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TEST LABORATORY PROGRESS REPORT  
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I SATURN I/IB PROGRAM

A. S-IB-5

Stage S-IB-5 arrived at MSFC on Barge Palaemon on February 27, 1966 and was installed in Static Test Tower East on February 28, 1966. The LOX pump shaft seals on all eight engines were removed by Rocketdyne personnel and replaced by modified seals with vent holes drilled through-out the seal housing. The LOX seal drain lines were removed and replaced by instrumented drain lines to provide temperature measurements during firing tests. Functional checkouts and leak tests are in progress. The propellant loading test is scheduled for March 17, 1966. The two static firings are presently planned for March 24 and 31, 1966.

The flame deflector was repaired and additional holes were drilled on places where erosion occurred on previous tests.

B. Power Plant Test Stand

1. No tests were conducted during this report period.
2. Engine firing and low temperature environmental testing of H-1 engine hydraulic package assemblies are planned for the next report period.
3. An environmental test setup has been prepared and engine H-7057 has been checked out and readied for static firing.
4. Testing will begin subject to receipt of hydraulic components from CCSD.

C. S-IVB Test Stand (MSFC)

1. Two tests were conducted during this report period as shown in the table below:

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<u>TEST NO.</u>	<u>DATE</u>	<u>DURATION</u>	<u>REMARKS</u>
S-IVB-016	2-21-66	40.19 seconds	Cutoff by the gas generator overtemperature device.
S-IVB-017	3-1-66	412.44 seconds	Cutoff due to fuel depletion.

2. The major objectives of test S-IVB-016 were to simulate the fuel tank pressures and thrust chamber pre-chill temperature expected on vehicle S-IVB-201 during launch. These objectives were met during the test.

3. The major objectives for test S-IVB-017 were as follows:

a. Program mixture ratio (Propellants were loaded so as to cause the P.U. valve to operate in the closed position for 100-150 seconds.)

b. LH<sub>2</sub> loading and topping using propellant tanking computer system.

c. Fuel recirculation system performance (dry fuel feed duct chilldown). All objectives were met on this test.

#### D. 200K H-1 Turbopump Testing

1. This program supports P&VE in the Saturn IB Vehicle "POGO" Study. The program is necessary to establish a relationship between suction line resonant frequency and pump suction pressure for the S-IB oxidizer and fuel delivery systems.

2. No tests were conducted during this reporting period due to higher priority test programs.

## II SATURN V PROGRAM

### A. F-1 Engine (West Area)

Modifications were completed on the West Area F-1 Test Stand thrust measuring system and F-1 Engine F-4T2 was installed for the next series of tests scheduled to begin on March 15, 1966.

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B. F-1 Heat Exchanger Development Tests

The purpose of this program is to establish reliability and to verify the design of the F-1 Heat Exchanger.

Three tests of 40-second duration each were conducted during this report period to calibrate the S-1C heat exchanger helium outlet flow orifice.

Testing was completed and the test cell is being readied to continue tests using cold helium in the heat exchanger helium coils.

Testing is scheduled to be resumed in March 1966.

C. Liquid Hydrogen J-2 Heat Exchanger

This test program has supported the development of the J-2 4-coil heat exchanger using LOX as the fluid through the heat exchanger coils. A series of tests were conducted on a J-2 4-coil "short-coil-pack" heat exchanger and a memo report covering these tests has been published. At this time, there is an indication from the P&VE design group that further testing under this program will not be required.

D. F-1 LOX Turbopump Seal Tests

This program is being conducted to develop and improve LOX turbopump seals. This will be accomplished by comparing wear characteristics of various materials and configurations in the seal test fixture at simulated turbopump operating conditions.

Minor modifications to the test stand are nearing completion. The shaft coupling has been modified and rebalanced. Precision alignment of the test fixture and drive turbine has been accomplished. Turbine and turbine instrumentation checkouts are underway. Static cryogenic tests of the test fixture will start in the near future.

E. LOX Circulation Pump Tests

This project is being conducted to determine if two LOX circulation pumps, which were being considered as a backup method to prevent geysering in the S-1C LOX suction lines, can meet acceptance requirements and operate satisfactorily.

Two tests, using LOX in the system, have been conducted with tentative results indicating satisfactory operation of the pump. The test data is under evaluation. Testing will continue.

F. F-1 Gas Generator Scale Model Injector

This program is being conducted to investigate scale model F-1 gas generator injectors of various designs to determine their suitability for full scale evaluation. Each candidate injector is subjected to a two-part test program. Part I consists of water flow tests to determine discharge coefficients and pattern characteristics. Part II consists of hot firings with various propellant mixture ratios and flowrates.

Cleaning of the LOX system was completed; however, no tests were conducted during this reporting period because of higher priority work - MTF Valve Testing. If MTF Valve Testing diminishes, the evaluation of candidate injector #5 will resume in March.

G. F-1 Gas Generator Development Tests

A project was established to conduct tests on an F-1 gas generator with different injector configurations. The objectives of the program are to alleviate detrimental pressure oscillations, reduce continued combustion in the turbine manifold, and increase gas generator performance.

Three tests were conducted on the Rocketdyne experimental doublet

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injector during this report period. The evaluation of the experimental doublet will be completed during March, and the evaluation of the P&VE double-swirlcup injector will follow.

A report covering the P&VE concentric-tube injector evaluation is being prepared.

#### H. Carbon Deposition Studies

This program is to determine what effect variables such as accumulated test time, heat exchanger surface temperature and water injection rates have upon the prediction of carbon film resistance on the F-1 heat exchanger. A test apparatus is being used which provides the capability to measure the thickness of carbon deposited on a tubular heat transfer section in cross flow.

Cleaning of the LOX and GN<sub>2</sub> systems was completed; however, no checkout tests were conducted because of higher priority work - MTF Valves and other test programs. Testing will be resumed during the month of March 1966.

#### I. LH<sub>2</sub> Gas Generator Development Tests

This is a development test program to support development of a J-2 gas generator injector. One test was accomplished in this period in which an injector with a modified LH<sub>2</sub> inlet was used. The modification greatly reduced LH<sub>2</sub> leakage. A change from a pyrotechnic ignition system to an electrical spark ignition system is being made. Testing is scheduled to continue the week of March 14, 1966.

#### J. MTF Components

Thirty-six cryogenic facility valves have been tested this month in accordance with requirements outlined by MTF. Eight valves leaked

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excessively and were returned to the Valve Laboratory for corrective maintenance. All valves were reserviced, retested, and found to be acceptable. All valves have been returned to the Valve Laboratory for shipment to MTF.

K. Pump Inducer Development Project

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

One test was conducted in February to check out the pump, system and instrumentation program.

Further testing has been temporarily delayed because of repairs necessary to the lube oil system for the prime mover. Testing should be resumed in March.

L. LOX Slosh Facility

1. The LOX Slosh Facility, a 40% scale model of the Saturn V, S-IC stage, LOX tank and suction lines was established to support P&VE studies of tank pressurization, propellant geysering, sloshing, and tanking phenomena.

2. One One Pressurized Drain Test with Propellant Slosh and two constant Pressure Drain Tests without Slosh were successfully conducted during the month of February. All three tests used  $\text{GH}_e$  as pre-pressurant and hot  $\text{GOX}$  as the pressurant. The initial ullage for all tests was 5%. The final test of the series is scheduled for March 8, 1966.

M. Liquid Hydrogen Slosh Testing

1. This program supports P&VE in the areas of  $\text{LH}_2$  propellant feed system studies and studies of LOX propellant feed systems in an ellipsoidal tank.

2. There was no testing at the  $\text{LH}_2$  Slosh Test Facility during this report period due to tests at the adjacent LOX Slosh Test Stand.

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Testing will be resumed in April 1966.

N. S-IVB Auxiliary Propulsion System Testing

1. The S-IVB Auxiliary Propulsion System Test Program was requested by P&VE to establish an in-house capability for conducting tests on upper stage ullage and attitude control motors.

2. Six "burp firings" were conducted at sea level conditions on the Saturn IB/S-IVB Module on February 16, 1966. These tests consisted of 125 millisecond bursts on each engine followed by two 65 MS ON - 134 MS OFF pulses on each engine. The purpose of the tests was to verify that the module would operate satisfactorily after remaining exposed to propellants for an extended period of time (20 days). All systems operated normally.

3. The Thiokol Steam Generator/Ejector System has completed acceptance and checkout tests. This system, in conjunction with the Gemini Steam Ejector System, will be used to maintain simulated pressure attitude during the  $4\frac{1}{2}$ -hour duty cycle to be conducted on the APS Module. This test is scheduled for the latter part of March.

O. 40,000 GPM Flowbench:

1. This facility supports the Instrument Development Branch of Test Laboratory by providing a high flow water calibration capability.

2. Failure of Toledo weighing system hardware necessitated facility modifications which are currently in progress.

P. Liquid Hydrogen Super Insulation Program

1. This program, requested by P&VE, consists of studying the effectiveness of "super insulated" LH<sub>2</sub> tanks in a simulated space environment of  $10^{-6}$  torr pressure.

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2. Two additional oil diffusion pumps (50,000 liter/sec each) have been installed on the vacuum chamber in order to reach a simulated space pressure of  $10^{-6}$  torr for further tests on the super insulated LH<sub>2</sub> tank. As reported last month, the chamber ultimate pressure was  $10^{-5}$  torr for the first series of tests on the LH<sub>2</sub> test tank (Test Tank #2).

3. Test Tank #2 has been reinstalled in the vacuum chamber and testing is scheduled to begin the week of March 14. Upon completion of the tests, Test Tank #2 will be returned to ME Laboratory for re-insulation. Test Tank #3 (insulated with Linde SI insulation) is scheduled for delivery to Test Laboratory during the first week of April 1966.

Q. F-1 Turbopump Facility

1. 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 engines.

2. Test data from S-IC POGO Test C-006-45 have been sent to Rocketdyne in support of the F-1 engine analytical contract NASW-16. This completes the transmittal to Rocketdyne of all test data taken during F-1 Turbopump POGO Tests. No tests were conducted during this report period. Testing is scheduled to resume in April.

3. Ten flow calibration tests were conducted on the M-1 Facility LOX turbine flowmeter. This program is scheduled to be completed by the middle of March.

4. Six Prevalve Closure Tests were conducted at the S-IC Fuel

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Flowline Test Position. These tests were performed to determine the closing characteristics of the AiResearch S-IC Fuel Prevalve. Flows varied from 4,000 GPM to 7,700 GPM. The prevalve was orificed to close in 1.610 seconds at a fuel flowrate of 7,700 GPM without exceeding a 80 p.s.i.g. pressure surge. This completes the valve closure tests to be performed on this prevalve. Similar tests will be conducted on a Whittaker Fuel Prevalve during March 1966.

5. Three tests were conducted at the S-IC LOX Flowline Test Position. These tests were performed to obtain flow and pressure data on the Flexonics S-IC LOX Inboard PVC. LOX flows were varied from 10,400 GPM to 38,900 GPM. These tests completed the program to be accomplished on this PVC. An Arrowhead LOX Inboard PVC will be tested in March 1966.

#### R. S-II Insulation

1. This test program was requested by P&VE to study the effectiveness of the LH<sub>2</sub> Tank Insulation currently planned for eventual use on the S-II stage of the Saturn V vehicle. The objectives of the program are: (a) to determine the heat transfer coefficient of the insulation, and (b) to determine what effect, if any, fill and drain cycles have upon the adhesive.

2. The Simulated Aerodynamic Heating Tests were delayed due to late delivery of sealer material. Testing will start one week after the material is received.

#### S. Zero Gravity Test Facility

1. The Zero Gravity Drop Tower will be 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.

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2. Twelve tests were conducted during February. One test with the LH<sub>2</sub> interface package (C-024-1G3), four tests with the LH<sub>2</sub> drain package (C-024-4F2 through 4F5), and seven tests with the LH<sub>2</sub> impulse package (six tests, C-024-3F1 through 3F6, with impulse of the LH<sub>2</sub> tank after drop and one test, C-024-2F1, with impulse of the LH<sub>2</sub> tank prior to drop).

3. The liquid for all tests was petroleum ether and the tests were conducted at 0.28 g and 0.02 g (drain package). The plexiglass window on the drag shield failed on test C-024-3F6. The failure was attributed to work fatigue of the glass and supporting structure. The window was replaced with aluminum.

#### T. Fluid Correlation Tests

1. These tests were requested by Astrionics Laboratory to evaluate the performance of F-1 servoactuators with 5606, RP-1 and RJ-1 fluids.

2. Hydraulic Research Servoactuators SN061 failed structurally on February 14, 1966, after completing 53,220 cycles of a 130,000 cycle endurance test. The failure was located in the same general area where H-R actuator SN-051 failed on October 29, 1965. Actuator 061 has been removed from the test setup and returned to Astrionics for failure analysis.

At the present time, Moog Servoactuator SN067 is undergoing endurance testing, and has successfully completed 55,000 cycles of the 130,000 cycle endurance test.

#### U. Ground Support Equipment

1. High Pressure Fluid Tests - The following tests are being conducted to qualify high pressure pneumatic components in the High Pressure Fluid Test Facility:

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a. Grayloc 10,000 p.s.i.g. Coupling Test. This program for KSC is to qualify Grayloc 10,000 p.s.i.g. couplings for use with pipe larger than 1-3/4" in diameter. All testing is complete. The final report is scheduled for completion on March 11, 1966. The couplings have performed satisfactorily.

b. Annin 10,000 p.s.i.g. Electrohydraulic Pneumatic Control Valve. This test program is being conducted for KSC to qualify the Annin pressure control system (EAC-11) for use in LC-39 high pressure pneumatic distribution system. The system utilizes an electrohydraulic circuit to control poppet position. Line size is 6 inches. The test schedule has slipped because of problems encountered by the manufacturer's field representative when adjusting the servo system and because of higher priority MTF work. Work has now resumed.

c. Vacco Regulator Test. This test for the Mississippi Test Facility is to evaluate the facility regulator (PCV-A) purchased for the pneumatic system at MTF. The PCV-A requires additional testing and modifications to prevent seat damage. The modified valves were received from the manufacturer on March 2, 1966.

d. Autoclave Hand Valve Test. This test program has been conducted for KSC to qualify this ON-OFF-type manual valve for use in a high pressure gas distribution system at Cape Kennedy. Testing is complete and the test report is being written. The valves functioned satisfactorily.

2. LC-39 Mobile Launcher Holddown Arm Test - The purpose of this test program for KSC is to verify the physical and functional integrity of the Saturn V holddown arms prior to installation on the mobile launcher. All four holddown arms of the second set with forged links have been tested

and shipped to KSC. The test program on all four sets is approximately 65% complete and is scheduled to be completed by May 27, 1966.

3. Cryogenic Rotary Joint Test - This joint is designed by KSC to relieve twist forces in flex lines. Preliminary tests were conducted December 30, 1965, and a defective seal caused leaks. A seal modification has been made and testing has been resumed with no additional problems detected.

4. Pressure Vessel Testing - This is a portion of a research program being conducted by Test Laboratory to determine the effect of hydrogen embrittlement in steel and the effect of pressure on a new nozzle design.

A 38-cu. ft. A. O. Smith laminated bottle has been hydrostatically tested to 160% design pressure. A 43-cu. ft. Taylor forge solid wall bottle has been hydrostatically pressurized to failure and is now at P&VE for analysis.

A 28-cu. ft. A. O. Smith laminated bottle has been hydrostatically pressurized to failure and awaits analysis. Testing is expected to continue for five months. This five-month period includes the three months that the vessels will be subjected to a gaseous hydrogen internal environment.

5. Service Arms - Qualification and acceptance tests are being conducted for KSC and P&VE on the Saturn V service arms prior to installation on the Mobile Launchers at KSC for launch of Saturn V space vehicles.

a. S-1C Intertank. This preflight service arm provides L02 fill and drain service to the S-1C stage. It has reconnect capabilities in case of a mission hold or abort.

The arm was installed on the tower simulator on January 28

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and testing of the reconnect assembly was begun on January 31, 1966. The capability of this assembly to connect to the vehicle plate, successfully transmit cryogenic fluid through the LO<sub>2</sub> couplers, and disconnect automatically, was verified. On February 17, 1966, arm retraction tests were begun. The deceleration valve plug was adjusted until satisfactory results were obtained, and a permanent plug cut to this length and installed.

A second reconnect assembly was received and installed on February 23, 1966. This assembly had been cleaned to LO<sub>2</sub> specifications, the replenish LO<sub>2</sub> line had been evacuated, and modified butterfly valves had been installed; these conditions had not been met on the first unit.

This unit was subjected to reconnect, disconnect, and tracking tests, and was found to be satisfactory. The arm was removed from the tower simulator on February 24, 1966, and was loaded on the barge on February 27, 1966, for shipment to Cape Kennedy.

Though several problems were encountered during testing, this arm is considered qualified for the Saturn V 500F wet test. Before the arm can be considered flight qualified, however, further testing and data analysis is required.

b. S-IC Forward. This preflight arm provides air conditioning, electrical, and pneumatic service to the S-IC stage.

System tests were completed using a modified deceleration valve, which gave an improved motion during retraction. The modification consisted of adjustable plug to preset the flow compensating portion of the valve.

The flight hardware was tested to finish off the test program. This service arm encountered some difficulty during testing;

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however, it can be considered qualified to support the SA 500F wet tests since there is to be no separation from the vehicle. Further testing is required before this arm can be considered flight hardware.

The arm, after modifications, was shipped by barge to KSC on March 1, 1966.

c. S-II Aft. This preflight arm serves as a personnel work platform in order to service the S-II intermediate service arm umbilicals and provides vehicle inspection to the aft end of the S-II stage.

The test program was completed on February 7, 1966, and the arm shipped to Cape Kennedy via truck on February 12, 1966. The service arm is considered qualified to support the SA 500F wet tests; however, modifications are required before it can be qualified for SA501 flight vehicle.

d. S-II Intermediate. This inflight service arm provides air conditioning, electrical, pneumatic, LH<sub>2</sub>, and LOX services to the S-II stage. The LH<sub>2</sub> and LOX fill lines have independent connections to the stage while the remainder of the service lines on the arm connected to the stage through one common carrier.

The hinge assemblies were received on January 17, 1966. These hinge assemblies and other associated hardware were installed and the service arm was installed in the test fixture on February 3, 1966.

Preliminary tests were conducted using LN<sub>2</sub> for simulated propellants on February 16, 1966; however, no conclusions were formed since the prototype propellant couplings leaked.

The power transition modification, hinge cylinders modification, and several miscellaneous modifications have been incorporated

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into the service arm. The qualification tests are scheduled for March 21.

e. Service Module. The service module arm is an inflight arm and provides air conditioning, electrical, hydrogen ventine, and water-glycol cooling services to the Apollo service module.

The decision has been made to keep the arm at MSFC for a complete test program.

Consoles 1 and 2 were received from Hayes on February 17, and have been installed on the tower.

The arm hinges were received from Hayes on March 2. The hinge cylinders were removed and delivered to BECO for modification. The arm has been assembled and was installed on the tower on March 8.

Preparations are being made on the tower to begin the planned test program.

f. Lift-Off Switch. Twenty additional tests were conducted on the secondary switch. Tabular data indicates the switch is functioning adequately.

The kinetic switches were replaced in the switch assembly and three tests were run on the primary and secondary switches. These tests indicate a need to adjust the follower arm lengths at any time the kinetic switches are changed to insure that the switches close at  $3/4$  of 22 in. of vehicle travel.

### III RESEARCH AND DEVELOPMENT TECHNOLOGY PROGRAMS

#### A. Jet Impingement on Water

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

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offshore sites.

2. Work is in progress on the single engine report. Tentative planning calls for the analytic phase to be completed by May 3, 1966.

B. Jet Impingement on Simulated Lunar Surfaces

1. This program was requested by P&VE to study the effects of a hot rocket jet impinging on probable lunar soil samples.

2. An Internal Note has been written for this program and is currently being finalized.

C. Propellant Dispersion System Feasibility Study

Testing has not resumed pending redesign of thermal conditioning system by P&VE Laboratory.

D. Combustion Dynamics

The 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<sub>2</sub> systems at the 30K and 15K thrust levels respectively.

Three tests were conducted with a 30K thrust LOX/RP-1 doublet like-on-like impingement injector. The 17-inch long chamber and uncooled nozzle were used for all of these tests. Two of the tests were conducted to performance-map this injector at different O/F ratios. The characteristic velocity was slightly higher than previous tests of this injector in a 12-3/8-inch chamber. One test was conducted to determine the ability of this injector-chamber combination to stabilize after being bombed with a 20-grain pulse charge. A significant pressure pulse occurred but was damped out in approximately 80 milli-seconds.

One GH<sub>2</sub> blowdown, utilizing an engine chamber pressure simulation

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device, was conducted on the 15K LOX GH<sub>2</sub> test facility. The data from this blowdown will be used to determine facility settings for future tests.

E. LH<sub>2</sub> Seal Evaluation Tests

This program was initiated to test various static seals for special manhole covers on a liquid hydrogen test tank.

Facility buildup is 99% complete. The vent line has been cleaned and checked for binding under cryogenic conditions after installation of the hangers. Upon completion of the liquid level probe instrumentation, the system will be ready for LH<sub>2</sub> tests.

F. Flame Study

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 environments.

The facility cleaning and valve servicing has been completed and testing has resumed. Six tests have been conducted. Static pressure, total pressure and temperature measurements were made in the rocket engine exhaust plume at 20 nozzle exit diameters from the engine. In addition, narrow view angle and wide view angle calorimetric measurements were made of the plume.

G. GH<sub>2</sub> Engine Development - Phase III

The purpose of this test program is to develop a 4000-pound thrust level engine using as much existing LOX/RP-1 engine hardware as possible.

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No modification to the combustion chamber has been required; however, redesign of the injector was necessary.

No testing was done during this reporting period due to facility cleaning. Testing will resume as soon as scheduling permits.

#### H. Acoustic Studies

Buildup of the new Acoustic Model Test Facility is approximately 90% complete. Facility checkouts are presently being conducted and testing is scheduled to begin around March 15, 1966.

### IV FACILITIES

#### A. Addition to Components Test Facility (FY64)

The contract is still approximately 99% complete. The contractor is in the process of correcting construction deficiencies and shock testing of the LH<sub>2</sub> and LOX piping has been delayed until critical deficiencies can be corrected. Shock test should be conducted in the latter part of March. Contract price is \$2,908,035. The contractor has submitted a claim of approximately \$67,000 for delay incurred by LH<sub>2</sub> piping being shifted to MTF.

#### B. Technical Systems

The contractor, LSI Contract NAS8-12093, has completed all work under the subject contract. AS-built drawings and final technical documentation was received February 22, 1966. This contract also covered technical systems for the Acoustic Model Test Facility at CTL. Contract price is \$1,659,553, plus pending additional \$22,000 change order which has not been finalized.

#### C. Extension to Components Test Facility Instrumentation - (FY65 Technical Systems)

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The contractor is 45% complete. The contract is scheduled to be completed by May 23, 1966. Design through delivery phase, Contract NAS8-12065 price is \$1,308,318. Installation Contract NAS8-17126 is \$124,000.

D. Acoustic Model Test Facility - NAS8-12093

The contractor, LSI Contract NAS8-12093, has completed all work under the subject contract. As built drawings and final technical documentation was received on February 22, 1966. This contract also covered technical systems for the Addition to Components Test Facility. Contract price is \$1,659,553 plus pending additional \$22,000 change order which has not been finalized.

E. Modernization of Instrumentation and Control Systems in the East Area (FY64-Lear Siegler NAS8-12051)

The contractor gave beneficial use of the Advanced Dynamic portion on February 23, 1966. Contract is scheduled to be completed including delivery of "as-built" drawings by March 15, 1966. Contract price estimated through pending change order is \$3,609,085. The contractor is 99.4% complete.

F. Expansion and Modernization of High Pressure Gas Systems (FY64)

Modules one and two are in continuous service furnishing high pressure N<sub>2</sub> gas into the high pressure N<sub>2</sub> gas distribution system. All usable equipment of modules three and four has been moved from building 4596 to the project where it is now being reinstalled along with the remainder of the vacuum jacketed pipe.

It is expected that modules 3 and 4 will be finished at the end of March.

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G. Saturn Support Test Area (FY65)

1. Transportation Hangar and Addition to Building S-4653 - BOD inspection of interior of building was held on February 17, 1966, in order to complete certain items. Original bridge crane is still scheduled to be installed by March 15. A change order has been processed for an additional bridge crane. This project was 95% complete February 10, 1966.

2. High Pressure Gas and Propellants - The construction contractor remains far behind schedule, mainly due to improper shop drawing submittals. The majority of submittals do not meet the requirements of the specifications. Construction is approximately 35% complete and 17 weeks behind schedule. Contract cost is \$969,000.

3. Cryogenic Type GHe Purifier - The strike at the Cryovac Company plant has ended. Initial testing of the purifier is expected this month with shipment to Test Laboratory scheduled for April. Cost is \$146,500.

H. Addition to Advanced Saturn GSE Test Facility (FY65)

1. Brick and Mortar - Beneficial occupancy inspection for the Test Cells at High Pressure Test Facility was held February 28, 1966. Beneficial occupancy was given March 1, 1966. This project is 88% complete.

2. Technical Systems - The design through delivery phase is 95% complete. The installation contractor was issued a change order to speed up installation and checkout of the Blockhouse portion and to be completed by March 1, and this task was accomplished. This was required in order to support the high testing density for Saturn V swing arms. Installation is approximately 60% complete. Contracted amounts NAS8-12087 \$969,618; NAS8-17125 \$125,000. Contractor is scheduled to be completed by May 1966.

F O R I N T E R N A L U S E O N L Y

I. Engineering Building Extension (FY66)

Construction began on October 26, 1965. The contractor is making excellent progress. The job is 37% complete and ahead of schedule. Contract was awarded for \$489,850.

J. Advanced Saturn Dynamic Test Stand (FY63)

The lightning arrester air terminals relocation, the final tower structural modifications and the monorail structural additions were inspected and accepted on February 23. Only the installation of the monorail hoists remains to be done after the hoists are received. Total modification costs were \$293,800.

K. S-1C Sound Suppressors

Washington State University has been successful in achieving reliable priming of the large siphon which will supply the sound suppressor. They also have reduced the design parameters involved to mathematical terms. Initial problems with the rebuilt Supercritical Hydraulic Analogy model have been corrected and tests are proceeding.

A meeting was held in Test Laboratory on March 2 and 3, to discuss initial progress and ultimate goals. GFE valves and transducers for the buildup of the Supersonic Air Jet Model are in process of being shipped to Washington. The contract supplement was made effective February 24. The new contract fixed cost is \$77,075.

L. GHe Line to GSE and S-1B Dynamic Test Stand

Notice to proceed with this supplemental package was given Greenhut this past month. Procurement of material is in process. Contract amount is \$62,000.

F O R I N T E R N A L U S E O N L Y



M. Minor Construction and R&A Projects

1. Construction is in progress on the following projects:

<u>PROJECT</u>	<u>SCHEDULED COMPLETION DATE</u>
Modifications to Elevator at Dynamic Test Stand	March 1966
Motorizing Large Valves, Test Area	March 1966
Modifications to Dodd Road	March 1966
Additional Electrical Power, Vacuum Facility, Building 4748	July 1966
Repairs to Concrete at S-1C Test Stand	March 1966
Additions to Deionized Water, Building S-4549	March 1966
Steam Line for Hydrogen Recharger	April 1966
Improvements to Air Conditioning & Ceilings, Building 4566	August 1966

BOD or final acceptance inspections for the following jobs were accomplished:

Air Conditioning Improvements, Rooms 112 and 113, Building 4674

Roof Repairs, Building 4583

Briefing Room, West Area Viewing Bunker, Building 4697.

Project for Improvements to Roads in Test Area has been omitted in FY66.

Criteria for Improvements to Test Cell "C" completed February 16, 1966.

2. The following is a status summary of the R&A Projects starting with FY65:

Projects submitted for approval -----	5
Projects pending criteria -----	0
Projects pending start of design -----	4
Projects approved for accomplishment -----	20

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Projects in criteria preparation -----	3
Projects in design preparation -----	4
Projects pending construction contract -----	0
Projects in construction -----	8
Projects completed -----	11
Projects to be submitted for approval -----	0

#### V MISSISSIPPI TEST FACILITY

During this period, Test Laboratory had 80 personnel supporting MTF. Twenty-eight were on TDY status, two were detailed, and fifty personnel were directly supporting MTF within Test Laboratory.

#### VI TRANSPORTATION

##### A. Land Transportation

1. A visit was made to Bendix Systems Division, Ann Arbor, Michigan and General Motors Defense Research Laboratories, Santa Barbara, California, on February 15 and 16 to review progress on the Mobility Test Articles (MTA) (Prototype Moon Vehicles). The Bendix MTA is scheduled to arrive at MSFC during the week of March 28, 1966. Funds for MTA Test Program have been received from NASA Headquarters. The testing is to be conducted at Aberdeen and Yuma Proving Grounds by the U. S. Army in June-December 1966.

2. Specifications have been written for modifying the S-1C stage simulator. This modification will include brackets and other hardware to permit safe tiedown for hurricane conditions during storage.

3. Action has been initiated for modifications of the cargo lift trailer. Modifications will include strengthening and adding roller

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ways for simplicity in loading cargo aboard an aircraft.

4. Charts and viewgraphs were made to support a presentation of the Swim Facility and the Simulation of Motion Facility.

5. Action has been initiated to procure seven S-1C special tool trailers before DY66 procurement cut-off date.

6. A set of S-1B dollies and frame of the cradle for transporting the S-1C thrust structure have been furnished to NAA for shipping the High Force Test Vehicle (HFTV). The HFTV will be shipped from NAA on March 25, 1966, and will arrive at MSFC on April 16, 1966. The HFTV will proceed to Wyle Labs for off-loading and testing.

7. The above transportation equipment will be used for moving the S-1C/S-11 adapter from Michoud to MSFC on 12-18 May, 1966.

8. Criteria for a steel storage ring has been prepared and R-TEST-BDE has been requested to design and fabricate two rings and hardware to be available in October 1966 and March 1967, respectively.

9. The IU transporter, which had the cover installed prior to shipment of IU 201 to KSC was disassembled at KSC and shipped to MSFC by truck. Since this was not planned in the transportation sequence, the lower portion of the cover was destroyed. After the transporter was assembled at MSFC, a new lower portion of the cover was installed. The covers will be modified to permit disassembly and reassembly.

10. Criteria is being prepared for a S-11 aft cover for use on the KSC supplied engine protective frame. This cover will be used between static test sites and KSC.

11. R-TEST-BDT has completed and delivered the Test Laboratory Fact Book to R-TEST-B.

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## B. Water Transportation

1. The loading and tiedown of S-II-F stage aboard the Pt. Barrow was observed at Seal Beach, California, on February 17-19, 1966. The S-II-F arrived at KSC on March 4, 1966. R-TEST-BDE also had observation personnel present for off-loading at KSC.

2. Loading arrangement documentation was provided by R-TEST-BDE for marine shipment of three Saturn V service arms, IU 500-F and the LH<sub>2</sub> Nose Cone aboard the Poseidon barge. The barge departed MSFC on March 1 and is scheduled to arrive at KSC on March 11, 1966.

3. R-TEST-BDE provided engineering assistance for the interchange of a liquid hydrogen tank from the ship, USNS Point Barrow to the barge Little Lake at New Orleans on March 7-8. The tank is coming from California to Test Laboratory, MSFC.

4. Preliminary design has been initiated for a trailer to be used for marine shipment of the S-IC fins, fairings and engine extensions. The use of such a trailer was to eliminate crane and fork lift handling while loading and unloading the barge as well as eliminate interference problems now encountered on the Poseidon barge.

## C. Air Transportation

1. R-TEST-BDT performed necessary coordination with DAC during modification of the S-IVB-D vehicle. These modifications were required to bring stage to flight configuration for the Super Guppy aircraft flight test. Instrumentation is also being added to the stage to define aircraft environment.

2. R-TEST-BDT provided technical supervision for loading of swing arms at Hayes International Corporation, Birmingham, Alabama. Weld

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failures occurred in swing arm adapters and R-TEST-BDT reviewed the corrective work.

3. R-TEST-BDT has reviewed flight test plans prepared by P&VE and DAC for Super Guppy flight of the S-IVB-D vehicle.

4. R-TEST-BDT provided technical supervision for preparation for shipment of IU 500-FS to Huntington Beach, California, by Super Guppy aircraft.

5. R-TEST-BDT has continued a coordination effort during modification of Super Guppy propellers.

## VII CONTRACTOR ACTIVITIES

### A. S-II Stage

1. Battleship (Santa Susana) - Test #029 reported previously in the January report, resulted in a cutoff at T +335 seconds. The fire reported was due to broken ASI LOX line on engine No. 4. No malfunction analysis has been reported on the cause of the line failure to date by S&ID.

During this report period, three tests were conducted at S-II Battleship facility. The first test, Test #030, resulted in a 69-second duration firing on February 22, 1966. Cutoff was initiated from the Gas Generator Over Temperature automatic cutoff system (GGOT) on engine No. 2. The cutoff was blamed on a loose connector that was not safety wired; however, the cutoff condition could not be duplicated.

The second test, Test #031B, resulted in a 361-second duration firing on February 25, 1966. Cutoff was initiated automatically from the LO<sub>2</sub> depletion sensors at the  $\frac{1}{2}$ % LOX level.

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On the evening prior to test #032, Rocketdyne examined the primary seal on engine J-2029 (Position 1) in the fuel turbine and found that a 2-inch arch section was missing from the honey comb seal; also, the turbine stator blades were damaged. The seal was replaced with the new type seal with reinforced backing and a complete new set of stator blades was required. Indications of the turbine seal deterioration was evident in the exceedingly high mixture ratio on test #029, test #030, and test #031. From information available, it appears that S&ID was lax in analyzing their test data.

The third test, test #032, resulted in a 360-second duration firing March 4, 1966. Cutoff was initiated from LH<sub>2</sub> low level cutoff as planned with 1% LH<sub>2</sub> residual.

2. S-11-T (MTF) - Detailed operational procedure #B-010, Stage Electrical Control Systems Checkout, is in process on the S-11-T and is expected to be completed by March 11, 1966. Stage and engine leak checks and changes to complete buildup to firing configuration are to be completed prior to LN<sub>2</sub> tanking presently anticipated for March 28, 1966.

B. S-1VB (Sacramento)

1. S-1VB 203 - Stage 203 completed a successful full duration acceptance firing on Saturday, February 26, 1966. Preliminary data evaluation indicated all objectives were met and no major anomalies occurred. Five attempts were required before a successful firing was achieved. Post static checkout is now underway.

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2. S-IVB 204 - Prestatic checkout activities on Stage 204 are proceeding on schedule. The static firing is scheduled for March 17.

Stage 204 is the first stage to be effected by the incentive contract. An incentive is placed on the ship date from the Sacramento Test Center.

*Karl L. Heimburg*  
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