PLUM BROOK STATION ROCKET SYSTEMS FACILITY STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
B-1	High Energy Rocket Engine Research Fac.	NERVA A2C,A2F,A6B (Nenneberry)	NERVA engine propellant feed system tests. The investigation will include turbo pump "boot strapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: All work at Plum Brook is either on or ahead of the PERT schedule. No facility problems are apparent at this time, however all major systems with the exception of the steam system are still in the hands of the contractors.

Checkout and operation of the steam system is well under way. All operations which the steam system was designed to perform have been performed satisfactorily. To date the only problem encountered is the operation of the outlet valves on the steam accumulators. These valves have operated satisfactorily in only one of eight times that the steam system has been operated. The manufacturer of the valve and the operator have been called in to study this problem.

With steam flowing at rated pressure through both ejectors all flares are "blown out" on the flare stack. This problem is currently being investigated.

The nozzle, turbo pump and reactor are currently scheduled for delivery to Plum Brook March 18, 1963. The reactor instrumentation is essentially complete. The nozzle instrumentation installation commenced approximately February 20, 1963 and is scheduled for completion March 18, 1963. The turbo pump was tested at the Rocketdyne plant on February 20, 1963. The test data is currently being analyzed. If the test was satisfactory the pump will be shipped to Lewis immediately.

PLUM BROOK STATION ROCKET SYSTEMS FACILITY STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA A2G, A2F, A6B (Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbo pump "boot strapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: All work at Plum Brook is either on or is ahead of the PERT Schedule. No major facility problems are apparent at this time.

The operation of the steam system has been thoroughly checked. The following problems currently exist: The motor operators for the steam accumulator discharge valves are undersize and sometimes will not open the valves. This is being corrected by replacing the operators. The 16" plug-type steam valves between the accumulator discharge valves and the pressure regulating station do not seal and the operators for these valves do not function properly. These valves are not required and are being replaced with spool pieces. The steam pressure regulating station is unstable. This problem is currently being investigated. With steam flowing at rated pressure through the ejectors, all burners on the flare stack are blown out. This problem is being investigated.

Checkout of the pumping capacity of the two stage ejector system was started on March 12, 1963. Five run days will be required to completely checkout this system. All checkout runs have been postponed until the steam pressure regulator can be stablized. It is currently estimated that these tests will be completed April 12, 1963.

Note (A) - The reactor and nozzle is rescheduled for delivery to Plum Brook on April 12, 1963. The turbo pump has not been received at LRC from Rocketdyne. The turbo pump is scheduled for delivery to Plum Brook the first week of May.

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC	NERVA A2C, A2F, A6B (Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbo pump "boot strapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: The reactor and nozzle, and Rocketdyne turbopump were delivered to the test stand on April 11 and April 24, 1963 respectively. The research installation piping, instrumentation, and electrical work has commenced and is scheduled for completion on June 15, 1963.

The steam system and ejectors have been operationally checked and work is in progress to correct deficiencies uncovered during this checkout. Specifically work is underway in the following areas; (a) Pressure Regulation - The existing unit was found to be unreliable in automatic mode. Design has started on a new control system using electro-hydraulics. This problem will not result in a delay as the present system can be operated on a manual basis. (b) S. M. Smith Rotovalves - These shut off valves upstream of the pressure regulating station have malfunctioned and would require new actuator cylinders. Review of operational procedures indicates that there is no necessity for these valves and they are consequently being replaced with spool pieces. (c) Preheat System - Based on experience during check out it is advisable to relocate the preheat line to the 24" high pressure header. Work is underway. (d) John Zink Flares - The flares have been extinguished during steam flow. A representative of the company has observed this problem and has recommended installation of a gas compressor to boost inlet pressure with a possibility of some modifications being required on the overhead lines. Gas compressor installation is scheduled for completion on June 3, 1963. (e) Limitorque Operators - These valve operators on the accumulator shut off valves have caused considerable

STATUS: operational difficulties. Investigation has shown they are marginal in design and larger operators have been ordered.

An effort was made to obtain pumping capacity data on the steam ejector system during the period March 15 to April 8, 1963. Structural failure of the pressure rakes resulted in no flow data being obtained. This failure was attributed to vibration fatigue as a result of three weeks of ejector operation in an effort to correct the difficulties with the pressure regulating station. A limited amount of blank off data was obtained. However, this data will be reported by Nuclear Rocket Systems Section.

Present scheduling calls for effort to be directed to the main process system at this time. Assuming no major operational difficulties during hardware installation or check out a cold shock with LN_2 is scheduled on or about June 15. Research operations are scheduled to commence on or about August 1.

PLUM BROOK ROCKET SYSTEMS DIVISION STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA A2G, A2F, A6B (Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "boot strapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: Note (A) : Present scheduling calls for LN_2 checkout runs commencing July 1, 1963. Research operations are scheduled to start the middle of August.

Leveling of the turbopump and support pads was completed May 22, 1963. Considerable difficulty was encountered in the leveling of the turbopump which was due to the flexibility of the support structure and Rocketdyne requirement that the 3 support pads be on one plane level within .003 of an inch. Due to flexibility of the structure, the pump could only be leveled to within .006 of an inch.

Installation of piping, instrumentation and electrical work is now scheduled to be completed by July 1, 1963. This work was delayed due to the difficulties encountered in leveling of the turbopump and the holding of PR's for the cable ladders and the mylar diffuser seal by the Budget Office.

The following is a list of steam system modification items: (a) A purchase request has been initiated to design, fabricate and install an electro-hydraulics control system for the steam pressure regulating valves. (b) The S. M. Smith rotovalves have been replaced by spool pieces. (c) Steam preheat line has been moved from the 30" second stage steam line to the 24" high pressure steam header. (d) New limitorque operators have been ordered for the 18" discharge lines on the steam accumulators. (e) Due to the flares being extinguished on the flare stack during rated steam flow, the aspirator sections on the flare stack must be lowered 10' and a gas compressor installed to raise the gas pressure to 15 PSI. These modifications are scheduled for completion June 15, 1963.

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA OTO250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "boot strapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

Note (A): Present scheduling calls for liquid nitrogen check out runs commencing September 11, 1963. Pressure checking and cold shocking of the systems with liquid nitrogen are scheduled to commence August 30, 1963. Research runs with liquid hydrogen are scheduled to commence September 25, 1963. The above dates can only be met by putting the existing manpower on a six day week. Without overtime, the research run schedule will slip to October 15, 1963.

STATUS: The following work remains to be done prior to final facility checkout: Mechanical - 2500 manhours, Electrical - 1700 manhours, Instrumentation - 1000 manhours.
The nitrogen purge system preliminary checkout was completed on June 18. Minor deficiencies were found which included minor leaks, improper pressure switch settings, and improper limit switch settings. All deficiencies are currently being corrected.
Most of the steam system modifications have been completed and hydrostatic testing of the system is scheduled for completion by June 28. The new operators for the accumulator discharge valves and the new pressure control system will be installed when the equipment is received.
The modification to the aspirator units on the flare stack has been delayed due to difficulties encountered in contracting this job.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA OT0250 (H.M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

NOTE (A): Present scheduling calls for liquid nitrogen checkout runs commencing November 4, 1963. Pressure checking and cold shocking of the systems with liquid nitrogen are scheduled to start October 21, 1963. Research data runs are scheduled to commence November 18.

STATUS: The above slippage in the schedule was caused by the transfer of one mechanic from "B-1" to the CENTAUR project at "E" stand and the fact that no overtime was worked during this month. It is anticipated that a new mechanic will be assigned to B-1. If this occurs, the run date will be improved accordingly. The following work remains to be done prior to final Facility checkout:

Mechanical 1786 manhours, electrical 1070 manhours. Instrumentation 1102 manhours.

The following items were completed during July:

a. Installation of hydraulic system was completed.

b. Contract awarded for the repair of the steam accumulator covering.

c. Contract awarded for the flare stack aspirator unit modification.

d. Installation of the He purge to the research piping was completed.

e. Two of the 4" Jamesbury valves on the N_2 purge system were found to have the bodies and stems galled. The valves were returned to Jamesbury Corporation for repair.

f. Cat walks and stairs at steam accumulators were installed.

g. Floor drain and permanent steam trap lines were installed in valve house.

h. Liquid nitrogen pump was installed.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA OT0250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

NOTE (A) : New research requirements called for helium and hydrogen gas runs which are scheduled to commence on September 16 and to be completed October 11. The liquid hydrogen run start date has been rescheduled from November 18 to October 29. Due to the addition of increased overtime efforts and the addition of outside contractors to assist in the installation work, run schedules have been improved from 3 to 5 weeks.

STATUS: The following items were completed in August:

a. Aspirator units on the flare stack were changed.

b. Wiring for chilldown panels was completed.

c. New operators were installed on the steam accumulator discharge valves.

d. Purge gas lines to reactor and nozzle windows were installed.

e. Helium purge was installed between LH_2 tank and insulation.

f. All research piping was installed complete.

g. Air drier was installed in test stand.

The following work remains to be done prior to final facility checkout:

a. Mechanical - 822 manhours.

b. Electrical - 508 manhours.

c. Instrumentation - 917 manhours.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC	NERVA OTO-250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: Checkout of the facility for helium gas flow tests was completed on September 20, 1963. Two research data tests have been made with three additional gas flow tests scheduled. These gas tests will be completed October 9, 1963. The first gas test was with a helium flow rate of 1½#/sec. A preliminary evaluation of the data indicated a 40G acceleration at the nozzle. The second test was made with no helium gas flowing to determine the vibration induced into the research hardware by the steam ejectors. The data from this test indicates that the 1 to 2 G's acceleration at the nozzle is due to the steam ejector system. With the assumption that the higher acceleration rates are a result of the gas flow through the system, this will be verified by future tests.

The liquid hydrogen runs are scheduled to commence about November 18, 1963. The following problems must be corrected prior to liquid runs:

a. Gas flares on second stage ejector will not stay lit with steam flowing. Several modifications to the flares have been made, however the problem has not been corrected. Currently John Zinc Company (Manufacturer of the flares) and NASA personnel are working on this problem.

b. Liquid hydrogen run tank discharge valves must be replaced. These new valves will have the capability of being ramped open. These valves will be furnished by the research engineers and are on order.

c. The vent check valves on the hydrogen vent lines must be replaced. The original check valves are not structurally adequate for surge pressures in the vent lines.

d. Liquid hydrogen lines not insulated under the original contract must be insulated.

e. Explosion proof lighting for movie and T.V. cameras must be installed.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA OT0250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: Eight data runs were made during the month of October. Tests were made with helium gas, at maximum flow rates of approximately 3 lb./sec. No movement of the reactor core modules was evident.

Accelerations as high as 40 g's were measured on the nozzle during these tests. An investigation to determine the cause of these accelerations is currently underway.

Following the completion of the gas test on October 25, 1963, all instrumentation was removed from the reactor and nozzle. Also, at this time, all other pressure transducers were disconnected. The following work must be done prior to liquid runs:

1. All pressure transducers will be checked, recalibrated cleaned and reinstalled.
2. All pressure channels will be checked.
3. All thermocouples on the reactor and nozzle will be reconnected and checked.
4. All pressure balance panels will be modified.
5. One module of A-16 amplifiers will be modified.
6. New amplifier modules will be installed and checked out.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	(Continued)	

7. New Rosemount electronics will be installed and checked out.
8. The automatic start feature will be incorporated in the SEL (10KC) digitizer.
9. Noise on any channel will be traced down and removed.
10. Tests will be conducted to determine the feasibility of paralleling the new SEL digital system with the other digital equipment.

At the present time, the nozzle is being pressure checked and the reactor core is being shimmed. New burners for the flares on the 2nd stage ejector have been received from John Zinc Co. A contract is presently being let to install these burners. Modifications for liquid hydrogen runs by the PB Service Units are currently underway and should be completed by November 29. The only delay in facility operations that apparent at the present time are the installation of the explosion-proof lighting. Award of the lighting contract is expected by November 4, 1963, with completion approximately 40 days after award. The instrumentation work schedule depends upon delivery of equipment from Cleveland.

NOTE Ⓐ : Liquid hydrogen tests are scheduled to commence the week of Dec. 16, 1963. The schedule change for the liquid hydrogen runs was due to extension of gas testing in an effort to determine the cause of high nozzle accelerations.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC.	NERVA OT0250 (H.M.HENNEBERRY)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: Facility preparations continued for the liquid hydrogen tests. The following major items were worked on during November:

1. The reactor core was shimmed and the nozzle was pressure checked. These items were then reinstalled in the facility.
2. Stiffeners were added to the no flow diffuser.
3. Anti-vortex assembly was installed in the liquid hydrogen tank.
4. All thermocouples on the reactor and nozzle were reinstalled and checked.
5. Pressure balance panels were modified.
6. One module of A-16 amplifiers was modified.
7. Six out of the eight new amplifier modules were installed and checked out.
8. Rosemount electronics were installed and checked out.
9. The B-1 Control automatic start feature for the 'H' Bldg SEL (10 KC) digitizer is in process.
10. Tests are in process to determine the feasibility of paralleling the new 'H' Bldg SEL (10 KC) equipment with the 'H' Bldg SEL (4 KC) digitizer equipment.
11. The contract for the installation of explosion-proof lighting was awarded and installation is in progress. Completion is expected the week of December 23, 1963.
12. New burners were installed on the 2nd stage ejector. These burners would not stay lit under rated steam flow. Further studies of this problem are in progress. These studies consist of two parts: (a) Are the flares required for safe operation of the facility? and (b) What modifications are required to insure that the flares will stay ignited under rated steam flow?

Facility preparation and checkout should be completed the week of Dec. 16. A full scale data run, using liquid nitrogen as the propellant, will be made the week of Dec. 16. Liquid hydrogen testing will commence after the successful completion of the liquid nitrogen checkout test.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH FAC	NERVA CTO-250 (H.M.HENNEBERRY)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: On December 18, 1963, an initial complete system liquid nitrogen data run was attempted. The run had to be aborted because the instrument noise levels were above the acceptable limits and additional problems were encountered in the monitor instrumentation. The monitor instrumentation problem has been corrected and an extensive investigation of the instrument wiring is being conducted to determine if the wiring installation is in accordance with established low-level signal shielding practices. Also, all noise sources will be rechecked and eliminated if possible. A complete instrumentation dry run is tentatively scheduled for January 13, 1964. Another liquid nitrogen data run is scheduled for January 17, 1964 if the instrumentation run is successful.

Facility mechanical work continues, with emphasis on preparation for a liquid hydrogen test. Present estimates indicate about 400 manhours of mechanical work are required to prepare for the liquid hydrogen test. A liquid hydrogen data run is scheduled for the third or fourth week of January, or one to two weeks after the successful liquid nitrogen test. Critical problem areas possibly affecting the liquid hydrogen run are:

(1) Resolution of the John Zinc burner problem. New desigr units are currently being installed. Checkout under various steam conditions by RSD personnel will be conducted January 7, 1964.

(2) Leak-tight sealing of the liquid hydrogen tank to adapter flange. Flange leaks were experienced with liquid nitrogen, so teflon coated self-energizing metallic "O" rings were ordered and are scheduled to be delivered January 7, 1964.

(3) Thorough checkout of the RocketDyne pump discharge valve to assure leak tightness. Valve leakage would cause a safety hazard during pump chill-down.

NOTE Ⓐ : Site operations schedule was changed because of difficulties encountered in checkout run of December 18, 1963

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA OT0250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

STATUS: The first liquid nitrogen data test run, under altitude conditions, was completed January 17. It was necessary to compromise some of the data channels due to excessive noise levels. Minor facility problems were experienced with the nitrogen purge system. The instrument noise has been attributed to the Rosemont temperature sensor power supply network. An instrument engineer from Rocket Systems Division has worked directly with Rosemont in attempts to eliminate this problem. Although promising results were obtained in the "laboratory", these results could not be obtained in the field installation. The nitrogen purge system problems have been corrected.

A second liquid nitrogen data test run was attempted on January 28 and was aborted due to high noise level on approximately 60% of instrumentation channels.

The major facility mechanical problem encountered was apparent failure of one hydraulic pumping unit. At the current time, work is continuing on both of these problem areas.

Other than those problems already mentioned, the major impediment to a liquid hydrogen test run is the leak-tight sealing of the Rocketdyne pump discharge valve which was found to leak at liquid nitrogen temperatures. Possible alternatives are presently under consideration to allow a liquid hydrogen test without hazarding the facility. The status of problems indicated in prior reports is as follows:

1. The new John Zink flare design has proven to be satisfactory in two tests.

2. The tank adapter flange outer "O" ring has been sealed at liquid nitrogen temperatures; however, additional work remains to be done on the inner "O" ring seal. A second liquid nitrogen data run is scheduled for the first week of February. The date of the first liquid hydrogen test run is approximately two weeks after a successful liquid nitrogen data run.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA OT0250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

On February 12, the second liquid nitrogen data run under altitude conditions was completed. According to the Lewis project engineer, the data appeared satisfactory with the exception of the Rosemount temperature sensor channels. To reduce the noise in these signals, individual Isoplys are being installed on each Rosemount channel. This work is scheduled to be completed for the next data run. Another problem encountered during the run was the freezing of condensed steam in the nitrogen purge system regulators. This problem will be eliminated by changes to the operational procedures. Progress on problem areas indicated in prior reports is as follows:

Barring additional and unforeseen difficulties with research pump seal checks and final assembly, it is planned to operate the liquid oxygen pump on liquid nitrogen during the week of March 15.

(1) Modifications to the instrument transmission cable grounding system has eliminated the major instrumentation noise problem which caused the cancellation of the January 28 test.

(2) The tank adapter flange was removed, inspected, the damaged inner "O" ring was replaced, and reassembled. The unit will be pressure-checked at cryogenic temperatures prior to the reinstalling of the pump inlet piping. Installation of the "O" rings is difficult because of their flexibility and large diameter.

(3) A conference was held with Lewis Personnel and the following decisions were made:

(a) The Rocketdyne pump discharge valve which is not sealing properly will be replaced with a 4" Hadley butterfly valve.

(b) General Monitors Corporation hydrogen sensors will be installed downstream of the Hadley valve to indicate leakage and control facility shutdown before unsafe conditions occur.

(c) An Annin hydrogen "dump" valve will be installed upstream of the Hadley valve, so that chilldown hydrogen can be dumped prior to initiating the start-up test sequence. This system will allow a more realistic initial condition in the downstream piping, nozzle and reactor. Formerly, the chilldown fluid passed through these components prior to the starting of the test sequence.

Hydrogen data run will be made about a week and a half after the delivery of the Hadley valve which is scheduled to be delivered on March 16, 1964.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA 0T0250 (H.M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

The first liquid hydrogen data run was achieved on March 25. No major problems were encountered and a preliminary data check indicates that the data acquisition system operated satisfactorily. However, final evaluation cannot be made until the run data has been reduced.

Prior to the March 25 liquid hydrogen run, the following facility modifications and improvements were completed:

(1) Individual "Isoplys" were installed on each Rosemont temperature channel. Checkout tests indicate the elimination of the noise previously experienced on these channels.

(2) Operational procedure changes eliminated the malfunction of the exhaust duct nitrogen purge.

(3) The run tank adapter flange was welded to the tank. This was necessary because all other efforts to seal this flange at cryogenic temperatures were unsuccessful.

(4) The Rocketdyne pump discharge valve was replaced with a 4" Hadley butterfly valve. The system was leak checked with liquid nitrogen and significant leakage was experienced during chilldown, but a good seal was obtained after approximately 20 to 25 minutes at liquid nitrogen temperatures.

(5) An Annin valve was added to dump the liquid hydrogen chilldown fluid overboard prior to test run startup.

(6) A Milton Roy Co. "Hymonitor" hydrogen detector was installed at the nozzle exit to detect any hydrogen leakage past the Hadley butterfly valve during the chilldown.

A second hydrogen test is scheduled for the week of April 6, with successive tests scheduled for every other week.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA 0T0250 (H.M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

On April 7, a second liquid hydrogen data run was aborted after the run tank had been loaded, when the normally open Jamesbury run tank vent valve could not be fully closed. The valve seemed to be frozen, but efforts to free it with ambient purge gas failed. The apparent trouble was caused by a decrease in the Jamesbury operating pressure due to a leaky bleed valve.

On April 22, a liquid hydrogen run was successfully made. Trouble was encountered with the run tank vent valve after the tank was loaded. The valve would close but could not be fully opened. The run was made by careful manual control of the run tank servo vent valve prior to and after the automatic sequence. The exhaust gas was ignited by the flare stack on the second stage steam ejector on this run. The present status of the facility is as follows:

Items completed this month:

(1) The four-inch Hadley pump discharge valve was removed and a new seat installed. (Valve indicated leaking under vacuum conditions on the first liquid hydrogen run.)

(2) The Hadley pump discharge valve was leak-checked with an external liquid nitrogen bath.

(3) Permanent control and power wiring were installed for five high-speed movie cameras.

(4) Temporary wiring for an additional TV camera was installed.

(5) TV selector switch and TV tape recorder were added.

Problems presently being investigated:

(1) The operation of the Hadley pump discharge valve, and the reasons for leakage experienced by this valve.

(Continued on Page 16)

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH		
			(2) The operation of the Jamesbury vent valve. Items to be completed in May: (1) The installation of a quality meter between the liquid hydrogen pump and the nuclear engine. (2) Addition of a bleed line from the pump discharge to the tank vent to facilitate a shorter pump cool down time. (3) The installation of a purge gas heater to be used to heat the engine to ambient temperature after the test run. (4) Repair of the support brackets for flare stack on 2nd-stage ejector,which were damaged by vibration on the last liquid hydrogen run. Liquid hydrogen test runs are scheduled for May 6 and May 20.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA OTO-250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages and equipment performance evaluations.

On May 6 and May 22, the third and fourth liquid hydrogen runs were successfully completed. The May 22 run was scheduled for May 20, but had to be postponed two days because of a blockage in the two-inch discharge line on the H-8 liquid hydrogen supply dewar. Facility modifications were required so that the H-3 dewar could be used.

Other items completed this month:

1. Jamesbury vent valve operator was modified so that pneumatic pressure would assist the spring in opening the valve.

2. A quality meter was installed between the pump discharge valve nozzle inlet.

3. A bleed line was installed immediately upstream of the pump discharge valve to facilitate pump chilldown.

4. The brackets supporting the flares on second stage ejector were repaired.

5. Exterior painting of the test facility was completed.

Problems presently being investigated:

1. The leakage of the four-inch Hadley pump discharge valve is being investigated.

2. Installation of a purge gas heater to be used to heat the engine to ambient temperature after the test run is being investigated.

Liquid hydrogen test runs are scheduled for June 3 and June 17.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA OT0250 (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests fluid instabilities in the engine flow passages and equipment performance evaluations.

On June 3 and June 17, liquid hydrogen runs No. 5 and No. 6 were conducted at liquid hydrogen flow rates of six pounds per second with 10 PSIG tank pressure and 14 pounds per second with 35 PSIG tank pressure.

Critical startup transient data was not recorded on the June 3 run because the "H" Building data recording equipment started 24 seconds late. The cause of the delayed start is unknown and the system has been repeatedly checked and it operated correctly for the June 17th run. Startup transients of the June 3 type will be repeated in future tests.

During the June 3 run, oscillations were observed on the pump inlet flowmeter, pump interseal gaseous helium purge pressure, and the pump aft bearing temperature. Following the run, the inlet flowmeter was removed and checked. The bearings showed considerable wear and they were replaced. The three instrument channels that were involved were checked for cross-talk, but none was found.

On the June 17th run the pump interseal purge was turned off and no oscillations were experienced. It was speculated therefore that the oscillations were caused by the pump interseal bleed; further investigation to verify this will be made on the run of July 1. Following the June 17 run, the pump exit Venturi flowmeter was removed and sent to Lewis for recalibration for the next run.

Items completed and items worked on in June:

(1) A general Monitors Company gaseous hydrogen detector was evaluated at Plum Brook for potential use as a hydrogen leak detector in inert atmospheres; this preliminary evaluation indicated the unit was not suitable for this application. Further consultation will be made with General Monitors personnel. Use of a modified MSA unit is now being investigated.

(2) Hydraulic and gaseous helium regulator system on pump package was relocated to improve TV viewing of pump turbine shaft.

(3) Rehabilitation of Boilers #2 and #4 is nearing completion. When completed, capacity of the Boiler House will be doubled, resulting in shorter time periods for charging steam accumulators.

Liquid hydrogen test runs are scheduled for July 1, 15 and 29.

NOTE Ⓐ: Schedules changed due to program re-evaluation. After startup transient tests with the present system are completed, one bootstrap test will be made prior to changing to flight weight piping system configurations.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (T1011) (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On July 1 and July 15, liquid hydrogen runs No. 7 and No. 8 were successfully conducted. Test Run No. 7 was conducted at a tank pressure of 10 PSIG with a maximum flow rate of $5\frac{1}{2}$ #/sec. Test Run No. 8 was conducted with the liquid hydrogen pump rotor locked to determine torque generated in pump due to liquid hydrogen flow. Tank pressure was ramped to 55 PSIG with a maximum flow rate of $9\frac{1}{2}$ #/sec. All previous tests had been conducted with the liquid hydrogen pump free to windmill.

Oscillations, as noted in the June Status Report, were experienced again on the run of July 1, with the pump gaseous helium interseal purge energized or de-energized. The run of July 15 was conducted after an increased chill-down period in an attempt to eliminate these oscillations without success. At the present time, the cause of these oscillations is unknown and further investigation is required.

On July 29, liquid hydrogen run No. 9 was attempted. Approximately eight hours was spent in attempting to define the performance requirements for the pump discharge servo valve.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH		

After this requirement was established, the remaining work which still had to be accomplished prior to running was considered excessive so the run was cancelled.

Items worked on in July:

(1) A static torquemeter was temporarily installed on the pump rotor for fit-up, sent to Lewis Research Center for application of stain gauges, and upon its return installed in system for Run No. 8.

(2) The Rocketdyne liquid hydrogen bypass servo valve was removed due to a seal leak and replaced with a new valve. The damaged valve was returned to Rocketdyne for repair.

(3) The gaseous nitrogen heater installation was completed and checked out.

(4) After the test run of July 15, the temperatures of the reactor, nozzle and several propellant piping components were monitored to obtain a history of their normal warm-up characteristics.

(5) Two additional hi-speed Fastex movie cameras are being installed for the next run.

Liquid hydrogen test runs are scheduled for August 12 and August 26.

Startup transient program will be completed with the run of August 26. The first "bootstrap" test will be made September 16, after installation of new control system for turbine, between August 26 and September 16. Between September 16 and September 30, new flight weight piping system will be installed and the remainder of tests made with this system.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (T1011) (H. M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On August 12, liquid hydrogen run No. 9 was successfully completed. The test was made with a tank pressure of 35 PSIG and the pump discharge valve was ramped to a maximum opening of 18%. The maximum flow rate attained was 5#/sec. "Pips" in the tank discharge flowmeter data were negligible on this run. The disappearance of these "pips" is attributed to the extended pump chilldown.

The test run scheduled for August 26 was cancelled by the Research Project Engineer because additional cooldown data was not needed, and the time could more effectively be used to make modifications for the bootstrap tests.

Items worked on in August:

(1) Contractor tie-in of "B-3" exhause duct to the "B-1" system was started.

(2) Flanges on the 96" butterfly valve in "B-1" exhaust duct were seal welded to repair a leak in the flange joint.

(3) The torquemeter was removed from the Mark IX turbo pump. A new shaft will be installed and then the assembly will be reinstalled.

(4) Modifications to servo-control systems necessary for bootstrap tests were started.

(5) After the test run of August 12, ambient temperature gaseous nitrogen was passed through the nozzle and reactor to determine warm-up characteristics.

Liquid hydrogen test runs are scheduled for September 16 and September 30. After the September 16 bootstrap run, the piping from the pump discharge to nozzle inlet will be changed to flight weight piping. The September 30 run will be the last cooldown test with the present test equipment.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (T1011) (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On September 21, 1964, liquid hydrogen Run #10 was completed. This run was delayed from September 16 to September 21 because the bellows in the turbine inlet line was leaking and had to be replaced. This run was the first attempt to "bootstrap" the Mark IX turbo pump. The turbo pump "bootstrapped" with a maximum LH_2 flow rate of 18#/sec. at a speed of 4,300 RPM. The test results were of limited value due to the following:

1. Run duration was short due to insufficient LH_2 supply to fill run tank prior to run.
2. Several important channels of instrumentation were not recorded.

On September 30, Run #11 was successfully completed. The turbo pump 'bootstrapped' with a LH_2 flow rate of 26 #/sec. at 7,000 RPM. Complete results of this test are not available since no data has been reduced at this time.

The piping from the pump discharge to the nozzle inlet has not been replaced with flight weight piping due to late delivery of component parts.

This piping is currently scheduled to be installed the week of October 19, 1964. LH_2 runs are scheduled for October 14 and October 28.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (OT1011) (H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On October 15, the third Mark IX Turbopump Bootstrap Test was completed (Run #12). The maximum flow rate was 26# per second at 7600 RPM. All test objectives were successfully met. This test run was delayed a few hours due to excessive pressure drop across the filter in the turbine lube oil system. After the run, the lube oil system was checked. It was found that the oil contained a large amount of carbon particles. These particles apparently were from the turbine seals. The oil system was cleaned and put back into service. A further investigation of this problem is being made. The pump discharge piping to nozzle inlet was replaced with Schedule 5 piping, lightweight flanges and gimbals.

On October 22 through 28, a series of steam ejector tests were made to determine the ejector air pumping capacity at design and reduced steam pressures. The data was reduced and a report has been published.

On October 30, Run #13 was successfully completed. This run was a chilldown test with no power being applied to the turbine. A maximum flow rate of 10# per second was attained with a pump speed of 3000 RPM. The test data for this run has not been reduced.

NOTE: Liquid hydrogen runs are scheduled for November 12 and November 25.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (OT1011) (H.M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

A planning meeting was held on November 6 with the Lewis Research personnel. The Mark IX turbo pump testing was scheduled for every two weeks until March 3, 1965. The Mark III turbo pump was scheduled to be installed after the Mark IX tests. Approximately six to eight weeks will be required to install the Mark III turbo pump and to accomplish the following items:

(1) Installation of the SEL equipment and the expansion of the "B-1" Test Stand instrument terminal room.

(2) Installation of a burnoff line from pump discharge to either test stand roof or ground level.

(3) Installation of a liquid hydrogen transfer line from the 200,000 gallon storage tank to "B-1".

(4) Installation of a new steam pressure control system.

It was also decided at this meeting that the 20,000 gallon liquid hydrogen run tank would not be installed during this shutdown.

On November 12, liquid hydrogen Run No. 14 was successfully completed and all the test objectives were attained. The maximum flow rate was 21#/sec. at 6300 RPM. This run was the first of a series of bootstrap tests with lightweight piping installed between the pump discharge and the nozzle inlet.

On November 18, while attempting to calibrate the torquemeter, the turbine lube oil sprayed out the turbine exit, indicating the failure of the carbon seals. This confirmed the conclusions made in the October status report. A spare turbine is being installed and the defective unit will be returned to Rocketdyne. Because of this problem, Run #15 had to be rescheduled from November 25 to December 9.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (OT1011) H.M.Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On December 9, Liquid Hydrogen run No. 15 was made. The turbine speed could not be controlled, therefore the run was shut down after sixteen seconds. Investigations indicated a faulty feedback signal to the speed controller caused the turbine power control valve to go to the full open position.

On December 22, Liquid Hydrogen run No. 16 was completed. A maximum hydrogen flow rate of twenty-nine pounds per second was obtained at a pump speed of 9000 RPM. Most of the systems functioned properly, however, the pump speed/flow control loop was unstable and caused the turbine pressure control valve to oscillate. This problem is being analized.

Facility work that was accomplished in December:

(1) The new turbine installation was completed.

(2) Additional instrumentation and a camera port were installed in the liquid hydrogen line upstream of the nozzle inlet.

(3) A new control-system was installed for the turbine power control valve.

(4) The railroad siding was completed.

(5) Preliminary design was initiated for the required modifications for Block II testing.

NOTE: The 'Bootstrap' Tests run schedule has been extended three weeks to the end of March. This schedule change was required because Run #15 did not accomplish the research objective.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA (OT1011) (H. M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On January 13, Liquid Hydrogen run #17 was completed. A maximum hydrogen flow rate of approximately 28 #/sec. was attained at a maximum pump speed of 8100 rpm. The run duration was 54 seconds. All data appears to have been satisfactorily recorded and there were no significant problems.

On January 27, Liquid Hydrogen run #18 was completed. A maximum hydrogen flow rate of 24 #/sec. was attained at a maximum pump speed of 7500 rpm. The run duration was 67 seconds. The data has not yet been reduced, however all the data appeared satisfactory at the conclusion of the test and no significant problems occurred during the run.

Other January work items were:

(1) The test stand heating system modifications were started. These modifications are required to increase the system capacity.

(2) Design work on facility modifications for Block II testing continued during January.

NOTE: Reactor structural tests have been added to the test program. They are scheduled to start in March 1966.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH	NERVA OT1011 (H.M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On February 10, liquid hydrogen run #19 was completed. A maximum hydrogen flow rate of approximately 23 #/sec. was attained at a pump speed of 6500 RPM. The run duration was 55 seconds. No significant problems occurred, and all data appear to have been satisfactorily recorded.

On February 24, liquid hydrogen run #20 was completed. A maximum hydrogen flow rate of 18 #/sec. was attained at a pump speed of 6000 RPM. The run duration was 75 seconds. No data has been reduced at this time; however, all data appeared satisfactory at the conclusion of the test.

Other February work items were:

(1) The test stand heating system modifications were essentially completed, with only a few minor items remaining to be done.

(2) Design work on facility modifications required for Block II testing continued during the month.

NOTE: The last test run in the Block I series will be completed by the end of March, and the facility will be shut down in order to start the modification work for the Block II series.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH		
		NERVA OTI011 (H. M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests, fluid instabilities in the engine flow passages, and equipment performance evaluations.

On March 10, liquid hydrogen run #21 was completed. A maximum hydrogen flow rate of approximately 21 lb./sec. was attained at a pump speed of 7500 rpm. The run duration was 49 seconds. No significant problems occurred, and all data appear to have been satisfactorily recorded.

On March 24, liquid hydrogen run #22 was completed. A maximum hydrogen flow rate of 18 lb./sec. was attained at a pump speed of 5500 rpm. The run duration was 65 seconds. No data have been reduced at this time; however, all data appeared satisfactory at the conclusion of the test.

Other March work items were:

(1) The test stand heating system modifications were completed.

(2) Design work on the facility modifications required for Block II testing continued during the month.

NOTE: Due to a Block I program extension, the run schedule has been extended to early April. Following these runs, the facility will be shut down in order to start the modification work for the Block II series.

SITE	LOCATION	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE RESEARCH STAND	NERVA OTIOII (H. M. Henneberry)	NERVA engine propellant feed system tests. The investigation will include turbopump "bootstrapping" tests fluid instabilities in the engine flow passages, and equipment performance evaluations.

On April 7, liquid hydrogen run #23 was completed. A maximum hydrogen flow rate of 31#/sec. was attained at a pump speed of 10 000 rpm. The run duration was 20 seconds.

On April 13, liquid hydrogen runs #24 and #25 were completed. A flow rate of 31#/sec., at a pump speed of 10 000 rpm was attained on run #24. A flow rate of 28#/sec. at a pump speed of 8 500 rpm was attained on run #25. Total run duration for these tests was 35 seconds.

On April 27, liquid hydrogen run #26 was completed. The turbopump system was bypassed for this run to obtain system dynamics data. A flow rate of 24#/sec. was obtained with a run duration of 24 seconds.

In mid-April, a decision was made by Lewis Management to transfer the NERVA Program from "B-1" to "B-3" where testing will be run on an alternating basis between full scale pump tests and system dynamics tests. The essential elements of the research hardware will be removed from "B-1" along with required instrumentation for transfer to the "B-3" stand.

Since no program presently exists for this facility, it will be maintained on a "standby" basis. This report will constitute a final status report until a research program is initiated for the B-1 Facility.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR — Advanced Centaur tests.
YOV2273 (E.R.Jonash)

B-1 Facility is currently scheduled to commence testing of the improved Centaur in mid-November. The Centaur test tank has been moved from General Dynamics and installed in B-1 Facility. Installation of facility systems to accommodate tank outflow and tank pressurization tests is as follows:

(1) Pressurizing gas conditioning system: Design is complete and pressurization skid has been assembled. Checkout of this system is scheduled for the second week of September.

(2) Liquid oxygen systems: A 13,000 gallon dewar has been installed at the facility. The existing vacuum-jacketed transfer line is being used for LOX. Fabrication of this system is completed. A contract for cleaning the system is to be awarded by October 1, 1967.

(3) Liquid hydrogen system: Vacuum jacketed transfer line from AF Plant #74 is scheduled for delivery to Plum Brook by the first of October. Foundations for the transfer line from the storage dewar to B-1 are designed and a contract for their installation should be awarded the first week of September.

(4) Instrumentation systems: A new patchboard and digitizer are being installed in the test facility. This work is being done "in house" and should be completed by mid-October.

(5) Hydrogen burnoff and LOX dump line: A combination burnoff and dump line has been designed and a contract for its installation should be awarded the first week of September. This system is scheduled for completion the third week of October.

(6) High pressure helium supply: Trailer #47 will be used to provide the facility with high-pressure helium to charge the Centaur storage bottles. The temperature conditioning bath for the storage bottles has been designed and is currently being installed.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR — Advanced Centaur tests.
YOV2273 (E.R.Jonash)

Centaur tank pressurization and outflow tests are scheduled to start in mid-November. Installation of facility systems to accomplish these tests are proceeding on schedule.

(1) Pressurizing gas conditioning system: The skid has been checked out. The skid is scheduled for installation in the stand in mid-October.

(2) Liquid oxygen system: The liquid oxygen transfer line is complete except for cleaning. Cleaning contract is to be awarded October 2 with completion within three weeks.

(3) Liquid hydrogen system: The vacuum jacketed transfer line from AF Plant #74 has been received at Plum Brook. Contract for the installation of foundations has been awarded with completion expected by October 26.

(4) Instrumentation systems: The patchboard and digitizer are currently being installed in the test stand terminal room. Installation of the instrumentation on the research package will be started in October.

(5) Hydrogen burnoff and LOX dump line: All government furnished equipment for this line, except the gimbals, have been received. The gimbals are due October 19. The installation contract has been awarded with completion expected by November 5.

(6) High pressure helium supply: The temperature conditioning bath has been installed. A problem of water causing corrosion of the titanium bottles has temporarily halted this job. An investigation into this problem is currently underway.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR — Advanced Centaur tests.
YOV2273 (E.R.Jonash)

Centaur tank pressurization and outflow tests have been rescheduled to start the first of December. Contract and in-house work has required more time than expected. Since we have been unable to procure flight weight vehicle vent valves which are self-regulating in the open position, a back-pressure control system is being designed by the Plum Brook controls group.

Installation of the facility systems is as follows:

(1) Pressurizing gas conditioning system: After checkout at "D" Site, the skid has been installed in the B-1 facility and the majority of mechnaical and electrical connections have been completed.

(2) Liquid oxygen system: The 13,000 gallon dewar has been cleaned. Cleaning of the Centaur LOX tank and transfer line by the contractor is expected to be completed by November 10.

(3) Liquid hydrogen system: The contractor has completed the foundations. Transfer Line A frame supports are presently being installed, with completion expected by November 10. Transfer line sections have been vacuum checked. Vacuum-jacketed flex sections have been fabricated in-house and installation of

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY (Continued)

the transfer line in the test facility is near completion.

(4) Instrumentation system: The patchboard and digitizer installation has been completed. Instrumentation on the research package is about 70% completed.

(5) Hydrogen burnoff and LOX dump line: Burner is in place and 90% of line has been installed. Contract completion date is November 5.

(6) High pressure helium supply: The remaining high pressure spheres required for this system were received October 30. All bottles will be hydrostatic pressure tested prior to installation.

CENTAUR 5-C TANK:

Inspection of Centaur 5C tank has progressed as follows:

(1) Tank pressure test was completed October 18, 1967. This test qualified the tank for the following conditions:

(a) Maximum pressure differential between LH_2 tank and ambient pressure - 30 PSID

(b) Maximum pressure differential between LO_2 tank and ambient pressure - 48 PSID

(c) Maximum pressure differential between LO_2 tank and LH_2 tank - 25 PSID

(d) Minimum pressure differential between LO_2 tank and LH_2 tank - 2 PSID

(e) Maximum pressure differential between LO_2 tank and intermediate bulkhead cavity - 48 PSID

(2) A cryogenic test will be performed at "F" Site. The site and the tank are being readied for this test. Expected test date is mid-December.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV2273 (E.R.Jonash)
(CPO - A.J.Stofan;
RSD - J.E.Sholes)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellents (LH_2, LOX) from a battleship type Centaur tank. Only one propellent will be outflowed in any one test, LN_2 being substituted for nonflowing propellent.

Liquid hydrogen tests are scheduled to commence in mid-December. System checkout has been started. The following major items were completed in November:

(1) Installation of 16" burnoff and LOX dump line.

(2) Installation of LH_2 transfer line supports.

(3) Vacuum check, cleaning, and installation of 3" vacuum jacketed LH_2 transfer line.

(4) Cleaning of Centaur LH_2 tank.

(5) Cleaning of LOX supply dewar, transfer line, and Centaur LOX tank.

(6) Pressure check and installation of high pressure GHe spheres.

(7) Installation of pressurizing gas conditioning system.

(8) Installation of LOX dewar and Centaur LOX tank vent lines.

(9) Installation of pressurizing diffuser to Centaur LH_2 tank forward door.

(10) Installation of the majority of facility and research instrumentation.

The following major items are in progress:

(1) Centaur LH_2 tank vent and discharge line installation.

(2) Insulation of natural gas line running beneath 16" burnoff line.

(3) Thermocouple instrumentation on GHe spheres.

(4) Cold-shock and pressure-checks of Centaur tank system.

(5) Insulation of Centaur LH_2 discharge line.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV2273 (CPO - A.J.Stofan; RSD - J.E.Sholes)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellents (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test, LN_2 being substituted for non-flowing propellent.

During the first two weeks of December all facility systems were checked out.

On December 13 and 14, the Centaur BPTV LH_2 and LOX sections were coldshocked with LN_2.

On December 20, an LH_2 boiloff test on the Centaur BPTV was conducted. The tank was filled to 100% liquid level and the boiloff rate was monitored while maintaining 5.29 psig back-pressure. All of the LH_2 was boiled off in 7 hours and 48 minutes. The boiloff rate was nearly constant in the cylindrical section of the tank at approximately 12#/min.

On December 21, five pressure rise tests were made on the Centaur BPTV LH_2 tank. These tests were made at five different liquid levels and consisted of closing the vent system and monitoring tank pressure rise from 5.3 to 15.0 psig. Also, the first series of helium burp tests were made. Four burp tests were made at 87% LH_2 tank ullage with 60 seconds of outflow at 1.5#/sec. Five burp tests were made at 60% LH_2 tank ullage and zero outflow. In all tests LH_2 tank pressure was increased from 5.3 psig to 12.8 psig and pressure maintained at 12.8 psig.

The next series of Centaur BPTV LH_2 tank helium burp tests is scheduled for January.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR YOV2273 (CPO - A.J.Stofan; RSD - J.E.Sholes)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellents (LH_2/LOX) from a battleship type Centaur tank. Only one propellent will be outflowed in any one test, LN_2 being substituted for non-flowing propellent.

Five series of Centaur LH_2 tank GHe burp tests were made, three on January 18 and two on January 24. Each series consisted of four separate test runs. A larger orifice plate was used to control burp pressure for these tests. The variable parameters were tank ullage volume, starting GHe bottle pressure, and outflow rate. Analysis of the test data from both run days indicated that the tank insulation had not reached a steady state chilled condition. Because the tank insulation temperature was still decreasing during the burp tests, the LH_2 boiloff rate was higher than normal and the test results were not valid. As a result of this situation, the test operation plan was modified for the next run.

On January 31, the Centaur LH_2 tank was filled and allowed to chill down overnight. The LH_2 boil-off rate and a tank insulation thermocouple reached a steady-state condition approximately 12 hours after the tank was filled. On February 1, ten series of GHe burp tests were made. A total of 36 test runs was conducted successfully, completing the GH_2 burp test program.

The Centaur LH_2 tank outflow tests are scheduled to begin on February 14.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

FEBRUARY 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV2273
(CPO - AJ Stofan;
RSD - JE Sholes)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellents (LH_2/LOX) from a battleship type Centaur tank. Only one propellent will be outflowed in any one test, LN_2 being substituted for non-flowing propellent.

On February 1, ten series of GHe burp tests were conducted. They covered thirty-six test conditions. These tests complete the GHe burp test program.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY (Continued)

CENTAUR (Continued)

On February 29 the tank was filled and allowed to chill down overnight prior to the March 1 tests. These tests were originally scheduled for the week of February 11, but were delayed because the GH_2 temperature conditioning system did not adequately cool the gaseous hydrogen. The original conditioning system consisted of three parallel coils of 3/8 inch copper tubing, 30 feet long, immersed in a LN_2 bath. Three changes were made that improved its operation to a successful level -- (1) the number of parallel coils was doubled, which increased the available surface area; (2) the outside of the coils was coated with carbolyne self-priming vinyl which acted as an insulating material. The effect is to increase the coil wall ΔT and shift the outside heat transfer process from the film-boiling to the nucleate-boiling regimes, which greatly increases the overall heat transfer rate; (3) the LN_2 inlet line was modified to create a swirling action in the bath. This somewhat increased the liquid velocity and further improved the outside heat transfer coefficient. The three changes were separately evaluated. The increased coil lengths and the swirl were not particularly effective without the tube-wall coating.

The March 1 tests will complete the testing on the Centaur LH_2 tank. (NOTE: March 1 testing was successfully completed.) The next series of tests will consist of Centaur LOX tank outflow tests. The LOX system was inspected and found to be contaminated. A contract to clean the system is being written. Testing is estimated to resume within four to six weeks.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV 2273
(CPO - AJ Stofan;
RSD - JE Sholes)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellents (LH_2/LOX) from a battleship type Centaur tank. Only one propellent will be outflowed in any one test, LN_2 being substituted for non-flowing propellent.

Research test runs were conducted on March 1, 14, and 19.

All Centaur LH_2 tank outflow tests were conducted on March 1. Three one-burn and seven two-burn outflow tests were made, completing this phase of the program.

As indicated in last month's report it would be near the end of April before Centaur LOX tank testing could be started. To utilize this time a series of Centaur LOX tank tests using LN_2 were planned. These tests were conducted on March 14 and March 19. A total of six burp tests and five outflow tests were made. It is hoped this data can be used to possibly lower the number of Centaur LOX tests required.

Modifications are presently being made to ready the test facility for Centaur LOX tank testing. It is anticipated that the contract for cleaning the LOX system will be awarded the first week of April.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV2273
(CPO - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for nonflowing propellant.

On April 3, a Centaur LOX tank LN_2 boiloff test was performed. This test substantiated heat leak data obtained on Centaur LOX tank LN_2 tests of March 14 and March 19.

The integrity of the six high-pressure GHe bottles being used at "B-1" for the Centaur tests was questioned. Therefore, a cryogenic hydrostatic pressure check was made in a test rig at "B-3" on April 16, 17, and 18. Since titanium alloy is more crack sensitive at low temperature, they were submersed in a LN_2 bath, filled with LN_2, and then pressurized to 4700 psi using GHe. All six bottles passed this test. However, two were rejected from use on a subsequent X-ray examination at Lewis-Cleveland. The four remaining bottles are now usable from 0 to 3300 psi for the test program.

The Centaur tank pressurant gas supply temperature conditioning system was tested on April 19. This test confirmed that the system could provide 180°R GHe at rated flow for the scheduled June tests.

In addition to these tests the facility was modified for Centaur LOX tests. The Centaur LOX tank, outflow line, 16" dump line, LOX transfer line, valves, and miscellaneous equipment were cleaned. Filling the 13,000 gallon supply dewar with LOX was started on April 26.

Centaur LOX tests are scheduled for May.

NOTE: Block I testing has been extended to include tank pressurization with cold (180°R) helium.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY

CENTAUR
YOV2273
(CPO - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for nonflowing propellant.

During May, three liquid oxygen test days were completed on the Centaur LOX tank.

On May 2, two burp and three outflow pressurization tests were made, for a total of eleven data passes.

On May 16, two burp and four outflow pressurization tests were made, for a total of thirteen data passes. These tests were originally scheduled for May 9, but were delayed to make repairs on the instrument bridges which are used with the platinum temperature sensors.

On May 24, four burp and three outflow pressurization tests were made, for a total of sixteen data passes.

These tests completed the original Block I test schedule. Presently, the test stand is being modified for the extended Block I tests to run LOX tank pressurization tests using cold (180°R) helium. Test runs are scheduled for the first two weeks in June.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOV2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test: LN_2 being substituted for non-flowing propellant.

Two days of testing were performed during June on the Centaur LOX tank using 180°R helium for pressurization.

On June 5, four burp tests and three outflow tests were made. The tank was pressurized thru the LOX vent standpipe for all tests.

On June 19, four burp tests and four outflow tests were made. Of these tests, one burp and one outflow were made using the standpipe for pressurization. The remaining six tests were performed by pressurizing the tank thru a diffuser installed near the tank bottom. In this manner, the pressurizing gas was bubbled thru the LOX agitating the liquid.

Two run days are scheduled for July using helium gas stored in the high pressure helium bottles at ambient and at LN_2 temperature. Tests will be made with and without the diffuser.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

During the first week of July the test facility was modified for the Centaur LOX tank pressurization tests.

On July 9 one outflow test and one burp test were made using the diffuser and ambient helium. Two other outflow tests were made using 140°R helium, one thru the diffuser and one thru the standpipe.

On July 12, four outflow tests and two burp tests were made. Two of the outflow tests were made using ambient helium thru the diffuser. The remaining tests used 140°R helium thru the diffuser except for one burp test thru the standpipe.

These tests complete the Block I test schedule. Block II testing using flight weight propellant ducts will begin in October.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	SPECIAL TEST	

HELIUM SPHERE TESTS
YOQ2273
(LVD - RF Lacovic;
RSD - JE Sholes)

The "F" Site helium sphere tests were completed in late June. The test rig was moved to "B-1" during the first week of July for further testing with the Centaur tankage. "F" Site was put in a standby condition, and the personnel reassigned to other sites.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
Y0Q2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

On August 27, a series of five helium blowdown tests were performed using one Centaur bottle at ambient temperature. Data were obtained on gas stratification in the bottle during blowdown, using four different control orifices.

In addition to preparing for this test, considerable time was devoted to investigating methods for insulating the flight-weight Centaur ducts. There are two sets of ducts to be insulated for future tests at B-1 and B-2. A technique for insulating the ducts has been decided upon and insulation will be started the first part of September when the first set of ducts arrive.

Modifications to the facility for Block II testing were initiated.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY

CENTAUR
Y0Q2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

Modifications for Block II Centaur tests continued as follows:

1. The outflow line was cut and is being altered to accept either LOX or LH_2 flight-weight ducts.

2. Two Centaur Engine LOX valves and two Centaur Engine LH_2 valves were checked out for operation as duct shutoff valves.

3. A new helium diffuser for the LOX tank was fabricated, cleaned, and is now being installed.

4. A new quartz view port was installed in the LH_2 tank.

Neither LOX or LH_2 ducts have been received from the contractor. The LOX ducts are expected the second week of October. They must be instrumented and insulated prior to installation.

Block II Centaur testing will start early in November.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

OCTOBER 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

The following items were accomplished in preparation for Block II Centaur LOX tests:

1. The LOX diffuser ring fabrication and installation was completed.

2. The high-pressure helium bottle instrumentation and installation was completed.

3. The Centaur LOX ducts were received October 15. The ducts have been instrumented and one set has been insulated.

4. Using the LOX ducts, the final field fit and fabrication of the outflow line was completed.

All components of the LOX outflow line should be cleaned and installed the first week of November. Two LOX outflow tests are scheduled for mid-November.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

NOVEMBER 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

The LOX outflow line components were fabricated, cleaned, and installed the first two weeks of November.

The first test of the Block II series of tests--which are to investigate the redesigned Centaur propellent ducts and tank pressurization hardware--was made on November 20. It was a two-burn outflow test using the LOX standpipe for pressurization.

Outflow Test #2 was made on November 22 using the LOX bubbler for pressurization. This test was aborted during the first burn due to human error in the operation of the paper tape programmer, causing LOX tank pressure to decrease rapidly.

The LOX duct chilldown time on both test days was about 40 seconds from the start of LOX transfer until LOX temperature was reached. The pressure drop across the LOX duct was considerably higher on November 22 than on November 20. This difference will be checked when Outflow #2 is repeated the first week of December.

Insulation of the second set of LOX ducts (to be used at B-2) was completed. One set of LH_2 ducts was received on November 21. This duct set has been instrumented and insulation has been started. The second duct set was received on November 27.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

DECEMBER 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur Tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

On December 3, the third and final LOX outflow test of the Block II series was made to check out the redesigned Centaur vehicle propellant ducts. This was a two-burn outflow test using the LOX standpipe for pressurization.

The LOX duct chilldown time was about 40 seconds from the start of LOX transfer until LOX temperature was reached. The pressure drop across the duct compared favorably with that obtained on the test of November 20. It is suspected that the higher pressure drop in one duct, observed on the test of November 22, was caused by blockage of the opposite duct. This blockage was evidently a piece of plexiglass which was part of a window in the thrust barrel. This window was installed to allow viewing of pull through in the LOX sump while still simulating the flow disturbance of the thrust barrel. When the LOX system was disassembled we discovered this window had broken up.

The following items were completed in preparation for Block II LH_2 tests:

1. The battleship captive firing adapter was modified to accept the new larger LH_2 engine duct.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	(Continued)	2. The second set of LH_2 ducts were instrumented. 3. The insulation on both sets of LH_2 ducts was completed. 4. The two total probe rakes for checking flow distribution in the LH_2 duct legs were completed. The Block II LH_2 outflow tests will begin the week of January 13 as scheduled.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

JANUARY 1969

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - EF Gustke)

Advanced Centaur Tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

On January 22 the first LH_2 test of the Block II series was performed. The purpose of this test was to check the pressure drop across the LH_2 duct during rated outflow and to verify that GH_2 was not trapped over the engine inlet valves during LH_2 transfer.

The LH_2 outflow rate was 11.3 lb/sec. and the LH_2 duct leg pressure drops were 0.90 and 0.96 psi. This verified the calculations of the pressure drops. Also, on transfer of LH_2 there was no evidence of GH_2 being trapped over the engine valves.

The next testing in "B-1" will be one- and two-burn LH_2 tests using the flight type pressurization panel. The panel will be chilled to cryogenic temperatures to simulate temperatures at "B-2".

The following items have been completed in preparation for these tests:

(1) The enclosure for temperature conditioning the flight type pressure panel has been fabricated and mounted.

(2) The LN_2 - GN_2 heat exchanger for temperature conditioning the flight type pressure panel has been fabricated.

The Block II LH_2 pressure panel tests will begin the latter part of February. However, the pressurization valves have not passed the acceptance tests at the vendor's plant and a delivery slippage will cause postponement of the B-1 testing.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

FEBRUARY 1969

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - DD Edie)

Advanced Centaur Tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

During February the pressurization valves failed to pass the vendor's vibration test. This has delayed delivery of the pressure panel to Plum Brook and, therefore, has delayed the Block II pressure panel tests. The following tasks were completed in February in preparation for this testing:

(1) Flight type tubing was installed from the helium spheres to the pressure panel location and from this location to both the hydrogen and oxygen tanks of the BPTV.

(2) The pressure panel temperature conditioning system was completed and checked.

(3) Nearly all instrumentation was installed for the Block II pressure panel LH_2 test.

After these tasks were completed, all "B-1" personnel were transferred to the "B-2" facility. They will return upon delivery of the pressure panel. Block II testing with the pressure panel is scheduled to begin the latter part of March.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

MARCH 1969

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - DD Edie)

Advanced Centaur Tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

Due to further delay in the delivery of the Centaur pressure panel to Plum Brook, no personnel were assigned to B-1 during March. The delay has been caused by failure of the flight-type pressure panel solenoid valves to pass performance tests.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

APRIL 1969

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
B-1	HIGH ENERGY ROCKET ENGINE FACILITY

CENTAUR
YOQ2273
(LVD - RF Lacovic;
RSD - DD Edie)

Advanced Centaur Tests. Data will be obtained on pressurization and outflow of propellants (LH_2/LOX) from a battleship type Centaur tank. Only one propellant will be outflowed in any one test; LN_2 being substituted for non-flowing propellant.

The Centaur tank pressurization panel was received at Plum Brook on April 15. It was installed in B-1, and was checked out with the chill system on April 22. Two valves failed to operate at the cold temperatures (260°R). On April 24 and 25 the two bad valves were replaced and the replacements were checked out. LeRC-Cleveland Centaur engineers decided to run LH_2 pressure panel tests with the panel at ambient temperatures to increase both the safety and reliability of the pressurization solenoid valves. On April 28 a successful checkout of the Centaur pressurization panel was made with the panel at ambient temperature. Liquid hydrogen outflow tests, using the pressurizing panel, are scheduled for May 1 and 2.

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

MAY 1969

SITE	SITE NAME	RESEARCH INSTALLATION & (TASK NO.) - PROJECT ENGINEERS
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR (YOQ2273)

LVD - R.F. LACOVIC;
RSD - D. D. EDIE

On May 2 the Centaur tank LH_2 outflow tests were made using the pressurization panel equipped with Valcor solenoid valves. As in previous LH_2 testing, the battleship Centaur tank was filled the day before and allowed to chill down overnight. Two 2-burn simulation and one single-burn simulation test were performed. Two additional helium burps were made at 3% ullage to verify high liquid level burp requirements. All tests were performed successfully and all equipment operated as programmed.

After this testing was completed, the LH_2 duct and outflow connection were removed and the LOX ducts and outflow connection were installed. Again, with the pressurization panel at ambient temperatures, four LOX outflow tests were performed on May 14. Valcor solenoid valves were used for GHe pressurization of the LOX tank. The first test was a 2-burn simulation with helium gas pressurizing the LOX tank through the standpipe. The second test was also a 2-burn simulation except that a bubbler ring was used during LOX tank pressurization. The third and fourth tests were one-burn simulations using varying programmed times for operation of the two LOX pressurization solenoid valves. All equipment performed as programmed.

On May 28, three LOX outflow tests were performed. For these tests the Valcor pressurization solenoid valves were replaced by Calmec pressurization solenoid valves. On a checkout on May 23 it was verified that the Calmec valves would operate at 140°R. The first test on May 28 was a two-burn simulation with the Calmec pressurization

(Continued on Page 29)

SITE	SITE NAME	RESEARCH INSTALLATION & (TASK NO.) - PROJECT ENGINEERS
B-1	(Continued)	valves at ambient temperature. The second test was identical to the first except that the Calmec pressurization solenoid valves were chilled to 200°R before the test. The third test was a one-burn simulation with the Calmec valves chilled to 140°R before the tests. All equipment functioned properly and all tests were successful. The completion of these eleven tests during May concludes all Centaur testing proposed for B-1 test facility.

NARRATIVES ON ADJOINING PAGE

B-1

TASK J.O.	PROGRAM	STATUS	SCHEDULE
YOQ2273	CENTAUR TESTS		
	LH_2 TESTS	. . . . . Complete	Completed
	LO_2 TESTS	. . . . . Complete	Completed
	NOTE: All proposed testing has been completed.		

CHANGES: None.
(Since last report)

SECTION II

PLUM BROOK ROCKET SYSTEMS DIVISION

TEST OPERATIONS REPORT

FOR THE MONTH OF

MAY 1969

SITE	SITE NAME	RESEARCH INSTALLATION & (TASK NO.) - PROJECT ENGINEERS
B-1	HIGH ENERGY ROCKET ENGINE FACILITY	

CENTAUR (YOQ2273)

LVD - R.F. LACOVIC;
RSD - D. D. EDIE

On May 2 the Centaur tank LH_2 outflow tests were made using the pressurization panel equipped with Valcor solenoid valves. As in previous LH_2 testing, the battleship Centaur tank was filled the day before and allowed to chill down overnight. Two 2-burn simulation and one single-burn simulation test were performed. Two additional helium burps were made at 3% ullage to verify high liquid level burp requirements. All tests were performed successfully and all equipment operated as programmed.

After this testing was completed, the LH_2 duct and outflow connection were removed and the LOX ducts and outflow connection were installed. Again, with the pressurization panel at ambient temperatures, four LOX outflow tests were performed on May 14. Valcor solenoid valves were used for GHe pressurization of the LOX tank. The first test was a 2-burn simulation with helium gas pressurizing the LOX tank through the standpipe. The second test was also a 2-burn simulation except that a bubbler ring was used during LOX tank pressurization. The third and fourth tests were one-burn simulations using varying programmed times for operation of the two LOX pressurization solenoid valves. All equipment performed as programmed.

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(Continued on Page 29)

SITE	SITE NAME	RESEARCH INSTALLATION & (TASK NO.) - PROJECT ENGINEERS
B-1	(Continued)	valves at ambient temperature. The second test was identical to the first except that the Calmec pressurization solenoid valves were chilled to 200°R before the test. The third test was a one-burn simulation with the Calmec valves chilled to 140°R before the tests. All equipment functioned properly and all tests were successful. The completion of these eleven tests during May concludes all Centaur testing proposed for B-1 test facility.