TEST LABORATORY

MONTHLY

PROGRESS REPORT

January 1, 1968 through January 31, 1968

GEORGE C. MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALABAMA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSFC - Form 1262 (September 1961)

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TEST LABORATORY MONTHLY PROGRESS REPORT

January 1, 1968 through January 31, 1968

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FOR INTERNAL USE ONLY

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V. OTHER SIGNIFICANT EFFORT

ADVANCED FACILITIES PLANNING OFFICE

I. FACILITIES

GEORGE C. MARSHALL SPACE FLIGHT CENTER
TEST LABORATORY
MONTHLY PROGRESS REPORT
SYSTEMS TEST DIVISION
January 1, 1968 Through January 31, 1968

1. SATURN IB

A. S-IB Stage

The following preparations were made for a series of short duration tests using stage S-IB-11 to study the effects of thrust structure compliance upon engine stability under conditions of rough combustion:

(1) The engines in position No. 1 (H-7092) and position No. 7 (H-4098) were removed and replaced by R&D engines H-T6-B and H-4067, respectively.

(2) After removal of the flight engines and before installation of the R&D engines, the high shear bolt type fasteners in the thrust structure of inboard Engine Position No. 7 were changed out to the next larger size to accommodate the anticipated higher thrust loads caused by the "bomb" tests.

(3) Special vibration, strain, pressure, and temperature measurements were added to the stage and H-1 engines.

Test SA-49, a 15.5 seconds test, was performed at the Marshall Space Flight Center (MSFC) on January 25, 1968. The test was terminated by console operator at expiration of the programmed duration. For this test only one engine, that in position No. 7, had an injector-face bomb installed. The bomb detonated as anticipated and induced engine instability that dampened satisfactorily.

Functional performance of all systems was satisfactory. Engine thrust levels, with the exception of Engine Position No. 8 (H-4095), were within specifications. The engine in position No. 8 was only slightly out of specifications. The engine in position No. 2, which was out of specifications during the previous test, responded satisfactorily to a change in gas generator LOX orifice size.

Preliminary data from strain measurements on the Engine Position No. 7 support structure indicate a maximum thrust overshoot of 38% due to the bomb induced instability. This is well within the capability of the stage; however, the high shear fasteners in the thrust structure of outboard Engine Position No. 1 were nevertheless also changed out. This was done to preclude a possible schedule impact on the next test wherein Engine Position No. 1 will be bombed along with Engine Position No. 7.

B. H-1 Engine

The MSFC Power Plant Test Stand was secured to a standby status. Future H-1 engine testing will be limited to critical high priority programs that may be generated as a result of anticipated or actual flight malfunctions.

C. S-IVB Stage

1. S-IVB-205

S-IVB-205 is presently in checkout in the Vertical Checkout Laboratory (VCL) at the Sacramento Test Center (STC). Stage shipment to the Kennedy Space Center (KSC) is scheduled for March 12, 1968.

2. S-IVB-206

S-IVB-206 was removed from the Beta III Test Stand on January 11, 1968, after having undergone a second post-static checkout, which also served to checkout the refurbished Beta III Test Stand. The stage was moved to the VCL for modifications prior to preparing the stage for shipment to KSC on February 16, 1968.

II. SATURN V

A. S-IC Stage

1. S-IC-T

Two LOX fill and drain tests were made at MSFC during the month to obtain data for evaluating the LOX transfer and bubbling procedures used at KSC. The final test is scheduled for February 1968.

At the request of Rocketdyne, functional checks of the handling equipment for removing and installing F-1 engine main valves and gas generator were made for design evaluation.

2. S-IC-D

Boeing conducted four fuel tank drain tests on the S-IC-D for evaluating the performance of the anti-vortex device. The S-IC-D stage is scheduled to be removed from the test stand at the Mississippi Test Facility (MTF) on February 1, 1968.

B. F-1 Engine

A request was received from R-DIR for additional acoustical testing at the West Area F-1 Test Stand due to a vibration anomaly in the low frequency range measured on the ST 124-M during the flight of AS-501. An IU model with a live ST 124-M installed will be utilized with the acoustic excitation provided by the F-1 engine. A minimum of six firings of 30 seconds duration and at least one firing of two minutes duration will be required.

C. S-II Stage

1. S-II-4

A successful LH_2/LOX propellant loading test and an unsuccessful acceptance static firing test of S-II-4 were accomplished at MTF during the month of January 1968.

Failure of the sidewall insulation rubber doublers, minor instrumentation problems and low pressures on the engines' turbopump purge and thrust chamber purge were the outstanding anomalies experienced during the propellant loading test. The test was conducted on January 16, 1968. All problems were corrected prior to the acceptance static firing test which was conducted on January 30, 1968. The acceptance static firing test was manually aborted after approximately eight seconds of mainstage due to problems with the LOX tank ullage pressure measuring system. The sidewall insulation rubber doublers failed again prior to engine start command, necessitating the use of back flow purge to the sidewall insulation. The propellant utilization system for LH_2 and LOX was discovered imoperative after engine cutoff. Three engine diffusers were damaged during the test probably from icing conditions in the water cooling system. Data evaluation and failure investigations are presently in progress to correct the above problems. No firm schedule has been established for the re-test of S-II-4.

2. S-II Structural Test Program

The S-II stage (V7-21) schedule for delivery to Test Laboratory has changed from March 25, 1968, to May 22, 1968. The facility construction, activation and test preparation are compatible with this schedule change.

3. S-II External Insulation Test Program

Testing by McDonnell-Douglas continues on the North American Rockwell (NAR) S-II external insulation specimen at the STC Alpha Test Stand 1 where activities now concern developing field repair techniques for the insulation.

D. S-IVB Stage

Stage S-IVB-506 arrived at the STC on January 25, 1968, and was installed on the Beta III Test Stand on January 26, 1968. The stage modification period will extend through March 13, 1968, at which time pre-static checkout will begin. The acceptance firing is scheduled for June 12, 1968.

E. J-2S Engine

Three tests were made at the MSFC S-IVB Battleship Test Stand utilizing J-2SE engine, S/N J-108. Summation of the tests is as follows:

DATE	TEST NO.	DURATION (SEC.)	REMARKS
1-17-68	SIVB-049S	Idle Mode - 1 Mainstage - 4.9	Test planned for 1 second idle mode and 70 seconds mainstage. Cutoff was given by erroneous signal from the stall approach monitor.
1-19-68	SIVB-050S	Idle Mode - 1 Mainstage - 70	Test planned for 1 second idle mode and 70 seconds mainstage. All test objectives were met successfully. The stall approach monitor was not active.

DATE	TEST NO.	DURATION (SEC.)	REMARKS
1-23-68	SIVB-051S	Idle Mode - 1 Mainstage - 75	Test planned for 1 second idle mode and 75 seconds mainstage. All test objectives were met successfully. The stall approach monitor was not active.

During each of the above tests, the engine operated and performed satisfactorily.

Test S-IVB-052S is scheduled for February 1, 1968, for a planned duration of one second idle mode, 75 seconds mainstage and 10 seconds idle mode.

III. APOLLO APPLICATIONS

A. Lunar Drill Program

Tests were conducted at MSFC on the Northrop Compressor with modified exhaust valves. Operation of the valves was inadequate and the problem is being investigated.

B. Mobility Test Article (MTA)

The obstacles fabricated for the MTA test courses have been secured and testing of the vehicles will begin whenever weather and manpower conditions permit.

C. Apollo Telescope Mount (ATM)

A schedule was received from R-ASTR on the delivery of test beam hardware to be used later for providing air pad support of the ATM solar panels during their ground test deployment. Component testing of the test beam design is scheduled to begin on February 6, 1968. A component test fixture for air pad testing is being fabricated by R-TEST-B and should be completed in time for the initial testing on February 6, 1968.

IV. VEHICLE STORAGE PROGRAM

Comments on all MSFC stage storage standards were received from the stage contractors and evaluated by the committee. The revised standards are in the process of finalization and approval and are scheduled for release by February 21, 1968.

The prototype stage storage cover in Building 4708 is undergoing an operational test that is scheduled for completion by February 15, 1968. A meeting was held on January 30, 1968, to discuss the actions required to fabricate stage covers and conditioning units as government furnished equipment. It was generally agreed that this approach is practical, and the necessary actions have been initiated.

Daniel H. Driscoll, Jr.

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COMPONENTS & SUBSYSTEMS DIVISION
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I. SATURN IB

A. Ground Support Equipment

1. Saturn IB Apollo Access Arm

The Apollo Command Module Access Arm supports an environmentally conditioned cab through which astronauts and service personnel enter the Apollo spacecraft. The arm and the environmental chamber were recently redesigned to accommodate the new spacecraft hatch design and also to incorporate changes that provide more reliable and faster egress routes.

The test facility was modified for testing the LC-37 configuration access arm. Included in the rework was the relocation of the tower pedestal and rerouting hydraulic and pneumatic lines.

The prototype environmental chamber, which will be used on LC-37, was modified to bring it up to the latest configuration. This includes installation of modification to the Adapter Positioning Device (APD) centering and lifting mechanisms and installation of new rollers on the extension platform.

Testing was completed on January 27, 1968. The environmental chamber will be removed from the test stand as soon as the shipping frame is received from KSC. The chamber is scheduled for shipment to KSC on 2-20-68.

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.

There were no tests conducted this report period due to required changes in the facility main LOX and fuel flow orifices and malfunction of the facility GG fuel pressurization system. The orifices have been sized and the pressurization system will be modified to correct the problem. Testing of the R&D 6+6 impeller F-1 Turbopump S/N 4072224 will continue in February 1968.

The S-IC 17-inch lox flowmeter S/N WE17-35 will be tested when a Whittaker prevalve is available.

2. LOX Depletion Testing

The purpose of this test program is to support R-TEST-SP and P&VE 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 and Saturn V flight vehicle.

The facility buildup is in progress. The planned test start date has been slipped to the middle of March due to the loss of personnel and other conflicting test programs in the general test area.

B. S-II STAGE

1. J-2 Engine Ignition - Model Study

Requester: R-P&VE-PAB

To more clearly define potential no-ignition hazard, a series of model tests will be conducted in an altitude chamber during which the J-2 start transient nozzle pressures and the potential ignition sources will be simulated. The plan is to establish supersonic flow of a predetermined mixture of gaseous hydrogen and oxygen in the chamber nozzle and then attempt to ignite it at a location where the turbine exhaust gas enters the J-2 nozzle.

The tests will then be repeated with the ignition source outside the nozzle to simulate an ignition source from the exhaust of an adjacent engine on the S-II stage.

Five tests were conducted during this reporting period. These were preliminary tests to establish satisfactory operation of the ignition source. Results of these tests have not proven to be satisfactory. Testing will continue.

C. S-IVB STAGE

1. J-2 Turbopump Test

Requester: R-P&VE-PAC

This project was requested by P&VE to further the development of existing and advanced J-2 turbopumps and subsystems. Test Position 501 is being prepared for this testing.

The test support shop is finishing pipe installation and supports. With the exception of the S-IVB sump adapter, shop work should be finished the week of February 5, 1968. The S-IVB sump adapter was damaged at the inner and outer bellows areas during a purging operation and is being repaired. This should be complete by February 16 and will not affect the activation schedule.

Buildup has been supported by additional mechanics and is progressing satisfactorily. The hydrogen storage tank was activated January 22, 1968, and has thus far received approximately 40,000 gallons of liquid hydrogen. The burn pond was checked out and appears to be ready for operation.

T.P. 501 system check-out tests are presently scheduled to commence March 4, 1968, and the first hot firing is scheduled for March 26, 1968.

2. J-2 Thrust Chamber Throttling Tests

Requester: 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 1 consists of facility design, facility activation, and initial J-2 testing. The facility utilizes pressurized propellant tanks and throttle valves to control the engine thrust level. The activation test firings 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.

Initial J-2 testing utilizes a J-2 thrust chamber with tap-off 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 a J-2 thrust chamber with and without hot gas tap-off 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 tap-off optimization.

One 6-second test was conducted during this reporting period. Test termination was caused by a loose printed circuit board in a throttle valve control module. Six tests remain to complete the Phase I of this program.

As per memorandum R-P&VE-PA-68-M-48, J-2X Thrust Chamber Throttling Tests have been suspended - effective January 24, 1968. The test hardware will remain installed until further instructions are received from R-P&VE-P. This program will not appear in subsequent reports unless additional work is performed.

3. <u>S-IVB LOX Fill and Drain Valve</u>

Requester: R-P&VE-PM

A potential problem for the S-IVB lox fill and drain system, which can result due to loss of electrical power to the pneumatic solenoid control valves is to be investigated. Fast closure of the fill and drain valve at high flow (1000 gpm) may generate surge pressures that could cause failure of the fill and drain system.

Test Position 114 at CTL is being utilized for this program.

During this reporting period, thirteen flow tests were conducted at flow rates up to 500 GPM. The pressure

spikes resulting from valve closure - without pneumatic boost-ranged up to 500 p.s.i. The flow across the butterfly, after the valve has just started to close, apparently creates forces which cause the test valve to slam closed and then slam back open in approximately 10 milliseconds before closing normally. The 500 p.s.i. pressure spike is associated with this rapid valve movement. This problem occurs with flow in either direction through the test valve.

During the last two tests, excessive seat leakage occurred. The valve has been removed for seat replacement. Test to study in more detail the operational characteristics of this valve and the associated control system will continue after the valve is repaired.

4. LH_2 Slosh Testing

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

No tests were conducted during this report period. All test programs at this facility have been completed or cancelled. The facility is being placed in an inactive/stand-by condition. This program will not appear in following progress reports.

D. Instrument Unit

1. Extended Life, Qualification Test of IU/ECS First Stage and Gas Bearing Regulators

Requester: R-P&VE-PME

This program was requested by P&VE to perform an extended life, qualification test on IU/ECS first stage regulator (1000 hrs) and gas firing regulator (1500 hrs).

The first stage regulator was delivered by P&VE on February 1, 1968. Testing will start during the week of February 5, 1968.

To date, 1320 hours of test time have been logged for the gas bearing regulator. Testing will continue for the planned total of 1500 hours.

E. 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-II Intermediate (AA-04-02) - 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.

The test program was completed on December 15, 1967, without resolution of a number of problem areas. The arm was removed from the test area and released for refurbishment on December 19, 1967. The arm was released to KSC for modifications on January 20, 1968.

P&VE is investigating the shear-out capability of the propellant couplers to determine the requirement of further testing. No conclusions have been reached from the investigation to date.

b. S-II Forward (AA-05-01) - This inflight service arm provides air conditioning, electrical and pneumatic services plus a GH_2 vent system for the S-II stage. All connections to the stage are through a common carrier.

Testing of the lanyard withdrawal system and associated hardware is complete. The arm was removed from the test area on November 21, 1967. The arm was turned over to KSC at MSFC for modification and refurbishment on December 23, 1967. The test report rough draft is complete.

c. S-IVB Aft (AA-06-01) - This inflight service arm provides LO_2 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.

Acceptance testing in accordance with the SK75M24639 (Rev. B) Test Criteria was begun on August 21, 1967. These tests were completed on October 4, 1967.

d. 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 arm was removed from the test area on December 4, 1967. The arm was turned over to KSC at MSFC for modifications and refurbishment on January 17, 1968.

e. 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.

The environmental chamber was removed on September 20, 1967, and shipped to KSC for modification. At present Boeing is making modifications to the control system on the arm. The test program will be resumed after these modifications are made.

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, disconnect, and retraction as well as damping oscillations. The test program is being conducted for P&VE Lab to qualify the system prior to its use on LC-39.

The control console for the ML-3 damper arm was installed on December 2, 1967. During the adjustment and checkout of the system, an adjustment problem with the redundant retract system was discovered as follows:

When the redundant retract hoists were adjusted so that the redundant system would fully retract the arm, the fully extended position of the arm was too high; when the carriage was extended to connect to a nominal fueled vehicle, it made contact with the LES tower approximately 12 inches above the stops. This is approximately 8 1/2 inches higher than desired.

By adjusting the redundant hoists for proper arm orientation for first the retract system tests and then the

carriage hookup and damping tests, the test program was completed on December 20, 1967.

After a meeting on December 21, 1967, attended by R-TEST-C, P&VE, R-QUAL, and ME personnel, the redundant retract cylinders were removed from the tower. One cylinder was disassembled for the purpose of cutting 4 inches off the cylinder rod spacer, which would have effectively added 4 inches to the cylinder stroke, and thus eliminate the adjustment problem noted above. However, inspection showed that the cylinder rod had been modified to accept the spacer, and that cutting off the spacer would require additional changes to the cylinder rod.

The redundant retract cylinders were reinstalled on the tower simulator, and the following solution was adopted:

With the redundant retract system adjusted so that proper hookup of the carriage to a low-stacked vehicle could be accomplished, the arm was retracted until the redundant retract cylinders were bottomed out. The distance between the arm and the latchback mechanism was measured so that shims could be fabricated to position the latchback to latch the arm in that position. Four inches of shims will be required to accomplish this for the most adverse stacking tolerance buildup (a low-stacked vehicle). Necessary changes are being made to incorporate the shims at KSC.

The following items were also accomplished:

a. A kickoff accumulator was installed in the system, to provide a more positive force to push the arm away from the tower. This change produced favorable results, eliminating the slack in the air winch cable at the beginning of the arm extend operation.

b. The S/N 819 air hoist was replaced by the S/N 732 hoist, for checkout purposes, following reassembly of the latter. The performance of the replacement air hoist was satisfactory.

Cleanup of the hydraulic system was begun on January 19, 1968, and the arm was removed from the tower simulator on January 24, 1968.

3. LC-39 Mobile Launcher Holddown Arms

The purpose of this test program for KSC is ı verify the physical and functional integrity of the Satur holddown arms prior to installation on the Mobile Launche Twelve 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 successfu completed November 2, 1966.

This fourth set of arms is a spare set and was retained at MSFC to serve as test bed for development of tl holddown arm secondary (explosive) release system (Internal Note-TEST-14-67) and protective hood. As this program is complete, the arm is being prepared for shipment to KSC.

4. S-II Insulation Close-Out Test

This test is being conducted, in support of the S-II structural test, to determine if removable sections of foam insulation (close-outs) can be removed to a of the S-II tank lateral and longitudinal welds, [illegible] inspection, replaced to provide adequate insulation of the weld-areas. A 70-inch tank insulated with a material similar to that to be used on the S-II structural test tank, is preser being installed at B-Cell, Building 4748. Testing should begi February 1, 1968.

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.

Five tests were conducted in January. These tests were performed to study the control of liquid sloshing dielectrophesis. A grid voltage of 27,000 volts was used with Freon 113 as the liquid medium. Two to four additional tests will be required to complete this series. Testing will continue through the next report period.

B. Storable Propellant Space Engine Testing

This program was requested by R-P&VE-P to provide support for testing of advanced technology engines.

No testing was conducted during this reporting period on the acoustic liner C-1 engine or on the monopropellant engines. Additional tests are scheduled on the modified C-1 engine during the next reporting period.

C. 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.

Due to anomalies experienced with the APS Modules on the SA 501 flight, especially that of decay in engine performan with flight time, tests were conducted on the Saturn V APS Modu in the large altitude cell. Conditions of the SA 501 flight were simulated, including engine firing density and oxidizer control module temperature. The oxidizer (N_2O_4) temperature was considered to be a major factor in the flow decay phenomenon which resulted in decreased engine performance.

The APS Module was loaded with propellants on January 25 and 5-second burp firings conducted on each of the four engines at a simulated altitude of 112,000 feet. The module was maintained under 50 p.s.i.g. blanket pressure until January 29, at which time the 5.5 hour SA 501 duty cycle was conducted. An infrared light was used to heat the oxidizer control module during the test. However, a preliminary data review has indicated no apparent decay in engine performance.

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

Requester: 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 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 is being 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 was conducted using the basic Saturn V booster scale model and has established baseline data. Phase II tests will use the same scale model booster but with the uprated F-1 engines. Phase III is utilizing the basic Saturn V scale model with 120-inch simulated solid motor strap-ons. Phase IV will use the basic Saturn V model with 157-inch simulated solid motor strap-ons.

No tests were conducted during this report period. Presently the launches platform is being modified by addition of the proposed booster holddown arms, and the flame deflector is being modified by canting the side walls to reflect the KSC deflector design. Both modifications are about complete and testing is expected to resume about February 9, 1968. For the next test, it is planned to use the 6° cant angle nozzles on the four scale model 120" solids and a maximum drift launch trajectory.

E. Dynamics and stability of Motions of a Cable-Connected Spinning Space Station

The purpose of this test program, requested by R-AERO-DD, is to determine the stability area of two bodies connected by a cable spinning in space.

The catapult system has been built and checked out by Test Laboratory. With this catapult system, the model will be spun up to a pre-determined speed, and then shot into the air. Data will be recorded using 16 mm motion picture cameras. A net will be erected to catch the model.

There will be approximately 100 missions obtained in 10 test periods. Tests utilizing this facility will commence when specific test requirements and space station models are received from R-AERO-DD.

IV. APOLLO APPLICATION

A. S-IVB Workshop

1. 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. Program includes tests on 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 curtain temperatures.

The 1/8 segment has been received from M.E. Laboratory and has been installed in the vacuum chamber. Build-up is progressing and installation of new curtains has delayed testing until the latter part of February 1968.

2. Insulation Flammability Study

This program was requested by R-P&VE-M to define and study the fire retardency of the S-IVB internal cryogenic insulation in a habitation environment.

Nine insulation flammability test samples were tested at the Redstone vacuum drying facility between January 2 - 17, 1968. Five of the tests consisted of burning known quantities of foam (7 in^3 to 20 in3) in the 35.3 ft^3 tank which had been pressurized to 5.5 - 6.0 p.s.i.a. with 100 percent gaseous oxygen; the vacuum chamber pressure was maintained at 0.5 p.s.i.a. The test tank pressure and temperature increases due to the combustion of the foam samples were recorded. The other four tests were conducted on 2 mil and 3 mil aluminum covered samples (3 ft diameter) in which various size semicircular cuts had been made. The test tank pressure of 5.5 p.s.i.a. was maintained under flow conditions as opposed to the static conditions of the previously discussed tests. In all tests the mechanical blower was utilized to supply a velocity at the sample center of 175 ft/min.

W. L. Grafton

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TECHNICAL SUPPORT DIVISION
JANUARY 1, 1968 through JANUARY 31, 1968

I. SATURN 1-B

A. S-1B Stage

1. Fabrication of the 6' x 9' vacuum chamber progressed to approximately 40% completion.

2. Fabricated and installed ladder and catwalk on 63' 6" level of high vacuum test facility.

3. Supported static test at STTE with GN_2, GH3, RP-1, and high pressure industrial water.

B. S-IVB Stage

1. Furnished transporter and personnel to move S-IVB Stage from Saturn V Dynamic Stand to Douglas Area south of bldg. 4619.

2. Continuing machine shop services for propulsion system testing.

C. Component Testing

Continued miscellaneous shop support for S-1B test facility.

D. Nose Cone & IU Transportation

Sketches were prepared for use by I-PL-T to ship a S-1B Nose Cone and IU together via the Super Guppy Airplane.

II. SATURN V

A. S-1C Stage

1. Fabrication of super insulation facility progressed to approximately 80% completion.

2. Continued build-up of 501 test facility progressed to approximately 95% completion.

3. Fabrication of S-1C fin fairing, cover and fin supports 90% complete.

4. Continuing fabrication of gaseous hydrogen pressure vessels. Blocks are 100% complete, specimens are 95% complete.

5. Acoustical test facility -

Booster scale model is 95% complete
Complex umbilical tower is 100% complete
Launcher is 75% complete
Deflector is 60% complete
Piping is 0% complete

6. Fabrication continued on the 36" x 48" vacuum chamber for familiarization effort, approximately 80% complete.

7. Fabricated and installed lox turbine simulator duct support - 80% complete.

8. Fabricated and installed GN_2 sphere support mount and blast screen for 23" dia. sphere at zero "G" drop tower - 80% complete.

9. Fabricated and installed support and tie down on fin and fairing trailer - 20% complete.

10. Supported lox fill and drain test with high pressure gases and high pressure industrial water.

11. The first S-1C steel storage and handling ring has been completed by Brown Engineering Company. The second ring is expected within the next few days.

12. Design and fabrication are still proceeding on the modifications to the S-1C fin and fairing trailer.

12. The revision of the barge "Orion" drawings to "as-built" condition is nearing completion.

B. S-II Stage

1. S-II structural stand buildup approximately 65% complete.

a. Wagon wheel and skirt fabrication complete.

b. Axial loading system approximately 70% complete

c. Lox aft bulkhead outboard load assembly (Shop portion 70% complete.)

d. Lox aft bulkhead inboard load assembly, fabrication 100% complete, needs insulation.

e. Aft lox bulkhead load ring, approximately 60% complete.

f. Specimen support ring (fab. by BECO 90% complete) schedule for completion 12/18/67.

g. On stand firex 50% complete.

h. Safety shower 40% complete.

i. Fabrication on access platforms 80% complete.

2. Cryogenic piping

a. High pressure GH_2 system approximately 95% complete.

b. LH_2 system complete, fabrication 60% complete.

c. GH_2 vent storage and load approximately 85% complete.

d. GH_2 vent lines and recharger fabrication 50% complete.

f. Igniter to be modified - 60% complete.

g. Defuser, 80% complete.

h. LN_2 fill and drain, fabrication 75% complete.

i. LN_2 vent system, fabrication 60% complete.

j. LH_2 vaporizer system, fabrication 90% complete.

k. Furnished towing equipment and personnel for transporting the S-II stage to bldg. 4755.

l. Fabrication of the broken stem on Test Lab valve 3002 relocated to S-II structural test area - 25% complete.

m. Fabricated 15 ea. power supply panels - 30% complete.

n. Fabrication of male and female adapters for testing hyd. cylinders - 10% complete.

o. Access platform for S-1C tank bulkhead 50% complete.

p. Fabrication and installation of aft lox bulkhead loading assembly 60% complete.

q. Fabrication and installation of drain line loading assembly 50% complete.

3. Supported J-2 model ingition at test position 112, CTL, with GH_2 and high pressure industrial water.

4. Fabrication of the GH_2 transmission line to tie the S-II structural and east area GH_2 system together was completed.

5. Hydrostats were conducted on all high pressure gaseous hydrogen lines and cleaning of the systems was st[illegible]ed.

6. Work has continued on pulling vacuums on the 12 LH_2 storage tanks at the S-II structural test area.

7. Work was started on an engineering analysis and cost estimate for a North American proposal to substitute a dual cable assembly for the "existing" rigid folding link assembly frame handling equipment.

C. S-IVB Stage & Aft Interstage

Supported test at the S-IVB facility with high pressure gases, high pressure industrial water, and recharging of the gaseous hydrogen system.

D. G.S.E.

Continuing miscellaneous shop suppprt.

E. Component Testing

1. J-2X thrust chamber - supported testing at test position 502 with high pressure gases, industrial water pressure, liquid hydrogen, and recharging of the gaseous hydrogen storage system.

2. Design of the test facility for the S-II aft stage structural test near completion.

3. Changes and modifications to piping systems are being made to accommodate revisions of a minor nature to the original requirements.

4. Minor structural changes during this period consisted of revising the wagon wheel weather protection cover from a plywood cover to a steel cover. Irregularities in concrete surface at anchor bolt locations were solved satisfactorily.

5. Minor modifications to the complex hydraulic systems were started to provide better loading control and reliability characteristics as they are determined.

6. Access equipment, handling equipment and on stand freight elevator equipment were reviewed for improvement and

simplification during this period.

III. APOLLO APPLICATIONS PROGRAM

A. Apollo Telescope Mount - GSE

Specifications are being prepared for use in awarding a contract to design and build the ATM transportation equipment.

IV. RESEARCH AND DEVELOPMENT PROGRAMS

A. Ion Gage Calibration System

Follow-up help was furnished on the Ion Gage Calibration System during this period.

B. LH_2 Mass Flow Calibration and Slush Hydrogen Facility

Design progressed on phase I of the LH_2 Mass Flow Calibration and Slush Hydrogen Facility to approximately 25% completion. The concrete foundation design will be complete sometime in early February, remaining design should be completed sometime by mid-June 1968.

C. Model Space Station Dynamic Stability Program

Re-analysis of the catapult system for the space station launch device used in dynamic stability studies continued.

D. High Flow - High Pressure LH_2 Test Position 300

Design progressed to 90% completion but is being delayed due to higher priority work.

E. Propellant Support

Supported the S-II Insulation Testing, APS Module Testing, Zero G Drop Test, Helium Liquefication Test, F-1 Turbo Test, Insulation Position Testing at Cell "A" and Insulation Position Testing at Cell "C" with high pressure gases and industrial water.

V. OTHER SIGNIFICANT EFFORT

A. Norwalk Compressor

Continuing miscellaneous shop support for Norwalk Compressor.

B. Propellant Support

Supported other offices and labs with LN_2, LH_2, GN_2, GHe and Air. Filled 100 GHe K-bottles at 200 scf each.

C. Piping on Modified GH_2 Bottle Battery

The piping was installed on the modified GH_2 bottle battery at Cell 115 after the cleaning and hydrostating was completed.

D. Air Compressors

Compressors numbers 2 and 3 in bldg. 4647, the new air station, have remained running with no problems. Measurements of misalignment and clearances and repairs are being made on number 1. Number 4 has not been worked on.

E. Pregnant and Super Guppy Aircraft

Assisted in review and inspection of Aero Spacelines, Inc. operations to insure better NASA service in future. Some of the areas looked into were as follows: (1) Failures which have occurred in the nose area of the Super Guppy Aircraft and the fixes that are to be made. (2) Methods of Quality Control and future program control to be enacted to insure reliability. (3) Flight evaluation of modifications to the Pregnant Guppy and corrections resulting thereof.

F. LH_2 Transfer Line at the S-1B Dynamic Test Facility

Design advanced to 90% completion on a vacuum jacketed transfer line from the S-1B dynamic test position LH_2 storage to the super insulation test chamber.

G. Helium Trailer Unloading System at Bldg. 4676

Design progressed to 30% completion on a helium trailer unloading system at bldg. 4676.

William E Marsalis

William E. Marsalis

Karl L. Heimburg

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GEORGE C. MARSHALL SPACE FLIGHT CENTER
TEST LABORATORY
MONTHLY PROGRESS REPORT
ADVANCED FACILITIES PLANNING OFFICE
JANUARY 1, 1968 THROUGH JANUARY 31, 1968

I. FACILITIES

A. R&A Projects

1. Additions to Cryogenic Storage - Project 7072. This project was essentially completed.

2. S-II Structural Test Pad - Project 7076. This project was essentially completed.

3. S-II Aft Section Test Assembly. This project was essentially completed. The one remaining critical item is repair of the 30-inch valve on the high pressure industrial water line.

4. Construction is underway on the following projects:

a. Project 7013 - Elevator for Test Stand 500	90% complete
b. Project for Fire Detection System	60% complete

5. Projects 8008 and 8003 - Action is underway to obtain local approval for submission of these two projects to Headquarters for release. These projects are Steam Ejector for Dynamics Test Stand, Building 4557 and High Pressure Air Pipeline. Project 8008 may be released upon local approval sometime during February. Project 8003 has yet to be sent to Headquarter.

B. 38' X 60' Vacuum Chamber

Planning drawings completed. Preparation of cost estimate is in progress.

C. Modification of East Side of Static Test Tower

Facility drawings were completed by Advanced Facilities Planning Office. Drawings for the deluge system of storable propellant tanks are prepared by R-TEST-BD.

D. C of F, FY 68 Fire Alarm System

Design drawings for 90% review were received during week of January 12, 1968. This project will tie in the FY67 fire alarm project and place additional fire detection equipment in the West Test Area.

J. B. Carrington

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