TWX

Correspondence to E G & G

TWX No.	Date	Subject
271	3-6-63	External Neutronics System
887	3-19-63	Delay of Facility Modifications Submittal
1040	3-20-63	ETS-1 400 CPS Power Requirements
889	3-21-63	Action Item No. 14, Minutes of I & C Meeting No. 3
067	4-2-63	External Neutronics System
124	4-3-63	Digital Data System, Phase I Design, Scope of Work Statement
517	4-12-63	EG&G Generated I & C System Flow Diagrams
548	4-12-63	External Neutronics Measurements
833	4-19-63	T. Moore's visit to E G & G
786	4-19-63	Space Allocation for Additional Kinescope Recorder
922	4-23-63	Comments on Functional Specs, T C & P System, E G & G File No. 13-xxx-xx
1052	4-25-63	Confirming Agreement of E G & G Submittals to RECON
094	5-2-63	Comments on Functional Specs, T C & P System
052	5-2-63	Activity No. 2, Detailed System Configuration Preliminary Detailed Design Specs.
176	5-6-63	Facility Graphic Display
218	5-6-63	ETS-1 I & C Power Requirements
217	5-6-63	Photo System Functional Specs, File #26-12x-03
224	5-6-63	E G & G ETS-1 I & C Quality Assurance and Reliability Meeting
223	5-6-63	Quality Assurance Meeting
281	5-7-63	Drafting Room Manual
	5-9-63	TWX E G & G TWX No. 3596, Detailed Preliminary Design Dwg. - Control Monitor Circuits, Photo System

TWX

Correspondence to E G & G

TWX No.	Date	Subject
553	5-14-63	I & C Cable Trench Requirements
922	5-22-63	Assignment of Communication Stations
923	5-22-63	ETS-1 Photo System
925	5-22-63	TC&P System Cabling
924	5-22-63	Comments on Preliminary ETS-1, I&C Systems Drawings & Doc. List
926	5-22-63	Digital Super Commutation within the Digital Data System
1167	5-28-63	TV Camera No. 12 Viewing Requirement
1243	5-28-63	Individual Power Supplies for Transducer Excitation
1242	5-29-63	Analog Tape Recorders
63	6-4-63	TC&P System REC System Requirement
189	6-4-63	TC&P File No. 13-25X-01, Detailed Preliminary Design Drawing
187	6-4-63	Communication Panel Amplifier/Speakers, Output Power of
188	6-6-63	Steam Generator & Duct Cabling Requirements, ETS-1
367	6-10-63	E G & G RFP Television Camera Motion System
508	6-13-63	ETS-1 Television System, Specific Viewing Requirements
826	6-20-63	Signal Conditioning Equipment Requirement
788	6-21-63	Equipment Rack Layouts ETS-1
50	6-24-63	Preliminary Design Package Submittal
915	6-24-63	Temperature Transducer Cond. Requirement
917	6-24-63	Equipment Rack Layouts, ETS-1
916	6-24-63	ETS-1 I&C Preliminary Design Package

TWX

Correspondence to E G & G

TWX No.	Date	Subject
1048	6-25-63	TC&P Cable Requirement Relative to Rack Relocations
1126	6-25-63	Safety System, Ref. E G & G Tax No. 4027, 8 June '63
1049	6-25-63	Technical Dir. Resulting from I&C Meeting No. 8 25-26 April '63
1044	6-25-63	ETS-1 TV System Station #3
061	6-28-63	Facility Control System Controller, For
062	7-1-63	Fire Protection System, ETS-1
166	7-3-63	ETS-1 I&C System, Electrical Power Sep., Recording Requirement
135	7-3-63	NETCS, Deletion of
275	7-9-63	Photo Coverage Requirements
580	7-10-63	ETS-1 Signal Conditioning System Specifications
678	7-16-63	Test Stand Terminal, Box Facility Modification Final Design Review, Minutes of
009	7-29-63	Fire Protection System, Console Space Requirements
135	7-31-63	Safety System, Alarms and Recording
011	7-31-63	Television System Sensitivity
136	8-1-63	ETS-1 I&C Timing System/R&C System Clocks
131	8-2-63	Conductor Size for Special TV Cable
130	8-5-63	ETS-1 Control Room Consoles, Design Package
392	8-12-63	Console, Rack and Front Panel Colors
389	8-12-63	Work Statement for the ETS-1 Digital Data System
428	8-13-63	ETS-1 Design Package Drawings
427	8-13-63	Analog Recording System/Facility Control Systems

TWX

Correspondence to E G & G

TWX No.	Date	Subject
548	8-15-63	ETS-1 I&C Construction Bid Packages
624	8-19-63	Signal Conditioning System
595	8-16-63	ETS-1 Flare Stack Information
591	8-16-63	"Data Processing System Study, ETS-1 I&C", dated 25 July 1963, submitted by E G & G
623	8-19-63	TV System ETS-1/ETS-2
622	8-19-63	ETS-1 I&C Design Package
692	8-20-63	Digital Data System Review
892	8-23-63	Revision Definition, Preparation of Digital Data System Specification
958	8-27-63	ETS-1 Facility Controls System
965	8-27-63	Operational Description for Revised Design Package
017	9-3-63	ETS-1 Facility Control System
05	9-3-63	Recording of Radiation
06	9-3-63	Monitoring Equipment, Safety System
0045	9-3-63	Fire Protection Panels
0046	9-3-63	E G & G TWX 4249, dated 22 August '63
062	9-4-63	Design Package Content
269	9-9-63	I&C Power System Recorder Requirements
268	9-9-63	Facilities Graphic Display Panel
0385	9-11-63	Control Point Building Layout, ETS-1
0383	9-11-63	Equipment Arrangements ETS-1 I&C System
0537	9-13-63	Electrical Power Requirements, ETS-1 Remote Engine Control System
0588	9-18-63	Steam Generator Location

MINUTES OF I & C MEETINGS

Date	No.	Location	Attendance	Topic
15-16 Nov 62	1	EG&G, Boston	SNPO-C, AGC-REON, AGC-Sacto, EG&G	Preliminary organization
11-12 Dec 62	2	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Presentation and discussion of EG&G plans and schedules
17-20 Dec 62	3	AGC-Sacto, AGC-Azusa	SNPO-C, WANL, AGC, EG&G	Discussion of functional and operational features of the ETS-1 I&C System
27-28 Dec 62	4	AGC-Azusa	SNPO-C, EG&G, AGC	Correction of facility control process drawings
21 Jan 63	5	SNPO-Cleve- land	SNPO-C, NASA, CCC, EG&G	Control and reporting
29 Jan 63	6	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Discussion of data acquis- ition system and AGC comments on TV Functional Specifications
13 Feb 63	7	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Action items and digital dat system plans
25-26 April 63	8	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Discussion on TWX's SNPO-C TWX to EG&G and return TWX
13-14 May 63	9	EG&G, Boston	SNPO-C, SNPO-W, AGC-REON, LASL, EG&G, Lewis RC	ETS-1 I&C orientation meeting
10 June 63	10	SNPO-Cleve- land	SNPO-C, AGC-REON, WANL, Wolf R&D, Lewis RC, EG&G	Discussion of ETS-1 data acquisition system, data processor and checkout fac- ility, equipment survey, and evaluation
14 June 63	11	SNPO-Cleve- land	SNPO-C, AGC-REON, WANL, Lewis RC, EG&G	Clarification of transducer and calibration power supplies
(12 missing) 20-26 June 63	13	SNPO-Cleve- land	SNPO-C, AGC-REON, Lewis RC, EG&G	I&C System design package reviews
24 June 63	14	SNPO-Cleve- land	SNPO-C, AGC-REON, Lewis RC, Wolf R&D, EG&G	Discussion of the ETS-1 data acquisition system, data processor and checkout facility equipment
18-19 July 63	15	AGC-Azusa	SNPO-C, EG&G/Bos. EG&G/Las Vegas WANL, AGC-REON	Presentation to EG&G of the technical direction in Vol. - II & III of Aerojet's commen on Design Package

MINUTES OF I & C MEETINGS

Date	No.	Location	Attendance	Topic
15-16 Nov 62	1	EG&G, Boston	SNPO-C, AGC-REON, AGC-Sacto, EG&G	Preliminary organization
11-12 Dec 62	2	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Presentation and discussion of EG&G plans and schedules
17-20 Dec 62	3	AGC-Sacto, AGC-Azusa	SNPO-C, WANL, AGC, EG&G	Discussion of functional and operational features of the ETS-1 I&C System
27-28 Dec 62	4	AGC-Azusa	SNPO-C, EG&G, AGC	Correction of facility control process drawings
21 Jan 63	5	SNPO-Cleve- land	SNPO-C, NASA, CCC, EG&G	Control and reporting
29 Jan 63	6	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Discussion of data acquis- ition system and AGC comments on TV Functional Specifications
13 Feb 63	7	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Action items and digital data system plans
25-26 April 63	8	EG&G, Boston	SNPO-C, AGC-REON, WANL, EG&G	Discussion on TWX's SNPO-C TWX to EG&G and return TWX
13-14 May 63	9	EG&G, Boston	SNPO-C, SNPO-W, AGC-REON, LASL, EG&G, Lewis RC	ETS-1 I&C orientation meeting
10 June 63	10	SNPO-Cleve- land	SNPO-C, AGC-REON, WANL, Wolf R&D, Lewis RC, EG&G	Discussion of ETS-1 data acquisition system, data processor and checkout fac- ility, equipment survey, and evaluation
14 June 63	11	SNPO-Cleve- land	SNPO-C, AGC-REON, WANL, Lewis RC, EG&G	Clarification of transducer and calibration power supplies
(12 missing) 20-26 June 63	13	SNPO-Cleve- land	SNPO-C, AGC-REON, Lewis RC, EG&G	I&C System design package , reviews
24 June 63	14	SNPO-Cleve- land	SNPO-C, AGC-REON Lewis RC, Wolf R&D, EG&G	Discussion of the ETS-1 data acquisition system, data processor and checkout facility equipment
18-19 July 63	15	AGC-Azusa	SNPO-C, EG&G/Bos. EG&G/Las Vegas WANL, AGC-REON	Presentation to EG&G of the technical direction in Vol. I, II & III of Aerojet's comments on Design Package

MINUTES OF I & C MEETINGS

Date	No.	Location	Attendance	Topic
25 July 63	16	EG&G, Boston	SNPO-C, AGC-REON, EG&G	Meeting to discuss the procedures and plans for preparation of ETS-1 I&C revised design package
31 July 63	17	EG&G, Boston	SNPO-C, AGC-REON, EG&G	Reliability and Quality Assurance Program Plan
6 Aug 63	18	EG&G, Boston	AGC-REON, WANL, EG&G	Implementation schedule review
(19 missing)				
27-29 Aug 63	20	AGC-Azusa	SNPO-C, WANL, AETRON, AGC-REON	Discussion on I&C Systems
5 Sept 63	21	EG&G, Boston	SNPO-C, AGC-REON, EG&G	Technical Direction and Coordination of Design Package revision
9 Sept 63	22	SNPO-Cleveland	SNPO-C, AGC-REON, EG&G	Discussion on catagories of drawings, documents, specifications, etc.
14 May 63		EG&G, Las Vegas	EG&G, Boston EG&G, Las Vegas Aetron, AGC-REON	Initial Design Review Meeting, TV and Photo Bunker Facility Modification
14 May 63		EG&G Las Vegas	EG&G Las Vegas AGC-REON	Review Meeting of ETS-1 Facility Control Design
5 June 63		EG&G Las Vegas	EG&G, Las Vegas Aetron AGC-REON	Initial/Final Design Review, Cable tray facility modification
6 June 63		EG&G Las Vegas	EG&G, Las Vegas Aetron, AGC-REON	Initial design review test stand terminal box facility modification
20 June 63		SNPO-C Cleveland	SNPO-C EG&G AGC-REON, WANL	Meeting on ETS-1 signal conditioning system
21 June 63		EG&G Las Vegas	EG&G, Las Vegas Aetron, AGC-REON	Facility modification-general-2nd and initial design review meeting, building modification
25 June 63		SNPO-C Cleveland	SNPO-C, EG&G-Boston, AGC-REON	
26 June 63		SNPO-C Cleveland	SNPO-C, EG&G-Boston, AGC-REON	Facility control systems i.e., graphic display panels, integration of ETS-2, Controllers, remote shut off valves.

MINUTES OF I & C MEETINGS

Date	No.	Location	Attendance	Topic
27 June 63		EG&G, Boston	SNPO-C EG&G, Boston AGC-REON	Design review meeting ETS-1 I&C System
19-20 June 63		AGC-Azusa	AGC-REON, WANL, EG&G	Meeting on signal conditioning system
1 July 63		SNPO-C Cleveland	SNPO-C, EG&G AGC-REON	I&L design activity meeting
2 July 63		SNPO-C Cleveland	AGC-REON SNPO-C, EG&G,	Regarding instrumentation and control for ETS-1
3 July 63		EG&G, Las Vegas	EG&G, Las Vegas Aetron, AGC-REON	Final design review, cable tray facility modification
8 July 63		SNPO-C Cleveland	SNPO-C, WANL AGC-REON	Design package review meeting
17 July 63		AGC-Azusa	SNPO-Cleveland, WANL, AGC-REON	ETS-1 I&C system design review meeting
18 July 63		AGC-Azusa	SNPO-Cleveland AGC-REON	ETS-1 I&C system design review meeting
11-12 July 63		SNPO-C Cleveland	AGC-REON ACC-LRP, SNPO-C, SNPO, LASL, WANL, Lewis RC	Review meeting of functions and operations of NERVA I&C systems as proposed by EG&G
19 July 63	15	AGC-Azusa	SNPO-C, EG&G-Boston EG&G-Las Vegas, WANL, AGC-REON	Presentation to EG&G the technical direction contained in Addendum 7 to ETS-1 I&C
26 Aug 63	19	EG&G-Las Vegas	EG&G, AGC-REON, AETRON, SNPO-C, SNPO-N, NVPO-N, WANL	Coordination of ETS-1 con- struction bid package activities
28 Aug 63		AGC-Azusa	AGC-REON	Meeting on remote engine control coordination
10 Sept 63		EG&G- Las Vegas	WANL, AGC-REON EG&G	Discussion of revision of design package as listed in Addendum 7

TWX'S

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

TWX NO.	DATE	SUBJECT
845	12-28-62	Technical Division Procedures
-	1-7-63	Technical Division Meeting of 27 December 1962
299	1-8-63	I&C Technical Information
334	1-8-63	Changes and Clarification of Technical Direction Procedures
333	1-8-63	EG&G TWX #3129 dated 1-4-62
334	1-8-63	Action Item No. 16, I&C Meeting 3 - Polarization of
332	1-8-63	I&C Technical Information
395	1-9-63	OPDP Reproducibles
633	1-15-63	Comments on Minutes of ETS-1 I&C Meetings 2 and 3
652	1-16-63	EG&G Report No. 1183-3B
-	2-2-63	TV Functional Spec. Review Comments
-	2-4-63	Drawings for Data Acquisition System
-	2-4-63	REON I&C System Design Review Schedule
187	2-6-63	REON I&C System Des. Review
-	2-8-63	I&C Technical Review Meeting
945	2-25-63	Drawing I&C-079A, OPDP, Page 587
974	2-25-63	Resolution of On-Off Indications
999	2-25-63	Analog Recording System
998	2-26-63	Verification of Cable Requirements E.C & REC
1128	2-28-63	Action Item No. 14, Minutes of I&C Meeting No. 3
270	3-6-63	Comments on Minutes of I&C Meeting No. 7
271	3-6-63	External Neutronics System
887	3-19-63	Delay of Facility Mods. Submittal
1040	3-20-63	ETS-1 400 CPS Power Requirements
889	3-21-63	Action Item No. 14, Minutes of I&C Meeting No. 3
067	4-2-63	External Neutronics System
124	4-3-63	Digital Data System, Phase I Dsn, Scope of Work Statement
517	4-12-63	EG&G Generated I&C Sytem Flow Diagrams
548	4-12-63	External Neutronics Measurements

TWX'S

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

TWX NO.	DATE	SUBJECT
833	4-19-63	T. Moore's Visit to EG&G
786	4-19-63	Space Allocation for Additional Kinescope Recorder
922	4-23-63	Comments on Functional Specs. GC&P System, EG&G File No. 13-xxx-xx
1052	4-25-63	Confirming Agreement of EG&G Submittals to REON
074	5-2-63	Comments on Functional Specs. GC&P System
052	5-2-63	Activity No. 2, Detailed System Configuration Preliminary Detailed Design Specs.
176	5-6-63	Facility Graphic Display
218	5-6-63	ETS-1 I&C Power Requirements
217	5-6-63	Photo System Functional Specs, File #26-12x-03
224	5-6-63	EG&G ETS-1 T&C Quality Assurance and Reliability Meeting
223	5-6-63	Quality Assurance Meeting
281	5-7-63	Drafting Room Manual
-	5-9-63	TWX Eg&G TWX #3596, Detailed Preliminary Design Drawings Control Monitor Circuits, Photo System
553	5-14-63	I&C Cable Trench Requirements
922	5-22-63	Communication Stations, Assignment of
923	5-22-63	ETS-1 Photo System
925	5-22-63	GC&P System Cabling
924	5-22-63	Comments on Preliminary ETS-1, I&C Systems Drawings and Document List
926	5-22-63	Digital Super Commutation Within the Digital Data System
1167	5-28-63	TV Camera No. 12 Viewing Requirement
1243	5-28-63	Individual Power Supplies for Transducers Excitation
1242	5-29-63	Analog Tape Recorders
63	6-4-63	TC&P System REC System Requirement
189	6-4-63	TC&P File No. 13-25x-01, Detailed Preliminary Design Drawing
187	6-4-63	Communication Panel Amplifier/Speakers, Output Power of
188	6-6-63	Steam Generator and Duct Cabling Requirements, ETS-1

TWX'S

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

TWX NO.	DATE	SUBJECT
357	6-10-63	EG&G RFP Television Camera Motion System
508	6-13-63	ETS-1 Television System, Specific Viewing Requirements
826	6-20-63	Signal Conditioning Equipment Requirements
788	6-21-63	Equipment Rack Layouts ETS-1
50	6-24-63	Preliminary Design Package Submittal
915	6-24-63	Temperature Transducer Condition Requirement
917	6-24-63	Equipment Rack Layouts, ETS-1
916	6-24-63	ETS-1 I&C Preliminary Design Package
1048	6-25-63	TC&P Cable Requirement Relative to Rack Relocations
1126	6-25-63	Safety System, Ref. EG&G TWX #4027, 8 June 1963
1049	6-25-63	Technical Discussion Resulting for I&C Meeting No. 8 25-26 April 1963
1044	6-25-63	ETS-1 TV System Sta #3
061	6-28-63	Facility Control System Controller, For
062	7-1-63	Fire Protection System, ETS-1
166	7-3-63	ETS-1 I&C System, Electrical Power System, Recording Requirements
135	7-3-63	NETCS, Deletion of
275	7-9-63	Photo Coverage Requirements
580	7-10-63	ETS-1 Signal Conditioning System Specifications
678	7-16-63	Test Stand Terminal. Box Facility Modification Final Design Review, Minutes of
009	7-29-63	Fire Protection System. Console Space Requirements
135	7-31-63	Safety System. Alarms and Recording
011	7-31-63	Television System Sensitivity
136	8-1-63	ETS-1 I&C Timing System/R&C System Clocks
131	8-2-63	Conductor Size for Special TV Cable
130	8-5-63	ETS-1 Control Room Consoles, Design Package
392	8-12-63	Console Rack and Front Panel Colors
389	8-12-63	Work Statement for the ETS-1 Digital Data System
428	8-13-63	ETS-1 Design Package Drawings

TWX'S

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

TWX NO.	DATE	SUBJECT
427	8-13-63	Analog Recording System/Facility Control Systems
548	8-15-63	ETS-1 I&C Construction Bid Packages
624	8-19-63	Signal Conditioning System
595	8-16-63	ETS-1 Flare Stock Information
591	8-16-63	"Data Processing System Study, ETS-1 I&C," dated 25 July 1963, Submitted by EG&G
623	8-19-63	TV System ETS-1/ETS-2
622	8-19-63	ETS-1 I&C Design Package
692	8-20-63	Digital Data System Review
892	8-23-63	Revision Definition, Preparation of Digital Data System Specification
958	8-27-63	ETS-1 Facility Controls System
965	8-27-63	Operational Description for Revised Design Package
017	9-3-63	ETS-1 Facility Control System
05	9-3-63	Recording of Radiation
06	9-3-63	Monitoring Equipment Safety System
0045	9-3-63	Fire Protection Panels
0046	9-3-63	EG&G TWX #4249, dated 22 August 1963
062	9-4-63	Design Package Content
269	9-9-63	I&C Power System Recorder Requirements
268	9-9-63	Facilities Graphic Display Panel
0385	9-11-63	Control Point Building Layout, ETS-1
0383	9-11-63	Equipment Arrangements ETS-1 I&C System
0537	9-13-63	Electrical Power Requirements, ETS-1 Remote Engine Control System
0588	9-18-63	Steam Generator Location

LETTERS

CORRESPONDENCE TO SNPO-C

Letter No.	Date	Subject
0067	1-9-63	Submittal of comments and requirements relative to the Design Submittal Schedule presented by REON at meeting of 11 - 12 December 1962 at E G & G
0074 0074	1-16-63	Submittal of clarification of functional and operational requirements for the Radio Frequency Communications System for ETS-1
0080	1-22-63	Items contained within Proposed ETS-1 Facility Modifications, Appendix 4.5 I & C System Design Criteria
0081	1-23-63	Electrical Hazard Definition, ETS-1 I & C Design
0082	1-23-63	Facility Operations and Control Systems
0083	1-24-63	Transmittal of Preliminary Design Submittal w/comments for TV System
0086	1-30-63	Transmittal of Comments on Final Functional Specification for Photo System
0087	2-1-63	Transmittal of Reproducible Copy of the ETS-1 Control Point Bldg. I & C Equipment Proposed Layout
0128	4-4-63	Transmittal of REON Dwg. ICC-028J, Engine Test Stand Flow Schematic
0136	4-10-63	Transmittal of Dwg. No. 091035 Composite Flow Diagram Process System
0123	4-26-63	Design Criteria, Emergency Coolant Flow Measurement Pipe Spool, Transmittal of
0162	4-26-63	Safety Warning System
0172	5-2-63	ETS-1 I & C Program Requirements Direction
0165	5-2-63	Transmittal of Addendum No. 6 - ETS-1 I & C Criteria, Timing System
0147	5-8-63	Transmittal of Addendum 4 & 5, I & C System Design Criteria

LETTERS

CORRESPONDENCE TO SNPO-C

Letter No.	Date	Subject
0189	5-15-63	ETS-1 I & C System TV Station 12
0212	6-5-63	Diesel Generator Test Plan
0213	6-13-63	Duct & Shield Monitors, Addendum No. 8
0234	6-25-63	ETS-1 Run Tank Topping Study
0257	7-30-63	Recommendation of Kinescope Recorders for the ETS-1 I & C System
0265	7-29-63	Minutes of NERVA I & C Meeting 11 - 12 July 1963
0266	7-29-63	Minutes of ETS-1 I & C Design Review Meeting 17 - 18 July 1963
0267	7-29-63	Minutes of ETS-1 I & C Technical Direction Meeting #15, 19 July 1963
0272	8-6-63	Justification for Utilizing Heated Ref. Junctions Rather than Thermocouple Ref. Wells at ETS-1
0284	8-15-63	ETS-1 I & C System REON Bi-Weekly Action Item List
0289	8-21-63	Performance Investigation of 32-Track F.M. Magnetic Tape Recorders for Use at ETS-1
0292	8-26-63	ETS-1 I & C System REON Bi-Weekly Action Item List #2.
0287	9-4-63	SNPO-C TWX ISS-AG/CEF dtd 20 June '63, Subject: ETS-1 I & C SNPO-C Comments on Addenda No. 4, 5, 6.
0291	9-4-63	ETS-1 F.M. Wide Band Recording System RCM Cost Analysis
0295	9-11-63	ETS-1 I & C System, REON Bi-Weekly Action Item List #3.
0300	9-20-63	Minutes of ETS-1 & 2 I & C Meeting No. 20, 27 - 29 August 1963, Held at Azusa
0296	9-26-63	Two Caterpillar Model 397 Diesel Gen. Sets, Proposed for ETS-1 & 2 Instrument Bus
0297	9-23-63	ETS-1 & 2 Elect. Power Gen. & Dist. Requirement Criteria
0320	9-23-63	ETS-1 I & C System, REON Bi-Weekly Action Item List No.4.
0322	9-26-63	Proposal for Use of Trailer Mounted Diesel
0323	9-27-63	SNPO-C Comments Concerning AGC Dwg. No. 091762 "ETS-1 Test Stand Flow Schematic (Prel.)"

LETTERS

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

LETTER NO.	DATE	SUBJECT
L0062	12-28-62	REON Clarification of the intent behind the requirement of the ETS-1 I&C Sep. Dsg. Crit.
L0063	12-28-62	Transmittal of ETS-1 I&C Sep. Documentation Flow Diagrams.
L0064	12-31-62	Transmittal of Report No. 2320 Instrumentation Data Book.
L0068	1-10-63	Transmittal of 1 set reproducibles of all dwgs. in the ETS-1 I&C Criteria dated June 1962 and the Overall Preliminary Design Package Report 2410, dated November 1962 and Dwg. Number List.
L0069	1-11-63	Transmittal of gapless-Read Tape Format in response to request made in tech. Mtg. No. 3 at Sacto.
L0072	1-14-63	Official correction of F.D.B. 5.1.1 as modified in Tec. Dir. Mtg. No. 3.
L0077	1-17-63	Transmittal of overall Preliminary Design Package
L0088	2-5-63	Transmittal of Comments on Final Functional Specifications for Electrical Power System.
L0089	2-6-63	Transmittal of Comments on Final Functional Specs. for Nuclear Effects Test Capability System.
L0090	2-8-63	Radio Frequency Communications System, Functional, & Operational Requirements.
L0094	2-8-63	Transmittal of Comments on Functional Specs. for Events Recording System.
L0095	2-8-63	Transmittal of Comments on Final Functional Specifications for Communications Systems.
L0097	2-11-63	Transmittal of Comments on Functional Specs. for Signal Conditioning System.

LETTERS

CORRESPONDENCE TO EDGERTON, GERMENSHAUSEN & GRIER, INC.

LETTER NO.	DATE	SUBJECT
L0092	2-12-63	Requests for Identity Numbers for sketches, charts, schedules etc., and drawing revision numbers.
L0099	2-12-63	Transmittal of Comments on Functional Specifications for Digital Data System.
L0100	2-12-63	Transmittal of Comments on Functional Specifications for Data Acquisition System.
L0101	2-12-63	Transmittal of Comments on Functional Specifications for Analog Recording System.
L0104	2-25-63	Transmittal of Reproducible Copy of REON Drawing ICC - 204B.
L0105	2-26-63	Transmittal of Supplemental Comment Sheets.
L0107	3-5-63	Transmittal of ETS-1 Data Acquisition System Computer Requirements.
L0114	3-6-63	Transmittal of CRD Report No. 23.6 Operational Safety Evaluation of ETS-1 Complex.
L0117	3-8-63	Transmittal of Data Acquisition List ICC-099 (CRD) and Detailed Summary ICC-120.
L0135	3-12-63	Facility Modification
L0142	3-12-63	Photo System Functional Specifications, Rev. A.
L0118	3-20-63	Transmittal of Comments on Functional Specifications for Facility Controls System.
L0019	3-20-63	Transmittal of Electrical Hazards, Definition, ETS-1 I&C System.
L0120	3-20-63	Transmittal of Signal Conditioning Requirements for all Systems, ICC-122A.
L0111	3-20-63	Agreements on the Facility Systems.
L0115	3-21-63	Transmittal of Photo Camera Fields of View & ETS-1 Photo Camera Bunker Positions.

LETTERS

CORRESPONDENCE TO EDGERTON, GERMENSHAUSEN & GRIER, INC.

LETTER NO.	DATE	SUBJECT
L0113	3-22-63	Transmittal of Results of TV Station Field Survey.
L0129	3-26-63	Transmittal of CRD Report 2316, Operational Safety Evaluation of ETS-1 Complex.
L0124	3-27-63	Transmittal of Comments on Facility Modification Criteria, TV & Photo Systems and Meteorological Tower.
L0126	3-29-63	Initial Tech. Evaluations of the Proposals Submitted to EG&G.
L0121	4-1-63	Transmittal of Aerojet Dwg. 088959 Test Stand Adapter and Thrust Structure Interface Control.
L0130	4-1-63	AETRON Bid Package No. 292-62-31, Radiation Shields.
L0116	4-2-63	Transmittal of Recommended Console Layout Drawings & Tabulations.
L0122	4-2-63	Transmittal of Photo Camera Station Locations.
L0131	4-5-63	Functional Spec. Analog Recording System.
L0133	4-8-63	Functional Spec. for TC&P Sep.
L0134	4-8-63	Functional Requirements Digital Data System.
L0132	4-9-63	Functional Spec. Events Recording System.
L0137	4-9-63	Facility Modifications.
L0139	4-9-63	Engine Installation Vehicle Assy. Dwg. No. 073915.
L0136	4-10-63	REON Dwg. 091035, Composite Flow Diagram, Process Systems.
L0138	4-12-63	Special/Standard Functional Family Tree.
L0141	4-12-63	ICC-100, Facility Graphic Display Panel.
L0140	4-15-63	Functional Specs. Safety System Rev. A.
L0145	4-15-63	Revision A - Functional Spec., Timing System.

LETTERS

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

LETTER NO.	DATE	SUBJECT
L0144	4-18-63	Television System Functional Specifications, Rev. A.
L0149	4-22-63	Addendum No. 6 - Transmittal of
L0146	4-22-63	Grounding Standards, Electrical Design Standards
L0152	4-22-63	Detailed Prel. Dsg DWGS R. F. Communication, Sys for ETS-1
L0143	4-23-63	Recommended Locations for T.V. Stations Numbers 9,10 & 1
L0150	4-23-63	Detailed Prel. Dsg. Dwg - Control Monitor Circuits, Photo System for ETS-1
L0151	4-23-63	Functional Specs. Notes - Rev. A.
L0153	4-23-63	Detailed Prel. Design DWGS, Communications System for ETS-1
L0159	4-23-63	Comments Concerning Deficiency of Submittals Received from EG&G
L0154	4-25-63	Television and Photo Systems, Facility Modification. Criteria, Rev. A.
L0156	4-25-63	(Supplement No. 1) on the Design Standards, Construction Bid Packages, Facility Modifications.
L0157	4-25-63	Special/Standard Functional Family Tree, W&P System File No. 13-424
L0160	4-26-63	Action Item 9.1 - Signal Interface for RLC System
L0163	4-30-63	Comments on Special/Standard Functional Family Tree, Communication System File No. 22-42x-01
L0166	5-2-63	Timing System - Comments Reserved Until Greater Design Detail Completed
L0167	5-2-63	Signal Conditioning System - Same as Above
L0170	5-2-63	Recommended Changes to Improve Accuracy of Digital Data System.
L0168	5-7-63	Timing System - Comments on. File No. 23-25 X and 23-35X

LETTERS

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INCL

LETTER NO.	DATE	SUBJECT
L0179	5-7-63	Approval of Digital Data Sys. Functional Spec., Rev. B EG&G File 34-1XX
L0173	5-8-63	Communication Station Field Survey - Technical Direct n
L0175	5-15-63	Comments on Cable Trays, Facility Modification Criteria File No. 49-41X-XX, Rev. A
L0183	5-15-63	Correction to Accuracy Analysis of Digital Data System.
L0190	5-15-63	Comments, Detailed Preliminary Design Dwg. TV System
L0176	5-20-63	Color Coding Facilities Graphic Display Panel
L0164	5-21-63	Electrical Hazards Definition ETS-1 I&C System
L0196	5-29-63	Requirements, Data Acquisition System ETS-1
L0203	6-6-63	Control Point Bldg I&C Equip. Proposed Layout, Revised
L0208	6-6-63	Comments - Facility Mod. Criteria, Television, Photo Systems, File No. 49-1XX-XX
L0205	6-10-63	Comments, Facility Modification Criteria - Bldg Modification Rev. A
L0217	6-11-63	Design Criteria, Emergency Coolant Flow Measurement Pipe Spool
L0218	6-12-63	Comments on Detailed Preliminary Design Dwgs NETCS, File No. 12-25X-01
L0225	6-21-63	Comments on Photo System
L0230	6-21-63	Communication & TC&P Sys. Agreements from Mtg Held at EG&G/Boston Between REON (R. Chavez) and EG&G (Saue--/ Ross/Stevens/ on 22-24 May 1963
L0232	6-21-63	Comments on Facility Cont. Sys, Func. Specs. File #21-XXX-XX
L0226	6-25-63	Comments on NETC System
L0228	6-26-63	Comments on Communications Sys.
L0233	6-26-63	Comments on Television Sys. Dwgs for

LETTERS

CORRESPONDENCE TO EDGERTON, GERMESHAUSEN & GRIER, INC.

LETTER NO.	DATE	SUBJECT
L0236	7-3-63	Approval of Facility Mod. Crit., Cable Trays, File No. 49-41X-31, Rev. B, Dtd 10 May 1963
L0229	7-8-63	Photo Sys Dwgs, Comments
L0240	7-11-63	Approval of Photo Sys Dwgs
L0237	7-15-63	Comments on Fac. Mod. Crit. Test Stand Terminal Boxes, File No. 49-7XX-XX, Rev. A & Planning Index ETS-1 Des. Data File, Fac. Mod, File No. 49-XXX-XX Rev. B
L0264	8-15-63	Duct & Shield Parameters to be Displayed
L0283	8-15-63	ETS-1 Television Camera Motion Sys RFP No. 1183-108
L0285	8-16-63	ETS-1 Control Room Consoles Des. Dwg
L0275	8-19-63	Transducer List for 3-way Vent Valve Sys ETS-1
L0288	8-26-63	Use of Relays in ETS-1 Control Monitor Circuits Photo System.
L0282	8-28-63	Comments, EG&G Draft. Room Manual
L0290	9-4-63	ETS-1 Data Acq. Sys. Dig. Data Processor Req'tmt Corr
L0294	9-4-63	ETS-1 Fac Cont. Sys-Solenoid Valve Box Drawings
L0297	9-23-63	Fac. Cont. Systems, Additions, Corrections & Deletions
L0319	9-26-63	Reconfirmation to Quest. on ETS-1 Fac. Cont. Items
L0321	9-26-63	Control Point Bldg. I&C Equip. Proposed Layout ICC 204 G
L0324	10-15-63	Minutes of Dsn Mtg Dig Data Sys Spec.

ADDENDA TO ETS-1 I&C DESIGN CRITERIA
SUBMITTED TO SNPO-C

Addendum No.	Date	Content
3	5 March 1963	Deletes electrical power, tunnel modification, and fire protection from I&C design criteria.
4	1 June 1963	A. Ammends Facility I&C Channel List, Vol. IV. B. Ammends Criteria Vol. I, Appendix 4.2 (transducers). C. Ammends Criteria Vol. II, 23 revised interface drawings.
5	1 June 1963	Provides A. Gaseous hydrogen system. B. Hydrogen venting. C. Complete block valve design. D. LH ₂ bleed valve. E. Revised temperature monitor. F. Completes information on temperature and pressure indication. G. Add to Criteria Vol. IV data aquisition list and Facility Channel list.
6	1 June 1963	Ammends design of timing system.
7	19 July 1963	Includes revisions and deletions required in the EG&G preliminary design package for completion of design Phase I.
8	1 June 1963	Revised technical data (OPDP November 1962) Duct and Shield Monitor Criteria.

LETTERS AND TWX

Correspondence from EG & G

<u>TWX NO.</u>	<u>LETTER NO.</u>	<u>DATE</u>	<u>SUBJECT</u>
	x	11-19	Transmittal of I&C Meeting #1 Minutes (15-16-November 62)
3091		12-6	Agenda for 11, 12 - December Meeting
	x	*12-14	Submission of Plans and Schedules
	x	12-14	Transmittal of Meeting #2 Minutes (11, 12 Dec.)
	x	1-2	Transmittal of Meeting #3 Minutes
3129		* 1-4	TDS-5.1 Meeting 3 not Accepted by EG&G
299		1-8	File Data System
	x	* 1-14	Monthly Status Report, 31 December 1962
	x	* 1-14	RFQ Digital System 1183-3P
	x	1-16	Submittal Preliminary Design TV System
	x	1-17	Submit Functional Spec Events
	x	1-18	Submit Functional Spec Photo
333		1-19	TDS 5.1 Changes
	x	1-21	Submit El. Power System Functional Spec
	x	1-21	Submit NETS Spec
	x	1-22	Submit Functional Spec Analog Recording
	x	1-24	Transmittal Minutes I&C Meeting #5
	x	1-24	Transmittal Minutes I&C Meeting #4
	x	1-25	Document Distribution
LA-037		1-25	Reference TWX 1010, Technical Meeting
	x	1-29	Submit Digital System Functional Spec
	x	1-29	Submit Data Acq. System Functional Spec
	x	1-30	Transmittal Functional Spec Communications
	x	1-31	Transmittal Functional Spec Timing System
	x	1-31	Transmittal Minutes I&C Meeting #3 revised
	x	2-1	Submittal Functional Spec Signal Conditioning
3220		2-4	Delay Submission of Spec on Facility Control
	x	2-4	Transmittal of I&C Meeting Number 6 Minutes

LETTERS AND TWX

Correspondence from EG & G

TWX NO.	LETTER NO.	DATE	SUBJECT
	x	2-5	Transmittal TV System Functional Spec (Rev A)
	x	2-5	Transmit TV System Functional Spec., Revised
	x	* 2-5	Format for Evaluation Digital System Prop.
	x	2-6	Transmittal of Repros D/A System
3239		2-7	TV Discussion at 2-11-63 Meeting
	x	2-11	Monthly Status 1-31
	x	* 2-11	I&C System Review and Approve Schedules
	x	2-11	Transmittal Facility Mods: METC, Cable Trays, Bldg. Mod
	x	2-15	Transmittal of I&C Meeting #7
	x	* 2-15	Submit RFP 1183-3B Digital Data System
3271		2-18	Reliability and Q.C.
5503		2-25	Cable Requirements EC and REC
3000		2-25	Digital Data Design Review Meeting
3303		2-26	Confirm Blanchard to SACTO
	x	2-27	Transmittal Facility Control Functional Spec
3311		2-27	As-Built Storage Vessel Drawings
	x	2-28	Transmittal Photo System Functional Spec Revised
3315		2-28	TV Cameras 9, 10, 11
	x	3-1	Trans. Facility Mode T.V. Photo and MET Tomet Funct Specs
	x	3-1	Transmittal Safety System Functional Spec
	x	* 3-6	Submittal 1 Line Electrical
	x	3-7	Transmittal Analog Functional Spec (Rev A)
	x	3-7	Transmittal Events Functional Spec
	x	3-8	Transmittal Communication System Functional Spec (Rev A)
	x	3-8	Transmittal Digital Data Functional Spec (Rev A)
	x	3-8	Transmittal METCS Functional Spec (Rev A)
3351		3-11	Schedule Submittal R and Q.C. Plan
	x	3-12	Transmittal Feb Status Report
	x	3-14	Transmittal R&Q Assurance Plan, QC Manual, Rel. Design Std.

LETTERS AND TWX

Correspondence from EG & G

TWX No.	LETTER NO.	DATE	SUBJECT
	x	3-20	Transmittal Safety System Functional Spec (Rev A)
	x	3-20	Transmittal Timing System Functional Spec Revised
	x	3-21	Transmittal Photo System Stds/Spec FFT
	x	3-22	Transmittal TC&P Functional Spec
	x	3-22	Transmittal Facility Mod Criteria: Terminal Boxes General FN Criteria Rev A, Intex and T-C Rev A, Design Stds
	x	3-25	Transmittal EI Design Grounding
3416		3-28	DDS, Phase I Design, Scope of Work Statement
	x	4-3	Transmittal Signal Cond S/S FFT
	x	4-3	Transmittal Photo Detail Prelim Design Dwg C&M Circuits
	x	4-4	Transmittal Comm System Detail Design Prelim Dwgs
	x	4-5	Transmittal Facility Mod Criteria (Rev A) TV and Photo
	x	4-15	Transmittal RF System Detail Prelim Design Dwgs
	x	4-15	Transmittal Timing System Detail Prelim Design Dwgs
	x	4-15	Transmittal TC&P S/S FFT
	x	4-15	Transmittal Timing System S/S FFT
	x	4-15	Transmittal Communications System S/S FFT
	x	4-15	Transmittal TV Detailed Preliminary Design
3500		4-15	Additional Cost TV Stat. 12
3504		4-16	Correspondence Distribution
19987		4-18	EG&G Submittal File Numbers
3526		4-18	Camera Effective Aperture, Periscope vs. Mirrors
3434		4-2	400 cps Power Requirement
	x	4-11	Transmittal Monthly Status March
3531		4-19	Cabling Conform to NEC
	x	4-24	Recommend Alt. Design MET. System
	x	4-25	Transmittal Facility Mod Criteria, Cable Trays (Rev A)
3536		4-25	Photo Lens App., Periscope vs. Mirrors
702-248-		4-30	Confirm Agreements Made at LV
7018			(1) Remove TV Control LSE
			(2) Delete Remote Control Door/Gate LSE
3582		4-30	Comment on NERS System

LETTERS AND TWX

Correspondence from EG&G

TWX NO.	LETTER NO.	DATE	SUBJECT
I22		4-30	Request Environmental Data Oxygen and Hydrogen Sample
3583		5-1	S/S FFT Data Avail. 6-10-63
I31		5-1	Added Cost Revise Facility Mod Title Block
	x	5-2	Transmittal TC&P Detail Prelim Design
3587		5-2	DDS Scope of Work
	x	5-3	REON Comment Facility Mod and CBP Design Stds
3596		5-6	Photo System Agreements C&M Circuits
	x	5-6	Transmittal NETCS Detail Prelim Design Dvgs
3591		5-6	EIS-1 Photo-Periscope vs. Mirrors
I46		5-6	Facility Mod Criteria, Cable Trays
I41		5-6	TV and Photo Bunk Facility Mod Design Review
3595		5-6	Agenda for QC Meeting 5-9-63
3597		5-6	Revision to TWX 3587
3602		5-6	Power System and Cable Trench Requirements
I52		5-7	Schedule Facility Mod Review
	x	5-7	REON Comment Facility Mod, Building Mods
	x	5-7	Transmittal Minutes I&C Meeting 8
3611		5-7	Agenda for Orientation at EG&G 5-13-63
3610		5-7	Reliability Photo System Design
3617		5-8	I&C Power for EIS-2
4001		5-9	Comment on EG&G Analog Recording
I70		5-10	EG&G Requirement for Facility Mod Met Tower
3626		5-10	Update Operational Requirement Photo System
I31		5-13	Title Block Facility Mods
	x	5-9	Response to REON Comment Events Recording
	x	5-14	Transmittal Preliminary List of Dvgs
	x	5-14	Transmittal Facility Mod Criteria TV and Photo
	x	5-14	Minutes of Controller Design Review
	x	5-14	EIS-2 Cable Requirements
3642		5-15	Breakers, Power System

LETTERS AND TWX

Correspondence from EG&G

TX No.	LETTER NO.	DATE	SUBJECT
	x	5-16	Transmittal Facility Mod Test Stand Terminal Boxes (Rev A)
617-262-9357		5-17	DDS Super Com. Technique
	x	5-17	Transmittal, Block Diagram
	x	5-17	Transmittal Safety System Drawings, Communication, Timing and Photo
	x	5-17	Transmittal Monthly Status April 1963
	x	5-20	Transmittal Facility Mod Cable Trays (Rev B)
	x	* 5-20	Site Survey, TV Camera Stations
	x	5-20	Transmittal Minutes of Orientation Meeting at EG&G 5-13-63
L-100		5-20	Cable Tray Facility Mod Design Review Schedule
	x	5-21	Transmittal of Photo and Communications Drawings
617-202-937		* 5-22	Action Items Photo Bunker Facility Mods
4016		* 5-23	ROM Costs TV Station 12
4012		5-24	Radiation Design Criteria TV Stations 9, 10, 11 and 12
	x	5-24	Transmittal DDS (1) Scope of Work Phase I (c), Function Specs (Rev C)
4016		* 5-24	TV Station 12 Cost Estimate
	x	5-24	Elect. Hazards Definition
	x	5-27	Transmittal Drawings, NETC Photo, Communications TV Overall System
	x	5-27	Transmittal Drawing List
	x	5-27	Transmittal Facility Mods Index, Terminal Boxes (Rev A)
	x	5-27	Transmittal Facility Control Functional Spec (Rev A)
	x	5-28	Survey of Equipment for Data Processor and Checkout Fac.
L-127		5-28	Fac Mod Design Rev Cable Trays and Terminal Boxes
	x	5-29	Transmittal Drawing and Document List (Rev B)
	x	5-29	TV Camera Locations
4021		* 5-31	Excitation Power Supply
	x	* 6-3	Transmittal, Equipment Cost Estimate for SP Phase
L-130		5-31	Safety System Submittal
4019		5-31	DDS Agreements Confirmed
4023		6-4	Relocate TV Station 3

LETTERS AND TWX

Correspondence from EG&G

TWX NO.	LETTER NO.	DATE	SUBJECT
L-130		6-4	Safety System Block Diagram
4023		6-4	Relocation of TV Camera Station 3
	x	* 6-5	Scope of Work and Costs CY 64
	x	* 6-5	Phase II Cost Estimates
	x	6-6	Transmittal S/S FFT Analog and Event Record
	x	6-6	REON Letter 741:0159, 4-23-63
	x	6-7	Transmittal RFP 1183-10B
4027		6-8	Safety System TD
	x	6-10	Fac. Mod, TV and Photo
	x	6-10	Transmittal EG&G DRM
	x	* 6-10	Facility Mod PO J141045
4030		6-11	ETS-1/2 Power Requirements
L-173		6-13	Facility Mod Bid Package
L-176		6-13	Control Room Layout, Design Review Meeting
	x	6-13	Transmittal Minutes, I&C Meeting 10
L-176		6-13	Acknowledge Receipt of L741:0205
L-177		* 6-13	Facility Mod Bid Packages
L-178		6-13	Correct TWX L-173
	x	6-14	TV Camera Motion System
4036		6-17	Confirm Design Package Submittal
	x	* 6-19	I&C Correspondence
4036	6-	6-20	Transmittal Design Package
	x	6-21	Transmittal Status May 1963
	x	6-21	Facility Mod Meeting 6-21-63
L-211		6-21	Rack Relocation, Facility Mod Schedule
L-210		* 6-21	Package Review
L-211		6-21	Relocation Racks, Cable and Equipment
L-213		* 6-21	SNPO-C Meeting
4050		* 6-25	EG&G Rep at Meetings
3710		* 6-25	Reliability and Q.C.
4057		6-26	Prelim. Design Package Submittal
4052		6-26	Prelim. Design Package Submittal

LETTERS AND TWXCorrespondence from EG&G

TWX NO.	LETTER NO.	DATE	SUBJECT
4059		6-27	LSE Display
95		6-28	EG&G Program Plans
4061		6-28	Oper. and Funct Req in Vol 2-5 of EG&G B-2598
	x	6-27	Transmittal minutes Meeting 12
4020		6-21	Safety Meeting at NRDS (5-31)
	x	7-2	Transmittal Drawings Equipment Racks
4066		7-2	Equipment Rack Layouts
	x	7-3	Minutes Final Design Review, Cable Tray Fac Mod
	x	* 7-3	Detailed Cost Estimate of Fac Mods
	x	7-3	Minutes of Final Design Review TV and Photo
3720		7-3	ETS-1/2 Power Requirements
	x	7-9	Transmittal Final Fac Mods ETS-1
L-268		7-10	Design Review Schedule Fac Modifications
	x	7-12	Transmittal Fac Mod Vellum and Cost Estim Terminal Box
	x	7-12	Const. Cost Estimates Fac Mods, Terminal Boxes
	x	* 7-12	REON Rev & App EG&G Documents
	x	7-15	Transmittal Console Design Package
4091		7-16	Elec. Power Supply Recorder Requirements
	x	* 7-16	Rev. & App. EG&G Documents
	x	7-18	Expanded Wide Band Data Acquisition Capacity
	x	7-18	Transmittal Final Design Drawing and Cost Estim TV and Photo Bunker
	x	* 7-19	Surplus Cable
L-298		* 7-23	Fac Mod Purchase Order J14105
4103		7-25	Timing System, REC Count Clocks
	x	* 7-29	CBP
4112		7-31	Console Rack and Panel Colors
4112		7-31	Console Rack and Panel Colors
4116		8-1	TV Cable Conductor Size
4113		8-1	ETS-1/2 Power Requirements
	x	* 8-2	Cost and Schedule, Design Package Revision
4119		8-6	DDS Outline of Work Statement
	x	8-6	Outline of Work Statement DDS
	x	* 8-7	Cost and Schedule Design Package Revision
	x	8-7	Transmittal I&C Meeting 18 Minutes

LETTERS AND TWX

Correspondence from EG&G

TWX NO.	LETTER NO.	DATE	SUBJECT
4222		8-8	Purge Speakers in Hazard Area
4224		8-8	Analog and Events, Addendum No. 7
4222		8-8	Communication Panels
4225		8-9	ETS-1 Computer Facility 400 CPS Power
4227		8-9	Reliability and Quality Assurance Plan
	x	* 8-9	Transmittal Preliminary CPB Cost Estim TV and Photo
L-344		8-9	Agenda Meeting EG&G/REON 8-12-63
L-344		8-9	Safety System
4230		8-12	Fac. Cont. System Meeting
L-346		8-13	Safety System Meeting
"	x	8-13	Transmittal Title Block Design Drawings
4233		8-14	Analog Recording System
L-350		8-15	Design Package Rev. Definition
4239		8-15	Fac. Cont. System
4231		8-15	Conclusions Reached Discussions Chertok/Bridenstine
	x	8-15	Fac. Controller
	x	* 8-16	Requirements for CBP PO-J14105
	x	8-16	Transmittal of Minutes I&C Meeting No. 17
L-361		8-19	Meeting on CBP Material
4244		8-20	Safety System Meeting 8-15, 16
4243		8-20	Comm. Panels 43, 44
L-365		8-20	CBP Material
4247		8-21	Operational Description for Revised Design Package Dwgs
	x	8-21	Safety Alarm Logic Diagram
L-369		* 8-22	Fac. Mods Interagency Coot. Meeting
4252		8-23	Conductor Size, Spec TV Cable
4243		8-23	Comm. Panel Requirements
	x	8-23	Fac. Control System
L-365		8-23	Const. Bid Package Material
4256		8-27	Cont. Console - Timing System Interface
4255		8-27	Power Distribution Drawings
L-379		8-27	Coordination of CBP I&C Meeting No. 19

LETTERS AND TWX

Correspondence from EG&G

TWX NO.	LETTER NO.	DATE	SUBJECT
4261		8-28	TV Motion System and LIE Console Indication
L-392		8-29	Fac. Control Agreements
4263		8-29	Item Deferred to Design Package
L-392		8-30	Fac. Cont. Tech. Direction
L-381		8-30	Additional Crafts Work
L-412		9-6	Safety System Meeting 9-10-63
414		9-9	Meeting L.V. 9-3-63
L-415		9-9	Min. of Mtg at AETRON 9-5-63
	x	9-11	Transmittal of Min. I&C Meeting No. 20
4985		9-11	ETS-1/2 Power Requirements
	x	9-12	Transmittal Rel. & Qual. Assurance Plan
	x	9-12	Design Package Schedule and Procedural Revisions
	x	* 9-13	DDS Spec. and Work Statement
L-430		* 9-13	Discussions between EG&G & AETRON
4992		* 9-13	Equipment Cost Estimate Phase II
4989		9-13	Flip Charts Meeting 9-12-63
	x	* 9-16	Monthly Status August 1963
4995		9-17	Flip Charts Meeting 9-12-63
435		9-18	Additional Craft Work
L-439		* 9-19	Proc. Dates GFE, Fac Mods
L-436		* 9-18	Proc. Dates GFE, Fac Mods
L-438		9-20	Fac. Cont. Console
	x	* 9-20	Categorés of Drawing Submittals
	x	9-20	Transmittal of Sec. 5 DDS Spec
	x	10-8	Design Package Review
	x	10-3	Transmittal of Data Processing System Study
	x	10-1	Transmittal R. & QA Plan
	x	10-10	Transmittal ETS-1 Program Plan
5031		10-10	Design Package Pub. Instruction
	x	10-15	Transmittal Data Processing System Study

LETTERS AND TWX

CORRESPONDENCE FROM SNPO-C

TWX NO.	LETTER NO.	DATE	SUBJECT
	x	10-9-62	Submit recommended safety warning system
SM 5		10-24-62	Control Room Layouts
	x	11-15-62	Attendance at EG&G Meeting
BT		11-27-62	I&C System Completion date
SM-021		12-21-62	Request Repro. of criteria and OPDP drawings
	x	12-28-62	TD procedure-flag cost changes
SM-040		12-28-62	I&C system completion dates
	x	12-31-62	EG&G statement of work
	x	12-31-62	Transmittal work statement I&C system
SN-114		1-4-63	Correct; oscillographs, patching, computer requirements, 2Ms events, intercom, meeting minutes, SNPO-C information, submittals, R.F. proposals, and schedule.
SM-011		1-8-63	Transmittal interphone requirements to EG&G
SM-017		1-9-63	Correct TWX SM-114
SM-033		1-10-63	Request for RF system clarification and AEC - NO proposal
SM-045		1-14-63	Procedures and schedules
O919R		1-17-63	Request EG&G attend PERT meeting
	x	1-18-63	Minutes of I&C Meeting No. 2
	x	1-18-63	Concur with minutes I&C Meeting 3
	x	1-18-63	Concur with minutes I&C Meeting 1
	x	1-21-63	REON required approval time
SM-018		1-21-63	Confirm telecon 1-18-63 transmit to EG&G Items A&B of REON TWX 617, 1-15-63

LETTERS AND TWX

CORRESPONDENCE FROM SNPO-C

TWX NO.	LETTER NO.	DATE	SUBJECT
SM-004		1-21-63	RF channels operation safety
	x	1-22-63	REON required approval time
SM-080		1-24-63	AETRON Drawing ETS-1 Complex
SM-079		1-24-63	Delete display panel on LIE
033		2-1-63	Consider facility Mod as TD
034		2-1-63	Comment on TV is T.D. Take Action.
	x	2-1-63	T.D. procedures
R-011545Z		2-1-63	Facility modifications and facility control
SM-055		2-7-63	Consider comments on photo system as T.D.
	x	2-8-63	TD procedures and EG&G work statement
R-122032Z		2-12-63	Monthly status report
		2-12-63	Q.C. and R.
	x	2-13-63	Revised EG&G work statement
R-181856Z		2-18-63	EG&G monthly status report
R-181908Z		2-18-63	SNPO approve control room layout
	x	2-18-63	N ₂ purge of instrument boxes
	x	2-19-63	El. hazards classification
PO-41803Z		3-4-63	ETS-1 El. hazards definitions
	x	3-8-63	Criteria Addendum 3
	x	3-8-63	Transmittal Addendum 3
	x	3-12-63	N ₂ purge instrument boxes
R-131708Z		3-13-63	TV station 9, 10, 11 and duct
	x	3-15-63	Miss-sent repor's of analog functional spec.
R-181756Z		3-19-63	Request REC complete flow dia.

LETTERS AND TWX

CORRESPONDENCE FROM SNPO-C

INX NO.	LETTER NO.	DATE	SUBJECT
R-181853Z		3-19-63	Clarify electrical hazard classification
R-181830Z		3-20-63	Request copies ICC 028
R-251606Z		3-25-63	Request Report 2316 to EG&G
R-292237Z		3-29-63	I&C meeting 5, April 1963
R-021559Z		4-2-63	Changes per notes of meeting (SNPO-C 2-14)
NSM 98		4-8-63	SNPO requests REON TD to EG&G
R-102125Z		4-10-63	REON review of EG&G work statements
R-102123Z		4-10-63	Approval of EG&G work statement
R-041925Z		4-11-63	Cost estimate changes in Addendum 4 & 5
R-131423Z		4-15-63	SNPO comment design standards CPB (4 March 1963)
R-131428Z		4-15-63	Clarification of EG&G submittal design file system
	x	4-15-63	Transmittal (a) prop work statement for AE electrical work ETS-1 Mods, (b) Drawing SNPO-C/FDG SK-E-101 Revision A.
R-122007Z		4-15-63	Correspondence distribution
R-122007Z		4-15-63	Correspondence routing
	x	4-16-63	SNPO comments on EG&G submittal, unsatisfactory
R-231627Z		4-23-63	Agenda for Meeting No. 18
R-231627Z		4-23-63	Agenda for Meeting No. 8
R-251529Z		4-25-63	Request extra copies Addendum 6
R-301629Z		4-30-63	Completion of blast valve and cable tray mods.
R-031718Z		5-3-63	SNPO concur with EG&G IBM DDS
R-031838Z		5-3-63	Electric power mod. and tunnel mods.
R-041634Z		5-6-63	Direct EG&G revise facilitate mod. title block
R-032020Z		5-6-63	Approval of Aetron PO

LETTERS AND TWX'S
CORRESPONDENCE FROM SNPO-C

TWX NO.	LETTER NO.	DATE	SUBJECT
R-0717556Z		5-7-63	SNPO-N Furnish REON As-built Vessel Drawings
R-071751Z		5-7-63	Status Additional 4 and 5 Cost Estimate Data
QAWA-079NL PD		5-8-63	Clarification Requirement TV Station 12
R-082010Z		5-9-63	DDS Work Statement Phase I
	x	5-20-63	Transmittal Minutes, Review Meeting at SNPO-C 5-9-63
	x	5-21-63	Emergency Coolant Flow Measurement Pipe Spool
R-221912Z		5-23-63	Digital Data System Scope of Work (Rev. B)
R-232249Z		5-24-63	Diesel Engine Tests
R-232215Z		5-24-63	DDS Functional Specification (Rev. B)
R-221912Z		5-24-63	DDS Scope of Work
R-312230Z		6-3-63	TV Station 12
	x	6-3-63	Transmittal Addendums 4, 5, and 6
R-062140Z		6-6-63	Cable Tray Space Requirement in CP
R-141812Z		6-17-63	Diesel Test Specification
R-141750Z		6-17-63	Excitation and Calibration Power Supplies
R-192423Z		6-20-63	Design Package Review
103		6-21-63	Correspondence Distribution
102		6-21-63	Comment Addenda 4, 5, and 6
	x	6-29-63	Document and Drawing Submittal
	x	7-2-63	Minutes of 7-1-63 Meeting, SNPO/EG&G/REON
R-032248Z		7-5-63	Design Package Review
R-092137Z		7-9-63	Analog Recording

LETTERS AND TWX'S
CORRESPONDENCE FROM SNPO-C

TWX NO.	LETTER NO.	DATE	SUBJECT
R-051857Z		7-9-63	Surplus Cable
R-032112Z		7-9-63	Design Package Review Meeting
	x	7-19-63	Eng./T.S. Interface
	x	7-22-63	Elect. Power Systems Mod.
R-231922Z		7-23-63	Location Steam Generator
R-231602Z		7-23-63	Meeting 7-25-63, Addendum #7
	x	7-24-63	ETS-1 I&C Design Package Revisions
	x	7-24-63	Design Package Revisions
R-262133Z		7-29-63	ETS-1, 2 Integration Safety System, Fire Protection System
	x	8-2-63	Data Processing System Study
R-022052Z		8-2-63	I&C Power Distribution
	x	8-6-63	ETS-1 I&C
R-241632Z		8-7-63	Facility Mod. Design P.O. J14105
R-262128Z		8-7-63	Attach 3A to SNPO-C ltr 7-24-63
R-131351Z		8-13-63	Safety System
SMA023		8-13-63	Safety System Recorder
SMA069		8-16-63	Calibration Variable Reluctance and Frequency Channels
R-162046Z		8-16-63	Calibration Steps for Variable Reluctance and Frequency Channels
	x	8-23-63	Transmittal Tech Note (a) VCO Performance (b) Bridge Circuits
SMA050		8-26-63	I&C Correspondence

LETTERS AND TWX'S
CORRESPONDENCE FROM SNPO-C

TWX NO.	LETTER NO.	DATE	SUBJECT
P-261850Z		8-26-63	Wide-Band Recording System
P-261901Z		8-26-63	ETS-1 I&C Correspondence
006		9-6-63	Location of Steam Generator
R-092045Z		9-10-63	Outline DDS Work Statement
R-092028Z		9-10-63	DDS Work Statement
	x	9-10-63	ETS-1 I&C Reliability & Quality Assurance Plan
	X	9-17-63	Minutes of I&C Meeting #22
SMA049		9-19-63	CBP
R-271230Z		9-27-63	I&C Systems Cost Estimate

S/T 3.4 TEST STAND ETS-2

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-3.4 (1) SUPPORT SNPO-C	(a) PROVIDE DESIGN CRITERIA FOR ETS-2 DURING CONTRACT YEAR (b) DEFINE INTERFACES AS REQUIRED (c) PROVIDE UPDATED REQUIREMENTS AS REQUESTED	(a) COMPLETED (b) PERFORMED (c) PERFORMED	(a) SEE BIBLIOGRAPHY FINAL REPORT #2502 DTD 7-12-63 (b) L741:039 DTD 9-19-63 (c) CONTINUING EFFORT
2-3.4 (2) DOCUMENT REVIEW	(a) PERFORM REVIEWS AS REQUESTED	(a) PERFORMED	(a) MEETING MINUTES SNPO-C/REV 10-12-63
2-3.4 (3) TECH ASSISTANCE ON I & C SYSTEM	(a) ASSIST AS REQUIRED	(a) PERFORMED	(a) CONTINUING EFFORT (REF. CY 64 W/S)

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.4 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

The A-E Phase I engineering analysis and design criteria report for ETS-2 was reviewed during August and September of CY 62 and October CY 63. Recommendations were discussed with SNPO-C and noted in conference notes/billings dated 12 October 1963. At this meeting SNPO-C directed REON to develop an ETS-2 basic criteria report. REON completed Report No. 2409 on 13 November 1962, and submitted preliminary copies to SNPO-C for review. Direction for revision of ETS-2 report, resulting from SNPO-C review, was received by REON in a letter dated 7 January. REON submitted the draft of the revised Report No. 2409 on 15 February. After review by SNPO-C during meeting on 27 February and as per directions in a letter dated 14 March, the report was again revised. At this time the report material was divided into two reports, No. 2506 and No. 2502, for ETS-1 and ETS-2, respectively.

Report No. 2502 was reviewed by SNPO-C on April 11, revised and issued in May with a limited distribution.

On 26 June a joint SNPO-C/AETRON/REON meeting was held to discuss revisions to Report No. 2502 per comments delineated in the letter, SNPO-C to AGC, dated 13 June. REON again revised the report and made a final issue on 12 July. Final approval of Report No. 2502 was received from SNPO-C by letter, SNPO-C to REON, on 7 August 1963.

a. Per SNPO-C TWX dated 13 August 1963 requesting determination and methods of interfacing ETS-2 Facility Control System into ETS-1, REON 3.4 Subtask assisted Subtasks 3.2 in preparation of a Facility Control Interface Scope Study Report L741:0309 which was submitted on 19 September 1963.

b. Anticipating the A-E requests for supplementary design requirement information, REON has been conducting evaluations on the latest Lockheed Tank Bottom Design concept and is accumulating available

information for the A-E. Preliminary work was also done on establishing a design concept for the tank isolation valve.

2. A&E Review

Except as noted in 1,a above, no effort was conducted during CY 1963 on A&E design review due to no release of contract effort by SNPO-C to the A&E which resulted in documents subject to REON review.

3. Technical Assistance on I&C System

a. During the CY 1963, ETS-2 general I&C requirements were included on Report No. 2502. Preparation of a detailed ETS-2 I&C criteria is scheduled to be accomplished in CY 1964 when the ETS-1 I&C design has been firmed and the ETS-2 facility design concept has been established.

Conclusion

The efforts expended under Subtask 3.4 have met all of the Work Statement requirements, and the criteria produced for ETS-2 will greatly assist in expediting the A&E phase of the program.

SUBTASK 3.4 - BIBLIOGRAPHY

TWX'S, LETTERS, MEETINGS & REPORTS

LETTER NO.	TWX NO.	FROM	TO	REPORT	MEETING	DATE	SUBJECT
810:185		Aetron	SNFO-C			9-20-62	Review of Aetron Phase I Report on ETS-2 on 15 February 1962
	X	SNFO-C	REON/ WANL			10-6-62	Meeting to be held at SNFO-C on 11-12 October to Discuss ETS-2 requirements, criteria, and overall ETS-1, ETS-2 capabilities and limitations.
					X	11 & 12 Oct. 62	SNFO-C instructed REON to prepare Report 2409, ETS-2 Criteria and ETS-1 Criteria and requirements for completion.
	760:1789	REON	WANL			10-16-62	Request reactor subsystems operations data.
	X	SNFO-C	REON			10-24-62	Acknowledge TWX dated 16 October requesting a preliminary description of types of tests, sequence, time required for C/O, etc. for reactor subsystems for ETS-1 & 2 due 10-29-62.
	X	REON	SNFO-C			1-25-63	Confirm telecon agreements on material in January 7 letter.
		REON	SNFO-C	2409 (Rev. C)		2-15-63	ETS-2 Criteria and ETS-1 Criteria and requirements for completion
					X	2-27-63	Meeting at Las Vegas to review preliminary Report No. 2409 (Rev. C)

3.4 - 1a

TWX'S, LETTERS, MEETINGS & REPORTS

LETTER NO.	TWX NO.	FROM	TO	REPORTA	MEETING	DATE	SUBJECT
TE&OB:DHR		SNPO-C	REON			3-14-63	Summarizes SNPO-C criteria report review comments of Las Vegas meeting.
741:0125		SNPO-C	WANL			3-27-63	Request review of draft AGC Report No. 2502, ETS-2 Criteria
		REON	NASA-WOO Astron	X		4-11-63	ETS-2 Criteria
					X	4-11-63	To review Report No. 2502 at REON W/ NASA-WOO and Astron.
	X	SNPO-C	REON			4-19-63	Transmittal NES vault criteria
X		REON	SNPO-C			May 63	Report 2502, ETS-2 Criteria, issued for limited distribution to SNPO-C only, May 1963
	X	SNPO-C	REON			6-11-63	Hold all copies of Report 2502 until SNPO-C release authorized
X		SNPO-C	REON			6-13-63	Schedule meeting at Azusa 26 June, to discuss revision of ETS-2 criteria report - encloses review comments of Report 2502
					X	6-26-63	Meeting at Azusa. Resolved all revisions to ETS-2 criteria concurred by SNPO-C and REON
765:545		REON	SNPO-C			7-13-63	Report 2502, ETS-2 criteria, July 1963 released for general distribution 7-13-63

3.4 - 2a

TWX'S, LETTERS, MEETINGS & REPORTS

LETTER NO.	TWX NO.	FROM	TO	REPORT	MEETING	DATE	SUBJECT
	TSB:AL	SNPO-C	REON			7-29-63	Request definition and methods of ETS-1/ETS-2 Electrical Control Interface.
X		SNPO-C	REON			8-7-63	Approval of ETS-2 Criteria Report No. 2502.
	X	SNPO-C	REON			8-12-63	Forwarding ETS-2 Schedule dates.
	X	REON	SNPO-C			8-13-63	Answer SNPO-C request for electrical control interface study plan and target date.
FDG:JJR		SNPO-C	REON			8-23-63	Transmittal of minutes of meeting to discuss AETRON cost proposal of ETS-2 studies.
	X	REON	SNPO-C			9-13-63	Request copies of AETRON cost proposal.
	741:0309	REON	SNPO-C			9-19-63	Submitted facility electrical control interface study to SNPO-C.

3.4 - 3a

S/T 3.5 E-MAD FACILITY

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.5 (1) SUPPORT TO SNPO	(a) PROVIDE AS REQUESTED UPDATED REQUIREMENTS AND JUSTIFICATIONS	(a) PERFORMED	(a) SEE BIBLIOGRAPHY (TOTAL 320 RE- QUIREMENTS DEFINED)
2-3.5 IDENTIFY ADDITIONAL FACILITY REQ	(a) PROVIDE AS REQUESTED NEW REQUIREMENTS FOR ADDITIONAL E-MAD FACILITIES	(a) PERFORMED	(a) AGC REPORT #2325 DTD 10-23-62 AGC REPORT #2520 DTD 5/63
2-3.5 (2) DOCUMENT REVIEW	(a) PERFORM REVIEWS OF A & E DESIGNS, SPECS, DRAWINGS AND REPORTS AS REQUIRED	(a) PERFORMED (REVIEWED 682 DOCUMENTS)	(a) SEE BIBLIOGRAPHY (TOTAL 61 COMMUNICA- TIONS OF REVIEW COMMENTS)
2-3.5 (2) EQUIPMENT DESIGN REVIEW	(a) PERFORM REVIEW OF WMHS	(a) PERFORMED (REVIEWED 42 DRAWINGS AND 1 STUDY REPORT)	(a) VITRO MEETING MINUTES DTD 8-28-63

S/T 3.5 E-MAD FACILITY

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.5 (3) ASSIST (d) IN FACILITY ACTIVATION PLANNING	PROVIDE GUIDES AND PLANS FOR E-MAD ACTIVATION AS REQUIRED	(d) PERFORMED	(d) CONTINUING STUDY PRELIMINARY REPORT IN PROGRESS
SPECIAL REQUESTS SNPO-C 5-14-63	CONDUCT FEASIBILITY STUDY OF E-MAD TO ACCOMODATE NRX	COMPLETED	(d) L741:0264 DTD 9-13-63
SNPO-C 5-14-63	CONDUCT STUDY TO RECOMMEND PROCUREMENT CATEGORIES FOR VARIOUS E-MAD EQUIPMENTS	COMPLETED	(d) SEE BIBLIOGRAPHY (TOTAL 5 COMMUNICATIONS)

REQN · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.5 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

This task was engineering work on a level of effort with no milestones, and support was supplied to SNPO-C in the following manner:

a. Provided as requested and/or as the need indicated, updated NERVA requirements and/or SNPO-C requested justification on various subjects as evidenced by the 320 requirements defined, evaluated and transmitted in 18 TWXs, 29 letters and 2 reports and at the 12 meetings noted on bibliography. Example of such efforts resulting in correspondence are:

(1) REON review of hot cell doors - L741:0058, 8 December 1962.

(2) E-MAD composite safety review enclosing NERVA operations, functional and safety requirements for E-MAD building radiation monitoring, L741:0186, 13 May 1962.

(3) NERVA post operative requirements and load distributions for the E-MAD post-operative cells, L741:0078, 18 January 1963.

(4) Preliminary outline for E-MAD shielding integrity check, L741:0195, 17 May 1963.

(5) NERVA operational requirements for material transfer in E-MAD post-mortem cells, L741:0242 dated 27 June 1963, consisted of three enclosures, NERVA operational requirements for E-MAD post-mortem door interlocks and controls, schematic for E-MAD post-mortem doors, and NERVA operational requirements for the material transfer in and the ability of the post-mortem area less electrical interlocks.

The results of this effort have provided SNPO-C support in their direction of the A&E effort.

2. Additional Facility Requirements

a. Identification of additional E-MAD facility requirements were made as requested during the contract year and are noted in bibliography, Enclosure (4). This effort identified the facility requirements for critical parts storage, engine transport system maintenance and NERVA warm engine parts post-mortem. In addition to the meetings [Ref. Bibliography, Enclosure (4)], the results of this effort were transmitted by letter L741:0078 dated 18 January 1963, Report No. 2325 and Report No. 2520. (See Bibliography.)

3. Document Review

a. Facility document review of E-MAD building designs were conducted. Comments and/or approval was given on 605 drawings, 74 specifications and three reports received in 83 separate and unscheduled transmittals. REON completed review of all documents received and comments were expedited to SNPO-C by 61 TWXs, noted in bibliography Enclosure (2).

The average number of working days required, between receipt of material and transmittal of comments, was 13.4 days with a minimum of 2 and maximum of 39 days. A specific problem encountered during this review effort was the absence of the A&E document release schedule. All reviews were therefore conducted on an unscheduled basis. Incoming transmittals varied from a minimum of one specification or report to a maximum of 116 drawings received in 1 day. REON transmitted 277 marked drawings and 80 marked specifications under cover of 15 letter of transmittals (see bibliography). Preliminary design and for-approval documents only were marked up for submittal.

The review effort performed was divided by the nature of the A&E effort into the following major activities:

(1) The review of E-MAD Phase I construction changes, a total of 152 drawings and 10 specifications received in 23 transmittals. The response to SNPO-C with review comments required an average of 6.9 days with the minimum 2 days and the maximum 21 days (see bibliography). This material received priority over concurrent review effort of Phase II design.

(2) The review of E-MAD post-mortem cells preliminary design was partially accomplished at meetings as noted in bibliography Enclosure (4), a total of 32 drawings. The review response time averaged 11.9 days with the minimum time 7 days and the maximum 24 days. For the subject 32 drawings, reference bibliography Enclosure (6).

(3) The review on E-MAD post-mortem cells final design included 256 drawings and 64 specifications received in 43 transmittals. These reviews were accomplished in an average of 15.1 days with the minimum 5 days and the maximum 39 days. [See bibliography Enclosure (7)].

(4) The "Certified for Construction" drawings for E-MAD Phase II were received in 6 transmittals and totaled 165 drawings. The average response with review comments was 7 days with the minimum requiring 1 day and the maximum 14 days. [See bibliography Enclosure (8)].

4. Equipment Design Review

REON participated as requested by SNPO-C in review of proposals for the wall mounted handling system procurement. Attendance at meeting and transmittal of review comments were made. Equipment design review was begun, per a SNPO-C supplied schedule, on the wall mounted handling system for the E-MAD east wall. REON reviewed 42 preliminary drawings, received one study report and participated in a technical conference August 27 and 28 (see bibliography). Formal transmittal of REON review comments was not made because of inadequacy and incompleteness of design as noted in Vitro Meeting notes September 1963.

5. Facility Activation Planning

Technical assistance on checkout and activation planning was provided as requested. However, no major requests were made to REON due to construction schedule readjustments into CY 1964. REON initiated early in the contract year an outline for and initiated compilation of E-MAD and support facilities operation data in preparation for activation efforts. The preliminary draft version is scheduled for printing in the first quarter of CY 1964. Activation planning was conducted throughout the contract year as

required to assess manpower requirements, organizational structure, and preliminary efforts associated with determining support contractor activities.

6. Special Requests

Special studies over and above those required to support the A&E design and construction effort were requested by SNPO-C and completed by REON were:

a. As requested by SNPO-C at the 14 and 15 May meeting and in program plans letter Schroeder to House dated 29 May 1963. REON initiated a three-phase program to complete a feasibility study of the E-MAD facility to accommodate the NRX. The three phases of the study program were:

Phase I Physical sizing of NRX to the E-MAD. This was transmitted by letter L740:0053 dated 4 June 1963.

Phase II Identifying special support equipment and facility requirement necessary to process an NRX through E-MAD, including floor space requirements for this equipment. This was transmitted by letter L740:0059 dated 25 June 1963.

Phase III Identifying and describing all facility modifications, new facilities, and all additional equipment required to process NRX through E-MAD, considering NRX activities concurrent with E-engine operations. This was presented in a progress report in preliminary form by L741:0249 dated 12 July 1963 to verify that SNPO-C objectives had been satisfied. The draft study of the completed exercise was transmitted by letter L741:0264 on 13 September 1963 which included 19 enclosures.

b. At the 14 May 1963 meeting, REON recommended all FY 1964 construction fund procurement items to be segregated in three categories with

the non-severable category being given the highest procurement priority. SNPO-C directed REON to study the recommended procurement categories and supply recommended quantity, type and description to meet minimum requirements and for procurement as part of E-MAD 1964 modification construction funds for

- (1) General health and safety equipment
- (2) General purpose fire protection equipment
- (3) Machine shop equipment (Rooms 117 and 118)
- (4) Physical counting room
- (5) Personnel counting room
- (6) Miscellaneous shop tools
- (7) Master slave manipulator
- (8) Rectilinear manipulator
- (9) Office furniture.

This assignment was completed by transmittal of the following letters which are noted in the bibliography:

L740:0047 dated 28 May 1963 "REON recommended minimum equipment lists for E-MAD machine shop

L740:0048 dated 27 May 1963 "REON recommended minimum office equipment list for E-MAD

L740:050 dated 28 May 1963 "Recommendations for minimum rectilinear manipulator systems

L740:0052 dated 4 June 1963 "Recommended minimum general health and safety; general purpose fire equipment lists for E-MAD facility

During the course of this study the requirements were questioned by SNPO-C and justifications were required. The mechanical equipment fork lift trucks, industrial cleaning equipment, vault storage equipment, personnel counting room equipment, assay laboratory equipment and miscellaneous

shop tools were removed from list as noted by the SNPO-C direction in the minutes of the meeting of 10 July 1963 (see bibliography). REON complied with SNPO-C direction to define total manipulator requirement for E-MAD by letter L741:0262 dated 31 July 1962. This transmittal also included data relative to the most recently available new manipulator equipment (see bibliography).

7. Summary

Technical management and integration was supplied by maintaining continuous liaison with SNPO-C, subcontractors, NTS and related subtasks, with appropriate information distributed to those organizations contributing to assure compatibility of the E-MAD complex with other facilities and/or equipment and the adequacy of the facility to accommodate the functional, operational and safety requirements of the NERVA program. Meetings with SNPC-C were held as shown in bibliography Enclosure (4).

The volume of communications, in addition to phone calls, that was generated by this subtask totaled over 370 pages in approximately 100 TWXs and 40 letters transmitted to SNPO-C. In addition, dissemination of data was made to subcontractors and NTO.

SUBTASK 3.5 - BIBLIOGRAPHY

SCHEDULE OF TWX AND LETTERS
TRANSMITTING REQUIREMENTS DATA

TWX DATE	REON MSG. OR LTR NO.	LETTER DATE	TITLE OR DESCRIPTION
10-10-62			E-MAD Phase II Design Requirements for Location of Borescope Periscope and Stereomicroscope.
10-11-62			Service requirements for each post-mortem cell viewing window.
	L741:0043	10-26-62	Transmitted preliminary sketch SK-2661-01-1 Transfer Car Track Layout for E-MAD.
10-25-62			REON transmitted requirements relative to shielding criteria and calculations.
10-21-62		10-21-62	Ltr. transmitted preliminary unedited rough draft of salient portions of NERVA Post Operative Requirements document.
	L730:2062:dh	10-23-62	Transmitted smooth rough draft of salient portions of NERVA Post Operative Requirements document.
	L741:0045	10-31-62	Encl. (1) Area Warning System Summary Encl. (2) Proposed Table of Safety Alarm and Warning Systems
10-23-62			Intercell Railway Door Shielding and Anchoring Requirements.
	L741:0044	10-23-62	Transmitted REON Drawing 037941 Transmitter-Receiver Location Plan.
11-2-62			E-MAD Alternates Procurement Priorities
	L741:0058	12-8-62	Transmitted "REON Review of Hot Cell Doors".
	L741:0048	12-4-62	"REON Review Comments on E-MAD Shielding Report" Vitro Report KLX 1842.
1-31-63			E-MAD Facility Wall Mounted Handling System Simultaneous motions.

TWX DATE	REON MSG. OR LTR NO.	LETTER DATE	TITLE OR DESCRIPTION
1-28-63			Requirement of Manipulators in the E-MAD Maintenance Balcony
1-22-63			Operational Analysis including cost analysis of economic values associated with the lift versus Plug doors on the Hot Cells in E-MAD Phase II Procurement.
	L741:0078	1-18-63	A detailed presentation (six enclosures) of the post-operative requirements and load distributions for the E-MAD post-operative core cell. This included detailed test requirements and cell loadings for post-operative examination of a NERVA engine with a B-4 core and was used for expansion of REON Report 2325 into REON Report 2520 "NERVA Post-Operative Requirements and Support Systems Utilization".
1-14-63			Post operative cells metallographic penetrations.
	L741:0006	1-10-63	REON, PNL Report "Handling of Reactors in the Cold Assembly Areas of the E-MAD Facility." This was initiated to establish crane height/operational requirements and then modifying of the operational plan to meet the facility constraint.
8-19-63	MSG. 834		Requirements for minimum penetrations for metallographic and microhardness test equipment (cells 165 and 166).
2-21-63	MSG. 994		Operational requirement for relocation of P-4 drawer and suggested corner utilization.
	L741:0102	3-7-63	Design data for imbedded liners in cell face wall.
3-25-63	MSG. 1286		Requirements for E-MAD Post-Operative Cell Faces plugs

TWX DATE	REON MSG. OR LTR NO.	LETTER DATE	TITLE OR DESCRIPTION
3-22-63			Technical requirements relative to priority of E-MAD windows conforming to procurement increments.
3-26-63	MSG. 1285		Side wall manipulators in E-MAD Balcony.
	L740:0044	4-2-63	Criteria for control and safe operation of Post-Operative doors.
4-12-63	MSG. 792		Requirement for opening in plug doors to provide transfer capability between cells 165-166.
4-22-73	MSG. 942		Requirements for 3-inch diameter pass through conduits at windows on south end of cell service area.
	L741:0162	4-26-63	General Area Safety Warning System for NRDS.
	L741:0186	5-13-63	E-MAD Phase II Safety Review with Encl. (2) "NERVA Operational, Functional and Safety Requirements for E-MAD Building Radiation Monitoring."
	L741:0171	5-2-63	Transmittal of REON sketch 208-1 depicting three alternates for locating 3-inch conduits at windows S-101 and S-102.
	L741:0195	5-17-63	Preliminary outline for E-MAD Shielding Integrity Check.
	L740:0047	5-28-63	REON Recommended Minimum Equipment Lists for E-MAD Machine Shop.
	L740:0048	5-27-63	REON Recommended Minimum Office Equipment List for E-MAD.
	L740:0049	5-27-63	REON Recommended Minimum Equipment Lists for Miscellaneous Shop Tools.
	L740:0050	5-28-63	Recommendations for Minimum Rectilinear Manipulator Systems.

TWX DATE	REON MSG. OR LTR. NO.	LETTER DATE	TITLE OR DESCRIPTION
	L740:0052	6-4-63	Recommended Minimum General Health and Safety; General Purpose Fire Equipment Lists for E-MAD Facility.
	L741:0242	6-27-63	NERVA Operational Requirements for Material Transfer in E-MAD Post-Mortem Cells. (Encl. 1) NERVA Operational Requirements for E-MAD Post-Mortem Door Interlocks and Controls. (Encl. 2) Schematics for E-MAD Post-Mortem Doors. (Encl. 3) NERVA Operational Requirements for the Material Transfer in and the ability of the Post-Mortem Area less Electrical Interlocks.
	L740:0053	6-4-63	Feasibility Study of E-MAD to accommodate NRX (Phase I).
	L740:0057	6-17-63	Material for Proposed Meeting on E-MAD Radiation Monitoring System and Shielding Integrity Check. (Encl. 1) E-MAD Radiation Monitoring System Phase I and II. (Encl. 2) Preliminary Outline for Shielding Integrity Check on E-MAD.
	L740:0059	6-25-63	Feasibility of E-MAD to accommodate NRS (Phase II). (Encl. 1) Estimate of Floor Space Requirements within E-MAD for NRX Processing. (Encl. 2) Estimated Equipment Requirements for processing NRX in the E-MAD facility.
	L741:0249	7-12-63	Feasibility Study of E-MAD to accommodate NRX (Preliminary submittal of Phase III).
	L741:0245	7-3-63	Ray Plot (8) dwgs. for viewing windows in E-MAD.
	L741:0262	7-21-63	Completion of Manipulator Specification Review including total requirements. (Encl. 1) E-MAD Rectilinear Manipulator Technical Backup Data and Total Requirements. (Encl. 2) E-MAD Building-Nuclear Rocket Development Stations, NERVA Operations Guide for Preparation of Procurement Specifications for Bridge Mounted Manipulator Assembly. (Encl. 3) E-MAD Master Slave Manipulator Technical Backup Data and Total Requirements. (Encl. 4) E-MAD Building- Nuclear Rocket Development Station, NERVA Oper- ations Guide for Preparation of Procurement Spec- ifications for Heavy Duty Extended Reach Master Slave Manipulators, Phase I and II.

TWX DATE	REON MSG. OR LTR. NO.	LETTER DATE	TITLE OR DESCRIPTION
	L741:0245	7-3-63	Ray Plots
	L741:0254	7-19-63	E-MAD Viewing - Phase I Results of REON Ray Plots transmitted on July 3, 1963.
	L740:0063	8-15-63	Transmittal of E-MAD Machine Shop Floor Plan and Machine Tool Arrangement Drawing.
	L741:0281	8-28-63	"Effects Cell Plug Doors have on NERVA Operations. (Encl. 1) Chronological list of REON/WANL identification of plug door influence on NERVA referenced operational plan.
	L741:0264	9-13-63	NRX Feasibility Study in book including 19 enclosures.
9-27-63	MSG. 1223		Power Tool Requirements for WMHS - E-MAD.

SCHEDULE OF REON REVIEW COMMENT TWX DATES AND THE
DRAWINGS AND SPECIFICATIONS REVIEWED

<u>REVIEW TWX</u>	<u>DWGS. & SPECS. REVIEWED</u>	<u>REVIEW TWX</u>	<u>DWGS. & SPECS. REVIEWED</u>
1-25-63	16 Drawings	5-20-63	5 Drawings
2-2-63	11 Drawings	5-23-63	29 Specifications
2-5-63	9 Drawings - 1 Spec.	5-31-63	29 Specifications
2-13-63	11 Drawings - 1 Spec.	6-6-63	6 Drawings - 1 Spec.
2-15-63	10 Drawings	6-11-63	11 Drawings
2-26-63	13 Drawings	6-12-63	41 Drawings
2-27-63	6 Drawings	6-17-63	2 Drawings
2-27-63	6 Drawings	6-18-63	16 Drawings
2-28-63	5 Drawings	6-20-63	2 Specifications
3-5-63	1 Specification	6-25-63	4 Specifications
3-6-63	1 Drawing	7-10-63	2 Drawings
3-14-63	7 Drawings	7-15-63	18 Drawings
3-15-63	7 Drawings	7-19-63	2 Specifications
3-19-63	7 Drawings	7-26-63	3 Drawings
3-19-63	1 Sketch	8-21-63	97 Drawings
3-20-63	4 Drawings	8-26-63	28 Drawings
3-26-63	11 Drawings	8-26-63	10 Drawings
3-28-63	7 Drawings	8-27-63	25 G.E. Drawings
4-3-63	3 Drawings	8-30-63	16 G.E. Drawings
4-8-63	8 Drawings	9-13-63	6 Drawings - 1 Spec.
4-15-63	15 Drawings	9-13-63	20 Drawings - 1 Spec.
4-16-63	5 Drawings	9-13-63	R.F.C. 44 Revisions
4-16-63	3 Drawings	9-23-63	5 Drawings - 2 Specs.
4-18-63	3 Drawings	9-23-63	R.F.C. 43 Revisions
4-19-63	23 Drawings	9-23-63	R.F.C. 46 Revisions
4-22-63	7 Drawings - 3 Specs.	9-23-63	Specification 1425-PS-4W
4-25-63	3 Drawings	9-24-63	Relocations of Amplidynes
4-30-63	14 Specifications		per Vitro request
5-1-63	48 Drawings	9-25-63	R.F.C. 34 Revisions
5-13-63	1 Drawing	9-26-63	11 Drawings - 1 Spec.
5-15-63	17 Drawings	9-26-63	2 Drawings - 2 Specs.

SCHEDULE OF LETTERS TRANSMITTING DRAWINGS AND/OR SPECIFICATIONS

MARKED WITH REON REVIEW COMMENTS AND REON REPORT REVIEWS

<u>LETTER NO.</u>	<u>DATE</u>	<u>MARKED DWGS. & SPECS. OR REPORT REVIEWS</u>
L741:0042	10-17-62	Review Comments of Specification 1425-PS-4
L741:0035	1-31-63	16 Drawings
	2-12-63	REON/WANL Review Comments of "E-MAD Facility Phase II Preliminary Design Report" KLX1844 - Marked Copy of Report Air expressed to P. Renas.
L741:0091	2-8-63	10 Drawings - 1 Specification
L741:0127		16 Drawings - 1 Specification
L741:0048	12-4-63	REON/WANL review of "E-MAD Nuclear Shielding Report" KLX1842 preliminary issue End (1) REON Review Comments on E-MAD Shielding Report KLX1842.
L741:0108	3-6-63	12 Drawings
L741:0102	3-7-63	11 Drawings - 1 Specification
L741:0112	3-5-63	9 Drawings
L741:0184	5-14-63	REON preliminary review comments of Vitro Report KLX1842 "E-MAD Facility Phase I Nuclear Shielding".
L741:0136	5-13-63	E-MAD Phase I Safety Review Enclosure (1) Final Drawings and Specifications Safety Review.
L741:0180	5-9-63	63 Drawings - 3 Specifications
L741:0248	7-9-63	Review Comments of Procurement Specification for Manipulator Assemblies
L741:0201	5-27-63	89 Drawings
L741:0241	6-28-63	53 Drawings
L741:0220	6-17-63	16 Specifications
L741:0210	6-7-63	50 Specifications
L741:0244	7-1-63	11 Drawings
L741:0273	8-9-63	2 Drawings - 6 Specifications

BRIEF SUMMARY OF REON MEETINGS WITH SNPO-C

<u>DATE</u>	<u>PARTICIPANTS</u>	<u>PURPOSE</u>	<u>RESULT</u>	<u>MINUTES</u>
10-2 1962	SNPO-C/REON	Establish Justification for E-MAD post-mortem Facilities.	REON was directed to define NERVA operational criteria and facilities utilization.	None
10-3 & 10-4 1962	SNPO-C/Vitro/REON/ WANL	Establish Criteria for Phase II Preliminary Design.	Adequate data was supplied to permit completion of preliminary designs. Also following the meeting, additional data was supplied on Viewing Adequacy, Intercell Railroad Requirement and Instrument Penetration locations, sizes and types.	Vitro Letter of 10-8-62.
11-13 & 11-14-62	SNPO-C/Vitro/REON/ WANL	Evaluate the Scope of Phase II Preliminary Design.	Thirteen action items developed relative to completion of requirements for Phase I and/or equipment. Vitro was authorized to proceed with finalizing the post-mortem cells and office area designs.	Vitro Letter of 11-16-62.
12-11-62	SNPO-C/Vitro/REON/ WANL	Clarify design criteria for various post-mortem cell design considerations.	Vitro authorized to work directly with AMF to resolve OPS interface problems. General arrangement drawings accepted by all with minor stipulations. Cell face provisions require revision to meet requirements and Vitro to proceed with design with minutes as firm design criteria.	Vitro Letter of 12-31-62.
12-19-62	SNPO-C/WANL/REON	Provide further justification of post-mortem cells.	REON was directed to expand justification study of core post-mortem cells and warm engine parts post-mortem.	None
3-12-63	SNPO-C/Vitro/REON	Review E-MAD Phase II Design, Scope of cell growth potential, change room layout, view windows, doors, and HVAC designs and schedule of plans and specifications.	SNPO-C clarified items included in Phase II funding and items deferred from Phase I construction, thus the scope of present design efforts were generally defined.	

BRIEF SUMMARY OF REON MEETINGS WITH SNPO-C

<u>DATE</u>	<u>PARTICIPANTS</u>	<u>PURPOSE</u>	<u>RESULT</u>	<u>MINUTES</u>
3-13-63	SNPO-C/Vitro/REON	Discuss technical provision of Wall Mounted Handling System Proposals.	Although all three proposals had several cases where they did not meet specification none were considered grounds for disqualification, and the merits of each case were to be considered when final recommendations were formally presented to AGC and Vitro.	Vitro Letter of 3-19-63.
4-4-63	SNPO-C/REON	Discuss Post-Operative door interlock safety system, Phase I Shielding Report and Radiation Monitoring Requirements.	It was agreed that REON would conduct a composite safety review of all Phase I drawings and specifications and would formally present NERVA operational, functional and safety requirements for E-MAD radiation monitoring. Both were accomplished by L741:0186 dated 13 May 1963.	
5-14-63	SNPO-C/REON/WANL	Define the procurement status and plans for E-MAD Building and identify funding interfaces.	Program Requirements Handbook was described consisting of PRD, PSP, OR and OD. SNPO-C supplied estimated dates of completion and scope of items procured with Phase I Construction Funds. REON segregated E-MAD FY 64 items into three categories and recommended the non-severable category be given highest priority - REON was directed to evaluate feasibility of NRX Assembly in the E-MAD Facility and to identify the problems, conflicts and additional requirements if any. This effort was to include concurrent NRX and E-Engine operations. REON was to provide Recommended Equipment Lists for procurement with E-MAD 1964 Modification Construction Funds.	REON Letter L741:0206 dated 4 June 1963.

BRIEF SUMMARY OF REON MEETINGS WITH SNPO-C

<u>DATE</u>	<u>PARTICIPATION</u>	<u>PURPOSE</u>	<u>RESULT</u>	<u>MINUTES</u>
6-4 & 6-5-63	SNPO-C/REON/WANL	Radiation Monitoring and Safety Alarm System and clarification of SNPO-C action or decisions relative to REON/WANL review comments previously transmitted for Phase II drawings and specifications.	It was agreed that Radiation Monitoring System did not appear to affect construction and construction drawings for future installation and further decisions on systems design would be made at a forthcoming meeting on 17 June 1963. It was agreed that the requirement for Area Radiation Warning and Alarm for the south end of E-MAD Building was an accepted operational requirement and AGC was to define an audio-visual system. All review comments for Phase II that were transmitted to date were discussed and resolved except for a list of hold items that were in transit.	REON Letter L741:0239 dated 27 June 1963.
6-28-63	SNPO-C/VITRO/REON/WANL	To establish and advise VITRO of changes to be made to Post-Mortem Cell Interlocks and Room 176 service arrangements.	REON presented L741:0242 dated 27 June 1963 on material transfer in the post-mortem cell area. VITRO was instructed to change high density blocks between cells to a contractor furnished and not installed item and temporary partitions are to be installed to balance the HVAC system.	VITRO Letter dated 9 July 1963.
7-1-63	SNPO-C/VITRO/REON/WANL	SNPO-C direction to VITRO relative to review comments and final changes to Phase II design and certified for construction issue of drawings and specifications.	Additions to room 176 were directed as outlined at the March 13 and 14 meeting. VITRO was directed to submit the 700 package refrigeration system for bid and the 200 and 300 packages (Post-Mortem Cells and Office Area) were to be prepared "certified for construction".	VITRO Letter dated 22 July 1963.

3.5 - 10a

BRIEF SUMMARY OF REON MEETINGS WITH SNPO-C

<u>DATE</u>	<u>PARTICIPATION</u>	<u>PURPOSE</u>	<u>RESULT</u>	<u>MINUTES</u>
7-10-63	SNPO-C/SNPO-N/ VITRO/REON	To review with all concerned the 1964 modifications.	Four previously included items were re- moved from the list. Review and request of specific requirements for listed units indicate REON had previously supplied the data in a series of letters transmitting minimum equipment lists. Ascertained that approval of radiation monitoring package dependent on overall site pro- cedure yet to be established.	VITRO letter of 23 July 1963.
8-27 & 8-28-63	REON/VITRO/G.E./ SNPO-C	Review of preliminary design of the WMS - East Wall.	G.E. was to provide commitments for a number of action items and directed to design the trolley drive system in accordance with the specification. The preliminary design submittal was in- complete and is to be completed and resub- mitted by G.E. No designs were approved.	VITRO letter of September 1963.

REON REVIEW ACTIVITIES ON E-MAD PHASE I CONSTRUCTION CHANGES

Incoming Drawings & Specifications

Transmittal of Review Comments

Vitro Letter Date	Date Received	Number of Drawings	Number of Specs.	
2-1-63	2-4-63	16	0	2-13-63
2-20-63	2-22-63	6	0	2-27-63
3-5-63	3-7-63	7	0	3-15-63
3-7-63	3-8-63	7	0	3-19-63
3-20-63	3-21-63	11	0	3-26-63
3-25-63	3-26-63	2	0	4-15-63
3-28-63	4-2-63	8	0	4-3-63
4-1-63	4-4-63	17	0	4-19-63
4-3-63	4-11-63	6	1	4-23-63
4-8-63	4-11-63	4	0	4-17-63
4-15-63	4-16-63	0	1	4-30-63
4-16-63	4-18-63	3	0	4-25-63
5-6-63	5-8-63	1	0	5-11-63
5-10-63	5-16-63	2	0	5-22-63
5-13-63	5-16-63	2	0	5-22-63
5-16-63	5-20-63	8	0	5-22-63
5-21-63	5-24-63	0	1	6-25-63
5-23-63	5-24-63	6	1	6-6-63
5-24-63	5-27-63	0	2	6-25-63
9-3-63	9-5-63	21	1	9-11-63
9-4-63	9-6-63	1	1	9-11-63
9-4-63	9-9-63	0	1	9-11-63
9-25-63	9-30-63	18	1	10-3-63

Response Time: Minimum 2 days
Maximum 21 Days
Average 6.9 days

REON REVIEW ACTIVITIES OF E-MAD POST MORTEM CELLS PRELIMINARY DESIGN

<u>DRAWING NUMBER</u> NUMBER TITLE	<u>TITLE</u>	<u>REVISED</u> <u>DRAWING NUMBER</u>	<u>REVISION</u> <u>NO. & DATE</u>	<u>TRANS.</u> <u>DATE</u>	<u>RECV.</u> <u>REON</u>	<u>APPROVED</u> <u>TRANS.</u>	<u>COMMENTS</u>
1425-K-101	Post-Mortem Cells - Air Flow Diagram	1425-K-201	2/12-21-63	12-21-62	12-26-62	11-14-62 11-30-62 12-11-62	Meeting TWX Meeting
1425-L-101	Post-Mortem Cells - Typical Face of Cell	1425-L-201	2/1-18-63	1-18-63	1-21-63	12-11-62 2-5-63	Meeting TWX
1425-L-102	Post-Mortem Cells - Crane & Manipulator Coverage	1425-R-109	1/5-18-63	3-18-63	3-21-63	12-11-62 4-4-63	Meeting TWX
1425-L-106	Post-Mortem Cells - East & West Face Elevation	1425-L-202	1/1-18-63	1-18-63	1-21-63	12-11-62 2-25-63	Meeting TWX
1425-M-101	Post-Mortem Cells - Piping	1425-M-201	3/1-3-63	1-4-63	1-7-63	1-25-63	TWX
1425-M-102	Post-Mortem Cells - Piping Diagram Waste	1425-M-202	3/1-3-63	1-4-63	1-7-63	1-25-63	TWX
1425-N-101	Post-Mortem Cells - Electrical 1-line Diagram	1425-N-201	4/1-25-63	1-28-63	1-31-63	12-11-62 2-12-63	Meeting TWX
1425-R-124	Post-Mortem Cells - Partial Plans Effect (Schematic 4)						
1425-R-125	Post-Mortem Cells - Partial Plans Effect (Schematic 5)	1425-R-205					
1425-R-126	Post-Mortem Cells - Partial Plans Effect (Schematic 5)	1425-R-207 1425-R-203	2/12-20-62	12-21-62	12-26-62	12-11-62 1-9-63	Meeting TWX
1425-R-128	Post-Mortem Cells - Partial Plans Effect (Schematic 5 alt.)						
1425-R-129	Post-Mortem Cells - Exhaust Piping and Fans	1425-K-209	2/2-3-63	2-11-63	2-14-63	12-11-62 2-27-63	Meeting TWX

3.5 - 13a

Response Time: Minimum
Maximum
Average
7 days
24 days
11.9 days

REON REVIEW ACTIVITIES ON E-MAD POST MORTEM CELLS FINAL DESIGN

Incoming Drawings & Specifications

Transmittal of Review Comments

Vitro Letter Date	Date Received	Number of Drawings	Number of Specs.	
1-4-63	1-7-63	11	0	1-25-63
1-4-63	1-7-63	1	1	2-5-63
1-13-63	1-21-63	8	0	2-5-63
1-28-63	1-31-63	11	1	2-13-63
2-4-63	2-7-63	10	0	2-21-63
2-4-63	2-7-63	2	0	2-27-63
2-11-63	2-14-63	5	0	2-27-63
2-11-63	2-14-63	1	0	3-6-63
2-14-63	2-18-63	3	0	2-27-63
2-15-63	2-19-63	0	1	3-6-63
2-18-63	2-19-63	4	0	2-23-63
2-20-63	2-22-63	5	0	3-15-63
2-27-63	3-1-63	2	0	3-15-63
3-4-63	3-6-63	4	0	3-18-63
3-13-63	3-21-63	5	0	4-4-63
3-21-63	3-25-63	3	0	4-9-63
3-25-63	3-26-63	10	0	4-15-63
4-1-63	4-4-63	1	0	4-19-63
4-2-63	4-4-63	4	0	4-17-63
4-2-63	4-5-63	2	0	4-15-63
4-2-63	4-5-63	1	0	4-19-63
4-3-63	4-5-63	9	1	4-30-63
4-4-63	4-5-63	1	0	4-17-63
4-4-63	4-5-63	0	2	4-23-63
4-5-63	4-9-63	2	0	4-17-63
4-8-63	4-10-63	2	0	4-17-63
4-13-63	4-22-63	24	0	5-1-63
4-19-63	4-23-63	27	0	5-1-63
4-23-63	4-25-63	0	15	5-23-63
4-23-63	4-25-63	0	11	5-31-63
4-24-63	4-26-63	12	0	5-15-63
4-24-63	4-26-63	22	0	5-15-63
4-24-63	4-26-63	8	0	6-14-63
4-24-63	4-29-63	7	0	6-14-63
4-25-63	4-29-63	11	0	6-11-63
4-25-63	4-29-63	10	00	6-14-63
4-29-63	5-1-63	7	0	6-14-63
4-29-63	5-1-63	14	0	6-19-63
5-3-63	5-6-63	0	7	5-23-63
5-3-63	5-6-63	0	22	5-31-63
5-3-63	5-6-63	0	2	6-20-63
5-21-63	5-24-63	2	1	6-19-63
5-24-63	5-27-63	1	0	6-25-63

Response: Minimum 5 days
Maximum 39 days
Average 15.1 days

REON REVIEW OF PHASE II

"CERTIFIED FOR CONSTRUCTION" DRAWINGS

VITRO LTR. DATE	RECEIVED DATE	NUMBER DRAWINGS	REVIEW TRANS. DATE
6-27-63	7-2-63	18	7-17-63
7-19-63	7-25-63	3	7-26-63
8-5-63	8-7-63	97	8-21-63
8-5-63	8-7-63	19	8-26-63
8-13-63	8-19-63	24	8-26-63
8-16-63	8-20-63	1	8-26-63

Response Time: Maximum 14 days
Minimum 1 day
Average 7 days

BIBLIOGRAPHY FOR
SUBTASK 3.5
E-MAD

CORRESPONDENCE FROM SNPO-C

TWX	LETTER	DATE	SUBJECT
	X	10-9-62	Recommended Simplified Warning and Alarm System.
X		10-10-62	Warm Machine Shop.
X		10-10-62	Recommended Method of Handling the Core.
	X	10-11-62	Post-Mortem Cell Criteria Required.
	X	11-2-62	Request for Proposal SNPO-C-56564, Addendum #1 Wall Mounted Handling Systems.
	X	11-8-62	Evaluation of Wall Mounted Handling System.
	X	11-20-62	NERVA Post-Operative Requirement and Support System Utilization.
	X	11-23-62	E-MAD Shielding
X		1-22-63	NASA Review of Preliminary Drawings.
X		2-6-63	Review of Vitro Phase II Preliminary Design Report.
X		2-6-63	Quality Assurance for the Wall Mounted Handling System.
	X	2-26-63	VITRO JOB 1425 - Post-Mortem Cell Shielding Windows.
X		2-27-63	Priority on Viewing Windows.
X		2-28-63	Phase II Post-Mortem Cells - Selection of Doors.
X		3-6-63	Meeting - Review of Phase II E-MAD Design.
X		3-11-63	Design Review Meeting
X		3-12-63	Provisions for Elimination of Hazard from Runaway U Cars from the Railroad.

CORRESPONDENCE FROM SNPO-C

TWX	LETTER	DATE	SUBJECT
	X	3-21-63	Argonne Comments on the E-MAD Facility.
	X	3-22-63	E-MAD Facility, Phase II.
X		3-27-63	WMHS Bidders Comments.
X		3-28-63	Information Required for Wall Mounted Handling System.
X	X	3-29-63	G.E. and G.M.I. Answers Addendum #4 of WMHS.
		4-1-63	Trade Windows.
	X	4-2-63	E-MAD Facility, Phase I, Safety Review and Report.
X		4-8-63	Budget Laboratory Time Equipment for E-MAD CY 64.
	X	4-15-63	E-MAD Facility, Phase II, Post-Mortem Cells, Proposed REON Door Interlock Schematic, Etc.
	X	4-18-63	Review of E-MAD, Phase II, Preliminary Drawings.
	X	4-18-63	Hot Box Facility at NTS.
	X	4-19-63	Scheduling of E-MAD Phase II Design.
	X	4-23-63	Phase II Post-Mortem Cell Viewing Window Size.
	X	4-24-63	E-MAD Facility, Phase II, HVAC Comments.
	X	4-26-63	Phase II Construction Drawings, Review of
	X	4-30-62	E-MAD Facility Viewing Window Priority Assignment.
	X	5-2-63	E-MAD Post-Mortem Cell Door and Lock.
	X	5-10-63	OPS Arrangement Drawings.
	X	5-13-63	Side Wall Manipulators Mounting E-MAD Building.
	X	5-17-63	Review of Additional Funds for Design and Construction of the E-MAD Building.
X		5-20-63	E-MAD 1964 Modifications
	X	5-27-63	E-MAD Vendor Drawings.

CORRESPONDENCE FROM SNPO-C

TWX	LETTER	DATE	SUBJECT
	X	5-27-63	E-MAD, AGC Phase II Design Review.
	X	5-27-63	Phase II E-MAD.
	X	5-29-63	Change Order Procedure.
	X	6-13-63	E-MAD Facility, OPS Design Data Interface.
	X	6-13-63	E-MAD Viewing Windows.
	X	6-14-63	ETS-1 and E-MAD Phase II PERT Report.
X		6-19-63	Proposed Meeting on E-MAD Radiation Monitoring System and Shielding Integrity Check.
	X	6-18-63	E-MAD Facility, OPS Design Data Interfacing.
X		6-19-63	E-MAD 200 Series Drawings, Hot Cells.
	X	6-20-63	E-MAD Phase II Safety Review.
	X	6-20-63	E-MAD 1964 Modification, Wall Handling System (West Wall).
	X	6-21-63	E-MAD Certified Print Distribution.
	X	6-26-63	E-MAD, Wall Mounted Handling System, West Wall Units.
X		6-27-63	E-MAD, Phase II.
	X	7-1-63	E-MAD, Phase II, Post-Mortem Plug Door Removal Plug Provisions.
	X	7-2-63	E-MAD, Phase II, Post-Mortem Plug Cell Door, Removal Plug Provisions.
	X	7-3-63	E-MAD, 1964 Modifications Railroad Remote Control Switches.
X		7-11-63	Technical Direction Meeting.
	X	7-13-63	E-MAD Building, Hook Travel Overhead.
	X	7-16-63	E-MAD Vendor Data Distribution.

CORRESPONDENCE FROM SNFO-C

TWX	LETTER	DATE	SUBJECT
	X	7-16-63	Vendor Drawing Distribution, CATCO Construction.
	X	7-18-63	E-MAD Facility Coordination with OPS.
	X	7-26-63	Radioactive Material Handling, Decontamination and Storage Complex.
	X	8-6-63	REON Report No. 2592.
	X	8-12-63	E-MAD Facility, 1964 Modifications, Radiation Monitoring System.
	X	8-12-63	Machine Shop Layout, Review of
X		8-12-63	ETS-2 Schedule.
X		8-9-63	Rectilinear Manipulator/Procurement Specification and Master Slave Manipulator/Procurement Specification.
X		8-13-63	Wall Mounted Handling System, East Wall.
	X	8-14-63	Wall Mounted Handling System for E-MAD.
	X	8-14-63	E-MAD 1964 Modifications, Criteria Requirements.
	X	8-15-63	E-MAD 1964 Modifications, Engineering Schedule.
	X	8-15-63	E-MAD AGC Remote Handling Equipment Interface Control Drawings.
	X	8-16-63	E-MAD, Phase II, 1964 Modifications, Rectilinear and Master Slave Manipulator Specifications.
	X	8-21-63	E-MAD, Procedures for Changing to Existing Construction Contracts.
	X	8-22-63	E-MAD, Phase I, Package H Hot Disassembly Bay.
	X	8-23-63	E-MAD, 1964 Mods. West Wall Units.
	X	8-26-63	E-MAD, 1964 Modifications - AGC Statement "Salient Commitment Requiring Response".
X		8-28-63	E-MAD Scheduling Information.
	X	9-4-63	E-MAD Facility 1964 Modifications - Machine Shop.

CORRESPONDENCE FROM SNPO-C

TWX	LETTER	DATE	SUBJECT
	X	9-5-63	E-MAD Facility 1964 Modifications, Machine Shop.
	X	9-5-63	E-MAD, Phase II Scope Drawings.
	X	9-9-63	E-MAD, Phase II Drawings and Specifications.
	X	9-9-63	E-MAD, Phase II AGC Review of Certified for Construction Drawings.
	X	9-18-63	E-MAD 1964 Modifications - Radiation Monitoring System.
X		9-19-63	E-MAD Facility 1964 Mods. - Engineering Cost Estimate.

S/T 3.6 REACTOR DEVELOPMENT FACILITY

ACCOMPLISHMENT

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-3.6(I) SUPPORT TO SNPO-C	(a) PROVIDE ANALYSIS AND STUDIES AS REQUESTED	(a) PERFORMED	(a) REON REPORT 2433 DTD 12/28/62 WANL TME 097 WANL TME 279 WANL TME 340 WANL TME 374 REON REQUEST*2703 DTD 9/63
2-3.6(I) DEVELOP FACILITIES REQUIREMENTS	(a) PRODUCE REQUIREMENTS AS REQUESTED	(a) PERFORMED	
2-3.6(I) REVIEW DOCUMENTS	CONDUCT REVIEWS AS REQUESTED	PERFORMED	(SEE TASK I.1)
2-3.6(I) ASSIST C/O AND ACTIVATION	PROVIDE TECHNICAL ASSISTANCE AS REQUESTED	PERFORMED	PREPARED AND ISSUED FOR APPROVAL 12 FACILITIES MANUALS

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.6 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. A study was conducted to evaluate Test Cell "A" utilization as an interim stand for E-Engine testing. This effort was reported in REON Report 2433, 28 December 1962. The results of the study indicated feasibility of using TCA for this purpose with only nominal modifications.

b. NRX documentation was reviewed to assess the adequacy of Test Cell "A" support and for coordination and dissemination of data. Pertinent reports evaluated were (1) the NRX-A-1 test plan, WANL TNR 097; (2) NRX-A-1 test specification, WANL TNR-121; (3) NRX-A-1 Operational Support Plans, Rev. 1. Results of these reviews have been consolidated in overall planning efforts.

c. NRX operational planning was evaluated in order to define facility adequacy. Test duration studies at Test Cell "A" initiated by WANL and presented by WANL TME-279 and 340 were reviewed to establish the magnitude of modification of Test Cell "A" during CY 1963 was impractical due to (a) lead time required and (b) potential effects on the LASL and early NRX tests. This subject was discussed during the May Coordination Meeting with SNPO-C.

As a result of the above efforts, certain modifications which could be accomplished without undue influence on test operations were authorized by SNPO-C during CY 1963.

d. Preliminary studies were conducted to determine the feasibility of providing a single phase propellant feed system as required for controlling the hydrogen propellant temperature of the reactor inlet. Coordination with LASL and evaluation of the LASL mixing chamber tests were initiated. Evaluation of WANL TME 374 which described the desired characteristics of the mixing system was made.

2. Develop Facility Requirements

Liaison with SNPO-C, WANL and test site organizations has been maintained to assure compatibility of proposed modifications to Test Cell "A" with the NRX test program and to assure the functional, operational, and safety adequacy of the Reactor Development Facility developed under this program.

Several major coordination meetings were held during the year with SNPO-C, REON, WANL and IASL personnel. These meetings provided management support, program review, and technical coordination and direction for developing the requirements for and scheduling modifications of Test Cell "A" for the NRX program. Pertinent meeting schedules and topics are listed in the bibliography. Minutes of meeting at SNPO-C regarding a Review of Test Cell "A" Instrumentation, Data Reduction and Data Acquisition were published as REON Report 2703, dated 30 September 1963.

3. Review Documents

All appropriate NRX documentation and test planning data coordinated under Subtask 1.1 was subject to review by Subtask 3.6 to assess the influence of the test planning on facility capability and to provide data necessary to assess proposed facility modifications.

The results of these reviews have been coordinated and incorporated by Subtask 1.1 as applicable.

4. Assist Checkout and Activation

Drafts of various NRDS Test Cell "A" facility documents and operations procedures were prepared and/or released during CY 1963. The effort associated with this activity was shared by Subtasks 3.6 and 1.8 during CY 1963. Documents were prepared under the direction and cognizance of NTO management. Typical examples are:

- a. LH_2 Fill Station, TCA
- b. GH_2 Fill Station, TCA
- c. He Fill Station, TCA

- d. N₂ Fill Station, TCA
- e. Vacuum System, TCA
- f. Flare System, TCA
- g. Room Inert, TCA
- h. Hydraulic System, TCA
- i. Compressed Air, TCA
- j. Reactor Shed, TCA
- k. LH₂ Turbopump, TCA
- l. Test Cart Cooling System, TCA

A complete listing is contained in the bibliography for Subtask 1.8. These documents will be used by NTO test site personnel for indoctrination and facility operations. This task represented a major activity during CY 1963.

Conclusion

In conclusion, the efforts conducted during CY 1963 on this subtask have fulfilled the objectives of the work statement and program requirements leading toward an adequate capability for testing the NRX reactors.

SUBTASK 3.6 - BIBLIOGRAPHY

REACTOR DEVELOPMENT FACILITY

CORRESPONDENCE	DATE	SUBJECT
WANL-TME-374	6-6-63	"Performance Criteria for an NRX-A Propellant Feed System Using Wiring Chamber Principle.
WANL-TME-279	5-3-63	Recommended Modifications to Extend Test Cell "A" Capabilities for NRX Testing.
WANL-TME-340	5-6-63	Request for Test Cell "A" Modifications.
WANL-TNR-097		Preliminary NRX-A1 Test Plan
WANL-TNR-212	8-63	NRX-A1 Test Specification
REON 2433	12-62	Utilization Study of TCA as interim stand for E-Engine testing.
REON/LRP	1-19-63	NRX-A2 Operations Support Plan.
REON- 2703	1-63	Summary of NERVA Instrumentation Review Meeting at SNPO-C - August 3, thru 15, 1963.
NRDS-TCA Documentation		
RN-FOP-0001		LH ₂ Fill Station
RN-FOP-0003		He ³ Fill Station
RN-FOP-0004		GN ₂ Fill Station
RN-FOP-0006		Vacuum System
RN-FOP-0008		Flare System
RN-FOP-0009		Room Inert
RN-FOP-0011		Compressed Air
RN-FOP-0012		Reactor Shed
RN-FOP-0013		LH ₂ Turbopump
RN-FOP-0014		Craft Cooling System
RN-FOP-0015		Dowar Deluge System
RN-FM-0001		Facility Familiarization Manual
741:MO412	4-15-63	"Test Cell "A" - Signal Conditioning & Recording Capabilities. D.E. Bridenstine to D.L. Limbacher.
740:MI087	7-30-63	"Review Comments NRX-A1 Test Specification" M. J. Neder to B. Mann.
737:LO134	8-23-63	"NRX-A1 Test Specification (Rough Draft) Review" Stinnett to Faught.
REON review form	9-6-63	"NRX-A1 Test Specification (Smooth Draft) Review".
REON review form	9-63	"NRX-A2 Test Plan Rough Draft Review".

TECHNICAL MEETINGS

MEETING DATE	WITH	TOPIC
10-25-62	WANL/REON/ SNPO-C	Progress & Status Planning for Test Coll "A" Test Requirements & Duration.
11-29-62	WANL/REON/ LFP/SNPO-C	(1) Describe AGC measurement requirements for NRX-A1. (2) Establish AGC/WANL/ACFI instrumen- tation form for NRX-A1. (3) Determine action items for NRX-A1 instrumentation. REF. (a) WANL minutes. (b) 733:MO133, 3 December 1962, Siev to Yoder.
3-20-63	REON/WANL/ SNPO-N/ SNPO-C/ SNPO-W/ LASL	Recommended Modifications to Exhaust Test Coll "A" Capabilities for NRX Testing (WANL-TME-279) REF. (a) WANL, Poindexter to Reilly SNPO-C, 28 March 1963. Note: Official minutes by SNPO-C, LASL
3-25 & 3-26-63	REON/WANL/ LRP	NRX-A1 Instrumentation. REF. (a) 737:M3063, 9 April 1963, Mann to Evleth.
4-26-63	REON/NTO	Preliminary Test Coll "A" Propellant Line Re- location. REF. (a) 741:MO437, 2 May 1963, Bridenstine to Weisul.
5-8 & 5-9-63	REON/SNPO- N,W,C/ LASL/WANL	NRX-A1 program review meeting. REF. (a) Faught (WANL) to Miller (AGC) 14 May 1963. (b) 741: MO457, 15 May 1963, Bridenstine to Weisul.
9-13 to 9-15-63	SNPO-C/ REON/LASL/ WANL/LEWIS	Instrumentation, Data Acquisition & Data Reduction Review for NRX-A Testing at NRDS (REON/WANL Report 2703).

S/T 3.7 RADIATION EFFECTS FACILITY

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.7(1) SUPPORT TO SNPO-C	(a) PROVIDE UPDATED REQUIREMENTS AS REQUESTED	(a) PERFORMED	(a) L741:0188 DTD 5-15-63 L741:0247 DTD 7-11-63 L741:0250 DTD 7-11-63 L741:0274 DTD 8-7-63
	(b) PROVIDE INTERFACE DRAWINGS	(b) PERFORMED	(b) AGC DWG. # 700269
	(c) MAINTAIN TECH. LIAISON WITH SNPO-C AND A&E COORDINATION ASSISTANCE	(c) PERFORMED	(c) L740:0046 DTD 5-2-63 TWX 741:162 DTD 9-10-63 SEE BIBLIOGRAPHY TECH MEETINGS
2-3.7(1) DOCUMENT REVIEW	(a) REVIEW A&E PRODUCED DWGS, SPECS & REPORTS AS REQUIRED	(a) PERFORMED	(a) L741:0238 DTD 7-2-63 L741:0306 DTD 9-26-63 L741:0188 DTD 5-15-63
2-3.7(1) ACTIVATION PLANNING	(a) ASSIST AS REQUIRED IN PREP. OF ACTIVATION AND C/O OF REF	(a) PERFORMED	
SPECIAL REQUEST SNPO-C 5-22-63	(a) PREPARE DATA ACQUISITION REQUIREMENTS DOCUMENT AND ROM COST STUDY FOR REF	(a) COMPLETED	(a) L741:0270 DTD 8-5-63

ROCKET ENGINE OPERATIONS - NUCLEAR

SUBTASK 3.7 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. "Provide Updated Requirements as Requested"

These requirements were submitted to SNPO-C in the following documents:

L741:0188, dated 15 May 1963, "REON comments to SNPO-C document 'revised technical and test objectives for NARF'"

This letter made corrections to and stated additional requirements to those requirements established by SNPO-C for the initial direction of the A&E.

L741:0247, dated 11 June 1963, "Propellant feed system operating temperature"

This letter established the pump and turbine discharge temperature requirements to be reflected in the facility.

L741:0247, dated 11 July 1963, "REON comments to SNPO-C ref redirection"

SNPO-C directed that the facility would be sized for a 10 minute run capability, in lieu of the 20 minute run capability.

REON's letter indicated that no questionable or adverse test results would be produced as the result of this redirection.

L741:0250, dated 11 July 1963, "Facility minimum startup requirements for PFS tests at NARF"

This letter established the flow, pressure and temperature requirements for pump and turbine inlets based on a 20 second startup.

L741:0274, dated 7 August 1963, "REON non-concurrence of SNPO-C proposal for horizontal mounting of PFS at NARF"

This letter stated that test results would be inconclusive if the PFS was mounted horizontally for tests at NARF.

b. "Provide Interface Drawings"

AGC Drawing No. 700296 "Preliminary Propellant Feed System Interface Control Drawing"

This drawing established the location of the hardware, the primary dimensions, and the interface location of all lines and harnesses that will be part of the test article.

c. "Maintain Technical Liaison with SNPO-C and A&E Coordination Assistance"

Five technical coordination meetings were attended as requested by SNPO-C for direct communication with General Dynamics/Fort Worth, and Kellogg/EG&G. (See bibliography for summary of technical coordination meetings.) Examples of this coordination are:

L741:0046, dated 2 May 1963, "REON procedure for processing Task 3.7 (Ref) A&E information requests and drawing review"

This procedure established the communication channels to be followed and the manner in which information would be submitted and drawing reviews conducted. Basically all communication to and from the A&E would be through SNPO-C.

TWX 741:162, dated 10 September 1963, "REON answers to M. W. Kellogg questions presented in Letter No. 13"

This TWX supplied information concerning the following:

- (1) Turbine backpressure
- (2) Turbine inlet temperature for full run and short periods
- (3) LH₂ inlet flow rate variances and rate of variance
- (4) Pump suction control response
- (5) Operating time for the turbine inlet scram valve.

2. Document Review

a. "Review A&E Produced Drawings, Specifications and Reports as Required"

Two packages of the M. W. Kellogg Company ref design material composed of drawings, reports, documents and specifications were received from SNPO-C by REON during CY 1963.

(1) Package 1 identified as Job 6029, No. 2425 consisted of:

- (a) Preliminary process schematic
- (b) Process description
- (c) Major component specification chart

REON's review comments and recommendation were presented at a review meeting held at SNPO-C in June and became part of the minutes of that meeting. (Ref: L741:0238, dated 2 July 1963)

(2) Package No. 2, "Process Specification (for approval) NARF Modification Program, Fort Worth, Texas," Job 6020, dated 16 August 1963.

REON's review comments and recommendations of this package were submitted to SNPO-C as enclosures to L741:0366, dated 26 September 1963.

3. Activation Planning

- a. "Assist as Required in Preparation of Activation and Checkout of Ref"

The facility design progress did not warrant initiation of activation planning during CY 1963; however, informal discussion with SNPO-C regarding operational responsibilities and internal REON planning has been accomplished.

4. Special Requests

- a. "Prepare Data Acquisition Requirements Document and ROM Cost Study for Ref"

L741:0270, dated 5 August 1963, "Preliminary Data Acquisition and Control System Requirements"

REON was requested by SNPO-C to prepare the data acquisition and control system requirements for PFS testing at NARF and to include a ROM cost estimate for the design, fabrication, procurement, installation, and checkout of such a system.

The data acquisition system, presented in REON Report 2319A, dated 1 October 1962, was based on the understanding that certain data acquisition capability existed at NARF which would require only minor supplemental equipment for PFS testing.

Since that time, we have been informed that this capability does not exist which required that our original requirements had to be expanded.

The data acquisition system as described consists of 165 channels to be recorded on analog tape, digital, oscillograph and strip chart equipment presents the direction that the NARF DAS shall be comparable to the LRP DAS which is to be employed for non-nuclear PFS development tests.

The control system described in L741:0270, also stated the functions of the test article and the facility that will be controlled by the PFS control console and the manner in which this control will be accomplished.

Conclusion

In conclusion, the efforts completed by REON under this subtask have met all of the defined SNPO-C requests and have aided materially in timely SNPO-C direction of the Ref program.

SUBTASK 3.7 - BIBLIOGRAPHY

RADIATION EFFECTS FACILITY

Correspondence to SNPO-C - TWX

<u>TWX No.</u>	<u>Date</u>	<u>From</u>	<u>To</u>	<u>Subject</u>
741:032	4-26-63	WD Stinnett	RW Schroeder	Review Comments Submittal Date
741:055	5-31-63	WD Stinnett	RW Schroeder	Target Date DA Requirements
741:058	6-5-63	WD Stinnett	RW Schroeder	Submittal Dates
741:070	6-14-63	LE White	JB Stauffer	Telecon Confirmation
741:079	6-21-63	JR Campbell	JB Stauffer	Telecon Confirmation
741:081	6-24-63	JR Campbell	JB Stauffer	Telecon Confirmation
741:089	7-1-63	WD Stinnett	RW Schroeder	Interface Drawing Date
741:090	7-1-63	JR Campbell	JB Stauffer	Telecon Confirmation
741:122	7-31-63	JR Campbell	JB Stauffer	Telecon Confirmation
741:140	8-23-63	JR Campbell	JB Stauffer	Telecon Confirmation
741:156	8-30-63	HJ Rosso	JB Stauffer	Telecon Confirmation
741:162	9-10-63	WD Stinnett	RW Schroeder	Answers to Kellogg Questions

Correspondence from SNPO-C - TWX

<u>TWX No.</u>	<u>Date</u>	<u>From</u>	<u>To</u>	<u>Subject</u>
	5-16-63	JB Stauffer	JR Campbell	Telecon Confirmation
101	6-10-63	RW Schroeder	WC House	Design Review Meeting
181945Z	7-18-63	RW Schroeder	WC House	LRP Visit Request

Correspondence to SNPO-C - LETTERS

<u>Letter Number</u>	<u>Date</u>	<u>From</u>	<u>To</u>	<u>Subject</u>
L740:0046	5-2-63	WC House	RW Schroeder	REON Operating Procedure
L741:0181	5-10-63	WC House	RW Schroeder	Telecon Confirmation
L741:0188	5-15-63	WC House	RW Schroeder	Review Comments SNPO-C Document
L741:0191	5-20-63	WC House	RW Schroeder	Telecon Confirmation
L741:0192	5-20-63	WC House	RW Schroeder	Telecon Confirmation
L741:0193	5-20-63	WC House	RW Schroeder	Telecon Confirmation
L741:0197	5-22-63	WC House	RW Schroeder	Telecon Confirmation
L741:0204	5-29-63	WC House	RW Schroeder	Telecon Confirmation
L741:0214	6-11-63	WC House	RW Schroeder	Facility Operating Temperatures
L741:0215	6-11-63	WC House	RW Schroeder	Telecon Confirmation
L741:0247	7-11-63	WC House	RW Schroeder	Comments to SNPO-C Redirection
L741:0222	6-14-63	WC House	RW Schroeder	Telecon Confirmation
L741:0250	7-11-63	WC House	RW Schroeder	Facility Startup Requirements
L741:0263	8-2-63	WC House	RW Schroeder	Cover Letter Interface Drawing
L741:0270	8-5-63	WC House	RW Schroeder	Data Acquisition Requirements
L741:0274	8-7-63	WC House	RW Schroeder	Non-concurrence Horizontal Mounting
L741:0306	9-26-63	WC House	RW Schroeder	Review Comments to Design Material

CORRESPONDENCE FROM SNPO-C

LETTER NO.	DATE	SUBJECT	FROM	TO
FDG:JBS	8 May	Information Requested by A&E	RWSchroeder	WCHouse
FDG:JBS	10 June	Transmittal Design Material	JBStauffer	JRCampbell
	1 July	SNPO-C Minutes of Meeting	JBStauffer	JRCampbell
	21 Aug	Transmittal of Design Material	JBStauffer	JRCampbell
	29 Aug	Kellogg Transmittal of Design Material	DAMemegaz	JLCarton

TECHNICAL MEETINGS

MEETING NO. 1

24 April - REON, SNPO-C, M. W. Kellogg, GD/FW Meeting at

SNPO-C, Ref: L740:0045, 5-3-63

This meeting established the communication channels to be followed in the interchange of information concerning the creation of the cryogenics facility at NARF under Task 3.7. Basically, this agreement said that all information will be transmitted through SNPO-C. All communication directed at REON would be through the 3.7 Task Manager. This agreement did not alter the communication channels previously established for other tasks, such as 1.2 and 1.9, but provided for the 3.7 Task Manager to be informed of activities in these tasks.

During this meeting, REON received copies of the SNPO-C document "Revised Technical and Test Objectives for NARF," which is the basis for the M. W. Kellogg design of the facility.

MEETING NO. 2

May 22, 23 - REON, SNPO-C, M. W. Kellogg, GD/FW, EG&G, and LRP

Meeting at Azusa, Ref: L741:0211

a. REON presented corrections, comments to SNPO-C document, "Revised Technical and Test Objectives for NARF."

b. SNPO-C made the following design schedule statement, "Preliminary design completed approximately 1 September 1963 - Final design completed approximately 1 November 1963."

c. REON went on record with the following statement, to which there hasn't been an acceptance or denial by SNPO-C. "Because of the complexity of the tests to be performed upon the NERVA Propellant Feed System at NARF, REON will supply key technical personnel for activation and checkout of the facility and to install hook-up and checkout prior to test and test the Propellant Feed System."

d. Basic ground rules for participant responsibilities were established for the facility, test article, Data Acquisition and Control Systems.

e. Basic facility operating requirements were established.

MEETING NO. 3

June 18, 19, 1963 - REON, SNPO-C, GD/FW, M. W. Kellogg, EG&G,
Lewis Lab., IRP Meetings at SNPO-C (Ref.
L741:0238)

Purpose: Review of Kellogg process flow diagram.

a. SNPO-C made the following redirection of REF.

(1) Facility to be sized for a 10-minute run capability.

(2) Facility startup requirements to be the same as ASTR

but not to exceed 20 seconds.

(3) NPSP need not be held to the steady state figure during startup and shutdown transients.

b. REON requested by SNPO-C to provide facility startup and shutdown curves.

c. Kellogg directed to proceed with design based on 10-minute run time and sizing "Level Pot"/"Run Tank" at minimum required to meet PFS requirements. The "Run Tank" is a large area in the line directly upstream

of the inlet to the tank shut-off valve, used to stabilize flow and pressure prior to entering the pump.

MEETING NO. 4

June 26, 1963 - REON, LRP, M. W. Kellogg, PFS Interface Meeting
at LRP (Ref. L741:0243).

The following agreements were reached:

- a. All AGC supplied lines, harnesses, etc. will terminate at a point adjacent to the thrust structure attachment.
- b. All disconnects will be in the same plane and emerge in the same general direction.
- c. AGC will provide both halves of all disconnects for PFS to test stand.
- d. Kellogg to proceed with design following these ground rules.

MEETING NO. 5

July 23, 24 - REON, SNPO-C, M. W. Kellogg, GD/FW, LRP Meeting at
LRP, (Ref. L741:0269).

REON requested by SNPO-C to provide answers to the following:

- a. In conjunction with the startup and shutdown curves presented by REON it will be necessary to know the rate of change and magnitude of change required during a test run of the pump inlet pressure and flow.
(answered 9-10-63 - TWX 741:162)
- b. What is the maximum time allowed for cutoff of turbine inlet gas flow to shutdown the TPA in an overspeed condition. (answered 7-11-63 - L741:0250)

c. The present state of the art of hardware design and materials available will not allow inlet conditions of hot gas to the turbine above 1850°F. REON's requirement of 2000°F cannot be attained at this time.
(answered 9-10-63 - TWX 741:162)

S/T 3.8 NRDS RAD MATL COMPLEX

HANDLING, DECON. & STORAGE COMPLEX ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.8 (1) SUPPORT TO SNPO-C	(a) PROVIDE AS REQUIRED UPDATED REQUIREMENTS (b) MAINTAIN TECH LIAISON WITH SNPO-C & OTHERS (c) PERFORM SPECIAL STUDIES AS REQUESTED	(a) PERFORMED (b) PERFORMED (c) PERFORMED	(a) AGC REPORT #2584 DTD 6-17-63 (b) SEE BIBLIOGRAPHY TOTAL 121 COMMUNICATIONS (c) SEE BIBLIOGRAPHY (MEETINGS)
2-3.8 (2) DESIGN CRITERIA	(a) PROVIDE CRITERIA, PLANNING DATA AND ROM COSTS FOR REF FACILITIES	(a) COMPLETED	(a) AGC REPORT #2592 DTD 6-25-63 AGC REPORT #2603 DTD 6-25-63 AGC REPORT #2603 (REV) DTD 8-22-63
2-3.8 (3) DOCUMENT REVIEW SPECIAL REQUEST SNPO-C 8-1-63	(a) PERFORM REVIEWS OF DRAWINGS, SPECS, REPORTS AS REQUIRED (a) CONDUCT REEVALUATION OF FACILITY SITING	(a) PERFORMED (a) COMPLETED	(a) L741:0308 DTD 9-13-63 MINUTES OF TECH MEETING #6 8-23-63

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.8 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. Updated Requirements

REON delineated NERVA operational, functional, and safety requirements for the radioactive materials handling, decontamination and storage facility capability at NRDS in REON Report No. 2584. This report was informally submitted on 5 April 1963 at Meeting No. 1 and, following revision in accordance with SNPO-C comments, was published on 17 June 1963 (Ref: Bibliography).

b. Technical Liaison

Technical liaison was maintained with SNPO-C, sub-contractors, NTO and related subtasks to assure the functional, operational, and safety adequacy of the design criteria developed under the subtask. The effort involved six technical coordination meetings with SNPO-C and produced 48 letters, 37 TWXs, and more than 30 telecons (Ref: Bibliography).

c. Special Studies

During the development of the design criteria and conceptual designs, special studies were conducted and reported in technical meetings. Typical of these studies are listed below (see Bibliography).

- (1) Evaluation of decontamination pad location
(741:0219 dated 14 June 1963)
- (2) Facilities siting studies
(741:0194 dated 21 May 1963)
- (3) Cost study of three spent fuel storage concepts
(741:0219 dated 14 June 1963)
- (4) Radiation analysis of spent fuel storage concept
(741:0223 dated 14 June 1963)

2. Design Criteria

REON was requested to prepare design criteria for the radioactive materials complex facilities and the engine transport system maintenance building at Meeting No. 1, held in Cleveland on 5 April 1963 (L741:0155 dated 23 April 1963).

Reports No. 2592 and 2603 were submitted on 25 June 1963 for the above facilities in full satisfaction of this milestone.

Report No. 2603, ETSMB design criteria, was subsequently revised in accordance with SNPO-C comments and published on 22 August 1963. As a result of SNPO-C direction, associated with the NRX feasibility study, this document is to be revised during CY 1964 to incorporate NRX requirements.

Final publication of Report No. 2592 was deferred to CY 1964 by SNPO-C pending further direction.

3. Document Review

No design review was required during the contract year.

4. Special Requests

Siting Study

A siting study was undertaken in response to the SNPO-C request of 1 August 1963. This effort involved site inspection and the development of three new drawings showing alternate facility layouts and plot plans.

The results of this study were presented to SNPO-C at Technical Meeting No. 6 and by letter L741:0308 dated 13 September 1963. After this meeting a meeting was called at SNPO-W for resolution of the site location. As a result of this meeting an alternate site location proposed by SNPO-C/REON was selected.

Conclusion

In conclusion, the effort expended by REON on Subtask 3.8 has resulted in complete fulfillment of all requirements and requests in a manner which provided required information for A&E services. The siting relocation for the

RMHDS and the NRX feasibility study will require some further revision of the criteria generated.

SUBTASK 3.8 - BIBLIOGRAPHY

NRDS RADIOACTIVE MATERIAL COMPLEX

Correspondence to SNPO-C

Correspondence	Date	Subject
TWX	30 April 63	Agenda for Meeting No. 2 Schroeder to L.E.White
Letter	10 May 1963	Data on Vitro Spent Fuel Storage Concept Brookshire to House
TWX	15 May 1963	Agenda for Meeting No. 3 Schroeder to House
TWX	15 May 1963	Comments on Preliminary Operational Req. to Report Brookshire to House
Letter	15 May 1963	Comments on Minutes of Meeting No. 2
Letter	7 June 1963	Comments on Minutes of Meeting No. 3 Brookshire to House
Letter	7 June 1963	Spent Fuel Storage Concept and Agenda Meeting No. 4 Brookshire to House
Letter	7 June 1963	ETSMB to remain in Task 3.8 Schroeder to House
Letter	11 June 1963	Approval of Minutes of Meeting No. 4 Brookshire to House
Letter	1 July 1963	ETSMB to remain in Task 3.8 Schroeder to House
Letter	6 Aug 1963	Supplying LASL Comments on Report 2592 Renas to White
Letter	9 Aug 1963	Hot Engine Hold Design Criteria Schroeder to House
Letter	9 Aug 1963	Relocation of Storage and Disposal Facilities Schroeder to House
Letter	3 Sept 1963	Approval Minutes of Meeting No. 5 & Agenda Meeting No. 6 Brookshire to House
TWX	17 Sept 1963	Meeting Notification Vissing to House
Letter	27 Sept 1963	Minutes of Washington Meeting Vissing to House

NRDS RADIOACTIVE MATERIAL COMPLEX

Correspondence to SNPO-C

Correspondence	Date	Subject
RN63002B	17 April 63	Change of Scope (Design Criteria) Ryland to Schroeder
L741:0155	23 April 63	Minutes of Meeting No. 1 House to Schroeder
L741:0178	8 May 1963	Minutes of Meeting No. 2 House to Schroeder
L741:0182	9 May 1963	Action Item Summary Report House to Schroeder
L741:0194	21 May 1963	Approved Minutes of Meeting No. 2 House to Schroeder
L741:0198	24 May 1963	Minutes of Meeting No. 3 Ryland to Schroeder
L741:0202	24 May 1963	Action Item Summary Report House to Schroeder
L741:0209	4 June 1963	Action Item Summary Report House to Schroeder
TWX 741:056	4 June 1963	Publication Date of Operational Requirements Report Stinnett to Schroeder
L741:0207	4 June 1963	Minutes of Meeting No. 4 House to Schroeder
TWX 741:057	5 June 1963	Telecon-Design Criteria Costs, Spent Fuel Storage Publication House to Schroeder
L741:0219	14 June 1963	Approved Minutes Meeting No. 3 Ryland to Schroeder
L741:0223	14 June 1963	Approved Minutes of Meeting No. 4 House to Schroeder
L765:510	17 June 1963	Transmittal of Report 2584 Operational Requirements Ryland to Corrington
TWX	19 June 1963	Telecon-Design Criteria Publication House to Schroeder
L765:529	27 June 1963	Transmittal of Reports 2592 & 2603 & Addendum Ryland to Corrington
TWX 741:086	1 July 1963	Telecon-Transmittal of Reports 2592 & 2603 & Addendum Stinnett to Schroeder
TWX 741:087	1 July 1963-	Telecon-Transmittal of Reports 2592 & 2603 & Addendum Stinnett to Schroeder

Correspondence	Date	Subject
TWX 741:094	10 July 1963	Telecon SNPO-C review comments on Reports 2592 & 2603 Stinnett to Schroeder
TWX 741:110	16 July 1963	Telecon-Date for Technical Meeting Stinnett to Schroeder
TWX 741:117	26 July 1963	Schedule for Publication of Final Report 2603 Stinnett to Schroeder
L741:0259	29 July 1963	Action Item Summary Report House to Schroeder
L741:0261	29 July 1963	Minutes of Meeting No. 5 House to Schroeder
TWX 741:125	12 Aug 1963	Telecon-Content of Report 2603 Stinnett to Schroeder
L741:0279	15 Aug 1963	Action Item Summary Report House to Schroeder
L741:0280	15 Aug 1963	Approved Minutes of Meeting No. 5 House to Schroeder
L765:599	27 Aug 1963	Transmittal of Final Report 2603 Ryland to Corrington
TWX 741:135	23 Aug 1963	Agenda for Meeting No. 6 Stinnett to Schroeder
L765:605	27 Aug 1963	Transmittal of Additional copies of Report 2603 Ryland to Corrington
TWX 741:148	27 Aug 1963	Use of Report 2603 Stinnett to Schroeder
TWX 741:151	28 Aug 1963	Telecon-SNPO-C data on fence requirements Stinnett to Schroeder
L741:0300	29 Aug 1963	Minutes of Meeting No. 6 Stinnett to Schroeder
L741:0301	29 Aug 1963	Action Item Summary Report Stinnett to Schroeder
TWX 741:152	30 Aug 1963	Telecon-Schedule for siting evaluation Stinnett to Schroeder
TWX 741:149	3 Sept 1963	Telecon-Schedules and criteria publication Stinnett to Schroeder
L741:0303	6 Sept 1963	Transmittal of ACFI Drawing Stinnett to Schroeder
L741:0308	13 Sept 1963	Siting evaluation Stinnett to Corrington
L741:0307	20 Sept 1963	Action Item Summary Report Stinnett to Schroeder
TWX 741:178	23 Sept 1963	Telecon-SNPO-C approval of minutes of meeting No. 6 Stinnett to Schroeder
L741:310	26 Sept 1963	Approved Minutes of Meeting No. 6 Stinnett to Schroe

NRDS RADIOACTIVE MATERIAL COMPLEX

Report 2584 - Operational Requirements for Radioactive Materials Handling, Decontamination and Storage Complex at NRDS

5 April Informal submittal at Meeting No. 1.
15 May SNPO-C and WANL comments supplied to REON, TWX of 15 May 1963.
17 June Transmitted Report 2584 (Letter 765:510).

Report 2592 - Radioactive Materials Handling, Decontamination, and Storage Complex Design Concept and Criteria

5 April SNPO-C request at Meeting No. 1.
17 April REON letter RN 63002B submitting costs.
27 June Preliminary report submitted with cost addendum (L765:529).
19 July SNPO-C review comments supplied and publication deferred pending SNPO-C direction.

Report 2603 - Engine Transport System Maintenance Building Design Criteria

5 April SNPO-C request at Meeting No. 1.
17 April REON letter RN 63002B submitting costs.
27 June Preliminary report submitted with cost addendum (L765:529).
19 July SNPO-C review comments supplied.
27 August Final report transmitted (L765:599).

NRDS RADIOACTIVE MATERIAL COMPLEX

Correspondence WANL to REON

<u>Correspondence</u>	<u>Date</u>	<u>Subject</u>
TME-245	11 Jan 63	Initial Operational Requirements
TME-287	4 March 63	Operational Requirements Faught to Miller
TVX 2288	13 May 63	Upgrading TME-287 Faught to Miller
TVX 2733	3 June 63	Transmittal date of cooling Reqts. Faught to Miller
GSE 117	11 June 63	Spent Fuel Cooling Faught to Miller
GSE 121	12 June 63	KIWI Dwg Information Faught to Miller
GSE 151	9 July 63	Upgrade Operational Reqts. Faught to Miller
GSE 185	9 Aug 63	Reactor Cooling Reqts Faught to Miller
TVX 4387	19 Aug 63	Telecon Reactor Monitoring & Cooling Reqts. Faught to Miller
TVX 4507	22 Aug 63	Telecon Meeting date reactor monitoring and cooling Faught to Miller
TVX 5248	26 Aug 63	Telecon Spent Fuel Cooling Faught to Miller

NRDS RADIOACTIVE MATERIAL COMPLEX

Correspondence REON to MAIL

Correspondence	Date	Subject
L760:2061	27 Nov 62	Preliminary Operational Requirements VRMiller
L760:2369	4 Jan 63	Operational Requirements VRMiller
TWX 583	14 Feb 63	TME-245 Deficiencies Stinnett to M. Johnson
L740:0043	20 Feb 63	Supplying Report Outline White to Johnson
TWX 741:040	8 May 63	Comment on Prelim. Op. Reqts Stinnett to Faught
TWX 741:048	22 May 63	Spent Fuel Cooling Reqts Stinnett to Faught
TWX 741:054	31 May 63	Request KIWI Test Car Dwg. Stinnett to Faught
TWX 741:067	12 June 63	Telecon Spent Fuel Storage Stinnett to Faught
L760:	July 63	Review Reports 259 & 2603 Miller to Faught
TWX 741:119	31 July 63	Telecon Engine Cooling Reqts Stinnett to Faught
TWX 741:124	7 Aug 63	Telecon Reactor Cooling Reqts Stinnett to Faught
TWX 760:4283	8 Aug 63	Spent Fuel Cooling Miller to Faught
TWX 741:126	8 Aug 63	Telecon Reactor Manitory Reqts Stinnett to Faught
L760:4292	9 Aug 63	Transmitt Report 2584 Miller to Faught
TWX 741:136	26 Aug 63	Telecon Spent Fuel Cooling Stinnett to Faught
TWX 741:150	28 Aug 63	Telecon Spent Fuel Cooling Stinnett to Faught
TWX 741:167	12 Sept 63	Telecon Spent Fuel Cooling & Reactor Monitory Stinnett to Faught
TWX 741:179	24 Sept 63	Telecon Spent Fuel Cooling & Reactor Monitory Stinnett to Faught

TECHNICAL MEETING

SUMMARY

Technical Meeting No. 1 was held in Cleveland on 5 April 1963 to define the SNPO-C requirements for REON technical assistance on NERVA Subtask 3.8, NRDS, Radioactive Materials Handling, Decontamination and Storage Complex.

This meeting concluded that REON would be responsible for design criteria for the subtask facilities, as well as the operational requirements. (Reference minutes of meeting L741:0155, dated 23 April 1963)

Letter RN-63002B, dated 17 April 1963, G. L. Ryland to R. W. Schroeder, presented the cost estimates for this change of scope and problem areas to be resolved by SNPO-C during the development of the criteria.

Technical Meeting No. 2 was held in Azusa on 2 - 3 May 1963 to establish the management procedures to be used during the development of the design criteria and to resolve the problem areas presented in letter RN-63002B. These items were satisfactorily concluded by this meeting. Early siting studies and facilities concepts were presented by REON. (Reference minutes of meeting L741:0194, dated 21 May 1963)

Technical Meeting No. 3 was held in Cleveland on 16 May 1963 to review the status of the design criteria development and to resolve outstanding problems.

REON presented an evaluation of locations for the decontamination pad and it was concluded that pad would be retained north of the E-MAD Building and any additional pad requirements would be provided at the Decontamination Facility.

REON also presented a preliminary cost evaluation of three concepts of storing spent fuel.

All outstanding action items were satisfactorily concluded. (Reference minutes of meeting L741:0219, dated 14 June 1963)

Technical Meeting No. 4 was held in Azusa on 28 - 29 May 1963 to review the status and schedule of the design criteria and the facility sites and concepts developed by REON and the operational, radiation, and cost considerations associated with the selection of those sites and concepts.

No major departures from SNPO-C concepts were identified and no new direction by SNPO-C was considered necessary at that time. All outstanding action items were satisfactorily resolved. (Reference minutes of meeting L741:0223, dated 14 June 1963)

Technical Meeting No. 5 was held in Cleveland on 19 July 1963 to review the SNPO-C comments and Preliminary Report No. 2592, Radioactive Materials Handling, Decontamination, and Storage Complex Design Concept and Criteria, and Preliminary Report No. 2603, Engine Transport System Maintenance Building Design Criteria, which had been submitted to SNPO-C on 25 July 1963 in satisfaction of the 1 July 1963 milestone.

No major technical changes were recommended except to the Hot Engine Hold Facility. Re-evaluation of the engine monitoring and cooling requirements were requested by SNPO-C.

SNPO-C directed that Report No. 2592 not be issued until after two other SNPO meetings and release by SNPO-C. (Reference minutes of meeting L741:0280 dated 15 August 1963)

Technical Meeting No. 6 was held in Azusa on 22 -223 August 1963 to review new siting arrangements of three facilities that were prepared in response to the SNPO-C request of 1 August 1963 and comments on Report No. 2592 supplied by LASL.

The LASL comments were reviewed and no real conflicts with the design criteria were determined; however, REON did not concur in the relocation of facilities as indicated by SNPO-C and planned to request further review and evaluation of the siting. (Reference minutes of meeting L741:0310, dated 26 September 1963)

SNPO held a meeting at AEC, Germantown, Maryland, on 19 September 1963, with REON represented. This meeting was to conclude SNPO outstanding action items including siting of the radioactive materials facilities. However, no decision on siting was reached. SNPO-N was to re-evaluate the siting and make a recommendation by 25 September 1963.

CONTRACT YEAR 1963

TASK ITEM 3.8

[illegible]

RESCHEDULED TO CY 64

S/T 3.9 RIFT STAGE DEVELOPMENT FACILITIES

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-3.9(i) SUPPORT TO SNPO-C	(a) MAINTAIN TECH LIAISON WITH RIFT CONTRACTORS	(a) PERFORMED	L740:0177 DTD 11-12-62 MINUTES OF NVPO MTG. (HUNTSVILLE) DTD 11-15-62
	(b) PROVIDE FACILITY CRITERIA AS REQUESTED	(b) PERFORMED	

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 3.9 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Support to SNPO-C

a. Provide Facility Criteria as Requested

(1) The dissemination of available NERVA information and data to NVPO personnel was made through the distribution of REON generated reports pertaining to ETS-1 and ETS-2, etc.

b. Maintain Technical Liaison and RIFT Contractors

(1) Liaison and coordinating meetings were conducted with RIFT contractors.

An informal meeting held in October 1962 with representatives of Lockheed was devoted to a discussion of ground support system interfaces in the RIFT test area.

Representatives of REON attended the 5 October 1962 meeting of the GSE subgroup of the nuclear engine interface working group. An initial list was prepared of GSE required to support nuclear engine testing through NRDS operations. (Refer to bibliography.)

Attended meeting with representatives of NVPO, LMSC, SNPO-C, REON and WANL at Huntsville on 15 November 1962, to review the initial RIFT facility concepts, plans and program schedules and to determine availability of the RIFT static test facilities in support of the NERVA engine development program.

Conclusion

In conclusion, minor effort was required under this subtask during CY 1963 associated with NERVA/RIFT support systems interface; however, it is anticipated that significant effort will be required during CY 1964.

SUBTASK 3.9 - BIBLIOGRAPHY

RIFT STAGE DEVELOPMENT FACILITIES

<u>ITEM</u>	<u>REFERENCE</u>	<u>SUBJECT</u>	<u>ORIGINATOR/ADRESSEE</u>
Ltr.	741:MO177 11-12-62	Minutes of Meeting, Lockheed Nuclear Engine Interface Working Group	L.E.White/to Stinnett

S/T 4.I PROGRAM PLANNING & CONTROL

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-4.1	1. IMPLEMENT PERT SYSTEM FOR PROGRAM MANAGEMENT	COMPLETED	{PERT COMPUTER LOG NETWORK MICROFILM FILE 2322 LETTERS 2434 OF 63002 TRANSMITTAL 63005
	2.SUBMIT BIWEEKLY PERT REPORTS	COMPLETED ADDED SCOPE	REPORTS 63-1 THRU 63-26 PERT COMPUTER LOG NETWORK MICROFILM FILE
	THREE MAJOR REPLANNING CYCLES TO SUPPORT 2322, 2434, 63002, 63005 - MAJOR EXPANSION OF PLANNING DETAIL REQUIRED- FROM 1500 ACTIVITIES TO 25,000 ACTIVITIES		

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 4.1 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Implement a PERT system to provide detailed integrated plans, schedules and corresponding status information as required by program management to monitor, evaluate and control the overall program.
2. Provide biweekly PERT status reports for internal and SNPO-C use.

Accomplishments

Program Planning and Control

REON planning and control operations perform a dual role in the NERVA program. The first of these is the role of a prime contractor with total program or system functions oriented toward major program objectives. The second is the role of a technical participant oriented toward accomplishment of technical objectives at the Azusa, Sacramento, Downey Plants and at NRDS.

The principal functions performed in both areas consisted of the following:

- Planning and Scheduling
- Monitoring and Evaluating for Management Control
- Reporting

1. Planning and Scheduling

Master program plans and schedules were prepared for the total NERVA program. Demand networks were prepared for each program objective or end item to establish explicit programmatic, schedule and interface requirements for all participant plants and subcontractors. The resulting preliminary requirements were reviewed with REON senior task managers for technical compatibility. Revised demand networks and requirements were prepared, approved by REON management, and issued to all participants. Subtask oriented preliminary planning networks were prepared for all plants to support the requirements and objectives defined by the demand networks. Typically, the preliminary networks were prepared under Task 4.1 and reviewed with task managers to verify logic and to obtain time estimates.

Preliminary planning networks from all participants including subcontractors supporting the demand networks were reviewed by the REON planning group and REON task engineers.

The plans were interfaced, schedule conflicts resolved with the affected participants and program or end item networks were prepared for major program objectives.

This programming cycle was repeated for each major program change or redirection.

Program plans were defined at the start of the contract year by 15 networks consisting of 1500 activities increasing to 115 networks and approximately 25,000 activities by the end of the contract year. A tabulation of all these networks will be found in the handout which I will give you.

2. Monitoring and Evaluating for Management Control

Task oriented networks were processed through the PERT computer program by LRP and REON for their cognizant in-house subtasks.

The biweekly reports from all participants together with the REON subtask reports were reviewed and verified by the planning group, and processed as an integrated NERVA PERT computer program. Biweekly meetings were held between the planning group and REON management to review total program status and define problem areas and corrective action. In addition, weekly management reviews are made of pacing items on critical paths.

3. Reporting

Twenty-six biweekly PERT reports were submitted to SNPO-C in accordance with the NASA PERT handbook, dated 30 October 1962. The reports included activity completions, activity time changes during the latter portion of CY 1963 and logic changes. The report was expanded to include a narrative report summarizing program status, identification of problem areas and indicated corrective action.

Monthly milestone status reports were prepared for inclusion in the monthly technical progress reports.

Supplemental status information was submitted to SNPO-C as requested.

Two-hundred-thirty-five planning networks were submitted to SNPO-C during the course of the contract year.

Added Scope

Program changes have required three more major replanning cycles than were originally contemplated. In addition, it became obvious during the year that more detailed planning networks were required to adequately define these program changes than anticipated. As a result, whereas we started the year with 15 networks and approximately 1500 activities, we finished with 115 networks and approximately 25,000 activities to describe the program recommended in Report RN-63005.

SUBTASK 4.1 - BIBLIOGRAPHY

CONTRACT YEAR 1964 PROGRAM PLANNING NETWORKS

SUB-TASK	DRAWING NO. P	DESCRIPTION	SPTS	REV	DATE
D	004901	NRX-A1, 2, & 3		N/C	8-10-63
D	004902	NRX- 4, 4S, 5, & 6		N/C	8-10-63
D	004903	NRX- 7, 8, 9, & 10		N/C	8-10-63
D	004911	E-Engine 1 & 2		N/C	8-10-63
D	004912	E-Engins 3, 4, & 5		N/C	8-10-63
00	004920	NRX-A1 Program Plan - Task Force		E	10-8-63
00	004921	NRX-A2 Program Plan - Task Force		N/C	10-21-63
00	004932	NRX-A1 WABL Interface		B	10-18-63
00	004925	NRX-A2 WABL Interface	2	A	10-21-63
00	004926	NRX-A3 WABL Interface		N/C	10-1-63
00	004927	NRX-A4 WABL Interface		N/C	10-1-63
00	004928	NRX-A5 WABL Interface		N/C	10-1-63
00	004931	NRX-A1 LRP Interface		C	10-9-63
00	004935	NRX-A2 LRP Interface		A	10-1-63
00	004936	NRX-A3 LRP Interface		N/C	10-10-63
00	004937	NRX-A4 LRP Interface		N/C	10-10-63
00	004938	NRX-A4 LRP Interface		N/C	10-10-63

CY 64 Program Planning Networks

SUB-TASK	DRAWING NO. P	DESCRIPTION	SHTS	REV	DATE
1.1	114001	Engine System and Mockup		B	8-23-63
1.1	114100	Engine and Cages	2	A&B	8-13-63
1.1	114101	1.1.2 FDIS		B	8-21-63
1.1	114102	1.1.8 NHX-A Engine	3	A	8-13-63
1.2	124101	1.2.2 Valves	2	A	8-12-63
1.2	124102	1.2.3 TPA		A	8-12-63
1.2	124103	1.2.4 TPA		A	8-12-63
1.4	144001	EH-6 Nozzle Propellant Feed & Applied Research		N/C	8-13-63
1.4	144101	1.4.2 T/S & Gimbal		A	8-12-63
1.4	144102	1.4.3 PV. Assembly		A	8-13-63
1.4	144103	1.4.1 Nozzle & Ext. Development	2	A	8-13-63
1.4	144104	1.4.6 1964 Applied Research Program		A	8-10-63
1.4	144105	1.4.5 Reactor Nozzle		A	8-12-63
1.5	154001	Control System		A	8-13-63
1.5	154104	Engine Controls		A	8-11-63
1.6	164001	Countermeasures System		A	8-13-63
1.7	174101	Pneumatic Power Supply	2	N/C	8-2-63
1.8	184001	System Analysis			8-27-63
1.9	194002	LHP Irradiation Effects Program	14	N/C	8-6-63
1.9	194003	Azusa Irradiation Effects Program	13	N/C	9-6-63

CY 64 Program Planning Networks

SUB-TASK	DRAWING NO. P	DESCRIPTION	SFTS	REV	DATE
2.1	214001	Alt. Remote Handling GSE	2	N/C	8-13-63
2.1	214002	Propellant Remote Handling GSE	2	N/C	8-13-63
2.1	214101	NRK - Remote Handling Equipment		A	9-3-63
2.2	224101	C/O & Test Equipment		A	9-3-63
2.3	234101	CFDTS & E-Engine Logistic Equipment		B	9-3-63
2.4	244001	Instrumentation System	4	N/C	8-13-63
2.4	244002	NRK-A Instrumentation	10		
2.4	244003	Elect. Irradiation Series 500	4		
2.4	244004	Mech. Irradiation Series 900	9		
2.7	274001	Preliminary Flight Safety System		N/C	8-13-63
3.1	314001	3.1.4 Duct System ETS-1		N/C	8-23-63
3.1	314003	NES Duct System ETS-2		N/C	8-23-63
3.1	314004	3.1.5 ETS - 1 Steam Generator		N/C	8-23-63
3.2	324001	ETS- 1 Comp. and Activities		A	9-4-63
3.3	334001	ETS- I&C System	2	N/C	8-13-63
5.1	514001	SIE- Test Zone C		N/C	8-15-63
5.2	524001	Cryogenic Laboratory Test Zone A		N/C	8-16-63
5.5	534001	SIE-Test Zone H	2	N/C	8-16-63
5.8	584001	SIE-AGC Temp. Laboratory		N/C	8-16-63
5.9	594001	SIE-Laboratory Facility - Sacto		N/C	8-16-63

PLANNING NETWORK SUBMITTALS TO SNPO-C DURING CY 1963

10-26-62 1.1 2.1
 1.2 2.2
 1.4-1 2.3
 1.4-2 2.4
 1.7

11-7-62 1.6

11-30-62 0.0 2.1R
 1.1R 2.2R
 1.2R 2.3R
 1.4-1R 2.4R
 1.4-2R
 1.5
 1.6R
 1.7R

12-7-62 Program Summary

TWX	<u>1-8-63</u>	KE 1.1	KE 2.1	KE 3.1	KE 5.1
		KE 1.2	KE 2.2	KE 3.2	KE 5.2
		KE 1.7	KE 2.3		KE 5.3
		KE 1.9	KE 2.4		KE 5.9
					KE 6.2

TWX M77:396	<u>1-9-63</u>	KE 1.4
		KE 1.5
		KE 1.6

Ltr 751:309	<u>1-25-63</u>	1.3 WR

Ltr 751:412	<u>3-9-63</u>	000	1101	15	211	315
		001B	1120	16	216	316
		002C	1401	19		32
			1301-1			
			1301-2			
			1301-3			

Planning Network Submittals to SMO-C
During CY 1963

45574	<u>4-12-63</u>	P01011	P00001	P02001	P03001	014683-1
45575		P01012	P00002	P02002	P03002	014683-2
		P01013	P00004	P02003	P03003	014683-3
		P01021	P00005	P02004	P030004	1301-1
		P01022	P00006	P02005	P03005	1301-2
		P01023	P00007	P02006	P03006	1301-3
		P01024	P00008	P02007	P03501	1401
				P02008	P03502	118 VIB
				P02009	P03503	27
				P02010	P03504	
				P02501	P03505	
				P02502	P03506	
					P03507	
Ltr 751:343	<u>4-18-63</u>	P03007				
Ltr 751:346	<u>4-23-63</u>	Microfilm of 4-12 Submittal				
Ltr 751:349	<u>4-29-63</u>	P02012				
		P00020W				
		P00021W				
Ltr 751:371	<u>6-5-63</u>	P03011				
		P03012				
		P03013				
		P03014				
		P03015				
		P03016				
Ltr 751:393	<u>7-5-63</u>	P00002D				
		P02016				
Hand-Carried TWX Confirm.	<u>7-8-63</u>	P02014				
		P02018				
		P02019				
Ltr 751:395	<u>7-12-63</u>	P00031				
Ltr 751:396	<u>7-16-63</u>	P00032				
Ltr 751:404	<u>7-19-63</u>	P02019				

Ltr 751:613	<u>8-30-63</u>	004901	Demand	214001 Sht 21	2.1
		004902	Demand	214002 Sht 2	2.1
		004903	Demand	244001 Sht 31	2.4
		004910	Demand	274001	2.7
		004911	Demand	314001	3.1.4
		004931	Comp.	314003	3.1
		004932	Comp.	314004	3.1.5
		114001"B"	1.1	324001	3.2
		114100"B"Sht 1	1.1.0	334001 Sht 2	3.3
		114100"A"Sht 2	1.1.0	514001	5.1
		114101"B"	1.1.2	524001	5.2
		114102"A"Sht 3	1.1.8	534001 Sht 2	5.3
		124101"A"Sht 2	1.2.2	584001	5.8
		124102"A"	1.2.3	594001	5.9
		124103"A"	1.2.4		
		133202	1.3		
		133203	1.3		
		133204	1.3		
		133205	1.3		
		133206	1.3		
		144001	1.4		
		144101"A"	1.4.2		
		144102"A"	1.4.3		
		144103"A"Sht 2	1.4.1		
		144104"A"	1.4.6		
		144105"A"	1.4.5		
		154001"A"Sht 2	1.5		
		154104"A"	1.5		
		164001"A"	1.6		
		164002	1.6		
		174101 Sht 2	1.7		
		184001	1.8		
		194002 Sht 14	1.9		

Planning Network Submittals to SWPO-C
During CY 1963

Ltr 751:518   9-12-63   194003-S14
                         214100A
                         224101A
                         234101B
                         324001A

SCHEDULES AND MILESTONES
CONTRACT YEAR 1963
TASK ITEM 4

AS
OF

↑ SCHEDULED MILESTONE

◇ RESCHEDULED MILESTONE

▲ MILESTONE ACHIEVEMENT

◆ RESCHEDULED MILESTONE ACHIEVEMENT

◇ RESCHEDULED TO CY 64

S/T 4.2 FISCAL CONTROL

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-4.2	1. DEVELOP DETAILED PROGRAM BUDGETS	COMPLETED	RU-2-2322, MOD VI, CY 1963 PROGRAM RN-2434, CY 1963 PROGRAM RN-63002, REV, MOD 8 RN-63013, C/O #1 RN-63005 INITIAL CY 1964 PROGRAM RN-2529, CY 1965 BUDGET
	2. PROVIDE COMPREHENSIVE COST STATUS REPORTS	COMPLETED	REPORTS: LO560- 10-15 THROUGH-27
	3. MONITOR & CONTROL COSTS & BUDGETS	PERFORMED	PROGRAM COST ARE WITHIN LIMITATIONS REPORTS: LO560-10-15 THROUGH-27

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 4.2 FISCAL CONTROL

ACCOMPLISHMENTS

W/S
REFERENCE

UNPLANNED ACTIVITIES

EVIDENCE OF
COMPLETION

ADDED SCOPE

FORMAT CHANGES - CY 1965 BUDGET

EXTENSIVE SEPARATION AEC-NASA COSTS

REVISED REPORTING FORMAT WITH BUDGET
CATEGORIES

SIGNIFICANT INCREASE IN MISC ADMIN
TYPE INFORMATION REQUESTS

RN-2560 REV. BUD-
GET ESTIMATE CY 65
RN-63002 & SUBSE-
QUENT REPORTS
DEVELOPMENT FOR
CY 1964
COST AREAS - MAN-
POWER SUMMARIES-
CHANGED OVERHEAD
RATES - REVAMPED
COMPUTER PROGRAMS

REON · ROCKET ENGINE OPERATIONS - NUCLEAR

SUBTASK 4.2 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Develop detailed program budgets.
2. Provide comprehensive cost status reports.
3. Monitor and control costs and budgets compatible with program objectives and contract limitations.

Accomplishments

1. Budgets have been developed for each redefined program. As you can see from the chart there have been seven basic budgets prepared including those for CY 1964 and CY 1965.
2. Budgets have been adjusted as the program changed or as technical difficulties were encountered.
3. Monthly cost reports L0560-10-15 through -27 were provided.
4. Program costs are within contract year limitations as evidenced by Report L0560-10-27.
5. In consideration of the fiscal year end problems associated with AEC funding, special administrative attention was given this problem in June. Consequently, the expenditures incurred for the AEC funded effort from 1 October 1962 through 30 June 1963 were within 1.3% of the AEC financial plan.

Added Scope

As in Subtask 4.1, three more major program cost estimates have been required than anticipated. Also, format changes for the April budget submission and for the CY 1964 definitive cost budgets, has necessitated additional effort. Extensive separation of AEC-NASA costs, revised reporting format and a large increase in miscellaneous administrative type informational requests involving specific cost areas, manpower summaries and changes in overhead rates has resulted in a heavier work load than planned.

SUBTASK 4.2 - BIBLIOGRAPHY

Documents to Which Subtask 4.2 Made Input:

<u>REPORT/LETTER</u>	<u>Title</u>	<u>Date</u>
2300	Program Plan	August 1962
2322	Program Plan	November 1962
2434	Revised NERVA Program Plan	December 1962
63002	Preliminary Program Plan - CY 1963	March 1963
2529	CY 1965 Budget Estimate	May 1963
2544	CY 1965 Budget Estimate	May 1963
2545	CY 1965 Budget Estimate	May 1963
2547	CY 1965 Budget Estimate	May 1963
2560	Revised CY 1965 Budget Estimate	May 1963
63002	Revised Program Plan - CY 1963	June 1963
63013	C/O #1 Program Plan CY 1963	August 1963
63005	CY 1964 Program Plan	September 1963
LO560-10- Issues 16-27	Fiscal Supplement to Monthly Progress Rept.	Monthly (22nd
Telephone Reports	Monthly Expenditure Forecast	Monthly (5th)
Letter Report	Monthly Report of Contractor Employment	Monthly (25th)
Letter Report	Monthly Report of Contractor Overtime	Monthly (25th)
Miscellaneous	One-Time Letter and Phone Reports	Average 1/wk 2-4 Mondays Effort

S/T 4.3 DOCUMENTATION

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-43A	MONTHLY REPORTS	COMPLETE	REPORT # L0560-10-16 THROUGH 27
B	SPECIAL TECHNICAL REPORTS	COMPLETE	93 REPORTS
C	SUMMARY TECHNICAL REPORTS	COMPLETE	REPORT #2323, 3 VOL.
D	PERFORMANCE EVALUATIONS	COMPLETE	REON LTR NOS. 756:355,760:3385 & 765:575
E	SUBCONTRACTOR REPORTS	COMPLETE	REPORT # L0560-10 SUPP. TIME'S ETC.
F	SUMMARY MOTION PICTURE	COMPLETE	PROD NO. M-382 - 379
G	PROGRAM PLANS	COMPLETE	8 ISSUED IN 30 BOOKS
	SPECIFICATIONS AND CRITERIA	COMPLETE	82 ISSUED
	PROPELLANT FORECAST	COMPLETE	12 ISSUED
	MONTHLY LISTING REPORTS	COMPLETE	7 ISSUED
	WEEKLY HIGHLIGHTS REPORTS	COMPLETE	50 ISSUED
	ADDED SCOPE		
	WEEKLY SIGNIFICANT EVENTS REPORTS	COMPLETE	26 ISSUED

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 4.3 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Provide the following:
  - A. Monthly progress reports
  - B. Special technical reports
  - C. Summary technical report
  - D. Performance evaluation report
  - E. Subcontractor report
  - F. Summary motion picture
  - G. Program planning reports
  - H. Specifications and criteria
  - I. Propellant forecasts
  - J. Monthly listing reports
  - K. Weekly highlights TWX
  - L. Weekly significant events reports

Accomplishments

All planned accomplishments were completed.

1. Informal Monthly Progress Report, Technical

Twelve reports (Letter Report No.s L0560-10-16 through L0560-10-27) were submitted in compliance with this requirement. The pages in this report increased from 144 in Report L0560-10-16 to 261 pages in Report L0560-10-27, representing an 80% increase in content between the first and last reports.

Supplements to this report were:

Fiscal supplement - 12 reports issued

Reliability and quality assurance supplement - 6 reports issued

2. Special Technical Reports

Eighty-eight reports were produced. The number of reports increased from about 5 per month at the beginning of the contract year to about 10 per month at the end of the year. The size of the reports increased as the year progressed. Some reports, such as the data books, consisted of several volumes and thousands of pages. It is estimated that 16,275 pages were published.

3. Summary Technical Report

Summary report for contract year 1962 in 3 volumes, Report No. 2323 dated November 1962, was submitted 15 November 1962. Preparatory work for the submission of summary report for contract year 1963, to be submitted 15 November 1963, was carried on during the year.

4. Performance Evaluation Reports

Three evaluations of subcontractor performance were submitted: Letters 765:355, 760:3385, and 765:575, dated 15 January 1963, 30 April 1963, and 10 August 1963, respectively.

5. Subcontractor Reports

Subcontractor reports were submitted as requested. REON Report No. L0560-10- supplement is submitted monthly, consolidating reliability and quality assurance reports of REON, LRP, Westinghouse Electric Corporation, the Bendix Corporation, and American Machine and Foundry Corporation. The weekly significant events and reactor component test program progress report is submitted weekly. Westinghouse Electric Corporation TMEs are submitted directly.

6. Summary Motion Picture

A summary motion picture for contract year 1962 was submitted on 30 November 1962. This delay from November 15 to 30 was concurred in by SNPO-C to get additional hot bleed information in the movie. Film strips have been taken throughout contract year 1963 preparatory to production of the summary motion picture for contract year 1963 schedule for submission on 25 November 1963.

7. Program Planning Documents

Eight program plans were published during the year, consisting of 30 volumes.

8. Work Accomplished but not Specifically Called Out in Work Statement

Twenty specifications and 62 design criteria were published. The most significant of these was the NERVA engine model specification no. AGC 10095C, dated 1 November 1962 and revised 12 July 1963.

Other periodic publications were:

Monthly listing report - 7 issued

Weekly highlights report (TWX) - 50 issued

Weekly significant events report - 26 issued

Propellant forecasts - 12 issued

Added Scope

1. A requirement for the weekly significant events report did not exist until after RN-63002 was prepared.

2. When the budget estimates were made for RN-63002 - preliminary draft, program plan for CY 1963, the "Special Technical Reports" requirements were averaging about 5 per month based on the months of December, January, and February. At that time the estimate allowed for some increase in report requirements but not nearly twice the effort. The average output per month from April through September was 10 reports with 14 being published in September. In addition, the size of the "Special Technical Reports" increased, e.g., the instrumentation data book report no. 2320 grew from 2 volumes and about 600 pages in April to 5 volumes and 1300 pages in September.

3. The budget estimates for RN-63002 were based on producing a program for CY 1964-1965 of about 800 pages covering approximately 47 subtasks. Actually four additional program plans were made for a total page count of 3464 pages - an increase over that estimated of about 350%. The last of these plans increased the number of tasks reported to 140 subtasks and sub-subtasks. In addition some of these plans were produced on very tight schedules requiring considerable overtime in the reproduction departments. Additional effort was expended in producing the budget estimates for 1965 because of a completely new format and method of presentation requiring fiscal year budgets and contract year budgets were developed.

SUBTASK 4.3 - BIBLIOGRAPHY

(This work includes editing, typing, printing, binding, and coordination of report production.)

A. Program Planning Documents

<u>Report No.</u>	<u>Vol.</u>	<u>Title</u>	<u>Date</u>
2322	I	Program Plan, CY 1963	November 1962
	II	do.	November 1962
2434		Revised NERVA Engine Program and Associated Tasks	December 1962
RN 63002	I	Preliminary Draft, Program Plan, CY 1963	March 1963
	II	do.	March 1963
RN 63002	I	Revised Program Plan, CY 1963	June 1963
	II	do.	June 1963
	III	do.	June 1963
2529	I	AEC Budget Estimate, FY 1965, Schedules 20 and 21b through 91	May 1963
	II	AEC Budget Estimate, FY 1965, Schedule 21a	May 1963
	III	AEC Budget Estimate, FY 1965, Schedules 189	May 1963
2544		NASA Budget Estimate, CY 1965, Schedules 189	May 1963
2545		Addendum Budget Estimate - 1965, GFE, Propellants, and SNPO-N Support	May 1963
2547		Addendum II - Budget Estimate - 1965	May 1963
2560	I	Revised Budget Estimate, FY 1965, AEC Schedules 20 and 21b through 91	May 1963
	II	Revised Budget Estimate, FY 1965, AEC Schedule 21a	May 1963
	III	AEC Schedules 189, FY 1965	May 1963
	IV	NASA Schedules 189, CY 1965	May 1963
	V	Addendum I - GFE, Propellants, and SNPO-N Support	May 1963
	VI	Addendum II - Alternate Plan, Reduced FY 1964 Budget	May 1963

A. Program Planning Documents - contd

<u>Report No.</u>	<u>Vol.</u>	<u>Title</u>	<u>Date</u>
RN 63005	I	Program Plan, CY 1964 - Summaries and Work Statements	August 1963
	II	Program Plan, CY 1964 - NTADs for Tasks 1 through 4	August 1963
	III	Program Plan, CY 1964 - NTADs for Tasks 5 through 9	August 1963
	IV	Program Plan, CY 1964 - Composite Cost Study	August 1963
	V	Program Plan, CY 1964 - WANL Cost Estimates	August 1963
	VI	Program Plan, CY 1964 - Support Equipment Provisioning Lists	August 1963
	VII	Program Plan, CY 1964 - Addenda 1 through 6	August 1963
	VIII	Program Plan, CY 1964 - Addenda 7 through 18	August 1963
RN 63005W		WANL Portion of Program Plan for CY 1964	September 1963
RN 63013	C	Changes to Revised Program Plan, CY 1963 (C.O. 1 to Mod. 8)	August 1963

B. Monthly Reports

Informal Monthly Progress Letters (Report Nos. I0560-10-16, October 1962, through I0560-10-27, September 1963)

Fiscal Supplement to Informal Monthly Progress Letters (Nos. I0560-10-16 through I0560-10-27)

Reliability and Quality Assurance Supplement to Informal Monthly Progress Letters (Nos. I0560-10-22, April 1963, through I0560-10-27, September 1963)

Monthly Listing Reports (Issued for February 1963 through August 1963)

Propellant Forecasts (12 issued)

C. Weekly Reports

Weekly Highlists TWX Reports (No. 1, dtd 10-24-62, through #50, dtd 10-2-63)

Weekly Significant Events and Reactor Component Test Program Progress Reports (No. 1 for period April 9 - 15, 1963 through No. 26 for period September 24 - 30, 1963)

D. Summary Technical Report

Report No. 2323, Volumes I, II, and III, Summary Report for CY 1962, was issued in November 1962.

E. Subcontractors Reports

Incorporated in Fiscal Supplement and Reliability and Quality Assurance Supplement to Informal Monthly Progress Letter Reports, in the Weekly Significant Events and Reactor Component Test Program Progress Reports, etc.

F. Performance Evaluations

These reports were submitted by Letters 765:355, 760:3385, and 765:575 dated 15 January 1963, 30 April 1963, and 10 August 1963, respectively.

G. Summary Motion Picture

Production No. M-382-379

H. Special Technical Reports

<u>Report No.</u>	<u>Title</u>	<u>Date</u>
2275, Rev.	Materials Properties Data Book	October 1962
2275, Rev.	do.	1-30-63
2275, Rev.	do.	July 1963
2276	Engine Systems Data Book	November 1962
2277	NERVA Program - Radiation Effects Data Book	2-15-63
2278	Interim Report - NERVA Engine Thermodynamic Cycle Selection	10-23-62
2305	Comparison of Gimbal and Gas Injection Systems for Thrust Vector Control of NERVA Engine	Issued in November 1962
2316	Operational Safety Evaluation of ETS-1 Complex	October 1962
2320	Instrumentation Data Book	January 1963
2320, Rev.	do. (2 Volumes)	April 1963
2320, Rev.	do. (3 Volumes)	July 1963
2320, Rev.	do. (4 Volumes - Vol. IV consists of 2 books)	October 1963
2321	Radiation Effects Facility, Conceptual Design NERVA TPA/ASTR Facility (Sacramento)	10-4-62
2402	Support Systems for a Typical Development Program	10-19-62
2403	Analytical and Experimental Evaluation of Ejectors with a 90° Turn for Use in ETS-1	November 1962
2409 - Preliminary Rev. A, B, C	NPDS Nuclear Rocket Engine Static Test Complex Operational Requirements	February 1963
2410	Preliminary Design Package - ETS-1	November 1962

H. Special Technical Reports - contd

<u>Report No.</u>	<u>Title</u>	<u>Date</u>
2420	Preliminary Survey - Nuclear Rocket Propulsion Systems for Advanced Applications	Published 5-9-63
2421	RIFT Safety Review Program - NERVA Systems Description, NERVA Program, SNP-1	November 1962
2421, Rev.	do.	August 1963
2429	Standard NERVA Engine Analytical Model for Radiation	February 1963
2433	Preliminary, NRDS-NERVA Nuclear Rocket Engine Auxiliary Static Test Facility Study	12-28-62
2467	Program Planning Details, NERVA Component Radiation Program, CD/TW - Engine Auxiliary Static Test Facility Study	Issued in December 1962
2473 Preliminary	Data Obtained from First Irradiation Test on Structural Materials	1-25-63
2473	do.	4-15-63
2474	Preliminary Design Report, NERVA Exhaust Duct, Large Radius Elbow AGC-2 Duct	August 1963
2477	NERVA Support Equipment Provisioning Lists and Schedule	February 1963
2481	Pressure Vessel - Reactor Interface Loads Report	February 1963
2482	Fanno Line Tables, NERVA Program	2-8-63
2483	Rayleigh Line Tables, NERVA Program	2-8-63
2487	REON Reliability and Quality Assurance Program Plan, NERVA Program, Feb. 1963	February 1963
2492	Standard NERVA Engine Analytical Model for Radiation Analysis	February 1963
2493	Scale Model Heat-Transfer Tests of NERVA	April 1963
2499	NERVA Engine Component Weight and Balance Report	April 1963
2502 Preliminary	Operation Requirements for Nuclear Rocket Engine Test Stand No. 2 at NRDS	Issued in March 1963
2502, Rev.	Basic Criteria for Engine Test Stand No. 2 at NRDS	May 1963
2502, Rev.	do.	July 1963
2506	Mandatory Facility Additions to Activate ETS-1 at NRDS	June 1963
* 2507	Preliminary Test Specifications for Ground Test Reactor (GTR) Tests of 4-20-63	--
2510	Compendium of Radiation Effects Test Plan, Specifications, and Test Results	Issued in March 1963
* 2506, Addendum 1	ETS-1 Fluid Requirements Addendum	June 1963

II. Special Technical Reports - contd

<u>Report No.</u>	<u>Title</u>	<u>Date</u>
2512	Incident Report - Materials Test Program, 30 March 1963	May 1963
2514	Final Test Specifications for Ground Test Reactor (GTR) Tests of 4-20-63	--
2516	NRX Operational Support Plan - Preliminary Draft	April 1963
2518	Dynamic Analysis - Kiva B4A Reactor Core Cluster Assembly	March 1963
2520	Post-Operative Requirements - E-MAD Bldg., EIS-1	May 1963
2531	Security Manual, NRDS	1 April 1963
2537	RECON SNFO Meeting Presentation Charts	Apr. 10/11, 1963
2543	Gen. II Engine Simulation Report	30 June 1963
2551	Experimental Investigation on Heat Transfer to Hydrogen in Tubes	May 1963
2554	Preliminary Test Specifications for ASTR Mechanical Pallet Test of 6-15-63	Issued 5-2-63
2556	Preliminary Test Plan - Cold Flow Development Test System	1 May 1963
2563	Preliminary Test Specifications - Control Drum Actuator Component	May 1963
2569	Final Test Specs for ASTR Mechanical Pallet, Tests of 6-15-63	June 1963
2573	Program Planning Details for CD/FW	May 1963
2574	Final Test Plan and Test Specification for Gamma Measurement of Modified ASTR, Test of 6-15-63	June 1963
2578	Program Requirements Document, NRDS	June 1963
2584	NRDS Radioactive Materials Handling Decontamination and Storage Complex	June 1963
2585	Evaluation and Comparison of Attitude- Control Systems for Spacecraft with NERVA Engines	Mailed 6-26-63
2592 Preliminary	Task 3.8 - NRDS Radioactive Materials Handling, Decontamination, and Storage Complex Design Criteria	June 1963
2597	Evaluation of Post-Operative Destruct System Concepts	8-9-63
2603 Preliminary	Task 3.8 - Engine Transport System Maintenance Bldg. Design Criteria	June 1963
2603, Final	do.	August 1963

H. Special Technical Reports - contd

<u>Report No.</u>	<u>Title</u>	<u>Date</u>
2605	Final Test Specifications for Ground Reactor (GTR) Tests	June 1963
2622	Final Test Specifications for Ground Test Reactor (GTR) Tests of 7-27-63	--
2626	Preliminary Test Specifications for Ground Test Reactor (GTR) Tests of 8-24-63	--
2628	Nuclear Engine Sizing Analysis (Briefing to NASA sometime in 1963)	--
2630, Vol. I	Preliminary Design NERVA Exhaust System ETS-1, SST-2 Duct	September 1963
2630, Appendix A	do.	September 1963
2636	SS Materials Control Instruction Manual for NERVA Program	July 1963
2640	Preliminary Test Specification for Ground Reactor Tests of 9-7-63	Mailed 7-18-63
2641	Preliminary Test Reports for GTR Tests during May 13 - 19, 1963	--
2652	Analysis of the Fast Neutron and Gamma Ray Environment - LRP Mechanical Radiation Test 901	30 Sept. 1963
2656	Organization of NERVA Test Operations	8-5-63
2657	NERVA Test Operations and Support Services Contractor Responsibilities at NRDS	8-5-63
2660	Final Test Specs for GTR Tests Nos. 8 and 9 of 9-21-63	--
2665	Final Test Specification for Second Mechanical Pallet Test at ASTR, Tests of 9-3-63	--
2667	Final Test Specifications for Plum Brook Reactor Facilities Tests of August 1963	--
2668	Structural Integrity Tests - Rectangular Coolant Channels	August 1963
2673	Final Test Specification for GTR Test No. 10, Tests of 9-21-63	September 1963
2678	ETS-1 Design Criteria	September 1963
2683	Kiwi-B2A Design Review	10 Sept. 1963
2691	Strain-Gage Research and High-Output Transducers	September 1963
2698	NRX-A1 Reactor Manpower Utilization, NRDS	Issued 9-13-63
2699	NES Duct (SST-2) Conceptual Design	September 1963
2703	Summary of NERVA Instrumentation Review at SNPO-C, August 13 - 15, 1963	--

H. Special Technical Reports - contd

<u>Report No.</u>	<u>Title</u>	<u>Date</u>
2704	Goals, Responsibilities, Accomplishments, NES Integration, Subtask 3.1	September 1963
2710	Cold Flow Development Test System Plan	September 1963
--	NERVA Program Communications Procedure Manual	Issued in October 1962

I. Specifications and Design Criteria

<u>Spec. No.</u>	<u>Rev.</u>	<u>Title</u>	<u>Date</u>
AGC-10095C		NERVA Engine Model Specification	1 November 1962
10095C	x	do.	12 July 1963
			<u>Date Released</u>
AGC-10095		Engine, Rocket, Nuclear, Shielded, Hot Eled, AJ30-5	--
10125	C	Vehicle, Installation, Engine, Nuclear	7-17-63
10126	A	Locomotive, 80 Ton, Nuclear Environment	7-15-63
10134	A	Car, Manned, Control, Nuclear Environment	10-3-62
10134	B	do.	7-26-63
10136	B	Positioning Subsystem, Overhead, for Remote Operations	7-26-63
10137	A	Handling Subsystem, Floor Mounted, for Remote Operations	10-3-62
10138	A	Test System, Development, Cold Flow, for SJ30-5 Engine	12-31-62
10138	B	do.	5-16-63
10144		Car, Railway, Flat, Special, Nuclear Environment	--
10145		Car, Railway, Side Dump, Nuclear Environment	--
10146		Tractor Shovel/Bulldozer, Remote Radio Controlled	3-22-63
10149		Engine, E-Series Block 1, Design Spec. for	9-15-63
10192		Bonding, Bokide, Strain Gages to Metal, Process for	7-30-63
10193		Generator System, Steam, for NERVA Exhaust System at LIS-1	5-20-63
10272		Pressure Vessel, Cryo, Vacuum Jacketed, for Use in Materials Test	8-26-63
10273		Tests, Vibration and Shock, NRX-A Assembly, General Requirements for	9-19-63

I. Specifications and Design Criteria - contd

<u>Design Criteria</u>	<u>Rev.</u>	<u>Title</u>	<u>Date Released</u>
NDC-02	C	Valve, Shutoff, Tank, (TSOV), for Heated and Hot-Bleed Engines	1-2-63
04	B	Valve, Turbine Power Control (TPCV) for Hot-Bleed Engine AJ30-5	--
06	B	Pressure Vessel, Hydrogen, for Hot-Bleed Engine AJ30-5	--
07	B	Line, Pump Suction, for Hot-Bleed Engine AJ30-5	5-3-63
08	B	Line Assembly, Pump Discharge, for Heated and Hot-Bleed Engines	4-15-63
14		Thrust Chamber Assembly	5-29-63
18	C	Simulator, Gen. II, Nuclear Rocket Engine, Heated Bleed, AJ31-6	11-27-62
19		Line Assembly, Propellant, for the NRX-A Reactor	7-26-63
22	A	Line Assembly, Turbine Exhaust, for Hot-Bleed Engine AJ30-5	9-19-63
24	A	Reactor Control System	11-1-63
26		Harness, Electrical, Hot-Bleed Engine AJ30-5	4-23-63
28		Pneumatic System, for Hot-Bleed Engine AJ30-5	10-31-62
29		Valve, Pressure Reducing, Tank, PS, Hot-Bleed Engine AJ30-5	10-31-62
30		Diaphragm, Burst, PS, for NERVA Hot-Bleed Engine AJ30-5	3-8-63
31		Coupling Assembly, Quick Disconnect, PS, Hot-Bleed Engine AJ30-5	10-31-62
36		Disconnect Assembly, Remote, PFS Lines, for Hot-Bleed Engine AJ30-5	12-3-62
37		Tank, Storage, Pneumatic, for Hot-Bleed Engine AJ30-5	3-4-63
39		Valve, Shutoff, PS, Hot-Bleed Engine AJ30-5	10-31-62
40		Valve, Relief, PS, for NERVA Hot-Bleed Engine AJ30-5	2-27-63
41		Valve, Check, PS, for Hot-Bleed Engine AJ30-5	12-14-62
41/1		Valve, Check, 1/2" Tube Size, Pneumatic System Hot-Bleed Engine AJ30-5	3-6-63
41/2		Valve, Check, 1-1/4" Tube Size, Pneumatic System Hot-Bleed Engine AJ30-5	3-6-63
41/3		Valve, Check, Disch. + Emergency Cooldown Line, PFS, Hot-Bleed Engine	1-9-63
41/4		Valve, Check, for Purge System PFS, Hot-Bleed Engine AJ30-5	12-21-62

I. Specifications and Design Criteria - contd

<u>Design Criteria</u>	<u>Rev.</u>	<u>Title</u>	<u>Date Released</u>
NDC-42		Filters, PS, Hot-Bleed Engine AJ30-5	10-31-62
43		Transducer, Pres., Poten. Type, for Use on T.C. Hot-Bleed Engine AJ30-5	9-23-63
44		Transducer, Temp., Res. Therm., for Use on T.C. Hot-Bleed Engine AJ30-5	9-23-63
50		Line Assembly Liq. Hyd. Propellant, ETS-1 Run Tank to NERVA Engine	10-15-62
52		Exhaust System, NERVA, for Test Stand ETS-1	2-1-63
53		Duct Assembly, Exhaust, Supersonic, Large Radius Elbow, for NES	2-1-63
54		Generator System, Gas	2-1-63
55		Trailer, Installation, for Exhaust Duct Assembly	2-1-63
56		Nozzle, Liquid Hydrogen Cooled, for NRX-A Reactor Test Assemblies	11-14-62
57		Nozzle Assembly, Propellant Cooled, for Hot-Bleed Engine AJ30-5	6-14-63
58		Turbopump, Assembly, for Hot Bleed Engine AJ30-5	4-23-63
59		Instrumentation, Exhaust Duct Assembly, Requirements for	2-1-63
60		Tank Assembly, Run, Propellant Feed, for Nuclear Rocket Engine Simulator Gen. II Mod.	12-26-62
61		Adapter Assembly, NERVA Engine to Test Stand Thrust Structure	12-21-62
62		Pressure Vessel, Hydrogen, for NRX-A Reactor Test Assemblies	2-25-63
65		Penetrations, Top Shield, ETS-1 Engine Compartment	6-28-63
66		Exhaust System, NERVZ, (SST-2), for use at Test Stand ETS-1	9-16-63
67		Duct Assembly, Exhaust (SST-2), for NERVA Exhaust System at ETS-1	9-16-63
68		Instrumentation, Exhaust Duct Assembly (SST-2) at ETS-1, Requirements for	9-16-63
69		Installation and Removal, NES Exhaust Duct (SST-2) at ETS-1, Process for	9-16-63
70		Trailer Assembly for Transporting the NES (SST-2) Exhaust Duct	9-16-63
71		Fabrication and Assembly of NES Exhaust Duct Assembly (SST-2) at ETS-1, Process for	9-16-63

I. Specifications and Design Criteria - contd

<u>Design Criteria</u>	<u>Rev.</u>	<u>Title</u>	<u>Date Released</u>
NDC-73		Aftercooling System for NERVA Engines	9-30-63
74		Covers, Dust, for E-Series Engines	9-30-63
75		Stand, Hold, Hot-Engine Remote	9-30-63
76		Trailer, Checkout, E-Engine	9-30-63
77		Containers, for Transport and Storage of Radioactive Materials	9-30-63
78		Waste Disposal, Radioactive Materials, Equipment for	9-30-63
79		Prime Mover, for Handling NES Duct Trailer in Nuclear Environment	9-30-63
80		Intercell Transfer System, E-MAD Bldg., NRDS	9-30-63
81		Inspection System, NERVA Exhaust Duct, ETS-1	9-30-63
82		Hot Cell Material Transfer System, Post- Operative Cells, E-MAD Bldg., NRDS	9-30-63
83		Test Stand Malfunctions and Equipment Requirements at ETS-1	9-30-63
84		Decontamination System, NES Duct at ETS-1	9-30-63

S/T 4.4 CENTRAL DATA SYSTEM

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-4.4	ESTABLISH AND MAINTAIN A CENTRAL DATA SYSTEM FOR STORAGE AND RETRIEVAL OF SIGNIFICANT PROGRAM DATA	COMPLETED	REPORT NO 751:378 DATED 10 JUNE 1963 MONTHLY ENG. DWG LISTS MONTHLY SPEC. STATUS REPORT 765:583 8/15/63 765:651 9/27/63 ENGINEERING DATA FILES (95000 CARDS)

BEON ROCKET ENGINE OPERATIONS - NUCLEAR

SUBTASK 4.4 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

Establish and maintain a central data system for storage and retrieval of significant program data.

Accomplishments

1. Preliminary criteria were established and forwarded to SNPO-C in June.
2. Implementation of a mechanized system scheduled to be accomplished in July was accomplished.
3. Issuance of monthly lists of engineering drawings was initiated in August.
4. Issuance of monthly specification status lists was initiated in August.
5. All available engineering drawings are microfilmed. Approximately 95,000 microfilm cards are already in storage.

SUBTASK 4.4 - BIBLIOGRAPHY

<u>Letter</u>	<u>Dated</u>
751:348	10 June 1963
765:583	15 August 1963
765:651	21 September 1963

S/T 4.5 SUBCONTRACT ADMINISTRATION

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2 - 4 a	ISSUE SUBCONTRACT DOCUMENTS	COMP	31 CONTRACT DOCUMENTS
b	LIAISON BETWEEN REON MGMT AND SUBCONTRACTORS	COMP	CONTINUING EFFORT
c	REVIEW SUBCONTRACTOR PROCUREMENT POLICY & PROCEDURES	COMP	CONTINUING EFFORT
d	SYSTEM FOR ACCOUNTABILITY OF GOVT PROPERTY	COMP	
e	PROCUREMENT APPROVAL REVIEWS	COMP	414 PACKAGES PROCESSED
F	COST AND PRICE ANALYSIS	COMP	CONTINUING EFFORT

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 4.5 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Issue subcontract documents.
2. Provide liaison with subcontractors.
3. Review subcontractor's policy and procedures.
4. Provide a system for accountability of government property.
5. Review subcontractor's procurement activities.
6. Conduct cost and price analysis.

Accomplishments

All efforts required under this subtask has been accomplished, the major areas are:

1. Fifteen major contract documents, covering \$37,720,617 in work were negotiated, issued, and approved. Eight smaller subcontracts, covering \$101,611 in work, were also issued.

2. Four hundred and fourteen procurement approval packages were processed, representing a total of \$8,739,186 in place of procurements requiring consent action.

3. Subcontractor procurement policies and procedures were reviewed on a continuing basis in conjunction with the procurement approval reviews.

4. The government property accountability system is in operation and has recorded acquisition of property valued at \$2,394,588 for the contract year.

5. Cost and price analysis functions have been performed on a continuing basis, both on major subcontracts and on procurement approval requests.

6. Subcontractor costs have been controlled essentially on or below planned budgets.

Added Scope

Repeated programming has increased significantly the planned workload.

Capital equipment accountability requirements associated with AEC accounting practices have proven more comprehensive than estimated.

SUBTASK 4.5 - BIBLIOGRAPHY

WORK STATEMENT, PAR 4 a

REON SUBCONTRACT ACTIONS
1 OCTOBER 1962 THROUGH 30 SEPTEMBER 1963

<u>SUBCONTRACTOR</u>	<u>TYPE</u>	<u>CONTRACT DOCUMENTS ISSUED</u>	<u>VALUE</u>
AMF - ATOMICS	CPFF	2	\$3,306,422
*BENDIX	CPFF	1	1,442,554
GENERAL ELECTRIC	CPFF	2	215,857
GENERAL DYNAMICS	CPFF	6	432,021
SHAWNEE INDUSTRIES	FP	1	370,357
WANE	CPFF	3	31,953,406
**OTHER	FP	8	101,611
	TOTAL	23	\$37,822,228
*PENDING - Amendment No. 1 to Supplemental Agreement No. 2			(\$57,194)
**PENDING - GENERAL ELECTRIC (FP) Thermometers			36,152

REON SUBCONTRACT ACTIONS (OTHER)
1 OCTOBER 1962 THROUGH 30 SEPTEMBER 1963

<u>SUBCONTRACTOR</u>	<u>CONTRACT DOCUMENTS ISSUED</u>	<u>VALUE</u>
ACF INDUSTRIES	1	\$15,487
AGC - NUCLEONICS	2	48,270
A & M MODEL MAKERS	1	10,000
DYNAMIC SCIENCE CORPORATION	2	26,654
PARENT TOOL & DIE COMPANY	1	540
WINDSOR GARMENT COMPANY	1	660
	TOTAL	8
		\$101,611

WORK STATEMENT, PAR 4 c AND 4 e

PROCUREMENT APPROVAL ACTIONS
1 OCTOBER 1962 THROUGH 30 SEPTEMBER 1963

	Received		Pending		Completed	
	<u>No.</u>	<u>Value</u>	<u>No.</u>	<u>Value</u>	<u>No.</u>	<u>Value</u>
AGC-AERON	36	\$804,926	2	\$30,880	34	\$664,750
AGC-AZUSA	10	95,970	2	23,741	8	72,229
AGC-DOWNEY	11	91,364	3	44,063	8	47,301
AGC-LRP	85	1,948,964	5	284,214	80	1,664,750
AMF-ATOMICS	28	484,241	9	89,486	19	394,755
WANL	244	7,448,447	37*	1,662,342	207	5,786,105
	<u>414</u>	<u>\$10,873,912</u>	<u>58</u>	<u>\$2,134,726</u>	<u>356</u>	<u>\$8,739,186</u>

* Awaiting Action 30 Sept 63

11 - WANL Action - \$ 806,566

11 - SNPO-C Action - 529,093

15 - AGC Action - 326,683

37 \$1,662,342

WORK STATEMENT, PAR 4 a

SUMMARY OF GOVERNMENT PROPERTY
CONTRACT SNP-1
FOR PERIOD ENDING 30 SEPTEMBER 1963

<u>PLANT</u>	ACQUISITION VALUE FUNDED BY		<u>TOTAL</u>
	<u>AEC</u>	<u>NSA</u>	
AGC - AZUSA	\$516,066	\$372,757	\$888,823
AGC - DOWNEY	-	32,747	32,747
AGC - LRP	-	623,547	623,547
WANL	761,987	87,484	849,471
TOTAL	<u>\$1,278,053</u>	<u>\$1,116,535</u>	<u>\$2,394,588</u>

SUMMARY OF DEPRECIABLE GOVERNMENT (AEC) PROPERTY
CONTRACT SNP-1

FOR PERIOD ENDING 30 SEPTEMBER 1963

<u>Accountability</u>	<u>Acquisition Value</u>	<u>Depreciation To Date</u>	<u>Balance To Be Depreciated</u>
AGC	\$ 516,066.00	\$ 97,020.41	\$ 419,045.59
WANL	202,968.85	10,289.30	192,679.55

S/T 4.6 SPECIAL PROGRAM SERVICES

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
	1. CONSULTANTS FOR NAG	PROVIDED	3 NAG MEETINGS
	2. SPECIAL EQUIPMENT & SERVICES	PROVIDED	IN USE

GREEN ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 4.6 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

1. Provide for nationally known consultants for the NERVA advisory group.
2. Provide special office equipment services.

Accomplishments

1. Three NAG meetings were held during the year.
2. A Clary office computer with peripheral equipment has been in use throughout the year.

S/T 5.1 PLANNED ACCOMPLISHMENTS

W/S REF. 63002

2-5.1-IA & B TEST STAND C-6 ALL EFFORT COMPLETED EXCEPT

A (1) FAB & INSTALL NOZZLE ADAPTER
COOLANT SYSTEM

DELETED DUE TO DIFFUSER DEFERRAL

A & B (3) COMPLETE CY 62 EFFORT

COMPLETE EXCEPT SS DIFFUSER

2-5.1-II A TEST STAND C-7 & 8 ALL EFFORT COMPLETED EXCEPT

(3) FAB & INSTALL VALVES FOR TPCV HOT
GAS TEST

VALVE PROCURED TO BE INSTALLED
NOV. 1963

(6) ACTIVATE TSOV VESSEL & NRX-ACFTS

TSOV COMP./NRX-A AWAITING NRX-A HDWARE

(7) ACTIVATE TSOV HOT GAS TEST SYSTEM

VALVE PROCURED TO BE INSTALLED NOV 1963

(8) COMPLETE CY 62 EFFORT

COMPLETE EXCEPT N₂ PRECHILL SYSTEM

2-5.1-II B TEST STAND C-7 & 8 ALL EFFORT COMPLETED
EXCEPT

(6) ACTIVATE NRX-A CFTS

WAITING NRX-A HARDWARE

REON · ROCKET ENGINE OPERATIONS — NUCLEAR

TASKS 5 AND 6 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

The objective of Task Items 5.1 through 5.9 is to provide for continued design, procurement, fabrication and modification of the special test equipment required during CY 1963 in Test Zones C, G, H and the Cryogenic Laboratory in support of the NERVA R&D test program in a timely manner consistent with the program test schedules and in compliance with all project requirements specified.

The objective of Task Item 6 is to provide G.F.E. for support of the NERVA R&D test program.

SUBTASK 5.1 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

All work planned for the C area was completed except for the following items:

2-5.1-I-A(1)

Fabricate and Install Nozzle Adapter Coolant System

2-5.1-I-A&B(3)

The effort not completed in the above W/S items relates to the supersonic diffuser effort for Test Stand C-6. This diffuser was planned for C-6 nozzle skirt tests. Due to the fact that H area will become available in time to accomplish this work, it is not planned to install a supersonic diffuser in the C-6 area.

2-5.1-II-A(3)

Fabricate and install valves for TPCV Hot Gas Drive

This valve was procured but has not been installed due to the urgency of TPA tests. Installation is planned for mid-November 1963.

2-5.1-II-A(6)

The TSOV vessel has been activated in Test Stand C-7, however the cold flow system for C-8 is awaiting the delivery of the test hardware for final activation.

2-5.1-II-A(7)

The activation awaits the installation of the above valve and the receipt of Generation II TPCV for tests.

2-5.1-II-B(5)

The procurement of these transducers was transferred to sub-task 2.4.

2-5.1-II-B(6)

Awaiting NRX-A hardware.

2-5.1-II-B(6) (cont.)

Work which has been accomplished under the above Subtask has involved the removal of STE from the C-6 area to make it available for nozzle testing. The C-8 area was modified to receive the Generation II engine simulator and this test system activated and the test completed. Work in Test Stand C-7 was involved first, in the modification of the test stant to provide hot gas drive to TPA and in August and early September the suction system was modified to install a TSOV vessel and simulated PFS suction piping for the TPA. This work was completed and the test stand reactivated.

AS
OF

RECON
ROCKET ENGINE
OPERATIONS NUCLEAR
AEROSPACE
GENERAL

S/T 5.2 PLANNED ACCOMPLISHMENTS

W/S REF. 63002

2-52 A CRYOGENICS LAB ALL EFFORT COMPLETE EXCEPT

(1) FAB & INSTALL 2 BEARING TESTERS FOR LAB & 5 FOR RET	COMPLETE EXCEPT 1 FOR LAB & 3 FOR RET
(2) FAB & INSTALL ENVIRONMENTAL CHAMBER	COMPLETE 10-21-63
(6) FAB & INSTALL LH ₂ PIPING	11-5-63
(7) FAB & INSTALL SIDE BY SIDE TEST SETUP	12-1-63

2-5.2 B

(1) PROCURE & INSTALL TRANSDUCERS	1-1-64
(2) PROCURE & INSTALL H ₂ LEAK MEASURING APPARATUS	11-2-63

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 5.2 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

2-5.2A(1)

All effort to provide special test equipment to the Cryogenic Laboratory was completed except as follows:

2-5.2A(1)

In CY63 two bearing testers were fabricated for RET and one for the laboratory. This reduction in work was brought about as a result of the deferral in the radiation test pallet schedule under Subtask 1.9 and as a result of fabrication and procurement delays of the bearing testers.

2-5.2A(2)

This work was completed in October rather than during the Contract Year as a result of procurement delays.

2-5.2A(6)

This effort will be completed early in November. The delay was caused by the concentration of effort in more critical areas. A portable LH_2 dewar was employed to supply LH_2 for the experiments being performed in the Cryogenic Laboratory.

2-5.2A(7)

This work statement item refers to a setup to checkout pallet No. 904. The effort has been delayed as a result of a slippage of the pallet schedule. It is planned for completion early in December.

2-5.2B(1)

This work has been completed with the exception of position, acceleration and load transducers which have not yet been delivered. This effort is scheduled for completion the first of January 1964.

2-5.2B(2)

Due to procurement delays this apparatus arrived late and is being installed at the present time. It will be complete early in November.

Work has been completed during CY63 such that the Cryogenic Laboratory construction has been completed and the laboratory equipment installed and activated. This includes the environmental test chamber, electrical test setups, a TPCV test setup, TSOV setup, the installation and activation of the bearing tester and the checkout equipment for the radiation effects bearing testers.

CONTRACT YEAR 1963

TASK ITEM 5.2

RESCHEDULED TO CY 64

S/T 5.3 PLANNED ACCOMPLISHMENTS

W/S REF. 63002

2-5.3A TEST ZONE H ALL EFFORT COMPLETE EXCEPT

(1) FAB AND INSTALL WORK PLATFORMS	DELETED
(2) FAB 2 GG FOR TPA AND TPCV TESTS	GG PROCURED, NOT INSTALLED
(6) FAB AND INSTALL MAIN INJECTOR	
(7) FAB AND INSTALL TURBINE EXHAUST EJECTOR	} DELAYED FOR NOZZLE TESTING
(8) FAB AND INSTALL H ₂ HEATER	
(9) FAB AND INSTALL TPCV HOT H ₂ TEST SETUP	
(10) FAB AND INSTALL NOZZLE ADAPTER COOLANT SYS	
(11) ACTIVATE TEST ZONE H FACILITY	12/26/63 FOR H-4 1/10/64 FOR H-6 (DELAYED FOR NOZZLE TESTING)
(13) FAB AND INSTALL VALVES FOR TPA HOT H ₂ O SYS	} DELAYED FOR NOZZLE TESTING
(14) FAB AND INSTALL TSOV VESSEL	
(15) REINFORCE H-4, 5 & 6 FOR BLAST OVERPRESSURE	
(16) MODIFY H-5 FOR NTS SUCTION LINE	DEFERRED
(17) ACTIVATE TSOV, NTS SUCTION LINE	1/10/64 (DELAYED FOR NOZZLE TESTING)

REQN · ROCKET ENGINE OPERATIONS — NUCLEAR

S/T 5.3 PLANNED ACCOMPLISHMENTS

2-5.3B TEST ZONE H ALL EFFORT COMPLETE EXCEPT

(1) FAB AND INSTALL EJECTOR ELECTRICAL SYSTEM	DEFERRED
(3) PROCURE AND INSTALL C/O EQUIPMENT	DELETED
(4) PROCURE AND INSTALL X-Y PLOTTER	DEFERRED
(5) ACTIVATE ZONE H FACILITY	12-26-63 H-4/1-10-64 H-6
(7) PROCURE & INSTALL CFDT'S DATA PROCESSING SYSTEM	DEFERRED TO 6-30-64
(8) PROVIDE ELECTRICAL CONTROLS HOT GAS SYSTEM AND TSOV VESSEL	1-10-64
(9) PROCURE & INSTALL TRANSDUCERS FOR TSOV VESSEL	1-10-64
(10) ACTIVATE ELECTRICAL SYSTEM FOR HOT GAS SYSTEM AND TSOV VESSEL	1-10-64
(11) FAB AND INSTALL TRANSDUCER SIMULATOR SYSTEM	DEFERRED
(13) FAB AND INSTALL ENVIRONMENT TRANSDUCER CALIBRATION SYSTEM	12-30-63
(14) FAB AND INSTALL CRYOGENIC REF. JUCTION	11-30-63
(15) INSTALL TRANSDUCER CALIBRATION EQUIPMENT	12-30-63
(16) FAB AND INSTALL ELECTRICAL SYSTEM VH-12 AND TPCV TEST SYSTEM	6-30-64

CHART 4

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 5.3 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

All effort in Test Zone H STE has been completed except:

2-5.3A(1)

This work was not accomplished in CY63 due to the concentration of effort on completing the assembly and activation of H area test setups.

2-5.3A(2)

The gas generators were procured but not installed.

2-5.3A(6) Fabricate and Install Main Ejector

2-5.3A(7) Fabricate and Install Turbine Exhaust Ejector

2-5.3A(8) Fabricate and Install H-2 Heater

2-5.3A(9) Fabricate and Install TPCV Hot H₂ Test Setup

2-5.3A(10) Fabricate and Install Nozzle Adapter Coolant System

2-5.3A(13) Fabricate and Install Valves for TPA Hot Hydrogen System

2-5.3A(14) Fabricate and Install TSOV Vessel

2-5.3A(15) Reinforce H-4, 5 and 6 for Blast of Pressure

2-5.3A(17) Activate TSOV NTS Suction Line

2-5.3B(1) Fabricate and Install Ejector Electrical System

2-5.3B(8) Provide Electrical Control Hot Gas System and TSOV Vessel

2-5.3B(9) Procure and Install Transducers for TSOV Vessel

2-5.3B(10) Activate Electrical System for Hot Gas System and TSOV Vessel

2-5.3B(13) Fabricate and Install Environmental Transducer Calibration System

2-5.3B(14) Fabricate and Install Cryogenic Reference Junction

2-5.3B(15) Install Transducer Calibration Equipment

The above items have been delayed due to several changes in H area activation plans. Due to the urgency of TPA testing required to meet the TPA 10-minute test milestone under Subtask 1.2, effort in the H area was directed toward the activation of H-6 which would provide the only test setup where the liquid hydrogen run capabilities existed to meet the run requirements. As a result of concentration on activating H-6, plans were made to delay the availability of H-4 for nozzle testing. Late in CY63 we were directed to make every effort to activate H-4 area as early as possible in order that long duration runs on the nozzle would be possible. As a result, activation effort in H-6 was discontinued and modifications necessary to the stand for activation of H-4 area were begun. This stand will be available for test December 26, 1963 and H-6 on January 10, 1964.

2-5.3A(11)

The above effort was deferred as noted above. Activation of H-4 will be accomplished December 26, 1963 and activation of H-6 January 10, 1964.

2-5.3A(16) Modify H-5 for NTS Suction Line

2-5.3B(3) Procure and Install Checkout Equipment

2-5.3B(4) Procure and Install XY Plotter

2-5.3B(7)

The above work statement items have been deferred until approximately June 1964 as a result of the deferral of the cold flow development test system activation date. This modification in our plans was brought about by the requirement to make additional long duration nozzle test firings to verify the nozzle design. This work must be accomplished before shutdown of the H area test stand for modification for the CFDTS.

The work which has been completed in CY63 in the H area involves the completion of the test stand structure and liquid hydrogen supply tank. This tank has been checkout and is ready for activation. The liquid hydrogen storage vessels for H area have been installed and activated. A gaseous and liquid oxygen system has been installed and is ready for activation. The test stand I&C has been installed. This includes a complex control system for the three test stands and a data processing system capable of handling the test data from any one of the three test stands.

CONTRACT YEAR 1963

TASK ITEM 5.3

CONFIDENTIAL

RESCHEDULED MILESTONE   RE
RESCHEDULED MILESTONE ACHIEVEMENT

RESCHEDULED TO CY 64

Sheet 1 of 2

CONFIDENTIAL

RESCHEDULE TO CY 64

RECON

ROCKET ENGINE
OPERATIONS, INFLUENCE

AERO
RESEARCH

TASK ITEM 5.4

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-5.4 (1)	PROCURE 25 DUAL AMPLIFIERS FOR PACE CONSOLE 231 R	COMPLETE	P.O. 353687
(2)	PROCURE 20 SETS OF MULTIPLIER CARDS FOR PACE CONSOLE 231 R	COMPLETE	P.O. 360337
(3)	PROCURE A 12-CHANNEL DIRECT WRITING RECORDER FOR CFDTS	COMPLETE	PROCURED 8-CHANNEL; SNPI-A-NAS-087
(4)	COMPLETE MODIFICATION OF THREE AEC-OWNED SINGLE CONSOLES FOR SIMULATED ENGINE TESTING	2 COMPLETED ; THIRD SCHEDULED COMPLETE IN JAN.	P.O. 350339
(5)	PROCURE CHECKOUT AND HARDWARE TIE-IN EQUIPMENT	COMPLETE	INVENTORY OF GOVT. PLANT EQUIPMENT 14 OCT 63 ; PAGES 301 TO 303 INCLUSIVE

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SUBTASK 5.4 - ACCOMPLISHMENTS FOR CY 1964

Purpose and Objective

The overall objective of this subtask was to support the controls effort of S/T 1.5, and the materials effort conducted under S/T 1.9. Specifically, the objectives were:

1. To modify and add to the analog computing equipment to provide an adequate system for engine simulation testing, and
2. To fabricate special equipment required to conduct materials thermal conductivity and tensile tests in a radiation environment.

In Subtask 5.4, the procurement of all the STE has been completed and delivery made except for the modification of one of the analog computer consoles. This modification is under contract to Comcor, and completion is rescheduled to January 1964.

2-5.4

A. In support of the systems analysis and controls program, the following work was performed:

1. The additional amplifiers to complete the full complement of the 231R console have been procured and have been in-house since the spring of 1963.
2. The multiplier cards to expand to the full complement of the 231R console have been procured and have been in use since mid-summer.
3. The procurement of a 12-channel direct writing recorder was changed to an 8-channel recorder due to a re-evaluation of paper size and the handling of the records. Also, upon re-evaluation it was decided that 8 channels of recording were adequate for the job. Another important factor in this consideration is that the paper on an 8-channel recorder does not creep like it does on the 12-channel recorder evaluated.
4. Two of the modified consoles have been integrated into the PACE computer complex. During the installation of these consoles considerable problems occurred in that noise on the power supply lines and amplifiers was increased intolerably when the consoles were connected into the complete computer installation.

5. The checkout and hardware tie-in equipment is in-house and has been in use for sometime.

B. In support of the materials radiation effects program, the following was performed.

1. A prototype thermal conductivity test apparatus was provided, and a demonstration test was completed. The remaining ten test units were manufactured but not assembled. Completion of these equipment will occur in contract year 1964. The test date is scheduled for June 1964. This work is being re-scheduled to be compatible with the rescheduling of the materials radiation tests at General Dynamics, Fort Worth.

2. All shear test fixtures and sub-size tensile test fixtures were completed and the shear test fixtures utilized for control tests.

As you can see from the milestone charts just handed you, five out of the seven milestones were completed; of the two milestones deferred, milestone No. 3 was deferred to contract year 1964 in order to allow maximum utilization of the PACE computer for solution of power range and cooldown problems. Milestone No. 7 was deferred to contract year 1964 to be compatible with the rescheduling of the materials program.

Conclusions

The objectives of this subtask, i.e., to support the controls effort and the materials effort, were met in a manner that allowed the most effort under the development subtasks to proceed as required, without any penalty in cost or schedule being imposed.

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S/T 5.5 SPECIAL TEST EQUIPMENT

ACCOMPLISHMENTS

<u>W/S REFERENCE</u>	<u>PLANNED</u>	<u>ACTUAL</u>	<u>EVIDENCE OF COMPLETION</u>
2-5.5(1) A1	FAB EQUIPMENT FOR DESTRUCT SYSTEM TESTS (E.G. TARGET DOLLY, BARRICADES)	COMPLETED	DNY 0716-16(09) MP/JUNE PG 12
2	MODIFY TEST BUILDING AND INSTRUMENT CUBICLES	DELETED	NOT NEEDED- GFTF ACTIVATION
3	MODIFY MECHANICAL TEST EQUIPMENT (E.G. TARGET DOLLY)	COMPLETED	DWGS - 511634A -512610
BI	INSTALL INSTRUMENTATION CONTROL CONSOLES	DELETED	NOT NEEDED-TESTS PERFORMED AT CHINO HILLS OR GFT FACILITIES
2	INSTALL ELECTRICAL COMPONENTS	DELETED	NOT NEEDED-TESTS PERFORMED AT CHINO HILLS OR GFT FACILITIES

REON ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 5.5 SPECIAL TEST EQUIPMENT

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-5.5 (I) B3	MODIFY INSTRUMENTATION	DELETED	NOT NEEDED - TESTS PERFORMED AT CHINO HILLS OR GFT FACILITIES
2-5.5(II) A1	PREPARE TESTING AREAS	COMPLETED	PR 175621 - NEDS DOWNEY PO 706179CD - NEDS DOWNEY
2	FABRICATE TEST STANDS	COMPLETED	DY 0716-16(02) MP/ NOV 1962 PG 40 DY 0716-16(0*) MP/ DEC 1962 PG 56

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S/T 5.5 SPECIAL TEST EQUIPMENT

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-5.5(II) A3	MODIFY TEST BUILDINGS	DELETED	NOT REQUIRED- EXISTING FACILITIES PROVED ADEQUATE FOR PARTICULAR TESTS CONDUCTED
4	TEST SETUP MODIFICATIONS (E.G. WATER TANK AERATION SET-UP)	COMPLETED	DY 0716-16(10) MP/ JULY 1963 PG 10
B(1)	INSTALL ELECTRONIC CONTROL UNITS (E.G. OSCILLOSCOPES, POWER SUPPLY UNIT)	COMPLETED	PO 445091 -CD, PO 443054 -CD, PO 448496 -CD
(2)	MODIFY TEST INSTRUMENTATION (EG. TIME DELAY GENERATOR, RESET GENERATOR, PROBE & PASSIVE TERMINATION)	COMPLETED	PO 445094 -CD, PO 444857 -CD, PO 444855 -CD, PO 444854 -CD

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

S/T 5.5 SPECIAL TEST EQUIPMENT

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-5.5 (II) A(1)	PREPARE TEST SITE	COMPLETED	H-NAD CHARGES SUBMITTED TO SNPO-C
(2)	FAB TEST STANDS	COMPLETED	DY0716-16(05)MP FEB 1963 PG 129 DY0716-16(06)MP MAR 1963 PG 107 DY0716-16(10)MP JULY 1963 PG 41
(3)	MODIFY TEST HARDWARE TO ACCOMMODATE CHANGES (E.G. 50 FT TEST STAND)	COMPLETED	PHOTO 963 188 14
B(1)	PROVIDE INSTRUMENTATION AND CONTROL DEVICES	COMPLETED	REON RPT NO. 2597 PG 107

S/T 5.5 SPECIAL TEST EQUIPMENT

ACCOMPLISHMENTS

W/S REFERENCE	PLANNED	ACTUAL	EVIDENCE OF COMPLETION
2-5.5(III) B(2)	PROVIDE MODIFICATION FOR INSTRUMENTATION CHANGES	COMPLETED	DY 0716-16(10) MP JULY 1963 PG 44
(3)	PROVIDE METEOROLOGICAL INSTRUMENTS	DEFERRED TO CY 1964	ALL ITEMS PURCHASED AND RECEIVED EXCEPT FOR PIBAL THEODOLETE AND WIND TELEMETRY EQUIPMENT. DELAY IN RECEIVING INFORMATION ON EXACT EQUIPMENT REQUIRED BY U.S. WEATHER BUREAU, LAS VEGAS, NEVADA

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

SUBTASK 5.5 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

The objective of this subtask is to provide the special test equipment needed at Downey, Chino Hills, or the Garfield Flats Test Facility in support of Subtask 1.6 Destruct System Program.

Specific objectives for CY 63 were to procure items of mechanical, photographic, instrumentation, and control equipment, meteorological equipment, and radiological equipment as dictated by the requirements of the various test programs.

2-5.5(1)A1

Support and individual test equipment for destruct system qualification and evaluation at the Downey Facility was fabricated. This equipment included target stands, barricades for cameras, and special equipment for the shipment of targets.

2-5.5(I)A2

The modifications of the test building and instrument cubicles for installation of the test equipment at the Downey Facility

This requirement was deleted. The activation of Garfield Flats Test Facility precluded the necessity for these modifications.

2-5.5(I)A3

Provide modifications to accommodate continuing test hardware configuration charges.

This item was completed. The target shipping dollies were modified to handle the more accurately simulated engine targets as required.

2-5.5(I)B1

(I)B2   These items or work were not performed since other AGC facilities
(I)B3   became available to support the test program.

2-5.5(II)A1

The testing areas for explosive concept evaluations at the Chino Hills Facility were prepared.

This preparation included black topping of a test area to facilitate recovery of fragments for data recording.

2-5.5(II)A2

Test stands and support units at the Chino Hills Facility were fabricated for the concrete-filled targets used in the development and evaluation tests of explosive charges and configurations.

2-5.5(II)A3

Test buildings for the installation of STE required for evaluation and qualification studies at the Chino Hills Facility were not performed since existing test buildings proved to be adequate for the installation of STE for test data recording.

2-5.5(II)A4

The water tank at Chino Hills Facility was modified, to provide a means of fragment recovery for the support research program studies concerned with graphite rod and B-4 fuel element fracture mechanisms.

2-5.5(II)B1

Firing units, power supply units and oscilloscopes were installed at the Chino Hills Facility in barricaded locations for the conduct of explosive and fragmentation tests.

2-5.5(II)B2

Time delay generators, reset generators, and other electronic components were installed in special circuits and modified as necessary to record applicable data at the Chino Hills Facility.

2-5.5(III)A1

Individual test sites adequate to accommodate the experiment assemblies to be evaluated and to allow for instrumented analysis at GFTF were provided.

2-5.5(II)A2

Test fixtures and stands to support the experimental assemblies to be evaluated were fabricated and installed at GFTF.

2-5.5(II)A3

A 50-ft test stand was installed and braced for a special test in September 1963. This involved modification of existing test stands to reach the elevation required. Dravo-Transportainers were modified and installed in a remote location for use as storage magazines.

2-5.5(III)B1

Instrumentation such as oscilloscopes was provided to collect and record necessary data. Firing panels were installed to ensure adequate control over explosive firings during test operations.

2-5.5(III)B2

Firing panels and time-delay generators were connected in special circuits to provide the means of introducing known time delays between the firings of various explosive charges in a target.

2-5.5(III)B3

Meteorological instruments and facility required to predict fallout of test particles at GFTF were procured.

All equipment items have been received except for a theodolite and three-wind recording-telemetry system. Purchases of the latter equipment were delayed pending receipt of exact equipment requirements from the U.S. Weather Bureau, Las Vegas, Nevada.

Conclusions

Five milestones were scheduled for completion in CY 63. Four of the five milestones were achieved as scheduled. One milestone was deferred into CY 64.

All special test equipment was procured and has been used except for four items of meteorological equipment. These include a theodolite and three-wind telemetry system for use at Hawthorne, Nevada. These items are on order and will be delivered in CY 64.

The delay in receipt of this equipment had no effect on the program progress since the CY 1963 testing was limited to unfueled targets.

SUBTASK 5.5 - BIBLIOGRAPHY

DOCUMENT LIST

I. PURCHASE ORDERS AND CONTRACTS

A. PURCHASE ORDERS

1. Install Electronic Control Units	P.O. 445091-CD
2. Install Electronic Control Units	P.O. 443054-CD
3. Install Electronic Control Units	P.O. 448495-CD
4. Modify Test Instrumentation	P.O. 445094-CD
5. Modify Test Instrumentation	P.O. 444857-CD
6. Modify Test Instrumentation	P.O. 444855-CD
7. Modify Test Instrumentation	P.O. 444854-CD

NERVA PROGRAM

SCHEDULES AND MILESTONES

CONTRACT YEAR 1963

TASK ITEM 5.5

[illegible]

DATE:

SCHEDULED MILESTONE

↑ MILESTONE ACHIEVEMENT

◆ RESCHEDULED MILESTONE

◆ RESCHEDULED MILESTONE ACHIEVEMENT

RESCHEDULED TO CY 64

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SUBTASK 5.7 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

The effort under this subtask is associated with the modification and maintenance of special test equipment necessary to support turbine drive bearing tester. This work was completed in the year.

S/T 5.7 5.9 6.1 & 6.2 PLANNED ACCOMPLISHMENTS

2-5.7 A AND B TEST ZONE G ALL EFFORT COMPLETED

2-5.9 A MISC. NON-TEST AREA LABORATORIES ALL EFFORT COMPLETED EXCEPT

(1) FAB AND INSTALL EXTENSION OF LN₂ PIPING DEFERRED

2-5.9B

(2) COMPOSITE CY 62 I & C EFFORT

COMPOSITE EX-
CEPT FOR CALIB-
RATION CRYOSTAT
1-1-64

2-6.1 A ZONE H GFE ALL EFFORT COMPLETED

2-6.2 A AND B CRYOGENICS LAB GFE ALL EFFORT COMPLETED EXCEPT

(1) FAB AND INSTALL LN₂ PIPING SYSTEM

11-9-63

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SUBTASK 5.9 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

All effort was completed with the exception of the following:

Fabricate and Install Extension of Liquid Nitrogen Piping

This effort was delayed due to late procurement and subcontractor difficulty in obtaining material.

2-5.9B(2)

This work has been completed in its entirety except for the provision of a calibration cryostat which is due January 1, 1964. Incidentally, in RN63002 the TAD is in error in that this item is included under Subtask 5.8 rather than 5.9.

The work under this subtask which has been accomplished involves the installation of an environmental chamber and fabrication equipment in the electrical test laboratory. This work has been completed and the equipment is installed and has been activated.

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SUBTASK 6.1 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

This item involved the installation of a liquid hydrogen pump and vaporizer for the H area. This equipment has been installed and activated.

SUBTASK 6.2 - ACCOMPLISHMENTS FOR CY 1963

Purpose and Objective

See page 5-1.

Accomplishments

This effort has been completed except for the following:

2-6.2A(1)

This work will be completed early in November. It was delayed as a result of late procurement and the contractor's difficulty in obtaining material.

The work which was accomplished in CY63 under this item was the installation and activation of a humidity chamber, the installation and activation of a gaseous hydrogen and nitrogen transfer piping system for the Cryogenic Laboratory, the installation of a variable frequency power supply for the bearing tester and the installation of an oscillograph record scanner, two mass spectrometer leak detectors and various power supply and instrument items.

TASK ITEM 6.2

SECRET

RESCHEDULED TO CY 64

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GENERAL

MEMO

To: Recipients of Report RN-S-0014
From: REON Documentation
Subject: Supplement to Report RN-S-0014

The attached material represents the contribution of Mr. W. D. Stinnett to the second portion of the NERVA presentation to SNPO-C on 30 - 31 October 1963. At the time of the publication of RN-S-0014, the attached material was not available for inclusion. For the proper sequence it should be inserted in Vol. II of RN-S-0014 directly preceeding section "D Summary."

R. B. Masterson, Jr.
Supervisor

TECHNICAL PROGRAM SUMMARY

You have heard a lot of detail during 12 hours of presentations that has indicated the magnitude of the effort of the SNP-1 Contract Year 1963 program. I would like to summarize the significant accomplishments in the light of the two major technical objectives of the program: these objectives being first to uncover the development problems by analysis and test and to take corrective action. The second is to provide the technical management necessary to maintain a balance between development items competing for available funds:

The problems encountered, the progress made toward their solution during the year and the status at the end of the year are summarized as follows:

SUB-TASK 1.1

A. In sub-task 1.1 the constraints imposed by the facility and NES system were recognized and the engine system was redesigned to dump the turbine exhaust gases into the nozzle exhaust at the exit plane.

B. The RIFT contractor proposed a different mechanical interface and a different TVC system from that of the NERVA engine. AGC analyzed their proposed method and made a presentation to NVPO and MSFC. The problems inferred by their proposal are far reaching - they could lead to a major redesign of the thrust structures, the pneumatic gas supply system, and possibly the test stand interface and support equipment redesigns. This is an open item at year's end but informal feedback indicates an acceptance by NVPO and MSFC of the NERVA mechanical interface and TVC system.

C. The need for various interface gages and match plates were reanalyzed, the requirements reduced by a plan that still yielded the same information.

D. Fabrication difficulties were encountered on the pressure vessel to reactor interface gage; they were overcome and the gage delivered on a schedule compatible with the NRX requirements.

E. While there were no specific problems in the systems analysis area, the many analyses being made were not coordinated to the most effective degree. In response to the customer's guide lines the efforts were centralized and, within Aerojet, brought into focus by reorganization.

SUB-TASK 1.2

A. At the beginning of the contract year the major problem of developing hydrogen cooled bearings for the TPA was still with us, and during the contract year we demonstrated the work statement requirement for one hour's endurance test in a non-radiation environment. Although the 5 minute demonstration in a radiation environment was not performed during the contract year, the test pallet was delivered and during the month of October this demonstration was made.

B. At the beginning of the contract year we were faced with the problem of a redesign of the TPA to take care of the increased head requirements brought about by the various increases in system pressure drop resulting from increased reactor core ΔP , increased nozzle ΔP and the normal increases one encounters and allows for. Normally, this problem would be handled by slight increases in pump speed; however, we were faced with the problem of handling a significant horsepower increase and we had a lid of critical speed imposed on us. The redesign was accomplished by eliminating one of these turbine stages. This resulted in an increase of the critical speed from 28-29,000 to 35-36,000 rpm, and allowed the design speed to be increased from approximately 20,000 rpm to 24,000 rpm.

C. The redesign above resulted in a decreased efficiency of the turbine and so the Mk IV was designed. The Mk IV incorporated the additional desirable features of the thrust balance piston and provisions for shaft seals so that a wet pump start may be utilized, if, for instance, the RIFT contractor proposal to move our tank shut-off valve downstream becomes an actuality.

SUB-TASK 1.4

A. The nozzle fabrication problem with the cast aluminum jacket was with us early in CY 1963. The first problem of separation of the casting from the tube bundle was corrected by providing interlocks; the second problem of brittle failure

of the first Kiwi nozzle resulted in a rapid acceleration of effort and has yielded an increase in "as-cast" properties from 1% or less to a minimum of 6% elongation (the design requirement). We have qualified two new foundries on this important problem and although we have not fully demonstrated the structural integrity of the design, there is every indication that the casting techniques will yield the required material properties. The problems we carry into Contract Year 1964, namely, the problem of obtaining reproducibility and the in-process handling problems are different than the one we encountered on the Kiwi nozzle failure.

SUB-TASK 1.5

The problem encountered with the turbine power control valve actuator has been described in some detail; that we have obtained a solution to these is evidenced by the satisfactory operation in a radiation environment. Detail analyses have uncovered potential problems associated with the integration of the actuator with the turbine power control valve. Corrective redesign was accomplished. The problem carried over into Contract Year 1964 is one of maintaining close tolerances. However, this problem was handled during CY 1963 by using lapping techniques which are generally accepted good practice in the early stages of development.

SUB-TASK 1.9

At the beginning of the contract year, it was recognized that the major problem involved in this area was primarily one of proper organization and management of this rather complex task. That corrective action has been taken at Aerojet may not have been apparent at the end of the contract year, but the fact that three of the five pallet tests carried over to Contract Year 1964 were completed in October of this year.

The Dewar failures encountered on the materials irradiation program has been corrected by redesigns which have been submitted to SNPC-C for approval.

TASK 2.4

Going into this contract year the major technical problem was one of measuring accurately the liquid hydrogen temperature in support of the TPA development program and the development of a reactor outlet temperature sensor for control purposes. One of these problems, namely the liquid hydrogen temperature sensor, was solved and although the other remains with us, the problem was defined and a development plan has been established for proceeding. At this time the sensor utilized by LASL is considered adequate for the NRX-reactor tests even though the ultimate life, response rates, and accuracy for engine operation are not met.

TASK 3.1

At the beginning of the contract year, we were confronted with a situation of having solved the technical problems of producing a design that would adequately handle the heat transfer problem, the safety, and the operational problem but the funding constraints and facility limitations (which could have been solved by additional funding for modifications) required a more economical solution. This imposed a new series of technical problems. In cooperation with the technical staff of SNPO-C and Lewis, solutions to these problems were made and on schedule. It should be noted that AGC recognized the magnitude of the problems and took the necessary steps to cope with them by establishing a separate project organization.

NRDS FACILITY SUPPORT TASKS

As you have seen, these tasks present a variety of problems, but the major one is the sporadic nature of the work load due to the unscheduled receipt by Aerojet of various sets of drawings and specifications for review. The work has in general been accomplished in a timely manner. However, we do recognize that all of the customer requested review completion dates were not met. We consider this a problem that needs the joint concerted action of SNPO-C and AGC. Anything that can be done to schedule the work load of A-E design reviews at a steady level will be directly applicable to the alleviation of this problem.

I would now like to summarize the milestone accomplishments for Contract Year 1962. (Use chart). I wish to point out that my analysis is based on the milestone report, exclusive of Task 4, included in the monthly report for September and, due to a few corrections to that report, is slightly in error and will be corrected at the same time we respond to the questions raised in this review. Of the 75 milestones carried over into Contract Year 1963, 22 are associated with the NRX program; of the 22 AGC is dependent upon the nuclear subcontractor for inputs for accomplishing 10 of them. None of the AGC items were, at the end of CY 1963, pacing the NRX program. Five are associated with the CFDTS and because of the reschedule of this system, are not pacing. An additional seven milestones are associated with the delays in placing the sub-contract with GE for the explosive irradiation experiments.

There are 24 associated with the Task 5 and 6 series and of the remaining, 15 are associated to the component development subtasks and 2 are solely dependent on the nuclear subcontractor's efforts.

CY 1963 MILESTONE SUMMARY

S/T	TOTAL NUMBER	NUMBER CANCELLED	NUMBER REMAINING	NUMBER COMPLETED	NUMBER CARRIED OVER
1.1	43	6	37	25	12
1.2	20	0	20	11	9
1.4	20	0	20	17	3
1.5	18	1	17	12	2
1.6	30	0	30	19	11
1.7	6	0	6	4	2
1.9	3	0	3	3	0
2.1	15	0	15	14	1
2.2	9	0	9	8	1
2.3	12	0	12	11	1
2.4	31	7	24	22	2
2.6	9	2	7	7	0
2.7	31	0	31	26	5
2.8	14	0	14	12	2
3.1	13	0	13	13	0
3.8	1	0	1	1	0
5.1	14	1	13	9	4
5.2	8	0	8	5	3
5.3	26	1	25	13	12
5.4	7	0	7	5	2
5.5	5	0	5	4	1
5.9	5	0	5	4	1
6.2	3	0	3	2	1
TOTALS	<u>343</u>	<u>18</u>	<u>325</u>	<u>247</u>	<u>75</u>

D. SUMMARY

We would now like to review the cost aspects of the CY 63 effort. These handout charts are provided for your reference during the discussion.

The first chart is provided as an overall SNP-1 summary. MOD 5 was in existence at the end of CY 62 with a total authorized committed cost of about 33.4 million. When MOD 6 was established, the total obligated authority increased by 57.9 million. However, several tasks, namely 1.1, 1.6, 1.9, 2.6 and 3.1 were partially funded pending further negotiation. Subsequently, MOD 8 was negotiated which, in removing the partial funding, also incorporated the revision to the hot bleed cycle rather than heated bleed. This increased obligational authority an additional 13.3 million.

The recent addition of change order 1, resulting in changes in sub-tasks 1.1, 1.3, 1.4, 1.6, 2.1, 2.2, 2.4, 3.1, 3.3, and 5.0, increased the obligational authority by approximately 1.7 million. This change order is not yet finally negotiated; however, the total obligational authority is undoubtedly very close to the \$106,318,324 noted on the chart.

It can be seen that, as of 30 September, we are under committed by 2.163 million and under expended by 4.135 million, but that open commitments are about 2 million more than originally estimated, thus indicating heavy procurement activity.

This total contract status has then been broken down to a CY 63 status by major participants. As can be seen, the under commitment is approximately evenly divided among AGC, WANL and AMF at about the \$700,000 level. However, the under expenditure is 2.9, .7 and .4 million, respectively, with Bendix \$39,000 under expended. More will be said later about the under committed variances.

Another way of describing the total CY 63 status is shown at the bottom of the chart to reference the amount of new funding for CY 63 as opposed to the unused portion of CY 62 funds that existed at the beginning of CY 63. It can be seen that the under commitment and under expenditure are both less than at the same time last year.

As noted on the chart, all costs include subcontractor G & A and fee, AGC G & A, but no AGC fee.

The next chart provides a summary of the cost elements involved in the previous information. Direct labor has been very close to budget with direct labor overhead within 3% of that forecast for the year. Material and outside production is 12% under estimate as would be expected from the general under-committed status although there has been some exchange of inside labor for outside services. Total administrative expense has been very close to that forecast, although the G & A rate has been somewhat higher than estimated. This would have caused total G & A expense to have been slightly higher had the subcontractor and outside procurement costs been fully realized.

The next series of charts entitled CY 63 NERVA Costs, are provided to reduce the previous information to the subtask level. To avoid possible confusion these charts are all prepared on a committed basis since we feel that is, in general, a more accurate approach to the measurement of progress than are expenditures. On these charts all subcontracting or outside procurement is included except that effort being performed by Westinghouse. This is done since you are primarily concerned with AGC at this briefing and since you had a review of Westinghouse last week.

The column entitled RN-62012 is the program plan number which resulted in Report 2322, and the costs are the same as in 2322.

In preparing these charts, recognition was given to the fact that you have already been given considerable detail during the subtask reviews. Therefore, the objective of these charts is to indicate the impact of the various contract changes from a cost standpoint and to summarize the major causes for variations from planned subtask costs.

The first of these charts reviews Task 1.

Subtask 1.1 - Engine System costs were \$544,000 under budget. As the year progressed, certain programmed effort became unnecessary or unrealistic. The NRX program slippages made it impossible to accomplish NRX hardware cold flow acceptance testing at LRP. The CFDTs relied on the use of NRX hardware which would become available following the NRXA-1 cold flow test. This interdependency

made it logical to reschedule the CFDTs which permitted a savings in CY 63. It became possible to use actual hardware, rather than special mockup hardware. Economies were achieved in fabrication and test administration costs. All these combined to effect a considerable saving in the CY 63 period and allowed this money to be re-allocated to other subtasks where problems were being encountered.

Subtask 1.2 - The propellant feed system effort exceeded that planned by \$701,000. Development problems in the turbo pump and bearing areas were encountered. In addition, several design changes were requested by SNPO-C during the year. Most significant of the latter was the decision to create the MOD 2 version of the MARK IV TPA to incorporate a balance piston and to provide a capability to operate as a "wet" pump without an upstream tank shut off valve. This decision resulted in substantial redesign and an extended schedule for completion of the MARK IV design. In addition, a number of added scope items, previously mentioned, added substantially to the total effort required.

Subtask 1.3 - The reactor subassembly task effort exceeded the planned cost by only \$64,000. However, since this is nearly a 20% variance it deserves some recognition. This variance represents only 2-1/2 man years effort and it was required to support the special NRX task force activities and the several program re-direction efforts.

Subtask 1.4 - Cost associated with the thrust chamber assembly exceeded that first planned by \$564,000. When difficulties were encountered in casting satisfactory aluminum jackets, a special task force was formed and alternate foundries were brought into the program. In addition, because of this problem and the critical effect on the NRX program, it was decided to rework two NRX nozzles to incorporate camera and light ports rather than only one. Further, poor quality pressure vessel forgings caused added fabrication and inspection effort.

Subtask 1.5 - The cost of the engine control task was less than planned by \$91,000. This was caused by the delay in availability of subcontracted hardware which delayed evaluation and analysis of the test operators console. An additional item not noted on the chart is a late procurement of an alternate source TPCV actuator.

Subtask 1.6 - The destruct system task was under committed by \$154,000. This resulted from a delay in resolving arrangements with the government which were required prior to proceeding with completion of the Garfield Flats Facility for explosive testing. In addition, a procurement delay was encountered with the subcontractor who will perform irradiation testing of explosives.

Subtask 1.7 - The \$43,000 cost variance in the pneumatic supply system task was caused by the need for additional liaison with the RIFT contractor with corresponding analysis and a small under estimate of fabrication costs.

Subtask 1.8 - NRDS operations cost was significantly below that first planned (\$513,000). This is entirely due to the delay in reactor testing which permitted a reduced level of staffing.

Subtask 1.9 - The cost of the radiation effects task was \$73,000 below budget. This resulted from the fact that delays were encountered in fabricating the mechanical and electrical radiation effects pallets. There was an exchange of funds planned for testing to permit repair of equipment at Convair, Fort Worth, but this was approximately an even trade-off.

Incidentally, before going to the next chart covering task 2, it may be appropriate to note that some of the delays just mentioned result in CY 63 work being carried over into CY 64. Mr. Ryland will cover this subject when I am through.

Subtask 2.1 - The under commitments of \$601,000 in remote handling equipment is the direct result of delays in procurement by the subcontractor.

Subtask 2.2 - The ground support equipment (checkout and test) task was accomplished \$19,000 below budget which is considered well within estimating tolerance.

Subtask 2.3 - The ground support equipment (handling and maintenance) task required \$206,000 more than first planned. Technical problems were encountered which necessitated considerable redesign and the fabrication costs of transporting and handling equipment for the pressure vessel were under estimated.

Subtask 2.4 - The cost to perform the diagnostic instrumentation task exceeded the estimate by \$220,000. This 14% variance resulted from changes in

the measurement lists for the NRX-A1 and A2 instrumentation and a greater-than-anticipated effort on the instrumentation data book.

Subtask 2.6 - The reliability and quality assurance task required \$119,000 or 11% less than estimated. Later-than-estimated implementation of the more comprehensive reliability and quality control program plans was the cause.

Subtask 2.7 - The safety program was performed for \$123,000 less than first estimated. Due to schedular considerations, the flight operational safety systems requirements report was deferred, thus permitting a lower level of effort.

Subtask 2.8 - A savings of \$21,000 was possible in the training program as a result of the rate of build up of staff at NRDS.

Subtask 2.9 - This LASL support task is a level of effort with support as requested. The requested level permitted an under expenditure of \$39,000.

The next chart presents the task 3 effort.

Subtask 3.0 - While this general support facilities task is under the estimate by \$13,000, it is desired to point out that a significant unplanned study effort was conducted this year at the request of SNPO-C to evaluate the possibility of using ETS-1 facilities or an alternate upward firing stand for reactor tests.

Subtask 3.1 - The NERVA exhaust system test was accomplished within \$59,000 of budget. This small variance was caused by late arrival of a GFE van which delayed the I & C installation in the test area where scale model testing is conducted.

Subtasks 3.2 through 3.9 - are basically level of effort activities and with two exceptions were all accomplished at less than first estimated. Subtask 3.3 required \$37,000 more than estimated because review of drawings and coordination with the ETS-1 I & C contractor exceeded the estimated scope. Subtask 3.6 reactor development facility required \$22,000 or approximately one man year more than estimated. This subtask provides field engineering support for test cell A activities and procedures, and was accomplished without permanent transfer of personnel to Nevada.

In all, a significantly lower cost (\$294,000) was realized while accomplishing task 3.

The next chart relates to task 4.

All of task 4 subtasks except subtask 4.3 were performed at less than budgeted levels despite their sensitivity to the numerous reprogramming efforts. The cost of these tasks is predominantly labor which indicates that desired staffing was not achieved. As in all other tasks, the required work was accomplished by use of excessive overtime, most of which was uncompensated. The cost, therefore, reflects a situation which we hope to correct in the future.

Subtask 4.3, Documentation , was over budget by \$46,000. Here a major portion of the effort is accomplished by hourly personnel so that the extra work load is necessarily reflected in the increased cost.

The next chart reviews tasks 5 and 6.

Subtask 5.1, STE - Test zone C, is under estimate by \$123,000. This occurred because certain work was delayed. Specifically this effort is associated with the nozzle adapter, diffusers, hot gas systems, associated instrumentation and the NRX-A cold flow installation equipment.

Subtask 5.2, STE - Cryo Lab, was within normal estimating tolerance on a contract year basis. However, delays were encountered which will reflect as costs after 1 October.

Subtask 5.3, STE - Test zone H, was performed for \$276,000 below budget. This reduction resulted from incompleteness of the nozzle adapter, coolant system, hot gas system, ejectors and miscellaneous propellant system test installations which were incomplete.

Subtask 5.4, STE - Azusa, was performed for \$16,000 or 16% below the estimate. This STE involves modification and updating of the PACE analog. All equipment planned for CY 63 was procured.

Subtask 5.5, STE Downey, was performed for \$10,000 less than estimated but could have been on budget had not the procurement of telemetry equipment and a theodolite been delayed.

Subtask 5.7 , STE - Test zone G, was completed for \$11,000 above estimate. While this is a large percentage, the small dollar value does not seem significant.

Subtask 5.8, was associated with the temperature lab at LRP. During the year it was deemed more proper to transfer effort associated with a calibration cryostat to subtask 5.9. The residual costs for subtask 5.8 are therefore \$55,000 below budget.

Subtask 5.9, STE - LRP laboratory bldg., was under budget \$36,000 including the effect of the transfer from subtask 5.8. However, this under budget condition results from incompleteness of LN₂ piping and the calibration cryostat.

Subtask 6.1, other government property - test zone H, was completed substantially below estimate (\$31,000).

Subtask 6.2, other government property - test zone A, was 11.5% (\$26,000) below estimate. This was a result of incompleteness of a LN₂ piping system because of subcontractor difficulties.

Subtask 6.4, other government property - development fabrication facility, was withdrawn from the program before MOD 8 was finalized and was shown only as reference to complete the MOD 6 summary.

SNP-I COST SUMMARY

SNP-I COST SUMMARY

	CONTRACT AMOUNT			ACTUAL COSTS		
	EXPENDED	OPEN	COMMITTED	EXPENDED	OPEN	COMMITTED
1	2	3	4	5	6	7
MOD 5	32,454,115	940,683	33,394,798	27,844,826	2,960,919	30,805,745
MOD 6	89,199,848	2,095,511	91,295,359			
MOD 8	99,524,975	5,057,303	104,582,278			
C/O NO.1	100,097,498	6,220,826	106,318,324	95,962,269	8,193,168	104,155,437

CY 63 PLANT STATUS

	EXPENDED			COMMITTED		
	BUDGET	ACTUAL	VARIANCE	BUDGET	ACTUAL	VARIANCE
1	2	3	4	5	6	7
AGC	34,039,523	31,085,440 ⁴⁸⁵	(2,954,083) ⁰³⁸	33,672,514	32,902,432 ⁴⁶⁵	(770,082) ⁰⁴⁹
WANL	33,957,139	33,233,035 ⁰³⁵	(724,104) ¹⁰⁴	36,800,842	36,078,107 ¹⁰⁷	(722,735) ⁷³⁵
AMF	2,739,627	2,321,598	(418,029)	3,562,710	2,895,973	(666,737)
BENDIX	1,516,383	1,477,825 ⁸²⁵	(39,058) ⁵⁸	1,476,513	1,473,150	(3,363)
TOTAL	72,252,672	68,117,443	(4,135,229)	75,512,579	73,349,692	(2,162,887)

CY 63 STATUS

1	EXPENDED 2	COMMITTED 3
NEW FUNDING CY63	67,643,383	72,923,526
UNEXPENDED CY 62	4,609,289	2,589,053
TOTAL FUNDING CY63	72,252,672	75,512,579
ACTUAL CY63	68,117,443	~~73,349,692~~
UNEXPENDED CY63	4,135,229	2,162,887

NOTE: ALL COSTS INCLUDE
S/C G & A AND FEE
AND AGC G & A.
ALL ACTUALS AS
OF 9/30/63

10/30/63

ROCKET ENGINE OPERATING RATIO

CY 1963 COST ELEMENT SUMMARY

COMMITTED

THOUSANDS

	<u>BUDGET</u>	<u>ACTUAL</u>	<u>VARIANCE</u>
DIRECT LABOR (AGC)	9,752	9,942	190
DIRECT LABOR OVERHEAD (AGC)	10,322	10,681	359
MTLS & O.P. (AGC)	11,427	10,005	(1,422)
SUBCONTRACTORS	41,841	40,447	(1,394)
G & A (AGC)	2,170	2,274	104
TOTAL	75,512	73,349	(2,163)

10-27-63 WLW

CONTRACT YEAR 1963 NERVA COSTS

WANL EXCLUDED
(COMMITTED - W/AGC G&A)

Thousands

Subtask	RN-62012 Mod 6	RN-63002 Mod 8	RN-63013 C/O #1	Total	CY 1963 Actual	Variance	REMARKS
1	2	3	4	5	6	7	8
1.1	971	2,991	33	3,024	2,480	(544)	Effort reduced due CFDTs and NRV acceptance test rescheduling. Used actual hardware rather than special mock ups. Achieved economies in fabrication and test administration. Reassigned funds to problem areas.
1.2	3,286	3,730	- -	3,730	4,431	701	Effort increased to solve development problems and to incorporate requested changes to Mark IV, Mod 2 TPA. Added scope items.
1.3	471	342	- -	342	406	64	Increased effort for reactor task force support and program re-direction effort.
1.4	4,565	5,233	119	5,352	5,916	564	Increased effort to resolve aluminum jacket casting problems and expedite fabrication through task force approach. Addition of windows in two nozzles.
1.5	2,179	2,013	- -	2,013	1,922	(91)	Late receipt of subcontractor hardware delayed evaluation tests and analysis of test operator's console.
1.6	1,440	1,704	- -	1,704	1,550	(154)	Procurement delay for explosive irradiation test and Garfield Flats facility.
1.7	365	239	- -	239	282	43	Additional RIPT liaison and underestimated fabrication cost.
1.8	- -	869	- -	869	356	(513)	Delay in reactor program permitted reduced staffing level.
1.9	845	2,443	- -	~~2,408~~ 2,443	2,335	~~(73)~~ (108)	Delay in mechanical and electrical radiation effects pallets.
Sub-Total	14,122	19,564	152	~~19,422~~ 19,716	19,678	~~(38)~~ (38)	

CONTRACT YEAR 1963 NERVA COSTS

WANL EXCLUDED
(COMMITTED - W/AGC G&A)
Thousands

Subtask	RN-62012 Mod 6	RN-63002 Mod 8	RN-63013 C/O #1	Total	CY 1963 Actual	Variance	REMARKS
1	2	3	4	5	6	7	8
2.1	4,221	3,692	25	3,717	3,107	(610)	Subcontractors procurement of remote handling equipment delayed.
2.2	932	415	30	445	426	(19)	Within estimated tolerance.
2.3	735	610	- -	610	816	206	Underestimated fabrication cost for transporting and handling equipment for pressure vessel.
2.4	965	1,552	15	1,567	1,787	220	Additional effort from changes in measurements lists for NRV-A1 & A2 instrumentation. Greater than anticipated effort on Instrumentation Data Book.
2.5	35	- -	- -	- -	- -	- -	
2.6	398	1,088	- -	1,088	969	(119)	Effort delayed due to later implementation of reliability and quality control program plans.
2.7	235	302	- -	302	179	(123)	Flight operational safety systems requirements report deferred. Lower level of effort applied.
2.8	114	124	- -	124	103	(21)	Task completed at reduced cost as result of slow NRDS build up.
2.9	469	242	- -	242	203	(39)	Support furnished as required.
Sub-Total	8,104	8,025	70	8,095	7,590	(505)	

CONTRACT YEAR 1963 NERVA COSTS

WANT EXCLUDED
(COMMITTED - W/AGC G&A)
Thousands

Subtask	RN-62012 Mod 6	RN-63002 Mod 8	RN-63013 C/O #1	Total	CY 1963 Actual	Variance	REMARKS
1	2	3	4	5	6	7	8
3.0	65	150	- -	150	137	(13)	Support furnished as required.
3.1	302	955	563	1,518	1,459	(59)	Late arrival GFE van deferred I&C installation.
3.2	499	354	- -	354	269	(85)	Support furnished as required.
3.3	230	224	8	232	269	37	Support furnished as required.
3.4	204	186	- -	186	109	(77)	Support furnished as required.
3.5	168	266	- -	266	250	(16)	Support furnished as required.
3.6	169	79	- -	79	101	22	Support furnished as required.
3.7	74	65	- -	65	32	(33)	Support furnished as required.
3.8	89	188	- -	188	133	(55)	Support furnished as required.
3.9	26	17	- -	17	2	(15)	Support furnished as required.
Sub-Total	1,826	2,484	571	3,055	2,761	(294)	

10-26-63WLW

CONTRACT YEAR 1963 NERVA COSTS

WANT EXCLUDED
(COMMITTED - W/ACC G&A)
Thousands

Subtask	RN-62012 Mod 6	RN-63002 Mod 8	RN-63013 C/O #1	Total	CY 1963 Actual	Variance	REMARKS
1	2	3	4	5	6	7	8
4.1	597	520	- -	520	488	(32)	Within estimating tolerance.
4.2	658	671	- -	671	631	(40)	Within estimating tolerance.
4.3	453	541	- -	541	587	46	Higher volume of reports than estimated.
4.4	86	109	- -	109	109	- -	
4.5	273	316	- -	316	239	(77)	Work accomplished with less than anticipated manpower.
4.6	- -	55	- -	55	36	(19)	Consultant costs less than estimated.
Sub-Total	2,067	2,212	- -	2,212	2,090	(122)	

CONTRACT YEAR 1963 NERVA COSTS

WALT E. CLUDED
(COMMITTED - W/ACC 75A)
Thousands

Subtask	RN-62012 Mod 6	RN-63002 Mod 8	RN-63013 C/O #1	Total	CV 1963 Actual	Variance	REMARKS
1	2	3	4	5	6	7	8
5.1	372	850	- -	850	727	(123)	Nozzle adapter, diffuser, hot gas system, instrumentation and R-A cold flow installation incomplete.
5.2	445	862	- -	862	908	46	Within estimating tolerance.
5.3	608	3,128	- -	3,128	2,852	(276)	Nozzle adapter, coolant system, hot gas system, ejectors, and miscellaneous propellant system test installation incomplete.
5.4	241	256	- -	256	240	(16)	Within estimating tolerance.
5.5	55	70	- -	70	60	(10)	Delay in procurement of telemetry and theodolite.
5.7	- -	18	- -	18	29	11	Task completed above estimate.
5.8	- -	67	- -	67	12	(55)	Effort transferred to Task 5.9.
5.9	<u>109</u>	<u>137</u>	<u>- -</u>	<u>137</u>	<u>101</u>	<u>(36)</u>	Incompletion of LH ₂ piping and a calibration cryostat.
Sub-Total	1,830	5,388	- -	5,388	4,929	(459)	
6.1	- -	56	- -	56	25	(31)	Completed below estimate.
6.2	110	225	- -	225	199	(26)	LH ₂ piping system incomplete due to subcontractor difficulties.
6.4	<u>329</u>	<u>- -</u>	<u>- -</u>	<u>- -</u>	<u>- -</u>	<u>- -</u>	Task never initiated.
Sub-Total	<u>439</u>	<u>281</u>	<u>- -</u>	<u>281</u>	<u>224</u>	<u>(57)</u>	
GRAND TOTAL	28,388	37,954	793	38,747	37,272	(1,475)	

10-26-63WTW

E. ESTIMATE TO COMPLETE CY 1963 WORK

On August 21 Aerojet-General Corporation made a presentation in Cleveland to describe the estimates to complete CY 1963 work which would not be finished at September 30. The premises were established as of July in order to create a start point for the 1964 Contract Year proposal. Assumptions were made regarding items which appeared to be close to completion at 30 September and, in general, these were estimated to be complete and the dollar amounts attributable to them were estimated to be committed. A number of these areas were not completed exactly as contemplated and have slid over the line resulting, as you have seen by Mr. Wheeler's discussion, in a lower than predicted commitment and expenditure at 30 September and a commensurate increase in the estimate to complete.

Aerojet in re-estimating its position as of the end of the Contract Year has been as objective as possible in establishing dollar amounts remaining to be committed against CY 1963 work. As you recognize, the contractor is bound only by the contractual language and not by numerous subsidiary written or oral representations which are not in the nature of contractual commitments. Nevertheless, in reviewing the status of the program we have recognized some gray areas wherein the contractual work statement was subject to interpretation and I wish to assure you that we have not always made our judgement solely one way. We recognize our presentation today is not in the nature of a negotiation, but is an effort to provide some bases for the Government's evaluation of the contractor's performance and completion status. The cost status and dollar estimate of work to be completed are only a part of this. Any differences on the dollar estimates to complete will, of course, be subsequently ironed out in the CY 1964 negotiations.

You have been given detailed technical presentations on each of the program areas. In addition, you have been handed "backup packages" which include milestone accomplishments, as well as deferrals past September 30. In the technical presentation charts the completion - non-completion status is correlated to the contract work statement requirements. It is not my intention to be redundant with that which you already have but to summarize, in

terms of dollars, the contract work for 1963 which remains to be accomplished after September 30.

The tabulation of our estimated cost to complete has been handed out to you. Let's take a look at the individual subtasks wherein we believe completion effort is indicated. As was stated previously in the cost status presentation, the figures shown exclude WANL carryover costs which are treated separately.

Subtask 1.1 - Engine System

The basic objectives of this integration task were met. There were some items affected, however, by the reactor test program schedule, and acceptance testing of NRX-A non-nuclear hardware will be completed in Contract Year 1964. Also remaining to be completed is the fabrication of certain CFDTS unique hardware. By Change Order 1 to Mod 8, nuclear rocket mission study work was initiated late in the contract year and this will be furnished in November. Together, these unfinished efforts total \$144,000.

Subtask 1.2 - Propellant Feed System

The major development effort on the propellant feed system was complete, but some early problems, numerous program changes plus unavailability of test facilities at the required time resulted in some hardware and test effort being carried over to CY 1964. These efforts include performance of a 10-min TPA endurance test, completion of thrust balance tester and testing, as well as radiation testing of liquid hydrogen cooled bearings (completed in October 1963) and completion of CFDTS feed lines. The unfinished portion of work is estimated at \$133,000.

Subtask 1.3 - Reactor Subsystem Management

This work was primarily level of effort and no carry-over is involved.

Subtask 1.4 - Thrust Chamber Assembly

The development problems related to fabrication of the nozzle resulted in hardware fabrication and test activities being performed after September 1963. The primary items remaining to be accomplished are fabrication and test

of NRX-A reactor nozzles and inlet lines, skirts, thrust structures and nozzles for development testing. The sum of remaining CY 1963 work is \$501,000.

Subtask 1.5 - Engine Controls

Essentially all work was completed with the exception of conduct of evaluation testing and analysis of test operators console design effort on remote engine control system and subcontracted TPCV actuator effort. This latter was committed in October. The total deferred cost is \$175,000.

Subtask 1.6 - Destruct System

All development work was completed with the exception of radiation effects on explosives which is being covered in Subtask 1.9. The facilitization of the Garfield Flats Test area in Nevada was not as complete as planned due to a combination of procurement and approval problems. A total of \$131,000 associated with this facility expansion will be done in Contract Year 1964.

Subtask 1.7 - Pneumatic System

All work was completed.

Subtask 1.8 - NRDS Operations

Since this was essentially a level of effort task to support testing at NRDS it is considered complete.

Subtask 1.9 - Radiation Effects Program

Effort associated with the subcontracted radiation effects on explosives plus fabrication and checkout of electrical and mechanical pallets for radiation effects testing amount to \$388,000.

Subtask 2.1 - Remote Handling Equipment

The later than anticipated completion of remote handling equipment fabrication by the subcontractor and the On Stand Hot Maintenance Study results in effort approximating \$667,000 being done in Contract Year 1964.

Subtask 2.2 - Ground Support Equipment - Checkout and Test Systems

This task was complete except for two items of checkout equipment for the NRX-A1 cold flow test - pressure vessel and nozzle closure kits - which will be complete early in Contract Year 1964. About \$5000 are involved.

Subtask 2.3 - Ground Support Equipment - Handling and Maintenance

This task has one area of incomplete fabrication and acceptance testing effort associated with NRX-A1 handling equipment. This amounts to approximately \$44,000.

Subtask 2.4 - Instrumentation

This subtask called for a major instrumentation development program. The outstanding effort at the end of the contract year was to provide additional NRX-A instrumentation and to complete subcontracted development effort on radiation resistant microphones and tungsten resistance thermometers. This effort amounts to \$357,000 to be performed in Contract Year 1964.

Subtask 2.6 - Reliability and Quality Assurance

There is no work deferred from Contract Year 1963.

Subtask 2.7 - Safety

This level of effort task is considered complete.

Subtask 2.8 - Training

This effort was completed.

Subtask 2.9 - LASL Support

This work was complete.

Subtask 3.0 - General Support Facilities

Subtask 3.1 - NERVA Exhaust System

Subtask 3.2 - Test Stand ETS-1

Subtask 3.3 - ETS-1 Instrumentation and Controls

Subtask 3.4 - Test Stand ETS-2

Subtask 3.5 - E-MAD Facility

Subtask 3.6 - Reactor Development Facility

Subtask 3.7 - Radiation Effects Facility

Subtask 3.8 - NRDS Radioactive Materials Handling, Decontamination and Storage Complex

Subtask 3.9 - RIFT Stage Development Facilities

The entire Task 3 series are considered complete for Contract Year 1963.

Subtask 4.1 - Program Planning and Control

Subtask 4.2 - Fiscal Control

Subtask 4.3 - Additional Documentation

Subtask 4.4 - NERVA Central Data System

Subtask 4.5 - Subcontract Administration

Subtask 4.6 - Special Program Services

All of the Task 4 Series are considered complete with the exception of 4.3 which has open the completion of the year end technical report and film report. Approximately \$38,000 are involved.

Subtask 5.1 - LRP-Test Zone "C"

Completion of Test Zone activation requires work in CY 1964 on a number of items including nozzle adapter coolant system, hot gas system, ejectors and other propellant systems. An estimated \$50,000 will be committed subsequent to September 30.

Subtask 5.2 - LRP Test Zone "A" - Cryogenics Laboratory

Approximately \$70,000 will be required to complete and install 4 bearing testers, environmental chamber LH₂ piping and leak apparatus plus some instrumentation.

Subtask 5.3 - LRP - Test Zone "H" Test Stands H-4, 5 and 6

As you know significant delay was incurred in activation of "H" area. A number of items were mentioned in the technical presentation which would be performed after September 30, 1963. Some of the more significant ones are completion of the nozzle adapter coolant system hot H₂ system, ejectors, instrumentation and control of H-4 and H-6. The estimated commitments to complete CY 1963 work are \$850,000.

Subtask 5.4 - Special Test Equipment

Complete.

Subtask 5.5 - Downey

Still open in support of destruct testing are procurement of some telemetry and theodolite equipment. Amounting to \$10,000.

Subtask 5.7 - Test Zone "G" - Test Stand G-7

Complete.

Subtask 5.9 - LRP Miscellaneous Non-Test Area Laboratories

To be completed is installation of LN₂ piping and a calibration cryostat. Estimated \$110,000 remain to be committed.

Subtask 6.1 - Test Zone "H" Test Stands H-4, -5 and -6

Complete.

Subtask 6.2 - Test Zone "A" Engineering Cryogenics Laboratory

Procurement difficulty results in necessity to complete LN₂ piping system installation for approximately \$15,000.

This brings us to the sum of estimated Aerojet work to be committed after September 30, 1963 amounting to \$3,688,000. This picture can be best shown by the Summary to Complete CY 1963 chart.

We have segregated Aerojet and WANL and present the actual September 30, 1963 cumulative commitments and expenditures against the contractual amounts authorized. The Aerojet costs shown can be checked out against our

most recent detailed cost report submitted on 22 October. The estimate to complete figure in the committed column is recognized from the review we just presented. Adding provides the total required versus that presently authorized and the difference is the additional funding required to complete CY 1963 work. The expenditures column is likewise explained.

The figures shown in the WANL breakdown result from their latest cost report and the presentation at Pittsburgh 22 and 23 October. The WANL cost to complete figures result from the application of their fee and Aerojet G & A to the approximately \$1.57 million reported as "Estimated Cost to Complete" in their Chart No. 28.

Adding the Aerojet and WANL figures presents a total commitment cost to complete of \$5.42 million and an expenditure cost to complete of \$7.39 million requiring additional Contract SNP-1 funding of \$3.258 million.

As I am sure you recognize, from the technical program description the contractor has performed a large number of complex tasks, made more difficult by frequent programmatic revisions. Certain additional efforts not originally contemplated were in fact done. The fact that \$3.258 million must be added to the contract should not be interpreted in a negative fashion. It is within reasonable estimating tolerance and it represents clearly that the contractor has approached a tough job without including normal cost contingencies one could consider and has maintained at the same time a necessary flexibility to meet various program changed requirements.

Again I point out, as I did in my opening remarks yesterday, Contract Year 1963 has been one of frequent reprogramming. The evaluation SNPO is making is in response to the experimental incentive fee clause of the contract. Aerojet has laid bare its unfinished work as well as its technical accomplishments and has attempted to be frank and objective throughout. Your evaluation affects an area about which industry and government are seldom completely objective. Yet we have given you the facts and ask that you weigh them carefully against the difficulty of the job, the year's environment, the context of a cost type R & D contract, and the probability of inventing on a precise schedule.

SNP-I SUMMARY TO COMPLETE CY '63

(THOUSANDS)

	AGC		WANL		TOTAL	
	<u>COMMITTED</u>	<u>EXPENDED</u>	<u>COMMITTED</u>	<u>EXPENDED</u>	<u>COMMITTED</u>	<u>EXPENDED</u>
ACTUAL - 9/30/63	56,682	52,067	47,473	43,895	104,155	95,962
COST TO COMPLETE	<u>3,688</u>	<u>5,659</u>	<u>1,733</u>	<u>1,734</u>	<u>5,421</u>	<u>7,393</u>
TOTAL REQUIRED	60,370	57,726	49,206	45,629	109,576	103,355
TOTAL AUTHORIZED	<u>58,122</u>	<u>55,478</u>	<u>48,196</u>	<u>44,619</u>	<u>106,318</u>	<u>100,097</u>
ADDITIONAL REQUIRED	2,248	2,248	1,010	1,010	3,258	3,258

NOTES: WANL FEE & AGC G&A APPLIED
 WANL COMMITTED ESTIMATE TO COMPLETE
 ASSUMED = EXPENDITURE

REON · ROCKET ENGINE OPERATIONS—NUCLEAR

LEGEND: "Q" - Question/Comment by SNPO
"A" - Answer/Comment by AGC

CONTRACT SNP-1
CY 1963 STATUS PRESENTATION
30-31 OCTOBER 1963

QUESTIONS AND ANSWERS

Subtask 1.1

- Q. When status is shown on the various charts, what is the "as of" date?
- A. All status charts reflect the completion status as of 30 September 1963.
- Q. When items are shown as deletions, does this mean by mutual agreement or were decisions unilateral?
- A. Some items were by customer direction, some by mutual agreement, others were decisions of the contractor based upon achieving objectives in a more economical way. It is believed the customer was aware of any such decisions.

Subtask 1.2

- Q. What was the specific design information with respect to TPCV actuators which was lacking?
- A. This detailed information will be furnished. It is as follows:
- Present fixed spline (female) on TPCV and fixed spline (male) on actuator could result in imposing radial load on actuator bearings. Bendix and IRP meeting held which resulted in solution to problem. It was decided to use male "crown" splines on both the TPCV and actuator shafts with a female spline coupling to join the two male splines. This will require a change to the valve/actuator interface which will be accomplished in a CY 64 design change to the TPCV.
- Q. Did the TPCV actuator test get run?
- A. It was not planned to conduct tests with the Bendix actuator in CY 63. Initial TPCV hot gas tests are to be run with an experimental actuator (hydraulic). Following this test series the Bendix actuator would be used for testing. Hot gas tests have been delayed due to late activation of facility for hot gas testing in C-7 area.

Q. Regarding additional effort performed, what is the "increased liaison with SNPO-C local representatives?"

A. The budget of this subtask was overrun. In analyzing the reasons for it, we assessed those things performed but not contemplated in the original estimates for CY 1963. One of these items was the extent to which time of our engineering personnel was devoted to communications and liaison with the technical representatives of SNPO-C at the Liquid Rocket Plant.

Subtask 1.3

Q. The design review by Aerojet of B2A and B4D was requested by whom?

A. Mr. Rod Spence of IASL.

Q. How many man hours were expended?

A. About 200 man hours in each case.

Q. Internal memoranda are listed in your charts as evidence of performance. Why aren't more memoranda in published reports and available to SNPO and WANL?

A. The content of such memos were used in meetings with WANL and as a general rule transmitted to WANL by letters.

Q. Effort on engine nozzle requirements really had to do with attitude control. Was this properly a Subtask 1.3 item?

A. Yes.

Q. How does work on flux determinations, etc. relate to WANL's work? How is this integrated? Are AGC maps different than WANL's?

A. The maps are based on similar information. The AGC maps include information on non-nuclear hardware. The first map had minor amount of difference as between WANL and AGC.

Q. How about codes?

A. Codes are related to the operational engine aspects, not the flux map.

Q. Are you using the same code information?

A. In many cases we are using codes of WANL. In other cases we are not. AGC is not developing nuclear codes. We're taking the information of others and using it.

- Q. Are you using WANL information and extending it to non-nuclear components?
- A. Yes. We are careful to avoid duplication of any work WANL does.
- Q. What is your estimate of the percent of time applied to integration effort of the overall system versus review and monitoring of WANL?
- A. No less than one half is integration (including program planning in this category).
- Q. What did you do "in-house" on the cementing of fuel elements program?
- A. We did three or four analyses on the advantages for clusters.
- Q. Any cementing work?
- A. Only related to fastening of strain gages on graphite. A long time ago, prior to NERVA, we did some work on cementing of graphite components.
- Q. Was any done in the last year?
- A. No. Fuel element instrumentation installation was worked on under Subtask 2.4.
- Q. Will you please review briefly your personnel buildup?
- A. In October 1962 the original staff was four people. There has been nearly a linear buildup to roughly twenty. The peak month was either June or July 1963 due to utilization of fabrication and test people on the button program.
- Q. Were results of LASL and AGC on the button program comparable?
- A. This was on B4C. LASL didn't perform the same type of investigation. LASL requested AGC to do this.
- Q. What documentation covers this work?
- A. An internal AGC memo describes this investigation. The content can be made available if you wish.
- Q. Tell us more about the organizational buildup.
- A. We had four in October 1962 and twenty in September 1963. The majority came on board in April, May and June. They became effective in June, July and August.

- Q. Separately, from this meeting, we'd like to explore the organization and subgroup assignments on Subtask 1.3.
- Q. Regarding program plans submitted by REON, these contain WANL portions. We know there may have been revisions to WANL's original submission. Did WANL respond consistently with the original guidelines?
- A. No. The initial WANL submittal for the CY 1964 program and the final WANL submittal differed significantly on numbers of reactors and test schedules.
- Q. It makes it difficult for SNFO-C to analyze when all the inputs from WANL are not received.
- Q. WANL arrived at a conclusion on the schedule two to three weeks ago which could have been arrived at sooner. There was no administrative flaw in what has taken place in the guidelines and response to them.
- Q. Was there any work done "in-house" at Aerojet related to WANL assigned effort?
- A. There was study work related to the support plate for the reactor. A preliminary investigation was made based on a forged plate design.
- Q. Was experimental work performed?
- A. Some work was done with a lucite model plus some early analyses.
- Q. Has WANL had the benefit of internal AGC work?
- A. WANL has received the content of any AGC investigation by incorporation into letters to WANL or discussions with WANL.
- Q. Is AGC in series on any WANL effort?
- A. No, unless incorporation or integration is required with other than WANL input.
- Q. Can SNFO have information which is in the many internal reports referred to?
- A. Yes. We'll make copies available to you.

Subtask 1.4

- Q. It is stated that design is complete and brazing development complete. There are real problems here and issuance of a first drawing is perhaps only 1% of completion. More drawings are needed as fabrication proceeds. Someone not close to the program could get an incorrect impression that the job is done.

- A. This is true, additional cycles are required. The intent of the presentation chart was to relate to the completion of the step or iteration planned. For instance, brazing development program is a continuing effort (Applied Research). "Completion" here means that the CY 63 portion was finished.
- Q. It is stated that conduct of Hybrid NERVA Nozzle, ACFT Pressure Vessel Structural Test was reported in March. SNPO-C actually received a report last week.
- A. Three (3) copies of the internal AGC test report R-C6415 issued 22 March 1963 were sent to SNPO-C on 1 May 1963. The final report, the NERVA Hydrostatic Test Structural Evaluation Report, Report No. 8207-6;9, AGC No. 10662 was sent to SNPO-C on 23 October 1963.
- Q. When are the two U-Tube nozzles to be complete?
- A. January 1964 and February 1964.
- Q. What is the radiation effects information on titanium? This status report says the material evaluation is complete.
- A. This work is done under Subtask 1.9 and is separately reported.
- Q. Radiation effects work is funded under 1.4, tested in 1.9.
- A. No. Radiation work is not funded in Subtask 1.4.
- Q. What were the plans for the NERVA nozzles?
- A. They were diverted to developmental purposes.
- Q. It is stated that delay to the RN-6 inlet line is due to a gimbal when in reality it is due to a hinge joint.
- A. Correct -- the language could have been more precise.
- Q. The HPNTS delay is stated to be partly due to the "H" area window. This should be omitted.
- A. The primary delay is due to lack of hardware as stated.
- Q. Injector development tests have been run for two years or so. Any progress?
- A. Yes. We still need long duration testing. There has been a considerable time period but relatively few tests.
- Q. Due to lack of hardware couldn't get more tests?

A. Due to lack of NERVA nozzles and emphasis on nozzle fabrication, we completed planned work with XLR87 nozzles.

Q. Are you getting over the hump?

A. We will have the proof when we test. We have redesigned and expect improvement in interface cooling, outer Channel (Steel) erosion problems.

Q. Which one of the twenty-seven nozzles fabricated will be used on NRXA-1 test?

A. The twenty-seven are equivalents, not specific completed nozzles. They include twenty-two in process of fabrication or completed, long lead materials procured for five, and five nozzles stripped and recast. For NRX-A-1 nozzle S/N 0000011 is prime S/N 0000010 backup. For NRX-A-2 nozzle S/N 0000012 is prime S/N 0000007 backup.

Subtask 1.5

Q. Do experimental data show that magnetic amplifiers will work in a radiation environment?

A. Yes.

Q. Regarding remote engine controls, what were the obligations in this contract year?

A. It was intended from early in the program to take simulation far enough to prepare design criteria for ETS-1 remote engine control system. We left in only the effort to complete simulation hardware.

Q. Regarding the 100-hour GTR test, how are the flux rates versus those expected in NERVA?

A. We believe we are OK above the shield. We have simulated NERVA conditions to the best of our ability except the heating due to the TPCV.

Q. Are design and development of amplifiers complete?

A. Yes -- through experimental models.

Q. Satisfaction with the amplifier design is indicated, but your reports on radiation tests indicate that magnetic amplifiers do not work well in a radiation field.

A. The last amplifier radiation tests run just recently put some fifty hours on them and indicate that the amplifiers operate satisfactorily. The radiation test that you may have been concerned about was a test run some-time in August wherein the amplifier design was such that

certain elements were not properly heat-sinked. As a result, improper operation was due to temperature effects. The designs tested recently in the GTR have corrected this design defect and, hence, the amplifiers work well within specifications.

- Q. Suggest N. Irvine and A. Hintze get together on any further detail questions.

Subtask 1.6

- Q. What was the cause of Vallecitos delay?
- A. Primarily an impasse on fee and contract provisions in placing the subcontract.
- Q. The "draft report" shown in the presentation chart indicates it includes much summary information. Is this considered complete even though SNPO-C hasn't seen the detail?
- A. We had no contractual requirement for a report but all the information is available to SNPO-C.

Subtask 1.7

- Q. What is preliminary design?
- A. In this case it includes basic layout, component criteria, schematics, etc., so that detail design can proceed.
- Q. You have said all milestones were complete yet the milestone chart disagrees. How come?
- A. Our error. As stated by the milestone chart, there were two milestones deferred.

Subtask 1.9

- Q. The redirection regarding the dewars is a matter of interpretation.
- Q. One area where the most trouble has developed is in the 501, 502, 503 series of radiation effects pallets. Why were they so late in getting tested?
- A. We would like to prepare a detailed answer on this item.

Subtask 2.1

- Q. You've indicated completion of preliminary design on the NES duct trailer. How far along is the fabrication of the OPS, EIV and MCC?
- Q. Understand meeting set for 5-6 November with AMF to get this status.
- A. Procurement of long lead hardware was initiated five months ago for all of these.
- Q. Reference to the number of WANL items complete doesn't mean one hundred percent completion of all WANL items of work does it?
- A. No. The actual number of WANL items completed has been presented in the WANL presentation of last week.
- Q. Will the duct transporter be available for the sheet metal duct testing?
- A. No.
- Q. The additional work listed regarding providing NRX equipment for E-MAD was really always contemplated wasn't it?
- A. It was always contemplated but the amount of work performed in Contract Year 1963 was significantly more than planned.

Subtask 2.4

- Q. Were milestones 25 and 26 complete?
- A. Yes. They are shown in the Instrumentation Data Book. The evaluation report has not been written.
- Q. What is the proof testing referred to in the Instrumentation Data Book?
- A. Only proof testing is per manufacturer's specifications. No testing is done by us. We are trying to buy as much as possible off-the-shelf instrumentation. Testing will be done on this program before commitment to NRX. Data from testing on another program may be acceptable.
- Q. You have referred to procurement status reports. Have such been sent to SNPO-C?
- A. Yes.
- Q. In the development program SNPO-C approval requirements exist yet work is being accomplished.
- A. There is a problem here but this discussion should be deferred.
- Q. You say you have run qualification tests for all NRX instrumentation.

- A. No. Just for the second objective. We are buying commercial instrumentation and trying to get improvements working with manufacturers. Proof testing finds the limitations of the instrumentation. This is "type-testing." One uses the information to go back to the manufacturer and it give guidance as to whether or not we can use the instrument. Qualification testing (which we are not performing) involves imposing an exact environment then keep testing until the instrument meets the requirements under this exact environment. We have only set the goals so far.
- Q. There are a number of other detail questions on measurement requirements, accuracies, etc., which are important and should be answered but can be handled outside this meeting.
- Q. How do we stand on NRX-A-2?
- A. Many instrumentation components have not yet been procured or qualified. Procurement had been postponed to take advantage of results of latest radiation effects tests.
- Q. You've stated that accuracy of $\pm .05^{\circ}\text{R}$ has been achieved. If true, this is a major improvement.
- A. We did accomplish this and agree it is a significant advance.
- Q. Do you feel comfortable with temperature control?
- A. Instrumentation for temperature control for NRX-A2 has not yet been developed to meet control system specifications. While this will not delay the NRX-A2 test, the control system may require a degraded performance level. Further analysis of the control system will give us a detailed answer as to possible lower performance.
- A. We are not comfortable regarding control of temperature within a radiation field.
- Q. When do you have to decide on instrumentation for NRXA-2 and initiate procurement?
- A. One to two months. There should be six months lead time from the test.
- Q. Instrumentation alternatives may have differing mounting requirements or affect other components. It is not known what instrumentation is to be used in the control system. Why don't you decide -- and then go ahead and buy it?
- A. We have been waiting for the test schedule to settle down and taking advantage of latest known information on instrumentation. It is clear that the final instrumentation decision dates for NRXA-2 are nearly upon us and we will get together with SNPO-C task engineers and review lead times and what actions will be taken.

Subtask 2.6

- Q. What use is made of LASL logs?
- A. WANL uses this information in designing the reactor and in reliability analyses.
- Q. How did you develop mathematical models for predicting reliability of the engine and non-nuclear components?
- A. The model for the reliability of the engine is based on the product law of statistics since the functional blocks of the apportionment diagram were selected so as to be series functions. The models for the components or functional blocks vary, depending upon the test data to be generated. These models are based on normal distributions, exponential distributions, margins of safety, etc. as applicable.
- Q. What operational data would be used?
- A. For non-nuclear components, test data on Titan and other programs were used for reliability apportionment and prediction. In using these data, changes in environment and operating conditions were considered.
- Q. Who is responsible for damage due to handling? How can this be prevented?
- A. Responsibility for handling damage is shared among several groups. Design engineering is responsible for designing a product which is least susceptible to damage. Manufacturing is responsible for providing adequate tooling and handling equipment, the preparation of handling procedures, and for the physical handling. Quality Control is responsible for reviewing handling procedures and for implementing corrective action. All of the above activities require improvement to prevent handling damage.
- Q. It is understood that items have been fabricated from drawings not checked by stress and Quality Control.
- A. It is NERVA policy that all drawings be checked for stress and quality control requirements prior to procurement or fabrication. On the modification of the No. 10 nozzle, permission was granted to use sketches rather than released drawings, but the requirements for stress and quality control checks were not waived.
- Q. AGC engineers were still considering three thicknesses of quartz glass for a nozzle window. This should have been established on the sketch or drawing by stress analysis.
- Q. (By AGC) Does SNPO-C consider there was a deficiency? Was the procedure faulty?
- A. (By SNPO-C) The procurement as agreed to by SNPO-C was satisfactory or it would not have been approved. This incident was related to a calculated risk on the thickness of the glass.

Q. The milestone charts indicate completion showing design review by Reliability. What evidence exists that these were done?

A. Milestone No. 4 was completed by WANL, but no formal report has been received by REON. Milestone No. 5 was completed by Bendix during CY 1963. The report on this review will be issued on 21 November 1963 in Report No. BPAD-863-4-15158R. Milestone No. 7 was completed by LRP, and a report has been issued by Memo No. 897 dated 28 August 1963. This report may be found in the Reliability Data Book in the Miscellaneous Section, No. 9999. A meeting of AGC and SNPO-C counterparts can explore this further if desired.

Subtask 2.8

Q. How many people were put through the entire training program?

A. One series of training was completed by twenty-eight people.

Subtask 3.1

Q. Is the scale model testing program completed for the ETS-1 duct?

A. No. The testing to date established the design operating point. Testing in CY 64 would be conducted to define the operating map of NES and for various interrelations of seal leakage, turbine flow, purge flow and nozzle area ratio and position.

Subtask 4.1

Q. When was the first time you had a computer run on NRXA-1 status and called together the responsible people to review it?

A. About two to three months ago we got our first computer run on a good integrated network and had review with responsible parties.

Q. Does WANL receive your evaluation of the overall NRXA-1 status?

A. Yes. There are various means of providing this but the most effective is via the Task Force. This group meets every two weeks.

Q. Does the NERVA Test Operation contribute directly to the integrated demand networks?

A. The input to the integrated demand networks comes via the NRX Task Force members which include the NTO.

Q. To set up a demand net, you need the people at NTO to give their input directly.

- Q. Have there been no meetings to review PERT work?
- A. There is constant daily phone communication among the participants. There are weekly meetings at LRP. There are REON composite meetings with WANL and LRP. We are not at present involving the top level REON WANL management in these meetings.
- A. In the near future a number of top REON management personnel will be indoctrinated into the Navy Polaris management system which provides for weekly overall program status reviews. These concentrate on performance, schedules and cost. All critical areas are reviewed and corrective actions taken.
- Q. This is most interesting. Could one or two SNPO-C personnel attend the briefing in Washington on this system?
- A. Yes, they are invited.

Subtask 4.4

- Q. Is there documentation as to what the central data system will do?
- A. There was a preliminary criteria report issued in June. It is noted in the bibliography.
- Q. It needs to pick up Quality Control and Reliability data, support equipment provisioning lists, etc.
- A. The criteria will be updated.

Subtask 4.5

- Q. The chart indicates an accountability system for Government property. Where is a comparable requirement for other subcontractors and AGC plants other than REON?
- A. The entire materiel functions under Contract SNP-1 are the responsibility of the REON Subcontracts Division. This includes accountability for Government property and a system has been established applicable to all AGC plants involved with NERVA work as well as to subcontractors.
- Q. What subcontractors have received approval of their procurement policy and procedures?
- A. There has been continuing review of all subcontractors' procurement systems with the objective of getting them upgraded to the extent approval can be granted of the "procurement systems." This would permit raising approval limits by both AGC and SNPO-C of subcontractor procurement packages. Improvements are being made but to date no increases in procurement approval levels have been granted. This would require joint SNPO-C and Aerojet concurrence.

Subtask 5.3

- Q. Regarding H-6 area slippage of activation from 25 October to April 1964, how much of this is due to delays by Linde and how much just general slippages?
- A. The original date for H-6 activation was 17 April 1963. This was moved to 1 June to accommodate the directed Pressure Fed Nozzle Test System conversion. It was moved to August as a result of Linde delay. Concurrently utilized this time to incorporate changes due to the Cold Flow Test and cycle changes. We could have saved ninety days except for Linde - we took advantage of the time however.
- Q. What is the end date of activation?
- A. The date we run the first test.
- Q. How confident are you of the 26 December activation date for H-4?
- A. Until three days ago we were confident. Now we have a report that the December date is in jeopardy due to late delivery of gimbal joints. Probably now moves us into the first of 1964 although there is some chance for recovery.
- Q. Does delay of H-4 mean delay of H-6?
- A. Yes. Due to labor problems we are kept off both stands simultaneously.

Costs and Estimate to Complete

- Q. Do the totals on the cost sheets include costs of subcontractors such as AMF and Bendix?
- A. Yes. The costs shown include all Aerojet costs plus all subcontractors except WANL. Costs for WANL are shown in summary on the chart entitled SNF-1 Cost Summary. The details of WANL costs were presented at Pittsburgh on 22-23 October.
- Q. On Subtask 1.9, the costs shown for Mod 8 vary from those indicated in the total column.
- A. This is an error and it will be corrected. The \$35,000 difference is due to an erroneous inclusion from Contract Year 1962.
- Q. There may be need of some further breakdown of committed costs to be incurred after Contract Year 1963. We can get together later on this.
- A. Yes. If you will advise what additional information is required, we will see that it is provided.