MPR-SAT V 66-1

GEORGE C. MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA

April 1966

XIV.1

SATURN V

QUARTERLY PROGRESS REPORT

JANUARY 1, 1966 — MARCH 31, 1966

PREPARED BY I-V-P

National Aeronautics and Space Administration

NASA

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GEORGE C. MARSHALL SPACE FLIGHT CENTER

MPR-SAT V-66-1

SATURN V QUARTERLY PROGRESS REPORT

(January 1, 1966 - March 31, 1966)

ABSTRACT

This Saturn V Quarterly Progress Report describes progress and major achievements from January 1, 1966 through March 31, 1966 in the Saturn V Program.

1. The S-IC-D was hoisted into the Dynamic Test Stand at MSFC on January 13.

   The S-IC-F arrived at KSC January 14.

   Removal of the S-IC-T from the Static Test Tower January 20 at MSFC concluded the test program.

   The first and second test firing of the S-IC-1 on February 17 and 25 were successful and concluded stage firings at MSFC.

   Horizontal assembly of S-IC-2 was completed January 17.

2. The S-II Battleship Test Program at Santa Susana was successfully concluded on March 15.

   Mating of the S-II-F into the total SA-500F vehicle was achieved on March 28.

   Final assembly of the fifth flight stage (S-II-5) was begun in January.

3. The Super Guppy aircraft flight test using the S-IVB-D was successfully completed during March.

   The S-IVB-F was mated with the S-II-F at KSC March 29.

   The S-IVB-500ST is to arrive at MSFC April 1 for installation in the SDF.

   Progress on the first four Saturn V S-IVB flight stages was satisfactory.

4. The S-IU-500F was shipped from MSFC to KSC on March 1. It became part of the SA-500F vehicle at the end of the month.

5. Five F-1 and ten J-2 Engines were delivered by Rocketdyne this quarter.

6. Debugging of the SA-500F Operating System and Test Programs began at the Systems Development Facility at MSFC March 23.

   Delivery of all umbilicals to support the SA-500F operation was completed.

7. Five major Facilities contract awards were made during the quarter.

GEORGE C. MARSHALL SPACE FLIGHT CENTER

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SATURN V QUARTERLY PROGRESS REPORT

(January 1, 1966 - March 31, 1966)

by

SATURN V PROGRAM CONTROL OFFICE

(I-V-P)

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GEORGE C. MARSHALL SPACE FLIGHT CENTER

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SATURN V QUARTERLY PROGRESS REPORT

(January 1, 1966 - March 31, 1966)

SECTION I. SUMMARY

The S-IC-D was moved from the MSFC Manufacturing Engineering Lab and hoisted into the Dynamic Test Stand on January 13. Testing began on January 24.

The S-IC-F was shipped from Michoud aboard the barge Poseidon and arrived at KSC VAB dock January 19. The stage was installed in the LUT March 15 and mated with the S-II-F on March 25.

The S-IC-T was removed from the Static Test Tower January 20 and moved to storage until it can be converted to the S-IC-4 configuration.

The S-IC-1 checkout was completed January 15. Post manufacturing test firing of the stage at MSFC was completed with successful firings on February 17 and 25.

The S-IC-2 Horizontal Assembly was completed and assembly of other S-IC flight stages progressed satisfactorily.

S-II Battleship testing was successfully completed in March. The facility is being held in an active status to accommodate further testing, if required.

The S-II-F stage and interstage arrived at Cape Kennedy at the beginning of March. By the end of the month they became a part of the SA-500F vehicle.

The S-IVB-F was mated with the S-II-F March 29 and the S-IU-500F March 30 at KSC.

The S-IVB-500ST was turned over to NASA March 30 and flown from California to MSFC aboard the Super Guppy.

The S-IVB-501 was shipped from Huntington Beach to Sacramento March 11 where it is now undergoing checkout for acceptance firing.

Factory Checkout of the S-IVB-502 began March 1. Assembly of the S-IVB-503 and 504 continued successfully.

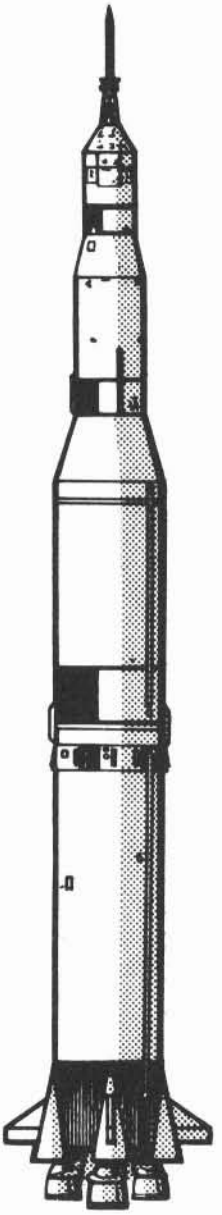
All engines for the S-IC-4 stage were delivered this period. Ten J-2 engines were delivered this period and assigned various applications.

The S-IU-500F was joined to the overall SA-500F vehicle on March 30.

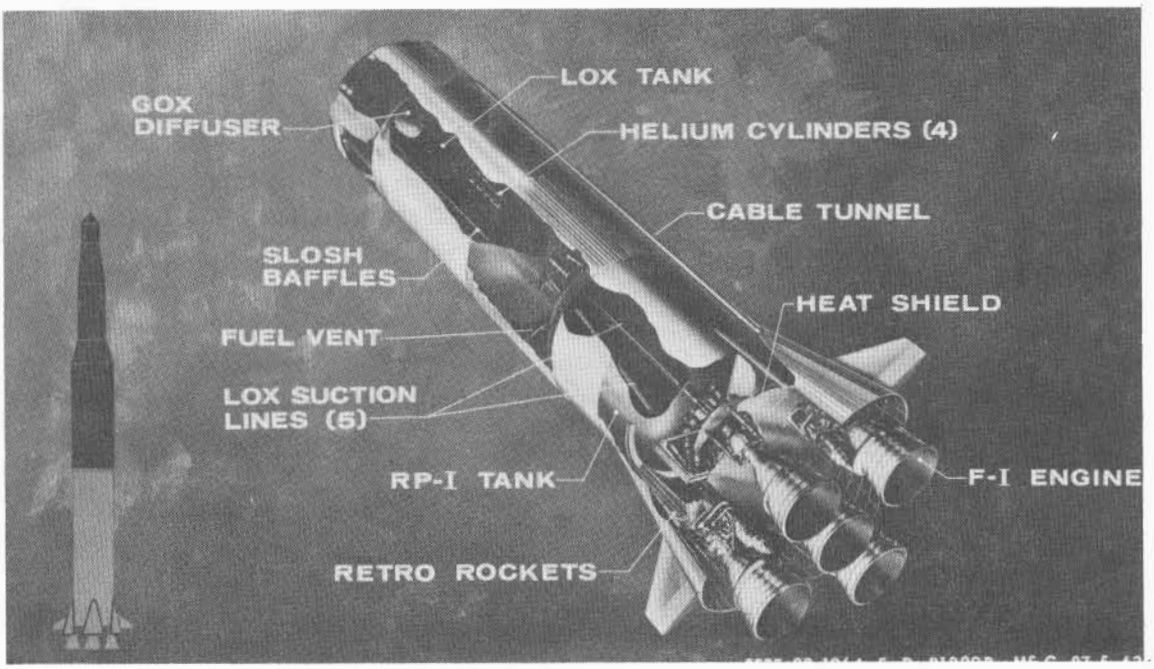
All LVGSE required to support the debugging of the SA-500F Operating System and Test Programs at MSFC was received and debugging began March 23 on schedule.

Five major facility contract awarded this quarter for Saturn V projects were mainly for additions and modifications to existing facilities. Beneficial occupancy was gained in several installations at MSFC and MTF.

SECTION II



SATURN V CONFIGURATION



SATURN V S-IC STAGE

A. S-IC STAGES

General

All phases of the S-IC program progressed satisfactorily during the quarter. The first static firing of the S-IC-1 was one week ahead of schedule and initiation of S-IC-2 post-manufacturing checkout was on schedule. The S-IC-F was accepted by NASA and arrived at KSC two days ahead of schedule. The S-IC-3 stage is proceeding through post-manufacturing test. Vertical assembly of the S-IC-4 was initiated on February 28. Subassembly operations on the S-IC-5 progressed as planned.

1. S-IC-D DYNAMIC STAGE

The S-IC-D Dynamic Stage was moved from the MSFC Manufacturing Engineering Hanger Building and hoisted into the Dynamic Test Stand (Figure 1) on January 13. Dampening tests on the stage began on January 24.

The Martin System Suspension Systems acceptance test was completed satisfactorily on February 11. Additional testing to determine the dampening effect on the restoration systems was completed February 18.

Installation of vertical fins, fairings, and retro-rockets began in early March.

Non-delivery of the Digital Data Acquisition System (DDAS) was a problem during the quarter; however, integration testing of the instrumentation trailer was implemented on the systems which could be tested without the use of the DDAS.

2. S-IC-F FACILITIES CHECKOUT STAGE

Post-manufacturing checkout of the S-IC-F stage was in progress at the beginning of the quarter at Michoud. Integrated testing was completed on January 6 and the stage was transferred from Test Cell I to Test Cell II for weighing and preparation for shipment. Post-manufacturing checkout of the minimum configuration S-IC-F stage was concluded on January 13 when weight and center of gravity were ascertained.

Figure 1 - S-IC-D Being Raised Into MSFC Dynamic Test Stand

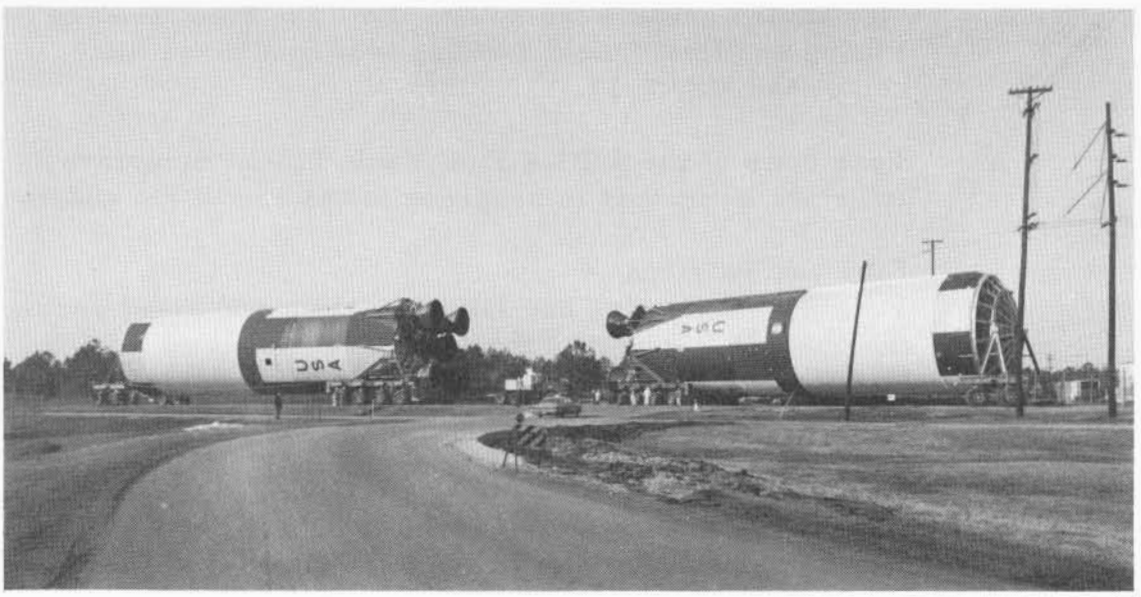


Figure 2 - S-IC-1 (right) and S-IC-2 (left) In Transit, MSFC

Preparation of the S-IC-F for water shipment to Kennedy Space Center included the installation of protective covers on both ends of the stage and all other critical surfaces. The environmental data instrumentation was checked out and calibrated and the stage was transported from the test cell to the Michoud dock. It was then found that the barge's GN_2 pressurization system was contaminated so an alternate system was fabricated and installed. The stage was loaded on the barge Poseidon January 14. The Poseidon left Michoud January 15, and arrived at KSC VAB dock on January 19, 1966. The S-IC-F was installed in the Launch Umbilical Tower March 15 and mated with the S-II-F on March 25.

3. S-IC-S STRUCTURAL STAGE

a) S-IC-S Fuel Tank/Thrust Structure/Intertank -
The S-IC-S Fuel Tank first and second test condition of Max Q Alpha were completed in February. A rerun of the Flight Cutoff condition was successfully conducted March 1. The test was run to a loading of 140 percent of the design limit. The rerun was necessary because a prior test had been terminated at 130 percent when high stress areas were noted. Both the Slow Release Fitting and Heat Shield Loading test conditions were completed March 17.

Tear down of the S-IC-S Fuel Tank/Thrust Structure/ Intertank setup was in progress at the end of the quarter.

b) Fins and Fairings -
Preparation for fins and fairing testing continued during the quarter adjacent to the Load Test Annex at MSFC. The first ambient test condition run is scheduled early next quarter.

c) SR_2 Inter-Tank -
The cryogenic temperature test of Max Q Alpha on the SR_2 Intertank was delayed due to the failure of the cryogenic ring during checkout on January 24. Cracks in the cryogenic ring were repaired and four test conditions were successfully completed by February 25.

d) S-IC-S Oxidizer Tank Assembly -
During January the Oxidizer Tank Assembly was moved into the VAB at MSFC for installation of instrumentation. The Oxidizer Tank will be moved to the Load Test Annex next quarter for test scheduled in July.

4. S-IC-T BATTLESHIP/ALL SYSTEMS STAGE

The final test firing of the S-IC-T at the Test and Checkout Station of MSFC was on December 6, 1965. Subsequent to that firing prevalves and flowmeters were inspected, automatic procedures were given final checkouts and four engines were removed for the installation of gold plated injector plates.

The S-IC-T was removed from the Static Test Tower January 20 and moved to the Manufacturing Engineering Hanger building for storage until it can be converted to the S-IC-4 configuration.

Final investigation of the S-IC-T Test firings indicates that of the 67 propulsion test objectives, 57 have been fully completed, five have been partially completed, three have been cancelled, one is incomplete, and one not performed because of possible hazard to stage and facility.

5. S-IC-1 FLIGHT STAGE

The S-IC-1 Stage Post-Manufacturing Checkout was completed January 15, and the stage was moved on January 17 (Figure 2) to the Manufacturing Engineering Lab for removal of internal access equipment and updating to a static firing condition. On January 24, the stage was moved to the Test and Checkout Station and mounted in the Static Test Tower. Preparations for test firings included pressure testing of various systems and alignment of all the engines.

The S-IC-1 was successfully test fired on February 17. The firing lasted 40.7 seconds and all main test objectives were met. A second test on February 25 was planned for 125 seconds duration but was terminated after 83.2 seconds by a red-line observer who received an incorrect reading from a faulty transducer. All criteria for the second S-IC-1 static firing were met and no additional static firings were required.

The S-IC-1 stage was removed from the Test Tower March 14 and moved to the Manufacturing Engineering new hanger building. The stage is undergoing refurbishment prior to the start of Post Static Checkout.

6. S-IC-2 FLIGHT STAGE

Horizontal assembly of the S-IC-2 was completed at the MSFC Manufacturing Engineering Laboratory on January 17 and the stage was moved (Figure 2) to the Quality Assurance Laboratory for Post-manufacturing checkout. The stage status check was completed February 1 and power was applied to the stage on February 3.

Post-manufacturing checkout was hampered when ground hydraulics supply fluid contaminated the LOX dome area of engine #1. Subsequently all five engines were removed for contamination checks and cleaning.

Post-manufacturing checkout completion is now planned for May 12 and a single 125 second static firing test scheduled for June 7.

7. S-IC-3 FLIGHT STAGE

Hardware shortages and design changes necessitated extensive use of work-around methods during assembly at Michoud. When the S-IC-3 was delivered to Systems Test on March 19, 162 installations remained to be completed. Of these,75 were accomplished by the end of the quarter on a non-interference basis with test activities. In addition, 27 new installations were ordered after the stage was moved. Nineteen of these were completed by the end of the quarter.

Connection of the stage to MSE I was completed on March 22 and power was applied March 23, 1966. Post-manufacturing checkout of S-IC-3 was on schedule at the end of the reporting period.

The first article configuration inspection (FACI) was satisfactorily completed on three S-IC-3 major structural units (the LOX and fuel tanks and the thrust structure) and on three systems (the F-1 engines, the LOX system and the fuel system).

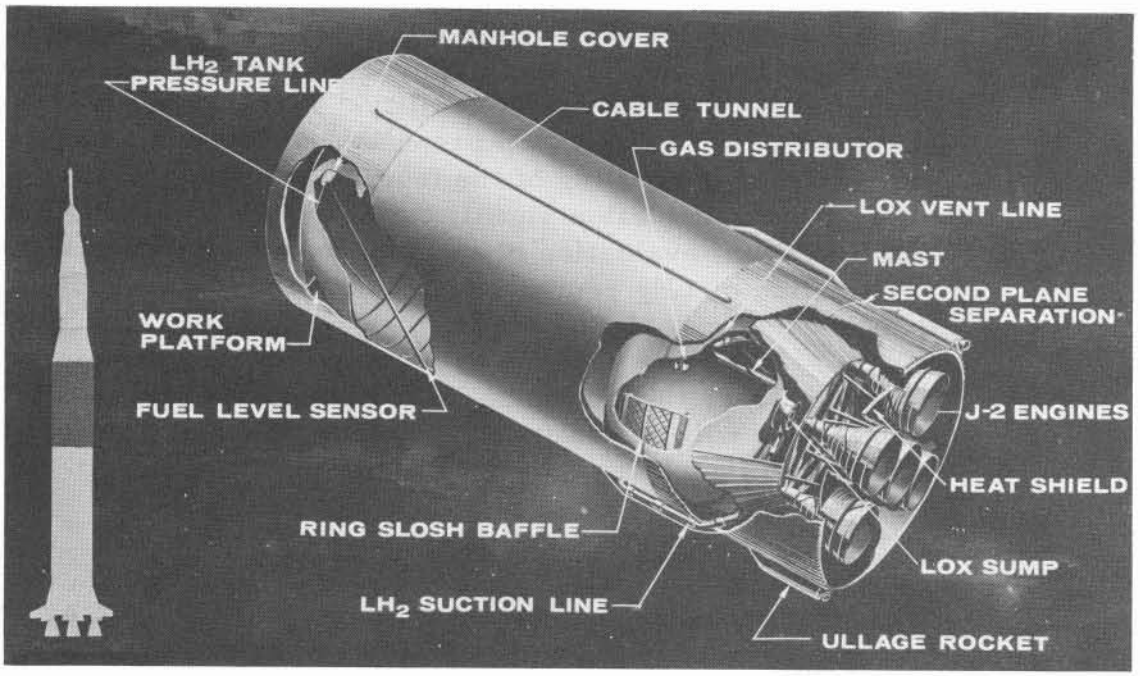
8. S-IC-4 FLIGHT STAGE

The S-IC-4 thrust structure assembly was completed on January 10, the intertank assembly on January 20, and the forward skirt assembly on February 8, 1966. Hydrostatic test of the fuel tank was finished on February 10. Vertical assembly was initiated February 28.

The pacing item in vertical assembly was the availability of the LOX tank. A girth weld problem was solved and the center engine LOX standpipe revision with associated baffle rework was accomplished. Work around methods in both vertical and horizontal assembly are expected to maintain scheduled delivery to Systems Test.

9. S-IC-5 FLIGHT STAGE

Final assembly operations on the S-IC-5 thrust structure, intertank, and forward skirt were on schedule at the quarter's end. The fuel tank was in the VAB tank assembly position 2, the LOX tank forward bulkhead was in the VAB tank assembly position 3, and the LOX tank aft bulkhead was in the VAB tank repair position.



SATURN V S-II STAGE

B. S-II STAGES

General

The S-II Battleship program was successfully concluded on March 15. The S-II-F was shipped to Cape Kennedy for use in facilities checkout. Final assembly of the fifth flight stage (S-II-5) was begun at the Seal Beach facility.

1. S-II BATTLESHIP STAGE

During this report period five full duration static firings with flight type engines were conducted successfully at the Santa Susana S-II Battleship facility. Major objectives achieved were: closed loop propellant utilization control; programmed gimballing of the four outboard engines; cutoff by the lox-depletion signal; cutoff by low level LH_2 auto cutoff system; evaluation of natural lox recirculation system; verification of LH_2 recirculation system; and checkout of the A7-71 LH_2 heat exchanger.

This concludes the planned S-II Battleship program. Battleship testing will be continued at a reduced level of effort for an indefinite period.

2. S-II-F FACILITY CHECKOUT STAGE

Insulation closeout, insulation pressure checks, and systems component installation were completed on January 30. Systems checkout and preparation for shipment were accomplished on February 19. The S-II-F stage and its interstage departed Seal Beach aboard the AKD Point Barrow on February 20 and arrived at Port Canaveral March 4, twelve days later (Figure 3). Low bay checkout at KSC was finished on March 24 and the S-II-F was mated to the S-IC and S-IVB on March 25 and March 28, respectively.

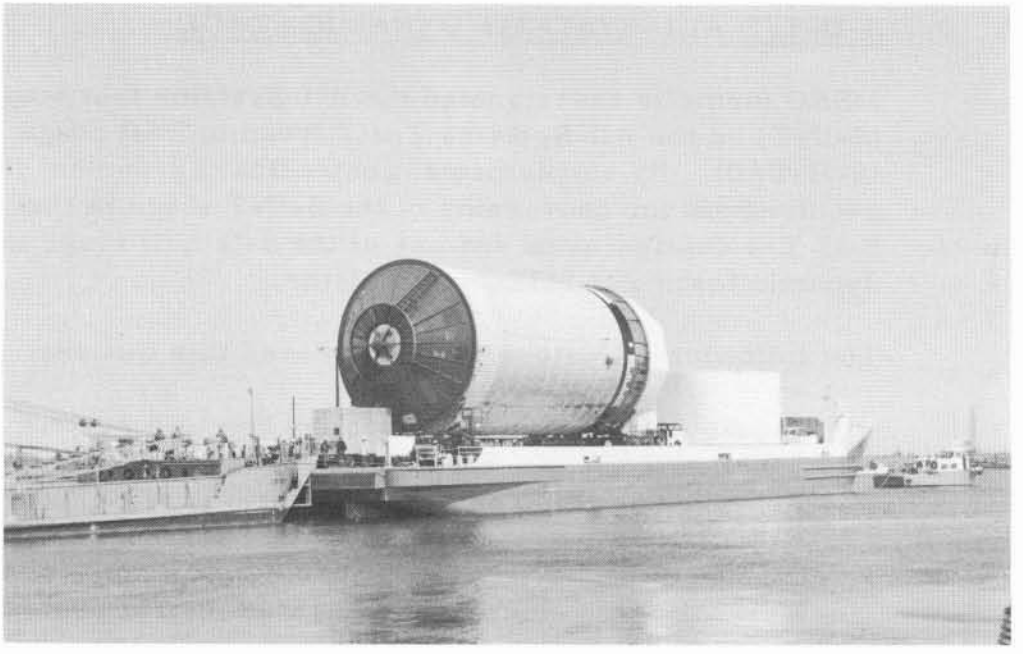


Figure 3 - Transfer Of S-II-F And Interstage From Dock To VAB, KSC

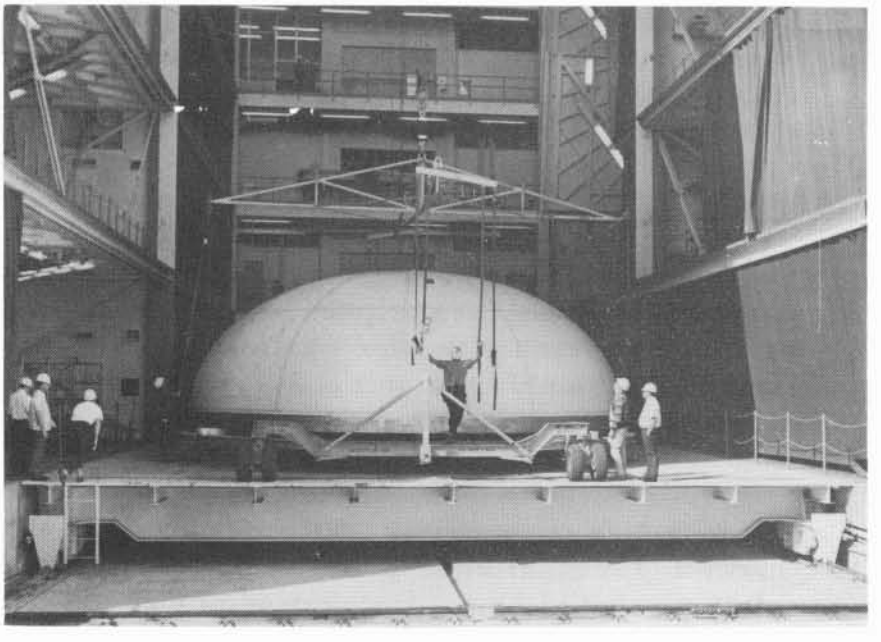


Figure 4 - S-II-2 Forward LH_2 Bulkhead Being Moved To VAB, Seal Beach

3. S-II-T/D ALL-SYSTEMS/DYNAMIC STAGE

MSFC formally redesignated the All-Systems test stage (S-II-T) as the All-Systems Test/Dynamic Test Stage (S-II-T/D). By supplemental contractual agreement the requirement for conversion of the S-II-T stage to the S-II-T-4 configuration and use of the S-II-S/D stage for dynamic testing at MSFC was deleted.

The following milestones were achieved this quarter:

January 16	-	Cold shock of the LH_2 system accomplished.
February 3	-	Integrated checkout of GSE completed.
February 22	-	Leak detection functional checkout performed.
March 14	-	Stage electrical control checkout completed.
March 29	-	LN_2 tanking completed.
March 30	-	LN_2 de-tanking (regular and emergency) performed.

Installation of fire detection instrumentation, blast instrumentation, and vibration instrumentation in preparation for start of LH_2 tanking is presently underway. The initial static firing is scheduled for April 23.

4. S-II-1 FLIGHT STAGE

The first S-II full-stage hydrostatic proof testing and cleaning was completed successfully on January 14. Between January 15 and 17 the tank structure was mated to the aft skirt/thrust structure assembly and on February 27 the forward skirt was installed on the LH_2 tank. All S-II-1 stage engines were installed on March 7.

The S-II-1 is currently in Station II at Seal Beach for continuity and megger checks, insulation close-out, and insulation proof testing. Installation of components in the LH_2 tank is scheduled for April 6.

5. S-II-2 FLIGHT STAGE

Forward skirt and aft lox bulkhead assemblies were completed on February 23 and March 10, respectively. Vertical buildup of the S-II-2 stage commenced in February (Figure 4) and completion is expected on April 9.

6. S-II-3 FLIGHT STAGE

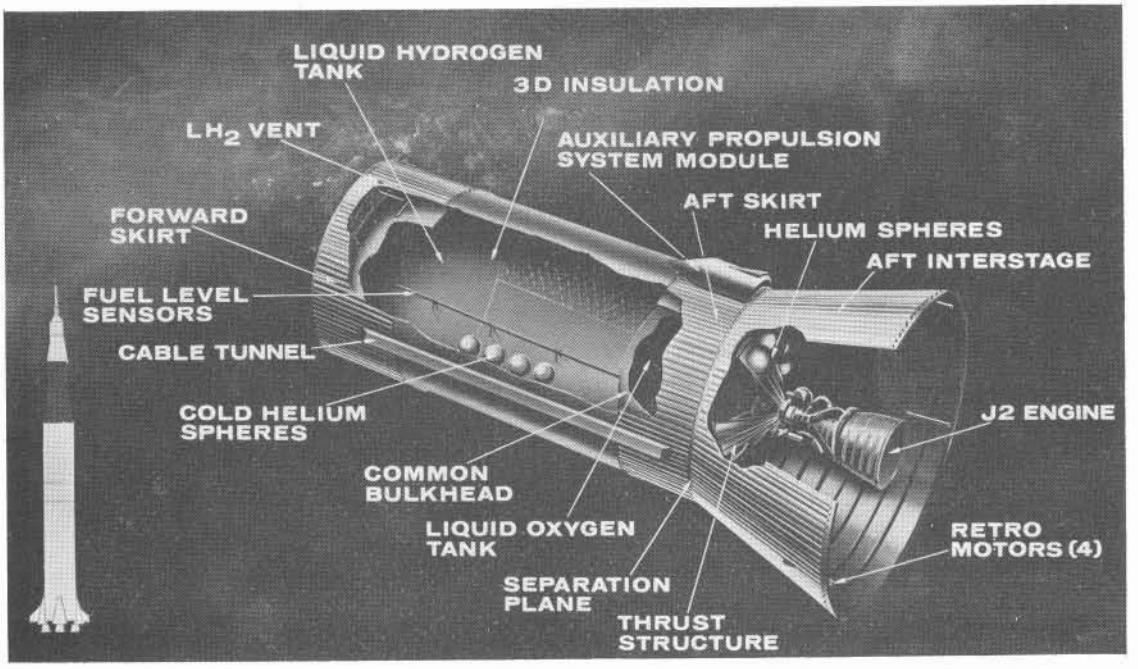
The S-II-3 aft skirt/thrust structure assembly was completed on February 26. Honeycomb-core machining of the aft facing sheet and bonding of the forward facing sheet were completed on the common bulkhead. Detail insulation gore segments are being assembled for the forward LH_2 bulkhead. Dollar-weld doubler segments on the aft lox bulkhead are also being installed. The interstage is in the process of being assembled.

7. S-II-4 FLIGHT STAGE

Meridian welding of the forward and aft facing sheets of the common bulkhead was completed in January. Meridian and dollar welding of the forward bulkhead was finished early in March.

8. S-II-5 FLIGHT STAGE

S-II-5 final assembly was started at Seal Beach in January. Meridian welding of the common bulkhead aft facing sheet was completed. Weld milling and x-ray and dye-penetrant inspection is in progress.



SATURN V S-IVB STAGE

C. S-IVB STAGES

General

The contract incentive conversion package was completed and will be forwarded to NASA Headquarters for approval during the next quarter.

The S-IVB Common Bulkhead Test Article, which is the modified All-Systems Stage, failed during reverse pressure testing at Sacramento January 13. The Common Bulkhead was severed completely around the circumference at the aft LOX bulkhead joint. Preliminary information indicates that a design deficiency probably exists in the joint area. The failed specimen has been shipped to Santa Monica for metallurgical and fracture mechanics investigation.

1. S-IVB BATTLESHIP STAGE (MSFC)

Seven test firing of the S-IVB Battleship stage were conducted at MSFC during this report period. The major objectives of the first four test were to demonstrate S-II hot gimballing of the J-2 Engine and evaluate performance of the Propellant Utilization System. All major test objectives were achieved in test S-IVB-014 and S-IVB-015. 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. Prime objectives of test S-IVB-017, Fuel Pressurization and Start Bottle Loading, were met during the test.

Test No.	Date	Duration	Remarks
S-IVB-012	1/19	7.3 sec.	Redline cutoff when the lox pump temperature measurement device failed.
S-IVB-013	1/24	100.46 sec.	Cutoff due to overheated diffuser when the diffuser coolant water supply valve failed to open.

Test No.	Date	Duration	Remarks
S-IVB-014	1/26	438.0 sec.	All engine and stage parameters appeared normal.
S-IVB-015	2/4	445.0 sec.	All engine and stage parameters appeared normal.
S-IVB-016	2/21	40.19 sec.	Cutoff by the gas generator over-temperature device.
S-IVB-017	3/1	412.44 sec.	Cutoff due to fuel depletion.
S-IVB-018	3/9	2.15 sec.	Cutoff by the gas generator over-temperature device.

2. S-IVB-D DYNAMIC STAGE

Modifications were made on the S-IVB-D vehicle to bring the stage to flight configuration for the Super Guppy aircraft flight test. Instrumentation was added to the stage to record aircraft environment. The S-IVB-D was loaded on the Super Guppy March 20, at MSFC. No significant problems were encountered during the test flight to or from Los Alamitos Naval Air Station.

A quick look at data gathered from the flight indicates acceptable conditions for transportation of S-IVB flight stages by Super Guppy air transport.

3. S-IVB-F FACILITIES CHECKOUT STAGE

Conversion of the S-IVB-F to the final Saturn V configuration was accomplished at KSC in the Low Bay of the VAB (Figure 5). The stage was signed off and available for LC-39 checkout on March 25. It was mated with the S-II-F March 28 and the S-IU-500F on March 30.

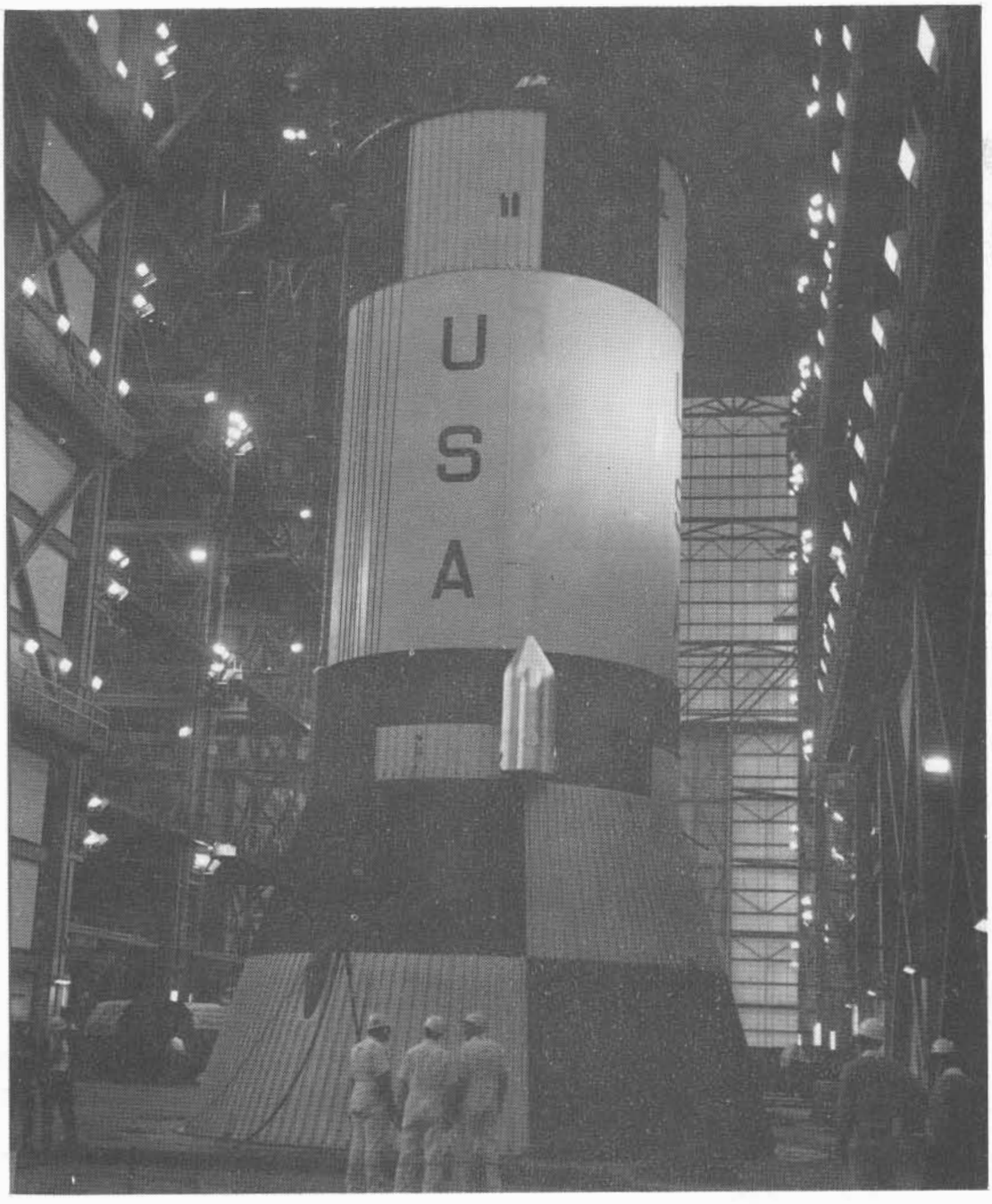


Figure 5 - S-IVB-F Joined To Aft Interstage at VAB, KSC

4. S-IVB-500ST SIMULATOR

Early period activity consisted of continuity checks and completion of modifications on the S-IVB-500ST in the Vertical Checkout Tower at Sacramento. The power on procedure was successfully completed February 7. Post manufacturing checkout was completed March 19 and the stage was removed from the stand. The S-IVB-500ST was turned over to NASA at Courtland, California, March 30. The stage was loaded aboard the Super Guppy and is expected to be received at MSFC April 1 for installation in the Systems Development Facility.

5. S-IVB-S STRUCTURAL STAGE

The Saturn V S-II/S-IVB Interface Test progressed during the period. Modifications to the S-II Forward Skirt, required to accommodate anticipated acoustical loads, were completed January 29. Installation of instrumentation for structural test of the interface joint continued throughout the quarter. The S-IVB Aft Interstage was positioned atop the S-II Forward Skirt in mid-March. Scheduled completion of the test is now estimated for November.

6. S-IVB-501 FLIGHT STAGE

Post manufacturing checkout of the S-IVB-501 at Huntington Beach was terminated on January 28. Late component parts installation continued until time for shipment to Sacramento. The stage was weighed March 5 and shipped from Huntington Beach to Sacramento March 11. Approximately 2,000 manufacturing hours were transferred to Sacramento.

The S-IVB-501 was installed in the Sacramento Beta 1 Test Stand March 21 (Figure 6). Hookup to the facility and GSE were completed and "power on" was accomplished on March 30. Modifications and checkout are continuing with acceptance firing scheduled for May 11.

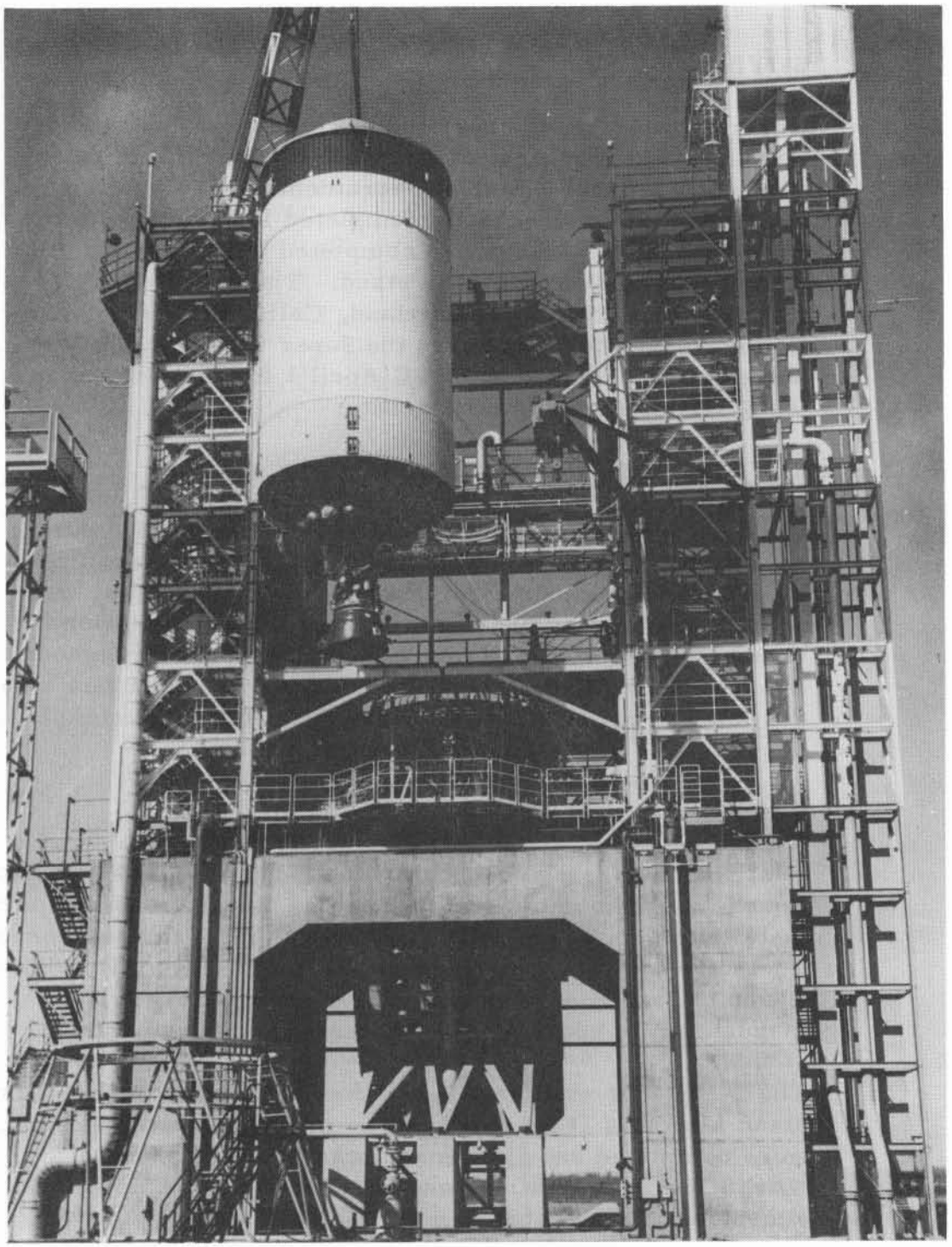


Figure 6 - S-IVB-501 Being Hoisted Into Beta 1 Test Stand

7. S-IVB-502 FLIGHT STAGE

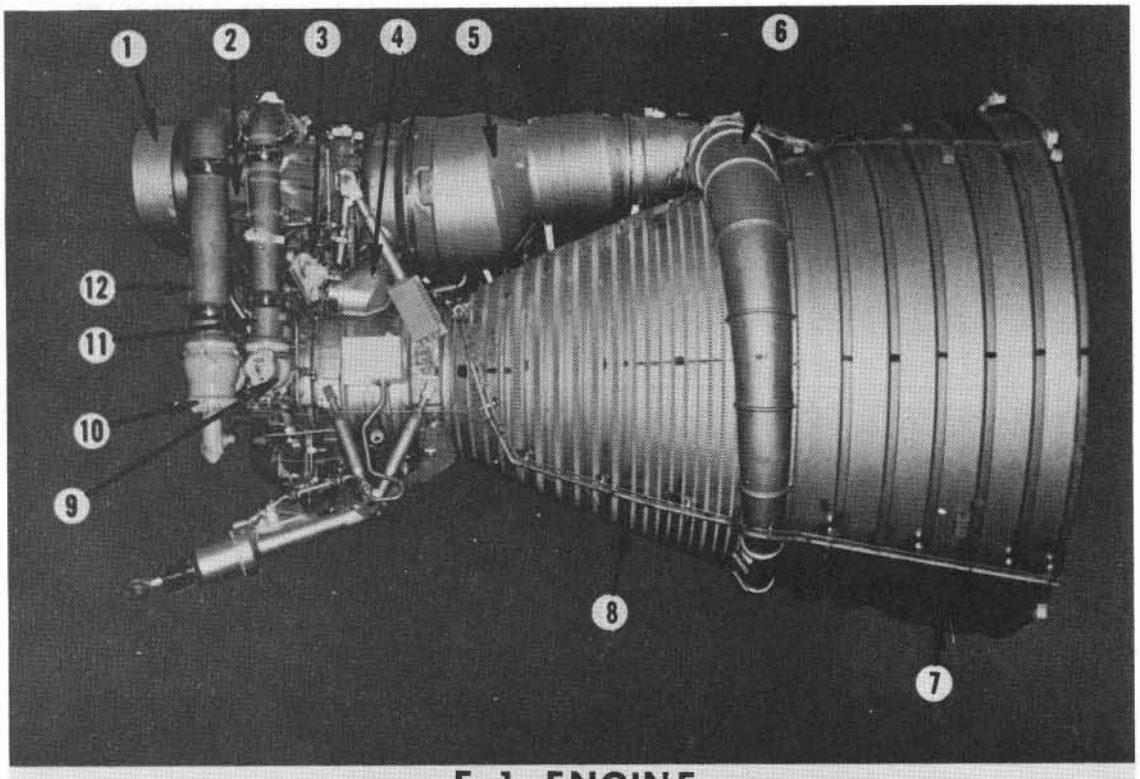
Checkout and manufacturing continued on the S-IVB-502, at Huntington Beach. Joining of the Aft Skirt, Forward Skirt and Thrust Structure was completed and the stage was moved into the checkout tower on February 20. Factory checkout was started and the first continuity test began on March 1. At the end of the report period 10 of the 40 checkout test are complete and manufacturing is estimated to be 87 percent complete. Completion of Factory Checkout is scheduled for April 28.

8. S-IVB-503 FLIGHT STAGE

The Aft Lox Dome of the S-IVB-503 stage experienced a shear type rupture during hydrostatic testing at Huntington Beach. Repair of the ruptured area was effected using internal and external doublers. The repair underwent successful hydrostatic proof testing to 105 percent limit on March 29. The stage will be moved to Tower # 8 for leak and dye checks early in the next quarter.

9. S-IVB-504 FLIGHT STAGE

LOX Tank Assembly was completed at Santa Monica and the tank was shipped to Huntington Beach on March 3. The Forward Dome (LH_2 Tank) was shipped to Huntington Beach on March 2. Late quarterly manufacturing activities at Huntington Beach included replacement of the Clevis Probe mount fitting in the Forward Dome because of a crack in the parent metal around the fitting.



F-1 ENGINE

1 INTERFACE PANEL
2 TURBOPUMP
3 GAS GENERATOR BALL VALVE
4 GAS GENERATOR
5 HEAT EXCHANGER
6 TURBINE EXHAUST MANIFOLD
7 THRUST CHAMBER EXTENSION
8 THRUST CHAMBER
9 NO. 1 MAIN FUEL VALVE
10 NO. 1 MAIN LOX VALVE
11 NO. 1 HIGH-PRESSURE FUEL DUCT
12 NO. 1 HIGH-PRESSURE LOX DUCT

SATURN V ENGINES

D. ENGINES

General

Through March 31, the F-1 Engine Program has conducted 1,416 R & D engine system tests for a total of about 103,504 seconds. Of these, 489 tests were for full duration with 167 exceeding 160 seconds.

The J-2 engine has been under development for approximately 67 months. During this period nearly 2,000 tests for an accumulation in excess of 160,000 seconds have been amassed.

ENGINE SYSTEM TESTING

1. F-1 Engines (EFL)

Developmental test activity continued at EFL (Edwards Field Laboratory) on the four R & D test positions. Two hundred and forty-nine R & D engine tests were conducted for an accumulated duration of 14,045 seconds; of these, 77 were full duration runs (150 seconds or more). The following engine system milestones were achieved during this report period:

1. First engine test of production configuration thermal insulation.
2. Demonstrate minimum NPSH.
3. Start test of complete R & D Qualification configuration engine.
4. Complete verification testing of qualification configuration dome and injector.
5. Complete interim specific impulse demonstration.
6. Complete qualification reliability demonstration.
7. Complete flexible duct insulation tests.

2. F-1 Engines (MSFC)

a) Static Test Tower West

Two tests for durations of 56 and 57 seconds were conducted on engine F-1002-3. The objectives of these tests were to observe the effects of injecting helium gas into the lox system, to evaluate the effects of eliminating low lox chamber purge during thrust chamber prefill, and to determine engine performance level change due to removal of gas generator lox screen.

b) West Area Test Stand

Four tests were conducted on engine F-4T2. The objectives of these tests were to checkout the new thrust measurement system in the F-1 test stand and to study engine performance at high lox NPSH. Each of these tests were conducted for a mainstage duration of 40 seconds. An additional test was conducted on engine F-2010 for a duration of 97 seconds to obtain data for the NPSH studies.

3. J-2 Engines (SSFL)

There were 172 R&D tests for a total of 23,072 seconds conducted at the Santa Susana Field Laboratory (SSFL) during this report period. Eighteen of the tests were for durations in excess of 470 seconds. Test objectives were as follows:

1. Start sequence evaluation
2. Reliability demonstration
3. Duration and restart
4. Thrust chamber injector instability study
5. Gimbal demonstration
6. Fuel tank repressurization
7. Lox heat exchanger evaluation
8. 230K engine performance evaluation
9. Thrust chamber insulation evaluation

ENGINE PRODUCTION AND DELIVERIES

1. F-1 Engines

The five engines, F-5029 through F-5033, for the S-IC-4 stage were accepted by the government at Canoga Park, California, (Figure 7) during this report period. Delivery was made to Boeing, Michoud, via Guppy aircraft. Twenty-six acceptance tests for a total duration of 1270 seconds, including seven full duration tests, were conducted at EFL.

Negotiations for conversion of the F-1 Deliverable Hardware Contract (NAS 8-5604) from CPFF to CPIF were successfully completed on January 11.

The data recorded during truck transport of engine F-4020 has been evaluated by the engine contractor and this mode of transportation appears to be satisfactory. The engine contractor has recommended that at least one additional shipment of an engine to Michoud be conducted prior to final determination. Examination of engines after receipt at MSFC reveals no apparent difference in condition regardless of truck or air shipment mode.

2. J-2 Engines

The ten engines accepted by the customer for delivery during this report period were assigned applications as follows: North American Aviation, S-II-3 Stage (5), S-II Spare (1); Douglas Aircraft Corporation, S-IVB-207 (1), S-IVB Spare (1); Arnold Engineering Development Center (AEDC) S-IVB Test (1); Marshall Space Flight Center, S-IVB Test (1). This brings to fifty-nine the total engines delivered by Rocketdyne. Forty-six tests for 6,155 seconds were accumulated during acceptance testing, including satisfactory performance at simulated altitude by the AEDC engine.

Negotiations for 52 deliverable J-2 engines were successfully completed on January 26.

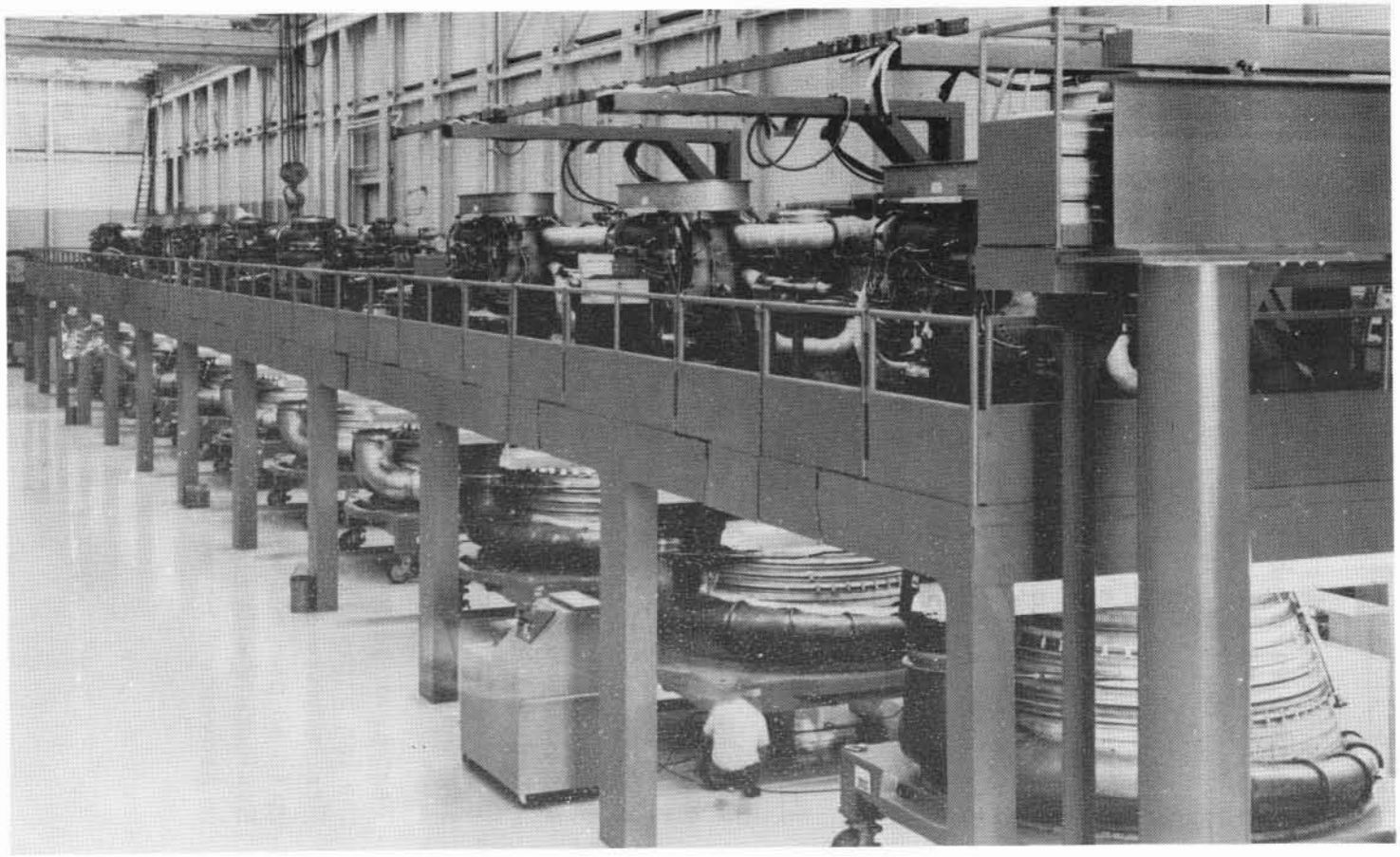


Figure 7 - F-1 Engine Final Assembly Area, Canoga Park

COMPONENT DEVELOPMENT

1. F-1 Engines

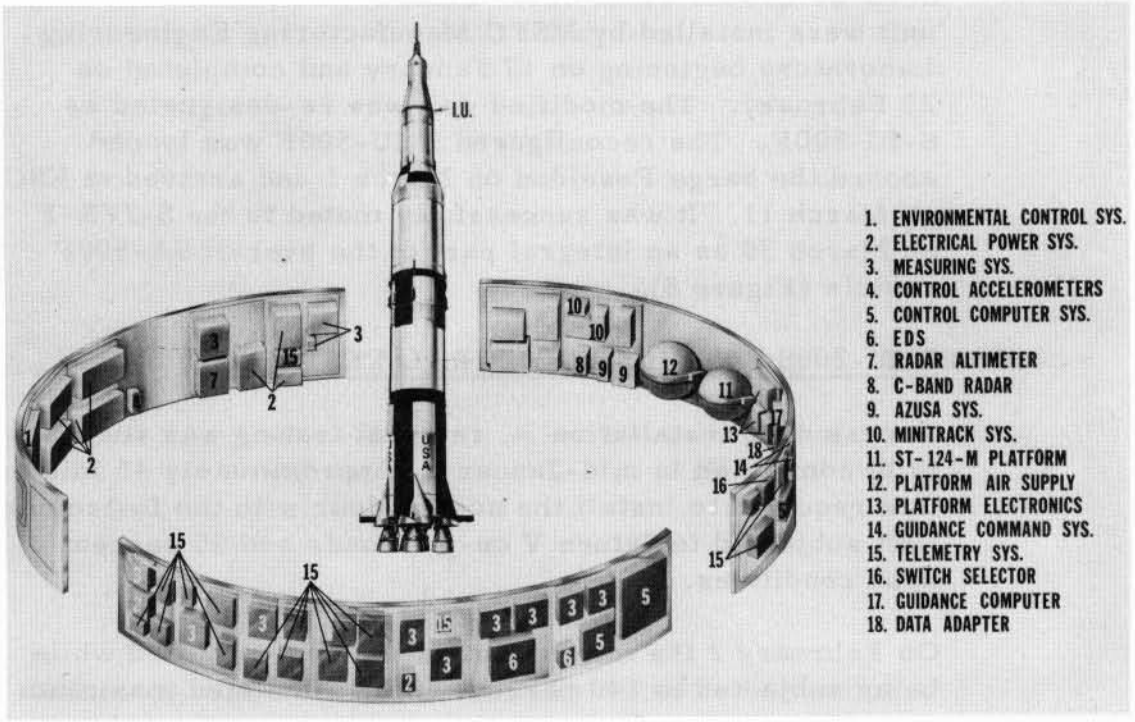
During the last report period tests were conducted with quarter-wave tubes installed on the lox ducting. The test results had shown no evidence of 425 - cps buzzing. To verify the effectiveness of the quarter-wave tubes the same injector and thrust chamber assembly were tested with no quater-wave tubes. High amplitude buzzing was again observed. These results strongly suggest that the quarter-wave tubes on the lox ducting are influential in preventing the 425-cps buzzing mode.

The inboard lox pressure volume compensator (PVC) successfully completed burst tests in January. This completed all testing on the seven feed line ducts being built by Arrowhead.

2. J-2 Engines

Cracks were found in the lox pump first stage turbine wheels of production engines 2038 (vehicle 501) and 2027 (MSFC). These cracks were caused by a critical vibration mode of the turbine wheel. An inspection procedure to locate other cracked turbine wheels was initiated. New thick turbine wheels, which will eliminate the cracking problem, are scheduled for vehicles 504 and subsequent. An investigation is being conducted to determine a positive solution for the engines in the earlier stages.

Testing of an R&D engine with the stator seal removed from the lox pump was initiated near the close of the report period. Preliminary data indicate a reduction in vibration levels of up to 50 percent without any noted effect on pump performance. Evaluation will continue to investigate this change as an improvement to the lox turbopump.



SATURN V INSTRUMENT UNIT

E. INSTRUMENT UNIT

General

The S-IU-500F was structurally integrated into the SA-500F vehicle at KSC at the close of this report period.

1. S-IU-500F FACILITIES CHECKOUT UNIT

S-IU-200F/500F structure, which was damaged at KSC during the previous report period, was replaced by S-IU-200S/500S structure. Components from the damaged unit were installed by MSFC Manufacturing Engineering Laboratory beginning on 17 January and completed on 25 February. The modified unit was re-designated as S-IU-500F. The reconfigured S-IU-500F was loaded aboard the barge Poseidon on March 1 and arrived at KSC on March 11. It was successfully mated to the S-IVB-F on March 30 as an integral part of the overall SA-500F vehicle (Figure 8).

2. S-IU-200S/500S-II STRUCTURAL TEST UNIT

Access door installation - removal testing was successfully completed in mid-January. Approximately 45 minutes was required to install the access door with the Instrument Unit subjected to Saturn V on-pad loads and 95 percent wind conditions.

On February 2 the instrument unit structure failed while being subjected to 140 percent of the simulated maximum dynamic pressure limit loads (maximum compression over the ST-124M stable platform position). This test completed qualification of Instrument Unit structure for Saturn IB missions. Continuation of tests to qualify SA-506 structure requires another unit to be delivered next quarter. These tests will involve maximum dynamic pressure loads applied over the access door and maximum dynamic pressure loads applied over the battery position.

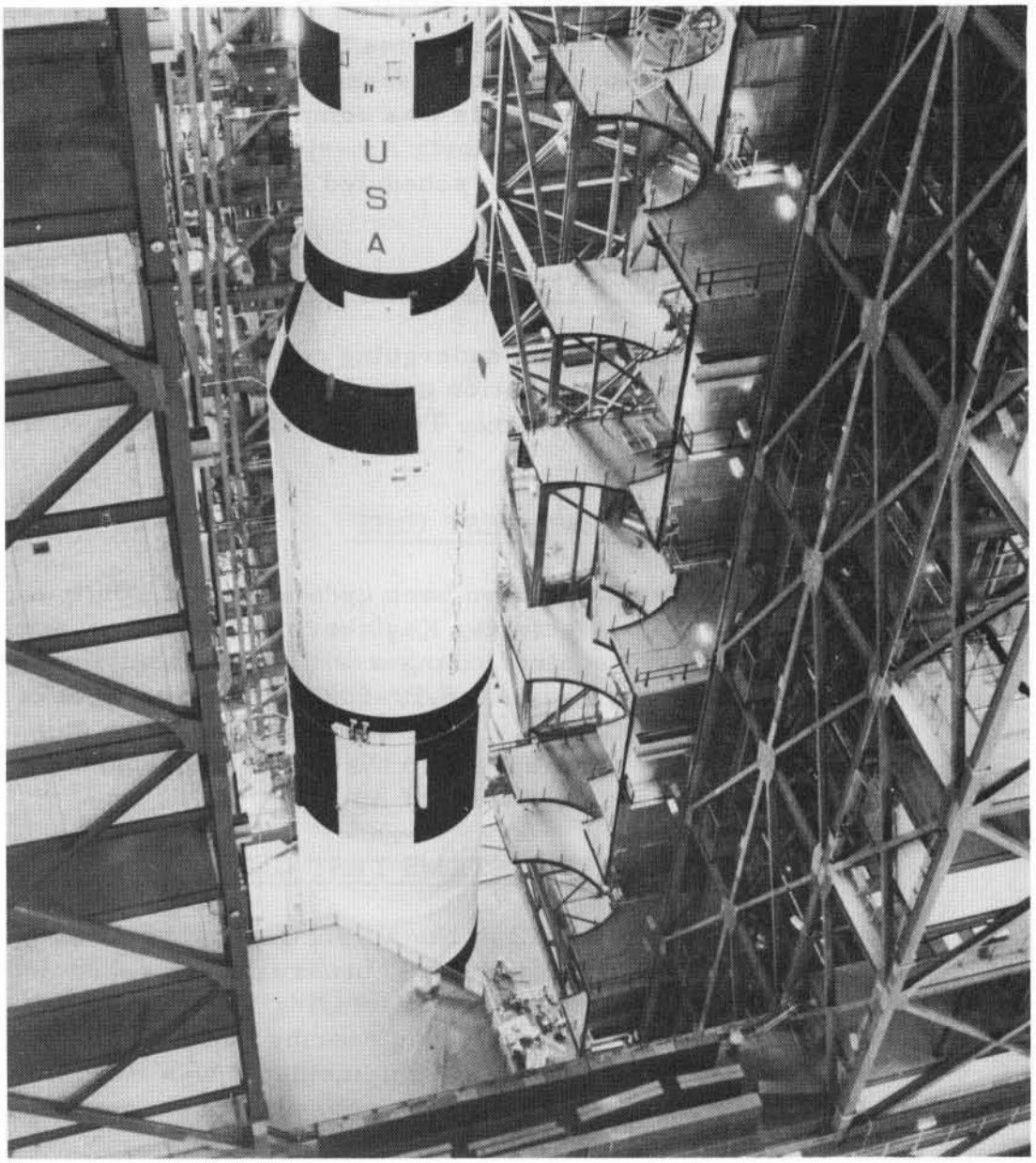


Figure 8 - Saturn V Facility Checkout Vehicle In The VAB, KSC

3. S-IU-500V VIBRATION TEST UNIT

Vibration testing of the General Dynamics 500V Instrument Unit was successfully completed on January 17. The unit was sent from Wyle Laboratories to the Manufacturing Engineering Laboratory for disassembly on January 28. Disassembly of components was completed on February 21 and reassembly into the North American Avaiation S-IU-500V-II structure is scheduled for completion on April 7.

4. S-IU-200D/500D DYNAMIC TEST UNIT

The S-IU-200D/500D is undergoing conversion to Saturn V configuration. Modification completion is expected by July 1 for start of Dynamic Test Program stacking operations.

5. S-IU-500ST SYSTEMS TEST UNIT

All available systems have been updated to 501 configuration by the MSFC Manufacturing Engineering Laboratory and and any further required changes will be accomplished on a non-interference basis. S-IU-500ST power-on checks and connection with GSE have been accomplished. The unit is scheduled to be positioned atop the S-IVB in preparation for systems tests the first week of April.

6. S-IU-500FS FLIGHT SYSTEMS TEST UNIT

Checkout of S-IU-500FS at the MSFC Quality Assurance Laboratory was completed on February 14, as scheduled. The unit was returned to Manufacturing Engineering for incorporation of mandatory Engineering Orders (EO's), repairs, and preparation for shipment. It was flown to Douglas Aircraft, Huntington Beach, aboard the Super Guppy on March 10.

Preparation for the S-IVB/Instrument Unit Test program continued at the end of the quarter (Figure 9). Environmental testing is scheduled to start May 30.

7. S-IU-501 FLIGHT INSTRUMENT UNIT

Structural fabrication and assembly (Figure 10) of the S-IU-501 was completed on January 28; component assembly is now in progress.

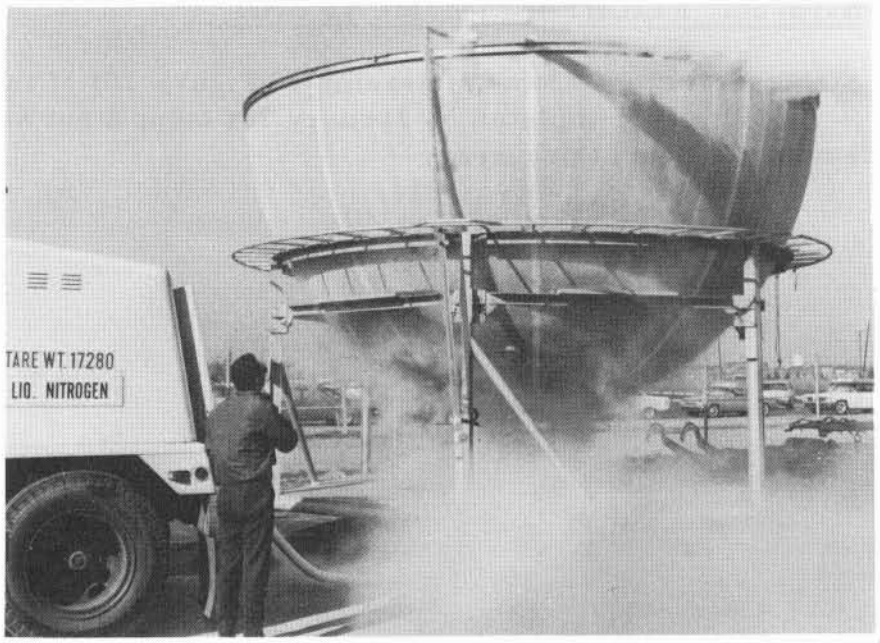


Figure 9 - S-IVB/IU Forward Dome During LN_2 Shock Test

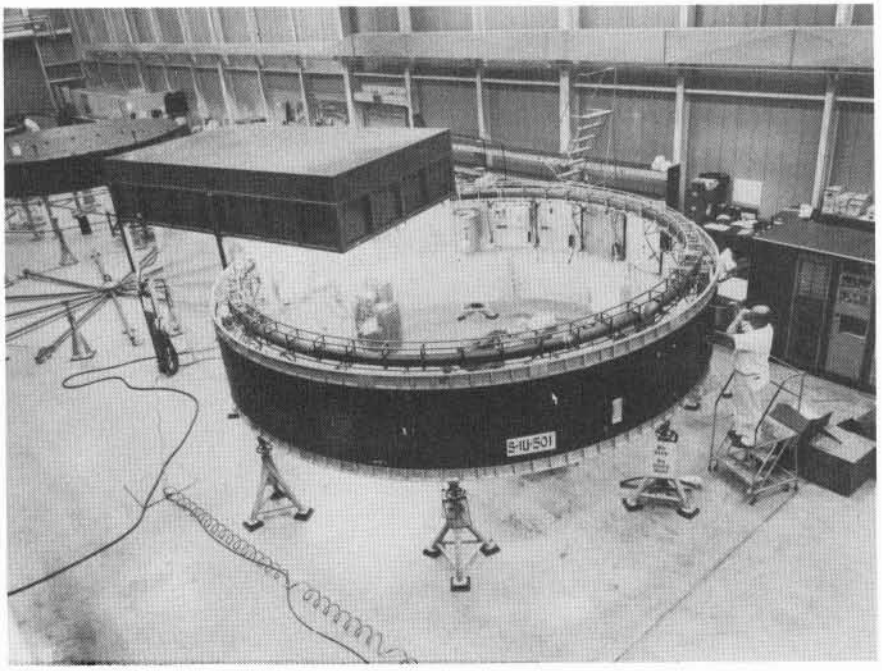
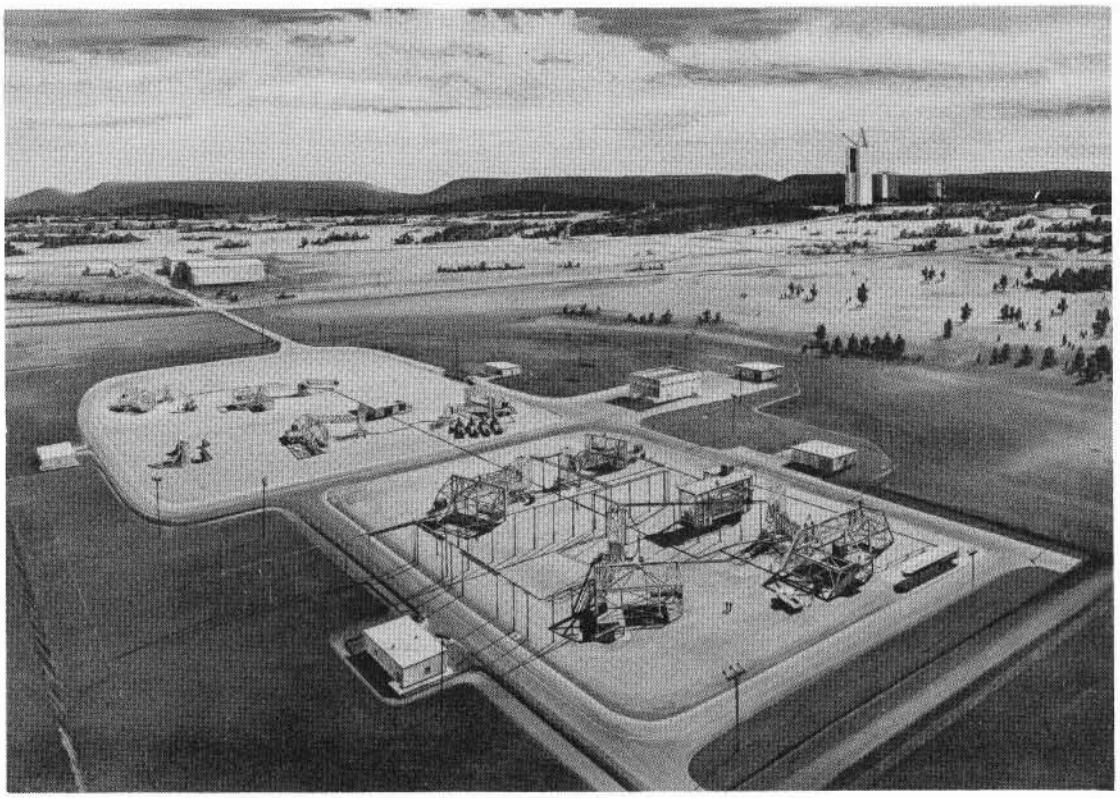


Figure 10 - S-IU-501 In Assembly



SATURN V LAUNCH VEHICLE GSE

F. LAUNCH VEHICLE GROUND SUPPORT EQUIPMENT (LVGSE)

General

LVGSE progress during the quarter indicates that the requirements for SA-500F and for SA-501 will be satisfied in a time frame that is compatible with the Saturn V program objectives.

KSC LAUNCH COMPLEX 39-1

The Discrete Control System (DCS) for Firing Room No. 1 (FR-1) arrived on-dock at KSC March 2. The DCS for LC-39 LUT No. 1 was delivered March 19. Both the FR-1 and LUT-1 systems were provisionally accepted March 29.

Installation of the Saturn V Operational Displays in Firing Room No. 1 was completed during the week of March 25. Completion of the Acceptance Test is planned for April 1.

The late definition and approval of the Hazard Monitoring System, in support of the SA-500F operation, has necessitated an attempt to provide an interim system. All other LVGSE is expected to support the SA-500F schedule.

RCA 110A COMPUTER

The RCA Logistics and Maintenance Contract NAS 8-15496 was signed at NASA Headquarters on January 5.

RCA 110A deliveries during this quarter were as follows:

LC-37, Kennedy Space Center (2)
January 18 and February 1

S-IC Test Control Center, Mississippi Test Facility -
February 5

Astrionics Laboratory, MSFC -
February 15

Douglas Aircraft Corporation, Huntington Beach, Calif. -
redelivered from MSFC Quality Assurance Laboratory
February 25

SYSTEMS DEVELOPMENT FACILITY (SDF)

Installation of the LCC Discrete Control System in the SDF was completed January 6.

Critical circuit checks of SDF ESE were started February 1. Critical circuit checks and subsequent GETS checks of affected ESE were performed on each subsystem as it became available and were complete on March 1.

The Saturn V Operational Display equipment was delivered to SDF on February 26. Installation and checkout were completed to support the SA-500F Tape debugging and validation.

Integrated GETS check began February 28 and was completed March 8.

Integration of ESE and Stage Electrical Simulators was started March 15 and completed March 21.

Debugging of SA-500F Operating System and Test Programs began March 23. All Operating System Programs are expected to be delivered to KSC during April. All Test Programs should be received at KSC during April with the exception of the S-IC Propellant Loading Monitor Program which is expected during early May.

The S-IVB-500ST is expected to be received at the SDF on April 1 and will support SA-501 tape debugging and validation.

Although all LVGSE required to support the start of the SA-500F Program Debug arrived on schedule, some items of LVGSE still appear to be delinquent. The ST-124 ESE-GSE is required April 30 but will not be available until September 1. The S-Band Command Communications System required April 15 to support validation of the SA-501 Program Tapes is not expected until early May.

SERVICE ARM/UMBILICAL DELIVERY AND TEST (SAUDT)

All umbilicals required to support SA-500F-1 have been delivered to KSC. Two of these umbilicals, S-IC Forward and S-IC Intertank, will also be used to support SA-501. The remaining SA-501 umbilicals to support SA-501 Service Arm testing are now available or will be delivered to MSFC during April for testing with Service Arms.

The S-IC Intertank, S-IC Forward, S-II Aft, S-II Forward, (Fig. 11) S-IVB Aft, and S-IVB Forward Service Arms, and Tail Service Mast No. 1 required to support SA-500F-1 have been delivered to KSC. The remaining Service Arms and Tail Service Masts are expected to be delivered during April to support the present KSC schedule for vehicle power-on roll-out from the VAB.

IBM HUNTSVILLE - INSTRUMENT UNIT CHECKOUT STATION

Despite problems with late deliveries of components, deficiencies in panels and patch distributors, progress continued on the Saturn V Checkout Station. Most of the Modification Kits for the station had been received by the end of the quarter. Cable verification started March 1 and Station Verification Tests began on March 30.

Current assessment concludes that the Saturn V Checkout Station will be available by the middle of May to support the S-IU-501 checkout.

OTHER

The first set of LVGSE Installation and Checkout Specifications were delivered to KSC during mid-March. Subsequent releases will be made incrementally as they become available.

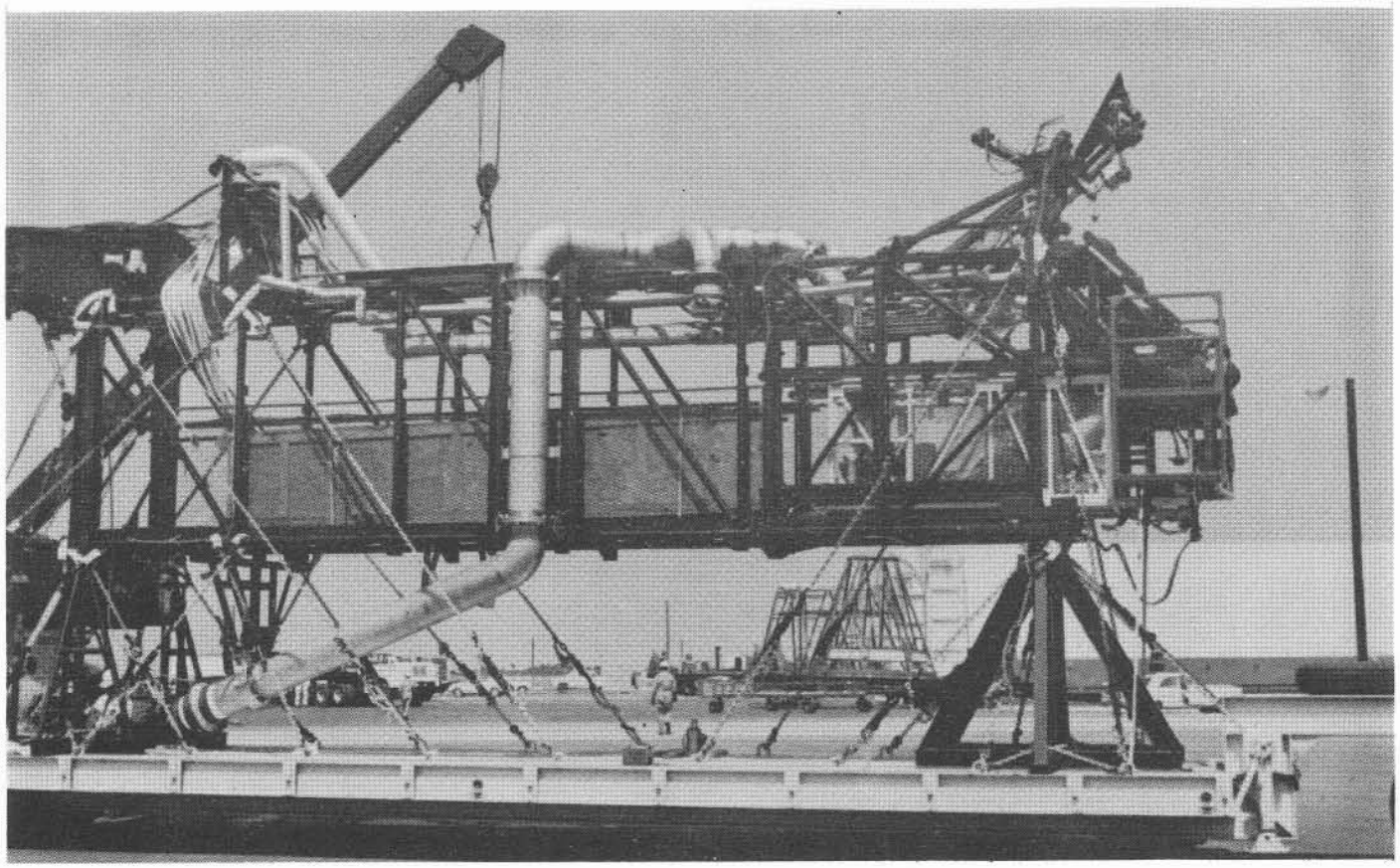
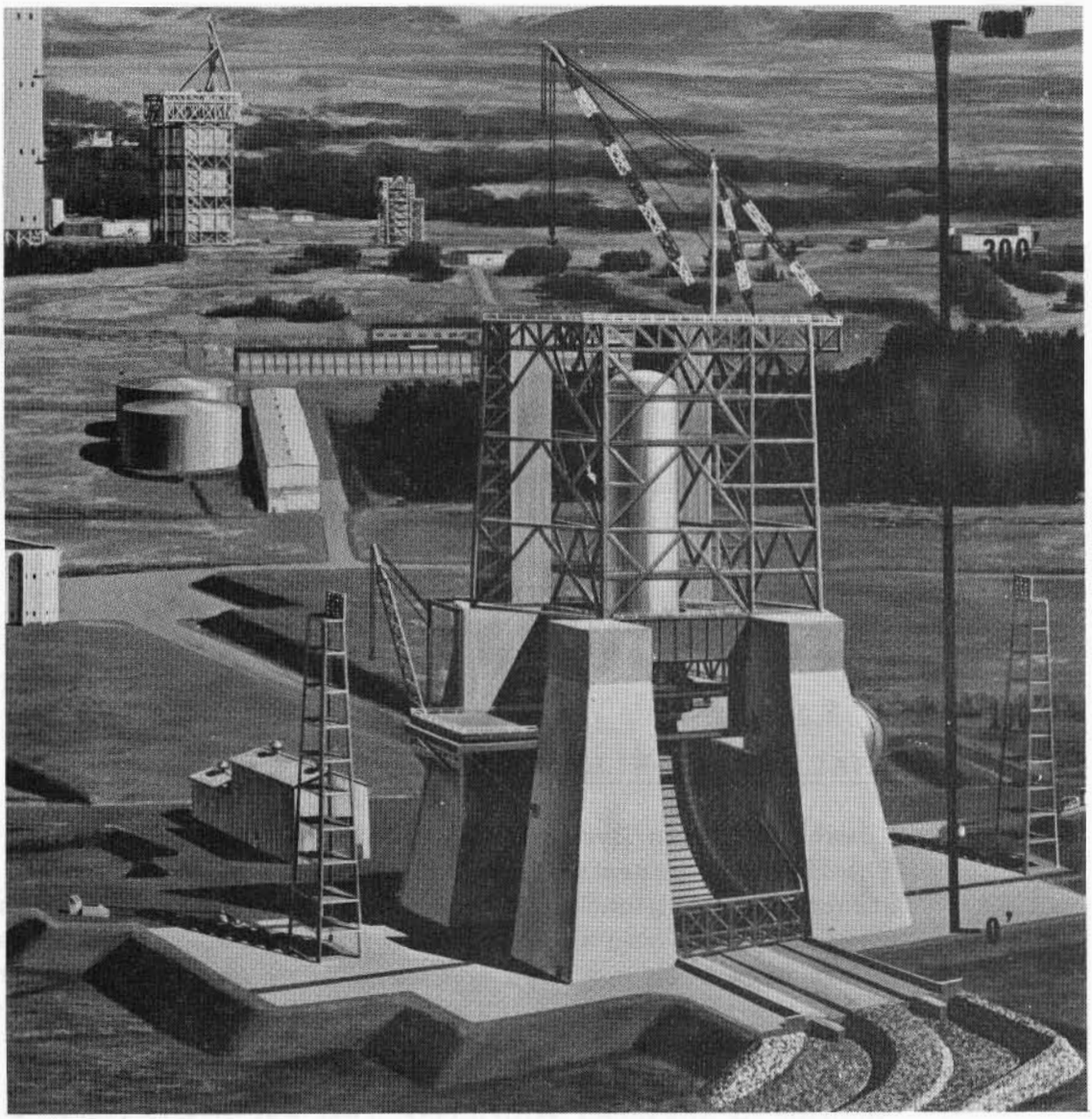


Figure 11 - S-II Forward Service Arm On The VAB Dock, KSC

SECTION III



SATURN V FACILITIES

SECTION III. FACILITIES

General

Major contracts awarded during this report period included:

a) Construction of Acoustic Horn Room for Project No. 6244 at MSFC awarded January 19 in the amount of $170,000.

b) Plant Utilities Monitoring System for Project No. 6314 at Michoud Assembly Facility, awarded February 14 in the amount of $358,000.

c) Modifications to Potable Water System and Plant Utility System for Project No. 6314 at Michoud Assembly Facility awarded March 23 in the amount of $887, 000.

d) Construction of Subassembly Facility for Project No. 9118 at Seal Beach awarded March 3 in the amount of $1, 664, 000.

e) Construction of Rotary Dynamic Test Facility for Project No. 9118 at Canoga Park awarded March 30 in the amount of $144, 000.

A. MARSHALL SPACE FLIGHT CENTER

1. Advanced Saturn Dynamic Test Stand -
The lightning arrester terminal relocation, final tower structural modifications, and monorail structural additions were inspected and accepted on February 23. The monorail hoists have been installed and were being checked out at the end of the report period. This work will complete the stand modifications and no further reports will be issued.

2. Addition to Advanced Saturn GSE Test Facility (FY-65) - Brick and Mortar
An inspection was held and beneficial occupancy of the High Pressure Test Facility was assumed on February 2. Beneficial occupancy of the Test Cells at the facility was given on March 1. Brick and mortar construction on the project was 93 percent complete at the end of the quarter.

Technical Systems

Installation and checkout of the Blockhouse portion of the facility was completed on March 1. The contractor is proceeding with installation of equipment at the High Pressure Pneumatic Test Position. The design through delivery phase is 98 percent complete and the installation and checkout are 95 percent complete.

3. Addition to Components Test Facility (FY-64) -
The contractor corrected construction deficiencies and completed shock testing of the LH_2 and lox piping. All Brick and Mortar portions of the facilities were accepted from the Corps of Engineers on March 16. All work by the Technical Systems contractor is complete.

4. Extension to Components Test Facility Instrumentation (FY-65) -
Technical Systems

Installation and checkout are 80 percent complete. The contractor is scheduled to be completed by May 23.

5. Acoustic Model Test Facility -
Technical Systems

The contractor completed all work on the installation and checkout phase on January 14. This work completed the facility.

6. Modernization of Instrumentation and Control Systems in the East Area -
Beneficial use of the blockhouse equipment was obtained on January 24. Use of the Advanced Dynamic portion was gained on February 23. The contract was essentially completed on March 14.

7. Saturn Support Test Area -
   a) Transportation Hanger and Addition to Building 5-4653 -

      Beneficial occupancy inspection of the interior of the building was held on February 17. By the end of the quarter the 25-ton Bridge Crane was installed and the building had been completed and occupied.

b) High Pressure Gas and Propellants -

The quality of the equipment being submitted on shop drawings has improved. Previously, disapproval of shop drawings had hindered construction. The new air compressor building framing, siding, and roof is complete. Construction is about 50 percent complete and is about 15 weeks behind schedule.

c) Helium Cryogenic Type Purifier - West Area -

A strike at the contractors facilities has moved the shipping date for this project to May 16.

B. MISSISSIPPI TEST FACILITY (MTF)

During this period, the following two contracts were completed on the dates indicated:

Contract No.	Description	Date Completed
2898	Administrative Area Sitework	January 1
2091	High-Pressure Water & Heating Fac.	February 8

1. S-II Test Stand A-2 - All high-pressure gas and propellant facilities are now operational with the completion of the cold shock of the liquid hydrogen system during this period. The support contractor has completed installation and checkout of remaining sitewide technical systems. The stage contractor has completed installation of ground support equipment and has system testing about 90 percent complete in preparation for the first static firing now planned for mid-April. Liquid nitrogen tanking was successfully completed on March 30.

2. S-II Test Stand A-1 - Construction of dock areas and installation of mooring equipment was essentially complete at the end of this quarter. Structural supports for the flame deflector were completed and eight manifolds placed. Superstructure steel erection started in late February was continuing to the tenth floor at the close of the quarter. The first six floors are ready for joint occupancy and technical systems installation is scheduled to start the first week of April.

The A-1 test stand and the remainder of the S-II Test Complex, including Technical Systems, are expected to be completed in early 1967.

3. S-IC Test Stand B-2 - In the center pier, joint occupancy of the seventh floor was effected on February 4 and beneficial occupancy of the first ten floors was received on March 18; the air conditioning system was accepted on March 25. Structural steel erection on the center pier was topped out with the completion of the nineteenth floor, and the steel roof decking was installed. Major structural work on the engine removal platform and load platform was accomplished. The west pier concrete was completed (Figure 12).

   In the Test Control Complex (TCC) the contractor has completed Mechanical Support Equipment (MSE) installation, and the calibration, checkout, and computer integration with MSE is currently in process (Figure 13).

   Completion of the B-2 position and related technical systems in the test stand and TCC is expected by the end of calendar year 1966.

4. S-IC Test Stand B-1 - The construction contractor for the B-1 position started work on this contract on March 9. Erection of flame deflector steel started on March 28. The B-1 position and the remainder of the S-IC Test Complex is scheduled for completion by mid-1967, if the GSE is approved and funded.

5. S-II Vehicle Service and Vertical Checkout Building - In the Vertical Service Building, joint occupancy of the first and second floors of the low bay area was received on January 17. Joint occupancy of the high bay area was effected on February 1. Installation of the five and ten ton cranes and the laying of pipe from the Vehicle Service Building to the high pressure gas vessels are the major current activities.

   In the Vertical Checkout Building, structural steel work and the installation of side panels, doors, and platforms have been completed. Installation of the elevator is in process, and piping insulation, electrical work, and painting are continuing. Brick and mortar construction is expected to be complete in June. Technical systems installation is scheduled to start upon completion of brick and mortar construction and to be finished in August.

Figure 12 - S-IC Test Stand, West Pier, MTF

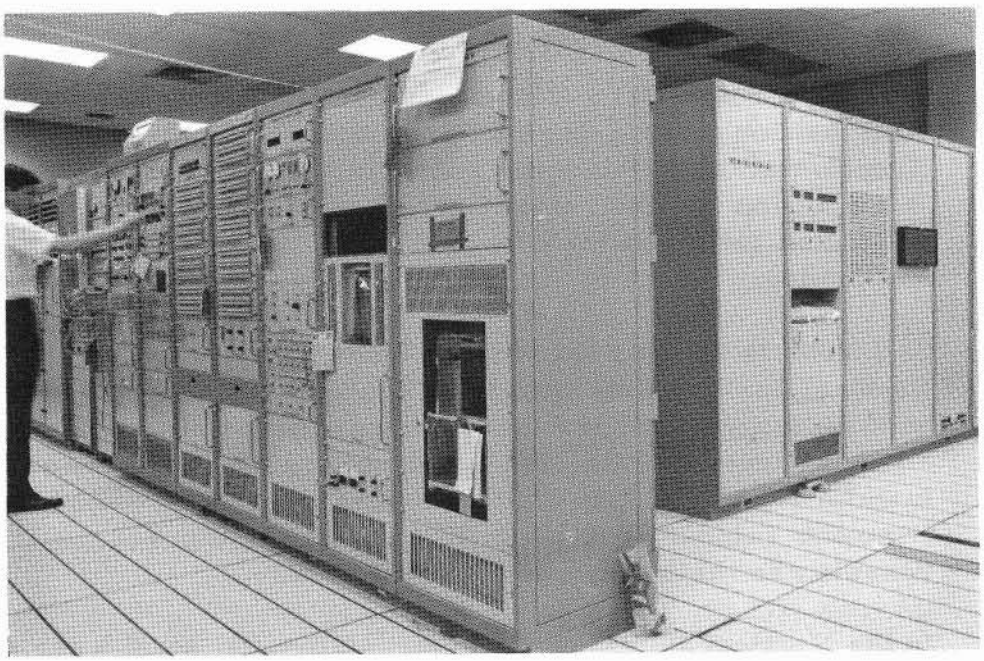


Figure 13 - Interior Test Control Complex, MTF

6. Components Service Facility - Installation of air conditioning ductwork was completed. The erection of room partitions is in process. High-pressure piping in the test cells is approximately 90 percent complete. Technical systems installation is scheduled to be started in May, and to be completed by October.

7. Mobile Equipment Maintenance Building - This facility is about 94 percent complete and is expected to be completed on schedule in May. No technical systems installation is involved.

C. MICHOUD ASSEMBLY FACILITY

Facilities activation at Michoud was essentially limited to shop and test items during this report period.

Approval was obtained from NASA to implement the Michoud manufacturing expansion plan. This is a manufacturing consolidation effort that will relocate to Michoud approximately 70 percent of the manufacturing task presently being performed in Wichita and Seattle.

1. Vertical Assembly Building - The installation of the motorized curtains in the final assembly position and the intercom system was completed.

   Modifications were made to the spray probe system in the hydrostatic test and cleaning facility to eliminate excessive sway of the probe. The modified system was successfully used during this report period.

D. CONTRACTOR FACILITIES

SEAL BEACH

1. Vertical Assembly and Hydrotest Building (Stations I-VI) - Modifications consisting chiefly of motorized hinged access floors, additional electrical power for welding, and curtains for temperature control were completed February 18 at Station III. Station IV modifications were essentially completed on January 7.

2. Vertical Checkout Building - Beneficial occupancy of the roof cranes was received from the Navy on February 7; however, NASA rescinded the order after a defective limit switch caused damage to the 50-ton derrick hook during proof-load tests. Repair of the switch and hook was accomplished and the derrick was proof-loaded successfully. Beneficial occupancy was again received on 23 February, and operator training was completed.

SACTO

1. Vertical Checkout Laboratory - Contractor efforts were essentially completed during the report period. Work on the boiler stack change order was completed. Crane malfunctions necessitated rework of the control system.

2. Beta Oxygen - Hydrogen Burner Modifications - The project has been approved and design is underway. Construction should begin late next quarter.

APPROVAL

SATURN V QUARTERLY PROGRESS REPORT

(January 1, 1966 - March 31, 1966)

The information in this report has been reviewed for security classification. Review of any information concerning the Department of Defense or Atomic Energy Commission programs has been made by MSFC Security Classification Officer. This report has been determined to be UNCLASSIFIED.

L. D. Kyle, Dep. Proj. Control

for: ARTHUR RUDOLPH
Manager, Saturn V Program

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