SATURN

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GEORGE C. MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALABAMA

SATURN MONTHLY PROGRESS REPORT
(December 16, 1963 - January 16, 1964)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

GEORGE C. MARSHALL SPACE FLIGHT CENTER

MPR-SAT-64-1

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SATURN MONTHLY PROGRESS REPORT

(December 16, 1963 - January 16, 1964)

ABSTRACT

The Saturn Monthly Progress Report describes progress from December 16, 1963 through January 16, 1964, in the Saturn I, IB, and V vehicle R&D programs. The asterisk (*) that appears throughout the report denotes continuation of an item cited in the last Monthly Report.

Saturn I Configuration: *As a result of studies on the SA-5 stress corrosion problem, Marshall directed that all critical tubing assemblies be replaced in subsequent S-I stages. *Critical tubing assemlies were replaced in the SA-5 booster, and the stage is now considered flight worthy. *S-IV-7 checkout is scheduled for completion late in January, with shipment to SACTO, for acceptance testing, planned for early February. *At Michoud, Chrysler continued checkout of S-I-8 and assembly of S-I-10. *DAC preparation of the S-IV All-Systems Stage for static firing progressed satisfactorily, with the first firing scheduled for January 21.

Saturn IB Configuration: *At SACTO, Douglas installed the S-IVB Battleship Stage in Beta Test Stand 1 on December 18, 1963. *DAC erected S-IVB hydrostatic test stage components into the assembly tower and completed welding of the LH_2 tank to the LOX tank.

Saturn V Configuration: *At MSFC, structural assembly of the S-IC test fuel tank half intertank was completed. *At MSFC, the lower fuel bulkhead-to-LOX tunnel extension weld and upper fuel bulkhead polar cap weld, were rejected, and the components removed; MSFC has initiated test welding programs to resolve the welding problems. At Seal Beach, S&ID completed meridian welding of the S-II Structural Test Stage aft common bulkhead. *On December 17, MSFC conducted, for a scheduled 36-second mainstage duration, the fifth test with F-1 Engine F-1001. *At MSFC, F-1 Engine Test Stand superstructure erection continued satisfactorily, with about 95 per cent of the steel in place. Early in January, MSFC requested S&ID to furnish engineering requirements for construction of a new two-bay vertical checkout building at S&ID's Seal Beach S-II Stage Assembly Facility.

author

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by

INDUSTRIAL OPERATIONS

GEORGE C. MARSHALL SPACE FLIGHT CENTER

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SECTION I. SUMMARY

*As a result of studies on the SA-5 stress corrosion problem, Marshall directed that all critical tubing assemblies be replaced in subsequent S-I stages. (Page 3, Para. A.1.)

*During the report period, critical tubing assemblies were replaced in the SA-5 booster, and the stage is now considered flight worthy. (Page 3, Para. B.1.a.)

*At SACTO, Douglas is installing MOOG actuators in S-IV-6. The stage is scheduled to arrive at AMR on February 26, 1964. (Page 3, Para. B.2.b.)

*S-IV-7 checkout is scheduled for completion early in February with shipment to SACTO, for acceptance testing, planned for early February. (Page 4, Para. B.3.6.)

*S-I-9 static test operations are scheduled to start at MSFC during mid-February. (Page 4, Para. B.4.a.)

*At Michoud, Chrysler continued checkout of S-I-8 and assembly of S-I-10. (Pages 4 & 5, Paras. B.5. and 6.)

*DAC preparation of the S-IV All-Systems Stage for static firing progressed satisfactorily, with the first firing scheduled for January 21. (Page 5, Para. C.1.)

*At SACTO, Douglas installed the S-IVB Battleship Stage in Beta Test Stand 1 on December 18, 1963. (Page 6, Para. A.3.)

*At Huntington Beach, DAC erected S-IVB hydrostatic test stage components into the assembly tower and completed welding of the LH_2 tank to the LOX tank. (Page 6, Para. B.4.)

*At MSFC, structural assembly of the S-IC test fuel tank half intertank was completed. The recently installed LOX tunnel was removed because of a poor weld, and a new tunnel successfully welded into the tank. (Page 7, Para. B.1.)

*At MSFC, the lower fuel bulkhead-to-LOX tunnel extension weld and upper fuel bulkhead polar-cap weld were rejected and the components removed; MSFC has initiated test welding programs to resolve the welding problems. (Page 7, Para. B.2.)

At Seal Beach, S&ID completed meridian welding of the S-II Structural Test Stage aft common bulkhead. (Page 8, Para. C.2.)

*Reduction of test data from the first phase of the S-II Stage one-quarter test tank stratification test program indicates that gas bubbling may be a successful means of preventing thermal stratification. (Page 8, Para. C.4.)

*The first S-II Battleship firing is now scheduled for November 1964 instead of June 1964, as originally planned. The change is due to Battleship Test Facility activation delays. (Pages 8 & 9, Para. B.7.)

*On December 17, MSFC conducted, for a scheduled 36-second mainstage duration, the fifth test with F-1 Engine F-1001. All test parameters appear to be within the expected range. (Page 9, Para. D.1.)

During the report period, Rocketdyne continued J-2 Engine static firing tests. The damaged thrust chamber side-load restrainers on Stand VTS-2 were replaced and six engine systems tests conducted for a total of 143 seconds. (Page 9, Para. D.2.)

During December, MSFC and Budd Electronics Company completed negotiations for the Instrument Unit/S-IVB ground cooling unit contract. (Page 10, Para. E.3.)

Completion date for the MSFC-constructed S-IC transporter is now scheduled for February 1 because of late electrical components deliveries from the contractor. (Page 10, Para. F.)

*At MSFC, F-1 Engine Test Stand superstructure erection continued satisfactorily, with about 95 per cent of the steel in place. (Page 11, Para. A.2.)

Early in January, MSFC requested S&ID to furnish engineering requirements for construction of a new two-bay vertical checkout building at S&ID's Seal Beach S-II Stage Assembly Facility. (Page 12, Para. C.2.)

At the Huntington Beach S-IVB Assembly Facility, Douglas completed certification of the assembly tower welding equipment. (Page 12, Para. C.4.)

SECTION II. SATURN I CONFIGURATION

A. VEHICLE GENERAL

*1. MSFC, during the report period, conducted detailed studies to determine the causes of the stress corrosion problem that created cracked sleeves in the high pressure lines of the SA-5 booster. As a result, critical tubing assemblies, on all Saturn I boosters, have either been replaced or are scheduled for replacement using properly heat treated material.

B. FLIGHT VEHICLE STATUS

1. SA-5 Vehicle

*a. At AMR, during the report period, S-I-5 critical tubing assemblies were replaced, and the stage is now considered flight worthy. Prelaunch activities are now proceeding satisfactorily toward a January 22 simulated flight test and the rescheduled launch date.

*b. DAC has further confirmed the reliability of the S-IV stage cold helium sphere mounting design. During SA-5 launch delay, DAC conducted extensive vibration testing in this area. The random test program was successfully completed January 16, and after visual observation, MSFC approved the present S-IV-5 installation. The additional testing will continue to further confirm mounting reliability for subsequent S-IV stages.

2. SA-6 Vehicle

*a. At MSFC, preparation for shipment of S-I-6 was interrupted to replace critical tubing assemblies. Following mechanical and electrical checkout, the booster will be shipped to AMR by barge. The stage is scheduled to arrive at the Cape on February 19, 1964, which is compatible with the availability of S-IV-6.

*b. Because of the additional time available for S-IV-6 work, as a result of the SA-5 launch delay, MSFC directed DAC to incorporate MOOG actuators into S-IV-6 at SACTO. Following this modification, the stage will be shipped to AMR via the Pregnant Guppy with a scheduled arrival date of February 26.

*c. S-IU-6 remained in checkout at MSFC during the report period due to the delay in SA-5 launch. Shipment to AMR with the booster is scheduled for February.

3. SA-7 Vehicle

*a. Post-static checkout of S-I-7 was stopped at MSFC to allow replacement of critical tubing assemblies; however, complete replacement is not scheduled until January 27, allowing S-I-9 work to continue on schedule toward the earliest possible static test date. This action will not delay S-I-7 launch activities.

*b. At Santa Monica, S-IV-7 checkout continued throughout the report period. The stage is scheduled to be removed from the vertical checkout tower on January 24 and arrive at SACTO, for acceptance testing, early in February.

*. At MSFC, S-IU-7 remained scheduled to begin final checkout February 10.

4. SA-9 Vehicle

*a. At MSFC, S-I-9 pre-static checkout was interrupted during the report period to replace critical tubing assemblies. Replacement is scheduled for completion on January 23, when pre-static checkout will continue. Static test operations should start February 17.

*b. At Santa Monica, the S-IV-9 stage is still in assembly. Completion of assembly and beginning of checkout is expected in February.

*c. During the report period, S-IU-9 structural fabrication was completed at MSFC. The structure will be stored until March 2, when assembly is scheduled to begin.

5. SA-8 Vehicle

*a. During the report period at Michoud, S-I-8 checkout was also interrupted to replace critical tubing assemblies. Following checkout, scheduled for completion in March, the booster will be shipped to MSFC for static testing.

*b. At Santa Monica, S-IV-8 assembly continued. The stage was installed into the hydrostatic tower early in the report period and, after successful leak checks, was removed. Structures modification is presently underway with completion of assembly scheduled for April.

*c. Structural fabrication of S-IU-8 is still in process at MSFC. Upon completion of fabrication, now scheduled for February, the unit will be stored until June when assembly is scheduled to begin.

6. SA-10 Vehicle

*a. CCSD continued S-I-10 assembly at Michoud throughout the report period. The fabrication of critical tubing assemblies for the stage is in process. Completion of assembly and start of checkout is expected in March.

*b. At Santa Monica, DAC continued to install S-IV-10 insulation throughout the report period. The stage is scheduled to be removed from the insulation installation room and be installed in the hydrostatic tower for leak checks in late January.

*c. Structural fabrication of S-IU-10 began at MSFC during the report period. After completion of fabrication, the structure will be stored until the scheduled start of assembly in September.

*d. A payload for SA-10 is still under study at MSFC.

C. TEST VEHICLE STATUS

*1. S-IV All Systems Vehicle

At SACTO, DAC preparation for the S-IV All Systems Vehicle first static firing progressed satisfactorily throughout the report period. The firing is scheduled for January 21.

SECTION III. SATURN IB CONFIGURATION

A. S-IB STAGE

1. S-IB-1

CCSD fabrication of components for the first Saturn IB booster, S-IB-1, other than those already available from S-I-111, is scheduled to begin at Michoud in March.

B. S-IVB/IB STAGE

1. S-IVB/IB-1

At Santa Monica, fabrication of the first Saturn IB second stage, S-IVB/IB-1, was started during the report period.

2. S-IVB Quarterly Review

The S-IVB Quarterly Review was satisfactorily held at MSFC December 18 and 19.

3. Battleship Test Stage

At SACTO, during the report period, S-IVB Battleship pre-installation operations were completed, and the stage was installed in the test stand December 18. Water calibration of the battleship tank was completed later in the report period.

*4. Hydrostatic Test Stage

At Huntington Beach, during the report period, hydrostatic test stage components were erected in the assembly tower, and welding of the LH_2 tank to the LOX tank was completed. Later, the stage was removed from the assembly tower in order to prepare for receiving and installing the forward dome. However, due to a questionable weld repair area in the hydrostatic forward dome, there is a possibility that the dynamics test stage forward dome may be substituted for the former.

*5. Dynamics Test Stage

Major component status for the dynamic test stage at the end of the report period was as follows:

a. LH_2 cylinder awaiting installation into the trim and weld fixture at Santa Monica.

b. LOX tank assembly received at Huntington Beach.

c. Forward dome approximately two weeks from completion.

*6. All Systems Test Stage

During the report period, work progressed satisfactorily on the all systems test stage at Santa Monica. Fitting and bonding of the common bulkhead is now 50 per cent complete, and miscellaneous fitting work is in progress on the aft dome.

SECTION IV. SATURN V CONFIGURATION

A. GENERAL

Following NASA Headquarters' approval of MSFC's new Saturn V delivery and launch schedule, all Saturn V contractors were directed to execute the new schedule. This schedule extends the launch date of all Saturn V vehicles and allows for the new all-up concept. This concept, recently directed by the Manned Space Flight Office, requires that all of the Saturn V launches be programmed to include all live stages.

B. S-IC STAGE

*1. At MSFC during the report period, structural assembly of the S-IC test fuel tank half intertank was completed. The intertank will be mated with the test fuel tank following tank cleaning, which is presently underway. The LOX tunnel was trimmed and welded into the test tank, but was removed because of a poor weld. After completion of welding tests, a new LOX tunnel was successfully welded into the tank.

*2. During the report period, MSFC also encountered welding problems in assembly of the S-IC-T Static Test Stage. The lower fuel bulkhead-to-LOX tunnel extension weld and the upper fuel bulkhead polar cap weld were rejected and the components removed; MSFC has initiated test welding programs to resolve the welding problems. To avoid further delay while weld tests proceeded, the upper fuel bulkhead-to-Y-ring and other welds were begun ahead of schedule. In other S-IC-T areas, the responsible sub-contractor encountered delays in fabricating seamless LOX tunnel. As a result, MSFC instructed Boeing to fabricate weld-type LOX tunnels as a backup. During the same time period, welding of the lower fuel tank cylindrical skin assembly was completed. All skin sections are available for the upper fuel tank cylindrical skin assembly, but will not be joined until the weld test program is completed. The first two S-IC-T LOX tank fitting-to-gore segment welds were also rejected; additional assembly attempts are being postponed until the weld problem is resolved. During the same time period, MSFC continued machining operations on the S-IC-T thrust structure. The first two thrust posts, delivered to MSFC in early January, are presently being installed in the thrust structure assembly fixture. Completion of the thrust structure is scheduled for June 1964.

3. At Michoud during the report period, the S-IC forward handling tool failed during a proof load test. Following repair, the tests will be completed and the tool delivered to MSFC; delivery has been delayed from January 15 to January 25.

4. During the report period, MSFC continued assembly of the S-IC mockups. Installation of the control pressure system in the forward and intertank mockup is 95 per cent complete. The basic heat shield support structure was assembled and installed in the tail section mockup. An interference problem was found in the S-IC Forward Area Mockup involving installation of the LOX pressure system and a discrepancy in the propellant direct support system; the design errors have been resolved.

C. S-II STAGE

1. During the report period at Downey, S&ID continued S-II stage stress investigations. Preliminary reduction of data obtained on S-II common bulkhead and cylindrical shell thermal stresses induced during propellant loading operations indicate that the propellant tank may have to be pre-conditioned prior to propellant loading. Definition of applied stress distribution in critical areas is essentially completed; the remaining major effort is determination of allowable stresses in the cylindrical shell.

2. At Seal Beach, S&ID has completed meridian welding of the S-II structural test stage aft common bulkhead. The bulkhead is now being prepared for dollar section welding, which is scheduled for next report period.

3. During December, S&ID continued studies to determine optimum fabrication techniques for the strip seal common bulkhead manufacturing concept, which is being developed as backup to the present bulkhead manufacturing method. Recently completed studies indicate that stretch forming may be the most desirable technique for fabricating bulkhead upper gore sections. The S-IVB stage contractor is forming similar parts by this method with excellent results.

*4. By the end of December, Beech Aircraft successfully completed the first phase of the one-quarter test tank liquid hydrogen thermal stratification test program. Test data reduction indicates that gas bubbling may be a successful means of preventing thermal stratification. On December 31, the second, and last, test tank for this program was delivered to S&ID. Insulation for this tank has been delivered to S&ID and will be installed during the next report period.

5. During the report period, S&ID performed the first burst cylinder test to determine weld allowables on the metal proposed for the S-II LH_2 tank. The test tank, with one longitudinal weld, was pressure tested at -423 degrees F and failed at about 85 per cent of the programmed load. Additional tests will be performed.

*6. During mid-January, Rocketdyne delivered to Downey the last J-2 Block III Engine for S&ID's S-II Stage Electromechanical Mockup. During the next report period, the contractor will replace the remaining J-2 soft mock-up engines in the Electromechanical Mock-up with the Block III engines.

7. During early January, the S-II Battleship firing schedule was altered; the first firing is now scheduled for November 1964

instead of June 1964, as originally planned. The schedule change, which will not affect the new Saturn V delivery and launch schedule, is due to delays in activation of the Battleship Test Facility at Santa Susana.

8. At S&ID in late December, MSFC reviewed the S-II Battleship stage electrical firing equipment design. The evaluation of the review data indicates that the design is adequate, and Marshall approval is expected to be issued during the next report period.

9. During the report period, MSFC completed assembly of the S-II Forward Area Mockup. Assembly of the S-II Interstage Mockup was also completed and temporarily installed on the S-IC Forward Area Mockup.

D. ENGINES

1. F-1 Engine

*a. On December 17, in Static Test Tower West, MSFC conducted, for a scheduled 36-second mainstage duration, the fifth Marshall-conducted F-1 (F-1001) engine test. Preliminary data review indicated all parameters were within the expected range. Investigation revealed engine damage consisted of one external thrust chamber tube leak in the exhausterator and seven cracks in the exhausterator.

*b. During this report period at Edwards AFB, Rocketdyne conducted eight successful F-1 engine system tests, including two tests on deliverable engine F-1002. Engine F-1002 operated for 150 seconds at 1,421K thrust and for two seconds of a scheduled 40 seconds at 1,511 thrust; the test was terminated by high fuel pump outlet pressure. Two tests with Engine 011-1, both scheduled for 150 seconds, were terminated at 70 and 12 seconds; the former because of high turbine bearing temperature, and the latter by a fire in the turbine area caused by a cracked turbine inlet manifold. Of four tests with Engine 013, two were scheduled for 150 seconds but were terminated after 5 and 6 seconds because of instrumentation line failures and low LOX pump inlet pressure, respectively. Two tests for 145 and 147 seconds successfully demonstrated fail-safe characteristics of the gas generator ball valve.

2. J-2 Engine

*During the report period, Rocketdyne continued J-2 engine static firing tests at the Santa Susana Test Area. By early January, the damaged thrust chamber side-load restrainers on Test Stand VTS-2 had been replaced and six engine system tests conducted for a total of 143 seconds. The objectives of the tests, which were generally

successful, included engine calibration, facility checkout, and determination of start characteristics at simulated vehicle inlet conditions. The engine is presently being replaced because a faulty fuel turbopump which caused early termination of the last test. Additional static firings performed in other test stands totaled over 1221 seconds including a long-duration test of 503 seconds. Objectives in these tests included engine checkout and calibration, facility checkout, and evaluation of flight instrumentation.

E. INSTRUMENT UNIT

1. During the report period, MSFC continued preliminary work for Saturn V Instrument Unit development. During the week of December 16, Marshall and IBM completed negotiation of the Electronic System Integration and Checkout contract. Formal award of the contract is expected during the next report period. On January 16, 1964, NASA Headquarters approved the revised ST-124-M Stabilized Platform Systems Procurement Plan. Early in the report period, Marshall received the cost and technical proposals for the prototype production phase of the IBM Guidance Computers and Data Adapters. These proposals are presently being reviewed.

2. During December, MSFC completed dynamic tests for comparing Instrument Unit cold plate mounting concepts. Analysis of test data indicates that the honeycomb core backup mounting transmits less vibration to the instrument unit structure than the standoff mounting brackets.

3. During December, MSFC and the Budd Electronic Company completed negotations for the Instrument Unit/S-IVB ground cooling unit contract. On December 9 and 10, MSFC and the contractor held a Phase I Design Review at Marshall. Design changes and comments emanating from the review will be forwarded to the contractor during the next report period.

F. GROUND SUPPORT EQUIPMENT

At MSFC, assembly of the first S-IC transporter continued, but completion is now scheduled for February 1 because of late electrical component deliveries from the contractor. The late deliveries were caused by defective parts received from the subcontractor. These components are expected to be available for shipment to MSFC in late January.

SECTION V. FACILITIES

A. MARSHALL SPACE FLIGHT CENTER

*1. MSFC continued construction progress on the S-IC Static Test Stand. Installation of East tower siding, and erection of the 200-ton derrick was completed; installation of cables for the hoisting machinery on the 150 and 200-ton derricks has begun. External stairway and other steel work installation is underway. Installation of the utilities, firex system, and load platform welding is continuing. All deflector steel is positioned and welding is underway. The facility is scheduled for completion in May 1964.

*2. At MSFC, F-1 Engine Test Stand superstructure erection continued with about 95 per cent of the steel in place. The 100-ton derrick was installed. Deflector manifold piping, firex water lines, and utilities installation is well underway. All siding is placed on the preparation building. Facility completion is scheduled for May 1964.

*3. During the report period, MSFC completed blockhouse excavation for the Saturn V Ground Support Equipment Test Facility. Test area and roadway grading, virtually halted because of adverse weather conditions, has resumed.

*4. Construction of the Saturn V Dynamic Test Stand at MSFC progressed with tower steel erected to the 168-foot level; the stairway is completed to the 144-foot level. Concrete work for tunnel A is completed. Estimated facility completion is August 1964.

*5. The construction of the J-2/S-IVB Liquid Hydrogen Test Facility at MSFC is proceeding on schedule. Excavation is complete for the tunnel between the LH_2 terminal building basement and the existing Power Plant Test Stand; forms and reinforcing steel have been installed for a 20-foot section of the tunnel. Concrete pouring was completed for the terminal building basement walls. Steel tower foundation excavation is complete. The test stand and terminal building is scheduled for completion in August 1964 with the remainder of work scheduled for completion September 1964.

B. MISSISSIPPI TEST OPERATIONS

1. At MTO, the Mobile District Corps of Engineers awarded a contract for the construction of a navigation lock and lock water supply on December 10, and a contract for High Pressure Industrial Water Pumps on January 9, 1964.

C. CONTRACTOR FACILITIES

*1. Facility construction at S&ID's Seal Beach S-II Stage Assembly Complex continued satisfactorily throughout the report period. Vertical Assembly Building construction is about 75 per cent complete and on schedule. On January 2 and 3, S&ID began installing S-II assembly tooling equipment in Vertical Assembly Building Stations I and VI respectively. Pneumatic Paint Packaging Building construction is about 35 per cent complete and on schedule.

2. Early in January, MSFC requested S&ID to furnish engineering requirements for construction of a new two-bay vertical checkout building at S&ID's Seal Beach S-II Stage Assembly Facility. Additional Navy property will be required for the building, which will be necessary for S&ID to checkout six stages per year; this rate presently appears impossible with existing facilities.

3. Bids for Seal Beach dock modifications had been received by the Navy at the end of the report period. The contract is scheduled for award during the next report period, and the modifications are expected to be completed by May 1964.

4. At the Huntington Beach S-IVB Assembly Facility, Douglas completed certification of the assembly tower welding equipment. Installation of the assembly tower overhead crane is scheduled to start January 27, with completion, including checkout, scheduled for February 10. Until crane installation is completed, S-IVB assemblies will be installed and removed from the tower by a mobile boom crane.

MPR-SAT-64-1
February 5, 1964

APPROVAL

SATURN MONTHLY PROGRESS REPORT

(December 16, 1963 - January 16, 1964)

by INDUSTRIAL OPERATIONS

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

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