TEST LABORATORY

MONTHLY

PROGRESS REPORT

June 1, 1967 through June 30, 1967

GEORGE C. MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALABAMA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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June 1, 1967 through June 30, 1967

SYSTEMS TEST DIVISION

FOR INTERNAL USE ONLY

COMPONENTS AND SUBSYSTEMS DIVISION

TECHNICAL SUPPORT DIVISION

ADVANCED FACILITIES PLANNING OFFICE

GEORGE C. MARSHALL SPACE FLIGHT CENTER
TEST LABORATORY
MONTHLY PROGRESS REPORT
SYSTEMS TEST DIVISION
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I. SATURN IB

A. S-IB Stage

1. S-IB-10

Stage S-IB-10 was removed from the MSFC Static Test Tower East on June 8, 1967, and shipped to the Michoud Assembly Facility on the barge Palaemon.

2. S-IB-MM

Feasibility studies were started to determine requirements for static firing the S-IB solid rocket motor (Minuteman) augmented configuration (S-IB-MM) at the MSFC S-IC Test Stand.

B. H-I Engine

H-I engine S/N H-4067 was checked out after installation in the MSFC Power Plant Test Stand. The H-I engine hydraulic system test plan for the modified S-IB hydraulic package was completed and forwarded to Reproduction. The modified hydraulic actuators from the Michoud Assembly Facility were received on June 15, 1967, and sent to the Instrumentation Laboratory for installation of strain gauges and calibration. General preventive maintenance of facility components (flex hoses, check valves, relief valves, etc.), was performed and installation of the serviced components was commenced.

C. S-IVB Stage

1. S-IVB-209

A successful 456 seconds duration acceptance firing for S-IVB-209 was conducted at the Sacramento Test Center on June 20, 1967. There were no problems experienced during the countdown.

Prior to the 456 seconds firing, there were two unsuccessful attempts on June 14, 1967. The first attempt was aborted prior to ignition due to a false indication from the reusable ignition detect probe. The second attempt was aborted due to an apparent relay failure, although post-test investigation failed to repeat the failure.

A special loading of S-IVB-209 was performed June 22, 1967, to investigate the depletion sensor cycling problem and to conduct a special chilldown test to investigate the high LH_2 pump inlet temperature experienced on S-IVB-207 and S-IVB-208. McDonnel Douglas Corporation (MDC) was unable to duplicate the depletion sensor problem. However, from the chilldown tests, it was determined that loose foam insulation blocks on the LH_2 chilldown pump caused the abnormally high engine pump inlet temperatures on the two previous stages.

MDC has been directed to perform an abbreviated post-static checkout on S-IVB-209 and then store the stage until shipment to Kennedy Space Center (KSC) on May 15, 1968. Prior to shipping the stage to KSC, MDC will do a complete post-static checkout.

2. Beta III Test Stand

Rebuild of the Beta III Test Stand and GSE continues ahead of schedule. S-IVB-210 will be the first stage to be fired on the refurbished stand and will be installed in the stand during October 1967.

II. SATURN V

A. S-IC Stage

1. S-IC-4

S-IC-4 was removed from the Mississippi Test Facility Test Stand B-2 on June 5, 1967, after an acceptable firing on May 16, 1967.

2. S-IC-5

S-IC-5 arrived at the Mississippi Test Facility on June 21, 1967, and was installed in Test Stand B-2 on June 29, 1967. The acceptance firing of S-IC-5 is planned for early August 1967.

3. S-IC-T

The S-IC-T stage was installed in the MSFC S-IC Test Stand on June 1, 1967, and is being prepared for an approximate 40 seconds duration test during the latter part of July 1967.

B. F-1 Engine

Tests FW-064 through FW-066 were conducted at MSFC on the F-1 Test Stand with F-1 engine S/N F-5038-1 for mainstage durations of 41 seconds (FW-064) and 42 seconds (FW-065 and FW-066). All three tests were terminated by the facility panel operator as planned. Primary purpose of these tests was to evaluate the thrust vector control system with a new servo-actuator filter assembly installed.

C. S-II Stage

1. S-II-3

Final checkout of S-II-3 at Seal Beach, California is nearing completion and the stage is expected to be shipped to the Mississippi Test Facility between July 14 and July 18, 1967.

2. MTF Test Stand A-1

The LH_2 transfer system cold shock and simulated static firing test was conducted at the A-1 Test Stand on June 16, 1967. Approximately 10,000 GPM of LH_2 was flowed through the fill and dump system without encountering any major problems during transfer. The simulated countdown portion was conducted with the GETS performing stage electrical

functions and with orifices installed in the fluid distribution system (S7-33) to simulate the stage gas interface requirements. Problems were encountered with the A7-71 heat exchanger and gimbal control console during the automatic sequence portion of the countdown. These problems are being investigated.

The LOX transfer system cold shock was conducted at the A-I Test Stand on June 22, 1967, with a flowrate of approximately 3500 GPM of LOX. All pumps were operated without problems except for one replenish pump which was not used due to the bearing temperature measurement being inoperative.

3. S-II Structural Test Program

Construction work is progressing toward a facility completion date of November 15, 1967. Final test requirements for the S-II-4 Structural Test Program have been received and are now being reviewed.

D. S-IVB Stage

1. S-IVB-503 (New)

Stage S-IVB-503 (New) continues in post-static checkout at the Vertical Checkout Laboratory at Sacramento, California. The scheduled KSC delivery date is July 31, 1967.

2. S-IVB-504 (New)

Stage S-IVB-504 (New) arrived at the Sacramento Test Center on June 16, 1967. The acceptance firing is tentatively scheduled for mid-August 1967.

3. S-IVB-BS-2000

One hot firing on the J-2 engine was conducted at the MSFC S-IVB Battleship Test Stand during this report period. Test S-IVB-045 was conducted June 26, 1967, for a duration of 199.0 seconds, using engine J-2060. Review of data indicated all parameters were normal and the test successful.

E. Ground Support Equipment

Saturn V LC-39 Swing Arms No. 1, 4 and 6 were relocated from the Swing Arm Test Facility to the S-IC Static Test Stand on May 16, 17 and 19, 1967, respectively, for pneumatic, cold shock, hydrostat and flow testing of the LOX lines. The tests were accomplished May 23 through June 2, 1967, under the following conditions:

SWING ARM NO.	GN_2 PNEUMATIC (P.S.I.G.)	LN_2 COLD SHOCK FLOW (GPM)	LN_2 COLD SHOCK DURATION (MINUTES)	HYDROSTAT PRESSURE (P.S.I.G.)	WATER FLOW TEST & RESUL
1	190	500 540	5 5	285	5750 g.p.m. of water (a 190 p.s.i.g. inlet) for 47 hours and 20 minutes test acceptable.

SWING ARM NO.	GN_2 PNEUMATIC (P.S.I.G.)	LN_2 COLD SHOCK FLOW (GPM)	LN_2 COLD SHOCK DURATION (MINUTES)	HYDROSTAT PRESSURE (P.S.I.G.)	WATER FLOW TEST & RESULTS
4	170	500 560	4 5	255	5750 g.p.m. of water (at 170 p.s.i.g. inlet) for 5 hours and 25 minutes; discharge flexhose (75M14015-5) failed. Replaced with rejected spare (for test purposes only).
4 (Second test; using rejected spare)					5750 g.p.m. of water (at 170 p.s.i.g. inlet) for 14 hours; rejected spare was unsatisfactory and replacement spare from KSC was installed.
4 (Third test)		775* 850*	3.5 2	255	5750 g.p.m. of water (at 170 p.s.i.g. inlet) for 35 hours and 35 minutes; test acceptable.
6	120	575 540	2 5	180	1150 g.p.m. of water (at 120 p.s.i.g. inlet) for 50 hours and 5 minutes; test acceptable.

NOTE: * Discharge flexhose cold shocked separately prior to installation.

A hinge joint in the LOX line discharge flexhose (P/N 75M14015-5) on Swing Arm No. 4 failed after 5.42 hours of testing (1st test). With the exception of the flexhose failure, all tests performed were acceptable.

III. APOLLO APPLICATIONS

A. Lunar Drill Program

Drilling with the Longyear commercial drilling system at Site No. 6 in the Howell, Tennessee structure was completed and drilling initiated at Site No. 6B.

Northrop Corporation Nortronics Division began work on Contract No. NAS8-20820. The contract duration is $8\frac{1}{2}$ months which consists of 7 months of performance and $1\frac{1}{2}$ months for preparation and delivery of the final technical report. Total contract cost is $98,000.

The Westinghouse and Joy Contracts were mailed by PR-RM for contractor signatures.

A meeting was held on June 22, 1967, to discuss a briefing for Dr. von Braun on the drill project. R-TEST, R-SSL, and I-S/AA presented material which should be included in the briefing. The briefing was tentatively scheduled for July 25, 1967.

B. LSSM Project

The Bendix Mobility Test Article (MTA) left R-P&VE on June 23, 1967, after the completion of static and dynamic characteristics determinations, and is presently undergoing steering tests at Building 4650. The General Motors MTA will undergo the same type of testing as soon as its refurbished wheels are delivered.

The nutator drive experimental test program (Bendix) functional tests were begun on May 27, 1967. Several problems occurred during the early functional checks with instrumentation and mechanical (gear) interferences.

IV. SUPPORTING RESEARCH AND TECHNOLOGY

High pressure valves and pneumatic operators for the Hydrogen Embrittlement Tests were ordered from the Autoclave Engineers, Inc. Final drawings of the test setup were released. Test procedures are being prepared.

V. VEHICLE STORAGE PROGRAM

A meeting of the R&DO members of the Working Group for Stage Storage was held on June 1, 1967, to further discuss a scope of work to support the stage storage study. This contract will involve a comprehensive review of the Government's and aerospace industry's past and present experience in the storage of airframes, space vehicles, ICBM's, rocket engines, GSE, and other hardware. The end purpose shall be to define the storage parameters that are most effective in reducing post-storage failure and to evaluate present storage requirements for space vehicles in terms of past experience. The final draft of this scope of work was submitted for approval on June 16, 1967.

The next meeting of the Working Group for Stage Storage was held on June 14, 1967. Various technical storage problems were discussed and a preliminary Test Laboratory storage guidelines document was presented. The first rough draft of a unified MSFC storage guidelines document is scheduled for July 14, 1967.

The following presentations were attended by the R&DO members of the Working Group for Stage Storage during this period: S-IB (Chrysler) June 7, 1967, at Michoud Assembly Facility; S-IC (Boeing) June 13, 1967, at MSFC; S-II (NAA/SD) June 20, 1967, at Seal Beach, California; and S-IVB (McDonnel Douglas) June 22, 1967, at Sacramento, California.

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I. SATURN IB

A. S-IB Stage

1. 200K H-1 Turbopump Testing

The H-1 Turbopump Facility supports R-P&VE in S-IB propellant feed system studies. The facility provides S-IB vehicle system simulation including prevalves, suction ducts, turbopump, high pressure ducts, and main engine valves.

A meeting with Western Company, the manufacturer of the FR-3 friction reduction additive, and R-P&VE personnel was held in an effort to determine the reason that the additive has not improved feed system performance. It was concluded that although the FR-3 is designed to reduce frictional pressure losses in a pipe with turbulent flow but the additive may also have increased the non-frictional pressure losses in the portion of the feed system which is simulated on this facility (tank outlet through engine main shutoff valve).

Test C-039-7 of the fuel additive test series was successfully conducted to verify the previous additive test results. The line pressure losses increased instead of decreasing as had been experienced in previous tests. After a discussion with P&VE personnel, the decision was made to discontinue the program on this test facility. A report will be written on this project. This item will not appear in any subsequent progress reports.

II. SATURN V

A. S-IC Stage

1. F-1 Turbopump Testing

The F-1 Turbopump Facility provides the capability to perform checkout, calibration, qualification, and development tests on S-IC/F-1 Turbopump propellant feed systems. This

facility contains a gas generator driven F-1 turbopump which is mounted on a thrust chamber and simulates the S-IC flow system from the suction duct inlets to the main shutoff valves of the engine.

R&D 6 + 6 Turbopump S/N 4072224 was received at MSFC on June 6, 1967. The F-1 Turbopump Test Facility is being prepared for testing this pump. Testing is scheduled to begin in August 1967.

Two LOX flow tests have been conducted during this report period. These runs conclude testing of S-IC LOX Flowmeter S/N WC17-1A and Flexonics S-IC LOX Outboard PVC S/N 106B5128. The primary objectives of these tests were to calibrate the flowmeter, prove the new teflon flowmeter bearing design, and gather data on the Flexonics LOX Outboard PVC. An additional S-IC LOX flowmeter will be installed for testing during the coming month.

2. LOX Depletion Testing

The purpose of this test program is to support R-TEST-SP in a study of the LOX depletion characteristics of the F-1 Engine shutdown sequence. The ultimate goal of the test program is to predict LOX depletion characteristics of the S-IC Ground Stage Engine System.

Facility buildup is in progress. Test start date has slipped to September 4, 1967, due to facility modifications and hydrostatic tests to be performed on high pressure tanks.

B. S-II Stage

1. S-II Insulation

B-Cell Position 1 - Foam Insulation (70" Tank)

This test program was requested by P&VE Laboratory to evaluate the structural integrity and thermal performance of an S&ID, CPR-369-3 foam insulation system.

The tank has been repaired and is ready for re-test. ME Laboratory is presently fabricating a 7 x 7 calorimeter for testing also.

B-Cell Position 1 - Linde Insulation (70" Tank)

The general objective of this test program is to evaluate a Linde pre-evacuated, panel-type insulation system for possible application to liquid hydrogen booster stages.

The main buildup is complete. Testing is scheduled to begin in July.

2. S-II LOX Prevalve Flow Test

Requestor: R-TEST-SS

The test objective for the S-II LOX Prevalve is to determine the acceptability and operating characteristics of the valve for shutdown conditions at various flowrates.

During Test 204-3, Run 8, June 7, 1967, the S-II LOX Prevalve malfunctioned. Investigation of the malfunction revealed the valve shaft bushing had seized (galled) to the valve shaft and the bushing was rotating in the bushing boss. This inspection was conducted at the Valve Shop and was witnessed by Test Laboratory (R-TEST-CV/BECO) and P&VE Personnel. The valve will be rebuilt when replacement parts are obtained from the vendor and returned for completion of testing by the end of July. Testing will then be completed by the end of August 1967.

The scope of the work order has been expanded to include LOX flow tests on the S-IVB (LOX) Prevalve. Information on this phase of testing and the hardware is being obtained and test buildup will be started after completion of the S-II Prevalve Flow Test. The modification required to change to the S-IVB LOX Prevalve will take approximately two weeks. Testing is estimated to start in mid-September 1967.

C. S-IVB Stage

1. J-2X Turbopump Test

Requestor: R-P&VE-PAC

This project was requested to further the development and verify the performance of advanced J-2 turbopumps and subsystems. Test Position 501 is being prepared for this testing.

The shop is still actively working on the piping systems and is about 80 per cent complete. The bobtail engine (cut off chamber with turbopumps) has been installed and is

being used for mockup purposes. The 100,000-gallon LH_2 storage tank has been cleaned and dried, and all associated plumbing is in the process of being re-installed. The storage facility is presently scheduled for activation during the latter part of July. Present schedules call for completion of the shop work on T. S. 501 by July 31, 1967.

Additional activation tests will extend through September with the first systems test scheduled for mid-October 1967.

2. J-2X Thrust Chamber Throttling Tests

Requestor: R-P&VE-PA

This program was established to evaluate the throttling characteristics of J-2 thrust chambers. Engine thrust excursions of 5K to 200K (Sea Level) are contemplated. This will be accomplished in a 2-phase program.

Phase I consists of facility design, facility activation, and initial J-2X testing. The facility utilizes pressurized propellant tanks and throttle valves to control the engine thrust level. The activation test firings will include ignition, partial transition, full transition, and mainstage of a tubular wall J-2 thrust chamber with a ceramic coating to increase combustion zone durability.

The initial J-2X testing will utilize a J-2 thrust chamber with tapoff capability. The thrust chamber will be evaluated at steady state conditions, four to six mixture ratios, and between 5K and 200K SL thrust levels (no dynamic throttling).

Phase II will consist of dynamic throttling of J-2 thrust chamber with and without hot gas tapoff capabilities, at four to six mixture ratios, and between 5K and 200K SL thrust. These tests will define engine and facility operating capabilities and will permit thrust chamber and tapoff optimization.

During this reporting period, one mainstage test at 300 psi chamber pressure and three mainstage tests at 700 psi chamber pressure were conducted. The total mainstage test time to date is 40 seconds.

Because of Hydrogen Embrittlement, the 5000 psig GH_2 Battery pressure has been restricted to 3500 psi which is

inadequate for tests at 700+psi chamber pressure. Therefore, the GH_2 Battery is now being converted to Helium which will be pressurized to 5000 psi. The next test is scheduled for July 11, 1967.

3. J-2 Engine Telescoping Nozzle

Requestor: R-P&VE-PA

The test objective is to evaluate the feasibility of the proposed J-2 Engine Telescoping Nozzle design. This proposal consists of a retractable engine nozzle skirt which will stow in the existing stage interface envelope. After stage separation, the nozzle can be extended to obtain optimum engine expansion ratio. The project will utilize a working mock-up (non-flight hardware) to evaluate the design proposal.

Received the J-2 Thrust Chamber and Telescoping Nozzle Extension on June 9, 1967, and assembled them on the wood test fixture which had arrived earlier in the week.

A meeting was called which was attended by P&VE, Test Laboratory personnel, and the BECO Test Engineer. A proposal for test objectives was presented and provided a basis for the discussion. The P&VE Project Engineer stated that his group would write a Test Plan and incorporate it in the minutes of the meeting which they would also prepare. It was decided to present the Test Program in phases. The first phase is to be a performance test series to evaluate the effect of adjustments (counterweight, release mechanism, linkage, etc.) on time required for extension. A PAP will be prepared as soon as the Test Plan is received.

Modification of the wood test fixture is in work at the carpenter shop in building #4650 per the request of P&VE designers.

The pneumatic hose and actuation cylinders that operate the release mechanism of the nozzle extension are currently being proof tested at 1.5 X maximum operating pressure expected to be needed.

The tests should begin about July 19, 1967, and be completed by August 15, 1967.

4. LH_2 Slosh Testing

This program supports P&VE and Test Laboratory in areas of LH_2 propellant feed system studies and LOX studies in an ellipsoidal tank.

Test C-004-11 was conducted during this report period. This test was to continue the study of Giannini mass gages in liquid hydrogen and to test a S-IC LOX prevalve at hydrogen temperatures. This valve is being tested in support of the S-II Structural Test. The valve was placed in the slosh tank "Venturi vent line" and subjected to LH_2 vent gases. Due to a physical line restriction, the valve did not chill to the temperature expected (approximately -350°F). The valve will be insulated and tested again next report period.

5. S-IVB Auxiliary Propulsion System Testing

The S-IVB Auxiliary Propulsion System Test Program was requested by P&VE Laboratory for conducting tests on upper stage ullage and attitude control engines and systems at simulated vacuum environments.

A program to study the gas bubble growth characteristics in the Saturn V/S-IVB APS propellant bladders under various tank ullage pressures is to be initiated the week beginning July 9, 1967. If the gas bubble is found to form at the proposed blanket pressure of 100 p.s.i.a., a test program will be started in late July to qualify Douglas ground support equipment designed to remove the gas bubbles from the APS systems at Cape Kennedy approximately 24 hours prior to launch.

D. Ground Support Equipment

Ground Support Equipment testing includes development and acceptance test programs of Saturn V launch vehicle support hardware under the design cognizance of both MSFC and KSC. Launch environments are simulated as closely as possible for both types of test programs although launch support equipment to be installed later at the launch complex is used for acceptance test programs only.

For vehicle service arm tests, the swing arms are mounted in a tower which duplicates the launch umbilical tower at KSC. The ground umbilical is connected to the vehicle umbilical plate that is mounted in a simulated vehicle skin panel. This panel is mounted on a random motion simulator which simulates the relative motions between the launch vehicle

and launch tower. For inflight disconnect arms, the panel is connected to the random motion simulators through an elevator system so vehicle lift-off accelerations can be duplicated. In addition, the equipment is exposed to wind, rain, and cryogenic temperatures to include worst case design conditions.

In the test programs, component checkout tests are conducted after installation of the test hardware in the test facility. This phase of the program is followed by subsystem checkouts and subsequently, complete systems tests simulating launch environments. A description of hardware undergoing tests and the results of these tests follows:

1. LC-39 Service Arms

a. S-IC Intertank (Set III) - This preflight arm supplies the vehicle S-IC stage with lox fill and drain service, as well as personnel access to the vehicle. The arm has automatic capabilities to allow reconnection in case of a mission hold or abort.

The 50-hour water flow test on the lox line (A portion of the Lox line qualification program) was successfully completed and on 15 June 1967 the S-IC Intertank arm was reinstalled in the test area. The special rain and cold tests have been resumed for P&VE. These tests are scheduled to be completed by June 30, 1967. Results to date indicate that a reconnection and a positive seal on the lox coupling cannot be made during rain when the hardware is at cryogenic conditions. The regular test program will resume July 10, 1967.

b. S-IC Forward (Set III) - This preflight arm supplies the forward end of the S-IC stage with electrical, pneumatic, air-conditioning services, and personnel access.

During this reporting period no umbilical tests were performed due to redesign and manufacturing of a prototype cable guide and assembly parts to correct problems reported in the last progress report. All parts were received as of June 28, 1967, and assembly is in progress.

Repair parts were received for the extension platform bumper. Checkout revealed that the spring tension was of insufficient strength to return the bumper to its center

position after removal of extension platform from simulator contact. Rod spring tension was doubled and the results were satisfactory.

Prototype checkout and flight umbilical testi should be completed during next reporting period.

c. S-II Intermediate (Set III) - This inflight service arm provides air conditioning, electrical, pneumatic, LH_2 and lox services to the S-II stage. The lox and LH_2 lines have independent connections to the stage while the remainder of the service lines in the arm are connected to the stage through one common carrier. The AA-04-02 arm was modified at MSFC by installing a lanyard withdrawal system for the main umbilical to replace the dual cylinder withdrawal system used on AA-04-01 and AA-04-03. R&D tests on the lanyard withdrawal system are now underway. At the conclusion of the R&D testing on the lanyard system, it is planned to retrofit the lanyard system on AA-04-01 and AA-04-03.

The service arm was reinstalled in the test facility on June 18, 1967, after completion of the lox line water flow tests. Preliminary umbilical withdrawal tests are being conducted on the revised lanyard withdrawal system. These tests are to determine the operating pressures and cable adjustments required for the system operation.

The lox lines on the S-II Intermediate arm successfully completed a 35-hour water flow test (5750 GPM at 170 p.s.i.g.) as part of the Lox Line Qualification Program. As reported in last month's Progress Report, a leak developed in the inner line of the arm/vehicle flexible, vacuum jacketed line after 5 hours of water flow. The failed line was replaced and the water flow test was successfully completed. A failure analysis on the failed flex line revealed that a swivel joint in the end of the line rubbed a hole in the inner portion of this line. As a result of the analysis, Test Laboratory was requested to modify some of these lines by removing the swivel joints and replacing with a straight section. These line modifications are in process.

After the lines are modified, the vacuum jacket (Annulus) will be evacuated to 50 micron of Hg or less and leak tested using GHe and a mass spectrometer. One line will then be hydrostated, cold-shocked, and delivered to P&VE Laboratory for vibration and flex cycling tests.

The remaining modified lines will be hydrostated, cold-shocked and installed in the test facility for tracking and withdrawal tests.

d. S-II Forward (Set 1) - This inflight service arm provides air conditioning, electrical, and pneumatic services, plus a GH_2 vent for the S-II stage. All connections to the stage are through a common carrier.

Modifications to the S-II Forward Arm 5 to correct problems reported in the last Progress Report continued until June 19, 1967. Among the modifications were such items as change out of the boom weldment assembly, modification to the minimum angle bracket, modification to the "T" head and installation of new static lanyard assembly, modification to the second element of the arm structure, changed out the 1,000 p.s.i.g. flex lines to 3,000 p.s.i.g. lines.

Testing was resumed on June 21, 1967, with checkout of the new static lanyard installation, by jogging and tracking the maximum vehicle envelope in accordance with new vehicle stacking and motion criteria received from KSC on June 6, 1967. Umbilical kickoff and withdrawal test started on June 27, 1967. On the first disconnect the umbilical leg struck the end of the service arm and broke the umbilical leg casting. Investigation is in process by KSC Design. Further umbilical disconnect tests have been suspended pending a solution to this problem.

e. S-IVB Aft (AA-06-01) - This inflight service arm provides lox and LH_2 fill and drain services to the S-IVB stage. AA-06-01 was returned to MSFC after being used at KSC in the Saturn V 500F wet test. The service arm was modified to a lanyard withdrawal system, which replaced the dual cylinder withdrawal system tested on AA-06-02 and AA-06-03. The 50-hour water flow test (portion of the lox line qualification program, reference last month's Progress Report) was successfully completed and the arm reinstalled in the test area on June 14, 1967. Testing was resumed by rerunning the primary system arm retraction tests at a lower pressure (2,300 p.s.i.g - 2,450 p.s.i.g.) as per direction from KSC Design (reference last month's Progress Report). The lower pressure resulted in increasing the retraction time under no wind conditions to 4.0-4.1 seconds in accordance with design criteria.

Umbilical disconnect and withdrawal tests were continued, but the spike loads experienced at certain vehicle positions were higher than had been encountered before. The peak loads in the primary lanyard went as high as 5,000 pounds; however, the spike loads were of short duration (less than 5 milliseconds).

A Parker-Hannifin shock accumulator (75M08416-1 was teed into the rod end supply to the hydraulic cylinder, and the results were encouraging, the peak load being reduced to 3,300 pounds with 1,000 p.s.i.g. precharge in the accumulator. Based on this, the accumulator was replaced by a Greer 30A one-quart accumulator, which was precharged to 1,200 p.s.i.g The spike load was drastically reduced, reaching only 750 pounds initially, with a maximum (no spike) load of 1,500 pounds. To date, insufficient testing has been done to verify the improvement, but the results are promising.

f. S-IVB Forward (AA-07-01) - This inflight service arm provides air conditioning, electrical, pneumatic, water glycol, and LH_2 venting services to the S-IVB stage and to the instrument unit (IU). The arm also supports the Lunar Excursion Module (LEM) umbilical carrier.

The umbilical carrier tracking tests have been re-run to new vehicle stacking and wind motion criteria received from KSC on June 6, 1967. No problems were encountered during the carrier tracking test. The "T" head tracking tests were also re-run to the new vehicle stacking and wind motion criteria. During these tests it was observed that the LH_2 vent line strikes the "T" head platform at certain vehicle positions. Also, coupling of the "T" head platform to the vehicle simulator when oscillating about a 95% wind condition is very difficult. Testing will continue during next report period.

g. Service Module - The service module arm is an inflight arm and provides air conditioning, electrical, GH_2 venting, and water-glycol cooling services to the Apollo Service Module umbilical connection.

As reported last month, the withdrawal system air motor would not function properly. An air motor bench test was requested by KSC to determine the air motor operating characteristics, torque and rpm. The air motor was tested, and it was determined that it would not operate at its rated pressure (125 p.s.i.g.). A new air motor was successfully tested, and subsequently installed on the arm. Further bench testing is planned on another air motor, and the air motor from the S-IVB Forward swing arm. Testing has resumed on the service module swing arm.

h. LC-39 Command Module Access Arm - The LC-39 command module access arm is a preflight arm which supports an environmentally conditioned chamber through which the astronauts and service personnel can enter the Apollo spacecraft. The arm also provides a support structure for air conditioning and space suit checkout lines.

Extensive redesign of the entire command module access arm system is in work at KSC. It is anticipated that the arm now in the test area will be reworked to the new configuration and tested. The period of testing is not known at the present time. Currently the arm is in standby condition.

2. Saturn V Damping, Retract, and Reconnect System (DRRS)

The DRRS is a system for the primary purpose of damping the Saturn V vehicle oscillation due to vortex shedding. The system has the capability of automatic extension, connection, and retraction as well as damping oscillations. The test program is being conducted for P&VE Laboratory to qualify the system prior to its use on LC-39.

The redundant hoist structures for use on ML-2 at KSC were received from ME Laboratory on June 23, 1967, and installed in the test area on June 26, 1967. The ML-3 truss assemblies were received by Test Laboratory on June 23, 1967, and the crossbeam assemblies were received on June 27, 1967. The truss assemblies and crossbeam were assembled and installed in the test area on June 28, 1967.

Download tests were performed on June 29 and June 30, 1967. Testing was then suspended until delivery of the remaining hardware (consoles, latches, kickoff assemblies, etc.) to Test Laboratory. The earliest anticipated delivery of the components from ME Laboratory is July 8, 1967.

3. LC-39 Tail Service Masts (Set 1)

The three service masts (lox, fuel, and environmental are located on the deck of the Mobile Launcher and are used to service the S-IC stage tail section. Mast retraction is initiated by vehicle lift-off.

Testing has been completed to test plan section 111.C.2.b.(1). Preparations are in progress for simulated lox flow mast 3-4, and simulated fuel flow, mast 1-2. These tests are to be completed by July 7, 1967.

Prior to the installation of flight hardware and flight hardware testing, special tests requested by KSC will be conducted. The purpose of these tests is to observe the mast reaction to various failure modes. These tests will be conducted July 10, 1967, to July 14, 1967.

4. LC-39 Mobile Launcher Holddown Arms

The purpose of this test program for KSC is to verify the physical and functional integrity of the Saturn V holddown arms have been structurally tested and shipped to KSC. Structural testing of the final set of arms (fourth set) began August 11, 1966, and was successfully completed November 2, 1966.

This fourth set of arms is a spare set and is being retained at MSFC to serve as test bed for development of the holddown arm blast shield.

As reported last month, ME Laboratory repaired cracks found on Arms 002, 003, 004, and 006. Upon completion of the crack repair the arms were returned to Test Laboratory for load testing. Load testing of the repaired holddown arms, requested by KSC Design, is being conducted; arm 002 is 75% complete. Load testing of the holddown arms will be continued during the next report period.

Present plans for further testing of the holddown arms include installation (on arm 003) and testing of a hood for vehicle engine exhaust blast protection. Hood installation, currently in progress, has been temporarily curtailed for KSC Design to release an EO required to rectify an installation clearance problem. KSC indicated all components required for testing were shipped as of May 23, 1967.

5. Saturn V Lift-Off Switches

This program is being conducted for KSC to ensure that the liftoff switch actuator arms can signal initiation of the umbilical disconnect and service arm rotation at the required vertical distance of vehicle liftoff.

Testing on a modified primary actuator assembly (rack and pinion) will be completed by July 14, 1967.

6. "Q" Ball Cover Removal System

The purpose of the test program was to demonstrate operational reliability of the system for removing the cone cover from the vehicle nose.

Tests were conducted in conjunction with the primary damper system to verify that a KSC modification would eliminate an interference problem between the damper arm and the "Q" Ball cover pneumatic line. The modification was satisfactory. The final report has been submitted. This item will no longer appear in the Progress Report.

7. High Pressure Test Facility

Anderson Greenwood and Company Relief Valves - The purpose of this testing is to evaluate the operating characteristics of two pneumatic pressure relief valves for the Mississippi Test Facility (I-MT-EF).

(1) P/N 3518G23-S - Testing was completed April 7, 1967, on this valve which had pulsating flow characteristics. MTF will send MSFC an identical valve, except for enlarged ports, for evaluation. Testing will be conducted on this valve and a report will be written to cover the original and modified valves.

(2) P/N 81C68-4 - Testing is complete on this valve. During the cycle test, galling was encountered between the valve spindle, guide, and nozzle. A re-evaluation of data was necessary; the test report will be distributed in July 1967.

8. S-IVB Aft Withdrawal Cylinder Life Cycle Test

The purpose of this test program, for KSC, is to determine the ability of one withdrawal mechanism to "track" vehicle motion of 1,100,000 cycles. Testing began November 22, 1966, and was completed June 9, 1967. Nine additional cylinders were functionally tested for use on LC-39. A 72-hour continuous cycle test was added and completed.

Cycling of the pneumatic withdrawal cylinder continued through June 9, 1967. The cylinder, to the latest design configuration, has successfully completed 1,282,000 cycles including a 72-hour continuous period. This completes

the test program and a test report is being prepared. This item will no longer appear in the Progress Report.

9. Flush and Purge Truck

This test program is being conducted (for P&VE) to ensure that the truck will service the F-1 engine as required.

Testing was initiated December 16, 1966, and the tests have been completed according to the original test procedure. P&VE has requested additional testing with minor modifications to the unit to determine if increased outputs can be achieved.

The additional testing is in progress. Re-evaluation and analysis of the test data have delayed completion of testing. Testing should be completed by July 15, 1967.

10. Hydrogen Embrittlement Test

The purpose of this test program is to determine the hydrogen embrittlement effects of gaseous hydrogen on the yield point and ultimate strength of various materials being used in high pressure hydrogen containers; to provide comparative data to enable R-P&VE-MM to study the material nil-ductility transition temperature, elongation of the material, change in cross sectional area, and radiographic and fractographic analysis of the fracture surfaces.

Buildup for this test is 98% complete. The test procedure is being reviewed. Tail service mast priority has delayed testing. Testing should begin during the next report period.

11. Straza Duct Proof Tests

These flexible, vacuum-jacketed propellant transfer lines are used to transfer lox and LH_2 to the S-II stage via the S-II Intermediate Service Arm. Three lines, two lox and one LH_2, will be hydrostatically proof tested and thermal shock tested (reference S-II Intermediate Section of this report).

III. SUPPORTING RESEARCH AND TECHNOLOGY

A. Zero Gravity Test Facility

The Zero Gravity Drop Tower is utilized to assist P&VE in the study of low gravity fluid mechanics and thermodynamics phenomena. The facility is located in the Saturn V Dynamic Stand.

Twelve tests were conducted during this report period. All tests were made with the impulse package to study orbital slosh phenomena. Approximately six more tests are required in this series.

B. S-IC Model Drop

This test program was requested by R-AS to evaluate the S-IC booster recovery concept as proposed by the Boeing Company. Testing is to be accomplished on scale models impacting on water.

Tests C-035-43 through 60 were successfully conducted during this report period. These tests used the 1/10 scale model at a weight of 701 pounds. All previous tests were conducted with the same model but with a weight of 584 pounds. Data covering tests C-035-21 through 60 is being prepared for transmittal to R-AS.

C. Liquid Hydrogen Super Insulation

This program, requested by P&VE, consists of studying the effectiveness of "super insulated" LH_2 tanks in a simulated space environment of 10^{-6} torr pressure.

Test Tank No. 3 with Linde SI will be repaired at ME Laboratory and is scheduled for delivery to Test Laboratory during the second week of August, 1967. These tests are scheduled shortly thereafter.

30-Inch Calorimeter: Two tests were conducted at altitude conditions during this period. The data from these tests are being analyzed before ME Laboratory installs the tank penetration. Quick look data indicates that the data did not repeat for these base line tests.

D. Storable Propellant Space Engine Testing

This program was requested by R-P&VE-P to provide support for testing (1) engines to be used on Project Thermo, and (2) advanced technology engines.

Two Kidde 40 pound thrust monopropellant engines, utilizing anhydrous hydrazine as propellant, were tested at a simulated altitude of 100,000 feet during the period of

June 23 - June 29, 1967. Engine #1 was fired for 60 minutes steady state plus eight pulses of 1 second on - 3 seconds off, and 200 pulses of 50 ms on - 50 ms off. Engine #2 was fired for 10 minutes steady state only. Significant chamber pressure oscillations were noted during the steady state firings on each engine, with the magnitude of the oscillations as high as ± 15 p.s.i. The engines were packed with Shell 405 Catalyst (iridium active agent) with 8 to 12 mesh size. The Pc oscillations were attributed to this large size catalyst. Since the exposed area of catalyst was minimized, non-uniform fuel decomposition was obtained.

The engines have been returned to Walter Kidde Company for repacking with 14 to 18 mesh size catalyst.

E. Jet Impingement on Water (½K Cluster Phase)

This program was requested by KSC to study the feasibility of launching large flight vehicles of the SATURN V and NOVA classes from offshore sites.

Tests C-002-23C through 29C were conducted during this report period. Estimated test completion date is October 1, 1967.

F. Combustion Dynamics

Requestor: R-P&VE-PA

This project investigates, at an intermediate thrust level, the combustion stability theories which have been developed analytically or at a very small thrust level. The main areas of interest are combustion stability of LOX/RP-1 and LOX/H_2 systems at the 30K and 15K thrust levels respectively.

No tests were conducted with the 30K thrust level engine during this reporting period. Test stand repairs and maintenance of facility components were completed.

Approximately seven tests with an existing solid copper injector will be conducted when scheduling permits.

P&VE has requested that testing at high chamber pressure levels with the 15K engine be temporarily suspended in order that a few research tests with liquid hydrogen at low chamber pressure levels might be conducted. All of the fuel

(LH_2) is to be injected through the transpiration-cooled wafers and the LOX will be injected through a slightly modified injector. The purpose of the test is to measure the temperature at the combustion chamber wall, near the injector, so that the phase of the combustion products might be determined.

The tests conducted for this effort were discussed with P&VE and R-TEST-C representatives in May, and it was agreed that three to five additional tests would be conducted with a new injector face. This injector face will impinge LOX on LOX in an attempt to improve the combustion efficiency of the engine. The injector face has been received, but no testing will be performed until Test Position 115 becomes operational in late August.

G. Pump Inducer Development Project

Requestor: R-P&VE-PAC

This project has been requested by P&VE in an effort to develop the hubless inducer for use on future turbopumps.

The test facility is in a standby condition and the project is in a dormant state. The pump assembly has been removed for inspection and several cracks were found in the inducer. A memorandum report has been started on the project as requested by P&VE.

H. Acoustic Studies

Requestor: R-P&VE-SVR and AERO-AU

Acoustic Studies currently being performed at AMTF are to investigate, analyze, and evaluate the noise generating mechanisms and the resultant acoustic fields of aerodynamic flows, i.e., rocket exhaust flows. These flow fields are generated by launch vehicle propulsion systems which are large in size and power; consequently, very severe acoustic environments in many instances are very crude or non-existent. Therefore, it is necessary that prediction techniques be developed and verified that will adequately define the associated acoustic environment.

These test programs cannot be conducted using full-scale flow fields, but by careful consideration of dynamic similarity principles and valid scaling procedures, scale model test programs of these flow fields can be successfully performed, to accomplish the above staged objectives.

Specific programs now planned at the AMTF are:

(1) Comparison of acoustic environmental characteristics of a cone and bell-shaped engine nozzle with duplicate exit diameters.

(2) Acoustic environmental variations due to nozzle exit pressure variations for a single engine.

(3) Ground plane acoustic environment (amplitude) for static and flight operation of a 1/20th scale Saturn V vehicle configuration.

(4) Vehicle acoustic environment (phase and amplitude) for the launch condition of a 1/20th scale Saturn V vehicle configuration.

(5) Acoustic source location study of a single, undeflected, rocket exhaust flow.

(6) Saturn V, MLV acoustic environmental definition for strap-on configurations.

(7) Supplementary study of cluster effects as a function of engine separation distance and cluster diameter.

(8) Study of the three dimensional acoustic field developed by a rocket exhaust flow impingement on a deflector (uni- and bi-directional flow).

No tests were conducted at AMTF during this reporting period. Preliminary data evaluation obtained during the varied engine exit pressure study indicated that four tests should be repeated: two tests to obtain more reliable acoustic data, and two tests to obtain the proper engine operating parameters. All completed data has been given to the program requestor for their immediate use.

Presently, the facility is shut down for semi-annual maintenance of components. Testing to complete the pressure ratio study will resume July 12, 1967.

I. Flame Study

Requestor: R-TEST-C

This project is to obtain free stream and disturbed stream calorimetric, temperature, and pressure data from existing Test Laboratory model rocket engines, which will be

useful in predicting full scale rocket engine plume environments.

Three tests were conducted during this report period with total pressure and temperature measurements being taken at 40 and 30 engine exit diameters. Testing will continue on the non-interference basis.

J. Improved Saturn V Launch Facilities (VLF-39) Model Study

Requestor: KSC

This program is a specific study of existing facility capabilities (VLF-39) necessitated by the proposed use of improved Saturn V Boosters which will use five uprated F-1 Engines and 4-each "Strap-Ons" 120-inch or 156-inch Solid Rocket Motors. This study will be used to establish the extent of launch facility (VLF-39) capability and/or modifications required when using the improved Saturn V Booster Configuration.

The test program, utilizing 1/58 scale model facilities, has the following objectives:

a. Determine the environment of vehicle base and facility elements during holddown and initial liftoff.

b. Determine the environment of the mobile launcher and umbilical tower for maximum vehicle drift.

c. Determine the extent of facility modification necessary for compatibility with Improved Saturn V vehicles.

The test program will be conducted in four phases. A 1:58 scale model of the Saturn V Booster will be utilized for all four phases of the test program.

The first phase will be conducted using the Basic Saturn V Booster scale model and will serve to establish baseline data. Phase II tests will use the same scale model Booster but with the uprated F-1 engines. Phase III will utilize basic Saturn V scale model with 120-inch simulated Solid Motor Strap-Ons. Phase IV will use the basic Saturn V scale model with 156-inch simulated Solid Motor Strap-Ons.

Baseline testing of the lower portion covers liftoff from 0 to 232 feet full scale and the upper portion covers liftoff from 212 feet to 454 feet full scale.

Four tests were conducted during this report period--one simulating vertical liftoff, and three the Case #5, 1.25 Yaw Bias trajectories. One additional test is planned for the 1.25 Yaw Bias liftoff.

A field trip to United Technology Center was made during this report period to view the solid rocket motor test firings and to receive instructions in field assembly procedures for the solid motors. All the inert hardware, cases, nozzles, and forward closures were shipped June 29, 1967, along with four cartridges.

Phase I testing is scheduled for completion July 14, 1967, after which the test stand will be modified for Phase III testing firing the basic Saturn V scale model with the 120-inch scale model strap-on rocket motors. Initial Phase III checkout tests are scheduled for the week of July 28, 1967.

K. Tektite Study

Requestor: R-AERO-AT

This project was initiated to support Goddard Space Flight Center through R-AERO-AT on an experimental and theoretical program involving a study of Tektites. Tektites are black rocks that have been found in localized deposits in several parts of the world. Markings on the tektites appear to have been caused by ablation as might occur upon entry through the earth's atmosphere.

This program was initiated to see if the markings can be duplicated on synthetic tektites using a lox/hydrogen engine to simulate entry temperatures and velocities.

One tektite test was conducted during this reporting period. Once again the tektite sample broke from its mount and fell off.

Testing will be resumed in July 1967 on a non-interference basis.

IV. APOLLO APPLICATION

A. S-IVB Workshop

1. Quick Release Manhole Cover, S-IVB Orbital Workshop

Requestor: R-P&VE-VSA

This project was to evaluate the performance of a proposed quick release manhole cover for the S-IVB Orbital Workshop.

Program has been suspended pending investigation of the accident which destroyed the test fixture on June 8, 1967.

B. S-IVB Workshop Environmental Control System

This program, requested by R-P&VE-P, is required to support the thermal design of the S-IVB Orbital Workshop environmental control system. Tests are scheduled for a condensation model and a 1/8 segment of the workshop compartment liner. The condensation model tests will be used to confirm the analytical model being used to investigate condensation effects. Results from the 1/8 segment will provide data on heat transfer coefficients, fan performance, wall temperature, condensation rates, and certain temperatures.

A flow study was undertaken after the flow pattern was found to be highly turbulent, and it has been decided to suck with the fan rather than blow.

After modifications to the flow were made, four tests were conducted with good results. Approximately eight more tests are scheduled before mounting the condensation model in a vertical position. Horizontal testing should be completed by the end of next month.

Assembly has started on the 1/8 segment, and testing is scheduled to begin during the first part of August in a 5 p.s.i.a. atmosphere.

C. Insulation Flammability Study

This program was requested by R-P&VE-M to define and study the fire retardency of insulation in an oxygen environment.

Nine 3-foot diameter polyurethane foam insulation samples (four 2-mil and five 5-mil aluminum covered samples) were tested in a 100% gaseous oxygen environment during this reporting period (Tests C-045-10 through -22). A test tank pressure of 5.5 - 6.0 p.s.i.a. under flow conditions and a vacuum chamber pressure of approximately 25 mm Hg were maintained during each test. Velocity simulation (155 ft/min) across the insulation surface was obtained using an electric blower primarily, although oxygen distribution manifolds were used to obtain velocity in three tests. Ignition was accomplished using a nichrome wire.

Two inch diameter circular insulation exposures were used on all 5-mil samples, and only localized burning was obtained (about 4 inches in diameter). However, when the same cut was made in the 2-mil samples and the velocity maintained with the fan, the insulation burned out to the test tank wall in a cone shape matching the fan exit cone. Approximately 25% of the total insulation surface was burned. A similar burn area was obtained when a ¼-inch x 1½-inch cut was made in a 2-mil sample. However, only very localized burning (1 sq. in.) was obtained when 1/8-inch x 1 ½-inch cuts were made in a 2-mil sample.

Testing of the insulation samples will continue through the next reporting period.

W. L. Grafton

GEORGE C. MARSHALL SPACE FLIGHT CENTER
TEST LABORATORY
MONTHLY PROGRESS REPORT
TECHNICAL SUPPORT DIVISION
JUNE 1, 1967 through JUNE 30, 1967

I. SATURN IB

a. S-IB/MM Stage Testing

A feasibility study with estimated costs and scheduling was completed for a S-IB/MM Stage to be mounted and fired in the S-1C Saturn Static Test Facility.

b. H-1 Turbopump

Supported testing with high pressure gases, high pressure industrial water and RP-1 fuel.

c. Continued shop support for S-IB Test Facility.

II. SATURN V

a. S-1C Testing

Design modifications started on the S-1C Saturn Static Test Facility in preparation for the S-1C-T firing. Modifications include the LOX Pressurization System, the Overboard Venting System and the Main LOX Storage System.

Installed S-1C-T in Test Facility.

Off-loaded S-1C Weight Simulator.

Completed Flow Testing on 3 Saturn V Swing Arms at S-1C Test Facility. Transported Arms back to GSE Facility.

Continued buildup of Super Insulation And 501 Test Facilities.

FOR INTERNAL USE ONLY

b. S-IVB Testing

Consultations continued concerning relocation of GSE and Blast Protection on the S-IVB BETA III Test Stand at SACTO. Trips were made to Kennedy Space Center and the Pratt & Whitney Test Facility to become familiar with their emergency escape equipment for possible adaptation to the BETA III Stands.

Supported LH_2 Slosh, J-2X Thrust Chamber and S-IVB Testin with high pressure gases, liquid hydrogen, gaseous hydrogen and high pressure industrial water.

Construction was started on the hydrogen gas transmission system which will support the S-IVB Stand, Acoustic Model Test Facility, Test Position 500, and Cell 115.

Completed two tanks for F-1 Turbopump Test Stand.

Continued machine shop and welding support for Saturn V Test Program.

c. F-1 Engine

Supported static firings at the West Area F-1 Engine Test Stand with high pressure gases, high pressure industrial water, trichlorethylene and ethylene glycol.

The piping required for tie-in of the 1,250 cubic foot 5,000 psig GN_2 vessel to the F-1 Stand is 50% complete.

d. Component Testing--S-II Structural

Design continued on the buildup for the S-II Structural Test Specimen and reached an overall about 85% completion. NAA furnished test fixtures have arrived at MSFC and their modification and adaptation began. Revised specimen loading is being re-evaluated through the testing structures. Completion date for design now appears to be August 1, 1967.

e. S-II Test Assembly

Modified legs on GH_2 storage, complete.

Continued fabrication Saddle Adaptors for 28,000 gal. LOX tank, LH_2 storage area, 25% complete.

Continued fabrication on S-II Tower Structures progressed to approximately 15% complete.

Progress on forward load Assy-S-II, material status 75%, fabrication 10%.

Plates for foundation tie down bolts, material 100%, fabrication 5%.

Fabrication for S-II Test Fixture Hoist Beam Dog Leg, 100% complete.

Off-loaded, transported, and installed S-II Test Speciman for P&VE.

f. GSE Testing

Design progressed to 75% completion on mounting the Saturn V lift off control switch in the S-1C Saturn Static Test Facility to check vibration effects under firing cond tions.

Completed console pipe weldments for GSE Arm 1 an Arm 2. Modified Hinge Cylinder.

Continuing support for Straza Duct Modification.

g. Component Testing

Design was completed on the GG LOX main valve at the F-1 Turbopump Test Position.

h. Transportation of Stages

The S-1C Forward Handling ring for the S-1C-D&F Stages is being reworked in-house. The earliest use date is now August 10, 1967.

The S-1C Steel Forward Handling Ring for S-IC-T & Flight Stages was completed and delivered by Progressive Welders, Inc. on June 29, 1967. It will be placed on the S-1C Simulator and Tested about July 3, 1967.

Procurement is still in progress on four additional S-IC Steel Forward Handling Rings for Flight Stages with one of the four to be delivered by Progressive Welders on September 1, 1967.

Technical monitoring of the Barge "Orion" modification by the Diamond Manufacturing Company in Savannah, Georgia is continuing.

Technical assistance was given for loading and tie-down for the air shipment by Super Guppy of the ML-2 Damper System and ML-1 Redundant Damper System (Saturn V GSE). "As built" documentation is in progress.

Design, documentation and checking is in process on the following projects: (a) "As built" drawings of the MTF Shuttle Barges; (b) S-IC Engine Extension Trailers; (c) Marine tie-down for empty S-IC Transporter; and (d) S-IC Transporter Drawings.

IV. SUPPORTING RESEARCH AND TECHNOLOGY

a. In House Applied Research and Technology

Design was completed on phase I of 1/10 scale model S-IC Booster Recovery Program. Phase II which includes rotational and angular impacting was started with about 5% completion attained. Go ahead to completion approval of Phase II is being awaited.

Test position design and management of the in house hydrogen embrittlement program continued.

Design continued on the installation of a LH_2, Mass Flow Calibration Systems in the Components Test Area.

Design was completed on a LH_2 gravity flow system to support LH_2 instrumentation development at Building 4746.

V. FACILITY BUILD UP AND MODIFICATION

a. Helium Compressor facility

Fabrication of pipe complete for the installation of helium compressor number 3. The pipe must be radiographed, hydrostated, and cleaned before installation.

Fabrication of the helium cryogenic purification system piping has continued during the month.

b. Air Compressor Station, Building 4746

Work has continued on the problems experienced with the compressor bearings. Three compressors are operational.

Coordinated, monitored and installed 20 high pressure hydrogen gas vessels and 12 LH_2 storage vessels.

The twenty 625 cubic foot high pressure hydrogen vessels were hydrostated to 6,600 psig.

Continued vacuum pull down and leak testing of the annular space on the 12 LH_2 storage vessels.

VI. OTHER PROGRAMS

a. Apollo Telescope Mount

Design is in process for the Apollo Telescope Mount Transportation Equipment. Discussion now centers around Transporter Instrumentation.

b. Voyager Program

All Interface Control Documents have been submitted by the Boeing Company. All documentation has been returned for correction of errors with a suspense date for final submittal of July 31, 1967.

c. Nuclear Ground Test Module

The route survey prepared by NAA has been received. It recommends "The Northern Route" as originally proposed by them. Money ($10,000) for the MSFC route has been requested for first quarter 1967.

VII. MISCELLANEOUS

a. J-2X, J-2T Program

Redesign of Components Test Position 502 continued to insure completion of Phase I and Phase II of the J-2T program.

b. 38' x 65' Vacuum Chamber

Design criteria development for the 38' x 65' Vacuum Chamber was cancelled.

c. Advanced Orbital Space Station Stability Program

Design of a dynamic launching and catching device for model study of a space station concept employing artificial gravity and the required orbital stability was completed.

d. Lunar Scientific Survey Module

Design on a power cable support boom from support vehicle to LSSM for road testing was completed.

Modification of component parts for Lunar Drill, 100% complete.

Modification to Flame Deflector to provide additional cooling, 100% complete.

Repaired 3 Kobe Pumps.

A study was initiated to establish a central gaseous hydrogen generation facility.

Julian S. Hamilton

Julian Hamilton

GEORGE C. MARSHALL SPACE FLIGHT CENTER
TEST LABORATORY
MONTHLY PROGRESS REPORT
ADVANCED FACILITIES PLANNING OFFICE
June 1, 1967 through June 30, 1967

I. FACILITIES

A. R&A Projects

1. Additions to Cryogenic Storage - Project 7072 - Design for the Brick and Mortar part of this project was completed in May. Piping design was completed in June.

During June the tank foundations were completed. Also the 12 LH_2 storage tanks were set on their foundations.

Work was begun on installing electrical, instrumentation, and control conduits. Foundations for the LH_2 Transfer Control Building were excavated.

Construction of the entire project is approximately 40% complete.

2. S-II Structural Test Pad - Project 7076 - Design of this project was completed in June. Construction will start in July, 1967.

3. S-II Aft. Section Test Assembly Special Requirements - Design will be completed in July, 1967.

The 20 GH_2 storage bottles were set on their foundations and have been hydrostatically tested. Cleaning of bottles is scheduled to start during week of July 3, 1967.

4. Design is underway for the Helium Line Extension to Building 4650, Project 8004; and for Installation of Steam Ejector System, Building 4557, Project 8008.

5. Project 8003, High Pressure Air Pipeline, is being held up pending determination of requirements of Aero-Astro Dynamics and P&VE.

6. Construction is underway on the following projects:

a. Project 66-35 - Elevator at Liquid Hydrogen Test Stand

b. Project 7008 - Additional LOX Storage for All Test Positions, Building 4583

c. Project 7009 - Firex System Addition, Test Stand 115

d. Project 7013 - Elevator for Test Stand 500

e. Project 7018 - Transformer Substation - Test Stand 500

f. Project 7021 - GH_2 Transmission System

g. Project 7023 - GH_2 Pipeline System

h. Project 6742 - GH_2 Connector Line

i. Project 7056 - LOX Trailer Parking Area

j. Project 6255 - Pavement Addition, Building 4653

k. Project 7058 - Extension of Steam Line to S-IV B Test Stand

l. Project 7068 - Cable Trays and Cable Installation, East Test Area

m. Project 7066 - Timber Clearing, West Area, FY 67 Landscaping, Part II

n. Project for Fire Detection System.

o. Project for Landscaping Dodd Road, FY-67 Part I.

B. ENVIRONMENTAL TEST COMPLEX

Based on the results of a Preliminary Siting Study presented on May 17, a Preliminary Facility Concept has been completed by Test Laboratory personnel and distributed to all members of the group engaged in this planning. Current efforts are being directed toward compiling the data and material required for a presentation to MSFC Management sometime after July 15, 1967.

C. INTERMEDIATE VACUUM CHAMBER

The preparation of criteria drawings was discontinued on June 8, 1967.

D. STORABLE PROPELLANTS TEST FACILITY

Preparation of budget drawings have been initiated. A Scope of Work for a PER has been completed.

E. NUCLEAR GROUND TEST MODULE

A funding requirement was given to P&VE for the first quarter FY-68. Specifications and procurement requests for high pressure vessels are being prepared. Specific approach to handle facility adoptions is being studied by F&DO. The criteria package for adaptation of the S-IC Test Stand for the NGTM is being updated to reflect changes due to construction of the Additions to the Cryogenics Storage in the West Test Area.

J. B. Carrington

Karl L. Heimburg

Karl L. Heimburg

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