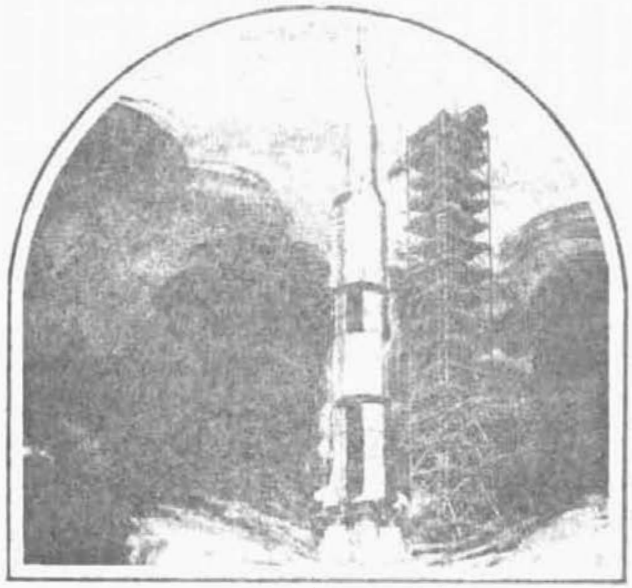

ANNUAL PROGRESS REPORT SATURN S-IC

JULY 30, 1965

FISCAL YEAR 1965

SATURN D5-12601-2

LAUNCH SYSTEMS BRANCH/AERO-SPACE DIVISION/THE BOEING COMPANY

DESIGN ENGINEERING AND RELIABILITY

1

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CONTENTS

ILLUSTRATIONS

FOREWORD

This Annual Progress Report has been prepared by The Boeing Company to fulfill the requirement under Article XXX, Paragraph A and C, Modification 100 of Contract NAS8-5608 as amended by NASA letter I-MICH-CB, dated May 19, 1965, B. H. Aldridge to E. S. Olason. Subject: Change of NAS8-5608 to incorporate Quarterly Technical Progress into the Annual Progress Report.

This document reports progress made by The Boeing Company on the Saturn S-IC program for the fiscal year 1965 (July 3, 1964 through July 1, 1965) pertaining to Schedule I Contract NAS8-5608. This report is the consolidation of D5-11994, "Quarterly Technical Progress Report," for the fourth fiscal quarter and the FY 1965 Annual Progress Report, and places special emphasis on activities of the fourth fiscal quarter.

Progress has been reported by contract part in accordance with NASA/MSFC instructions. In cases where activity progress encompassed more than one contract part, it was reported under the contract part considered to have the major role.

The report is arranged by the contract numerical designation and includes the following subjects:

Stage and GSE design and logistics support.
Reliability.
Facilities activation at Michoud and Huntsville.
Assembly and manufacturing effort.
Quality Assurance Program development and implementation.
Developmental, qualification and reliability testing—planning and status.
Ground test and static firing participation.
Technical assistance rendered by The Boeing Company.
Launch operations support and liaison effort.
Manufacturing support rendered to NASA/MSFC.
Discussion of program administrative effort necessary in the performance of contract.
S-IC systems mission support, with emphasis upon the conduct of the structural test program.

THE **BOEING** COMPANY

LAUNCH SYSTEMS BRANCH, AERO-SPACE DIVISION P. O. BOX 29100, NEW ORLEANS, LA. 70129

July 30, 1965

National Aeronautics and Space Administration
George C. Marshall Space Flight Center

IN REPLY REFER TO

Progress in the Saturn V/S-IC Program during fiscal year 1965 was highlighted by the transition from initial implementation for hardware production to actual fabrication of full scale S-IC boosters. The most impressive advancement was the completion of the S-IC-T booster for engine firing tests.

The first single-engine firing occurred April 9, 1965, in the S-IC booster test stand at MSFC. The first five-engine test firing took place one week later, on April 16, 1965. This firing was nearly two months ahead of the target set in Plan VIII, the current S-IC schedule. The success of these and subsequent manual firings was made possible by the concerted and cooperative efforts of all S-IC Program participants. Plans for automatic test firings have been advanced from December to September, 1965, as a result of these successes.

The S-IC-D dynamic test stage was the first booster to be structurally assembled in the Vertical Assembly Building at Michoud. Its completion marked the passing of an important milestone at the Michoud Assembly Facility. Currently, the S-IC-D is undergoing final installation of equipment in the factory before being barged to MSFC for dynamic testing. The ease with which the booster was removed from the Vertical Assembly Tower, placed horizontally on the transporter, and moved to the factory is a result of the personnel training and equipment checkout performed with the S-IC Stage Weight Simulator.

Booster and GSE basic designs are complete. On schedule release of engineering drawings and documentation reflects a recovery from a behind schedule condition at the start of the year. This was made possible by improvements in the document release system, and enlargement of reproduction facilities.

The early delivery to the MSFC Quality and Reliability Assurance Laboratory of an S-IC Test and Checkout Station on June 21, 1965, assures timely support to the S-IC-1 booster, which is scheduled for start of checkout on September 27, 1965. Completion of the Qualification Program has been advanced from July, 1966 to December, 1965, and the Reliability Test Program is now planned for completion in consonance with static firing tests of S-IC-3 at MSFC in September, 1966.

Throughout the fiscal year, actions have been taken to implement NPC 500-1, "Apollo Configuration Management Manual." The Configuration Control Board was activated in March, 1965, and is chaired by the S-IC Program Executive. A Configuration Management Information Center has been established for management visibility of change status, program impact, and trends.

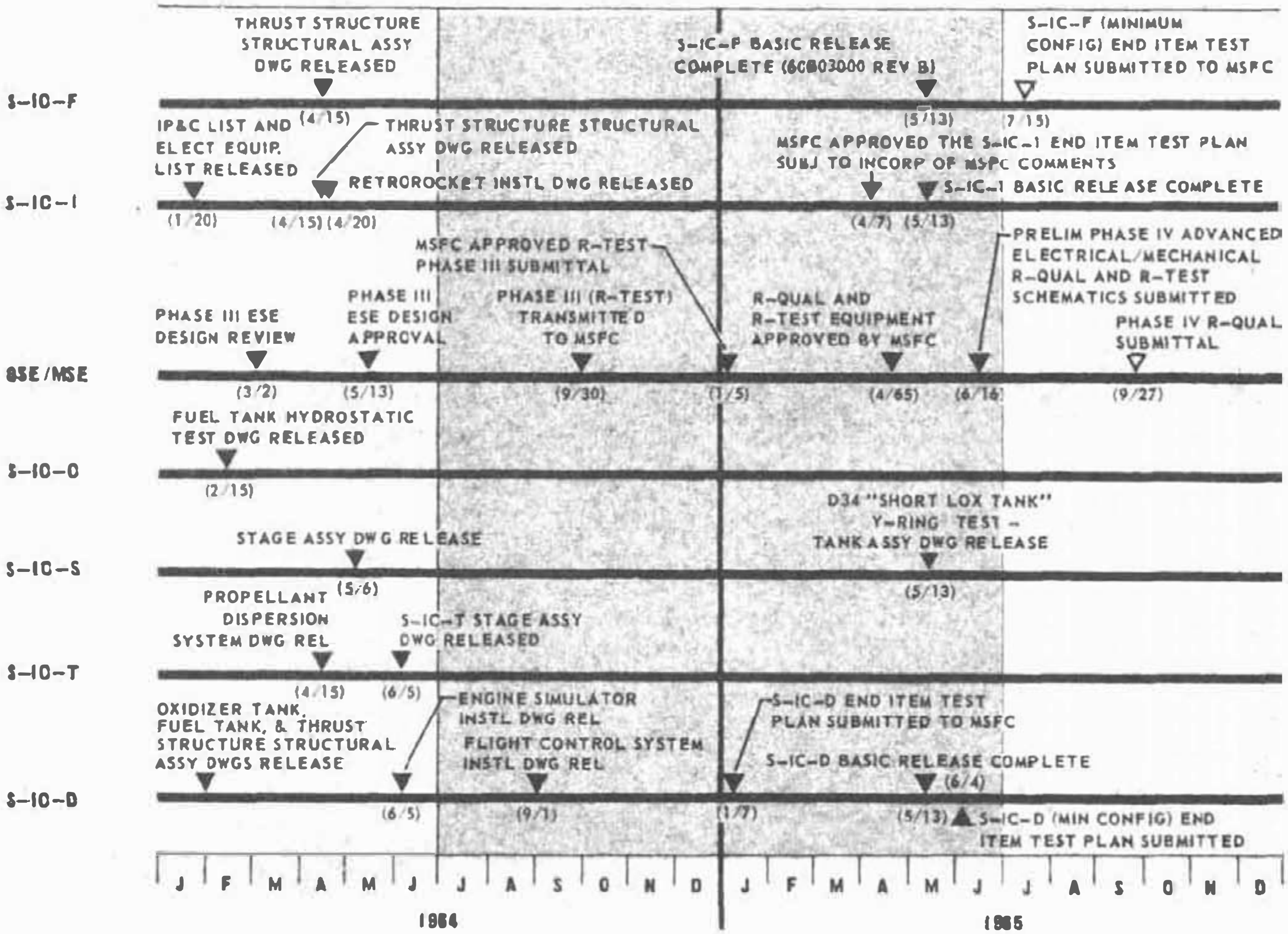
The outlook toward the next fiscal year looks promising even though established goals are obviously ambitious. Judging by past successes, it is fully expected that these goals will be achieved.

THE BOEING COMPANY
Aero-Space Division

R. C. Dunigan
S-IC Program Executive
Launch Systems Branch

DESIGN & ENGINEERING MILESTONES

(PLAN VIII)



STAGE DESIGN

DOCUMENTATION

The release of basic documentation accelerated during the last half of FY 1965 and overcame the behind schedule condition that existed at mid-year. The completion of the last electrical and instrumentation drawings, completed the basic design releases for the S-IC-D, -F, and -1 through -10 in the fourth quarter (Figure I-1). The basic release of structures and propulsion-mechanical documentation was virtually completed by year-end FY 1964 and almost all of the FY 1965 releases were electrical and instrumentation. Over 80 percent of the total electrical and instrumentation documentation for all vehicles other than the S-IC-T was released during the past year, following establishment of instrumentation requirements during the third quarter of FY 1964. There have been continuing changes in instrumentation requirements; however, such changes are being handled by change action memo rather than basic documentation. The basic release history by major program element for the first flight stage (S-IC-1) is shown in Figure I-2.

Release of Change Action Memo (CAM) documentation continued in the fourth quarter at about the same rate as in the third quarter (Figure I-3). Documentation release was completed on the 35 CAM's listed in Figure I-5. Thirty-three new CAM's were initiated (approved by Engineering management for presentation to the S-IC Change Board) during the fourth fis-

ENGINEERING BASIC RELEASE SCHEDULE-STAGE

ALL EFFECTIVITIES

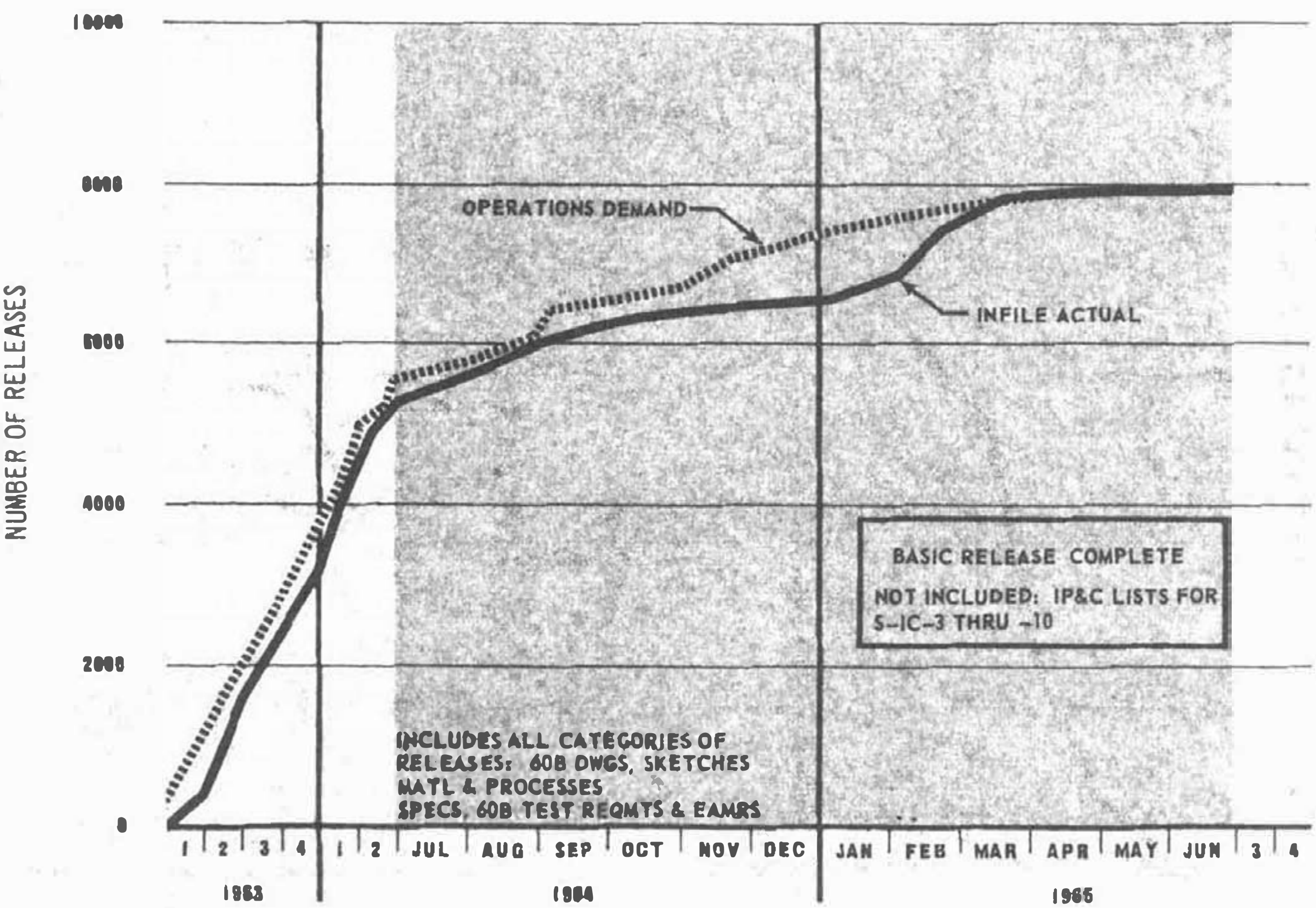


FIGURE I-1

cal quarter. All changes either initiated or committed during the quarter, with their commitment data, documentation completion schedule, and vehicle effectivity, are listed in Figure I-4.

A series of joint MSFC/Boeing meetings was held during the year to survey outstanding CAM's against S-IC-T, S-IC-1 and S-IC-2 as each vehicle neared a critical phase of completion. Each change was reviewed by management teams to evaluate real need—based on test mission—and to develop minimum impact schedules. The detail procedures for processing and committing changes were streamlined during the year to further minimize the impact on critical test missions. At present, some urgent changes (particularly stage/F-1 engine interface changes) are being incorporated as liaison field installations, with Class I as-built CAM documentation scheduled for release later.

Implementation of the automated Engineering Release Documentation System, defined by D5-11979, "Required Engineering Release Documentation," was begun in June, 1964. In mid-October, as implementation of the basic system neared completion, several major problems were discovered. These resulted from inadequate computer inputs, deficient programming, unsatisfactory computer tapes, and faulty data transmission. Resolution of these problems was accomplished, and system implementation was completed in early January, 1965. At that time, there was a substantial backlog of requests for the computer-produced drawing-generation-breakdowns. These are some of the important outputs of the system. By pro-

S-IC-1 BASIC RELEASE

BY MAJOR PROGRAM ELEMENT

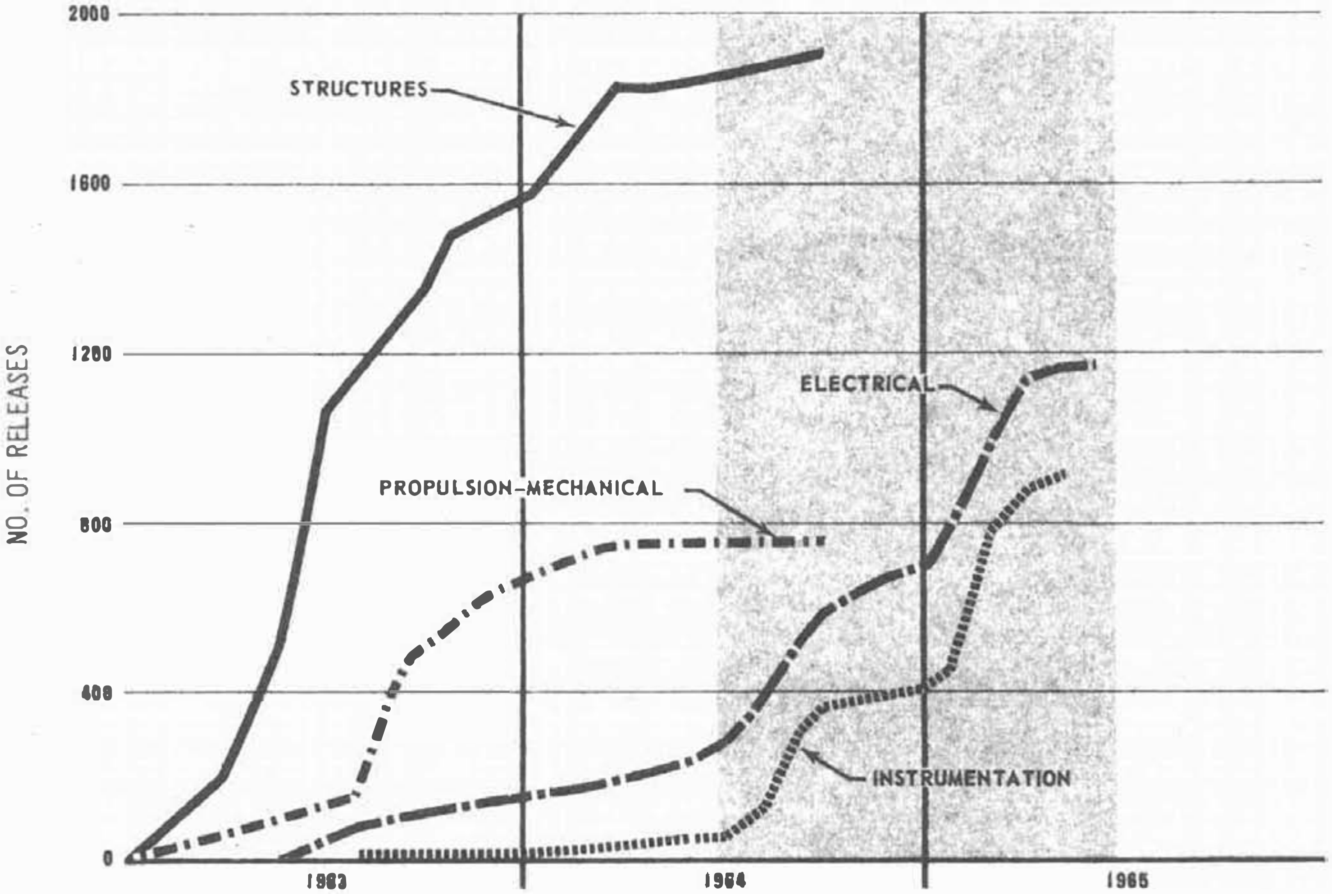


FIGURE I-2

gramming to provide only needed parts, rather than complete breakdowns, the backlog was eliminated.

Several additional program developments and system improvements were made to provide vehicle comparison reports, improved parts-to-specification cross-reference lists, and addition of qualification status information in the Engineering Master Parts List to supplement D5-12741, "Qualification Status List." System studies and programming are presently underway to cover submittal of S-IC data to the Saturn V Data Bank Center in Huntsville. Work has also started on converting existing computer programs from ARGUS to COBOL programming language, as directed by NASA/MSFC.

DESCRIPTION OF S-IC STAGE CAM'S INITIATED AND/OR COMMITTED DURING FOURTH FISCAL QUARTER

CAM 307—Requested by MSFC Technical Directive 246 and Modification 179 to Contract NAS8-5608. This change revises the S-IC stage electrical system to provide an emergency detection and flight combustion monitor system to detect stage malfunctions.

CAM 328—Requested by The Boeing Company to correct technical deficiencies in telemetry transmitters and power amplifiers.

CAM 337—Requested by Modification 239 to Contract NAS8-5608. This change requires redesign of the S-IC stage TV antennas and the antenna checkout hat.

CAM ENGINEERING RELEASE SCHEDULE - STAGE

ALL EFFECTIVITIES

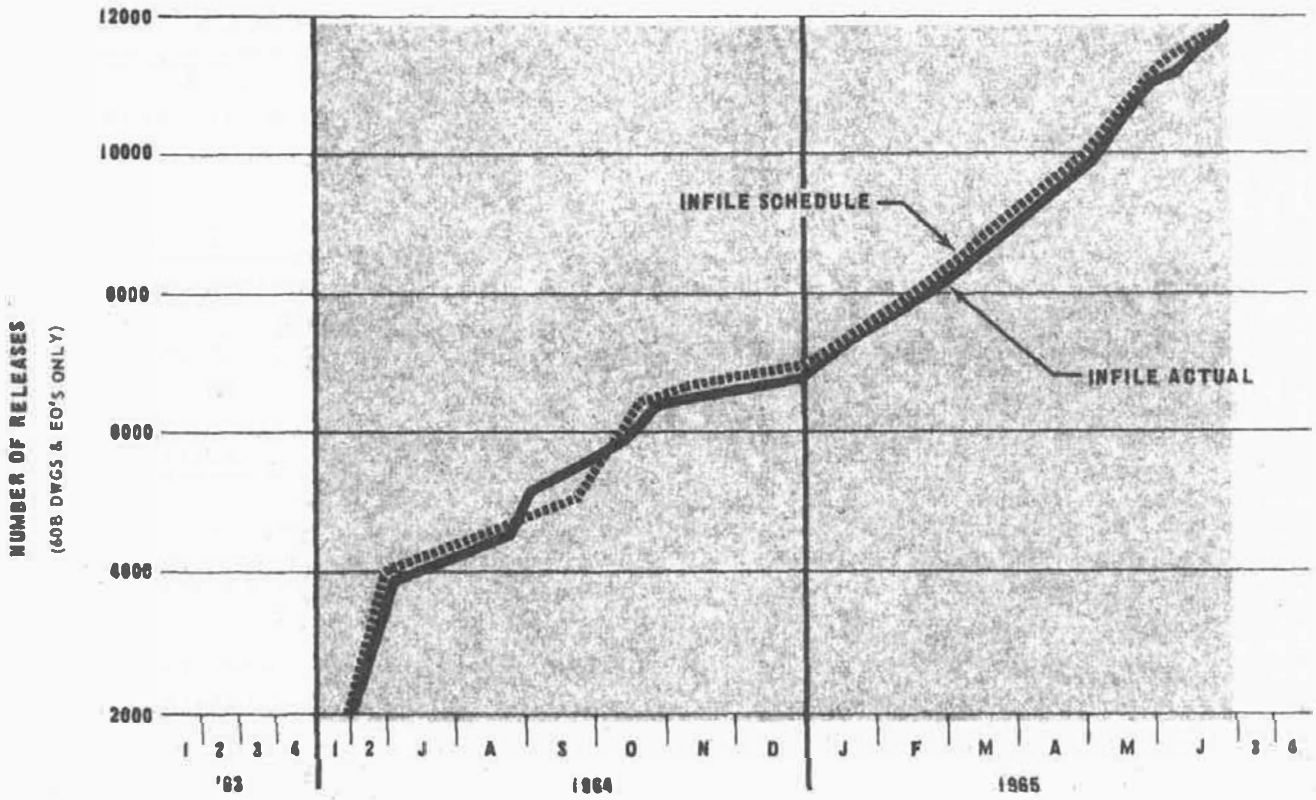


FIGURE 1-3

S-IC STAGE CAM'S INITIATED ƆR COMMITTED DURING 4TH QUARTER FY '65

CAM NO.	PRIORITY	DATE COMMITTED BY CHANGE BD.	DOCUMENTATION COMPLETION SCHEDULE	EFFECTIVITY STAGE	EFFECTIVITY GSE MSE
307	B	5-10-65	10-28-65	D, F, 1-10	R-QUAL, R-TEST, MTO, MAB, MICH
309	B	4-13-65	6-2-65	D, F, 1-10	R-QUAL, R-TEST, MTO, MICH
315	B	4-12-65	5-17-65	F, 1-6	
328 *	B	4-27-65	7-15-65	1-10	
330	C	5-17-65	9-14-65	T, 1-6	
331	C	5-17-65	9-14-65	T, 1-6	
332	B	5-17-65	10-12-65	1-6	
333	B	5-17-65	3-14-66	T, -1	
335	B	4-19-65	5-14-65	D	
337	B	5-25-65	12-15-65	D, F, 1-10	R-QUAL, R-TEST, MTO, MICH
340	B	5-17-65	10-22-65	D, F, 1-10	R-QUAL, R-TEST, MTO, MICH
342	B	5-17-65	8-9-65	1-10	R-QUAL, R-TEST, MTO, MICH
343	B	5-4-65	5-26-65	1-10	
344	A	5-14-65		1-10	
345	B	5-14-65	7-22-65	D, F, 1-10	
346 *	A	5-18-65	6-4-65	T, D, F, 1-10	
`47	B	5-24-65	3-14-66	2-10	
,49 *	B	5-18-65	7-6-65	D, F, 1-10	
350	C	6-18-65	9-14-65	6-10	
351	B			2-10	MICH
352	B	6-22-65	8-12-65	1-10	
354	B	6-9-65		3-10	
357	B	6-9-65	7-6-65	D, F, 1-10	
359	C			1-10	
360	B			4-10	MTO, MICH
361	B	5-17-65	9-2-65	T, 1-6	
362	B	5-17-65	12-8-65	T, 1-6	
363	B	5-17-65	12-7-65	-1	
364	B	6-9-65	8-3-65	2-10	
365 *	B	6-7-65	6-18-65	F, 1-10	
367	B	6-9-65	3-14-66	T, 1-10	
368	B	7-1-65	9-24-65	F, 1-4	R-TEST, R-QUAL, MTO, MICH
369	B	6-23-65	7-16-65	1-10	
370	B	6-30-65	8-11-65	T, D, F, 1-10	
371	B	6-30-65		D, F, 1-10	
374	A	6-18-65	7-29-65	T, 1-10	
375	B			D, F, S, 1-10	
377	B			T, D, F, 1-10	
379	B			4-6	

* DESIGNATES COMPLETION

FIGURE 1-4

STAGE
CAM'S COMPLETED DURING 4th QUARTER FY '65

CAM NO.	TITLE
138	CHANGE TO TITANIUM FASTENERS
207	MODIFICATION OF INTERTANK RING FRAMES AND SKIN PANELS
238	DELETE LOX SUCTION DUCT INSULATION AND CONDITIONING BUBBLING SYSTEM
239	ADD REMOTE DIGITAL SUB-MULTIPLEXER ASSEMBLY TO STAGE PCM TELEMETRY SYSTEM
242	REVISE FUEL AND LOX PREVALVES
247	RELOCATE FUEL TANK VENT VALVE CONTROL SOLENOID
271	MODIFY PANEL CUTOUTS TO PROVIDE CLEARANCE FOR PLUMBING INSULATION (FLIGHT CONFIGURATION)
274	MODIFY SHIELD AND SUPPORT STRUCTURE
277	ELIMINATE WELDMENT OF FITTINGS TO GORES IN UPPER AND LOWER HEADS OF FUEL AND OXIDIZER TANKS
278	ADD AERODYNAMIC SEALING TO ELECTRICAL AND PRESSURE TUNNELS
279	DELETE JOINT LEAKAGE MEASUREMENT
282	ADD TEMPORARY INSTALLATION OF SEPARATION EBW UNITS AND PULSE SENSORS
284	RELOCATE FUEL DENSITY MEASUREMENT RESISTANCE THERMOMETER TRANSDUCERS
285	ADD INSTRUMENTATION FOR THRUST STRUCTURE STRAIN MEASUREMENTS
286	ADD SUPPORTS FOR ELECTRICAL AND OTHER MISCELLANEOUS EQUIPMENT ON THRUST STRUCTURE
288	INCREASE LIQUID LEVEL SYSTEM OUTPUT VOLTAGE AND PROVIDE ADDITIONAL LIQUID LEVEL INFORMATION VIA HARDWIRE
289	INCORPORATE FAIRING HEAT SHIELD SUPPORT STRUCTURE
292	REDESIGN RATE GYRO ENVIRONMENTAL COVER
294	MODIFY TELEMETRY CHANNEL ASSIGNMENT AND LOX AND FUEL PREVALVE MEASUREMENTS
295	MODIFY STATIC FUEL PRESSURIZATION DUCT SUPPORT FLANGE
298	MODIFY S-IC-S STAGE TO INCLUDE RECENT DESIGN DEVELOPMENT
304	ADD FUEL DENSITY MEASUREMENTS TO IP&C LIST AND PROVIDE NECESSARY GSE
305	MODIFY FLUID POWER DUCTING INSULATION AND THRUST VECTOR CONTROL ENGINE INSULATION INTERFACES
306	ADD INSTALLATION PROVISIONS FOR CABLING AND INSTRUMENTATION
308	MODIFY PROVISION FOR HELIUM AND NITROGEN BOTTLE PRESSURE SWITCHES
313	REVISE ELECTRICAL WIRING TO AGREE WITH MSFC INTERFACE DOCUMENTATION
315	MODIFY SINGLE-SIDE BAND AND RF ASSEMBLY
316	MODIFY EQUIPMENT SUPPORT BRACKETS TO MATCH F-1 ENGINE
325	MODIFY THRUST STRUCTURE TO ACCOMMODATE SLOW RELEASE MECHANISM
328	REVISE TELEMETRY TRANSMITTER AND POWER AMPLIFIER
339	REVISE ELECTRICAL CABLE DISCONNECTORS AT THE UNIT 115-116 INTERFACE
343	ADD OPTICAL TARGETS TO ENGINE FAIRING
346	REVISE COLD HELIUM MANIFOLD MATERIAL FROM STEEL TO ICONEL
349	PROVIDE SUPPORTS FOR RETROROCKET CABLING
365	MODIFY THE GOX LEAKMETER ASSEMBLY

FIGURE I-5

CAM 340—Requested by MSFC letter. This change adds heaters to LOX fill-and-drain valves to ensure valve operation at cryogenic temperatures.

CAM 342—Requested by MSFC letter. This change modifies insulation and cabling to accommodate a new engine actuator configuration.

CAM 343—Requested by Modification 242 to Contract NAS8-5608. This change adds painted targets on the fairing for optical viewing of vehicle first motion at liftoff.

CAM 344—Requested by The Boeing Company to redesign the flexible heat shield curtain to withstand aerodynamic loads.

CAM 345—Requested by The Boeing Company. This change deletes the LOX prevalve bypass system to increase the reliability of the stage.

CAM 346—Requested by The Boeing Company. This change replaces the AM-350 steel cold helium manifold with Iconel-718 to avoid the possibility of brittle failure at cryogenic temperatures.

CAM 347—Requested by MSFC letter. This change modifies the heat shield curtain to accommodate Rocketdyne engine pan redesign.

CAM 349—Requested by The Boeing Company to provide supports for retrorocket initiation cabling.

CAM 350—Requested by The Boeing Company to delete LOX and fuel prevalve flowmeters to improve reliability and to decrease cost and weight.

CAM 351—Requested by MSFC letter. This change replaces Boeing-released telemetry documentation with MSFC Class I telemetry documentation for compatibility with the overall Saturn V telemetry system. This is a documentation change only.

CAM 352—Requested by The Boeing Company. This change deletes ceramic inserts on heatshield bolts. The ceramic breakage rate is high during installation and stage handling.

CAM 354—Requested by MSFC letter. This change replaces a GFE selector switch to provide redundant circuitry.

CAM 357—Requested by The Boeing Company. This change adds cable support brackets to the thrust structure.

CAM 359—Requested by The Boeing Company. This change limits re-use of retrorocket cases to developmental firings only.

CAM 360—Requested by MSFC. Change Order No. 244 to Contract NAS8-5608. This change provides for separation of R&D and operational instrumentation systems on S-IC-4 and -5 so that R&D instrumentation systems may be deleted without affecting the operational instrumentation system or the stage.

CAM 361—Requested by MSFC I-V-SIC ECP F1-76. This change modifies Boeing engine instrumentation installation to avoid interference with revised engine insulation.

CAM 362—Requested by MSFC I-V-SIC ECP F1-76. This change replaces engine instrumentation supports deleted by Rocketdyne.

CAM 363—Requested by MSFC I-V-SIC. This change deletes separate insulation for an engine-mounted connector panel now protected by revised engine insulation.

CAM 364—Requested by MSFC I-V-SIC. This change modifies the servo-actuator control harness on the F-1 engine because of a change in the F-1 engine configuration.

CAM 365—Requested by The Boeing Company. This change modifies the GOX leak meter assembly to eliminate welded or brazed stainless steel parts to minimize the possibility of corrosion and cracking.

CAM 367—Requested by MSFC memo. This change adds doublers to Boeing cutouts in engine insulation and revises thrust chamber extension instrumentation brackets; both modifications to meet stress requirements.

CAM 368—Requested by The Boeing Company. This change replaces the present fuel slosh electronics unit with another design because of inability of the unit to meet S-IC qualification requirements.

CAM 369—Requested by The Boeing Company. This change modifies the actuator boot assembly that structurally failed during testing.

CAM 370—Requested by The Boeing Company to provide protective covers for instrumentation, measurement identification markings (decals), and work platform support markings.

CAM 371—Requested by The Boeing Company to add measurement mounting provisions to electrical and pressurization tunnels.

CAM 372—Requested by MSFC. This change modifies the S-IC-F to a minimum configuration that will satisfy test objectives. Elimination of unnecessary equipment will aid in meeting program schedules.

CAM 374—Requested by The Boeing Company. This change provides a new design for the servo-actuator fluid return duct for increased reliability.

CAM 375—Requested by The Boeing Company. This change deletes the engine fairing airscoops to eliminate excessive air loads on engine components and to minimize differential pressure on the base heat shield.

CAM 377—Requested by MSFC. This change replaces the control pressure system regulator deemed unsatisfactory by MSFC.

CAM 379—Requested by MSFC. This change revises engine instrumentation cabling and calorimeter purge line clamping as a result of an engine design change.

WEIGHT STATUS

The calculated dry weight for the S-IC-1 stage, including engine, increased 2203 pounds during FY 1965. Variations in S-IC-1 dry operational weight during the year are plotted in Figure I-6, with the dry weight of other flight vehicles at the year's end shown for comparison. During this same period the weight of that portion of the stage for which Boeing has responsibility decreased

S-IC OPERATIONAL DRY WEIGHT

FISCAL YEAR 1965 HISTORY

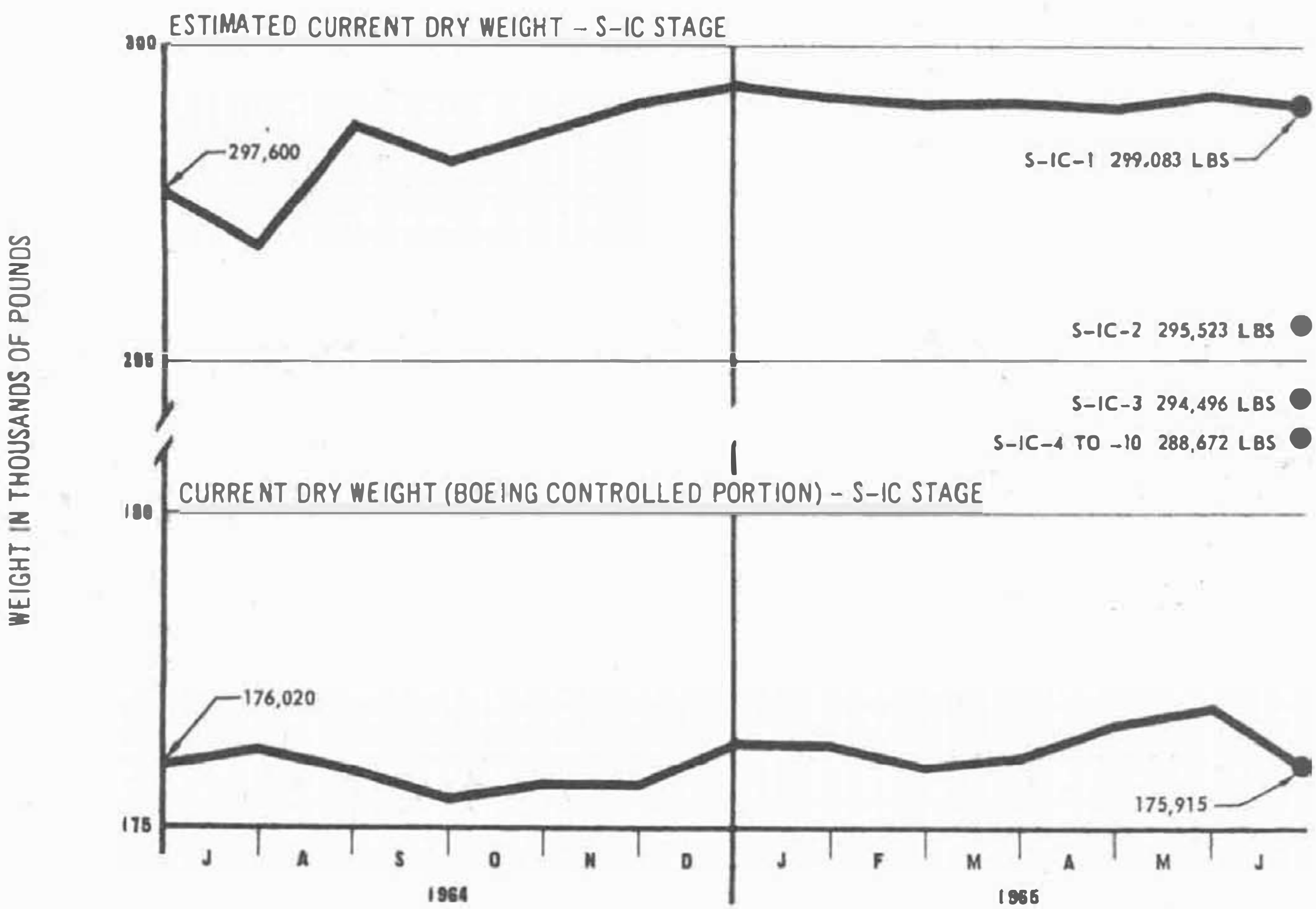


FIGURE I-6

105 pounds as compared with a decrease of 532 pounds in the specification weight. At year end, Boeing was 1267 pounds under the Boeing specified weight of 177,182 pounds. The actual weight values are tabulated below:

	Jul 1, '64	Jul 1, '65	Changes
Dry Opn Wt*	296,880	299,083	+2203
Boeing (Current)			
Dry Wt*	176,020	175,915	- 105
Boeing Spec Wt*	177,714	177,182	- 532

*Weight in Pounds

The effect of later vehicle weight reduction programs, for both S-IC elements and the F-1 engines, is shown in the tabulation of flight vehicle weights below. Portions of the weight reduction shown for the S-IC-4 are also effective on -2 and -3.

	Jul 1, '64	Jul 1, '65	Net Change
S-IC-1*	296,880	299,083	+2203
S-IC-4*	289,774	288,672	-1102
Reduction*	7,106	10,411	

* Weight in Pounds

These weight figures do not include the weight of the R&D instrumentation, which varies from vehicle to vehicle and will be deleted entirely after S-IC-5. The current additive R&D instrumentation weights are:

S-IC-1	5798 lbs
S-IC-2	7346 lbs
S-IC-3	7346 lbs
S-IC-4 to 10	5816 lbs

The increased weight for S-IC-2 and -3 reflects the addition of visual instrumentation (television and motion picture cameras). The S-IC-4 and -5 weights do not yet reflect the effect of Contract Change Order 244, which requests a design change to separate R&D and operational instrumentation and to provide NASA/MSFC with the option of deleting R&D instrumentation earlier.

DESIGN

As noted in the Documentation section, basic release for all stages was completed early in the fourth fiscal quarter. Almost all of the documentation released during the year was electrical and instrumentation drawings. To support production schedules, most of the structural and propulsion documentation was released during FY 1964 in advance of the firm establishment of instrumentation requirements and subsequent design. It was therefore necessary to handle provisions for electrical and instrumentation installation by change action against structural and propulsion documentation. A substantial amount of design effort was devoted to this during the past year. Other activity, in general, consisted of additional change activity, support of manufacturing and suppliers, support of test programs, and other sustaining work. The more important activities and events of the year are listed in the paragraphs below.

Stage Design Loads

The structural load criteria of the S-IC stages were derived from various NASA/MSFC directions and other loads data developed by Boeing. These loads criteria were officially documented by Technical Directive 183 (March 23, 1964) and the Boeing response to this directive. Subsequently, in February, 1965, Technical Directive 255 was issued. The load requirements, submitted in TD 255, were sufficiently higher and substantial structural redesign would have been required. Boeing was later advised by NASA/MSFC that a complete updated set of structural loads would be provided; however, these had not been received at fiscal year's end. The impact of higher structural loads cannot be evaluated until the actual loads criteria are received. Any appreciable change from TD 183 criteria will necessitate substantial redesign and affect structural components already fabricated for several vehicles.

Intertank Design

As previously reported, the intertank was redesigned after test failures were encountered during developmental testing of scale models by Boeing. Based on these tests, NASA/MSFC directed a substantially heavier intertank design for S-IC-1, -2, and -3, with a lightweight intertank design to be released for subsequent stages after further developmental testing. The changes were to be accomplished by CAM 207. Destruction testing of a full size intertank by NASA/MSFC to substantiate correlation of scale model to full-size test results were accomplished during the past year. A lightweight intertank design was released based on these tests. However, NASA/MSFC later directed cancellation of the lightweight intertank. Accordingly, documentation has been revised to call for the S-IC-1 intertank on all ten flight vehicles.

Responsibility for structural testing of the full-scale S-IC-1 intertank was assigned to Boeing, and actual testing is scheduled early in the third quarter of FY 1966. (See Figure XI-1 for further information.)

S-IC-D and -F Configuration

The initial design criteria for the S-IC-D and -F defined configurations similar to the flight vehicles. The major differences on the S-IC-D were the omission of certain instrumentation and the substitution of mass simulators for electrical equipment. Engines were omitted on both S-IC-D and -F. During the third fiscal quarter, a minimum configuration was defined for each vehicle to expedite production and still satisfy the fundamental ground test missions. The S-IC-D will now have only a limited number of electrical cables and mass simulators. Propulsion-mechanical components not vital to the test mission are being deleted, and fluid system cleanliness requirements have been relaxed on those systems installed. Simple covers will be installed on tank ports where equipment was deleted. The S-IC-F will have only those systems that are essential to LOX and fuel loading, LOX and fuel tank pressurization, environmental control, fin and fairing instrumentation, an F-1 engine mockup, and instrumentation required for wind load testing. Documentation to accomplish these changes will be covered by Production Memo (an engineering stop-work order) on S-IC-D; and on S-IC-F by Class 1 release under CAM 372.

Changes Resulting from F-1 Engine Modifications

Propulsion and instrumentation systems designs have been increasingly affected by F-1 engine changes. Thermal insulation, ducting, instrumentation and instrumentation supports, and cabling were affected. To reduce the flow time involved in making stage changes, Boeing is maintaining close liaison with Rocketdyne through its resident representative there. As a result of several MSFC-Rocketdyne-Boeing meetings during the fourth fiscal quarter, Boeing was authorized to proceed with changes immediately upon receipt of a Rocketdyne Engineering Change Proposal (ECP). At present, engine instrumentation changes (because of their magnitude and their timing with respect to production schedules are being committed for S-IC-1 and -2 by sketch releases. Class I documentation of these changes will be released at a later date. CAM's for S-IC-3 and on are being committed for Class I documentation release and in-sequence installation.

Deletion of Engine Fairing Air Scoops

Technical Directive 268, received in January, 1965, directed installation of deflectors at the fairing air scoop exits to reduce excessive air loads on engine components. Design studies indicated that incorporation of the baffles would cause a schedule slide in fairing deliveries for S-IC-1 and would also impose a high weight penalty. In addition, it was determined that the scoops, with or without baffles, were contributing to a high differential pressure across the base heat shield. This could necessitate heat shield redesign. Moreover, it was found that base thermal protection design is not dependent on cooling provided by the fairing air scoops, and that air from the scoops does not diffuse around the engine actuators. After these findings were presented to NASA/MSFC at a meeting in late May, it was concluded that deletion of the scoops would have no adverse effect on the vehicle and would benefit vehicle performance and delivery schedules. Boeing accordingly initiated CAM 375 to delete the fairing air scoops.

Separation of R&D Instrumentation

Physical separation of telemetry and flight measurements into separate operational and R&D packages were discussed at a Boeing/NASA/MSFC/KSC meeting in January, 1965. Contract Change Order 244 was subsequently issued in March to authorize the change. CAM 360 is being processed to separate the R & D and operational instrumentation effective on S-IC-4 and -5, in order to permit deletion of R&D systems without affecting the operational instrumentation package or stage. Stage cabling, instrumentation telemetry, and power distribution systems will be affected, together with associated GSE.

Developmental Test Activities

Flow testing of the oxidizer tank GOX distributor in June, 1964, resulted in a structural failure of the mesh screen at flow rates below design requirements. Investigation revealed that the Rigimesh screen failed because of the severe sonic vibrational loads. Flow testing was resumed in September, 1964, with a revised configuration incorporating a perforated shell concept. Redesign of the GOX distributor was completed during October. Qualification testing of the redesigned distributor was started in December and successfully completed in February. In anticipation of similar failure, documentation was prepared for revising the fuel tank helium distributor from Rigimesh to perforated shell, and two revised helium distributors fabricated for test purposes. As expected, the original design helium distributor structurally failed during flow testing. Structural verification and flow testing of the revised helium distributor were successfully completed during February, 1965.

The retrorocket motor development program was completed on schedule with the static test firing of the last development motor on March 26, 1965. Expected development problems failed to materialize, and a total of 19 motors, one less than originally planned, were fired. The success of the developmental phase is also reflected in the corresponding reduction of the number of motors to be subjected to qualification tests. Boeing's proposal to eliminate the steel nozzle exit cone was accepted by NASA/MSFC. This resulted in a weight savings of about 23 pounds per motor, for a total of 186 pounds per stage. The panel blow-off test was conducted by the retrorocket motor subcontractor on April 8, 1965. The test hardware included a production-Type F-1 engine forward fairing, a simulated aft fairing, and a simulated stage structure. Two motors were utilized to simulate an actual motor installation. All aspects of the test were satisfactory, including the departure of the forward fairing from the simulated stage and ballistic performance of both motors. The S-IC flange and seal verification program was completed during the last quarter of the year. A number of the separable seal connections that were tested exhibited measurable leakage; however the rate of leakage was, in all cases, such that the performance of the S-IC stage would not be degraded or the mission jeopardized. The final report, concluding that all connections tested are acceptable, is presently being prepared. This will be released during the first quarter of the next iscal period.

During the past quarter, inspection of pressure-volume-compensating (PVC) fuel duct support links disclosed cracks on new parts issued from stock at MSFC. Further inspection of PVC support links at Huntsville and at Michoud disclosed numerous failures of the link support assemblies. Investigation indicated that failure was caused by excessive tension stress in the thin walled lug because of bearing interference fit. Stress corrosion was also considered a probable factor; however, inspection of several failed links showed no evidence of stress corrosion. Engineering has released documentation to correct this situation by specifying a controlled clearence fit for all bushings in applicable 7079 aluminum parts. In addition, 100 percent shot peening of the bearing lug surfaces was specified to prevent any stress corrosion cracking of the thin walled lug. Link assemblies for S-IC-1 and -2 have been satisfactorily reworked, and rework for other vehicles is in progress. Boeing recommended to NASA/MSFC that the S-IC-T vehicle link assemblies be reworked whenever possible without affecting the static firing schedule.

The engine flexible heat shield flame curtain was designed and fabricated in accordance with MSFC Technical Directive I-V-SIC-144. During March, 1965, Boeing conducted tests to simulate the dynamic pressures predicted by MSFC memo R-P&VE-PTD-64-M-78. The curtain specimens, when subjected to predicted aerodynamic flight pressures and buffeting, failed under test. A redesigned flame curtain is currently being evaluated. Documentation to revise flight heat shield curtains will be released under CAM 344. Present curtains are satisfactory for static firing since they will not be subjected to aerodynamic loading.

Qualification Test Support

With the initiation of S-IC-T firings in early April, 1965, increased emphasis was placed on accelerating the successful completion of qualification tests for procured specialty hardware. Continual and intensive technical surveillance over vendor design and test activities was maintained to expedite resolution of problems resulting from test failures and to initiate proper corrective action. At the close of this fiscal period, qualification of all procured S-IC-T specialty items was approximately 90 percent complete. Completion is anticipated by the end of September, 1965. When qualified hardware was not available, it was necessary to provide work-around components and systems to support the S-IC-T firings. This was accomplished by sketches in lieu of Class I documentation since it is planned to replace those items with qualified hardware as it becomes available.

Although developmental and qualification testing exposed a number of the functional problems that are associated with a developmental program of this magnitude, the major cause of qualification test failures was the severe vibration levels imposed by the S-IC environment. Vibration failures were encountered in fluid and engine system ducts, supports, flexible joints and other components; and in electrical equipment instrumentation and fluid level measurement systems. The difficulty experienced with qualifying some vendor items forced development of alternative sources to ensure timely delivery of qualified hardware. Engineering representatives are stationed at vendor's plants, qualifying critical stage components.

Manufacturing Support

Early in the fiscal year, a weld improvement committee was formed to monitor the Michoud welding operations, to pinpoint problem areas, and to recommend corrective action. The chairman of this group was furnished by Engineering, and all affected Manufacturing, Quality Control, and Engineering organizations represented on the committee. This central welding committee played a major role in achieving weld processing improvement during this reporting period. The defects that the committee investigated included: (1) distortion in the form of "tenting and "oil canning," (2) weld mismatch, and (3) weld defects, such as porosities, inclusions, and weld bead cracking. An additional and related problem was refinement of inspection requirements and procedures to be employed to detect such defects. The tenting and weld mismatch problem of the gore-to-gore weld was successfully reduced by a minor addition of external vacuum strongbacks to the tools used for manufacture of the tank heads. In parallel, Engineering conducted a test program to determine the extent that mismatch and tenting conditions can be accepted without degrading the structural integrity of propellant tanks. No further serious problems concerning mismatch and tenting conditions were encountered.

"Oil canning" is still a minor problem on the fuel tank upper head assemblies because of the easily deformed thin membranes. Careful weld control and technique, however, have greatly reduced this problem. Minor "canned" conditions can be accepted without rework because they do not degrade the tank assembly. Major "canned" conditions have been successfully reworked by the magnetic hammer process; however, in some cases cracks in the welds were propagated and rework required.

Weld cracks were first reported during fabrication at MSFC in September, 1964. Multiple cracks were detected in the welds of both the fuel and oxidizer tanks of the S-IC-T and -S. Further investigation of the cracks indicated that the main problem was associated with the tail-out technique and coupled with the lack of adequate surfaoe inspection processes to detect the cracks when the weld is made initially. Changes in the tail-out technique greatly reduced the problem. Shaving of the weld beads and penetrant inspection of the shaved beads was made a manufacturing and inspection procedure through implementation of CAM 281. Shaving of the beads results in a more uniform ductility across the beads, removes the majority of surface defects, and facilitates penetrant inspection. Further improvement was made in the weld repair procedure by development of new grind-out and repair techniques that are now being used successfully.

Shrinkage incurred during welding of fuel and oxidizer system connections to tank-head gores was a recurrent problem. Distortion in the welded assemblies cannot be completely removed during aging. A change (CAM 277) was initiated in December, 1964, to substitute machined bosses and bolt-on fittings for the former weldments.

Warpage of thrust structure skin panels during roll forming became a problem early in the fiscal year. This has been corrected by rolling skin panels with fillers placed in the sculptured davities in the skins. Localized shot-peening was recommended for correcting local depressions that could not be removed by rerolling, and for preventing stress corrosion in warped panels pulled to contour on installation by the use of bolts instead of rivets.

Another manufacturing support problem involved the application of the MSFC-PROC-158A soldering process creating inspection problems with vendors whose product was not suited to this process. Coordination between Boeing and NASA/MSFC involving engineering, manufacturing, and quality control, resulted in an informal memo interpreting the requirements of MSFC-PROC-158A. This memo has acted as a medium for reducing several vendor problem areas.

S-IC Stage Mockup

An S-IC mockup at Michoud was initially completed in the S-IC-T configuration and inspected by representatives from various Boeing and NASA/MSFC organizations to provide an early checkout of the released S-IC-T engineering designs. Important changes and refinements were made to engineering releases and reflected in the S-IC-T at MSFC as a result of review of the mockup. In addition, this review resulted in some redesign of electrical/electronic equipment and cabling installations in the thrust structure area, plus the redesign of electrical cable installations in the forward skirt. These changes were subsequently incorporated in the mockup when it was updated to the S-IC-1 configuration. As a result, engineering releases for these units in the S-IC-1 and later configurations had the benefit of mockup refinement, especially in the areas of plumbing and electrical wire routing. Electrical cable lengths have also been established by the mockup cables and are reflected in the Class I documentation.

GSE/MSE DESIGN

DOCUMENTATION

Basic release for GSE/MSE was approximately two-thirds complete at the beginning of this fiscal year.

At the end of the year, all scheduled basic releases were completed for R-TEST, R-QUAL, Michoud, and MTF, except for MTF installation documentation and some system test requirements. Installation documentation for the Michoud programming and evaluation computer (GE-235) will be completed following official notification from NASA/MSFC to proceed and release. Although basic release was slightly behind schedule (Figure I-7) during the first fiscal quarter, schedule recovery was effected during the third fiscal quarter, and release continued on schedule throughout the remainder of the year. The bulk of the remaining MTF installation documentation will be released during the next quarter; however, test requirements release will continue well into FY 1966.

Phased design submittals and approvals for the various test and checkout complexes during the year are listed below (Phase I - System Design Concept, Phase II - Prototype Design, Phase III - Production Design, Phase IV - System Schematics—essentially as built schematics for use in system checkout and maintenance).

R-QUAL - Preliminary Phase IV advanced electrical/mechanical schematics were prepared and distributed on February 22, 1965, and again on June 15, 1965. These preliminary Phase IV submittals kept pace with the equipment configuration as design changes were approved. The next scheduled release of Phase IV schematics is concurrent with the start of the S-IC-1 stage testing at R-QUAL.

R-TEST - The Phase III design submittal was transmitted to NASA/MSFC on September 30, 1964. Approval was received on January 5, 1965. Preliminary Phase IV advanced electrical/mechanical schematics were transmitted to the NASA/MSFC Test Laboratory on June 16, 1965. Final Phase IV submittal is scheduled for the first quarter of FY 1966.

Michoud - Preliminary Phase IV advanced electrical/mechanical schematics will be released during the first quarter of FY 1966.

MTF (Contract Modification 102) - The Phase III design submittal was transmitted to NASA/MSFC on March 9, 1965. Phase III design approval is anticipated during the first quarter of FY 1966.

The following end-item test plans were submitted to NASA/MSFC during the reporting period:

S-IC-D	Submitted January, 1965. Revised to reflect minimum S-IC-D configuration and resubmitted in June, 1965.
S-IC-1	Approved by NASA/MSFC in April 1965, subject to incorporation of comments.
R-TEST Test Equipment	Approved by NASA/MSFC in April, 1965.
R-QUAL Test and Checkout Complex	Approved by NASA/MSFC in April 1965, subject to incorporation of comments.

The test procedures required to accomplish the above test plans will be completed during the first half of FY 1966. At present, the test and checkout procedures are being verified at R-QUAL. S-IC-1 post-manufacturing test procedures are approximately 70 percent complete and are ready for evaluation at R-QUAL.

Formal change activity (CAM's) did not materially affect GSE/MSE design until the beginning of FY 1965, as shown in Figure I-8. Before that time, needed changes were, for the most part, incorporated in the basic documentation release. The CAM documentation release rate increased about mid-year and continued at about that same rate the rest of the year. During the fourth fiscal quarter, documentation release was completed for the 22 CAM's listed in Figure I-10. Twenty-two new CAM's were initiated (approved by Engineering Management for presentation to the S-IC Change Board) during the quarter.

All CAM's either initiated or committed during the last fiscal quarter, with their commitment dates, documentation completion schedule, and vehicle effectivity, are listed in Figure I-9.

DESCRIPTION OF GSE/MSE CAM's INITIATED AND/OR COMMITTED THE THIRD FISCAL QUARTER

CAM 825 — Requested by MSFC Technical Directive 231. This change allows a normal 28-VDC power to be restored to the stage after emergency power operation without test interruption.

CAM 859 — Requested by The Boeing Company. This change provides additional cooling for the PCM/PF assembly during functional testing.

CAM 860 — Requested By The Boeing Company. This change modifies the telemetry RF test bench and the multiplexer test bench to add test capability and to accommodate present stage system configuration.

ENGINEERING BASIC RELEASE SCHEDULE-GSE/MSE

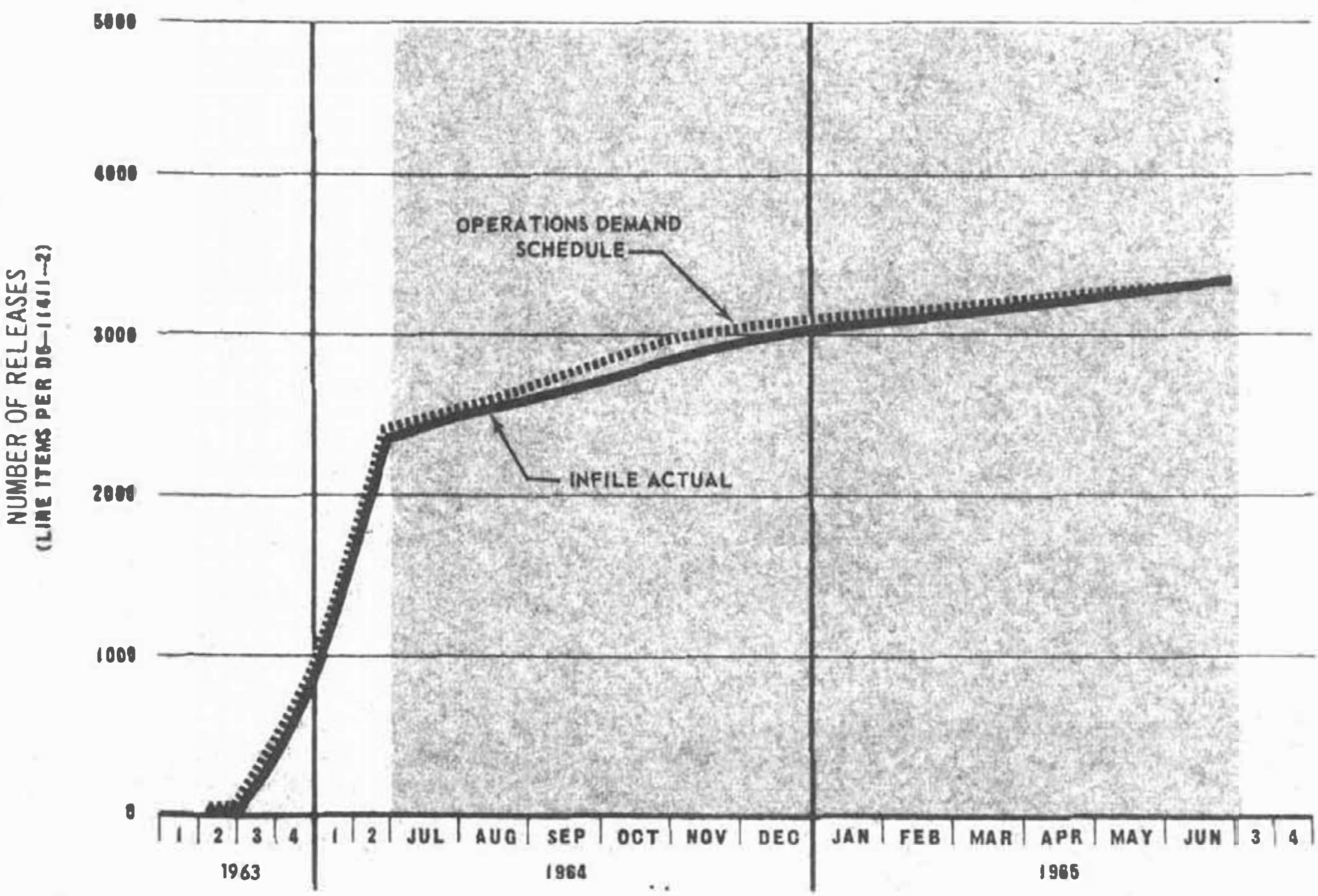


FIGURE 1-7

CAM 861 — Requested by The Boeing Company. This change adds portable test equipment to detect faulty flight-measurement strain gauges.

CAM 873 — Requested by MSFC (R-QUAL). This change provides means for maintaining positive propellant tank pressure during periods of extended test complex shutdown.

CAM 874 — Requested by The Boeing Company. This change provides termination for telemetry inputs that would be open circuits when flight heat shield, engine skirt extensions and flight batteries are not installed during testing.

CAM 875 — Requested by MSFC. This change adds fin and fairing electrical simulators to properly terminate telemetry channel inputs during testing without fins and fairings installed.

CAM 881 — Requested by MSFC R-TEST-IEW-38. This change revises mechanical test control equipment to meet Phase III technical review comments.

CAM 882 — Requested by The Boeing Company. This change modifies the propellant measuring system test set to allow operation with the measuring system water adaptor.

CAM 883 — Requested by The Boeing Company. This change adds a time data editor to the integrated telemetry ground equipment to allow high speed search of tape recorded telemetry data by time code.

CAM ENGINEERING RELEASE SCHEDULE-GSE/MSE

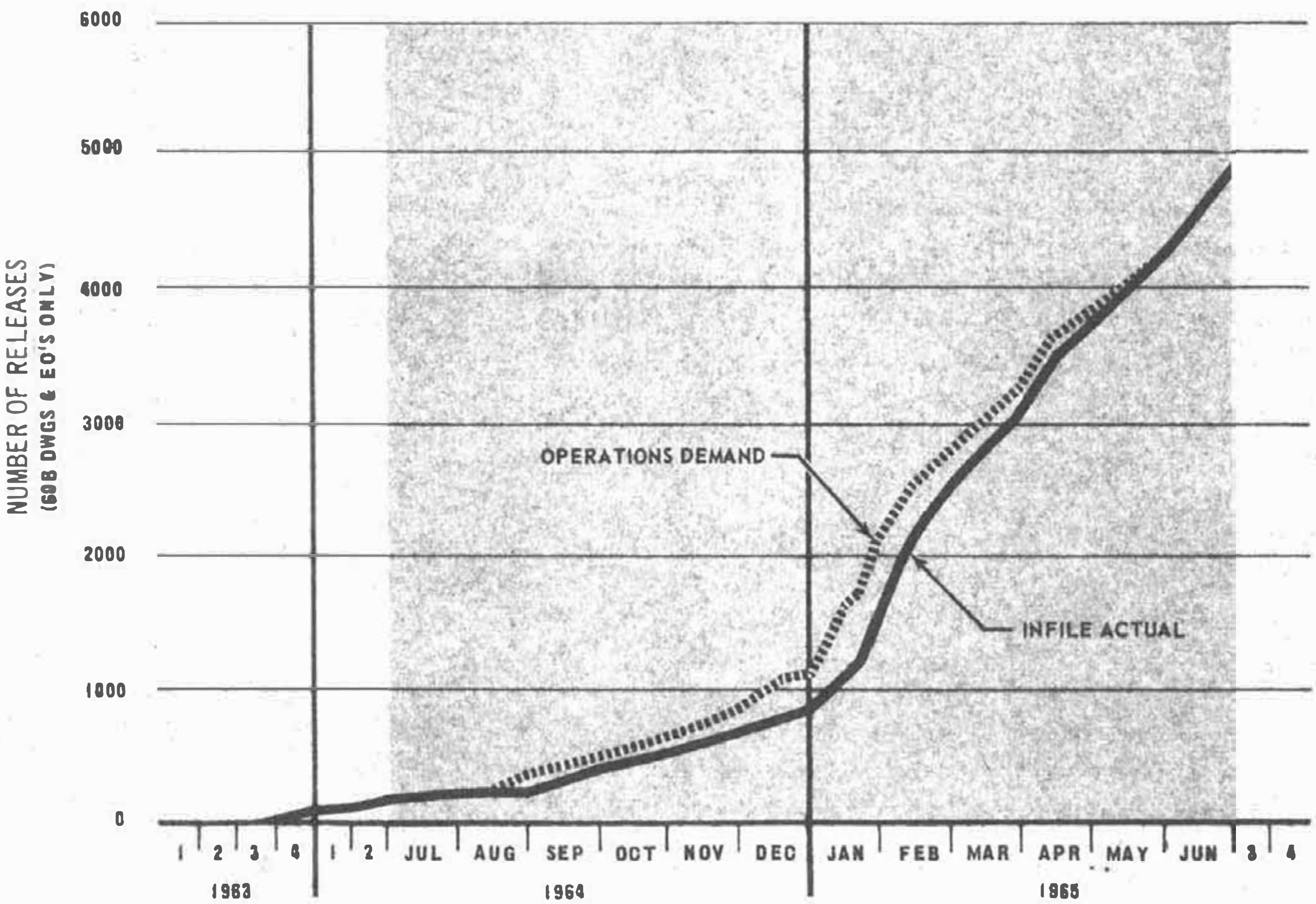


FIGURE I-8

GSE/MSE CAM'S INITIATED OR COMMITTED DURING 4TH QUARTER FY'65

CAM NO.	PRIORITY	DATE COMMITTED BY CHANGE BD.	DOCUMENTATION COMPLETION SCHEDULE	EFFECTIVITY STAGE	EFFECTIVITY GSE MSE
825*	C	2-23-65	6-15-65		R-QUAL, MICH, MTO
859	C	3-1-65			MICH
860	C	6-1-65	6-30-65		MICH
861	B	5-10-65	7-9-65		R-QUAL, R- TEST, MICH, MTO
873	C	5-27-65	9-23-65		R-QUAL, D, F, 1-10 MICH
874	B	4-20-65			R-QUAL, MICH
875	B	5-10-65	9-17-65		R-QUAL, MICH
876	B	4-20-65	5-13-65		R-QUAL, R-TEST, MTO, MICH, MILA
879	B	4-14-65	1-3-66		MTO
881	B	5-4-65	7-6-65		R-TEST, MTO
882	B	4-6-65	7-12-65		MICH
883	C	5-19-65	10-11-65		R-QUAL, R-TEST, MICH, MTO
885	A	5-10-65	7-1-65		R-QUAL, R-TEST, MICH, MTO
886	B	5-10-65	9-17-65		MTO
887	B	6-2-65	11-3-65		MICH
888*	B	5-4-65			R-QUAL, MICH, MTO
890	C	5-26-65	7-16-65		R-QUAL, MICH
891	B	5-24-65			MAB
892	B	6-9-65			R-QUAL, MICH
893	B	6-9-65	7-6-65		MILA
894	B	6-18-65	12-29-65		R-QUAL, MTO, MICH, R-TEST
896	B	6-18-65	7-9-65	F, 1-10	MILA
897	C				MAB
899	A	6-16-65	7-21-65		MICH, R-QUAL
900	B	6-30-65	7-6-65		R-QUAL, R-TEST, MTO, MICH
901	B				MTO, MILA
902	B			F, 1-10	MICH, MTO, R-QUAL, R- TEST
903	A	6-18-65	6-30-65	T,D,F, 1-10	STAGE SIMULATOR

* DESIGNATES COMPLETION

FIGURE 1-9

CAM 885 — Requested by The Boeing Company. This change provides a test fixture to leak test the fuel tank emergency drain duct.

CAM 886 — Requested by The Boeing Company. This change removes attenuators from the MTF radio frequency terminal equipment to provide an acceptable signal level.

CAM 887 — Requested by MSFC (R-QUAL). This change modifies the ground equipment test set to provide real-time checkout of GSE computer programs before operation of the S-IC stage.

CAM 888 — Requested by The Boeing Company. This change modifies the thrust structure horizontal access equipment to eliminate interference.

CAM 890 — Requested by MSFC. This change incorporates a commercial elevator car safety in the aft platform elevator.

CAM 891 — Requested by The Boeing Company. This change relocates the Mechanical Automation Breadboard fuel tank vent control solenoid valve to reduce system response time.

CAM 892— Requested by MSFC. This change provides portable flowmeters to measure engine purge during Level I factory test.

CAM 893 — Requested by MSFC (P&VE). This change modifies the AFT No. 3 umbilical carrier assembly to accommodate a new environmental air duct.

GSE/MSE
CAM'S COMPLETED DURING 4th QUARTER FY'65

CAM NO	TITLE
812	REPLACE 115-VOLT, 400-CYCLE GAS GENERATOR SPARK IGNITION SYSTEM WITH 28-VOLT DC SYSTEM
813	REPLACE 115-VOLT, 400-CYCLE GAS GENERATOR AND 28-VOLT DC TURBINE EXHAUST IGNITION SYSTEM WITH 500-VOLT, 60-CYCLE SYSTEM
825	ADD PROVISIONS FOR RESTORING NORMAL 28-VOLT DC POWER AFTER EMERGENCY POWER OPERATION
827	ADD NON-FLIGHT INSTRUMENT ASSEMBLY TO F-1 ENGINE HYDRAULIC CONTROL SYSTEM CHECKOUT
828	ADD REMOTE CONTROLLED VENTING CAPABILITY TO GSE PRESSURIZATION DUCTS
834	ADD LEVEL I CALIBRATION CAPABILITY FOR DDAS
840	MODIFY ENGINE TEST PROGRAMMER TO ELIMINATE OUTPUT SIGNAL DISTORTION
841	ADD AMPLITUDE RESPONSE CALIBRATION SIGNALS AND STAGE COMMAND FUNCTIONS TO ICE
842	ADD SEMI-AUTOMATIC TELEMETRY EVALUATOR TO SUBSYSTEM TEST FACILITY AT MICHOUD
846	MODIFY CABLE INTERFACES FOR AUDIO AND CLOSED CIRCUIT TV SYSTEMS
848	REDESIGN OF PNEUMATIC CHECKOUT RACKS
851	ADD HEAVY DUTY RELAYS TO UMBILICAL PATCH DISTRIBUTOR
852	REVISE 60-CYCLE REMOTE CONTROL PANEL IN COMPUTER IODC POWER SUPPLY
855	ADD REMOTE MONITORING TO PRIMARY REGULATION MODULE AT S-IC PNEUMATIC CONSOLE
856	PROVIDE FOR ACCEPTANCE TEST OF UMBILICAL CARRIERS
857	MODIFY PURGE MODULE IN PNEUMATIC SUPPLY UNIT
858	REVISE MAB FUEL AND LOX PREVALVE CONTROL
863	MODIFY LOX AND FUEL TANK LOW PRESSURE PURGE MODULES IN PNEUMATIC SUPPLY UNIT
867	MODIFY PRESSURE REGULATOR IN GOX FLOW CONTROL VALVE TESTER
869	REVISE CONTROL AND MONITOR CONSOLE DISPLAY CONTROL AND ASSOCIATED CIRCUITS
876	PROVIDE 760-MILLI SECOND TIMED OUTPUT FROM IGNITION SEQUENCER
888	MODIFICATION OF STAGE HORIZONTAL INTERNAL ACCESS EQUIPMENT, THRUST STRUCTURE

FIGURE 1-10

CAM 894 — Requested by MSFC. This change provides a digital voltmeter for more accurate measurement of engine deflection during testing.

CAM 896 — Requested by The Boeing Company. This change provides a "Minus D" ground cable to the Aft No. 1 and 2 umbilical assemblies to meet MSFC requirements.

CAM 897 — Requested by MSFC. This change provides a forward umbilical service unit and GOX purge module for the Mechanical Automation Breadboard for complete pneumatic signal simulation.

CAM 899 — Requested by The Boeing Company. This change modifies the stage weighing equipment rocker assemblies to improve safety and accuracy.

CAM 900 — Requested by The Boeing Company. This change provides diodes of higher capacity in the computer discrete output circuits of the input/output distribution equipment.

CAM 901 — Requested by The Boeing Company. This change initiates the removal of interference between the forward skirt vertical internal access equipment and the stage.

CAM 903 — Requested by The Boeing Company. This change redesigns the stage attach fittings that fractured during load testing. These fittings are used for hoisting the S-IC stage.

R-QUAL ACCEPTANCE CHECKOUT

Installation of the R-QUAL Test and Checkout Complex began in October, 1964, and was essentially completed during April, 1965. Calibration and checkout was accomplished during April - June, 1965. This activity consisted of performing calibration and acceptance test procedures and verifying proper operation of ground support equipment in the manual and automatic mode. Operational demonstrations included performance of approximately 10 of the 45 GSE automatic checkout programs intended for end-item acceptance. Extremely tight development schedules and delays in the delivery of hardware necessitated reducing the amount of automatic mode verification. Discrepancies uncovered during this testing were resolved, and the complex was deemed operable on June 21, 1965. From this date until the start of S-IC-1 checkout, NASA/MSFC will operate the equipment against a stage simulator, and stage automatic programs will be used to verify both GSE software and hardware.

AUTOMATIC CHECKOUT PROCEDURE AND COMPUTER PROGRAM DEVELOPMENT

The RCA 110A computer (scheduled for use in the test and checkout complexes in late FY 1964) was unavailable and NASA/MSFC provided Boeing with an RCA 110 computer for use in the Huntsville Engineering Evaluation Laboratories. The computer became operational in July, 1964, and was used continually during the past fiscal year. This effort was part of a plan to evaluate critical hardware interfaces between the ground computer system and the ground support equipment before delivery of the RCA 110A system to R-QUAL and Michoud. The job of determining computer code logic, producing the codes, and debugging programs by actual computer runs would normally require at least a one-year lead time after availability of the computer. The activities in the Huntsville Engineering Evaluation Laboratories were intended to reduce this lead time through use of the substitute RCA 110 computer to the approximate 29-week period between RCA 110A delivery and the operational date for the R-QUAL Test and Checkout Complex.

Beneficial occupancy by NASA/MSFC of the R-QUAL test complex in June, 1965, reported above, culminated the computer programming activity begun in July, 1964. During this period, computer program development was accomplished on IBM 7094, GE-235 and RCA 110 and 110A machines. The programming support systems routines on IBM 7094 and GE-235 computers became operational and are satisfactorily performing ATOLL translation, assembly, loading, and data processing. Some refinements, additional editing and update capability, and considerable documentation remain to be accomplished.

These support system programs were used to develop operating sequences for the RCA 110 computer from July, 1964, to about February, 1965. Checkout programs and executive-routines were generated for the RCA 110A computer since its delivery to R-QUAL February 2, 1965. In this latter period, the on-line operating system for the checkout computer was made operational with some limitations in the options available at test time. All GSE and stage automatic acceptance procedures have been processed by at least one machine pass and considerable hardware verification was accomplished. Although numerous minor problems still exist, these will be resolved during the period before S-IC-1 and S-IC-T checkout by joint team actions of NASA/MSFC and Boeing personnel. Both GSE complex and stage checkout programs will be run against various stage simulators. Nearly 70 percent of the checkout procedures associated with GSE complex and S-IC post manufacturing, pre-static, captive firing, and post-static tests may be implemented in the automatic or semi-automatic control modes by test statements expressed in the ATOLL language. Other sections of the procedures are expressed and implemented as computer coding sequences written by programmers from specifications supplied by test engineers. No major obstacles are presently anticipated in achieving automatic checkout of either the S-IC-1 or S-IC-T stages. Although the computer programming effort is still in an early development phase and considerable work and additional definitions remain to be accomplished, it is expected that the automation goals of both NASA/MSFC and The Boeing Company will be on schedule.

TEST AND CHECKOUT EQUIPMENT

Control and Monitor Station

The feasibility model Cathode Ray Tube (CRT) display system was maintained in the Huntsville Engineering Evaluation Laboratory in order to support the development of programming for the RCA 110 computer and to develop display techniques for the S-IC checkout. This effort was completed in March, 1965. Surveillance was maintained on the Raytheon Company's design and production effort of the production model display systems. The first system was delivered to R-QUAL on April 12, 1965. It was interfaced with the RCA 110A computer, and total system compatibility was verified. The display system for R-TEST and the first of the two for Michoud are scheduled early in the next quarter.

Computer Station

Design releases for the computer station equipment were completed early in this report period. The computer station consists of the RCA 110A computer (GFE), the count clock, input/output distribution equipment, and the test step indicator equipment. All of the R-QUAL equipment has been installed and integrated into the test and checkout complex.

Breadboard models of the count clock, input/output distribution equipment and the test step indicator equipment were constructed to support the Huntsville Engineering Evaluation Laboratory. All this equipment was successfully integrated with the RCA 110 computer. In accordance with Contract Modification 140, the CRT input/output data channel was changed from GFE to CFE. As directed by NASA/MSFC, RCA, Van Nuys, California, was placed under contract to design and build this equipment to a Boeing design procurement specification. The first unit was delivered and integrated into the R-QUAL Test and Checkout Complex. The second, third and fourth units were delivered installed in their companion RCA 110A computer. The fifth unit is expected to be delivered with its companion computer by early August, 1965.

Redesign of the input/output distribution equipment (CAM 818) was required to accommodate the firm RCA 110A computer interface information that was received from NASA/MSFC early in FY 65. The original design released was based on the RCA 110 computer interface, since 110A information was not available.

Mechanical Test Station

In addition to sustaining released design, including CAM activities, coordination on vendor items, preparation of Michoud and R-QUAL Phase IV schematics, preparation of MTF Phase III drawings, and preparation of handbooks, the following were accomplished:

Critical Design Review for the hydraulic power supply unit was conducted with the vendor, Sprague. Both units were manufactured, acceptance tested, and shipped to Michoud.

Design support was provided for procurement, manufacturing, testing, installation, and checkout of the first units, which were delivered to R-QUAL in April, 1965. The operating and servicing handbook was prepared and released.

The GOX flow control valve tester for R-TEST and MTF usage was redesigned (CAM 867) because of difficulties in obtaining a vendor-provided remote controlled pressure regulator and also because of an instability encountered with the vendor breadboard during development tests. This redesign resulted in a regulator with improved performance, a simplified and more reliable design, and less expensive hardware. The new design was proved on the GOX flow control valve tester breadboard and was accomplished in accordance with NASA/MSFC Test Laboratory schedule requirements.

Data System Test Station

Four sets of PCM/DDAS ground equipment were constructed, acceptance tested, and delivered to their respective locations. The fifth unit, scheduled for Michoud, is in final stages of completion and will be delivered during July, 1965. The first unit was delivered to the Huntsville Engineering Evaluation Laboratory where it was used in conjunction with an RCA 110 computer to evaluate computer interface compatibility and programming techniques. The initial installation and evaluation of PCM/DDAS ground equipment modifications will be made on this unit. This was necessitated by the addition of the remote digital sub-multiplexer to the S-IC stage. Afterwards it will be delivered for installation in the MTF telemetry complex.

Five sets of telemetry digitizing equipment were constructed, acceptance tested, and delivered to their respective locations. The first unit was delivered to the Huntsville Engineering Evaluation Laboratory to support the computer (RCA 110) interface evaluation program. This evaluation program was completed, and the results used to make modifications required to interface the telemetry digitizing system with the PCM/DDAS ground equipment. These modifications were incorporated in all units.

Four of five integrated units of telemetry ground equipment were fabricated, acceptance tested, and delivered to their respective locations. The fifth unit, intended for MTF, should be delivered in August, 1965. The single-sideband demultiplexers and instrumentation tape recorders, which are major subsystems of the telemetry ground system but procured under separate contracts, were all similarly processed and delivered. One integrated telemetry unit, manufactured for use at Michoud Complex I, was diverted to the Huntsville Engineering Evaluation Laboratory for engineering evaluation through July 15, 1965.

RF terminal equipment for R-QUAL and R-TEST were manufactured, tested, and delivered. The RF terminal equipment is being augmented by an additional rack of equipment as a result of the addition of the ODOP transponder and the visual instrumentation TV camera system (CAM 224) to the S-IC stage. Production drawings for the fabrication of this additional equipment rack were released.

The DDAS tape recorder is used to record PCM/DDAS signals during stage checkout. This also serves as a backup recorder to the instrumentation recorder in the integrated telemetry ground equipment. All units were fabricated, acceptance tested, and delivered. Two tape recorders, one DDAS tape and one instrumentation tape recorder, were diverted to the Huntsville Evaluation Laboratory to support, respectively, tape recorder and telemetry ground equipment engineering evaluations.

Remote automatic calibration systems consisting of one remote automatic calibration unit, four manual control drawers, and five portable control units were fabricated, acceptance tested, and installed at all usage locations except MTF. The MTF unit has been undergoing engineering evaluation in the Huntsville Engineering Laboratory. The engineering evaluation will be completed during the first quarter of FY 1966.

The electrical design of the visual instrumentation (CAM's 224 and 225) checkout equipment was completed. Production drawings for the fabrication of this equipment are under preparation and scheduled for completion during the first quarter of FY 1966.

Checkout Auxiliary Equipment

The initial electrical design of the antenna checkout set and the necessary redesign brought about by the addition of the visual instrumentation TV camera system (CAM 224) to the S-IC stage was completed. Production drawings for the fabrication of this test set were released, and the initial unit has been fabricated, evaluated, and delivered to R-QUAL. Electrical design of the SWR measuring set necessitated by the addition of the TV camera system has been completed and production drawings have been released. Three tools to aid in the installation of the film cameras (CAM 225) for the stage visual instrumentation system have been designed and released.

SUBSYSTEM TEST EQUIPMENT

Design of the lower-level test equipment proceeded satisfactorily on the schedule needed to support manufacturing operations and is virtually complete, except for continuing changes necessitated by changes in design of stage systems.

Contract go-ahead for contract Modification 233, which established requirements for equipment for performing F-1 engine receiving inspection checkout, was received during the third quarter of FY 1965. Critical design reviews were held in April for both the Boeing-designed equipment and the vendor-designed hydraulic pumping unit. The design is approximately 90 percent complete for both. Government furnished drawings for the electrical test set have been released for procurement action.

TRANSPORTATION AND HANDLING EQUIPMENT

Basic design releases and all committed design change releases for the stage horizontal internal access equipment have been completed (Figure I-11). Installation

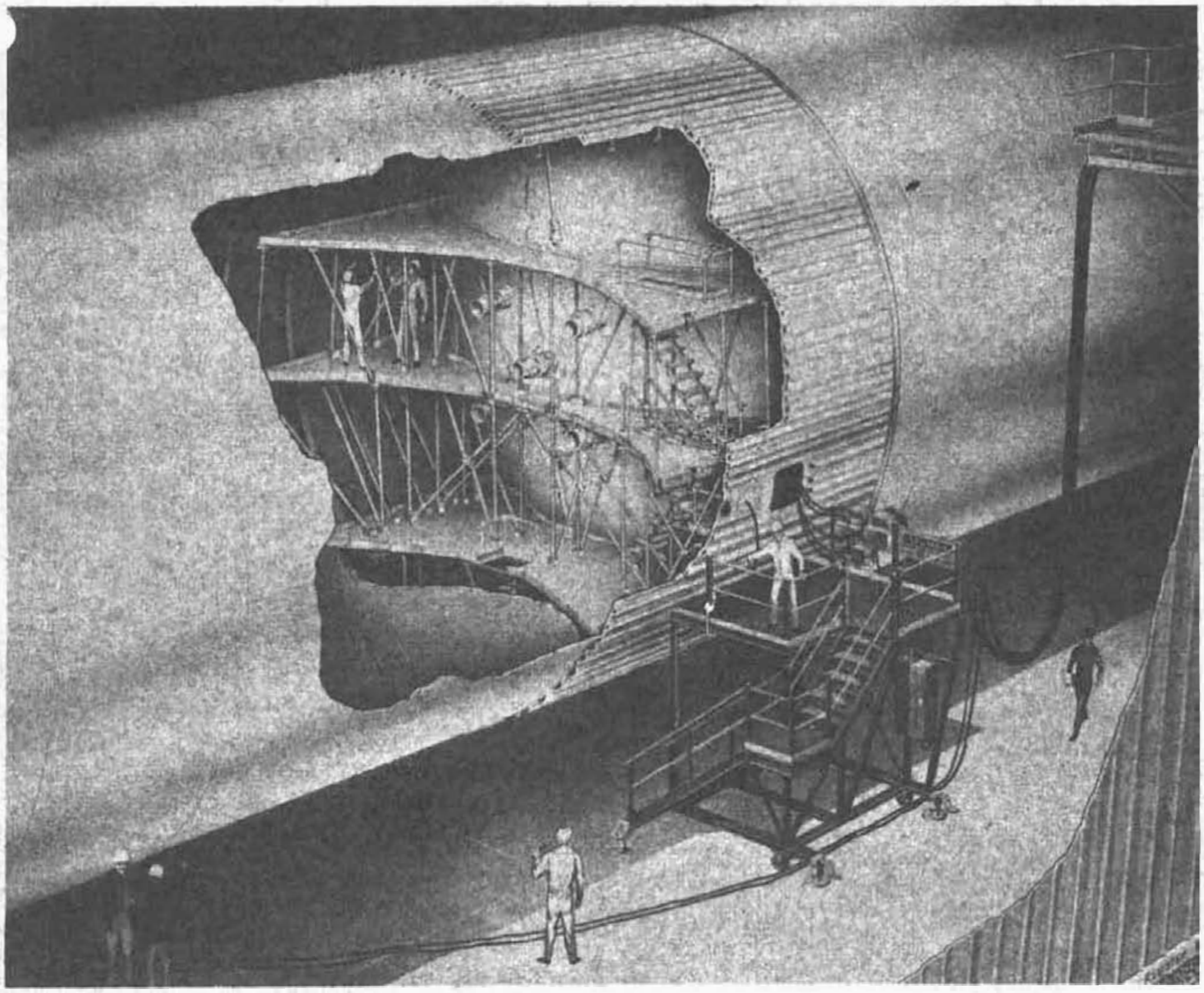


FIGURE I-11 STAGE INTERTANK WORK & ACCESS PLATFORMS

procedure handbooks for these stage internal work platforms were prepared. Basic design releases and all committed design change releases for the intertank, thrust structure, LOX tank, and fuel tank stage vertical internal access equipment were completed (Figure I-12). Engineering design changes to the basic release of the vertical internal access equipment are in work for the LOX and fuel tank upper bulkhead protection equipment, and forward skirt internal access equipment. Changes to these items are necessary to make them compatible with cabling releases of flight vehicles made subsequent to GSE releases and with other committed stage changes.

The stage weighing equipment was successfully used to weigh the stage weight simulator at R-QUAL. Several components of the weighing equipment were delivered on an interim basis for use with the weight simulator. These components will be replaced with improved design before the first scheduled use of the weighing equipment with a flight stage at R-QUAL.

Design releases were completed for three items of engine handling equipment used to support the installation of the S-IC/F-1 engine weight simulator. This equipment consists of:

a) A counterbalance tool capable of aligning and positioning the F-1 engine weight simulators for installation on the horizontally oriented S-IC-F stage;

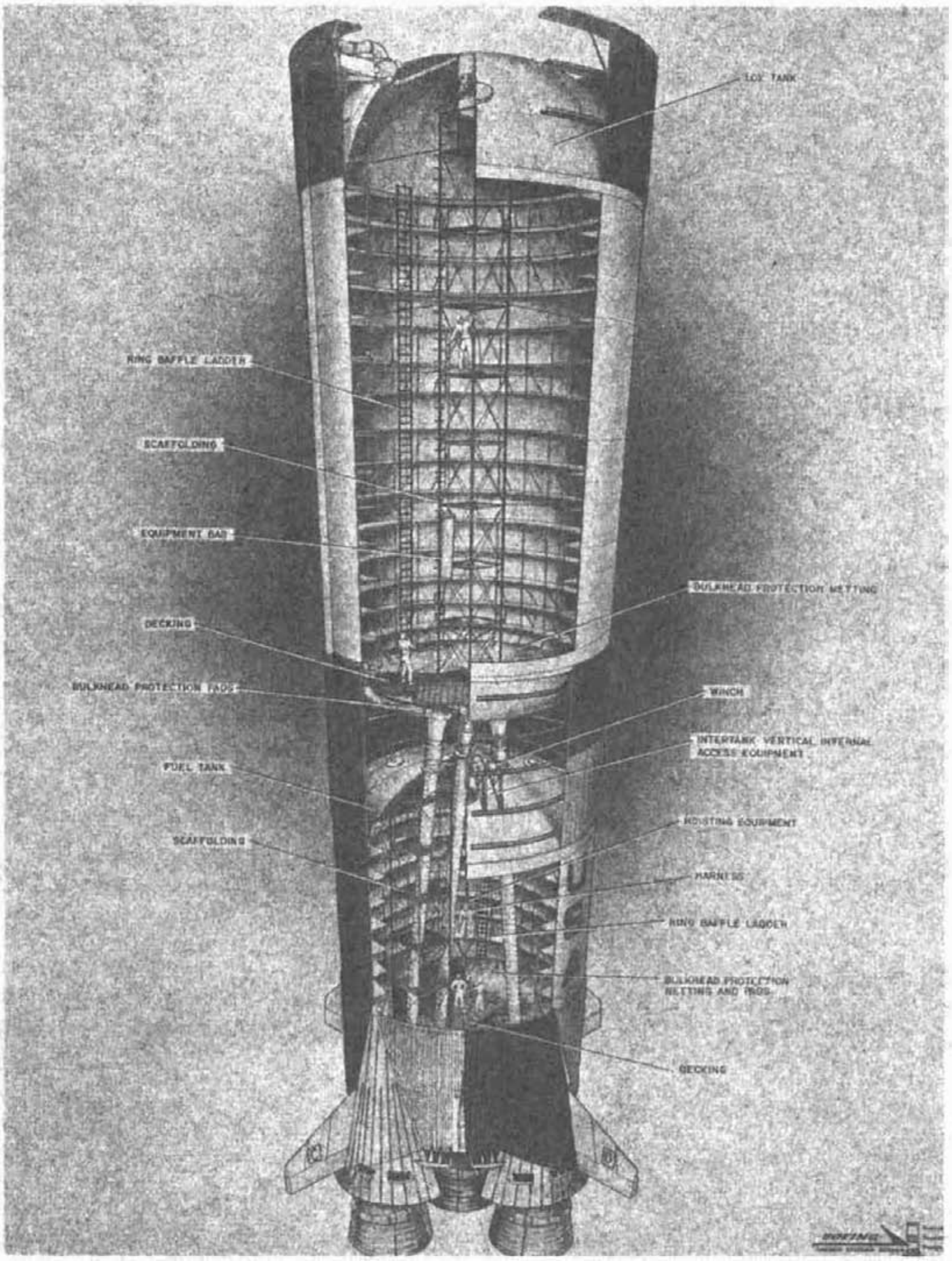


FIGURE 1-12 S-IC STAGE FUEL & LOX TANK ENTERING EQUIPMENT

b) A shackle installation for lifting and installing engine weight simulator weight plates;

c) A weight plate installation pallet for installing weight plates onto the engine weight simulator on a vertically-oriented stage.

All design releases for the propellant tank pressure monitor and control equipment were completed, and the operating and servicing handbook prepared and released. The first two pressure control modules, manufactured by Hayes Co., were delivered to MSFC R-QUAL in June, 1965.

MECHANICAL AUTOMATION BREADBOARD (MAB) (CONTRACT MODIFICATION 94)

Design was completed and fabrication documentation released for the following elements of the MAB: fuel system, LOX system, control pressure/surge system, F-1 engine gimbal stand, manual operations

-nter, and thrust chamber simulator. Design continues on the following elements: fuel and LOX depletion, MAB interconnect, and hydraulic load simulator.

The requirement for the hydraulic load simulator was established by contract Modification 234. The simulator will be capable of simulating the dynamic hydraulic loads encountered during the S-IC five engine starting sequence. A supplement to the modification, calling for a severable shelter over the MAB hydraulic equipment at MSFC, has been received.

UMBILICAL EQUIPMENT (CONTRACT MODIFICATION 123)

The designs were completed and all fabrication documentation released for the substitutes, simulators, vehicle plates, MILA carrier umbilicals and interconnecting piping. At present, activity consists of sustaining, monitoring of qualification testing, implementing changes, and writing operating and servicing instructions. The operating and servicing instructions are approximately 20 percent complete.

Simulated lift-off tests were conducted by the NASA test laboratory on the tail service mast in conjunction with the aft three umbilicals. In addition, development tests were conducted on the Aft No. 1 umbilical assemblies and the intertank assemblies. As a result of these tests, several design changes were required. These were made and documentation released.

All test requirements and procedures documents for both vendor and in-house testing were completed and released. Vendor qualification testing was successfully completed for the umbilical switch, all umbilical couplings, the intertank pneumatic actuators, and the intertank butterfly valve. Both vendor and Boeing documentation packages are being processed for the vendor-designed hardware. These packages include test requirements, procedures, reports, maintenance manuals, microfilm, reproducible drawings etc.

The liquid oxygen fill-drain assembly is presently undergoing vendor qualification testing. Qualification testing on Boeing-designed hardware assemblies is proceeding, following satisfactory completion of component testing of Boeing-designed hardware. The forward umbilical vehicle plate and carrier assemblies were qualification tested satisfactorily. Intertank assemblies underwent the functional portion of qualification testing and are in the final phase of humidity and low-temperature testing. All functional qualification testing of the Aft No. 1 umbilical is complete and preparation is being made for the final phase of vibration and shock testing. Qualification testing of the Aft Nos. 2 and 3 umbilical assemblies is scheduled to begin early in FY 1966.

LAUNCHER UMBILICAL TOWER (LUT) PNEUMATICS (CONTRACT MODIFICATION 174)

The S-IC pneumatic console, pneumatic checkout racks (PCR), and the pneumatic console test set designs were completed and released at the end of FY 1964. Subsequent revisions to the functional requirements of the LUT pneumatic equipment required redesigns of the pneumatic checkout racks to change the stage testing technique, to delete manual testing functions, and to repackage from six to four racks. An accompanying redesign of the PCR tester portion of the pneumatic console test set was completed by mid-FY 1965.

CAM's 225 and 278 provided for a new console, and the forward umbilical service unit. This is to be located on the 100-foot level of the LUT. The design was completed in the third fiscal quarter. A qualification program for the pneumatic components used in the LUT pneumatic equipment was established, conducted, and completed this year.

LOGISTICS

During the past year S-IC stage and GSE logistics support efforts were confined to preparing the S-IC-1 portion of the Saturn V Technical Information Handbook, the Pneumatic Test and Checkout Maintenance Manual, and recommended Maintenance Spare Parts List for stages S-IC-D and S-IC-F. An important effort during the past year was the Boeing MSFC development of comprehensive integrated logistics support program plan. These Boeing and NASA/MSFC efforts culminated in the contractor's receipt of Contract Change Order MICH-44, June 3, 1965. Since that time, the contractor has prepared detailed plans and work statements and has established an organization to implement the logistics effort. The Boeing Company has the following obligations under MICH-44:

a) Prepare an S-IC Logistics Support Program plan describing how the logistics support elements will be developed to provide logistics support for certain S-IC stages and contractor-furnished S-IC stage-peculiar GSE. This plan was submitted to NASA/MSFC on June 3, 1965.

b) Conduct a maintenance analysis on the S-IC-1 through -10 stages from on-dock delivery at

KSC/MILA through launch of the Saturn V vehicle. This effort will include an analysis of the contractor-furnished S-IC stage-peculiar GSE at KSC. Maintenance analysis will be based on MSFC-furnished Saturn V operations analysis and maintenance concepts.

c) Establish, maintain, and control a spare parts support program for the contractor-furnished S-IC-F and S-IC-3 through -10 at KSC, the contractor-furnished S-IC stage-peculiar GSE at KSC, and the R-TEST S-IC umbilical carrier hardware. This responsibility includes, but is not limited to, such functions as spare parts identification, acquisition, configuration control, storage at Michoud, inventory management, and transportation. This spares effort is in support of the stage and GSE repair, replacement, refurbishment, and retest functions. The Boeing Company is responsible for repairing and overhauling reparable parts replaced by maintenance spare parts provisioned in support of this program.

d) Identify and prepare technical support data (technical manuals) covering Operations and Level I maintenance at KSC for the S-IC-1 through-10 stages and contractor-furnished S-IC stage-peculiar GSE.

e) Provide logistics field support engineers at the appropriate time at MSFC and KSC to analyze, evaluate and resolve logistics problems, and report and coordinate logistics matters with NASA/MSFC, NASA/KSC, or Boeing.

The Pneumatic Test and Checkout Equipment Maintenance Manual for the Launch Umbilical Tower was prepared under Contract Modification 174 and delivered in the last quarter of FY 1965. The delivery schedule for the S-IC-1 portion of the Saturn V Technical Information Handbook is included in D5-12528, "Technical Manual Program Plan." The S-IC-D and -F recommended maintenance spare parts lists mentioned above were submitted under Part III, Paragraph D of Contract NAS8-5608.

Because of the late establishment of the Logistics Support Program, spares procurement problems may cause program disruptions. To minimize program impact, spares must be ordered and procured on an expedited basis. Certain technical manuals will be provided to support Operations and Level I maintenance at KSC; however, time will not permit their preparation to support the S-IC-1 at MSFC. Therefore, the first interface between the procedures provided in the technical manuals and the S-IC-1 stage equipment will occur at KSC.

The late authorization for an integrated Logistics Support Program notwithstanding, vigorous attention to all problem areas and energetic objective action by both the Contractor and NASA may reduce, but not eliminate, delay and excess expense for logistics support of early flight stages.

RELIABILITY

INTRODUCTION

The Saturn S-IC "Reliability Program Plan," D5-11013, initially released in January 1963, has been updated by a revision. The revision was submitted to I-MICH-QR and approved during the fourth fiscal quarter (see Reliability Documentation and Reporting.)

A joint review of the S-IC stage reliability program by Boeing and NASA/MSFC was conducted in preparation for a briefing of the Presidential Scientific Advisory Committee. This committee reviewed the Saturn V Program at MSFC on March 24 and 25, 1965.

Personnel assignments in the reliability program at the end of FY 1965 are shown in Figure I-13.

Auditing of all organizations for compliance with the "Reliability Program Plan," D5-11013, as revised, was conducted quarterly. The results of these audits were presented to Boeing management and to NASA/MSFC. The audit was summarized in Documents D5-12604-3 and -4, and D5-12955-1 and -2, "S-IC Reliability Program Status."

ACTIVITIES

Reliability Analysis (Figure I-14)

The January, 1965, release of "Propulsion/Mechanical Systems Design Analysis," D5-12572-1, incorporated two additional systems, fuel delivery and LOX pressurization. The last remaining system, control pressure, was revised to reflect a major design change (CAM 242) and will be included in the July, 1965, release. This release will reflect results of the evaluation studies conducted by Saturn Booster Technology.

The April, 1965, updating of D5-12572-2, "Operational Electrical Systems Design Analysis," was not completed on schedule. The completed analysis was reviewed and was being prepared for a July, 1965, release. This issue will consist of failure mode and effects analyses (FMEA) and probability analyses (PA) based upon August, 1964, system configuration.

Parameter recommendations for the propulsion/mechanical single thread analysis and emergency detection system (EDS) were released October 1, 1964, in D5-12789, "Design Analysis for S-IC-1 Malfunction Detection System." The document was updated in February, 1965, to show propulsion/mechanical design changes, and again in April, 1965, to integrate the electrical/electronic systems into the single thread diagram.

The latest revision to D5-12789 was released June 1, 1965, as scheduled, and was changed to reflect the recent NASA/MSFC, R-P&VE-VO, analysis ground rule which eliminated gimbal and flex hose major leaks and ruptures as valid failure modes. This ground rule change results in a somewhat limited single thread analysis, in that major failure effects such as "LOX tank rupture due to over-pressure" do not appear on the diagram. In order to present a single thread diagram representing the complete design analysis results, D5-12572-3, "Integrated S-IC Systems Design Analysis," was prepared and released in June, 1965.

A study was provided in support of contract Change Order No. MICH-29, "Evaluation and Preliminary Design of an S-IC Gas Injection System." An FMEA and a PA were conducted for the various configurations under study.

Reliability Assessment (Figure I-14)

Document D5-11954, "Saturn S-IC Stage Assessment and Prediction Program," was updated and released in May, 1965. The updating reflected the current models and methods being used in the assessment and prediction program. The multiple failure mathematical model was modified to provide for the incorporation of data changes, and to minimize time required for computer simulations.

Document D5-11954-1, "Saturn S-IC Stage Reliability Analysis Record," was released in April, 1965, to present the evaluation of the propulsion/mechanical system using the single failure effects simulation model. Inputs of additional data were provided in order to complete a preliminary prediction of the S-IC-1 stage using the single failure effects simulation model by August 1, 1965.

All inputs of reliability data for the multiple failure effects simulation model were completed and placed in FORTRAN form. The final S-IC-1 prediction using the multiple failure simulation model is scheduled for completion January 15, 1966.

RELIABILITY ORGANIZATION SATURN S-IC

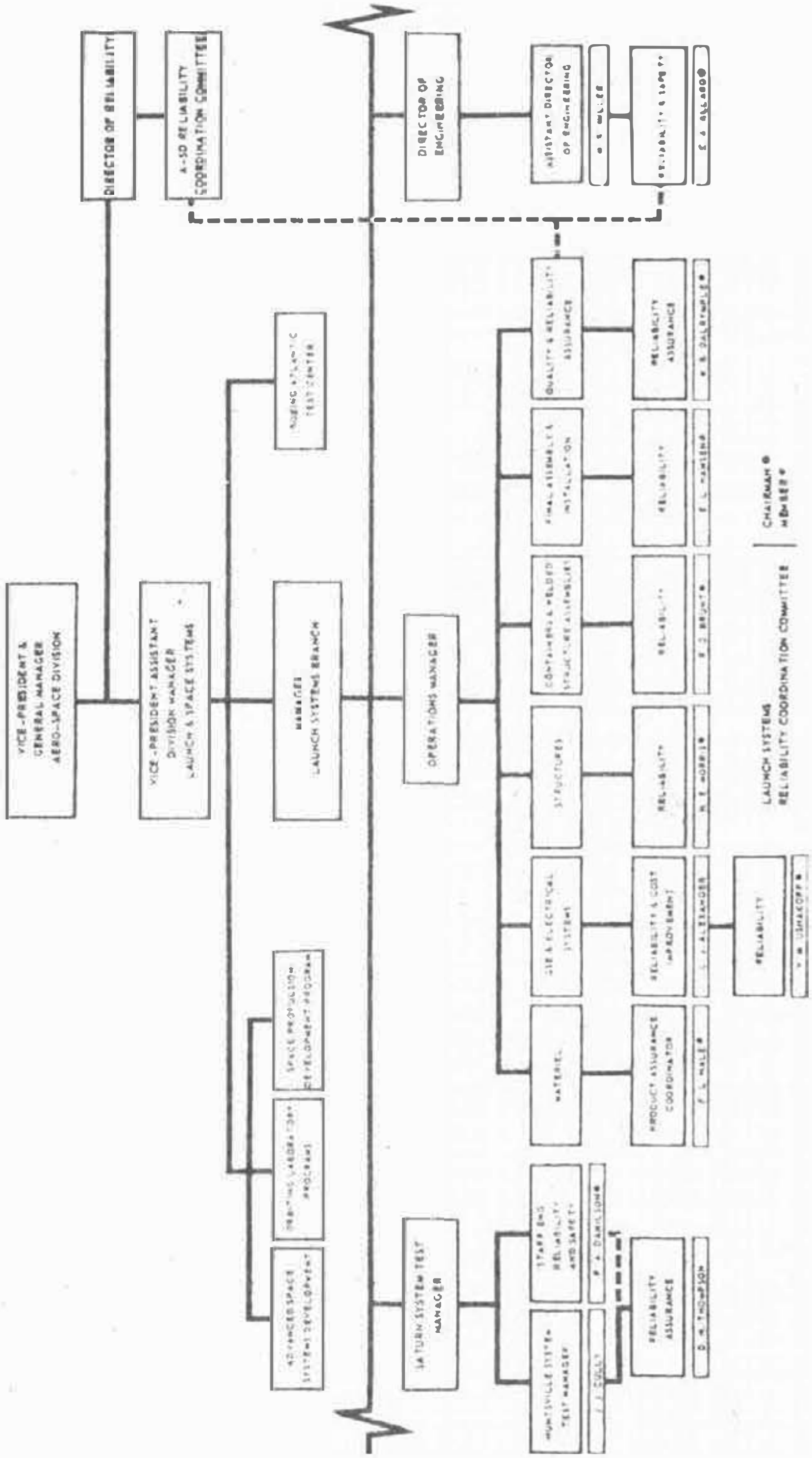


FIGURE 1–13

RELIABILITY PROGRAM MILESTONES

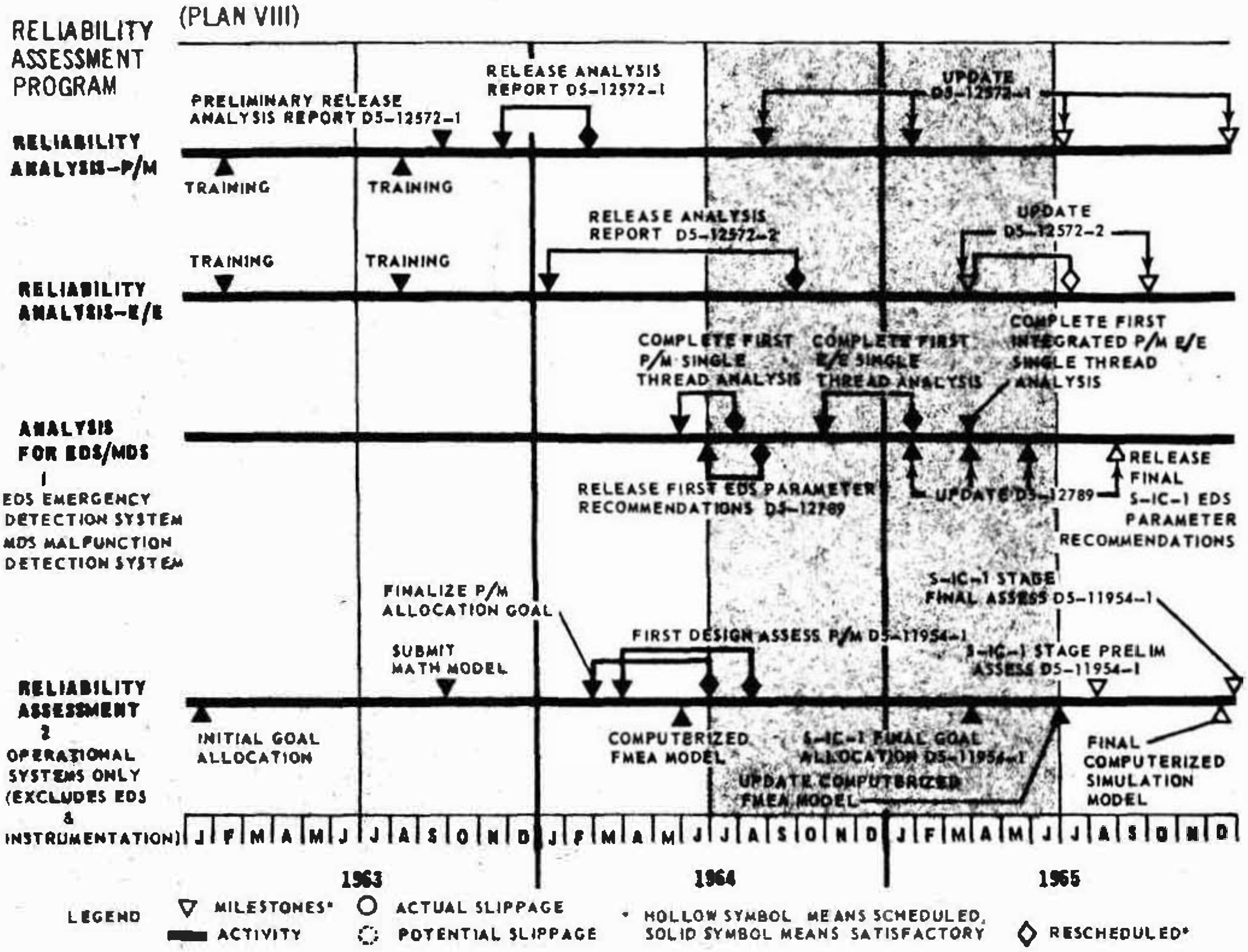


FIGURE I-14

Documentation and Reporting (Figure I-15)

A revision of D5-11013, "Reliability Program Plan," was released in September, 1964, to incorporate the changes requested in letter I-MICH-C, July 2, 1964. Subsequent coordination meetings were held with I-MICH-QR during March, 1965, to resolve all items necessary for plan approval. A May 1, 1965, revision reflecting the requested changes was submitted for approval by letter 5-1118-M-71-699, dated May 12, 1965. Approval was granted by I-MICH-QR letter dated June 21, 1965.

All four quarterly releases of D5-11910, "Reliability Status Report," reflected the current status of reliability task accomplishment and the critical items list. Goal and assessment data originally contained in D5-11910 were removed from the January, 1965, issue and transferred to D5-11954-1, "Saturn S-IC Stage Reliability Analysis Record." A supplemental revision to the D5-11910 critical items list was released in May, 1965. This revision correlated reliability test identification numbers to specific critical items.

Document D5-11593, "Launch Systems Branch Record System," was under revision. The estimated release date is July 15, 1965. Certain related documentation will be delayed due to the status of this document.

RELIABILITY PROGRAM MILESTONES
(PLAN VIII)

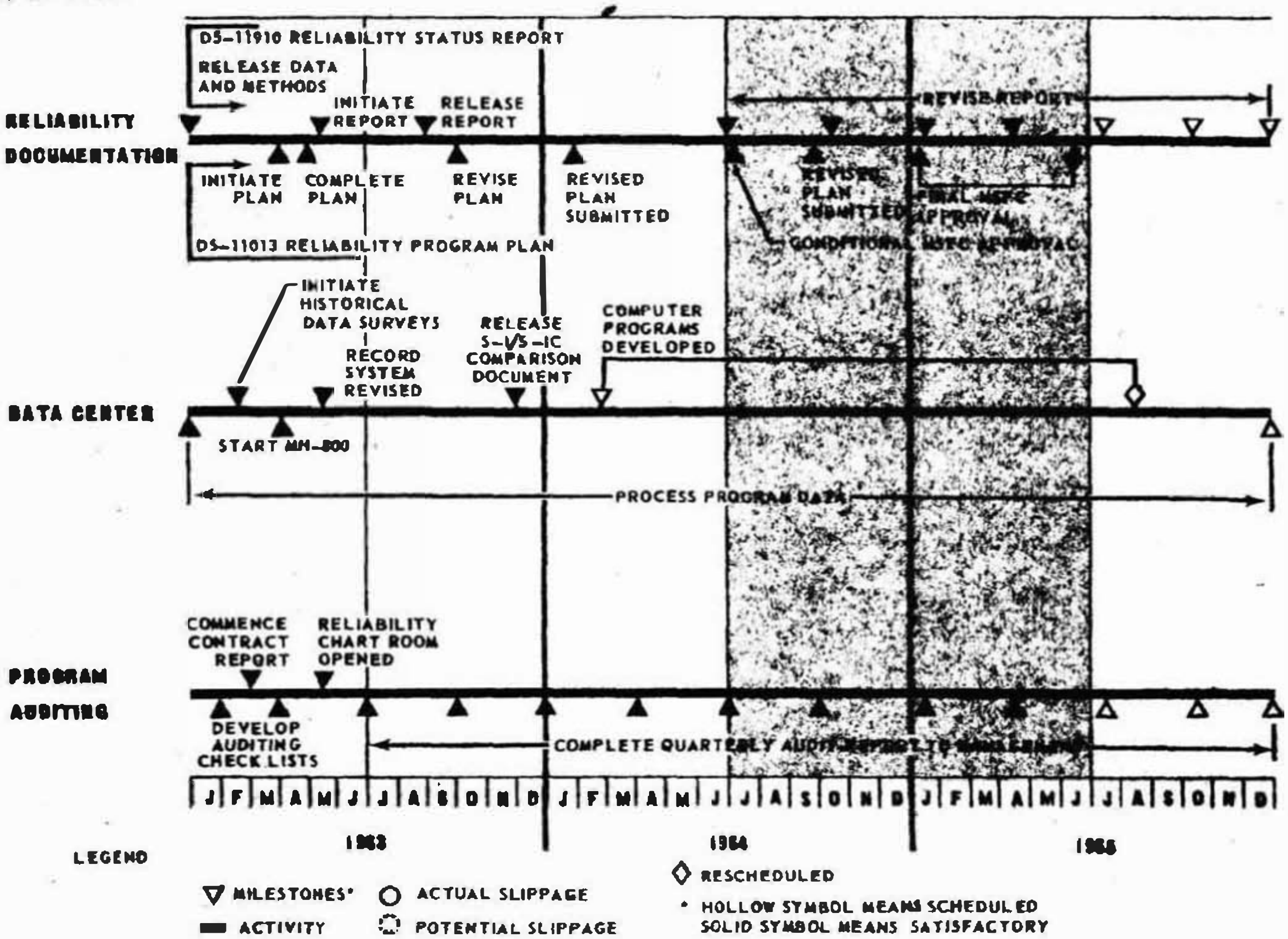


FIGURE I-15

Action was initiated to control age or time/cycle sensitive items and to upgrade D5-12713, "Time/Cycle Recording Requirements," to Class I documentation. Engineering drawings now must specify what items are age or time/cycle sensitive. A new form, the Age-Life Record card, was initiated to log the cure/manufacturing dates, shelf-life and installed-life of age-life sensitive material.

"GSE and Electrical Systems Organization Reliability Program Plan - S-IC," Document D5-12982, which outlines the reliability responsibilities, policies, operating procedures, and follow-up activity for the GSE and Electrical Systems Organization, was released on April 14, 1965.

DESIGN REVIEWS

Critical design reviews were conducted on eight items during the fourth fiscal quarter. These items are enumerated in the chart at the top of the next page.

Review Date	Drawing No.	Title
4-1-65	60B79609-1, -3	LOX Tank Optics
4-7-65	60B52101	Valve-Solenoid, 3-way
4-7-65	60B52106	Valve-Solenoid, 2-way
4-28-65	60B47001	Retrorocket Motor
4-28-65	60B20000	Base Heat Shield
5-4-65	60B41136	Valve-LOX Inter-connect
5-4-65	60B74600	T. V. Transmitter
6-29-65	60B52000	Control Pressure System

Total number of reviews conducted by the end of FY 1965 on critical systems, subsystems, and components or items were as follows:

a) Eleven of twelve structure items were reviewed with the remaining one, intertank, scheduled for first quarter FY 1966.

b) All eight reportable propulsion/mechanical subsystems (per D5-11910) were reviewed.

c) Only eleven operational electrical subsystems of the electrical/electronic portion of the S-IC stage are classed as reliability critical. The intent of formal critical design review per Launch Systems Branch O. P. 650.3 was considered to have been completed by a previous Boeing-NASA/MSFC review.

d) Of the forty-eight critical propulsion/mechanical items at the component/piece level, thirty-three scheduled reviews have been conducted. Three Boeing controlled items, seals, were not subject to formal review. The remaining twelve items are MSFC controlled.

e) Of the fifty-six operational electrical systems critical items, there are sixteen Boeing components, six MSFC components, and thirty-four MSFC or Boeing piece parts. Three scheduled reviews on Boeing components were conducted. Boeing piece parts are not considered subject to formal critical design review.

SELECTION AND CONTROL OF PARTS

Document D5-11372, "Parts Selection and Control Program Plan - Saturn S-IC," was prepared as directed by Technical Directive No. I-V-S-IC-216 and released July 23, 1964, for approval. Technical Directive No. I-V-S-IC-250 was received November 16, 1964, directing implementation of D5-11372 with minor changes. The document, revised to incorporate the NASA/MSFC requested changes, was submitted for approval by letter 5-1118-M-71-579, dated February 26, 1965. Change Order I-9 to Contract NAS8-5608 was received April 2, 1965, cancelling Document D5-11202, "Specifications and Deviations for the S-IC System." NASA/MSFC letter I-MICH-QR, dated June 3, 1965, stated that the provisions of D5-11372 satisfied the requirements of Paragraph H-14, Part I, Exhibit "A", Technical Work Statement of Contract NAS8-5608, and that the document was approved.

FAILURE ANALYSIS

Drafts of the failure flash report for both branch procedures and engineering instructions were released during the fourth fiscal quarter. Engineering standard operating instructions (SOI) 650.9, "Failure Analysis," was released in February, 1965. The first edition of the "Failure Analysis Monthly Status Report" was released in June, 1965.

The following was the status of Boeing and supplier failure analyses at the end of FY 1965.

In Work	Completed	Total
6	17	23

RELIABILITY EDUCATION

A training course was prepared and presented to instruct personnel in the proper control of contamination for propellant wetted components. Factory personnel are expected to complete this course by the early part of FY 1966.

A course entitled "Installation and Handling of Electrical Connectors" was developed and is being conducted by Industrial Relations Training Department for technicians, mechanics, and inspectors who handle, install, modify, repair, or inspect electrical wiring and connectors. This four hour course will provide training necessary to reduce damage to electrical wiring and connectors.

SUPPLIER CONTROL

In the monitoring of supplier processes and hardware failure problems, special emphasis was directed toward those suppliers who furnish mechanical components. The principal problem encountered is in cleaning and packaging LOX clean parts. To resolve this problem, supplier cleaning processes were reexamined to verify that cleanliness levels were adequate and to assure that no potentially detrimental cleaning operations were utilized. A team representing cognizant organizations was formed to assure complete compliance with cleaning requirements. Six Boeing cleaning specialists are presently working with suppliers in support of this program.

A system is being established to assure that all engineering orders (EO) or process specification deviations (PSD) referenced in procurement drawings are transmitted in a timely manner to all affected suppliers. The system is targeted to be in operation during first quarter FY 1966.

A total of 30 management reviews and quality system surveys were conducted at supplier facilities during the quarter. Document 60B00010, "General Requirements for Suppliers," is being revised to assure configuration control of supplier-furnished hardware through improvements in the part-marking system.

EQUIPMENT QUALITY ANALYSES

The thirteen parts listed below were subjected to Equipment Quality Analyses (EQA) during the last fiscal quarter.

EQA No.	Drawing No.	Item
EQA 016	60 B76478-1B	T/M Power Supply
EQA 019	RV78A	Marotta Valve
EQA 020	60 B73061-13B	DC Amplifier
EQA 021	60 B73078-3C	Emitter Follower
EQA 022	60 B72099-1B	Temp. Transducer
EQA 023	60 B75130-1	Multicoupler
EQA 024	60 B76371-1A	Sub. Carr. Osc.
EQA 025	60 B76101-1A	Single S/B Assy.
EQA 026	60 B76373-1A	DC-DC Converter
EQA 027	60 B72199-3	Press Transducer
EQA 030	60 B51407-1B	Valve Assy.
EQA 031	60 B41028-1A	Valve Assy. Check
EQA 032	BRPL29K1AT6A-3 Relays	

Receipt of satisfactory replies from suppliers enabled three EQA's to be closed during the fourth fiscal quarter.

Design changes and qualification testing continued to delay the delivery of parts. Twenty-two EQA's are scheduled for the first quarter of FY 1966.

Twenty-eight EQA's were conducted between July 3, 1964 and July 1, 1965. Seventeen have been closed, four are awaiting supplier reply, and seven are in documentation.

DATA COLLECTION AND ANALYSIS

All reliability data center computer programs were developed except the "Actual versus Design Configuration Comparison" program. The testing of this program was delayed because of NASA computer facility programming language conversions. This program was being tested for expected implementation by August, 1965. (Figure 1-15.)

The "Corrective Action Request (CAR) Status Report" was released in May, 1965. This is a monthly report reflecting the status of outstanding CAR's.

A programatic flexowriter was ordered for preparation of "Actual Configuration" and "Unplanned Event" raw data for use in computer programs. This method will cut costs by reducing the amount of hand transcribing and by eliminating keypunching. The Friden Company has promised delivery the first week in August, 1965.

The "Actual Configuration Indentured Parts List" computer program was tested with S-IC-D thrust structure data. This program is planned to support delivery of the S-IC-F booster with a mechanized configuration listing.

Ten reports on qualification and reliability testing of fluid couplings and one report on development testing of linear shaped charges were submitted for the interservice data exchange program (IDEP).

Experience retention studies were completed on "Hydrogen Embrittlement" (October 16, 1964) and "NAS 1022A Nuts" (December 2, 1964). In addition, the following investigations were completed and will be released as experience retention studies:

a) Ducting and tubing contamination;

b) Analysis of S-IC stage component failures during vibration testing;

c) Welding problems;

d) Precipitation observed during dye leak tests of tanks.

Research for historical data was provided for approximately 100 parts since January, 1965, in support of the engineering standard parts selection program.

A total of 545 requests for corrective action were processed by the Reliability Data Center. These requests were generated by NASA/MSFC and various Boeing organizations. Of the total requests, 505 were resolved and 40 are outstanding.

A weekly welding analysis report was initiated in January, 1965, to provide process history and quality trends and to identify problem areas.

RELIABILITY AUDITS

Beginning with the third fiscal quarter, management visibility of the reliability effort was improved by reporting audit findings against the major contract elements. Previous audit findings were reported against organizations.

Audits during the third fiscal quarter rated eight elements as satisfactory, six as having deficiencies, and two as problems. The problem elements were:

a) Data Collection. Clarification of conflicting instructions and revision of training courses were recommended. The updating and revision of Document D5-11593, "Launch Systems Branch Records System" is scheduled for release July 16, 1965. Pending this release, revisions to organizational procedures, instructions, and training were held in abeyance.

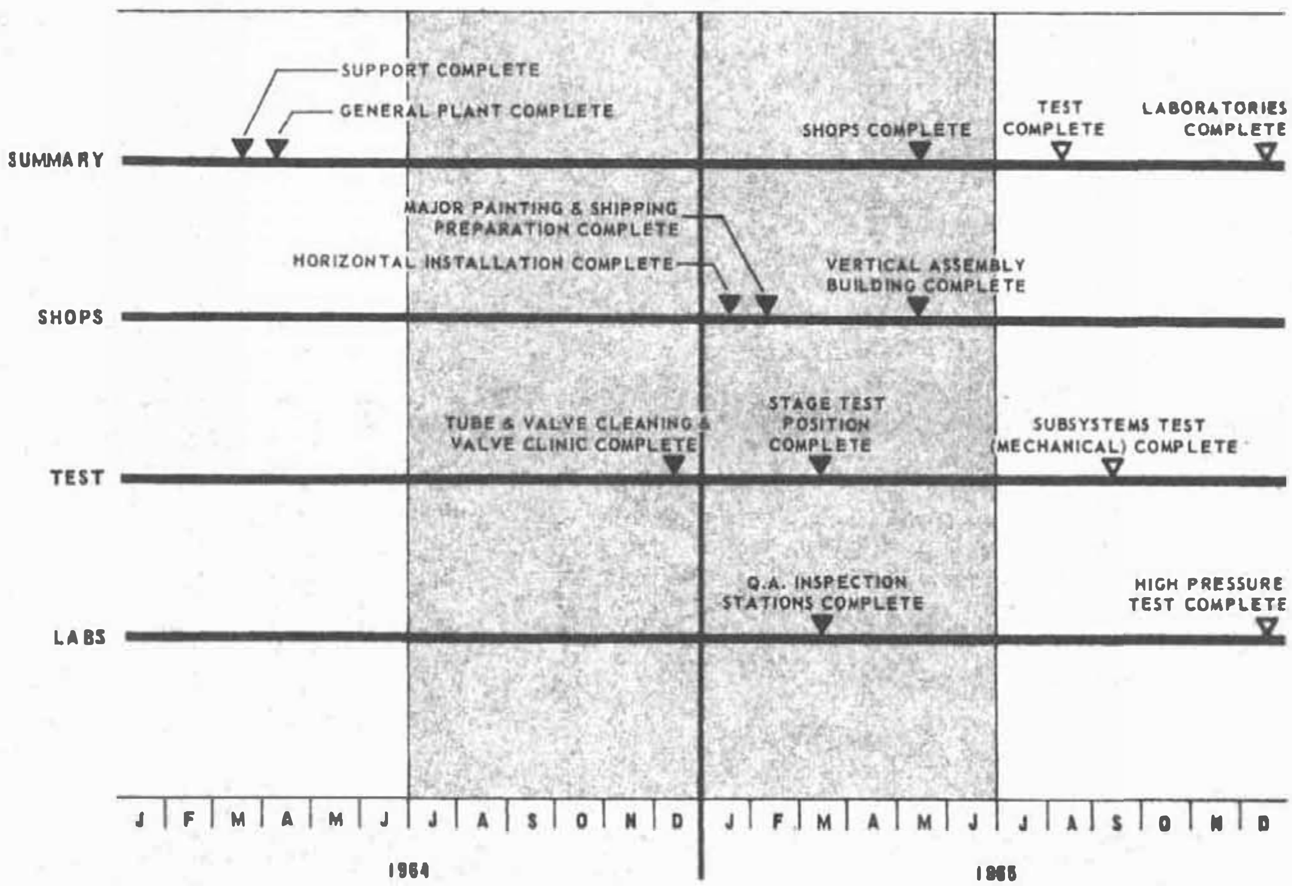
b) Testing. Recommendations included updating of documentation, improved planning of qualification and reliability testing, and releasing of reliability test requirements.

The fourth fiscal quarter audits indicated that improvement was made in documenting the qualification and reliability test schedule and the items to be tested, and in releasing reliability test requirements. The data collection area was awaiting release of the revised D5-11593 at the end of FY 1965.

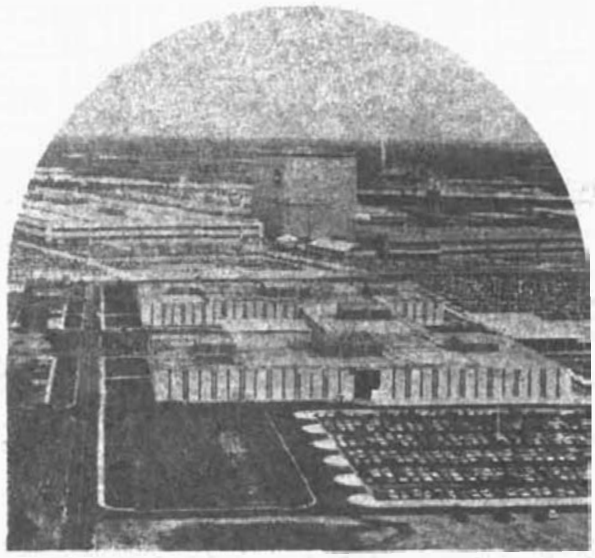
During the week of April 26, 1965, a team of NASA/MSFC personnel conducted an audit of the Launch Systems Branch reliability program, using the NASA "Manual for Evaluating Apollo Contractor Reliability Plans and Performance." The audit findings were described in NASA memorandum R-QUAL-RE-146-65, dated May 18, 1965. The audit disclosed no major Boeing problems. However, twelve action items were outlined for NASA/MSFC. Among these were requirements to provide a policy on time/cycle limits; provide engineering and FMEA data on GFE parts; identify the first manned launch vehicle; release the "General Test Plan for the S-IC Stage;" and develop procedures for forwarding flash and detail reports on S-IC failures occurring during testing at MSFC.

FACILITIES MILESTONES

(PLAN VIII)



FACILITIES



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SUMMARY

MICHOUD FACILITIES

During FY 1965 significant progress in facility activation was realized. Only two Michoud facilities remain to be completed—the engine test and buildup areas and the high pressure test facility. All partial and interim facilities were eliminated during the year. Several modifications and additions were made to previously activated facilities. This requirement is increasing in scope and is becoming a significant portion of facility activation efforts.

Thirty construction contracts were completed during the year, with seven still in work. One construction contract is awaiting NASA approval.

Activation of shop facilities included the two tank assembly positions, the final assembly position, and the hydrostatic test and cleaning facility, all in the Vertical Assembly Building. Upon completion of the hydrostatic test and cleaning position, a containment wall was added as a safety measure in the event of tank rupture during test operations. Other shop facilities activated during the year included horizontal installation, and major painting and shipping preparation.

Test facilities completed during FY 1965 included mechanical subsystems test (except engine test and buildup), tube and valve cleaning and valve clinic, and the stage test building. Construction was started in completed Component Test areas to modify the facility in support of the qualification test program (MOD 92).

The initial activation of Michoud labs was completed with activation of the quality assurance rotary table inspection station in the third fiscal quarter. Exception is the high pressure test facility. This facility had been partially activated since 1963; however, several changes in facility requirements by the user delayed the design and construction activities on the remainder of the facility. Mutual agreement by all parties allowed construction to begin on the remainder in the fourth fiscal quarter with completion scheduled by the end of CY 1965.

Completion of the NASA Engineering Office Building at Michoud during the second fiscal quarter allowed Boeing to vacate all leased space in downtown New Orleans.

A contract to paint the interior of the factory was awarded in the third fiscal quarter 1965. It is scheduled for completion in the first fiscal quarter 1966.

Requirements for a Rocketdyne facility were established in the third fiscal quarter. Design was completed the following quarter.

HUNTSVILLE FACILITIES

During FY 1965, additional office space was leased in Huntsville to support increased manpower buildups. Work was started on a Boeing owned office building located in the Huntsville Research Park. Its completion is scheduled for mid-CY 1966.

PLANT ACTIVATION STATUS—MICHOUD

At the end of the reporting period, 91 percent, in dollar value, of the total S-IC construction of facilities (C of F) program at Michoud had been completed. It is anticipated that 95.7 percent of the facilities will be complete by the end of the next fiscal quarter.

In June 1965, MODS 15, 16 and 17 were added to the SFC Equipment Contract NAS8-5606(F). Of the total funding for Michoud SFC equipment, 76 percent had been committed by the end of the reporting period. It is anticipated that 82 percent will be committed by the end of the next quarter.

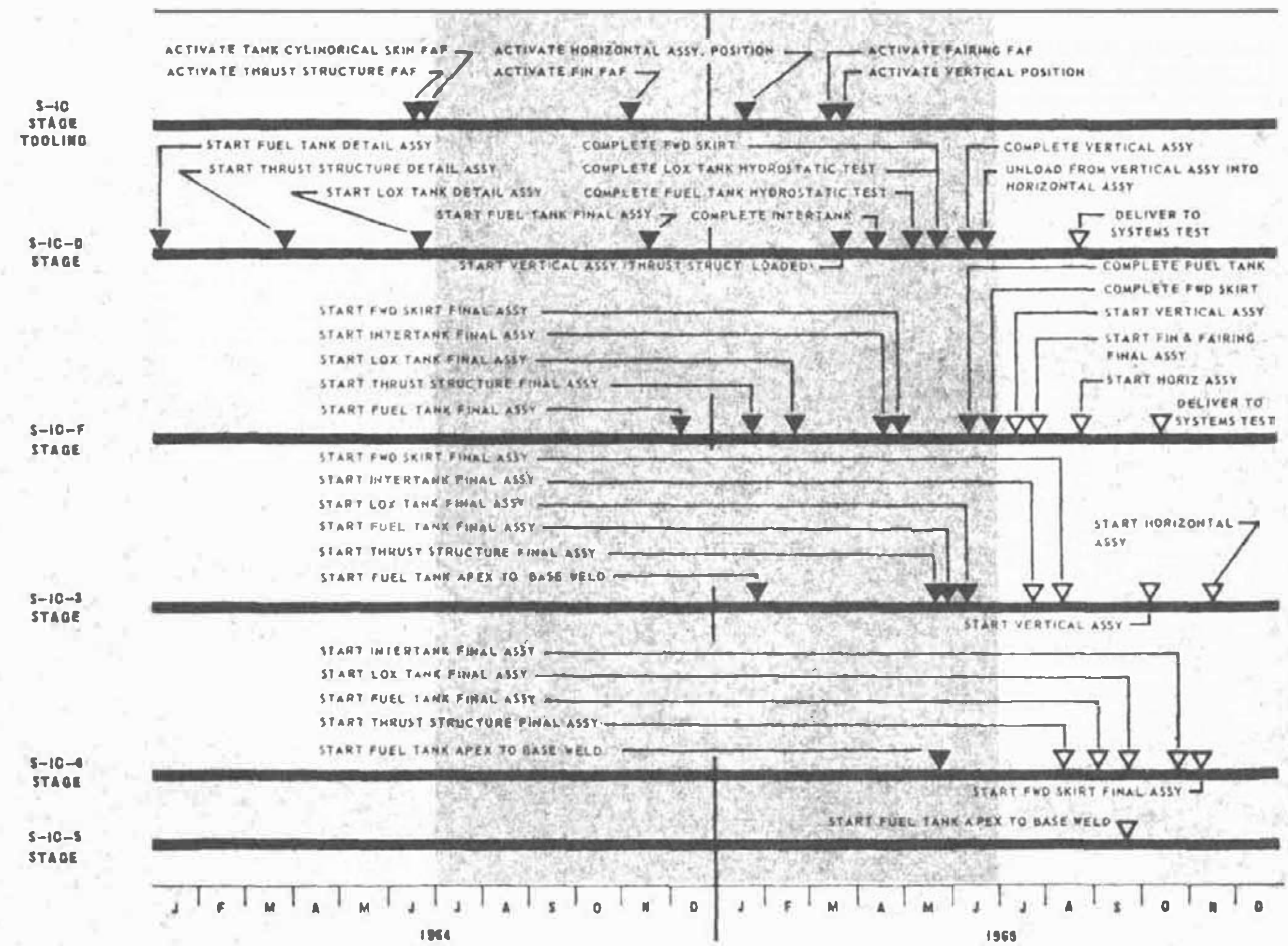
The following table indicates the percentage of brick and mortar activation (in terms of dollar value of C of F funds expended), and the percentage of equipment provisioned by major category S-IC facilities (in terms of funds committed).

	ACTUAL As of 6/30/65		PROJECTED As of 9/30/65	
MAJOR FACILITIES	BRICK & MORTAR	SFC EQUIPMENT	BRICK & MORTAR	SFC EQUIPMENT
Shop Facilities	96.2%	86%	96.8%	89%
Test Facilities	98.8%	67%	99.7%	72%
Laboratories	74.3%	76%	92.9%	84%
Support & General Plant Facilities	85.2%	57%	90.6%	61%
TOTAL MICHOUD PLANT	91%	76%	95.7%	82%

Follow-on modifications and additions to present facilities are currently in progress in the minor assembly area, Vertical Assembly Building, horizontal installation area, major painting and shipping preparation facility, subsystems test (mechanical), stage test position and support, tube and valve cleaning and valve clinic, component test area, support and services areas and painting of factory. These are all scheduled for completion during the first half of FY 1966.

STAGE ASSEMBLY AND MANUFACTURING MILESTONES

(PLAN VIII)



MICHOUD SHOP FACILITIES

MINOR ASSEMBLY

FUNCTION - This facility provides for fabrication and assembly of bulkheads, skin sections, thrust structures, intertank structures and forward skirt assemblies (Figure II-1).

USING ORGANIZATION - Operations

AREA - 238,500 sq. ft.

MILESTONES - The minor assembly facility was initially activated in FY 1964.

The following additional facility projects were completed during FY 1965:

Phase I - The rearrangement and expansion of minor assembly areas.

Phase II - Construction of foundations for the cantilever ring baffle assembly position, and utilities for wiring tunnel covers and the base heat shield assembly.

Modification of the 15-ton crane in mechanical fabrication areas.

During the fourth fiscal quarter the following additional facility projects were completed:

The installation of a one-ton bridge crane over the thrust structure skin panel assembly fixtures.

Installation of the Y-ring pocket-milling facility.

EQUIPMENT - Of the total Michoud SFC equipment funding for minor assembly, 86 percent in terms of dollar value was committed by the end of the reporting period.

FIGURE II-1 MINOR ASSEMBLY AREA IN THE "GRAY BOX". THE PICTURE AT RIGHT SHOWS EQUIPMENT FOR TRIMMING AND WELDING BULKHEAD GORE SEGMENTS. IN THE PICTURE BELOW A Y-RING IS BEING PREPARED FOR ATTACHMENT TO A BULKHEAD

VERTICAL ASSEMBLY BUILDING

FUNCTION - This facility is required to assemble the complete S-IC stage in a vertical position. In addition, the area will be used to assemble tanks, install baffles. assemble tank connection sections, perform hydrostatic testing, and clean flight vehicle LOX piping and RP-1 fuel tanks (Figures II-2 and II-3).

USING ORGANIZATION - Operations

AREA -	VAB	44,400
	Support	51,800
	TOTAL	96,200 sq. ft.

MILESTONES - During FY 1965 activation of the VAB included:

a) Tank assembly positions 1 and 2
b) Final assembly position
c) Hydrostatic test facility

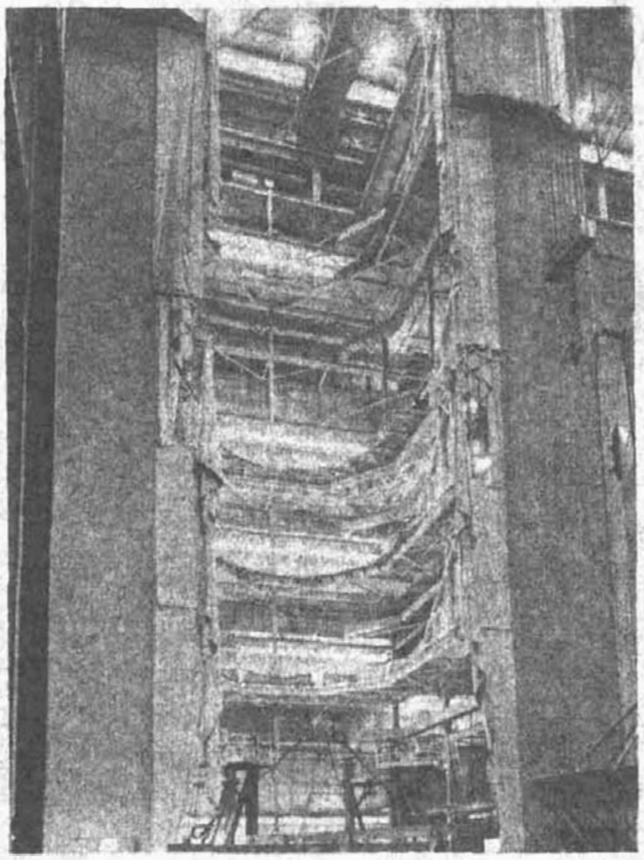


FIGURE II-2 FINAL ASSEMBLY POSITION IN THE VERTICAL ASSEMBLY BUILDING

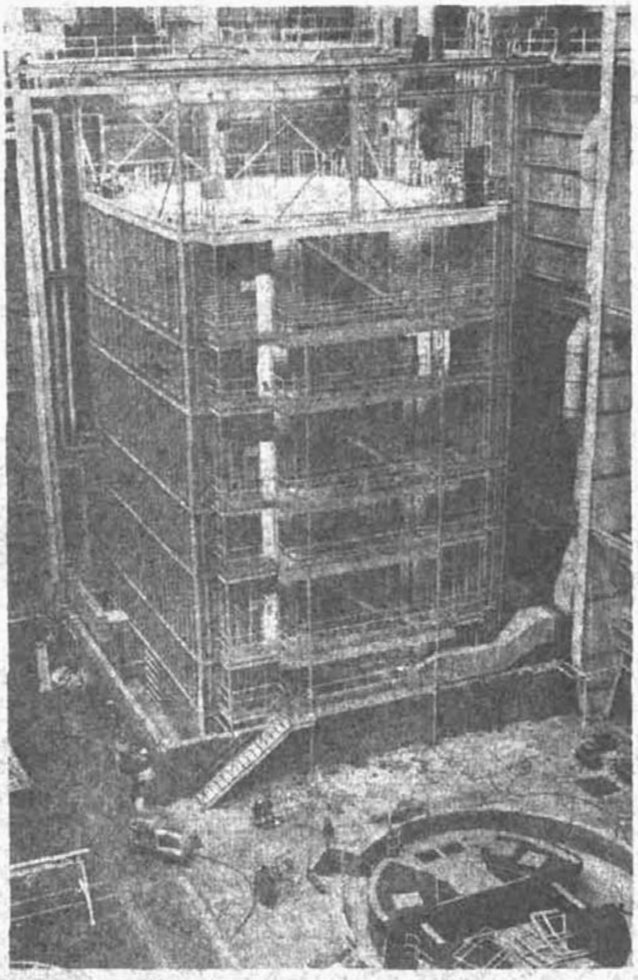


FIGURE II-3 HYDROSTATIC TEST AND CLEANING POSITION IN THE VAB

A containment wall in the hydrostatic test facility was constructed following the initial facility activation.

During the fourth fiscal quarter construction of the tank repair position was completed.

During the fourth fiscal quarter the following additional facility projects were initiated and will be completed during the next quarter:

a) The hydrostatic test personnel elevator
b) Construction of ladder and catwalks in hydrostatic test

EQUIPMENT - Of the total Michoud SFC equipment funding for the Vertical Assembly Building, 89 percent in terms of dollar value was committed by the end of the reporting period.

MICHOUD SHOP FACILITIES

HORIZONTAL INSTALLATION FACILITY

FUNCTION - This faciliy is used to install the F-1 engine and associated hardware on the S-IC stage in the horizontal position and to refurbish the engines subsequent to static testing (Figure II-4).

AREA -	Horizontal installation	35,700
	Refurbish	13,800
	TOTAL	49,500 sq. ft.

USING ORGANIZATION - Operations

MILESTONES - The following milestones were accomplished during FY 1965:

Construction and activation of the horizontal installation facility was completed January, 1965.

During the fourth fiscal quarter, additional activities included design of utilities in support of purge units to be installed. The installation of these utilities will be completed during the next quarter.

EQUIPMENT - Of the total Michoud SFC equipment funding for the horizontal installation facility, 80 percent in terms of dollar value was committed by the end of the reporting period.

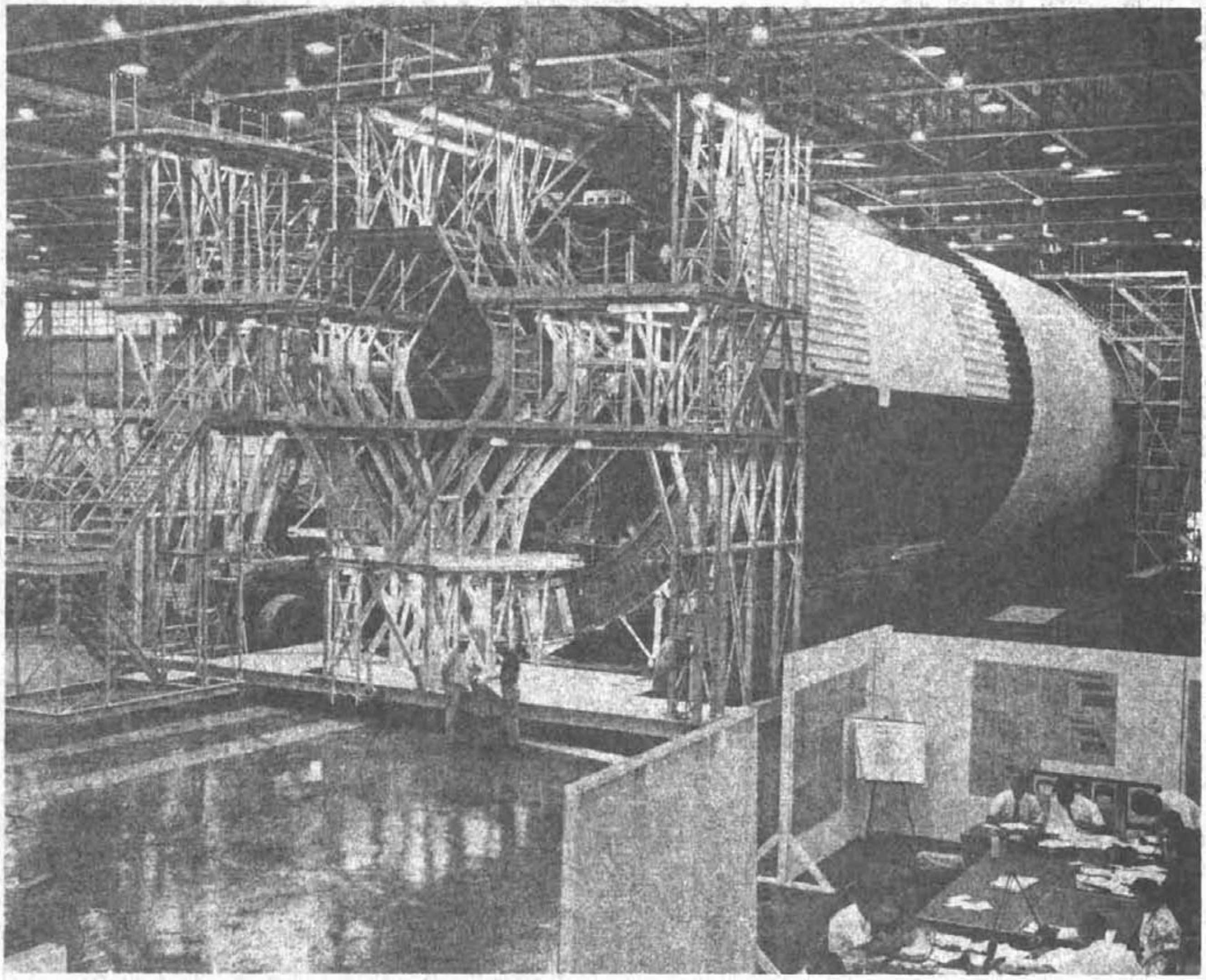


FIGURE II-4 S-IC-D IN THE HORIZONTAL INSTALLATION FACILITY

MAJOR PAINTING AND SHIPPING PREPARATION FACILITY

FUNCTION - This facility is required for final preparation of the booster for shipment. This preparation includes painting, decal application, protective coating, dust sealing and systems draining (Figures II-5 and II-6).

AREA - 16,800 sq. ft.

USING ORGANIZATION - Operations

MILESTONES - Activation of the major painting and shipping preparation facility was completed during the third fiscal quarter.

During the fourth fiscal quarter the following additional facility projects were initiated:

a) Turntable for paint booth number 1
b) Raise height of paint booth number 2

EQUIPMENT - Of the total Michoud SFC equipment funding for the major painting and shipping preparation facility, 90 percent in terms of dollar value was committed by the end of the reporting period.

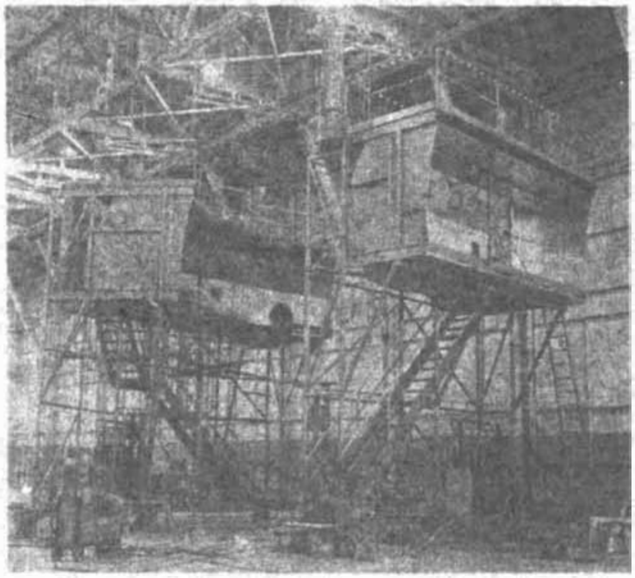
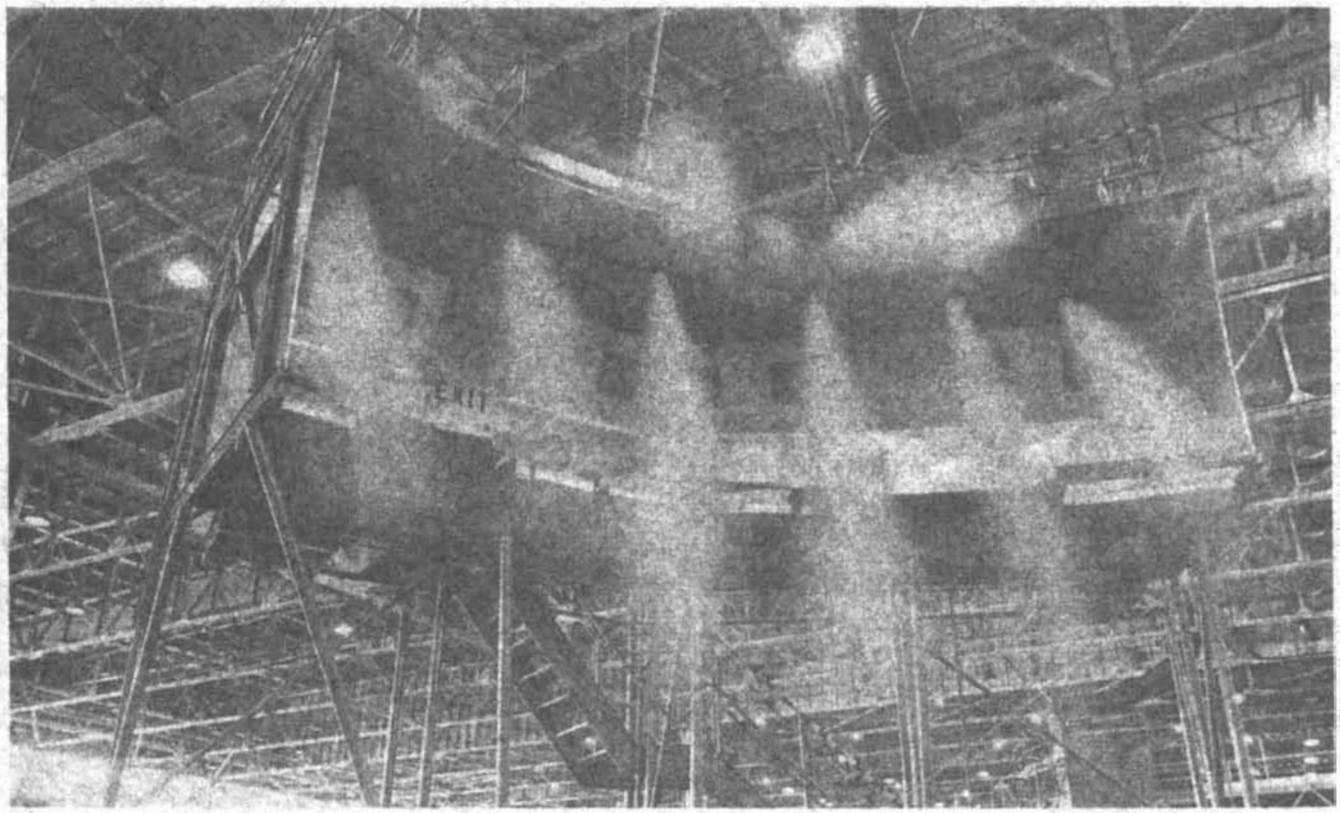


FIGURE II-5 PAINT BOOTHS NOS 1 AND 2

FIGURE II-6 CO_2 FIRE EXTINGUISHERS BEING TESTED



SUBSYSTEMS TEST (MECHANICAL)

FUNCTION - This area is used to test mechanical subsystems and components, vendor-furnished items and subsystems which have failed in static-firing or upper-level checkout. This includes testing and measuring of instruments, testing components and subassemblies that must operate at extremely low temperatures, testing and proofing of pressure pneumatic system components, checking valve cracking pressures, and testing LOX and fuel systems flight hydraulic components and subassemblies of the F-1 engine Figure II-7).

The engine buildup capability function is performed in the engine test area of subsystems test (mechanical). It includes the ability to install components that had been removed for shipping, to re-establish the internal alignment of the engine, to preset the actuator, and to assemble, inspect and verify the fit of the skirt to the engine nozzle.

The Rocketdyne area is required for logistic and component repair support of the F-1 engines.

USING ORGANIZATIONS - Operations and Systems Test

AREA -	Subsystems test	27,200
	Engine test	13,650
	Rocketdyne	4,800
	TOTAL	45,650 sq. ft.

MILESTONES - Activation of the subsystems test mechanical facility was completed in December 1964.

Designs of the engine test buildup facility and Rocketdyne facility were completed during the fourth fiscal quarter. Construction will begin during the next quarter.

EQUIPMENT - Of the total Michoud SFC equipment funding, 79 percent for subsystems test (mechanical) and 100 percent for engine buildup capability in terms of dollar value was committed by the end of the reporting period.

FIGURE II-7 THE TEST STAGING AREA IN SUBSYSTEMS TEST (MECHANICAL)

MICHOUD TEST FACILITIES

STAGE TEST POSITION AND SUPPORT

FUNCTION - This facility is needed for final checkout of the S-IC stage. Four test cells will be used for performing various tests on the pneumatic, hydraulic, mechanical, telemetry and electrical systems of the S-IC stage to ensure system integrity (Figure II-8).

AREA - 114,400 sq. ft.

USING ORGANIZATION - Systems Test

MILESTONES - Construction of the Stage Test Building was completed during FY 1965.

Additional construction projects initiated during the fourth fiscal quarter included:

a) Support stairs and vents
b) A gaseous nitrogen system

EQUIPMENT - Of the total Michoud SFC equipment funding for the stage test building, 53 percent, in terms of dollar value, was committed by the end of the reporting period.

MICHOUD TEST FACILITIES

TUBE AND VALVE CLEANING AND VALVE CLINIC

FUNCTION

a) Tube and Valve Cleaning

This facility is required for cleaning the fuel,

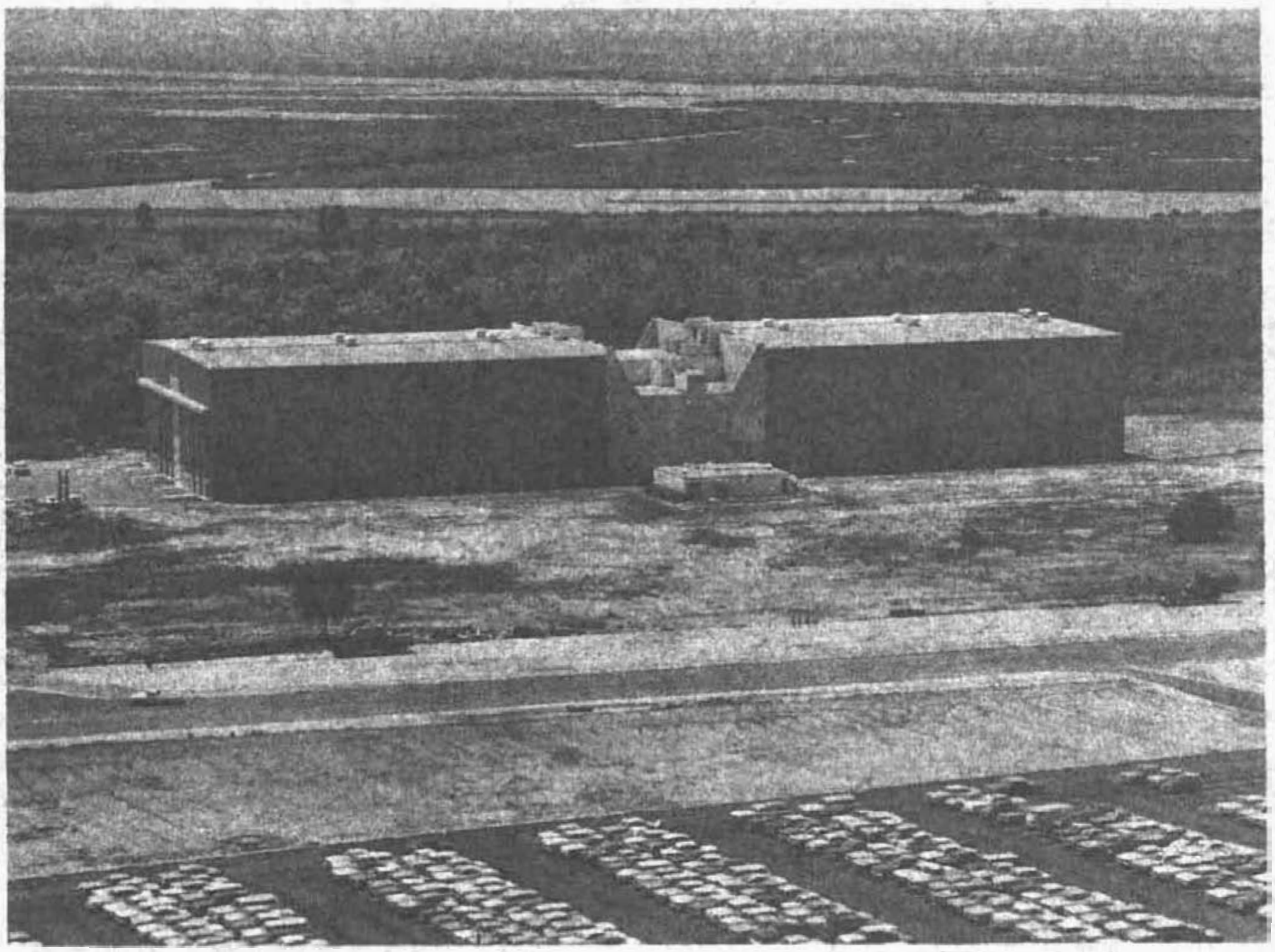


FIGURE II-8 STAGE TEST BUILDING

LOX, and pneumatic components to the levels required for the system. Tubing will be flushed with the cleaning agents, dried, and packaged at this location. Valves and components will be cleaned and rinsed in ultrasonically energized fluids, dried in vacuum ovens and flushed to certify cleanliness (Figure II-9).

b) Valve Clinic

This facility is used to take apart and reassemble valves. All inoperable valves, orifices, regulators, and the like, will be dismantled and inspected to determine the cause and extent of damage or malfunction.

AREA - 6,700 sq. ft.

USING ORGANIZATION - Operations

MILESTONES - Construction of this facility was completed in December, 1964.

A trichloroethylene recovery system in the exhaust ducts was designed during the fourth fiscal quarter and will be installed during the next quarter.

EQUIPMENT - Of the total Michoud SFC equipment funding for these facilities, 71 percent in terms of dollar value was committed by the end of the reporting period.

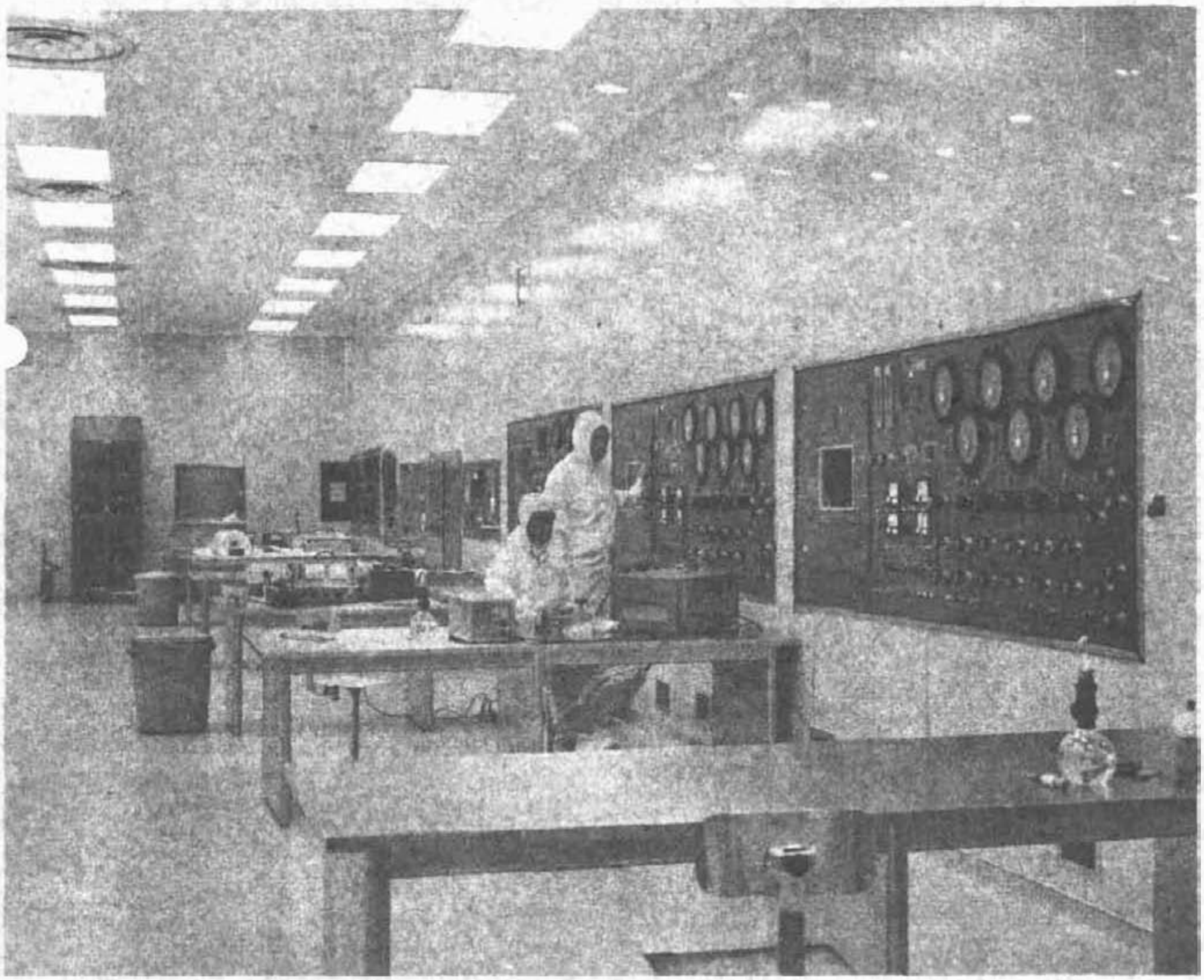


FIGURE II-9 TUBE AND VALVE CLEANING

MICHOUD LABORATORY FACILITIES

COMPONENT TEST AREA

FUNCTION - This area is used to test mechanical, electrical, and hydraulic components of the S-IC booster to establish and prove the design concepts and manufacturing techniques used. Test equipment is able to produce, sense, and record simulated flight and ground handling conditions (e.g., acceleration, force, vibration, pressure, and temperature environments) to establish the high degree of reliability necessary for booster flight (Figures II-10 and II-11).

AREA - 73,600 sq. ft.

USING ORGANIZATION - Engineering

MILESTONES - The component test area was activated in June 1964. Modifications and additions to the facility were initiated in support of the S-IC qualification test program (MOD 92) during FY 1965 and completion of this effort is scheduled in the fourth quarter of CY 1965.

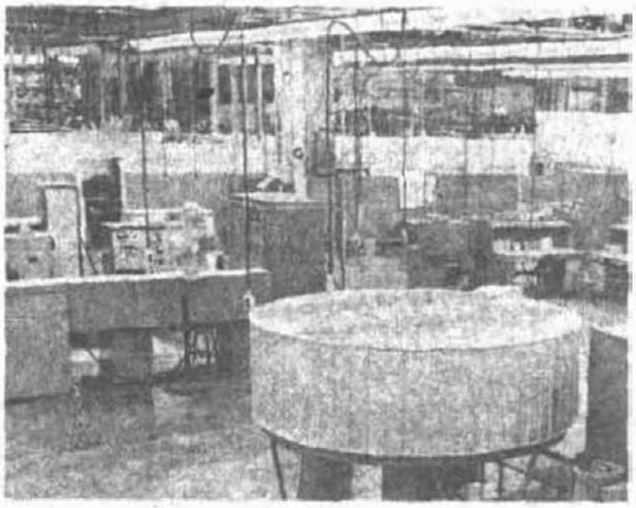
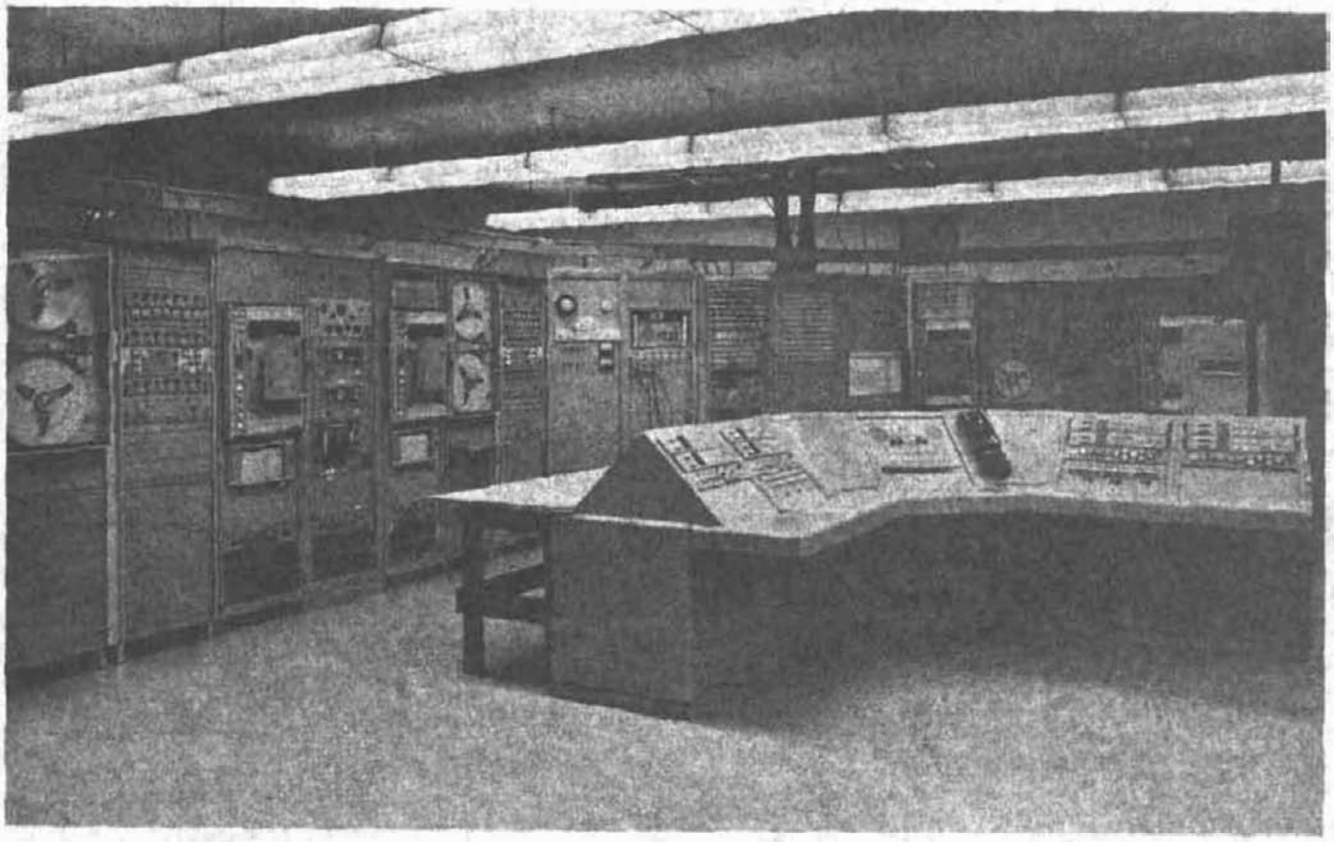


FIGURE II-10 ELECTRICAL ELECTRONIC TEST AREA

EQUIPMENT - Of the total Michoud SFC equipment funding for the component test area, 82 percent, in terms of dollar value, was committed by the end of the reporting period.

FIGURE II-11 DATA AND INSTRUMENTATION ROOM



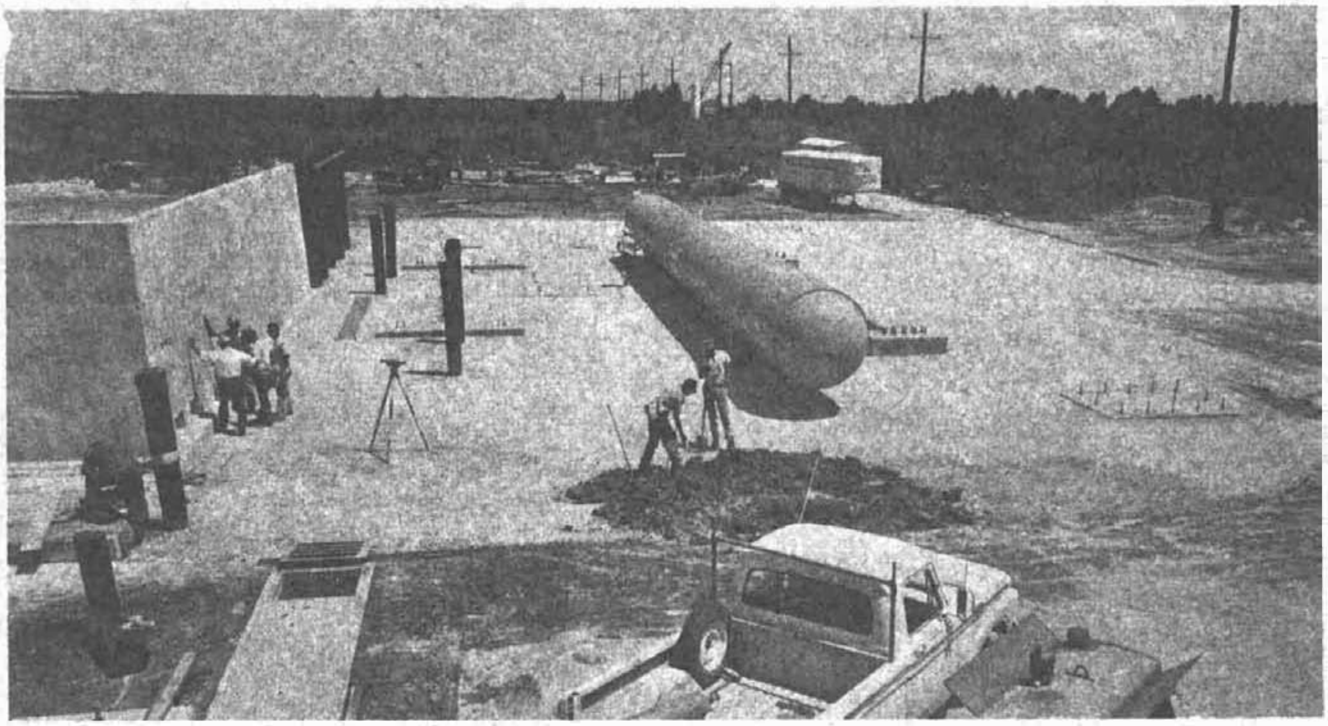


FIGURE II-12 CONSTRUCTION OF THE BASIC HIGH PRESSURE TEST FACILITY IS STILL IN PROGRESS

MICHOUD LABORATORY FACILITIES

HIGH PRESSURE TEST

FUNCTION - This facility conducts all testing of a hazardous nature for both booster and ground support equipment. Components, subassemblies, subscale test hardware, tanks, and ground support equipment will be subjected to various pressure flow and burst tests to ensure compliance with design requirements under normal and emergency environment and operating conditions (Figures II-12 and II-13).

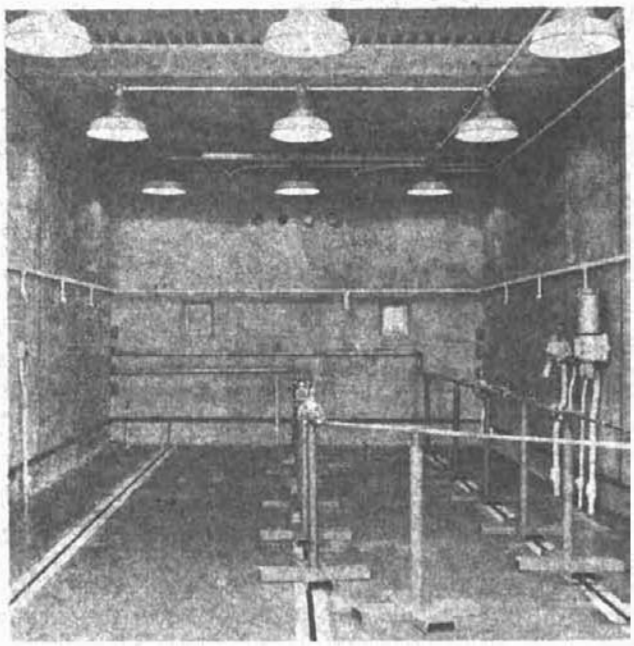
AREA - Control center & test cell building	5,000
Test area	295,000
TOTAL	300,000 sq. ft.

MILESTONES - During FY 1965, the liquid level test area of the high pressure test facility was completed.

During the fourth fiscal quarter construction began on additional foundations, test pads piping and utilities required in support of the S-IC qualification test program (MOD 92). The gas and control systems of the basic facility remained in construction.

EQUIPMENT - Of the total Michoud SFC equipment funding for the high pressure test facility, 74 percent in terms of dollar value was committed by the end of the reporting period.

FIGURE II-13 A TEST CELL IN THE HIGH PRESSURE TEST FACILITY



MICHOUD LABORATORY FACILITIES

QUALITY ASSURANCE INSPECTION STATIONS

FUNCTION - Numerous inspection stations are located throughout the plant to ensure that all work performed by Boeing and Boeing contractors conforms to NASA and Boeing specifications.

AREA -	Shops	4,600
	Test	1,400
	Labs	2,300
	Support	4,300
	TOTAL	12,600 sq. ft.

MILESTONES - During FY 1965, the last quality assurance inspection station was activated with the installation of the 33-foot rotary table and associated work platforms (Figure II-14).

EQUIPMENT - Of the total Michout SFC equipment funding for QA inspection stations, 73 percent in terms of dollar value was committed by the end of the reporting period.

MICHOUD SUPPORT FACILITIES

OFFICE AND ADMINISTRATION AREA
(NEW ORLEANS OFFICE SPACE)

FUNCTION - Provide office users with space to conduct required functions at Michoud Assembly Facility.

AREA - 394,500 sq. ft.

USING ORGANIZATIONS - All

MILESTONES - During FY 1965, activation of the NASA Engineering Office Building was accomplished when Boeing vacated downtown office space. Office space at Michoud assigned to Boeing by NASA was insufficient based on NASA office density standards. Reductions in personnel have partially relieved the office space deficiency; however, manpower forecasts during the fourth fiscal quarter still indicate a requirement for additional office space. Space densities have been increased to accommodate all office users.

During the fourth fiscal quarter, plans for modification and upgrading of Boeing office areas were submitted to NASA for consideration. There modifications include new partitioning, private office sound suppression, and upgrading of existing lighting.

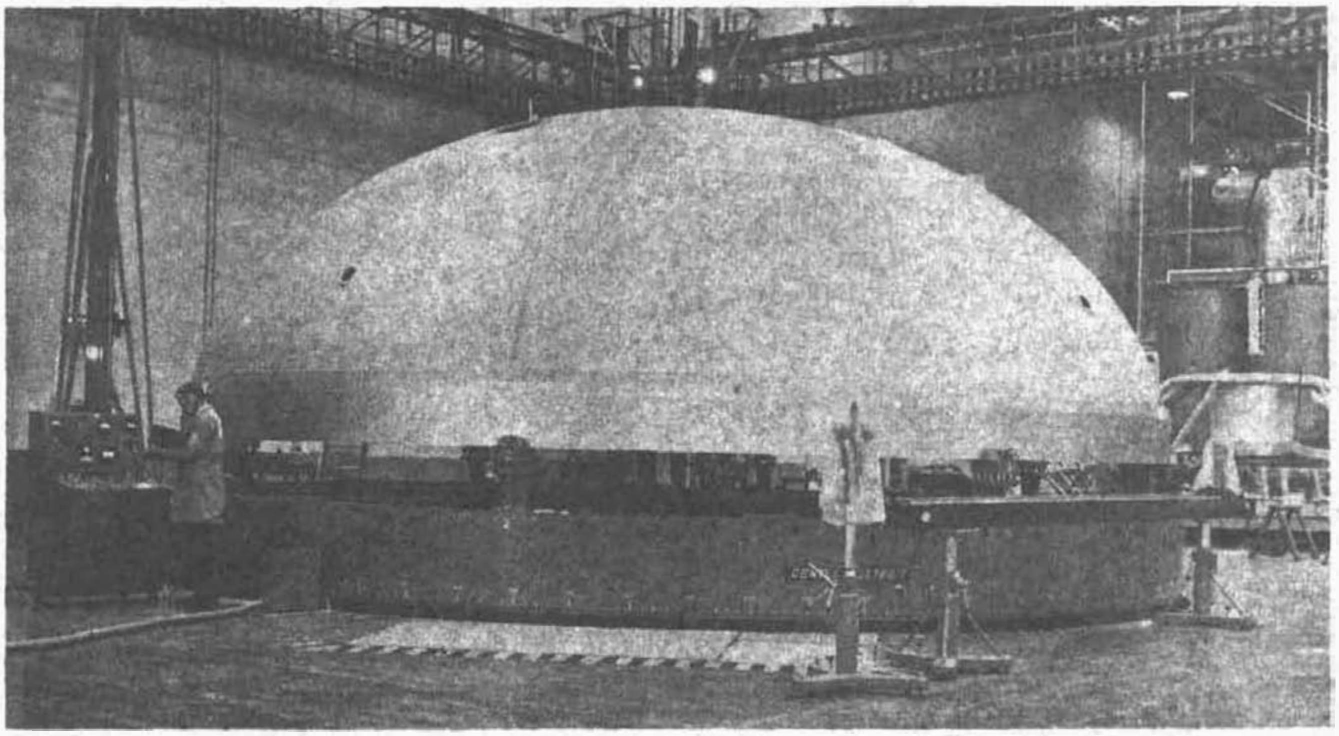


FIGURE II-14 A BULKHEAD BEING INSPECTED ON THE ROTARY TABLE

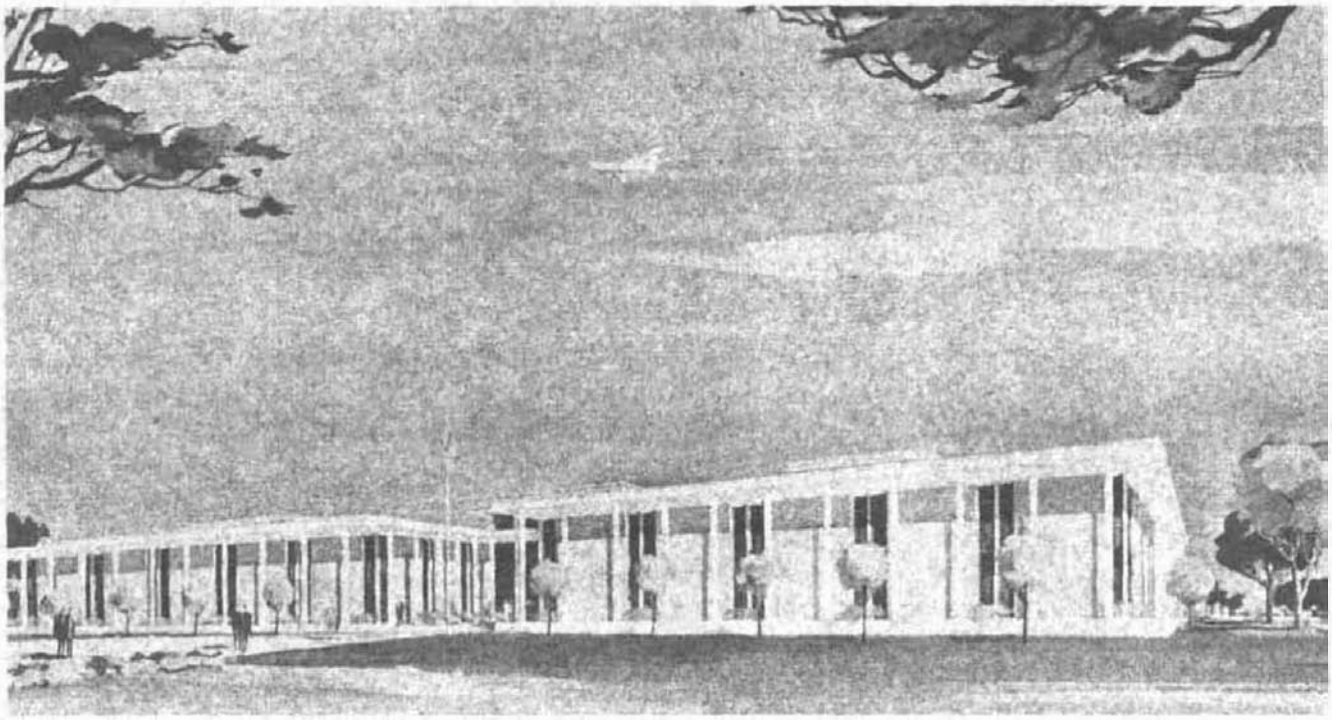


FIGURE II-15 AN ARTIST'S RENDERING OF THE BOEING OFFICE BUILDING IN HUNTSVILLE

HUNTSVILLE FACILITIES

OFFICE SPACE EXPANSION

Manpower requirements for the Huntsville area have increased during the past year due to the addition of the Saturn V Systems Mission Support effort to Contract NAS8-5608. As a result, requirements for office space in Huntsville have been satisfied by leasing additional space at the Huntsville Industrial Center and at several remote downtown locations. Boeing exercised its options on previously leased space at the Huntsville Industrial Center. Office space also is being provided Boeing at MSFC to support various programs being conducted there. The total gross Huntsville area occupied by Boeing is 347,000 square feet.

SHOP AND LABORATORY PLAN

A shop and laboratory plan for the Huntsville area was being developed at the end of FY 1965. This plan is intended to satisfy immediate requirements generated as a result of the transfer of responsibility for all shop functions to the Huntsville Operations organization. It also envisions a long range plan for consolidation and expansion of existing shop and lab capabilities. On June 21, 1965, the initial phase of the shop plan was approved by Boeing's Huntsville manager.

EQUIPMENT

Of the total Huntsville SFC equipment funding, 70 percent in terms of dollar value was committed by the end of the reporting period.

FACILITY EXPANSION

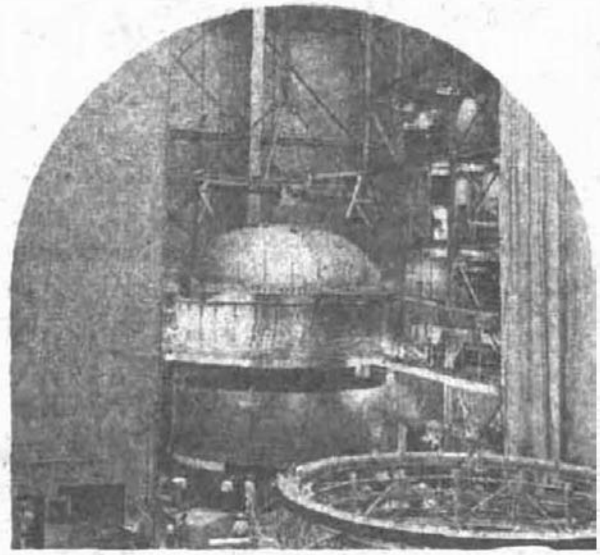
Plans and studies of ways to satisfy the requirements for Boeing facilities were made and coordinated with NASA/MSFC during the first half of the fiscal year.

In February, 1965, it was agreed that Boeing would make a significant capital investment in the Huntsville Saturn program. Further negotiations with NASA/MSFC management led to a plan for Boeing to construct a 100,000 square foot office building in the research park.

Approval by the Boeing Board of Directors for this capital investment was granted in March, 1965.

During the fourth fiscal quarter the research park site was purchased under option. Preliminary design was completed. Final design was initiated, and the first phase of site grading begun. Present schedules call for construction to begin in August, 1965, with completion in July, 1966 (Figure II-15).

ASSEMBLY AND MANUFACTURING



3

SUMMARY

S-IC stage assembly and manufacturing was behind schedule (Plan VII) in the first quarter of FY 1965 primarily because of problems with the weld equipment and weld processing used in the fabrication of fuel and LOX tank bulkheads. This, along with certain unavailable electronic and instrumentation parts, threatened a significant slide in the delivery of the S-IC-D. The late condition of the S-IC-D was impacting the follow-on units because each was paced by the completion of major assemblies and the vertical assembly of the preceding stage.

The Operations activities were reorganized, during the second fiscal quarter, to assign management responsibilities along product as opposed to functional lines. These responsibilities were grouped into four areas: containers and welded assemblies, structures, GSE and electrical systems, and final assembly.

In the third fiscal quarter the decision was made to eliminate hardware not necessary for performance of the S-IC-D mission. This reduction, along with the resolution of the weld problems, the incorporation of workaround methods, the employment of out-of-sequence installations and NASA/MSFC schedule relief resulted in schedule recovery to accomplish the on-schedule delivery of the S-IC-D to Systems Test. The S-IC-D is the first S-IC stage assembled at Michoud.

Delivery of the S-IC-F to MILA will be on schedule. This assessment is based on factors including the S-IC-D schedule recovery, the adoption of an S-IC-F minimum configuration and the use of such workaround methods as out-of-sequence cable installation.

In the last quarter of FY 1965, the MSFC schedule was revised from Plan VII to Plan VIII. This affected the delivery schedules of vehicles S-IC-3 through S-IC-10. Delivery was stretched varying from two months on the S-IC-3 to seven months on the S-IC-10. This required a rephasing of manpower utilization and program milestones.

S-IC-D STAGE

The weld equipment and weld processing problems encountered in the first half of the reporting period were resolved in the third quarter; however, bulkhead welding problems still paced tank completion.

During the first three quarters fuel tank fabrication extended from welding of the cylindrical skins through completion of final assembly. LOX tank fabrication extended from ring baffle assembly through completion of the upper and lower subassemblies.

An S-IC-D minimum configuration sufficient to satisfy the dynamic test vehicle (DTV) mission requirements was agreed on by NASA/MSFC and Boeing in the third quarter. It reduced cleanliness requirements for the propulsion system, revised transportation and storage pressurization requirements and eliminated unnecessary hardware.

In the fourth quarter, the LOX tank upper and lower subassemblies were joint welded (Figure III-1) and ring baffle installations were completed. The fuel and LOX tanks were hydrostatic tested and delivered to final assembly on May 6, 1965 and May 26, 1965, respectively.

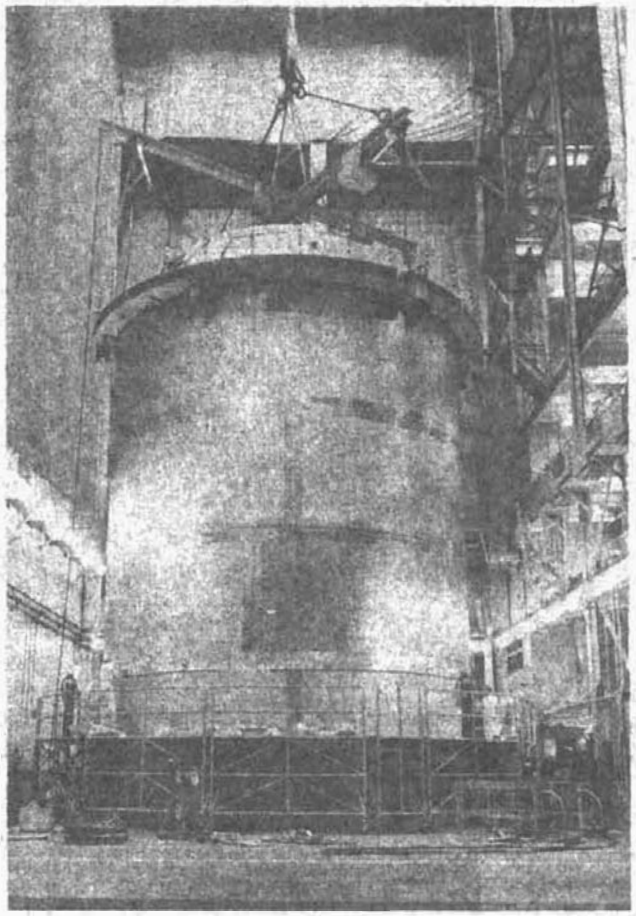


FIGURE III – 1 THE JOINING OF UPPER AND LOWER HALF OF S-IC-D LOX TANK IN PIT #2 VAB

The intertank assembly was completed on April 17, and the forward skirt on May 26, 1965. The thrust structure was loaded into the vertical assembly tower March 24, 1965. Vertical assembly of the S-IC-D stage was restrained because the fuel tank was not available for loading until May 10, 1965. The intertank was positioned May 11, 1965 (Figure III-2). Both the LOX tank and forward skirt were set into position May 28, 1965 (Figures III-3 through -5). Final joining of the basic structures was accomplished June 16, 1965. The vehicle was unloaded from the vertical assembly tower into the horizontal position June 27, 1965 (Figures III-6 through -8).

Unload of the vehicle from the vertical tower was delayed because of faulty GSE fittings that secure the thrust structure to the transporter.

The rework and testing of these fittings delayed laydown of vehicle two weeks. However, there was no impact on delivery of the vehicle to Systems Test because items scheduled for installation in horizontal assembly were installed while the stage was in the vertical tower.

The elimination of certain flight electrical/electronic items and LOX cleaning requirements from the S-IC-D in accord with the DTV minimum configuration allowed re-allocation of specialty hardware to the S-IC-F and generally improved the schedule position of both vehicles.

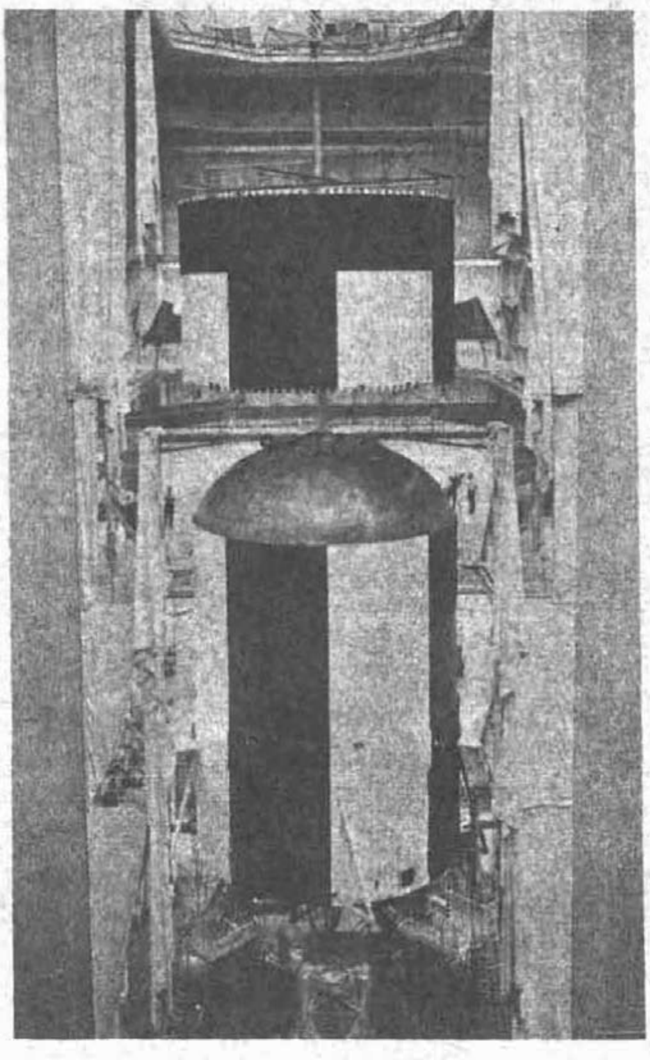


FIGURE III – 2 LOWERING S–IC–D INTERTANK ONTO FUEL TANK AND THRUST STRUCTURE IN VERTICAL ASSEMBLY POSITION IN VAB

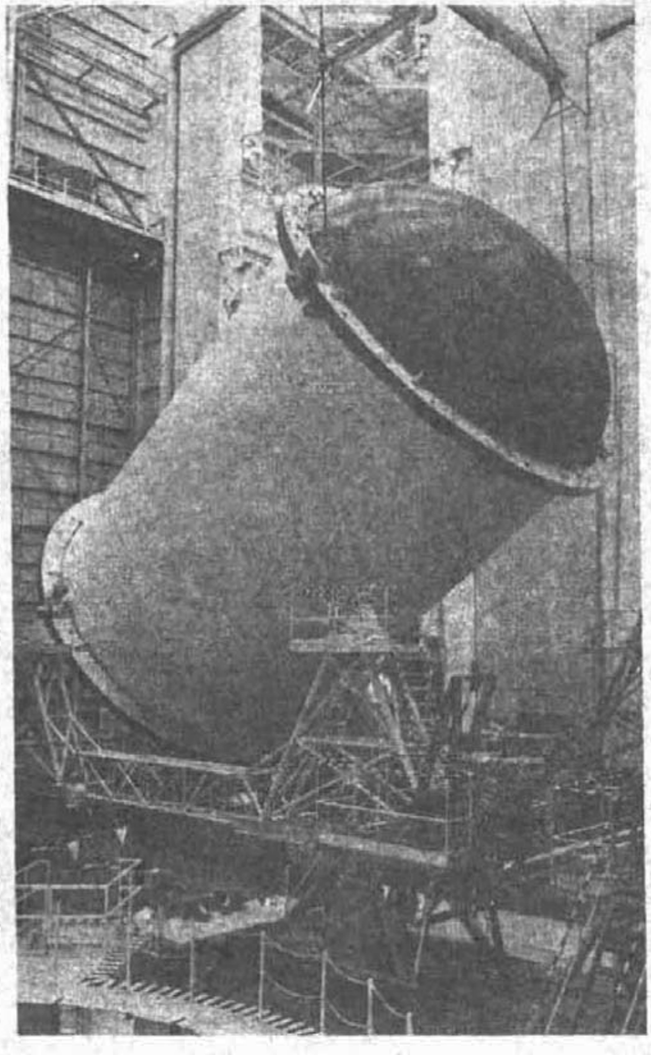


FIGURE III – 3 LIFTING OF S–IC–D LOX TANK FOR INSTALLATION INTO VERTICAL TOWER

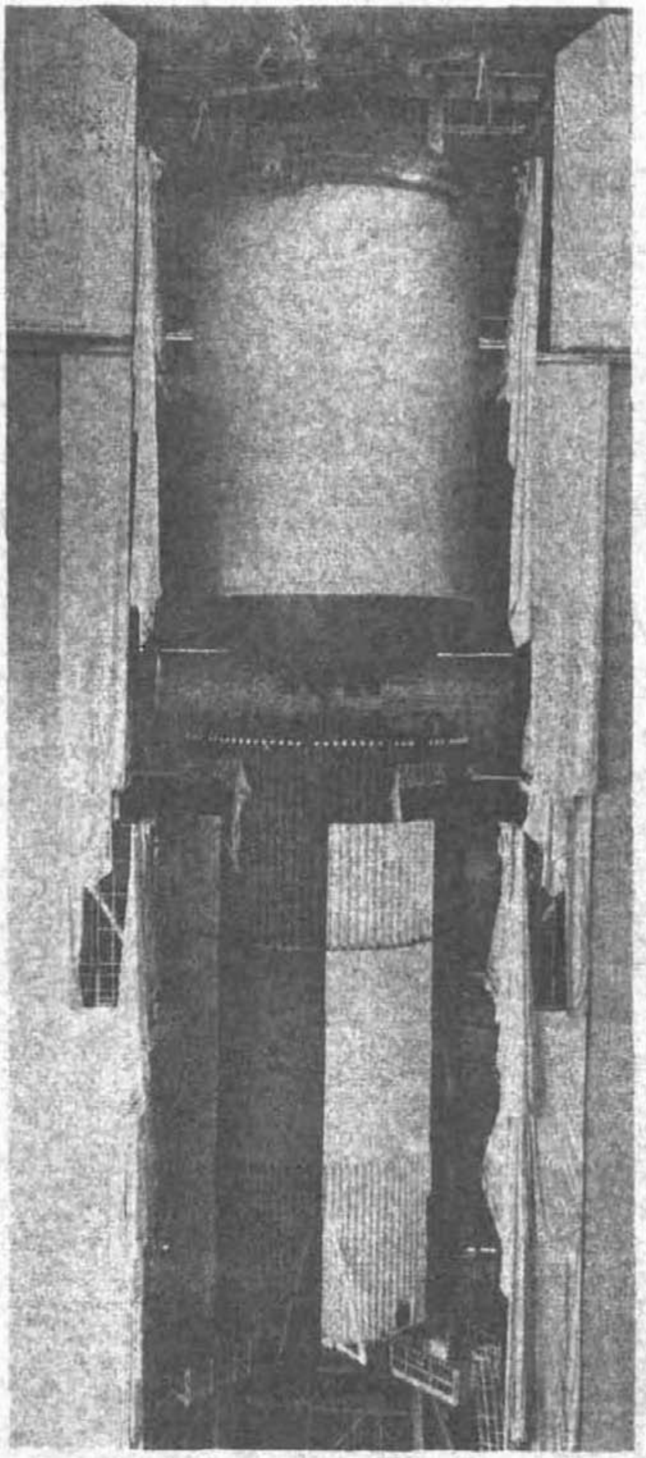


FIGURE III - 4 LOWERING OF S-IC-D LOX TANK ONTO INTERTANK

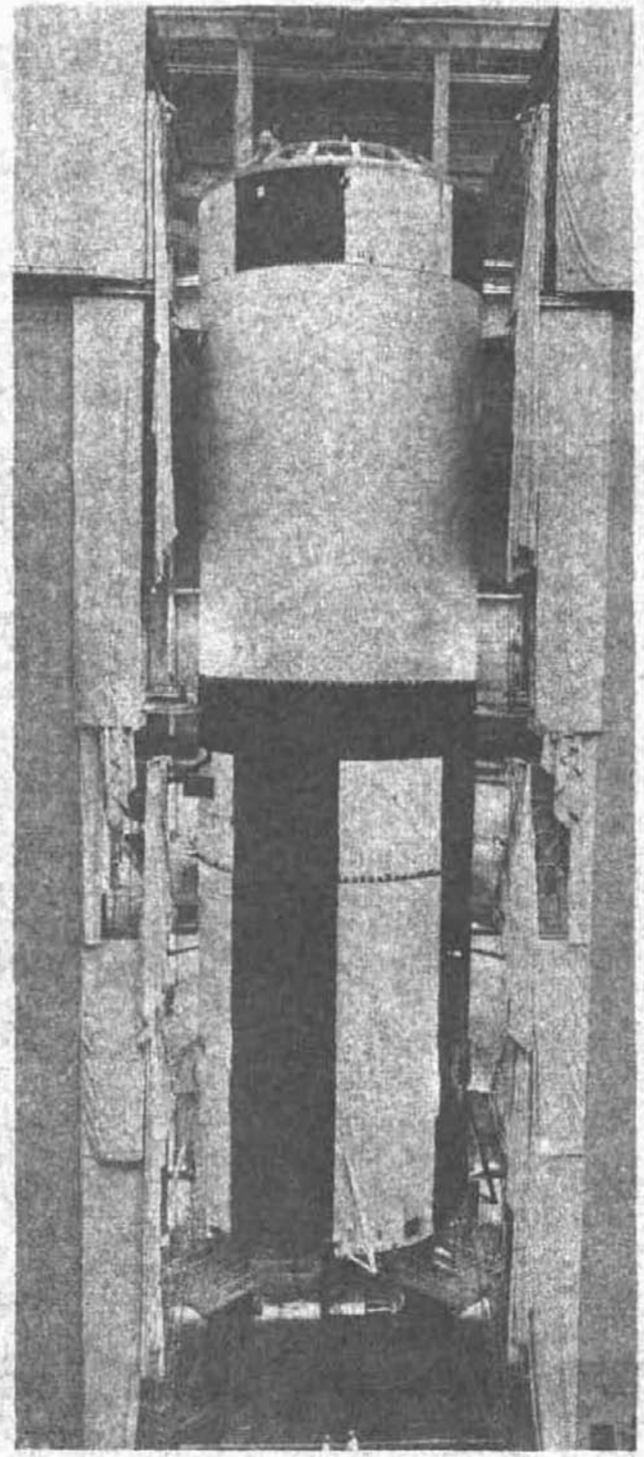


FIGURE III - 5 S-IC-D FORWARD SKIRT LOWERED INTO PLACE TO COMPLETE MAJOR COMPONENT BUILD-UP

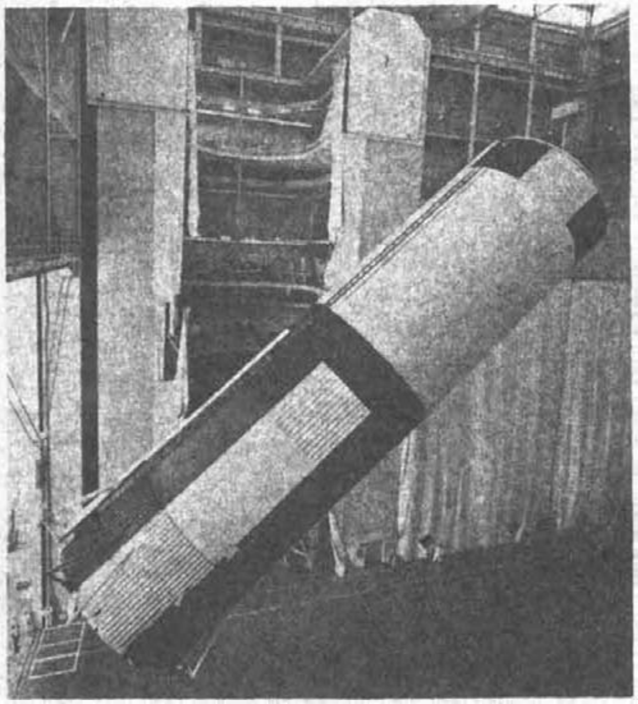


FIGURE III – 6 LOWERING OF S–IC–D VEHICLE TO HORIZONTAL POSITION IN VERTICAL ASSEMBLY BUILDING

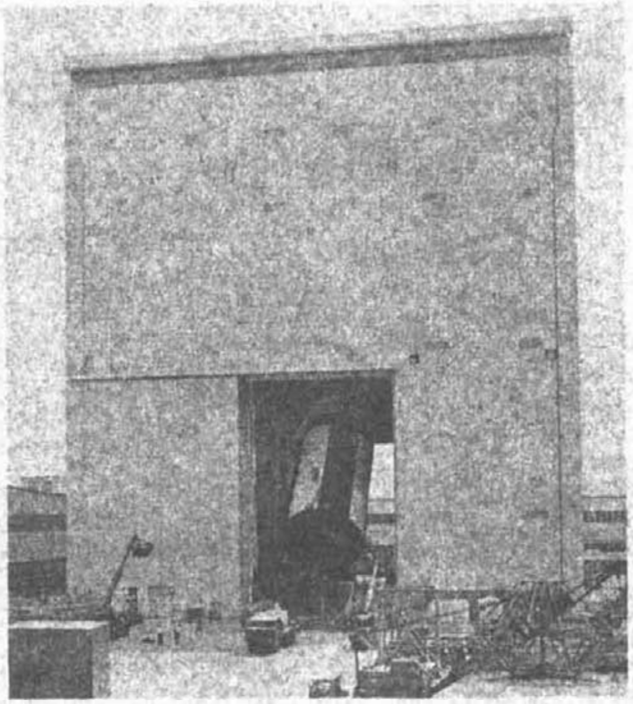


FIGURE III – 7 LOWERING OF S–IC–D VEHICLE FROM VERTICAL TOWER TO HORIZONTAL POSITION

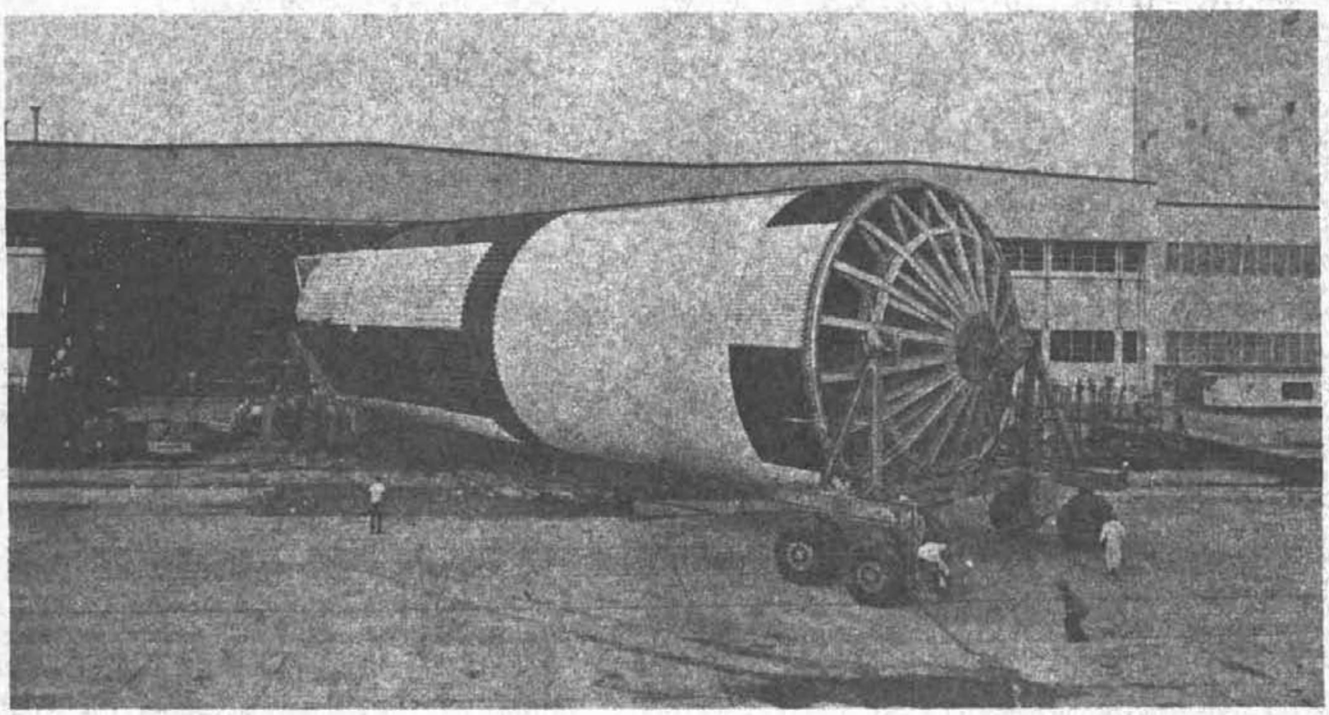


FIGURE III – 8 TRANSPORTING S–IC–D VEHICLE FROM VERTICAL ASSEMBLY BUILDING TO MAIN FACTORY AREA FOR COMPONENT INSTALLATIONS

No difficulty is anticipated in meeting the Plan VIII schedule for delivery of the S-IC-D stage on dock at MSFC/Huntsville October 15, 1965.

S-IC-F STAGE

In the first three quarters, fabrication of the S-IC-F was paced by the completion of the S-IC-D. At fiscal year's end, completion of vertical assembly of the S-IC-F was forecasted to be five weeks late. This forecast was due primarily to the late availability of cables, procured hardware, and hydrostatic test position. S-IC-F cables will be installed out-of-sequence, incorporating work-around methods, because of a late S-IC-1 cable program authorization. The S-IC-F mission has been reviewed and those items not necessary for mission performance were eliminated.

At the end of the third fiscal quarter, fabrication of the S-IC-F fuel tank upper and lower bulkhead assemblies was complete and the LOX tank skin rings were being welded. One NASA/MSFC-fabricated LOX tank bulkhead was received.

During the fourth quarter, the fuel tank was completed and positioned for hydrostatic test June 14, 1965. LOX tank assembly had progressed to the point where the closeout weld was the next operation.

The forward skirt was finished June 30, 1965. Work on the thrust structure to prepare it for installation in the vertical assembly position was 97 percent complete at the end of the reporting period.

MODIFICATION OF S-IC-F MISSION

In order to deliver the S-IC-F stage as economically as possible within schedule limits, a minimum configuration was agreed upon by Boeing, NASA/MSFC and NASA/KSC. The reduced configuration fulfils the requirements for stage pressurization, propellant loading and unloading at KSC, and instrumentation for wind-loading tests at KSC. The stage will be kept as close to flight configuration as possible within schedule requirements.

S-IC-3 STAGE

Assembly and manufacturing of the S-IC-3 was frequently interrupted because of unavailable specialty hardware. However, it appeared at the close of the reporting period that the only thing likely to impact final delivery of the S-IC-3 would be the availability of the F-1 engines.

In the first three quarters of the report period, tank fabrication extended from completion of minor assemblies through completion of the gore-to-gore welds for the lower bulkhead. Major operations included: Apex-to-base welds for the lower and upper bulkheads, and completion of the gore-to-gore welds for the lower bulkhead.

In the fourth quarter the upper subassembly was completed in the following operations: gore-to-gore, Y-ring to bulkhead, polar cap to bulkhead, bracket installation, skin ring assembly, baffle installation, and skin ring assembly to bulkhead.

The following operations were performed to complete lower subassembly: Y-ring to bulkhead, polar cap to bulkhead, bracket installation, skin ring assembly, exclusion riser installation, baffle installation, and skin ring to bulkhead.

The S-IC-3 is the first complete flight vehicle built at Michoud and requires all systems. Late delivery of two F-1 engines is forecasted. An attempt to improve the servo actuator delivery dates was requested in order to prevent a schedule slide caused by this GFE. Completion of all CSE/FE requirements is expected during the first quarter of FY 1966.

S-IC-4 STAGE

There were no major problems on the S-IC-4 stage at the close of the reporting period. Delivery is expected to meet Plan VIII schedules.

Completed operations include welding of the following fuel and LOX tank components: fuel suction fittings, Y-ring segments, fittings to apexes and bases, ring baffles, cruciform panels, and apexes to bases. The lower fuel bulkhead has been completed through gore-to-gore weld, with skin ring welds expected to be finished in July, 1965.

The Boeing-developed pocket-milling technique for producing T-stiffened Y-rings, to be used on the S-IC-4 and subsequent vehicles, will save approximately 5000 pounds of weight per vehicle (Figures III-9 and 10).

S-IC TOOLING

At the end of FY 1965, all basic tool design and fabrication was complete for fin and fairing assembly

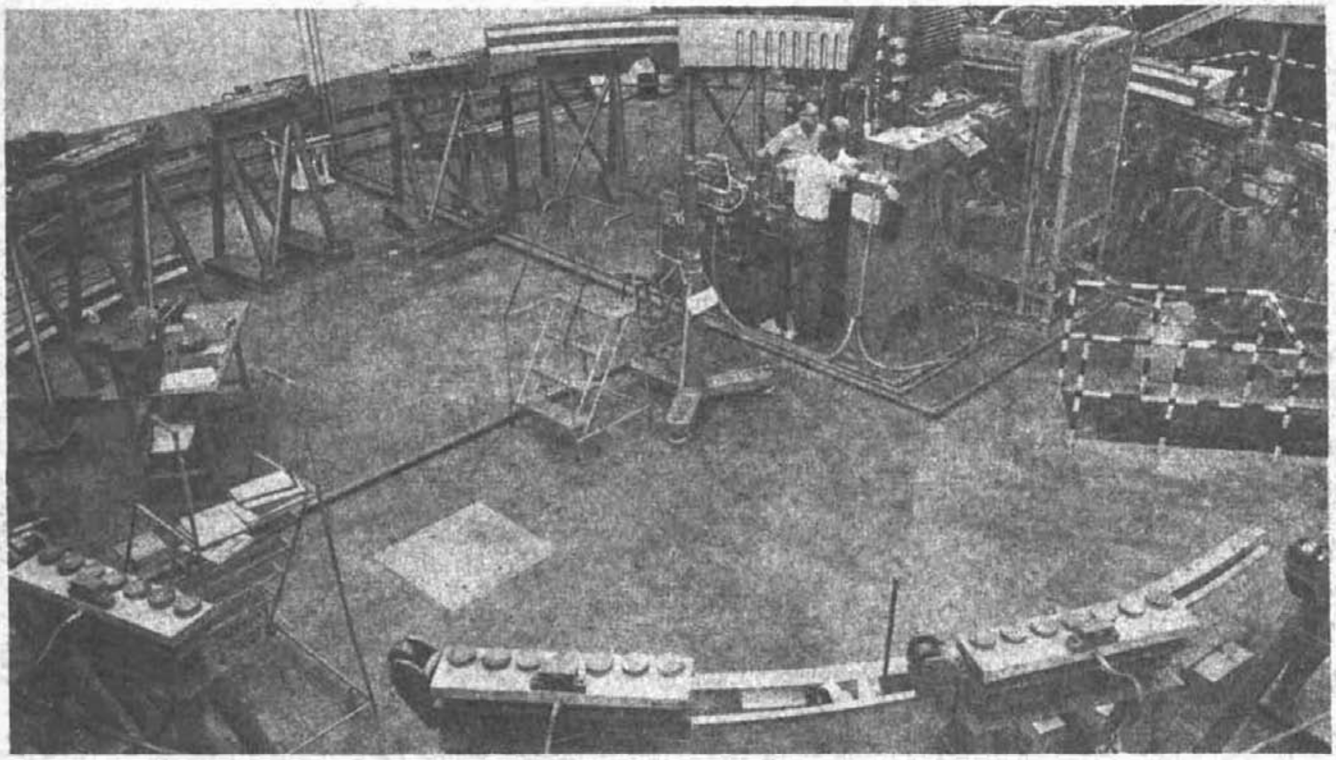


FIGURE III-9 FIXTURE FOR POCKET MILLING Y-RINGS

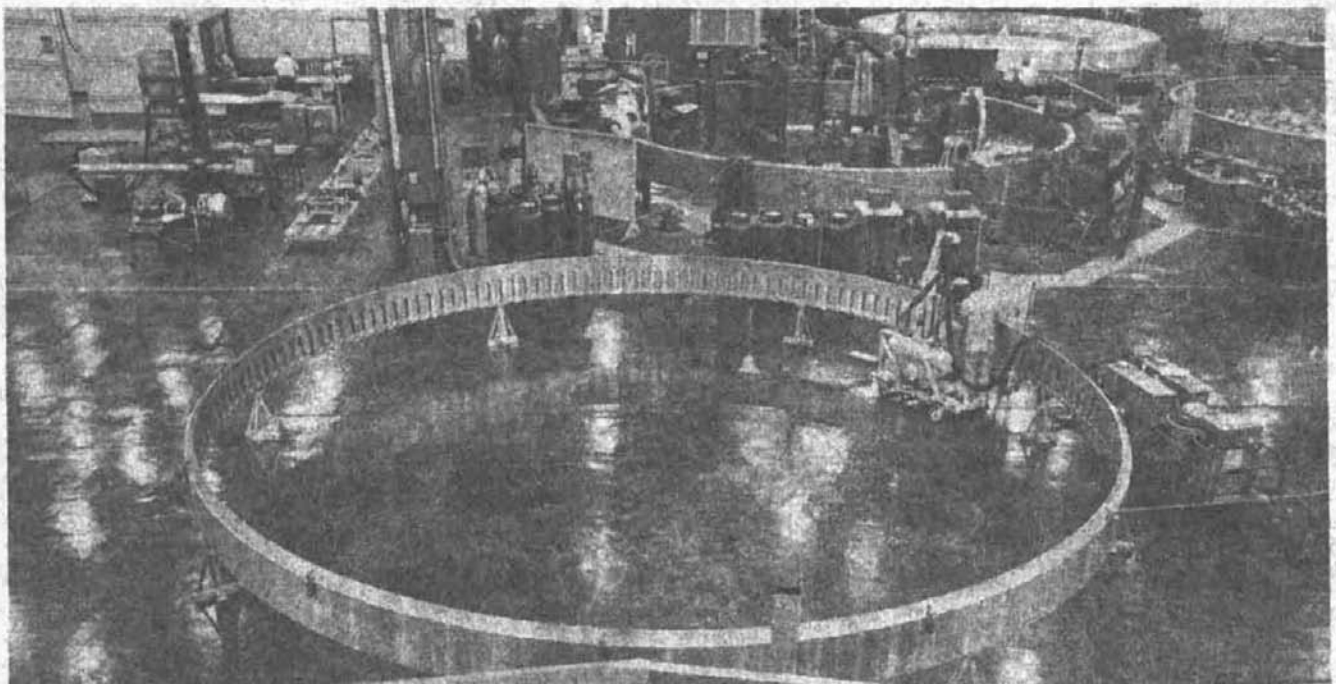


FIGURE III-10 T-STIFFENED Y-RING FOR S-IC-4 for manufacture of propellant duct supports, and for intertank rework under CAM 207.

Tooling previously installed at MSFC for assembly of the S-IC-S, -1, and -2 thrust structures was moved to Michoud early in the fiscal year.

The paint and inversion dolly for LOX and fuel tanks and the tooling for the hydrostatic test position were completed. The Y-ring mill fixture for CAM 189 was erected. Newly designed equipment replaced the roller rotating system and outside welding system for the tank skin weld station.

All final assembly tooling required for joining the major subassemblies was on hand or in fabrication in the first fiscal quarter except the forward skirt to LOX tank drill fixture.

The S-IC mockup was used in the development of S-IC-T tubes and cables in the second fiscal quarter, and in the development of S-IC-D tubes and cables until the S-IC-D mission configuration modification was implemented. S-IC-F tube and cable development on the mockup was interrupted when NASA/MSFC requested its use for development of S-IC-1 cables.

MANUFACTURING DEVELOPMENT

Manufacturing Development continued to support production of the S-IC program and to promote improvements in manufacturing performance through the modification and refinement of existing processes and manufacturing techniques.

Although most of the development work to establish basic processes has been concluded, production improvement continued during the reporting period. This activity included the development of improved weld settings for Y-ring to bulkhead welds, the repair of isolated weld defects using TIG spot welding, the modification of processes for the major component cleaning facility, the development of improved procedures for removing blind bolts, and other refinements to advance manufacturing technology and support design modifications.

WELD DEVELOPMENT

Y-Ring to Bulkhead

All thicknesses of Y-ring-to-bulkhead welds have been certified with the exception of the upper fuel .224 bulkhead. Development work has been started to improve MIG weld settings for .224 material. Improvements include an increased filler wire diameter, an altered edge preparation, and a mixed gas shielding. These alterations will improve the joint geometry and production quality.

TIG Spot Welding

Development work on the repair of isolated weld defects using TIG spot welding was in progress. Initial effort was directed toward .224 gage material. The approach involves drilling through an isolated defect and spot welding to fill the hole. Initial results are very encouraging. This technique may result in a significant saving of manhours and flow time spent on grinding out defective welds and making manual repairs.

The feasibility of using the TIG spot weld technique to join the destruct cowling to the membrane sections of the tanks is under investigation. This process, if adaptable, should reduce production flow time and provide a joint that is more readily inspectable than those on bonded assemblies. Quality spot welding was obtained in all those gauges used for bracketry with the graph settings developed by Manufacturing Development. Figure III-11 shows bracketry that has been TIG spot welded to the bulkhead.

Tank Assembly

All tank weld settings were developed, certified, and put into production during this reporting period. The fuel and LOX tanks for the S-IC-D and the fuel tank for the S-IC-F are complete. Some welding equipment developed problems but these were resolved and no other major difficulties are anticipated. Tapered skin tank welds for the S-IC-4 will be certified in the vertical skin-to-skin weld station. Girth welds will be certified in the VAB.

Transition segment welds were transferred from the VAB to the minor assembly area. The weld process has been certified and two production welds were accomplished successfully.

LOX Tunnel

Using restraining tooling to prevent mismatch, LOX tunnel welds were recertified in the VAB following previously established weld processes. The five tunnels for the S-IC-F were welded in five working days with a minimum number of defects. No rejectable mismatch was evident. Figure III-12 shows the welder controlling the weld penetration by using a remote amperage potentiometer inside the fuel tank.

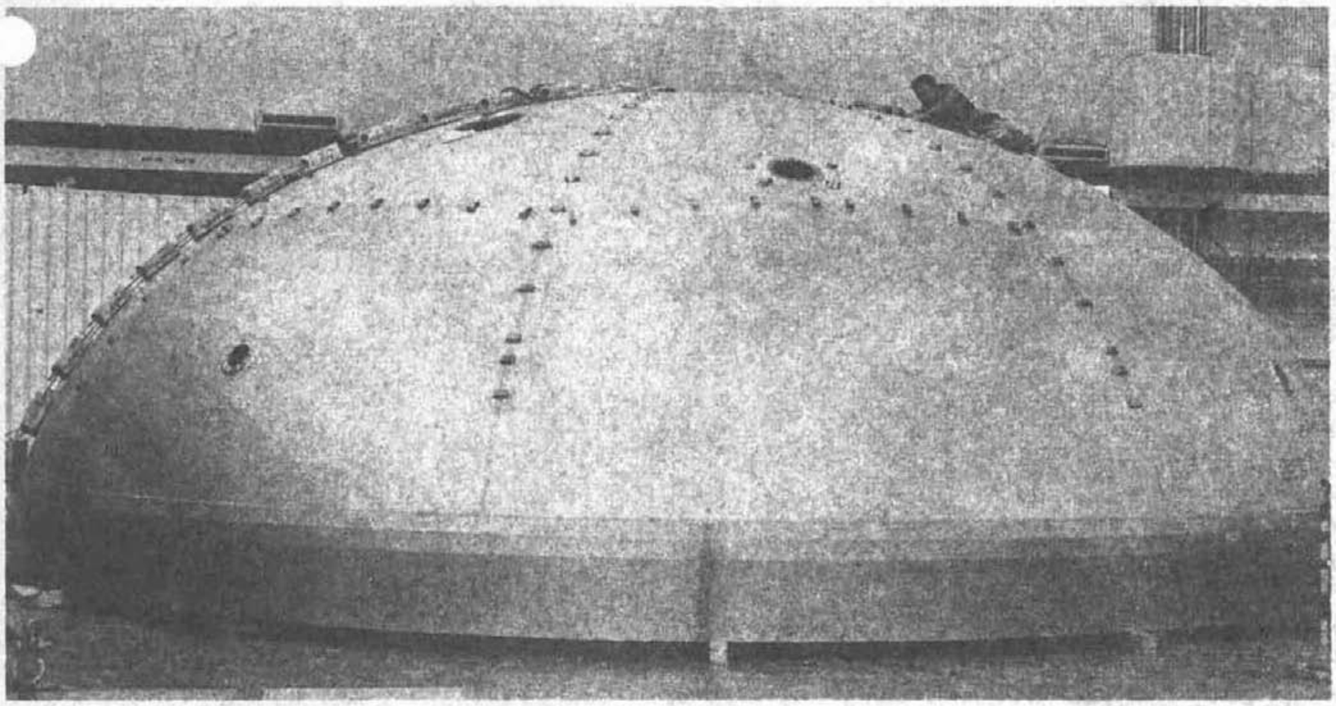


FIGURE III–11 BRACKETRY TIG SPOT WELDED TO BULKHEAD

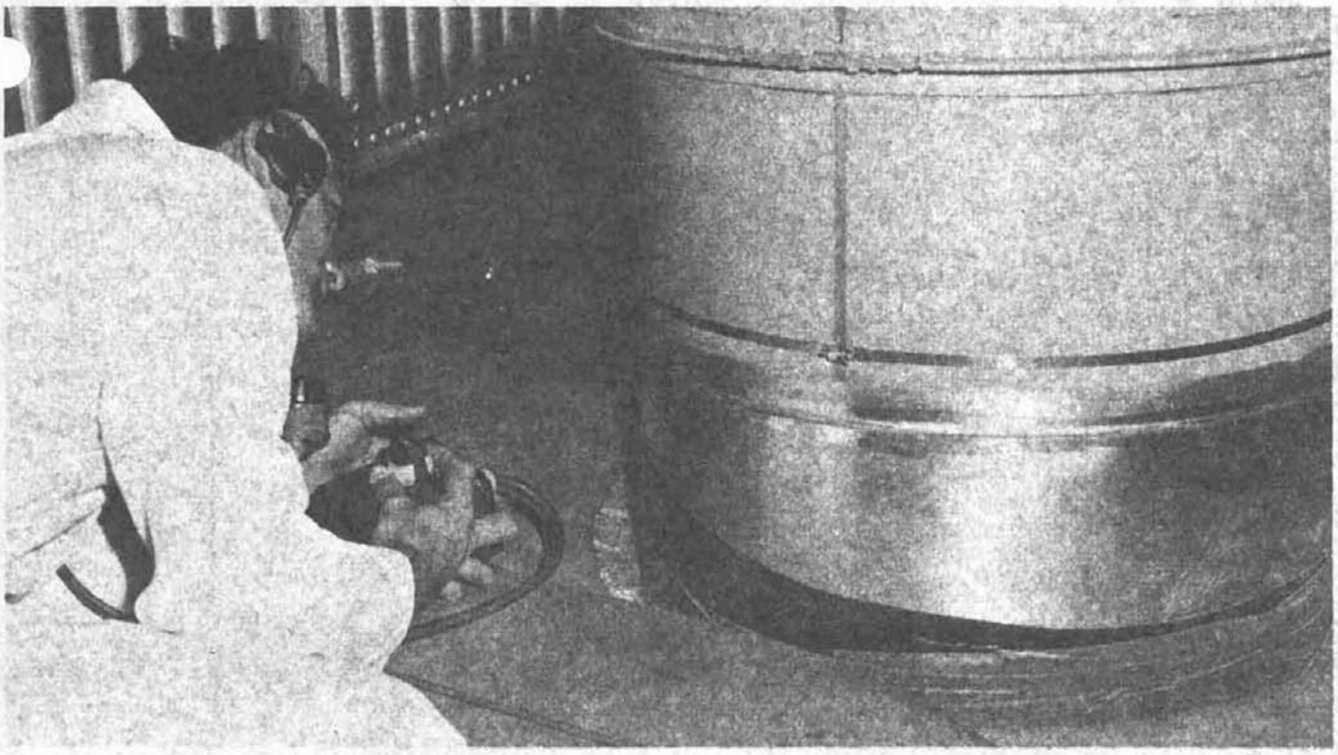


FIGURE III–12 THE WELDER IS SHOWN CONTROLLING WELD PENETRATION BY USE OF A REMOTE AMPERAGE POTENTIOMETER FROM INSIDE THE FUEL TANK

CHEMICAL PROCESSES

Process Modification

Process controls, applicable to the major component cleaning facility, were reviewed, and in some instances revised, to introduce cost reduction features. Adequate application and control procedures are maintained.

Previously, it was necessary to manually strip the conversion coating from the weld zone of cylindrical skin sections prior to welding. However, it was demonstrated that the cleaning facility can accommodate a welded skin section assembly so that it can be cleaned, etched, and conversion coated after welding. This permitted the edges of the skin section to remain bare or to be chemically stripped in the aluminum tank line. The costly manual operation was thereby eliminated. Also, it was determined that manual solvent wiping to remove adhesive residue provides an adequate alternate to trichloroethylene flush as a degreasing operation in major component cleaning. There can be further cost savings by eliminating the deoxidizing step prior to etching.

Exclusion Riser Installation

The procedure for installing fuel tank exclusion risers, using vendor supplied prefoamed polyurethane blocks, was fully developed in the second fiscal quarter. Three successful factory installations were accomplished.

Cable Clip and Destruct Cowl Bonding

Techniques of surface preparation and adhesive application for metal-to-metal bonding were developed. An extensive factory personnel training program was conducted to ensure that operators qualified on the requirements of structural bonding will be certified. Emphasis was placed upon the use of BMS 5-10 and 60B cryogenic adhesives for bracket, destruct cowl, and cable clip bonding applications. Production implementation of the bracket and destruct cowl adhesive bonding processes was accomplished on the S-IC-D fuel and LOX tanks.

Evaluation of Spray Paint Equipment

Airless electrostatic paint spraying equipment was selected for final painting of the S-IC because of its fast paint buildup, minimum over-spray and simplified operation. A training program will be conducted and all painters will be certified. Other personnel associated with the operation will receive training but it will not be necessary that they be certified.

Final Cleaning in Hydrostatic Test Tower

Final cleaning of the S-IC-D fuel and LOX tanks was accomplished in the hydrostatic test facility with moderate difficulty. Problems included the clogging of line filters and solid particles of Iridite 14-2, numerous fitting and manifold leaks, and malfunctioning of several automatic air-actuated pumps and valves. The spray processes include solvent-alkaline cleaning, reconversion coating prior to hydrostatic testing, non-ionic detergent cleaning prior to calibration, and final trichloroethylene flushing of the LOX tank.

Brush Cadmium Plating

Brush cadmium plating has long been accepted as a repair procedure (BAC 5701), but personnel had difficulty applying this process. Charts for estimating stylus area, current density, and plating time were prepared and certified. Training and certification of operators resulted in more reliable brush cadmium plating in production areas.

Non-Foaming Aerowash

Regular Wyandotte Aerowash cleaning solution produced excessive foam in the major component and hydrostatic test tower cleaning facilities. Non-foaming additive (tri-butyl-phosphate) reduced the foam to an acceptable level. The vendor-reformulated Aerowash with a non-foaming detergent and it has proven very satisfactory.

MACHINING AND FASTENING

T-Stiffened Y-Rings

Development tests were conducted on 1/4-scale T-stiffened Y-rings to determine the amount of growth, or movement of the outside diameter of the ring, after pocket milling. Test results showed an increase in diameter at the bottom end of the Y-ring. Complete analysis of the tests indicate that the full-size Y-ring should be machined on a taper to allow for an increase of .125-inch to the bottom diameter.

Further tests on milling pockets on full size T-stiffened Y-rings indicated a need for cutters that could be interchanged without changing machine settings or sequence of cuts. It is also desireable to use a cutter with replaceable inserts to eliminate cutter regrinding and a large inventory of tools.

Blind Fastener Installation and Removal

A hand operated tool for installing blind fasteners was designed and fabricated by Manufacturing Development. A small tool, using a screw-jack principle, was fabricated and used successfully to install the antenna brackets mounted on the hat section stiffeners of the forward skirt. The tool can be adapted to other blind fastener installations with slight modifications.

Huck blind bolts are used at the attach point of the thrust structure to the fuel tank because of limited access in the crotch area of the fuel tank Y-ring. Only a small percentage of these bolts require removal after installation because of improper forming of the upset sleeve or premature pin breakage. Manufacturing Development designed and fabricated an undercutting tool to cut the sleeve into two pieces. One piece of the sleeve is removed by pulling it out of the hole and the remaining portion is pushed back out of the crotch area. Undercutting tests on sample sleeves were successful; however, a slight modification to the cutting tool is required to compensate for cutter point regrinding. The cutting action takes place inside the fastener hole of the Y-ring, with the cutting tool designed to preclude damage to the hole or crotch area.

ELECTRICAL/ELECTRONICS

Heat shrinkable polyolefin boots are under consideration as a substitute for conventional clamshell mold dies (Figure III-13). Manufacturing Development has developed tooling for hot air shrinking of these boots, and is working on the refinement of a vendor developed infrared heater (Figures III-14 and 15).

Thermocouple Cable Assembly

A holding device was developed for the assembly of connectors to metal sheathed thermocouple cables. Adoption of this fixture by production shops has resulted in a decrease in rejections and less expenditure of manhours per assembly.

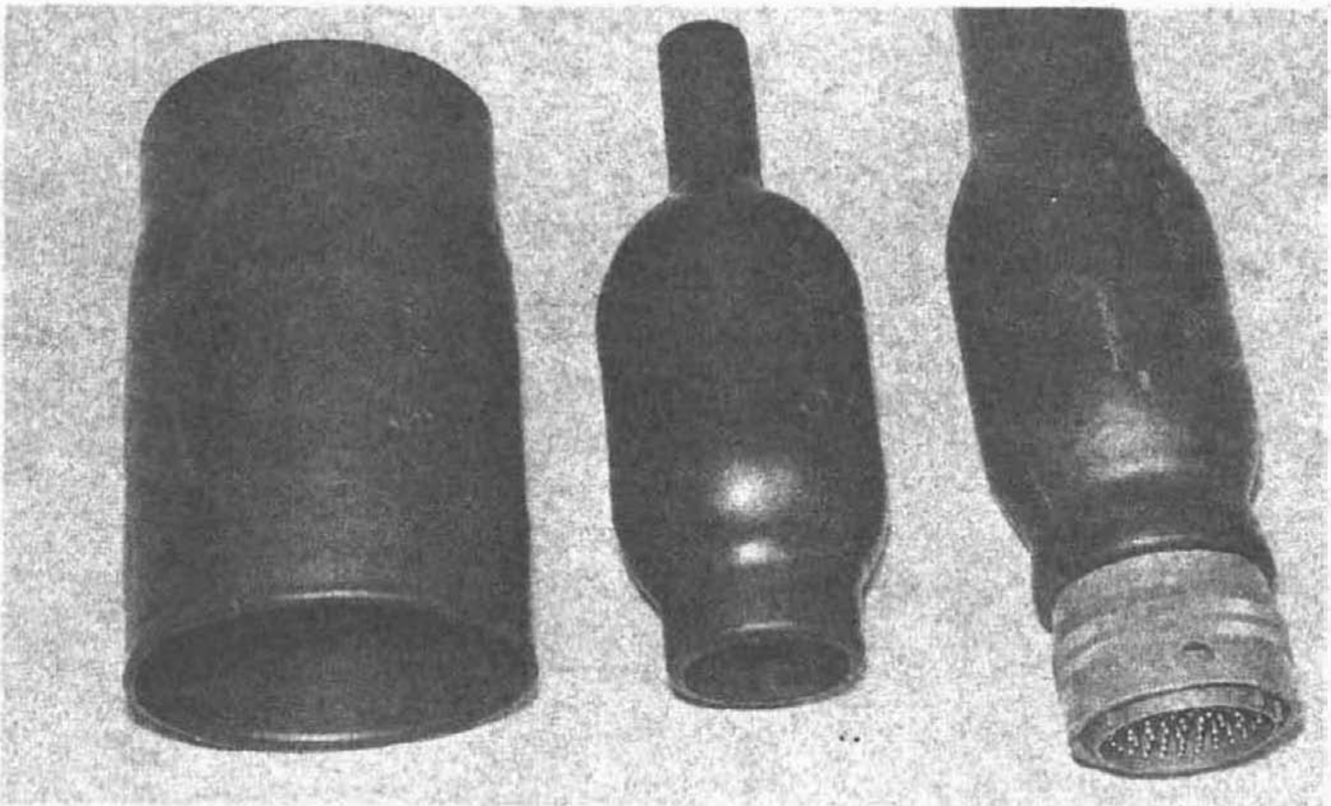


FIGURE III-13 HEAT SHRINKABLE POLYOLEFIN BOOTS

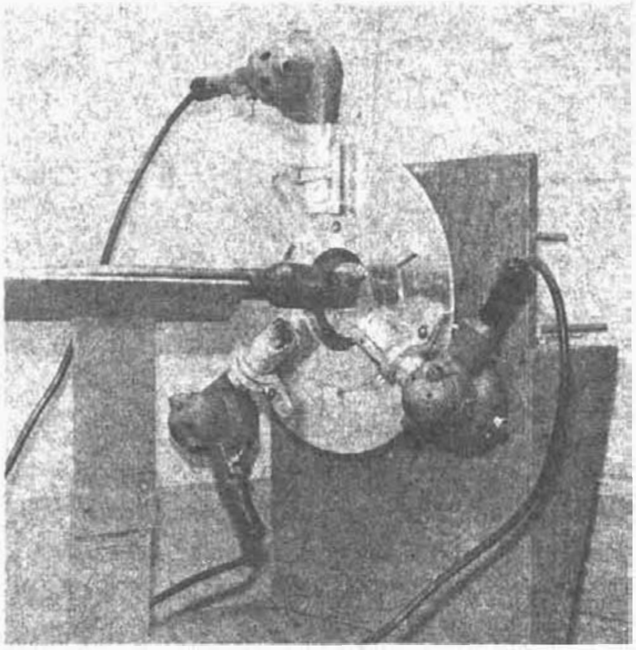


FIGURE III-14 HOT AIR SHRINKING OF POLYOLEFIN BOOTS

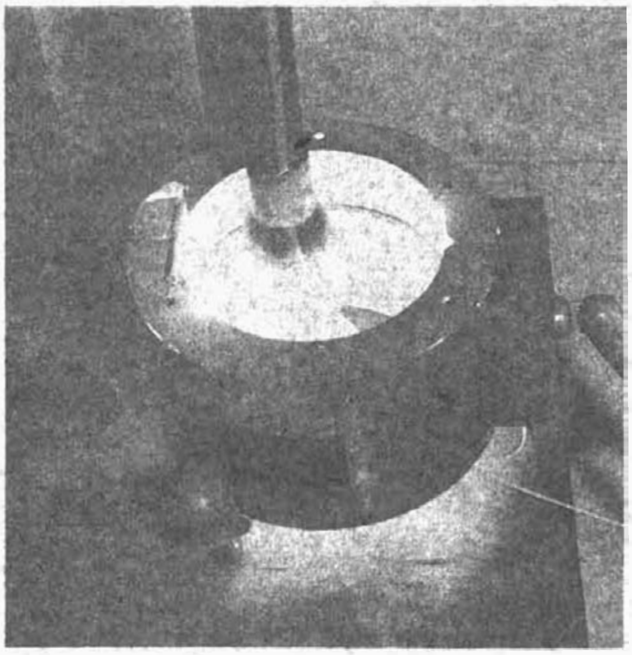


FIGURE III-15 INFRARED HEATER FOR SHRINKING POLYOLEFIN BOOTS

OUTPLANT DEVELOPMENT

Correction of Weld Distortion

Distortion of bulkhead parts due to weld shrinkage and mismatch was corrected by the use of an electromagnetic forming tool developed by NASA/MSFC. Approximately 30 production apex and base gores have been formed to the correct contour using the electromagnetic method.

Boeing and NASA/MSFC have jointly conducted development work on weld planishing techniques to eliminate distortion in the fitting-to-gore weld areas. Roll planishing resulted in removing distortion in weld areas, but an increase in tensile, burst, and fatigue properties was noted. However, the notch sensitivity increased as the thickness of the base metal increased. Therefore, roll planishing is recommended only for material of less than .375-inch thickness.

LOX Fill and Drain Elbows

Seattle Manufacturing Development perfected a process for fabricating LOX fill and drain elbows by the use of hot forming on a tube bending machine. Saturn production parts are being fabricated by this method.

GSE/MSE PROCUREMENT AND MANUFACTURING

STAGE TEST AND CHECKOUT COMPLEXES

At the beginning of FY 1965 a high priority schedule recovery effort was begun in GSE/MSE procurement and manufacturing. Workaround methods were developed to overcome equipment shortages, a vendor expediting service was developed, and some assembly work was reassigned to outside sources.

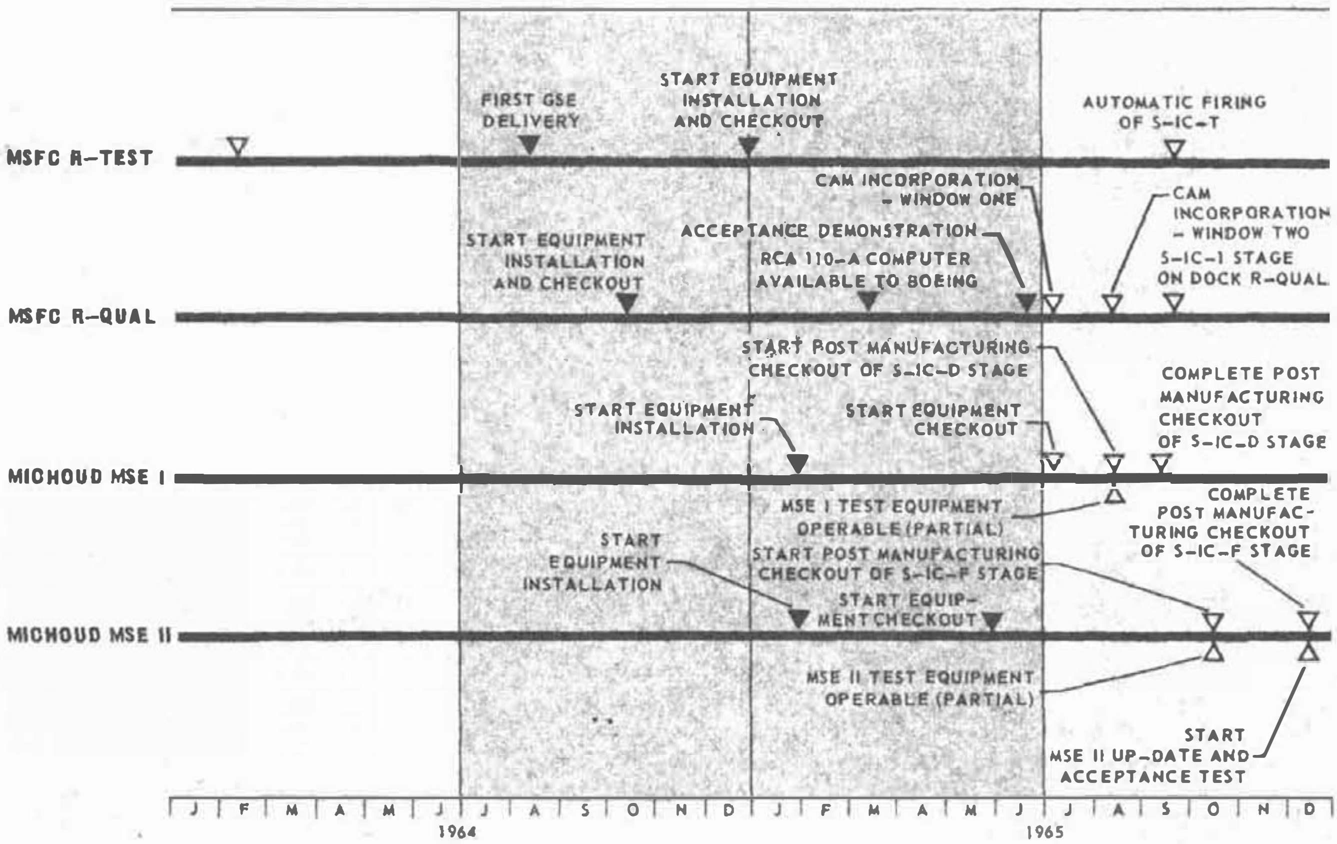
During the first fiscal quarter, five of nine scheduled R-TEST items were delivered. Testing of components and subassemblies was accomplished in Subsystems Test in support of manufacturing of major elements for R-QUAL, MSE I and MSE II.

In the second fiscal quarter, 30 major elements of GSE were delivered, essentially on scheduled recovery dates. Included was telemetry equipment for R-QUAL which was shipped short of some items. Manufacturing and testing of components, subassemblies and major elements continued for MSE I and MSE II.

At the end of the third fiscal quarter, approximately 98 percent of all engineering had been released for R-QUAL, R-TEST, MSE I and MSE II. Supplier surveillance continued on critical items. Delivery of the integrated telemetry ground equipment consti-

GSE/MSE ASSEMBLY AND MANUFACTURING MILESTONES

(PLAN VIII)



tuted the first R-QUAL delivery. Approximately 50 percent of the major end items for the R-QUAL control room were delivered, and R-QUAL platform delivery was completed during the quarter.

At the year's end, approximately 99 percent of all known materiel requirements were released for R-QUAL, R-TEST, and MSE I and II, and are on order. Approximately 95 percent of MTF 1 requirements were released and are on order, except for a few short-lead-time items. No requirements were received for MSE III or MTF 2.

During the fourth fiscal quarter, 38 R-TEST end items were delivered to the customer. Total cumulative end item shipments to date are 113 compared to the Plan VIII total cumulative requirement of 136. R-QUAL end item shipments totaled 112 in the fourth fiscal quarter.

Additional status information on R-QUAL, MSE I and MSE II is indicated in Figures III-16 through III-26.

HANDLING AND TRANSPORTATION EQUIPMENT

Twenty-six end items were shipped in the fourth fiscal quarter for a cumulative total of 50.

Design problems with stage attach fittings resulted in bearing failures during proof load testing. The design was revised and parts that were completed for S-IC-S, -T, and -1 will be returned to Michoud from MSFC for rework and retest. This problem caused the S-IC-D to be held in the vertical assembly position awaiting fittings.

Structural proof load tests were conducted on four forward handling rings. Additional tests were conducted on manual engine actuator support assemblies, stage weighing stands, fin and fairing cradles, and stage attach fittings.

Mockup F-1 engine, FM-105, was received and is being utilized to establish and verify handling and transportation equipment procedures, and to familiarize personnel with the engine. The mockup will be installed on the S-IC-F vehicle.

LAUNCH SUPPORT EQUIPMENT

Launcher Umbilical Tower Pneumatics (Modification 122/174)

A task force was established during the fourth fiscal quarter and was effective in delivering the items to satisfy most program requirements. The pneumatic console and pneumatic test racks for MAB were completed in June, 1965. The console was reallocated to R-TEST to satisfy a requirement of higher priority. A total of 20 end items have been shipped—all during the last quarter—compared to a scheduled cumulative demand of 18 at the year's end. All supplier qualification test programs were complete.

Modification 123/185

All umbilical fluid couplings were delivered; however, numerous couplings were rejected at Michoud for cleaning reasons and returned to the supplier. All returned hardware will be returned to Michoud by August, 1965. Qualification testing was complete on all couplings.

Modification 124/224

The LOX and fuel tank protective devices for R-TEST were delivered complete to MSFC in late March, 1965. Shipment of the fuel segments to MILA is continuing at a rate that will support the required delivery schedule. The LOX segments were cancelled pending receipt of design changes which are scheduled for release in July, 1965.

Modification 227

All components to be delivered from BATC arrived on-dock Michoud July 1, 1965. The first unit was assembled on schedule. However, a new delivery schedule has been committed to allow the modification of 50 control valves with LOX compatible seals. No further delivery problems are anticipated.

Modification 233

Contract Modification 233, effective February 16, 1965, authorized the design, fabrication or procurement, and test of equipment which will be used to receive, transport, buildup, test and install the F-1 engines. Test and handling equipment authorized by the above modification was being procured or fabricated and is scheduled for completion in August, 1965. This will support the present engine test schedule. Of 40 categories of equipment required, 21 are on-dock.

GSE/MSE MANUFACTURING SUPPORT ACTIVITIES

During the past year the subsystems test area emphasized testing of GSE/MSE components. Testing is approximately 80 percent complete. Approximately 3250 instruments, 836 drawers and 180 end items were tested.

In the pneumatic-cryogenic area, an ultraclean test area was activated in the second fiscal quarter for running high pressure tests up to 6000 psi and low temperature tests as low as -320°F.

Telemetry test stations were activated to test the S-IC-T telemetry systems. They are being modified to the S-IC-1 telemetry configuration. Modification is 90 percent complete and some S-IC-1 parts were tested. Approximately 700 items were tested utilizing these test stations. A semiautomatic evaluation bench that will save some 460 manhours per stage is expected late in the first quarter of FY 1966.

Level 5 and 6 test stations were complete with the exception of six minor test fixtures added because of new test requirements. Modifications are being made to improve the pressure transducer test station, the calorimeter test station, and the signal conditioner test station.

The antenna test bench was available for interim use. The RF test bench was complete less CAM 312. The electronic and instrumentation test benches are still in work, but are expected to be available during July, 1965.

Mockup and fabrication of GSE tubing started in January, 1965. Approximately 2400 tubes were mocked up and 5800 production tubes were fabricated and hydrostatic tested in the first six months of operation. Initial certification for the manufacture of stage tubing to NASA/MSFC Specification 146 was completed.

The implementation of assembly line production methods in the cable fabrication and mold areas allowed high-rate cable production to exceed 600 per week during the last half of FY 1965.

Improved wiring assembly methods implemented in the electrical/electronic assembly area resulted in production rates exceeding 50 console drawers per week during the third and fourth fiscal quarters.

GSE/MSE INSTALLATION AND CHECKOUT

Fiscal year end status of GSE/MSE delivery, installation and checkout at MSFC R-QUAL, Michoud MSE I and Michoud MSE II stage test and checkout complexes is indicated graphically in Figures III-16 through III-26.

MSFC R-TEST

Boeing Systems Test personnel are responsible for receiving GSE at R-TEST but installation, calibration and checkout is a joint activity with NASA/MSFC. For this reason R-TEST installation and checkout is not included in the graphical status presentation.

In December, 1964, Boeing Systems Test established a staging area at Building 4481 at MSFC Huntsville to receive GSE for R-TEST.

Preparatory work on telemetry room GSE installation, calibration and checkout started January 4, 1965. Mounting bases and cable trays were positioned so that equipment could be installed as it arrived. Telemetry room equipment started arriving in February and the majority of the required GSE was installed. Level III checkout was started on March 1, 1965, and is 60 percent complete. Most of the remaining checkout is on the integrated telemetry ground equipment.

The air conditioning system and the false floor were installed in the computer room by facility contractors. Equipment was received, inspected, and stored in the room. Installation will start when scheduled by NASA/MSFC. Boeing Systems Test personnel began writing checkout procedures for the computer room equipment. The RCA 110A Computer was installed and is undergoing checkout by RCA personnel.

Control room equipment received during FY 1965 was installed on mounting bases awaiting interconnection and checkout.

Some test stand GSE was received, but installation has not started.

MSFC R-QUAL

The GSE installation, calibration and checkout effort at R-QUAL was completed. The R-QUAL S-IC test and checkout complex successfully underwent its acceptance demonstration on June 21, 1965, as scheduled, with the exceptions discussed later in this section.

R-QUAL facilities were made available to Boeing in September, 1964. Work on GSE installation, calibration and checkout started immediately, but was hampered by late delivery of equipment.

In October, 1964, an installation, calibration and checkout command center was established to resolve problems with manufacturing, delivery, installation and checkout of GSE. Other committee objectives were to shorten lines of communications, shorten decision time, use Design Support engineering expediting services, and share technical problem resolution.

Considerable schedule recovery during the fourth fiscal quarter enabled the completion of R-QUAL GSE installation, calibration and checkout except for some shortages and the use of some workarounds and prototype equipment for the acceptance demonstration.

The following GSE shortages, rework items, and installation and checkout effort, none of which affect the operational capability of the test and checkout station, are to be provided by Boeing by July 30, 1965.

Shortages:

a) Electrical Checkout Unit;
b) 52W7 Cable;
c) Vent Duct Extension Equipment (LOX);
d) LOX Vent Duct Fixture;
e) GOX Duct Assembly Fixture;
f) Fuel Tank Supplemental N_2 Duct;
g) Fixture Assembly;
h) Manual Engine Actuator Support Assembly;
i) Tie Rod End;
j) Load Valve Assembly.

Rework:

a) Elevator Assembly;
b) Ground Cooling Equipment.

Installation and Checkout:

a) Power Supply, 60 CPS Ground;
b) TV Closed Circuit Equipment.

All R-QUAL calibration and acceptance test procedures were written and distributed for review. The majority of Systems Test effort was completed except for revisions after the reviews were complete.

Twenty-two CAM's were incorporated at R-QUAL. Seven CAM's that were partially incorporated prior to June 21, 1965, will be completed on a noninterference basis. Forty-six CAM's have been scheduled for incorporation in the future.

Two shutdown periods were scheduled at R-QUAL for CAM incorporation. The first period (window one) was from July 1 to July 7, 1965 inclusive; the second window is from August 7 to August 13, 1965. Seven CAM's were scheduled for incorporation during window one and eighteen during window two. Eight CAM's will be incorporated prior to the arrival of S-IC-1 stage at R-QUAL, and are scheduled for September 27, 1965. Nine CAM's are scheduled for incorporation after the arrival of S-IC-1 stage and four are pending.

MICHOUD MSE I AND II

The Michoud Stage Test Building was occupied by Boeing Systems Test personnel during the third fiscal quarter. Office areas were established for Test Engineering, and Test Operations. Blueprint files in the Stage Test Building contain a complete set of MSE and stage prints. A material staging area was activated to provide storage space for small hand tools and second order test equipment.

Installation and checkout of equipment of MSE I and II is progressing satisfactorily to meet the first need dates. Delivery of the equipment started during the third fiscal quarter. Ninety racks of equipment, including the RCA 110A computer consisting of 18 racks, have been installed in MSE I and II.

Major emphasis is being placed on MSE II in support of the first major stage checkout operation, the S-IC-F stage checkout starting in October, 1965. The first stage tests will be conducted on the minimum configuration S-IC-D stage in MSE I in August, 1965.

Approximately 74 percent of the interconnecting cables was installed. Pneumatic tubing from the fourth floor supply equipment to the extremities of the catwalks in Test Cells 1 and 2 was installed and will be pressure-tested and LOX-cleaned in place. All stage work platforms were assembled in the test cells.

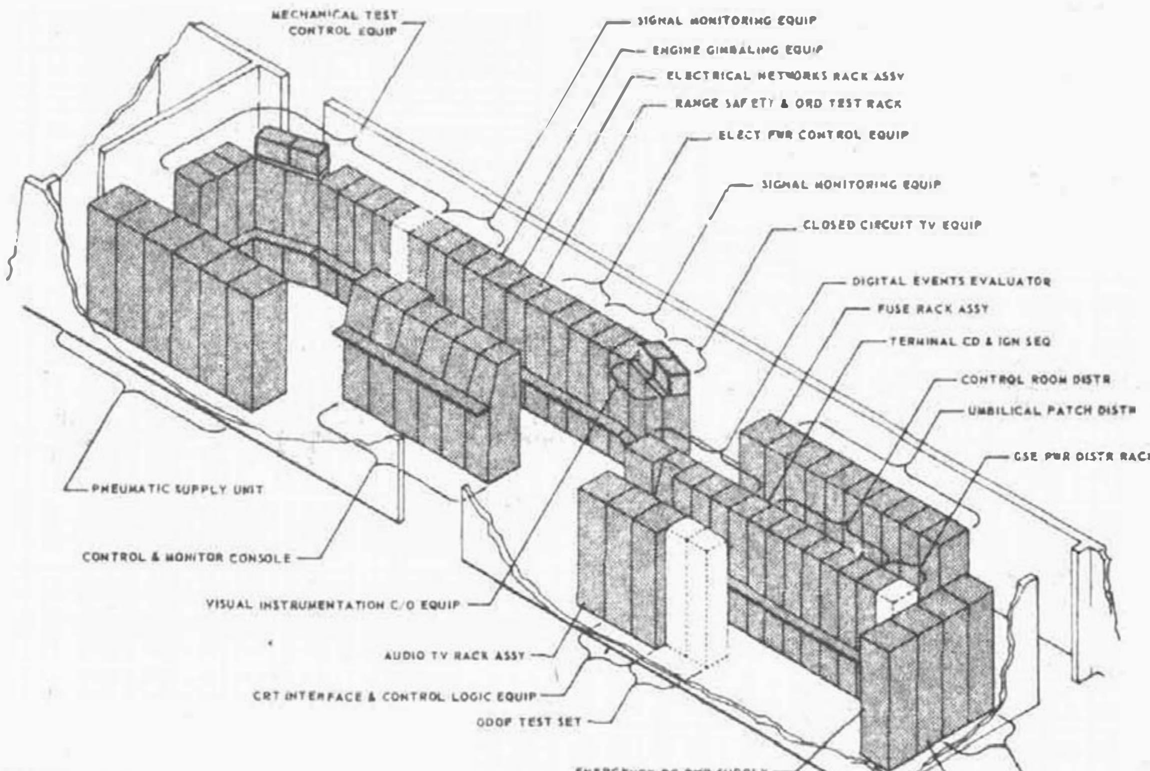
POST MANUFACTURING STAGE CHECKOUT

The S-IC stage checkout and acceptance test procedures and calibration procedures for the Michoud test complex are being redrafted from those previously written for R-QUAL. The stage checkout procedures for the S-IC-D are 90 percent complete and for the S-IC-F are 25 percent complete. Manual acceptance test procedures and all calibration procedures for MSE II are approximately 50 percent complete and will be finished on schedule.

The computer programs developed for automatic testing at R-QUAL will be modified for use at Michoud. Initial draft of the procedures for those operations that must be performed manually when testing in either the automatic or manual mode will be finished ahead of schedule. Drafts of the manual mode stage test procedures (to be used if the computer or computer programs are not available) will be finished on schedule.

The procedures (Equipment Activation Guides) required to manually check out the test equipment were completed during the fourth fiscal quarter.

CONTROL ROOM GSE-MSFC R-QUAL



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LEVEL III
ACCEPTANCE TESTED

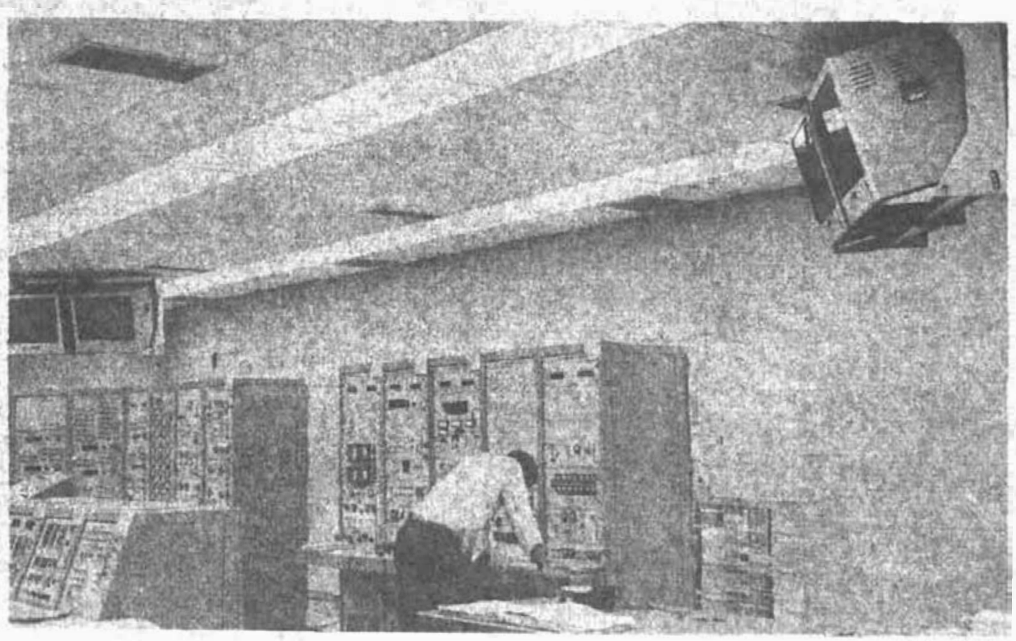
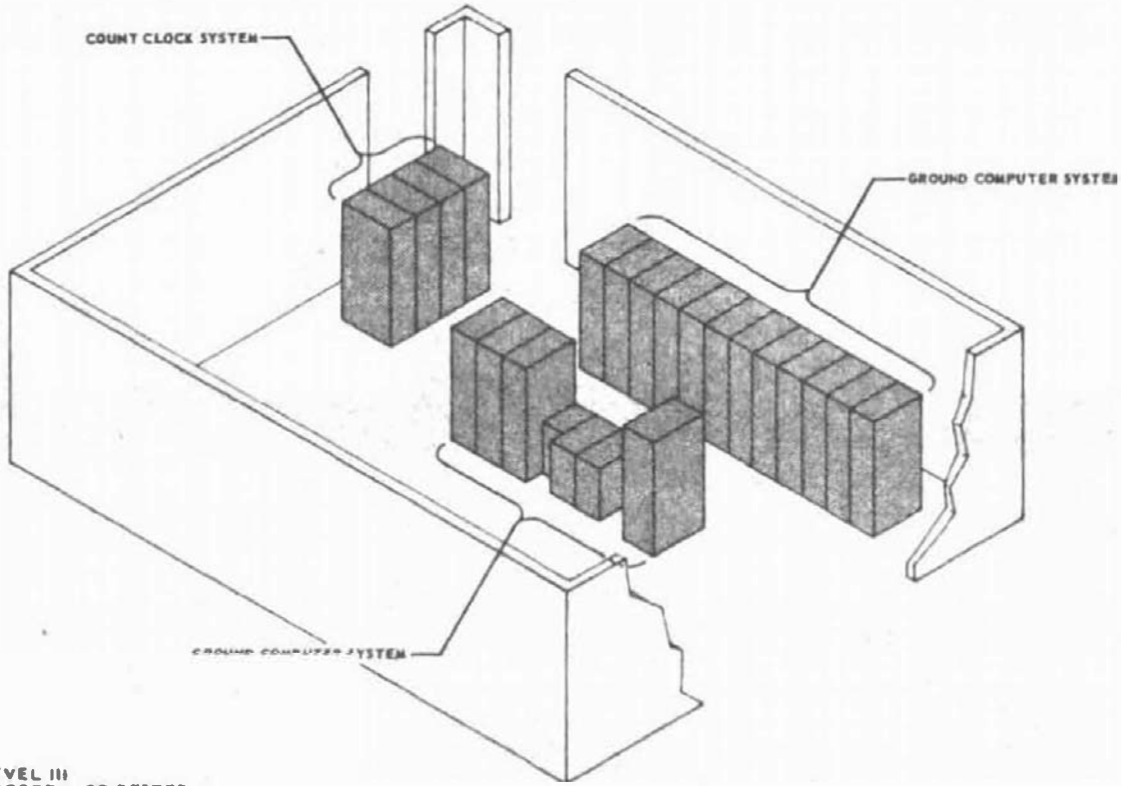


FIGURE III-16

COMPUTER ROOM GSE-MSFC R-QUAL



LEVEL III
ACCEPTANCE TESTED

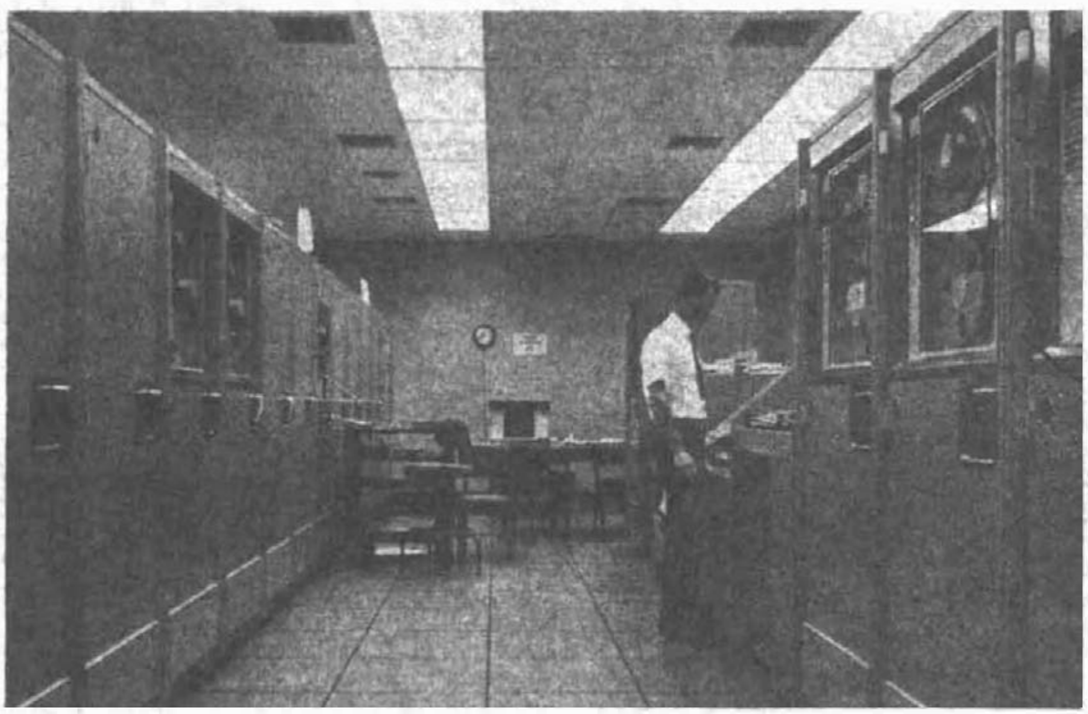


FIGURE III-17

TELEMETRY ROOM & SPECIAL POWER ROOM GSE-MSFC R-QUAL

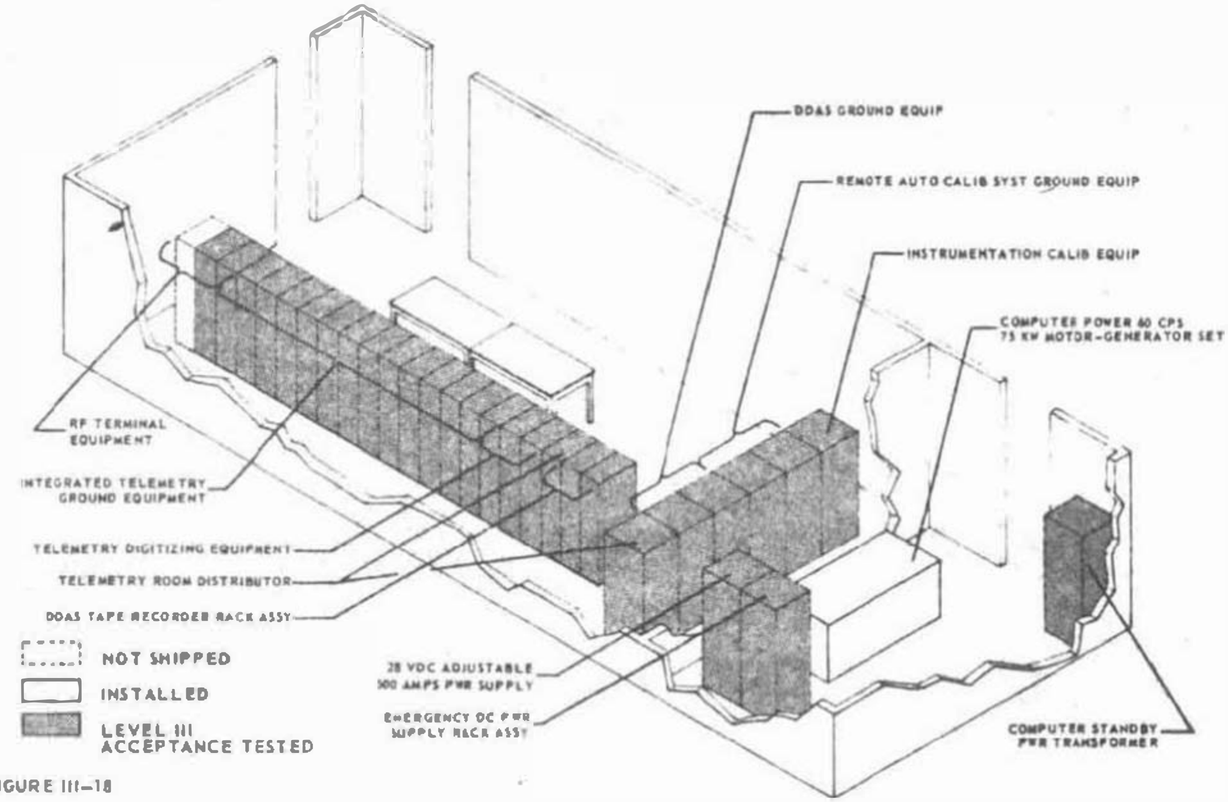


FIGURE III–18

TEST CELL GSE-MSFC R-QUAL

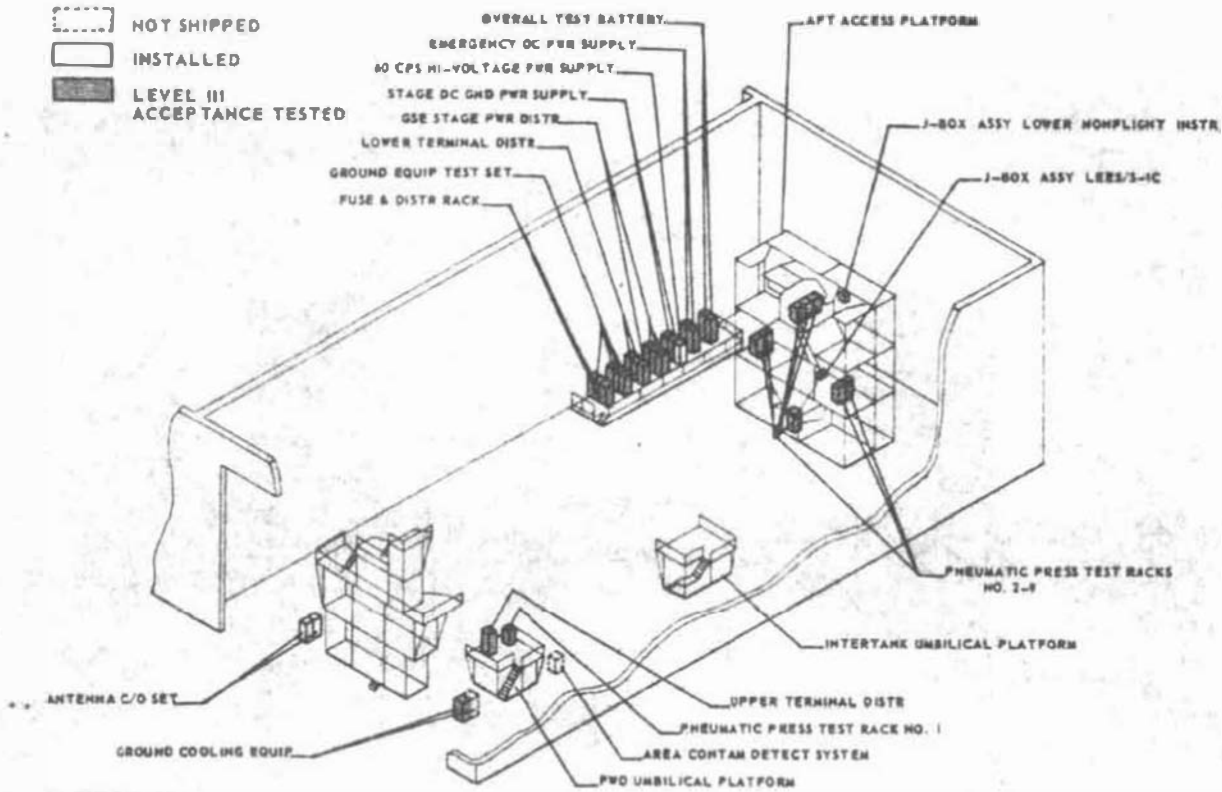
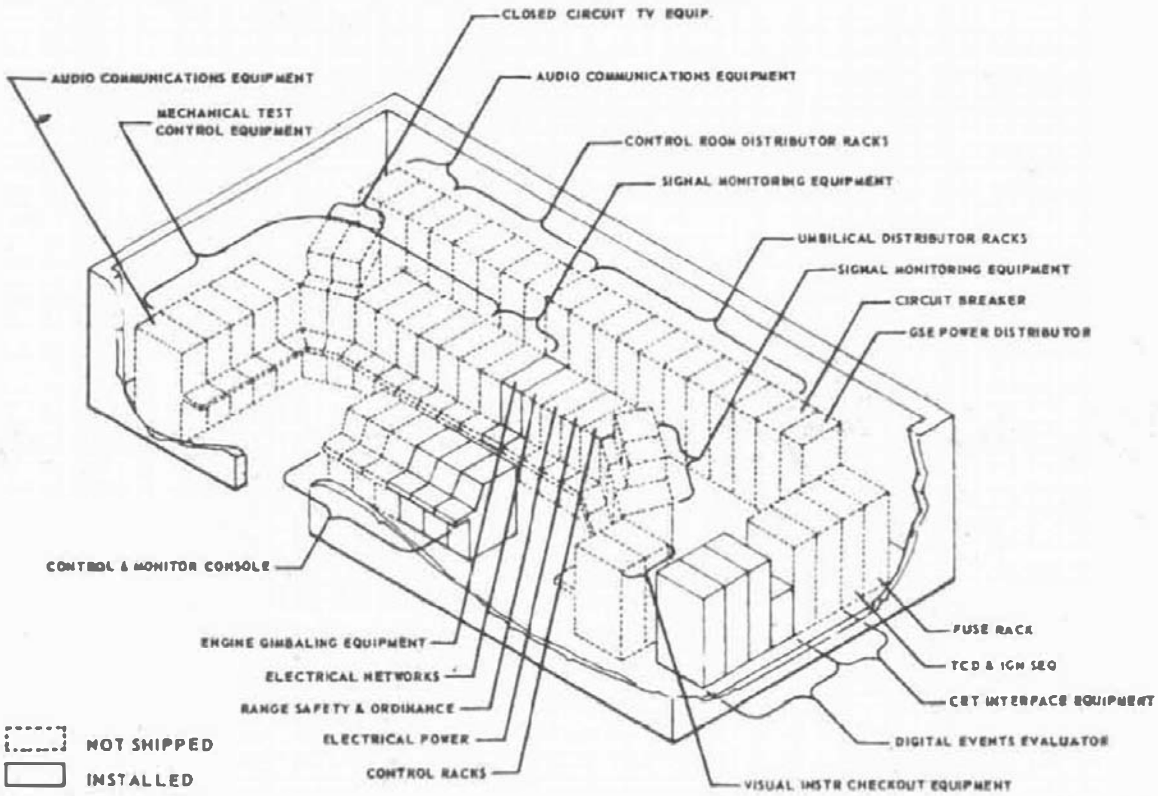


FIGURE III–19

CONTROL ROOM MSE-MICHOUD COMPLEX I



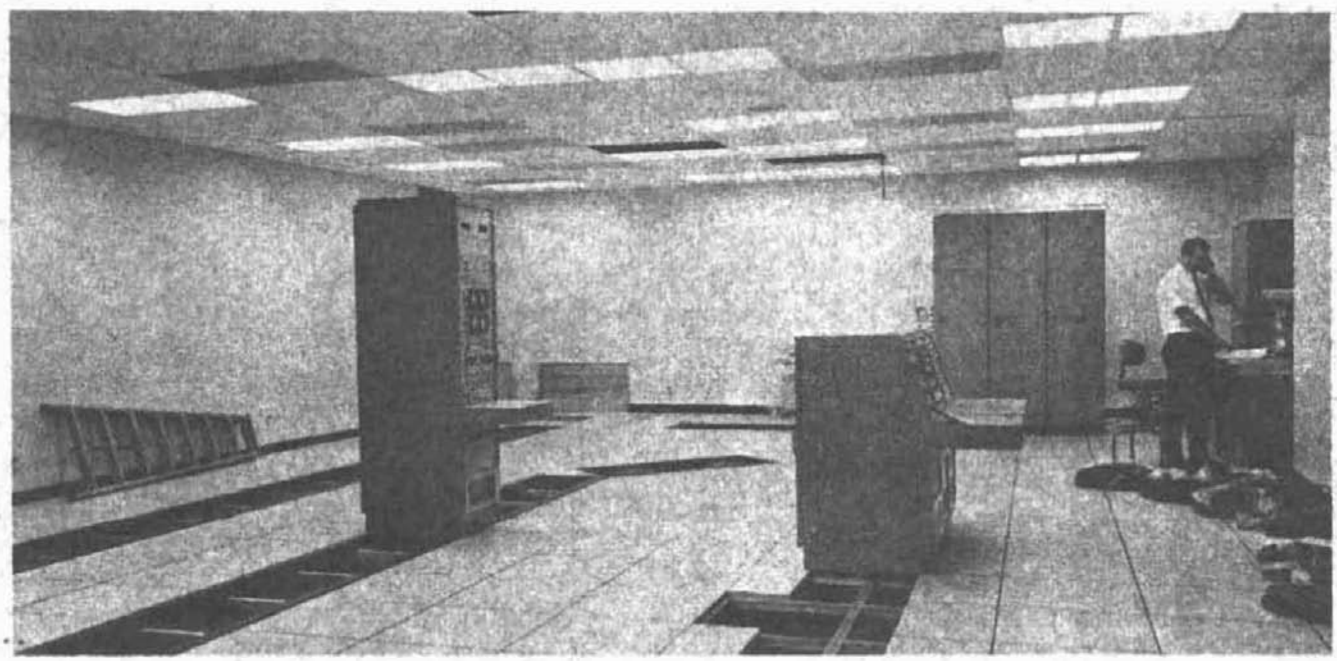
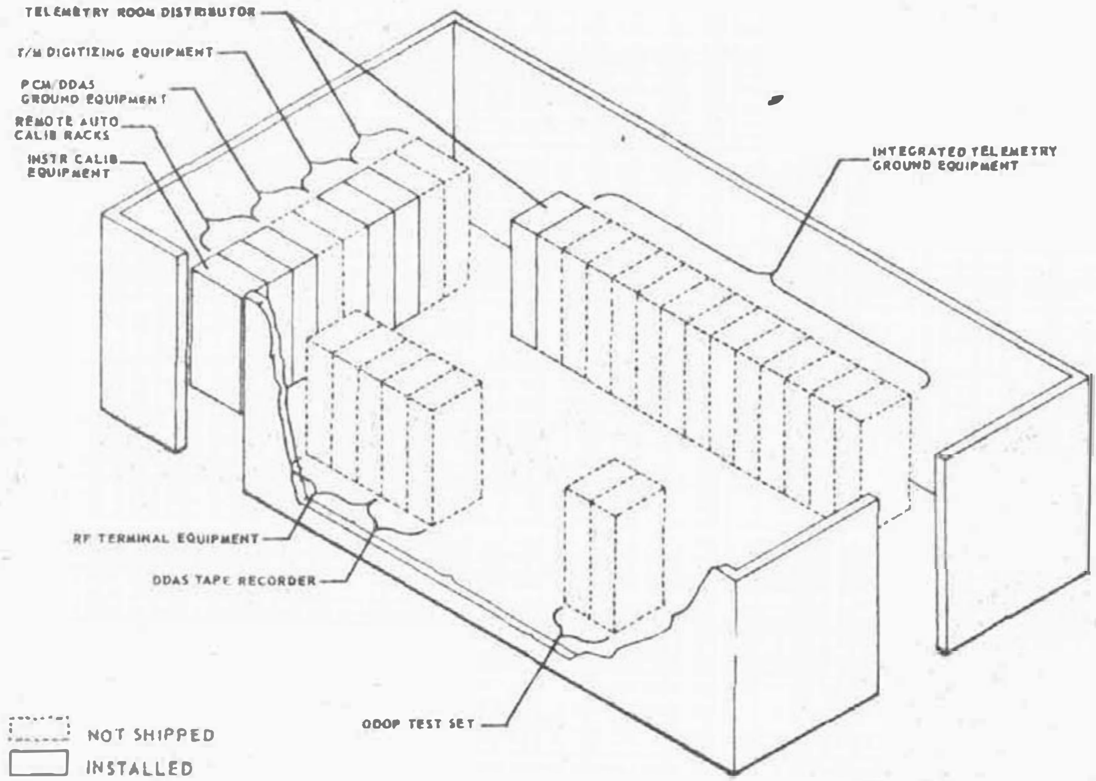


FIGURE III-20

TELEMETRY ROOM MSE-MICHOUD COMPLEX I



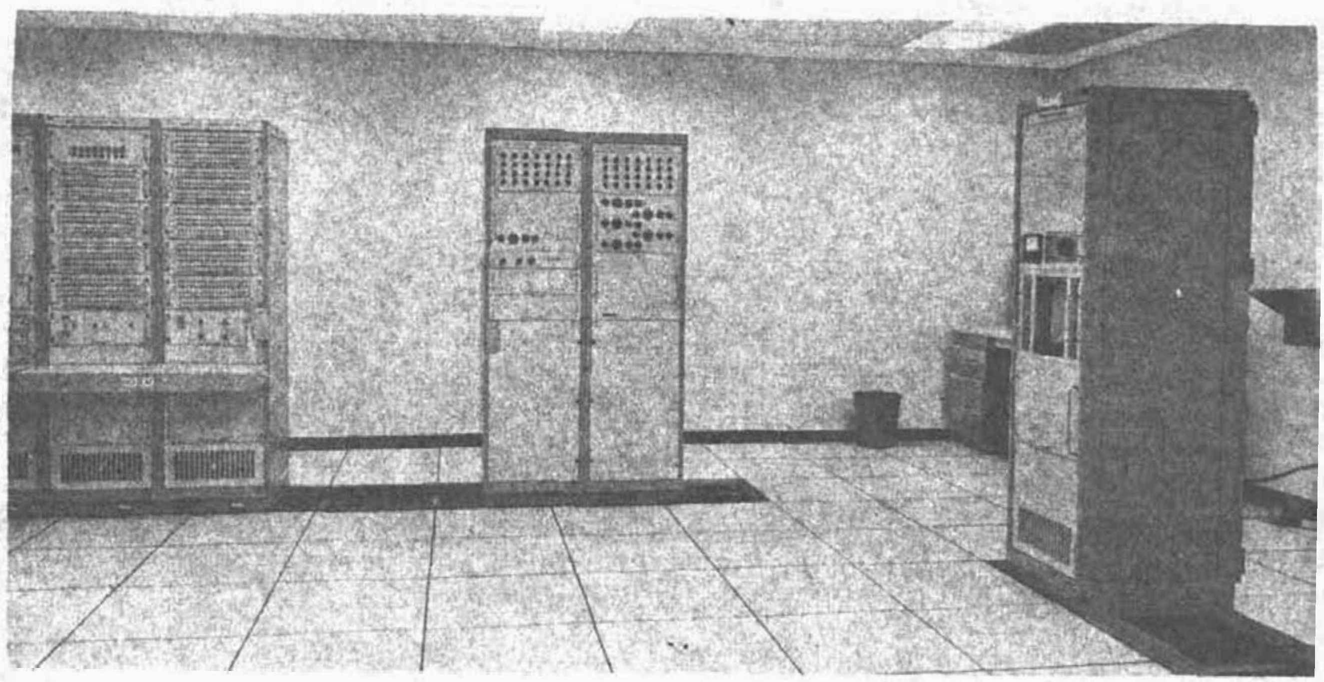
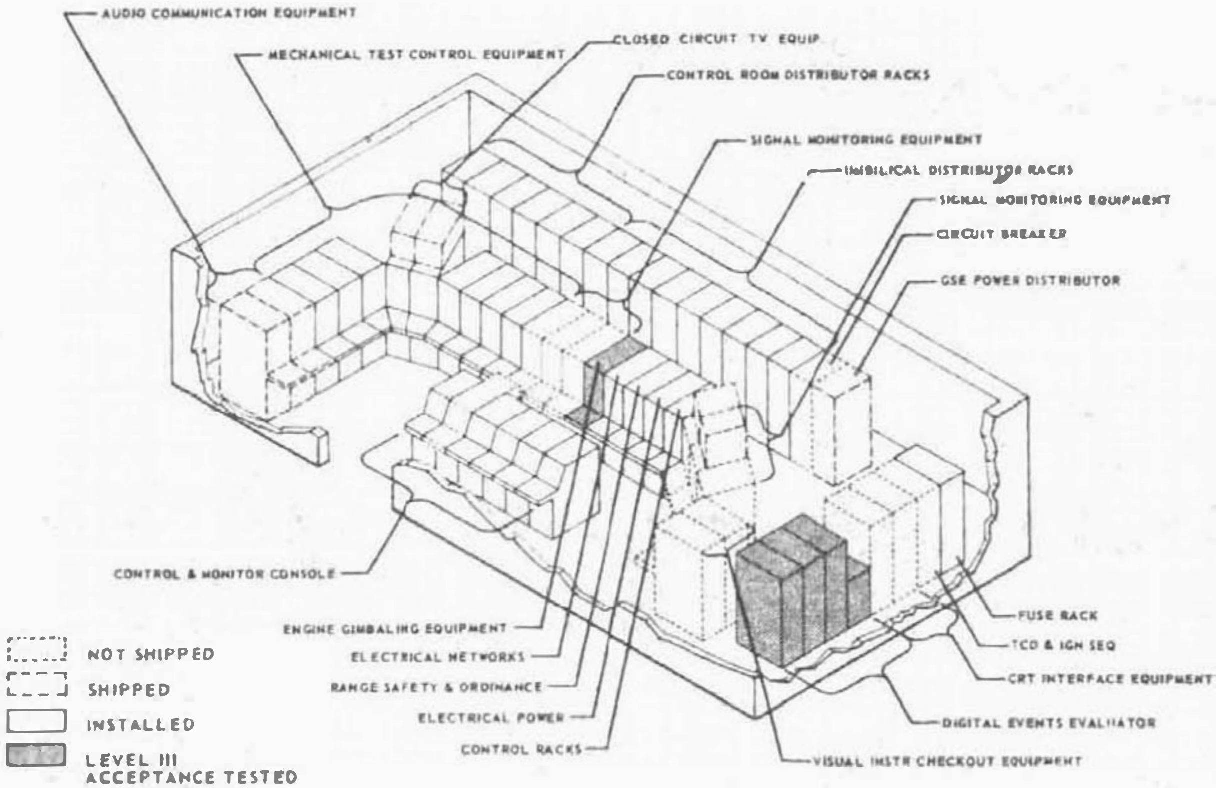


FIGURE III-21

CONTROL ROOM MSE-MICHOUD COMPLEX II



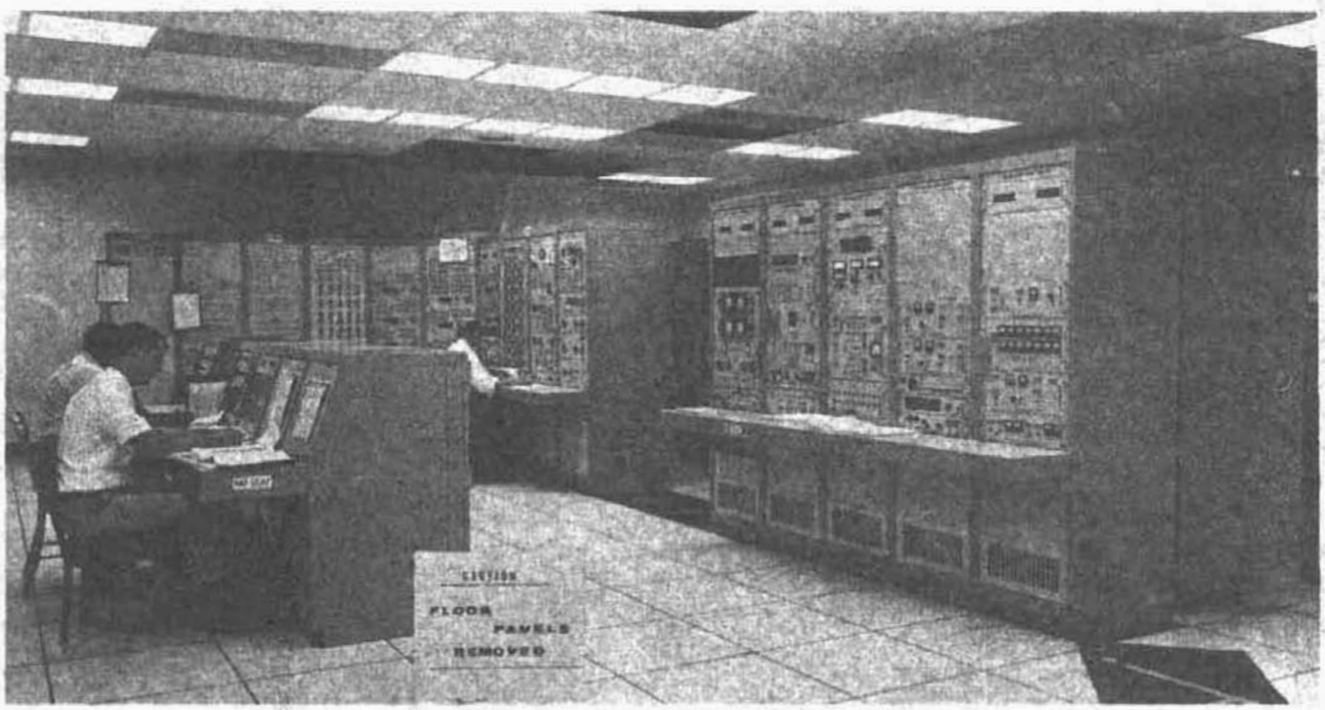
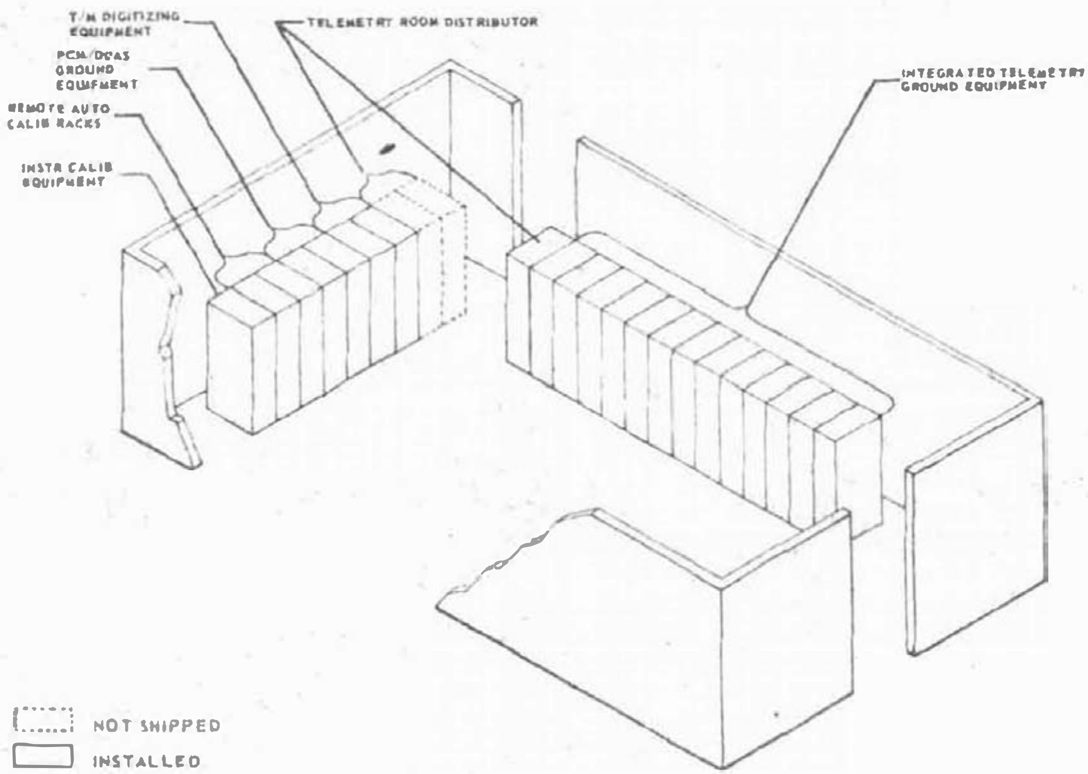


FIGURE III-22

TELEMETRY ROOM MSE-MICHOUD COMPLEX II



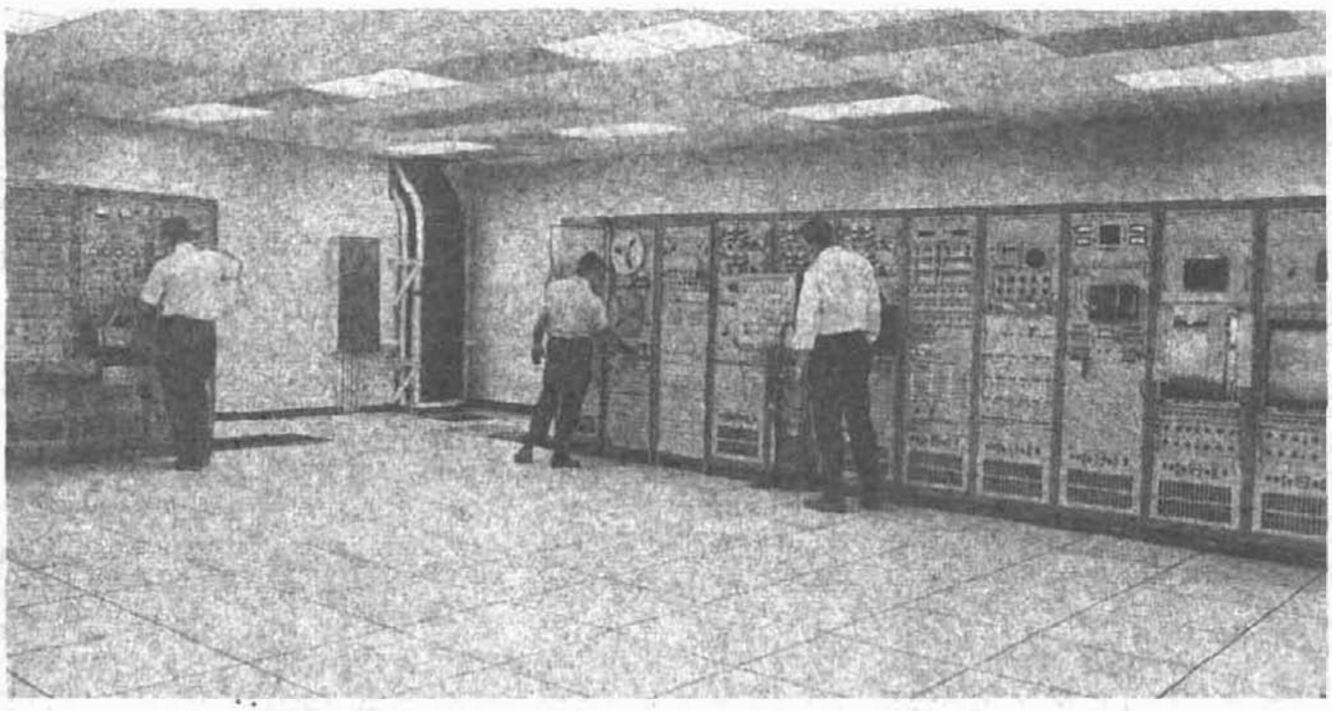
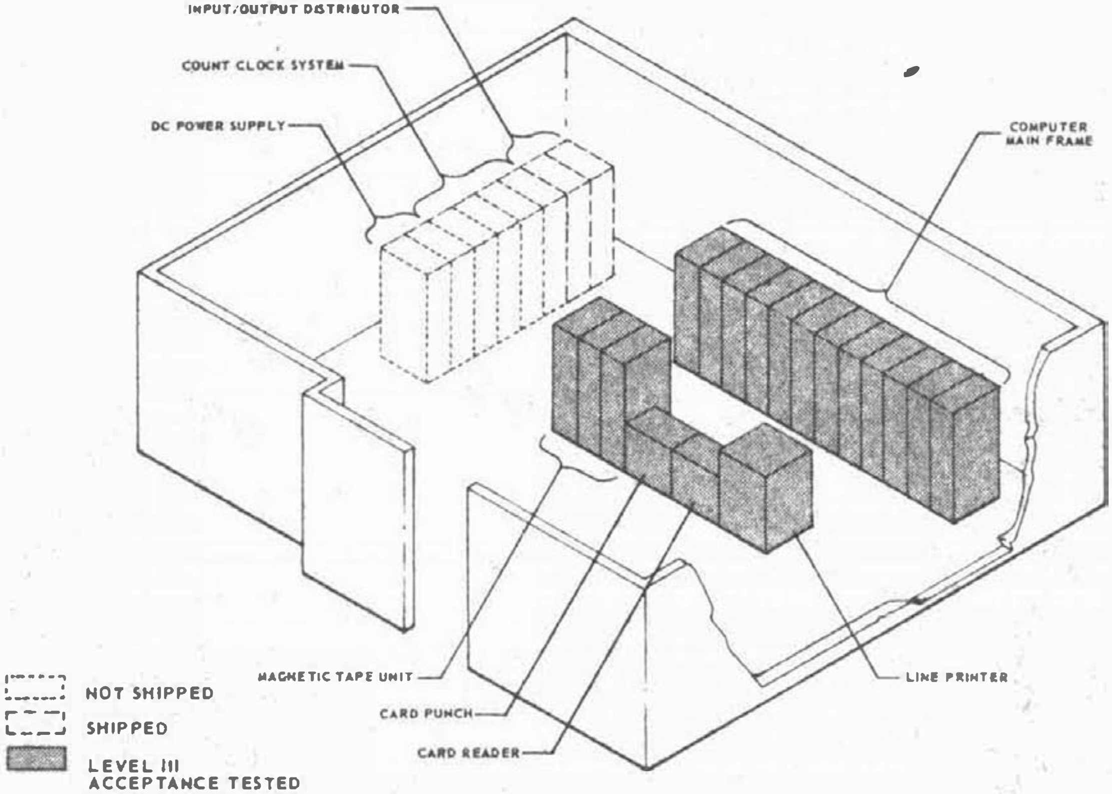


FIGURE III-23

COMPUTER ROOM MSE-MICHOUD COMPLEX II



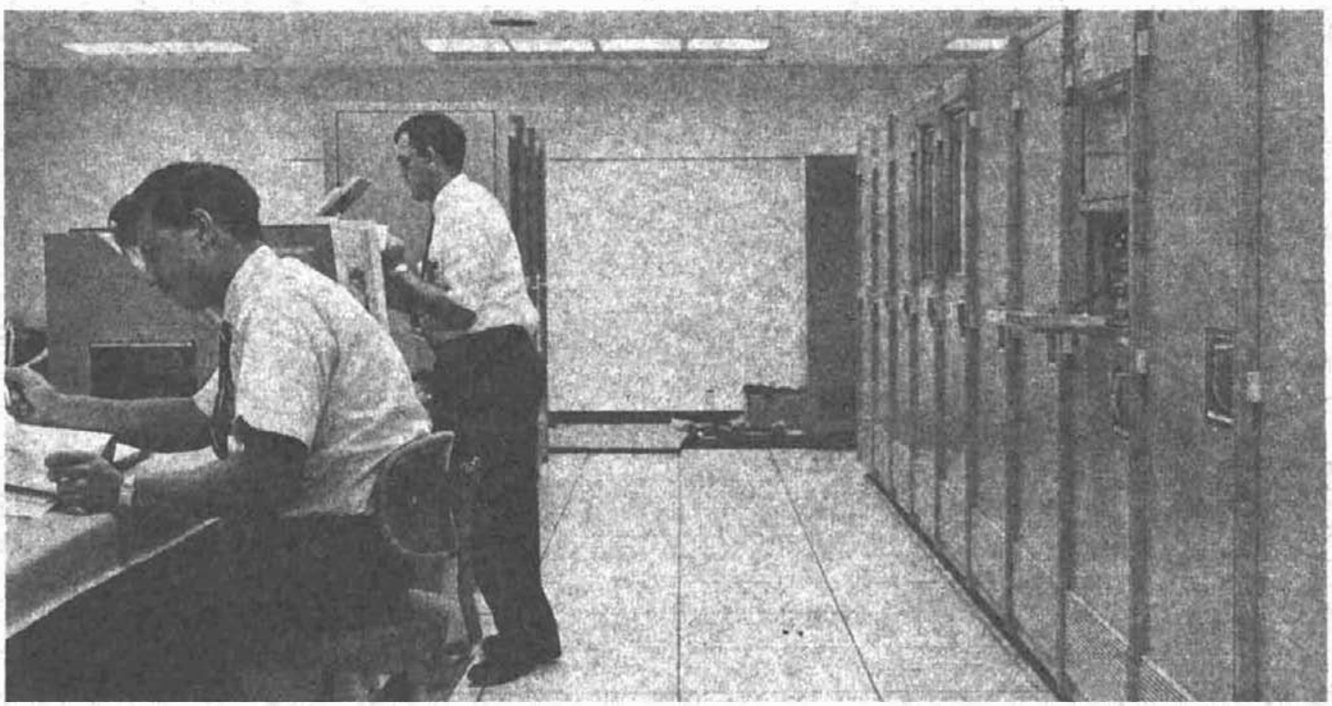


FIGURE III-24

TEST CELL MSE-MICHOUD COMPLEX II

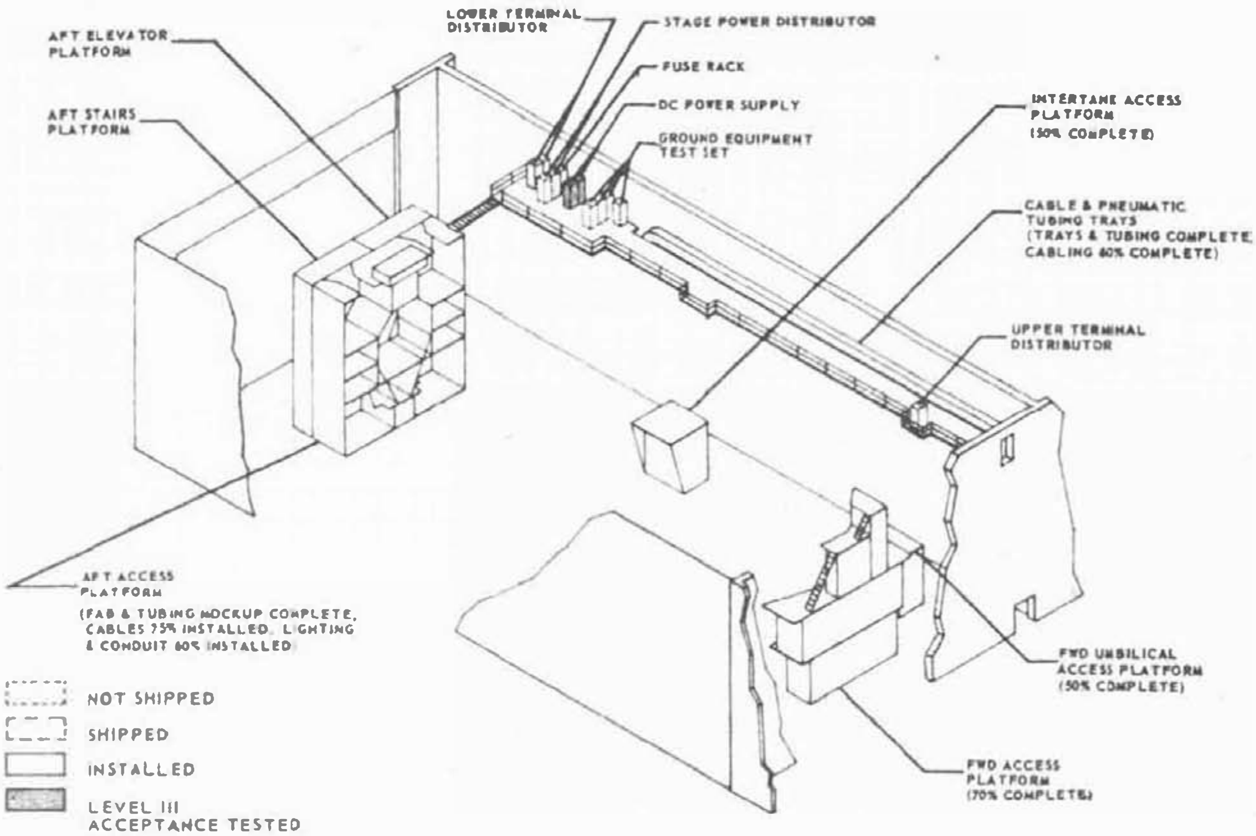


FIGURE III-25

HYDRAULIC PUMP HOUSE MSE-MICHOUD (GENERAL)

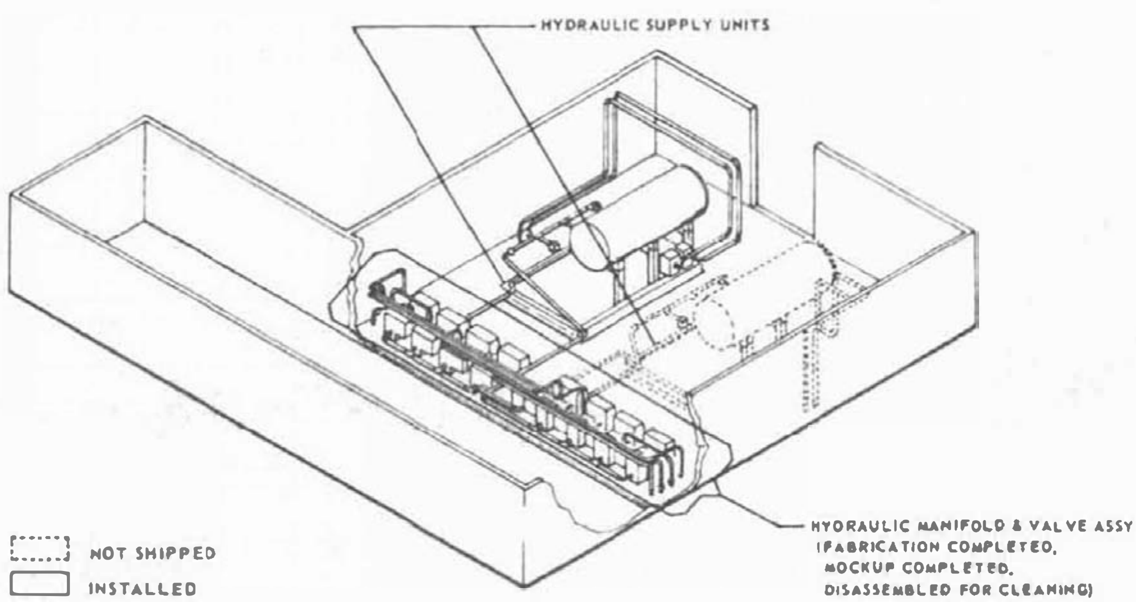
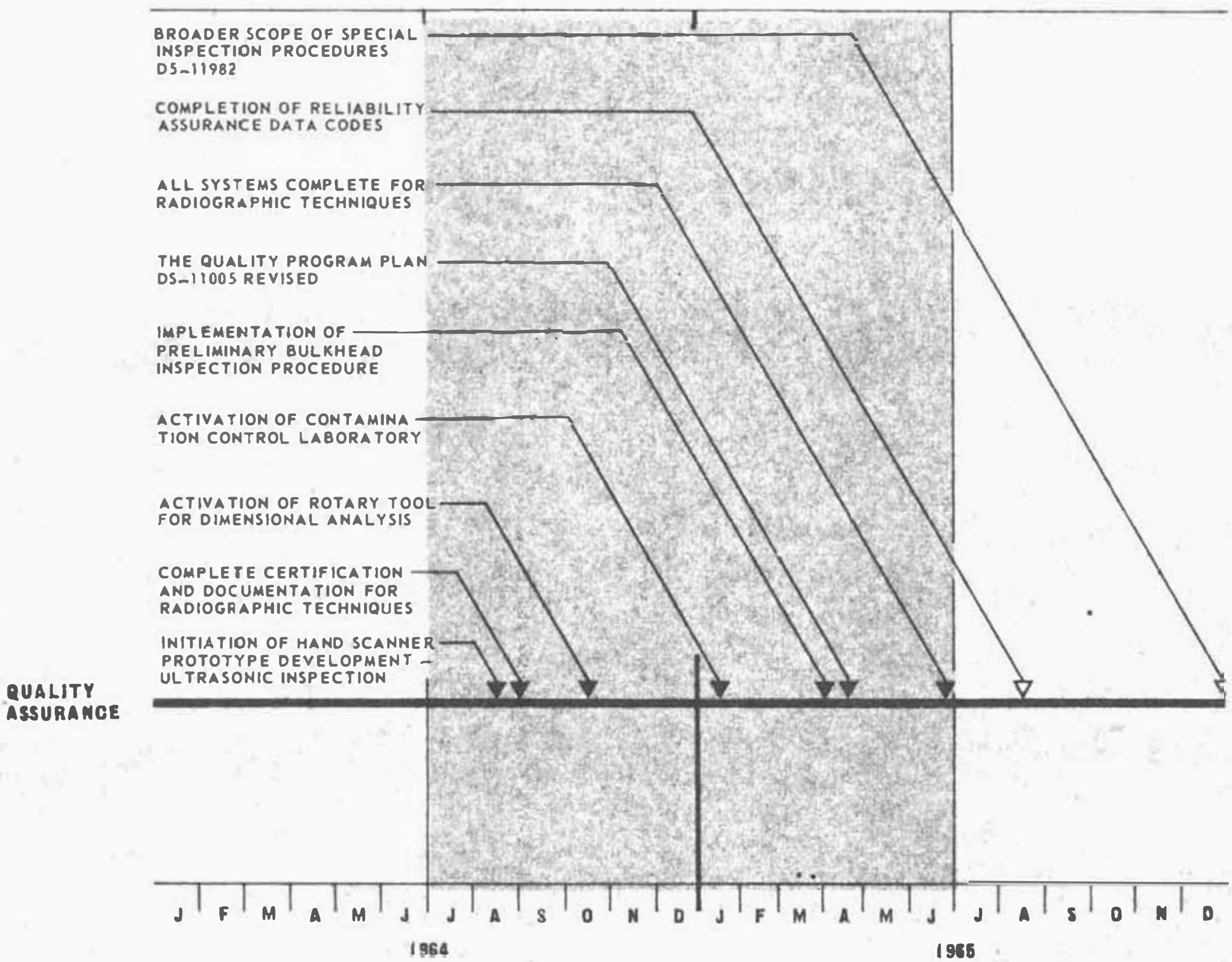


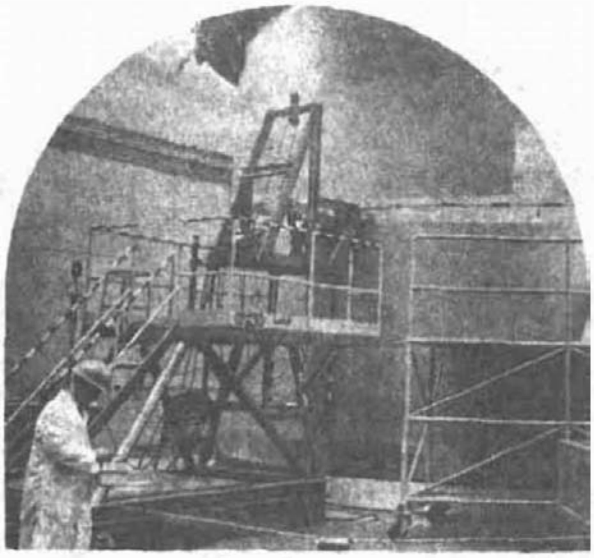
FIGURE III - 26

QUALITY ASSURANCE MILESTONES

(PLAN VIII)



QUALITY ASSURANCE



4

INTRODUCTION

Significant progress was made during the last half of FY 1964 in all basic functions of Quality and Reliability Assurance. Permanent laboratory facilities were activated; refinements were made to systems, procedures, and techniques as initial deliveries were made on S-IC-T vehicle components. FY 1965 was characterized by further refinement and increased application of systems, procedures, and techniques during fabrication and assembly of the S-IC-D stage. Capabilities were increased by the development and application of new techniques and the acquisition of additional equipment. An important milestone was the hydrostatic testing of the S-IC-D fuel tank during the last fiscal quarter. The contamination control laboratory, located in the subsystems test area, was completely activated during the year.

During the last quarter of FY 1965, milestones included the Revision of Document D5-11005, "The Quality Program Plan," April 19, 1965; and the implementation of the bulkhead inspection technique.

Milestones which are to be achieved during the first quarter of FY 1966 are the completion of reliability assurance data codes, scheduled for August 15, 1965; and the release of the revised special inspection procedures, D5-11982, scheduled for December 31, 1965.

PROGRAM DEVELOPMENT

SYSTEMS

A new system of reviewing purchase orders to determine receiving inspection requirements before release to the supplier was implemented during the year. A new system of routing and processing documentation in the receiving inspection area was also implemented. These systems have substantially reduced redundant paper work and improved the material flow time.

Emphasis was placed on development of the weld certification and evaluation program during FY 1965. The purpose of this program is to control welding operations by establishing the quality performance of both welding machines and welding operators through actual performance certification. This certification then serves as a baseline for machines and operators. Future quality performance will be built up from this baseline. Continuing measurements are made of the operators' performance and their standing relative to their certified level of performance.

This is accomplished by using the radiographic inspection data generated by equipment and weldor, evaluating the data against process standards, and assigning a quality performance level to each factor. Corrective action is taken when this level indicates degradation of quality performances as measured against process standards, base-line certification, and cumulative part performance. This action may require a mandatory recertification of a machine or operator.

Implementation of the weld certification and evaluation program required the assignment of competent personnel not only to handle the basic task but also to develop good working procedures and motivational display media.

PROCEDURES

Two new standard operating instructions covering destructive testing of small lot-size receipts were implemented during the year. These procedures have combined virtually all of the destructive sampling tables which were conducted on individual procurement specifications into two tables, thus reducing the time inspection planners need to determine sample size and acceptance criteria.

A new procedure for reviewing engineering drawings was implemented. The drawings are now reviewed as check prints and comments are resolved before release. The new procedure resulted in considerable cost savings by eliminating the need to revise released drawings to incorporate Q&RA comments.

During the year, the basic inspection document, D5-11982, "Special Inspection Procedures," was expanded and updated consistent with program progress. This document identifies 30 stage oriented systems emcompassing 100 different inspection procedures, and provides workable inspection procedures for use during all first article inspection activities. Examples of such procedures made available during the year were the hydrostatic tape leak detection, rotary table dimensional analysis, and stage alignment procedures. When completed, this document will contain all inspection techniques used on the S-IC program.

By mid-FY 1966 this revised document D5-11982 will be released. Document D5-11982 incorporates the major portions of D5-11962 "Non Destructive Test Development Plan," and D5-11961 "Functional Test Inspection Development Plan." Therefore by July, 1965, these documents will be retired.

TECHNIQUES

A technique that simultaneously measures the dew point and percent of argon and helium in weld gas was implemented during the year. The gas density balance and the dew point apparatus have been coupled to permit determination of both characteristics at the same time. Seven gas bottles now can be analyzed in the same amount of time formerly required to analyze five bottles.

A study was conducted on Y-ring cracking by metallurgists in the quality evaluation laboratories. The most impressive observation made during this study was the ease of detecting defects in a sample by using fluorescent penetrant inspection and black light compared to detecting defects visually. This method permits detection of cracks as small as .0008 inches, and now is being used by Factory Inspection on Y-ring components.

FACILITIES

The contamination control laboratory, located in the subsystems test area, was completely activated January 15, 1965. This laboratory provides the capability for performing analyses of environmental control testing media, cleaning solutions, and contamination-sensitive parts.

PRODUCTION INSPECTION - TOOLS AND EQUIPMENT

Development of special inspection equipment during FY 1965 continued to meet additional requirements imposed by increasing production activity. Significant developments are described below.

The topographical recorder shown in Figure IV-1 is basically a mismatch gauge designed for use in measuring relative mismatch between parts of the S-IC container assemblies that have been welded together. Measurement is made at numerous points along a weld seam. The instrument produces a direct ratio tracing on pressure sensitive paper that is in integral contact with a surface traverse stylus. By positioning the recorder (which is compact enough to be hand held) over a welded joint and moving the stylus across this welded interface surface, a tracing is produced on pressure sensitive paper. A measurement of the mismatch, if present, is made from the tracing and the actual mating characteristics are established.

Procurement of a prototype hand scanner was approved during the year and is being fabricated by the vendor. This equipment will be used in conjunction with X-ray and penetrant inspection for identifying and pinpointing surface cracks in welds. It also will confirm the existence of other nonconformances previously identified by other nondestructive test methods.

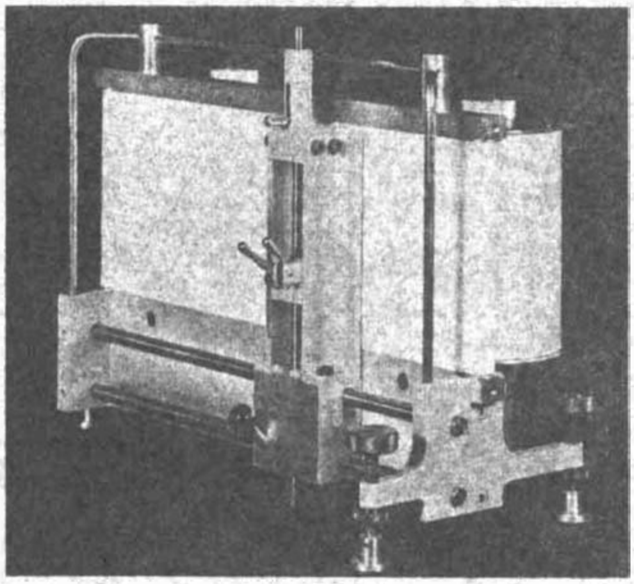
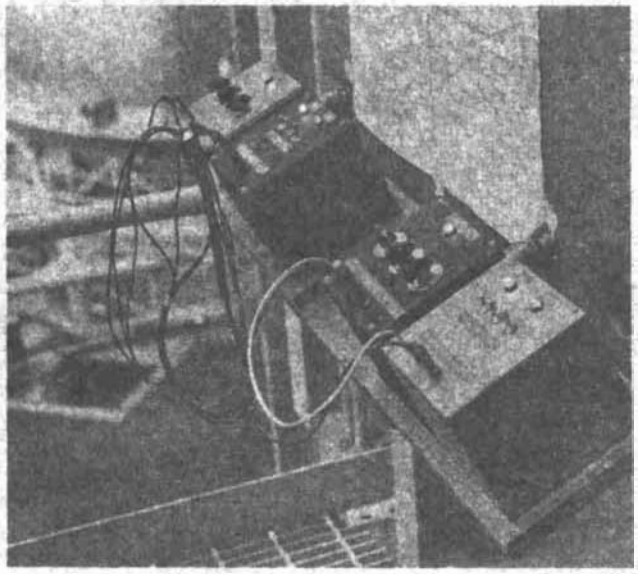


FIGURE IV-1 A TOPOGRAPHICAL RECORDER SMALL ENOUGH TO BE HAND HELD

FIGURE IV-2 A CIRCUIT MONITORING PANEL FOR THE ELECTROLYTIC TAPE LEAK DETECTOR DEVELOPED BY QUALITY ASSURANCE PERSONNEL



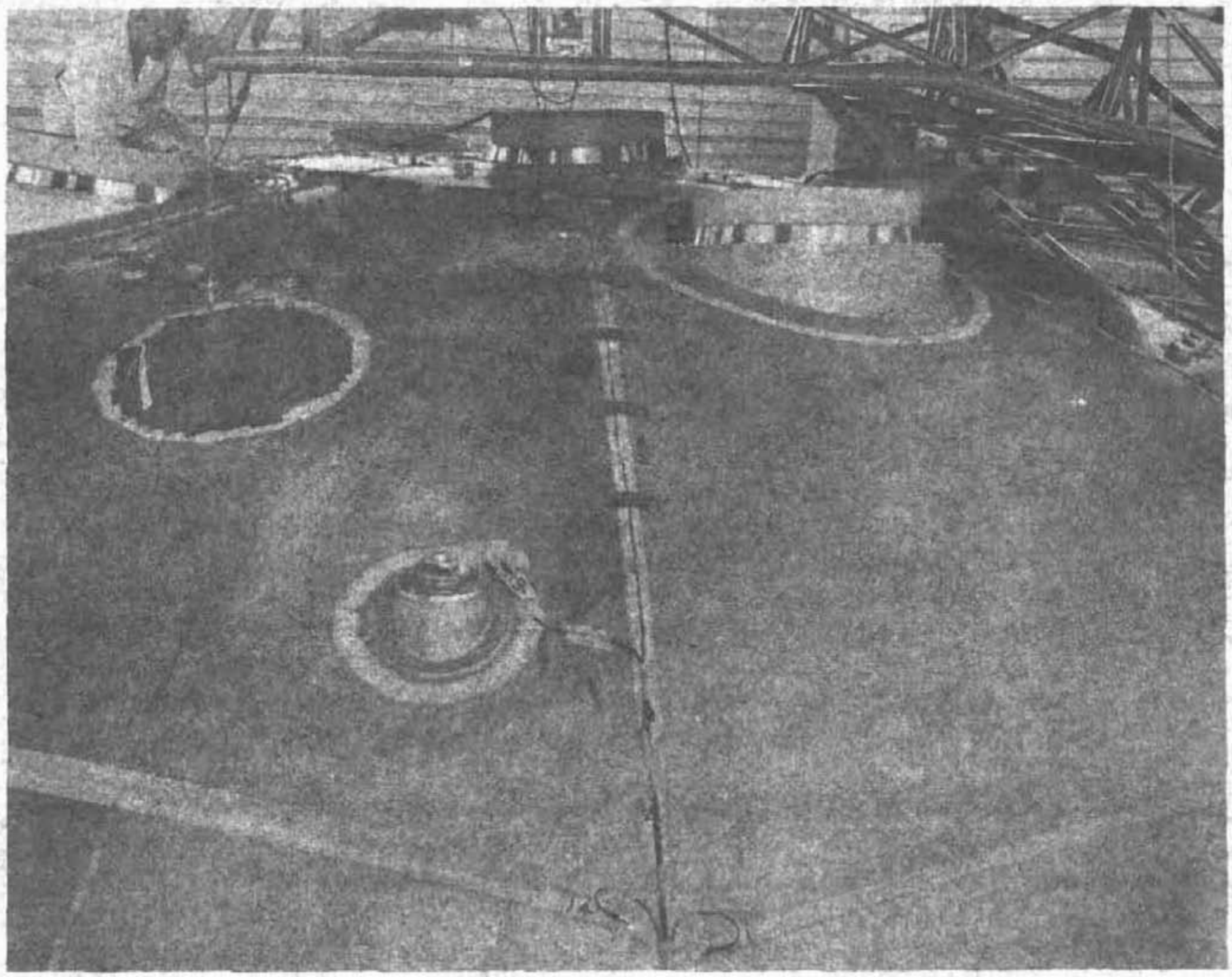
Quality Assurance personnel developed an "Electrolytic Tape Leak Detector" for detecting leakage during hydrostatic testing. This method utilizes an electric current that is applied to a narrow strip of aluminum foil to set up an electric circuit. The foil, in turn, is laminated to a special water soluble paper and to a weld seam. The electric current is not disturbed unless a short circuit is developed. This can happen when a water droplet, penetrates the soluble paper, creating a short circuit between the tape and the weld. Occurrences are indicated at a control console illustrated in Figure IV-2. Figure IV-3 illustrates the system in use on the S-IC-F fuel tank, upper fuel bulkhead, and lower fuel bulkhead.

This technique offers several advantages over other leak detection systems because there is no need to add a dye to the water. Consequently, the expensive cleaning cycle for the Saturn application is eliminated. In addition, it allows the detection of minute leaks which would not be detectable by any of the visual systems. The safety factor is also important since the technique does not require an inspector to enter the test cell during the hydrostatic loading.

LABORATORY - TOOLS AND EQUIPMENT

Capabilities of the quality evaluation laboratories and the measurement control laboratory were ex-

FIGURE IV-3 ELECTROLYTIC TAPE IN PLACE ON THE MERIDIAN WELD OF THE UPPER FUEL TANK BULKHEAD



panded during FY 1965 by the receipt of additional tools and equipment. The following paragraphs list some of the more significant items received.

The Mansfield-Green distilled water deadweight tester was received in the measurement control laboratory. It was used to calibrate pressure gauges in the subsystems area clean room.

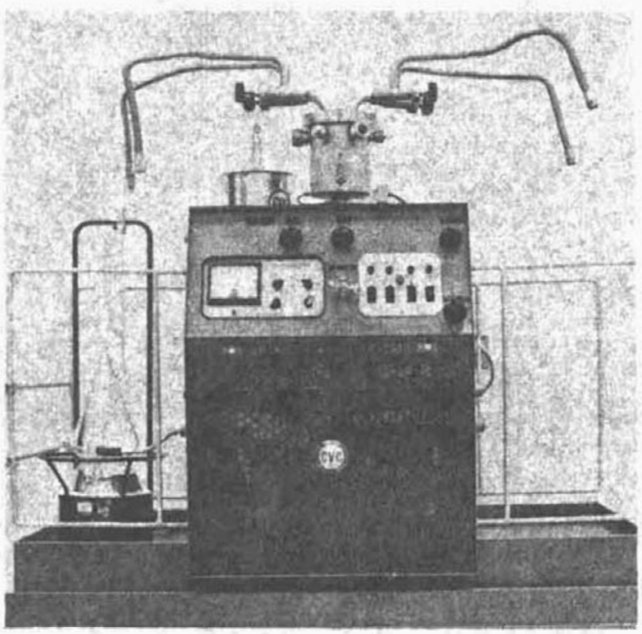
A high vacuum system shown in Figure IV-4 was received in the measurement control laboratory. This system provides a source for absolute pressure and is used primarily for the calibration of vacuum gauges or transducers.

A Seederer-Kohlbusch specific gravity balance was received in the quality evaluation laboratory and is used to determine the specific gravity of liquids.

The quality evaluation laboratory received an Automet polisher which produces superior metallurgical specimens at reduced cost.

The Leco vacuum fusion analyzer shown in Figure IV-5 was received in the quality evaluation laboratory. This instrument makes quantitative measurements of the amounts of hydrogen, oxygen, and nitrogen dissolved in metals. It is used primarily in gas determinations in titanium alloy, sheet metal, and standard parts. Approximately 13 minutes are required per sample for analysis of these three gases.

FIGURE IV-4 THE HIGH VACUUM SYSTEM



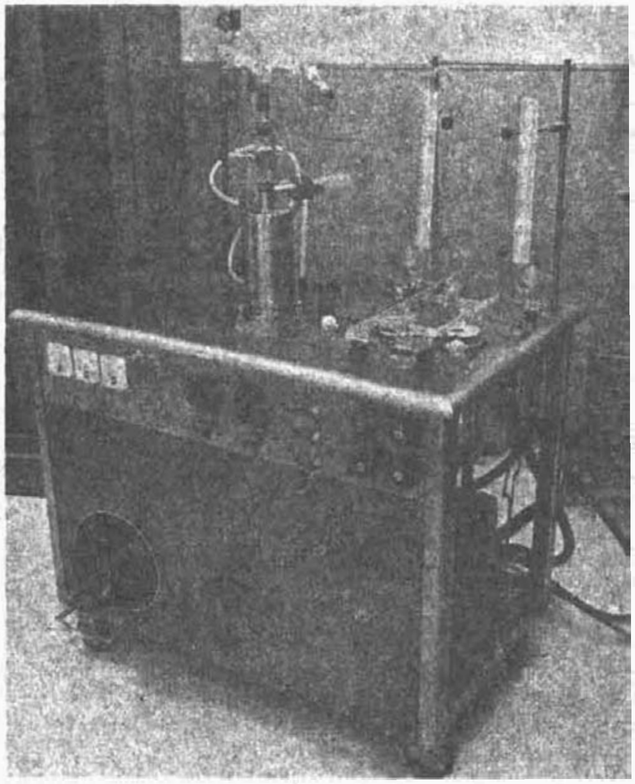


FIGURE IV-5 LECO VACUUM FUSION ANALYZER

PROGRAM IMPLEMENTATION

QUALITY ENGINEERING REVIEW

A total of 8000 stage and GSE drawings were reviewed during the year to assure compliance with the quality requirements of NPC 200-2. The Boeing Quality and Reliability Assurance organization also participated in 23 critical design reviews. The overall quality of engineering documentation showed steady improvement during the year.

The Boeing Quality Engineering organization was assigned responsibility during the year for maintaining surveillance over new developments in quality assurance concepts and techniques. Particular attention will be given to assessing refinements in nondestructive testing.

QUALITY AUDITS

During the last half of FY 1964, 31 quality program audits were conducted resulting in a total of 101 instances of non-compliance with quality program requirements. Appropriate action was taken to resolve each item.

The audit summary chart contained in Figure IV-6 shows that quality audits accomplished 24 inplant audits, 9 outplant audits, 43 supplier audits, and 9 special audits during FY 1965. The total of 84 audits reported 51 discrepancies. This represents a significant improvement over the previous reporting period. A total of 36 audits are planned during the first half of FY 1966.

Greater emphasis was placed on audits at supplier facilities during FY 1965, resulting in the decision to place greater management emphasis in our source control offices. Greater effort was also expended on system and special audits, and this emphasis will continue in FY 1966. These audits have proven to be very effective because they are directed towards a known or suspected problem area.

SOURCE EVALUATION AND SURVEILLANCE

Surveillance of processing facilities in 18 states continued during FY 1965. Supplier performance surveys increased over FY 1964, and a similar increase is anticipated in FY 1966. This is being accomplished by an arrangement with Aero-Space Division superintendents in the midwestern and eastern sections of the United States to give a portion of their time to source control on the Saturn program.

At year's end, Source Control had eleven supplier problem areas. These problems encompassed such items as fuel filter discrepancies and inoperative pressure switches. One major task is assuring that a supplier's cleaning procedure is revised according to recommendations resulting from LOX cleaning surveys. Another current notable problem is concerned with the 60B49013-1 valve.

It has been difficult to get this valve to pass qualification and acceptance tests. Tests are scheduled for completion by August 1, 1965. All problem areas are monitored constantly, and all items will be required to meet prescribed standards before final acceptance by Source Control representatives.

RECEIVING INSPECTION

Hardware receipts continued to accelerate during FY 1965. Approximately 73,100 receipts were processed compared to 41,460 during FY 1964.

QUALITY EVALUATION LABORATORIES

The increase in capabilities of the quality evaluation laboratories as a result of the acquisition of additional equipment was paralleled by a reduction of flow time. A specific example was the activation of the automatic penetrant inspection spray system and technique developments, which have decreased penetrant inspection time of tank skins, gore apexes, and gore bases by as much as 50 percent.

Approximately 18,000 tests were performed in the quality evaluation laboratories compared with 12,635 during FY 1964.

MEASUREMENT CONTROL LABORATORY

Approximately 30,280 items of equipment were processed and released during the year by the measurement control laboratory compared to 21,380 items during FY 1964.

PRODUCTION INSPECTION

Tooling inspection during FY 1965 changed from tool erection inspection to an effort more concerned with tool sustaining inspection. By year's end all Michoud assembly tooling was installed and activated, including vertical assembly tooling in the VAB.

Significant progress was made during FY 1965 in the welding of container assemblies. The S-IC-S upper LOX bulkhead was the first welded subassembly at Michoud, and difficulties were encountered in establishing proper machine settings and techniques. Boeing Quality Assurance personnel assisted in defining the weld discrepancies through nondestructive testing methods, and also assisted Manufacturing in determining causes for discrepancies. Although this bulkhead was found unacceptable and eventually scrapped, the effort expended by Quality Assurance resulted in the development of new techniques and procedures that have been used on subsequent bulkhead assemblies.

The highlight of Quality Assurance activities in nonwelded structural assembly areas during the year was the activation of the 34-foot rotary tool in October, 1964. This tool, illustrated in Figure IV-7 accomplishes dimensional analysis of major stage components with greater speed and accuracy than was ever experienced on airframes of this size. The rotary tool and the associated optical tooling system are directly responsible for this

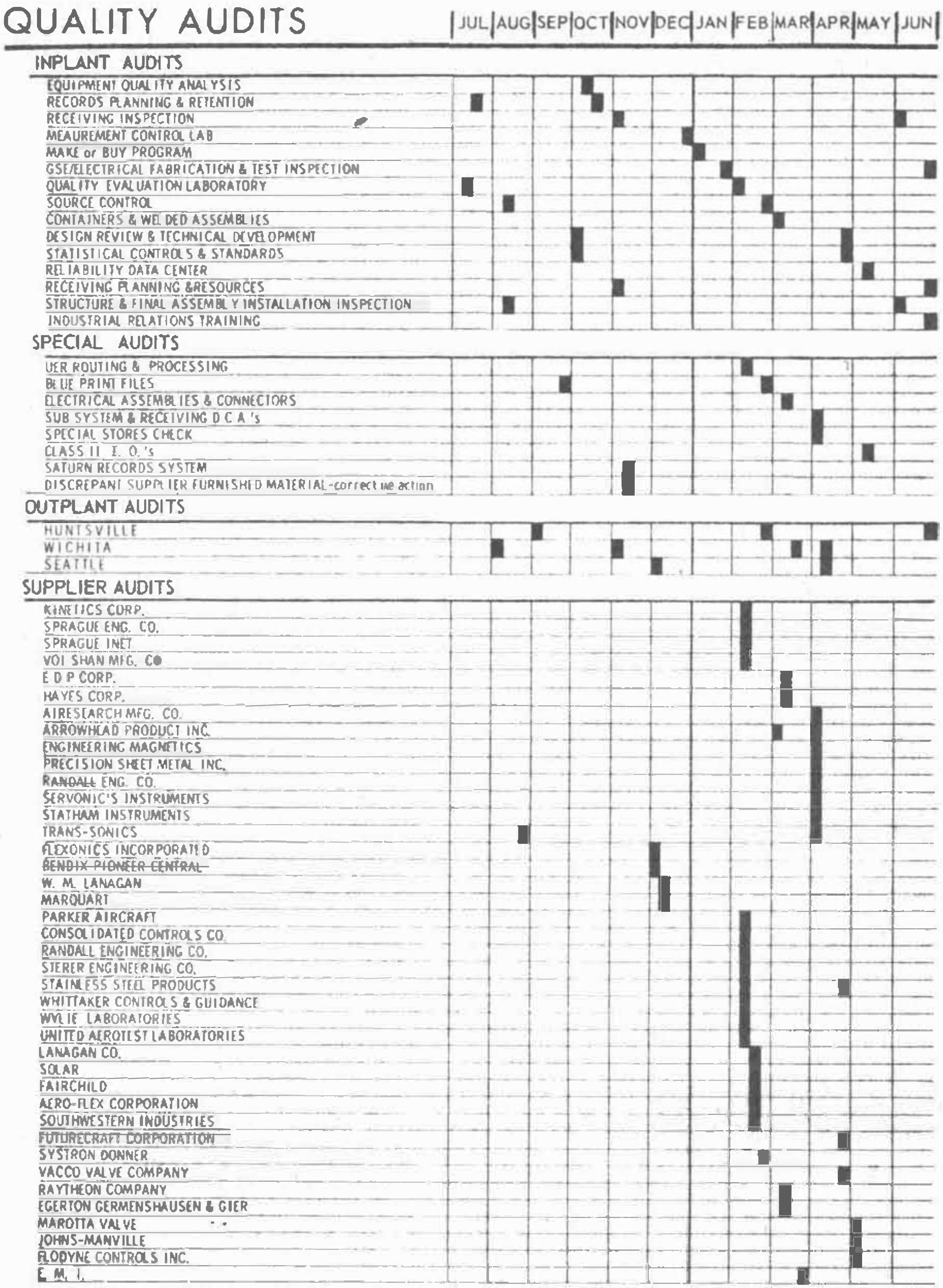


FIGURE IV-6 QUALITY AUDIT SUMMARY CHART

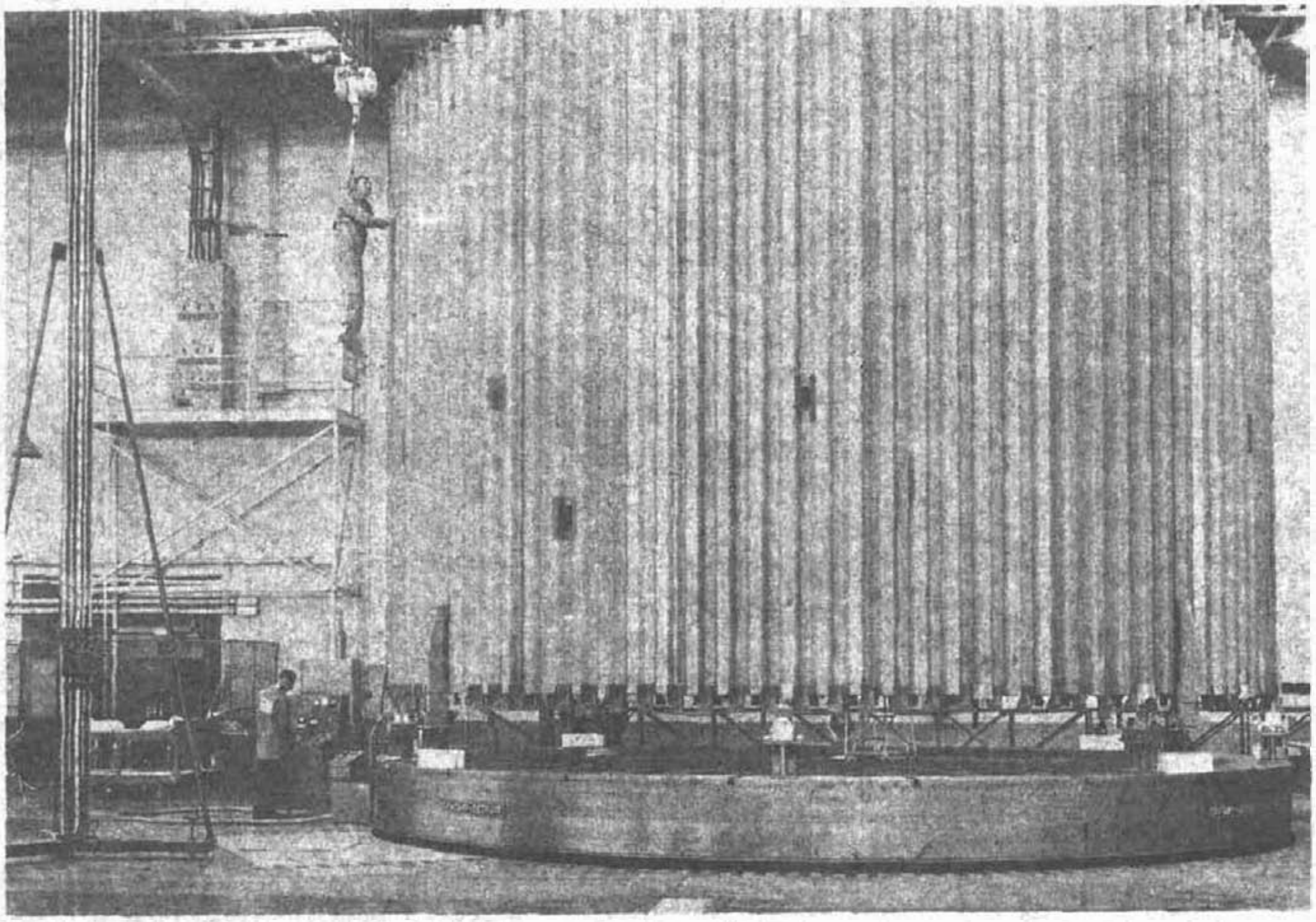


FIGURE IV-7 DIMENSIONAL ANALYSIS ON THE ROTARY TABLE

major breakthrough in precision dimensional inspection of large components.

Linear dimensions, ranging from zero to 540.000 inches in the horizontal, and zero to 360.000 inches in the vertical can be measured to an accuracy of ±.010 inches. Angular dimensions, ranging from zero to 360 degrees can be measured to an accuracy of 2 seconds of arc. These precise dimensions can be made at elevations ranging from 3 feet to 38 feet without sacrificing accuracy or speed.

The linear readout (vernac) is a direct readout system as is the angular (inductosyn) readout system. This virtually eliminates the possibility of error.

TEST INSPECTION

Extensive functional testing of components was accomplished during FY 1965, and included such items as ground support equipment, manufacturing support equipment, and several stage functional items. The hydrostatic testing of both the S-IC-D LOX and fuel tanks was also completed. The tape leak detection system was used on both tanks. Both tests were successfully completed.

CONFIGURATION ACCOUNTABILITY AND PRODUCT DELIVERY

Configuration Accountability

Configuration accountability functions continued to expand during FY 1965 to meet increasing program demands. Principal activities included analyzing all released planning to assure that items were built to engineering and contractual specifications and that adequate inspections were conducted. This also included reviewing all changes to released planning that affected components. During FY 1965, approximately 81,000 initial released planned event packets and 900,000 liaison changes were reviewed.

Product Delivery

Delivery data packages were prepared for 7000 end-items that were delivered to the customer.

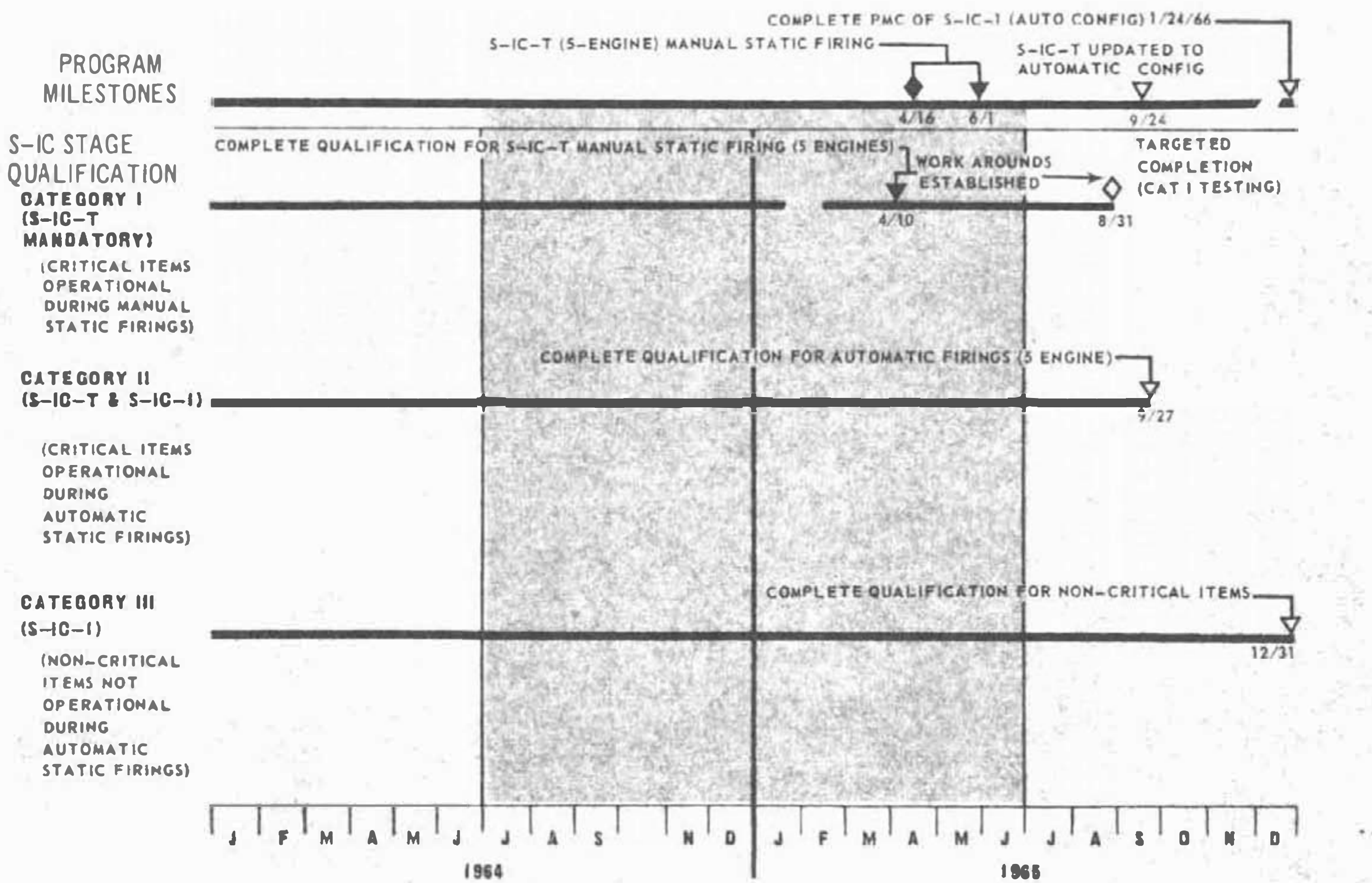
These packages define the as-built and as-designed configuration of end-items and assure that engineering or contractual authority exists for all exceptions. On completion of the data packages, the Boeing Quality and Reliability Assurance organization has the responsibility of obtaining customer acceptance of end items.

This function also includes maintaining completed records that provide proof of The Boeing Company's compliance with contractural and engineering requirements. Approximately 150,000 completed records are now on file.

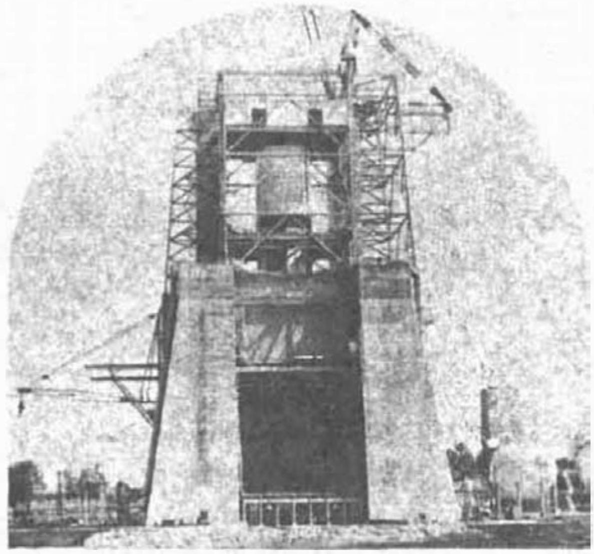
SYSTEMS AND SUBSYSTEMS TEST MILESTONES

– S-IC QUALIFICATION TEST PROGRAM

(PLAN VIII)



SYSTEMS AND SUBSYSTEMS TEST



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DEVELOPMENT TESTING

Development test progress during the year was satisfactory, generally providing needed design data or confirmation of design assumptions. Where difficulties were encountered, necessary design changes were made. Significant development testing activity is discussed in context with design activity in Section I.

S-IC QUALIFICATION PROGRAM

The qualification test program progressed substantially during the past year. Approximately 60 percent of the parts requiring qualification were successfully tested. Completion of all physical testing for S-IC-1 is presently targeted for mid-FY 1966, and progress toward that target is presently satisfactory. Status of testing against target dates is shown in Figure V-1. Approximately 80 percent of the test work is being performed at vendor plants and the remainder at Boeing facilities.

Qualification test program completion is, by contract, keyed to the S-IC-1 flight; however, a number of factors dictated that a large part of the test program should be planned for completion much earlier. These factors are: (1) the need to have critical S-IC-T and S-IC-1 hardware qualified before its use during static firing, (2) the need to qualify inaccessible flight hardware before its production installation in S-IC-1, (3) the need to consider production installation schedules to minimize removals necessitated by qualification test failures, and (4) the necessity to allow for modification and re-test flow time after qualification test failures.

These considerations resulted in a priority categori-

S-IC STAGE CONTRACTOR QUAL TEST SUMMARY

ALL CATEGORIES

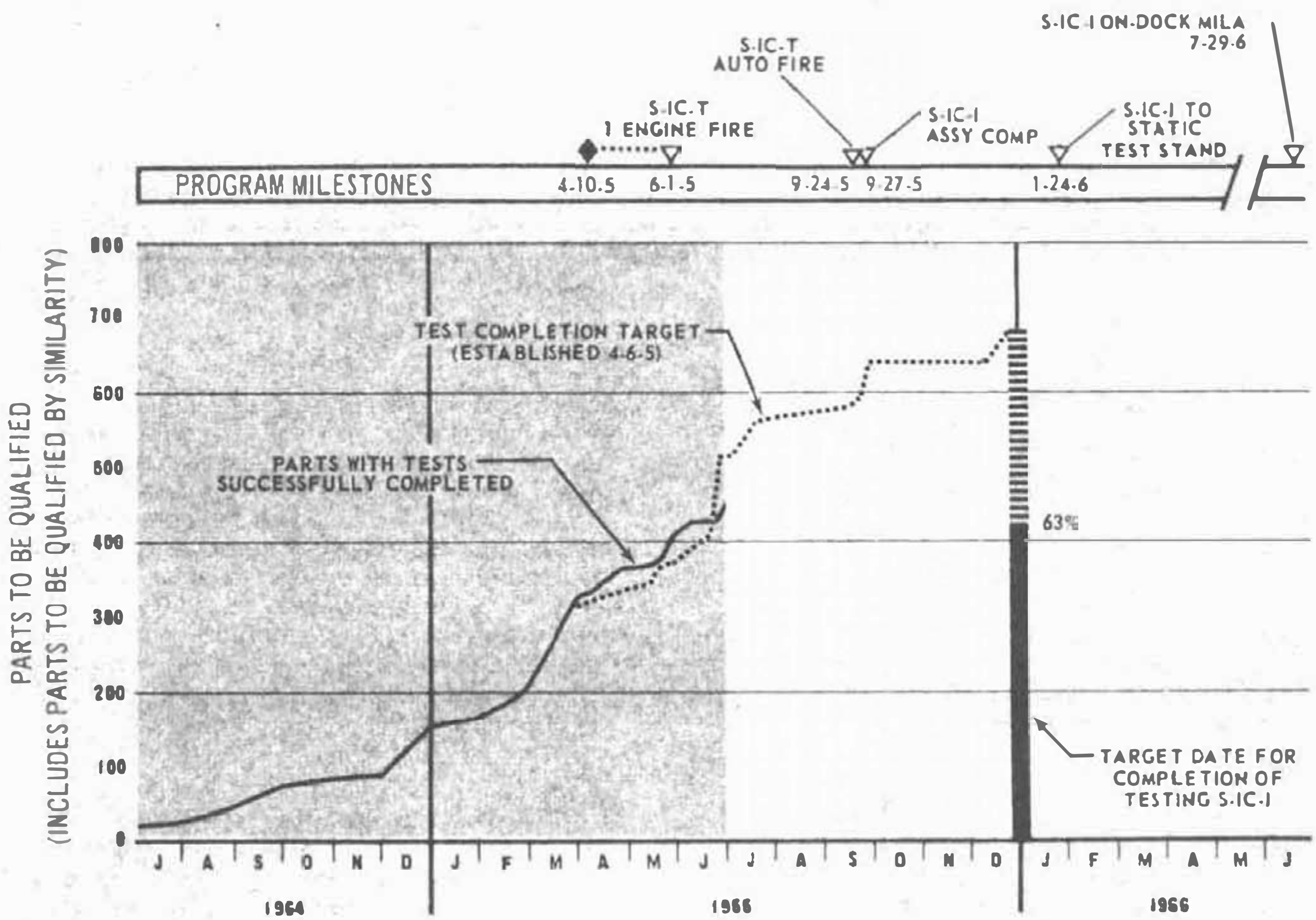


FIGURE V-1

S-IC STAGE QUALIFICATION TEST PROGRAM PHASING RELATIONSHIPS

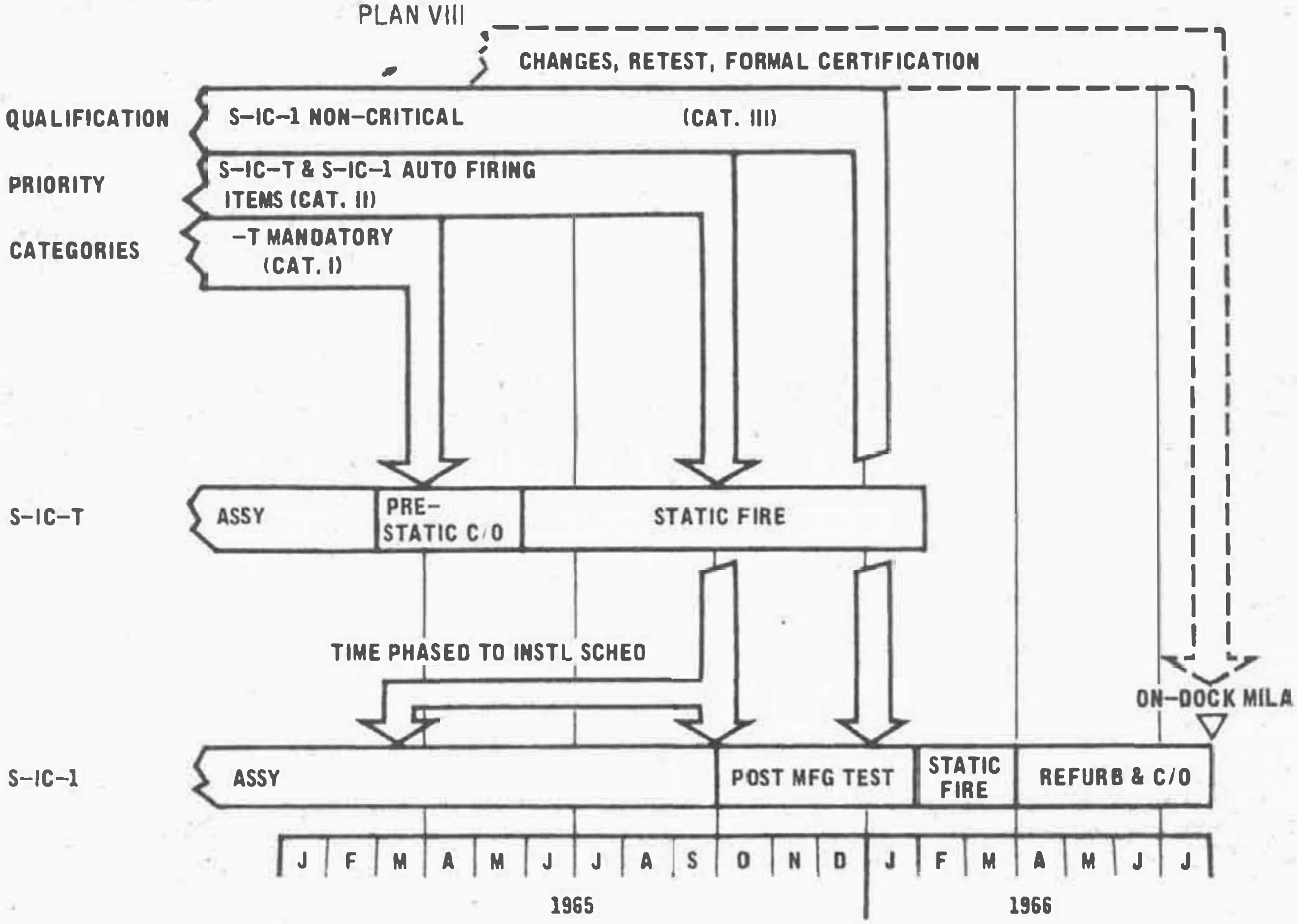


FIGURE V-2

zation of qualification tests based upon the program phasing relationships shown in Figure V-2. Category I includes those hardware items necessary to support the S-IC-T manual static firings; Category II includes those necessary to support S-IC-T and S-IC-1 automatic static firings; and Category III includes S-IC-1 non-critical tests.

The initial list of S-IC-T mandatory (Category I) items was established in November, 1964, by joint agreement between NASA/MSFC and Boeing. All Category I items were not completed by the March 31, 1965, target date necessary to support the accelerated S-IC-T static firing date; however, workaround measures were provided so that static firing could be started. The current status of qualification testing of Category I parts is shown in Figure V-3.

Subsequent to establishment of the Category I list, remaining qualification parts were grouped into Categories II and III. Detailed test completion target dates that considered S-IC-1 part installation sequence and post-installation accessibility were agreed to by NASA/MSFC and Boeing in April, 1965. The status of qualification testing of Category II and III parts is shown in Figures V-4 and V-5. The various status charts include parts that will be qualified by similarity to other parts actually tested. The high qualification rate at the end of FY 1965 in the Category II target schedule reflects a large number of such similarities.

To emphasize the qualification program, a management task force was established during the third fiscal quarter. This task force, headed by a qualification project manager reporting to the director of

S-IC CONTRACTOR QUAL TEST SUMMARY

CATEGORY I-T MANDATORY

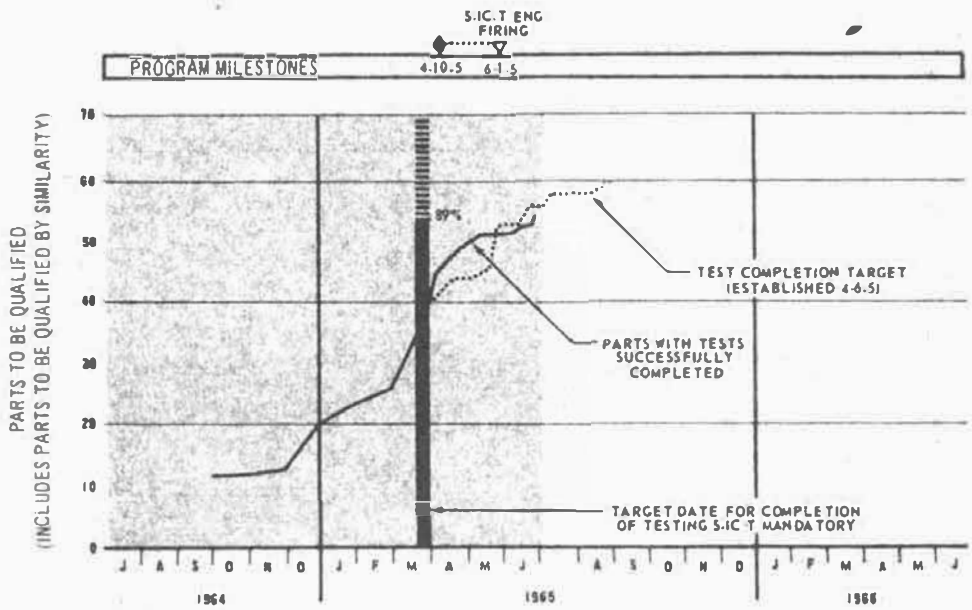
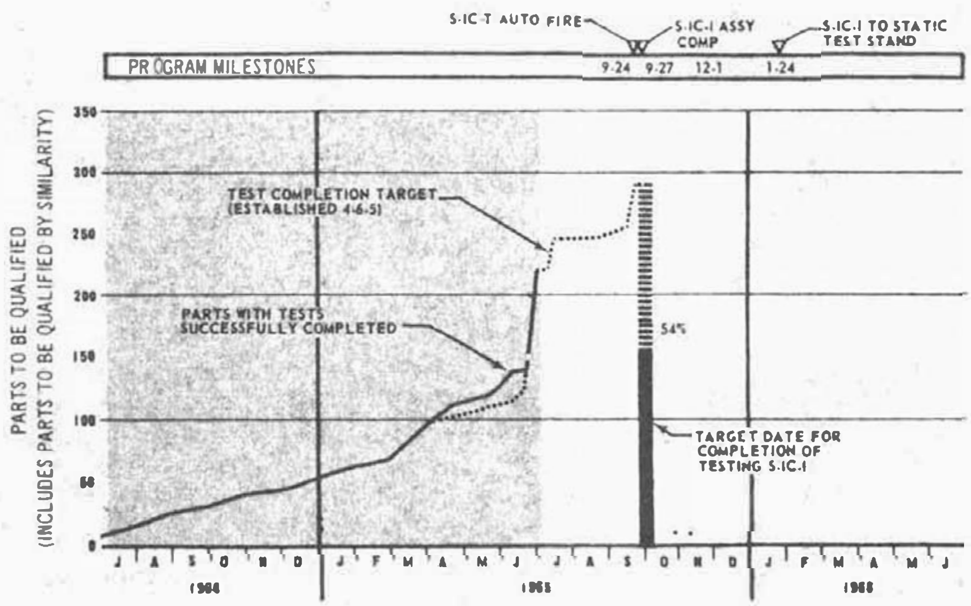


FIGURE V-3

FIGURE V-4

S-IC CONTRACTOR QUAL TEST SUMMARY

CATEGORY II S-IC-I & T AUTO FIRE



S-IC CONTRACTOR QUAL TEST SUMMARY

CATEGORY III

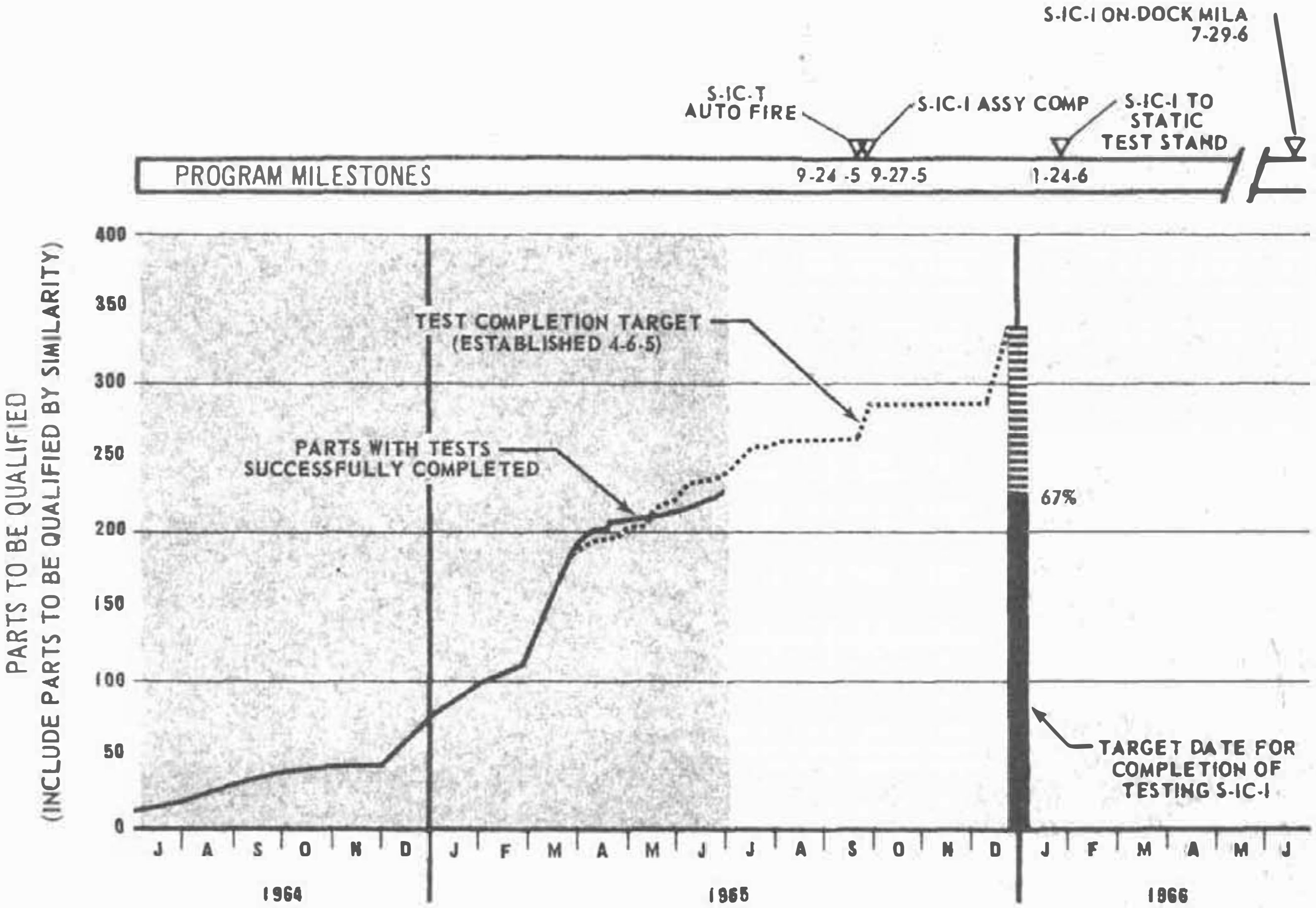


FIGURE V-5

Engineering, is composed of senior management representatives from the various functional organizations involved in the testing program. It has the responsibility of planning, scheduling, and ensuring timely execution of the test program, together with sufficient authority to remove bottlenecks and restraints impeding the program. To expedite the flow of decisions and information between Boeing and NASA/MSFC, a NASA/MSFC counterpart to the Boeing project manager was appointed early in the fourth fiscal quarter.

A large part of the task force effort, after categorization and detail scheduling of the program, was devoted to surveillance and management of the vendor test programs. A field office staffed with a complete complement of Engineering, Materiel, and Quality Control representatives was established in Los Angeles to provide on-site support to supplier activity in the California area. Boeing senior supervisors, supported by additional technical personnel when needed, were assigned as resident managers at the facilities of suppliers who had experienced difficulty in their qualification test program or subsequent hardware deliveries. Personnel from the management task force made systematic and repeated visits to plants of all suppliers involved in the qualification program.

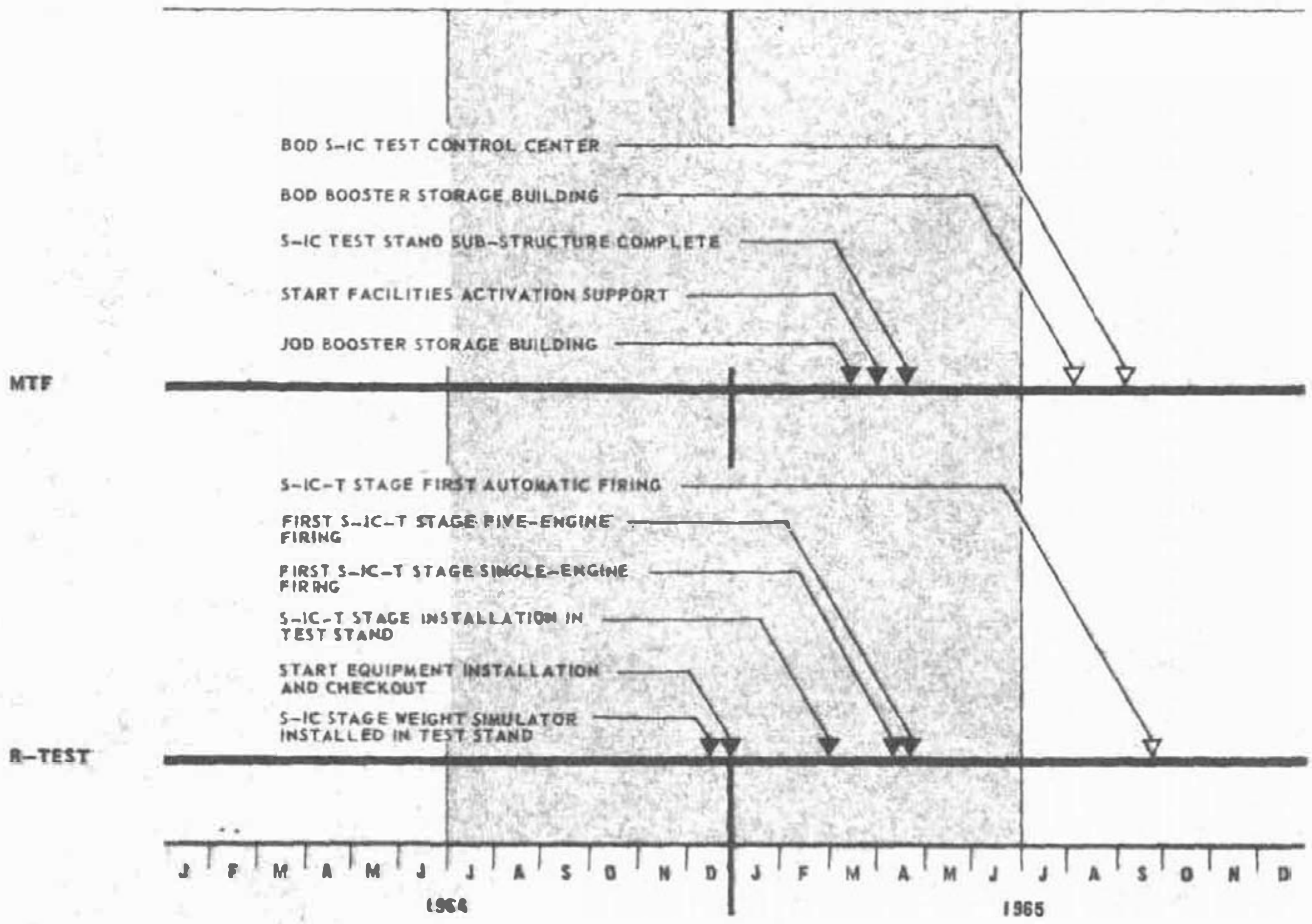
As a result of this intensive effort, most of the problems delaying the supplier program were eliminated, and the delivery of qualified hardware, both for production and for the subsystem qualification tests being performed at Boeing facilities, was substantially expedited.

Formal documentation of the S-IC qualification pro-

SYSTEMS AND SUBSYSTEMS TEST MILESTONES

GROUND TEST AND STATIC FIRING PARTICIPATION

(PLAN VIII)



gram is provided by Document D5-12741, "S-IC Qualification Status List," which is formally submitted to NASA/MSFC on a quarterly basis and informally as a working document on a biweekly basis.

RELIABILITY TEST PROGRAM

The reliability test program is covered by Contract Modification 92, which was received late in FY 1964 and is presently in negotiation. Under Modification 92, completion of reliability testing was keyed to program Plan VII delivery of S-IC-7 to MILA in late 1967. However, recent NASA/MSFC correspondence indicates that test program completion should be based upon the S-IC-3, rather than S-IC-7, schedule. This will require substantial compression of test program schedules. Therefore, the entire program is presently being re-examined to determine what steps should be taken to match the S-IC-3 schedule. This includes examination of test requirements for possible reduction or consolidation, acceleration of test hardware availability, and compression of test schedules.

To ensure proper attention and efficiency in the program, a reliability test program manager was appointed during the last fiscal quarter. His function will be similar to that of the manager of the qualification test program.

As described in the reliability sections of previous Quarterly Technical Progress Reports, the hardware to be subjected to reliability testing was determined by conducting "failure mode and effect" analyses, which identify all critical items and their relative criticality ranking. All critical items will be subjected to reliability test except where similar families of hardware exist. In such cases, only the representative "worst case" will be subjected to testing. In a few cases exceptions will be made for hardware items that have demonstrated a satisfactory margin of safety during other testing. The number of test specimens required to provide an adequate reliability sample is still a subject of discussion between NASA/MSFC and Boeing.

Hardware for all identified tests is presently being procured, and preparations are being made for the start of physical testing, expected to begin during the next fiscal quarter. With the exception of two minor tests, all reliability testing is to be performed in-house by Boeing.

GROUND TEST PARTICIPATION

Boeing Systems Test personnel assisted in static and dynamic testing of the S-IC static test stand structure at MSFC, technical systems tests, installation of the S-IC-T stage in the test stand, and S-IC-T stage thrust structure testing in preparation for static firing tests. Test Engineering and Test Operations personnel participated in installation of test fixtures and instrumentation and in preparation of the test stand. They assisted in testing of test stand systems such as the flame deflector water cooling system, the hydraulic system and the fire extinguishing (Firex) system. Test control center testing consisted of ground equipment test set checkout of manual GSE and testing of the telemetry digitizing system.

Boeing also participated in writing installation and checkout procedures, operating procedures, and test procedures for the R-TEST static testing, and participated in reviews of test requirements, drawings, and other documentation.

MSFC STATIC FIRING PARTICIPATION

At the beginning of FY 1965 Boeing Systems Test personnel participation in F-1 engine and S-IC-T stage static firings was limited to test observation and data reviews. In the first fiscal quarter, Systems Test Operations personnel began active participation in engine preparation and in test and checkout of data acquisition and control and monitor equipment. They participated in preparations for F-1 engine firings and post-test refurbishment; and observed and participated in handling and transportation tests of engine components. Test Engineering personnel assisted in equipment installation reviews, instrumentation calibration, and facility design reviews.

Boeing personnel participated in 37 F-1 engine firings (Figure V-6) during this report period to gain knowledge of engine characteristics and experience in testing procedures.

The S-IC-T stage was received at R-TEST in February, 1965. Systems Test personnel participated in stage transportation and handling, in F-1 engine installation on the S-IC-T stage (Figure V-7), and in preparation of the stage and test stand for static test.

Eight S-IC-T stage tests have been performed to date (Figure V-8), beginning with a 2.51-second, single-engine firing on April 9, 1965. Testing has progressed in complexity and duration to a 90-second, five-engine firing. The four outboard engines have been gimbaled up to five degrees during test.

Systems Test personnel are taking a more active part in F-1 engine and S-IC-T stage tests as console operators and chart observers during the tests, in

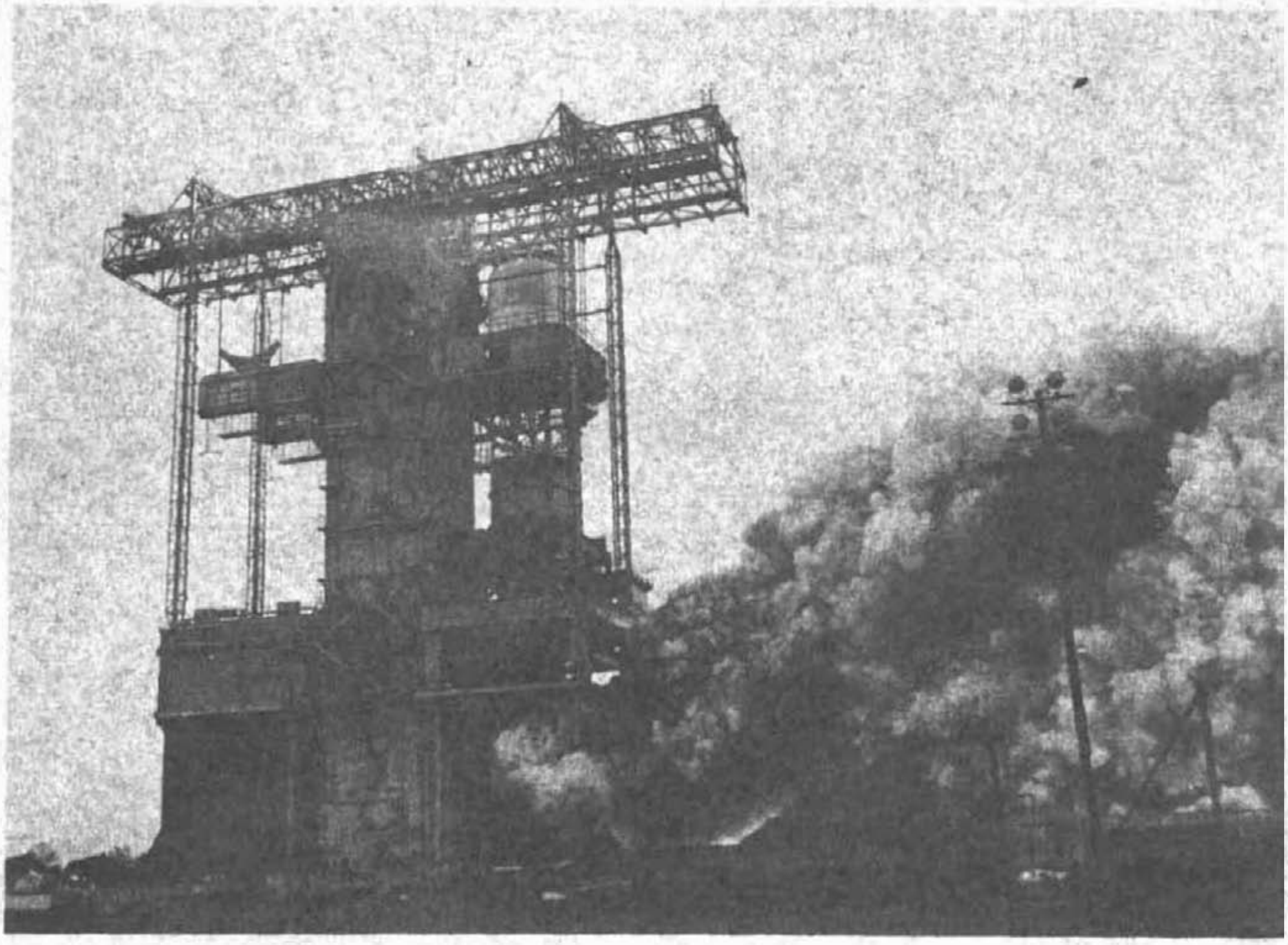


FIGURE V-6 DEVELOPMENTAL STATIC FIRING OF THE F-1 ENGINE AT MSFC

preparing instrumentation and control equipment before the tests, and in post-test refurbishment and data reviews.

MSFC REFURBISHMENT AND POST STATIC CHECKOUT PARTICIPATION

Boeing Systems Test personnel participated in post test refurbishment and checkout of the F-1 engines and the single-engine test stand following the F-1 engine developmental firing tests. They also assisted in refurbishment and checkout of the S-IC-T stage and the S-IC test stand following the S-IC-T engine firings during the fourth fiscal quarter. This effort consisted of participation in engine removal, inspection, and refurbishment of engines on the S-IC-T; inspection of the stage and test stand; and repair of the flame deflector.

Boeing Systems Test personnel conducted a study of base heat shield requirements for the Mississippi Test Facility. It was concluded that the base heat shield for use at MTF should be of the S-IC-3 rather than the S-IC-T configuration.

CONTRACTOR STATIC FIRING AND REFURBISHMENT

Preparation for contractor static firing and refurbishment consisted of document preparation, PERT network preparation, and classroom training.

DOCUMENT PREPARATION

Systems Test documents required for the Huntsville operations and for Mississippi Test Facility are being prepared on schedule. The document release schedule (Figure V-9) shows the Plan VIII demand date, the present completion status—as a percentage—and the estimated final release date.

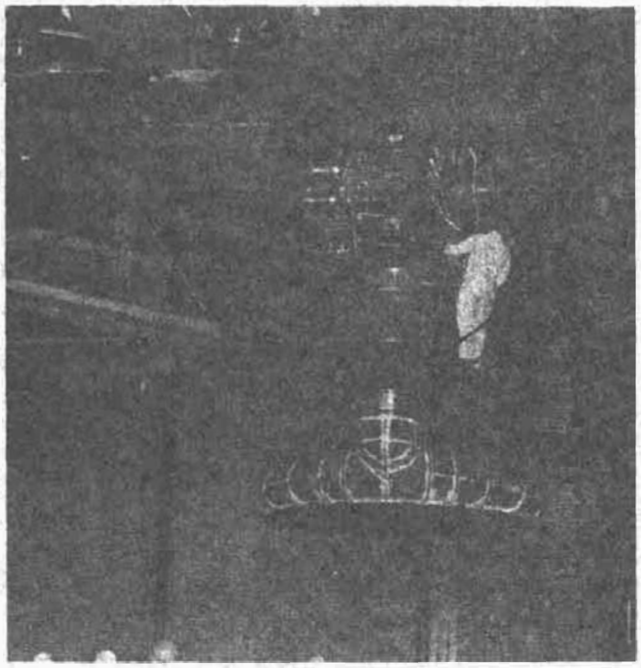


FIGURE V-7 THE FIRST F-1 ENGINE BEING INSTALLED IN THE S-IC TEST STAND

PERT ACTIVITIES

In July, 1964, NASA/MSFC concluded that the Boeing PERT system was compatible with other Saturn PERT systems. The networks were completed and submitted to NASA/MSFC on September 15, 1964. In November, Boeing Systems Test - Huntsville began submitting weekly inputs to NASA/MSFC to keep the system current.

R-QUAL PERT networks were revised in December, 1964 to implement the recovery program for R-QUAL installation, calibration and checkout. R-TEST and MTF networks are being revised to reflect Plan VIII schedule changes.

CLASSROOM TRAINING

Systems Test personnel attended 28 different courses of instruction during this report period in preparation for contractor static firing and refurbishment.

ACTIVATION OF S-IC COMPLEX AT THE MISSISSIPPI TEST FACILITY

ORGANIZATION

In February, 1965, Boeing began organizing and manning support of the NASA activation task force in management control, activation preparation, installation, modification and checkout, subsystem testing, system testing, demonstration, and turnover in order to activate the S-IC facilities at Mississippi Test Facility as defined in Contract Modification MICH 17.

The organization and staffing consists of the MTF Complex Organization Group (COG) under the direction of the Boeing activation task force manager, and the staffing of the activation base camp under the direction of the Boeing site manager.

PLANNING AND SCHEDULING

On April 17, 1965, Boeing established PERT networks for activation of all S-IC facilities and systems. The basis for this exercise was Plan VIII, which indicated September 15, 1966, as the on-dock date for the S-IC-T. From this, Boeing developed an integrated PERT network showing last-ditch dates for completion of facilities and technical systems and start dates for installation of GSE.

PERT data from Boeing and General Electric combined with construction status information from the Corps of Engineers was being used at the year's end in planning activity to ensure meeting the Plan VIII schedule for testing the S-IC-4 at MTF.

ACTIVATION OF FACILITIES

S-IC BOOSTER STORAGE BUILDING

This building is being activated in incremental stages. Since the beneficial occupancy date (BOD) on April 7, 1965, Boeing has shared the building with the Space and Information Division (S&ID) and the Rocketdyne Division of North American Aviation. During the next fiscal year, after S&ID and Rocketdyne vacate the building, the final test in activating the building's facilities will be performed using the S-IC stage weight simulator to load test the floors.

OTHER S-IC COMPLEX FACILITIES

Preparation of interface and surveillance logs and a library of engineering information was started in the fourth fiscal quarter and will continue through the next two quarters. At the end of FY 1965 the majority of the activation personnel were moving from Huntsville into trailers at the S-IC complex.

The next two quarters' activities will consist of surveillance of construction and preparation of test procedures, acceptance logs, and scheduling. Activation personnel also will observe S&ID activation testing of the S-II test stands.

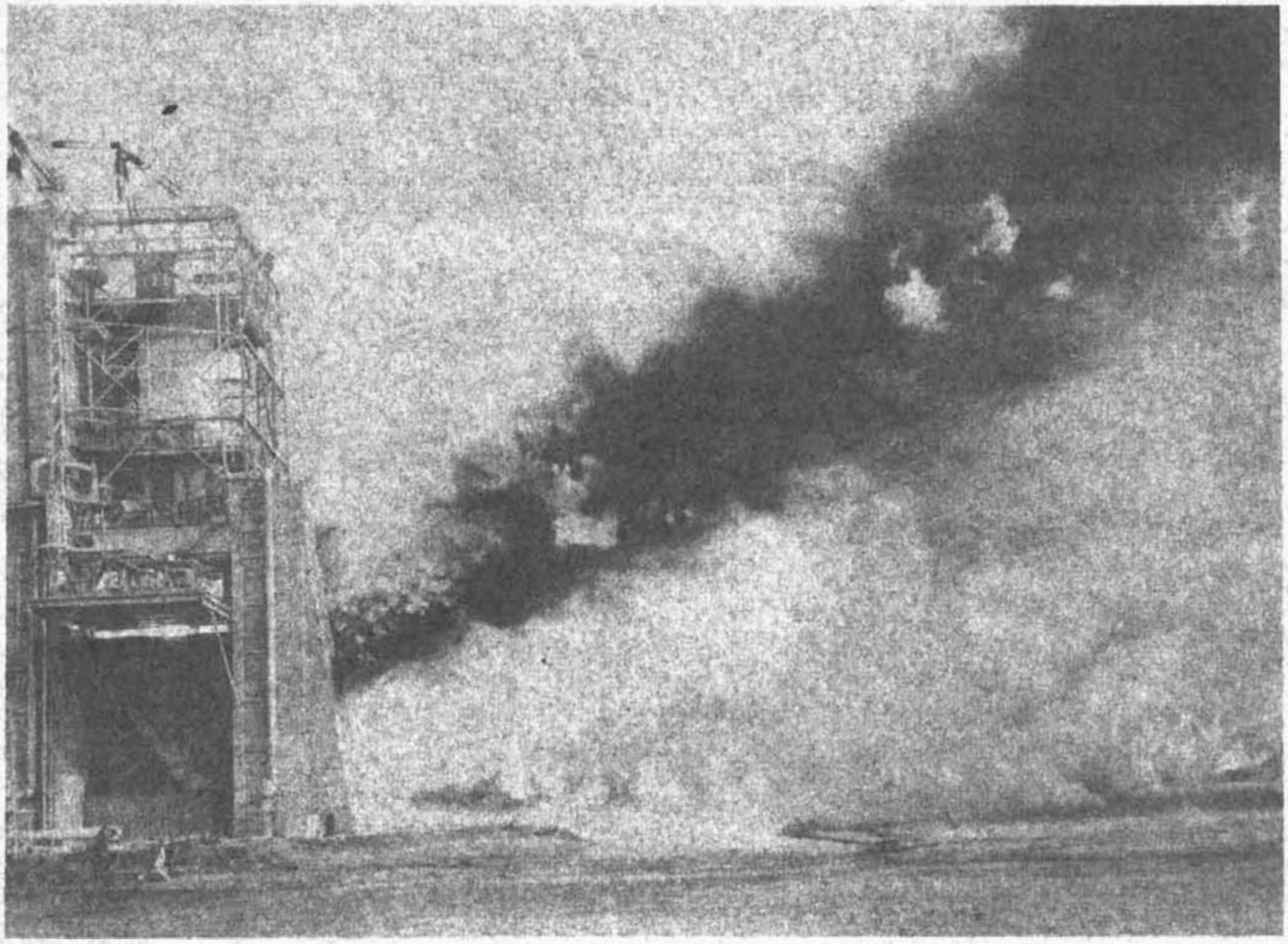


FIGURE V-8 FIVE-ENGINE FIRING OF THE S-IC-T STAGE AT MSFC

Photographs (Figures V-10, V-11, V-12) show general construction progress as of June, 1965.

MISSISSIPPI TEST FACILITY WORKING GROUP (MTF/WG)

Support to the NASA MTF/WG continued throughout the year. Boeing Systems Test personnel reviewed shop drawings and change orders, coordinated requirements between Ground Systems Design (GSD) and the MTF/WG, released incremental Phase II technical system design review, and participated in the 90 percent design review on June 28, 1965, at Lear Siegler in California.

In the future, the support to the MTF/WG will be phased out as their activities become absorbed by the activation task force. The full support to NASA Phase II technical system engineering group will continue until all drawings are released and approved.

MISCELLANEOUS TEST SUPPORT ACTIVITIES

RADIO FREQUENCY INTERFERENCE STUDY

Boeing Systems Test personnel participated with the MTF activation office in the study of radio frequency interference at Mississippi Test Facility. This study was requested by the activation office to document a NASA request to the Federal Aviation Agency to prevent aircraft flights over MTF.

A list was prepared of those S-IC test sequences and related stage, test and checkout equipment that might be susceptible to interference caused by aircraft. The list was submitted to the activation office on November 13, 1964. The preliminary conclusion was that aircraft flying above 3,500 feet will not cause radio frequency interference with operations.

SYSTEMS TEST MTF & SYSTEMS TEST HUNTSVILLE DOCUMENT RELEASE SCHEDULE

DOCUMENT NUMBER	TITLE	APPL	ESTIMATED FINAL REL	%	PLAN VIII DEMAND DATE
	OPERATIONS AND ADMINISTRATIVE MANUALS FOR SYSTEMS TEST – MTO	MTF	CONTINUOUS EFFORT		8–1–65
D5–11054	SYSTEMS TEST – MTO EQUIPMENT REQUIREMENTS (CONTRACTOR FURNISHED)	MTF	7–1–65	80%	7–1–65
D5–11061	GOVERNMENT FURNISHED FACILITIES, EQUIPMENT AND SERVICE REQUIREMENTS, S–IC – MTO	MTF	7–1–65	75%	(REVISION C) RELEASED
D5–11062	PARTICIPATION AND TRAINING PLAN, SYSTEMS TEST – MTO	MTF	9–15–65	50%	7–15–65
D5–11064	SYSTEMS TEST – MISSISSIPPI TEST OPERATIONS PROCEDURES FOR SATURN RECORD SYSTEM	MTF			RELEASED
D5–11071–3	PLAN FOR ACTIVATION AND OPERATION OF THE S–IC COMPLEX AT MTF	MTF			RELEASED
D5–11397	NASA–BOEING–SUPPORT CONTRACTOR INTERFACE RESPONSIBILITIES AT MTF(SUSTAINED OPERATIONAL PHASE)	MTF			RELEASED
D5–11408	R–QUAL DELIVERY PLAN	HTVL			RELEASED
D5–11765	INDEX OF S–IC ACTIVATION AND TESTING PROCEDURES AT THE MTF	MTF	10–1–65	0	8–1–65
D5–11769	INDEX OF S–IC TEST REQUIREMENTS AT THE MTF	MTF	8–15–65	60%	8–15–65
D5–11775	EQUIP INSTALLATION AND FACILITY INTERCONNECT PLAN	MTF	10–1–65	10%	11–1–65
D5–11776–000	PLAN FOR INTERCONNECTING THE S–IC STAGE TO THE TEST STAND AND GROUND SUPPORT EQUIPMENT	MTF	6–1–66	50%	8–15–66
D5–11789–000	STATIC TEST ACCEPTANCE OPERATIONS SEQUENCE PLAN	MTF	6–15–66	50%	8–15–66
D5–11791	EQUIPMENT AND FACILITIES SUBSYSTEM AND SYSTEM CHECKOUT PLAN	MTF	10–1–65	10%	11–1–65
D5–11792–000	STAGE PRE-STATIC AND POST-STATIC FIRING CHECKOUT PLAN	MTF	7–1–66	50%	8–15–66
D5–11793	RECEIVAL, RECEIVAL INSPECTION AND SHIPPING PLAN FOR S–IC ACTIVATION AND OPERATIONS	MTF			RELEASED
D5–11794–000	COUNTDOWN & STATIC FIRING PLAN	MTF	7–15–66	50%	8–15–66
D5–11797	HANDLING AND TRANSPORTATION PLAN	MTF	7–15–65	98%	8–1–65
D5–11805	COMPUTER PROGRAM REQUIREMENTS FOR STATIC TEST	MTF	4–1–66	30%	4–1–66
D5–11809	PLAN FOR ACTIVATION AND CONDUCT OF S–IC DATA HANDLING EVALUATION AND REPORTING OPERATIONS AT MISSISSIPPI TEST FACILITY	MTF	9–1–65	10%	9–1–65
D5–11812–000	SYSTEM TEST–MTO STATIC FIRING EVALUATION REPORTS	MTF	8–15–66	0	8–15–66
D5–11814	SYSTEMS TEST – MISSISSIPPI TEST OPERATIONS BASE ACTIVATION REPORTS	MTF	10–1–65	0	10–1–65
D5–11817–000	SYSTEMS TEST – MISSISSIPPI TEST OPERATIONS STATIC FIRING QUICK-LOOK REPORT	MTF	8–15–66	0	8–15–66

FIGURE V–9

SYSTEMS TEST MTF & SYSTEMS TEST HUNTSVILLE DOCUMENT RELEASE SCHEDULE (CONT)

DOCUMENT NUMBER	TITLE	APPL	ESTIMATED FINAL REL	%	PLAN VIII DEMAND DATE
D5-11818-000	SYSTEMS TEST - MISSISSIPPI TEST OPERATIONS STAGE PROCESSING REPORTS	MTF	8-15-66	0	8-15-66
D5-11820	MISSISSIPPI TEST FACILITY OCCUPANCY AND CONFIGURATION CONTROL PLAN	MTF	8-1-65	75%	8-15-65
D5-11822	SYSTEMS TEST - MISSISSIPPI TEST OP LOGISTIC PLAN	MTF	8-15-65	90%	8-15-65
D5-11826	SYSTEMS TEST MISSISSIPPI TEST OPERATIONS SAFETY PLAN	MTF	8-2-65	50%	8-2-65
D5-12300-8	SST MANAGEMENT PLAN MTO TEST OPERATIONS MANAGEMENT SUPPLEMENT	MTF	9-1-65	50%	8-1-65
D5-12300-9	SST MANAGEMENT PLAN, HUNTSVILLE TEST OPERATIONS MANAGEMENT SUPPLEMENT	HTVL	9-15-65	0	NOT DETERMINED
D5-13033-000	TEST MEASUREMENT REQUIREMENTS	MTF	7-1-66	0	7-1-66
D5-13034	SYSTEMS TEST MISSISSIPPI TEST OPERATIONS SPECIAL TEST	MTF	7-15-65	0	7-15-65
D5-13034-1	PLAN FOR HOLDDOWN ARM PROOF LOAD TESTS FOR S-IC TEST STAND AT MISSISSIPPI TEST FACILITY	MTF	5-15-66	80%	6-15-66
D5-13034-2	PLAN FOR DYNAMIC RESPONSE TEST OF S-IC TEST STAND AT MISSISSIPPI TEST FACILITY	MTF	6-1-66	0	6-1-66
D5-13035	CONFIGURATION CONTROL MODIFICATION STATUS AND REPORTING PLAN	MTF	8-1-65	5%	8-1-65
D5-13036	STAGE AND GROUND SUPPORT EQUIPMENT TO FACILITY INTERFACE CONTROL PLAN	MTF	8-1-65	20%	8-1-65
D5-13037	DIRECTIVE/CONTROL PLAN FOR S-IC OPERATIONS AT THE MISSISSIPPI TEST FACILITY	MTF	12-1-65	0	12-1-65
D5-13039	SYSTEMS TEST - MISSISSIPPI TEST OPERATIONS STATIC TEST DATA REQUIREMENTS	MTF	12-1-65	0	12-1-65
D5-13040-000	SYSTEMS TEST - MISSISSIPPI TEST OPERATIONS BOOSTER SUMMARY ADDITIONS	MTF	NOT DETERMINED	0	8-15-66
D5-13041	SYSTEMS TEST - MISSISSIPPI TEST OPERATIONS MASTER SCHEDULE/PERT	MTF	9-1-65	25%	9-1-65
D5-13043	PLAN FOR ACTIVATION OF THE SECOND POSITION OF THE S-IC COMPLEX AT MTF	MTF			RELEASED
D-XXXXX	MTO TEST OPERATIONS CONCEPTS DOCUMENT	MTF	9-15-65	0	NOT DETERMINED
D5-XXXXX	SATURN SYSTEMS TEST - HUNTSVILLE SAFETY PLAN	HTVL	9-15-65	0	NOT DETERMINED
D5-XXXXX	SATURN SYSTEMS TEST - HUNTSVILLE MASTER SCHEDULE/STATUS	HTVL	9-15-65	0	NOT DETERMINED
D5-XXXXX	R-QUAL TEST OPERATIONS CONCEPTS DOCUMENT	HTVL	9-15-65	0	NOT DETERMINED
D5-XXXXX	R-QUAL REPORT	HTVL	9-15-65	0	NOT DETERMINED
66B-XXXXX	R-QUAL IC&C PROCEDURES	HTVL	9-15-65	0	NOT DETERMINED
D5-13127	S-IC FACILITIES ACTIVATION PROGRAM PLAN	MTF	7-1-65	80%	7-1-65

FIGURE V-9 (CONT)

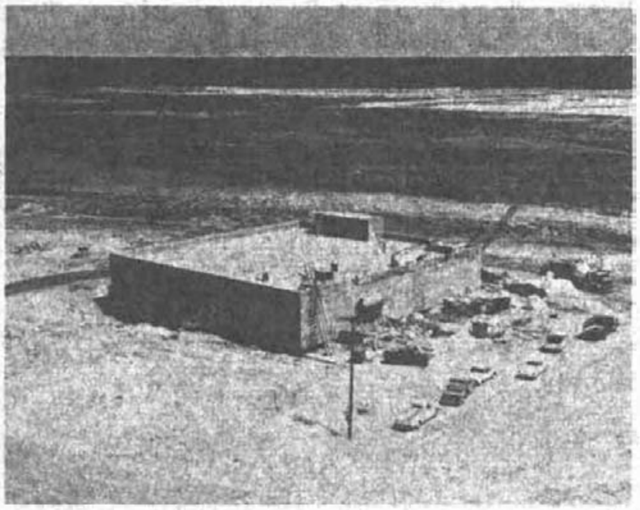


FIGURE V-10 MTF S-IC TEST CONTROL CENTER SHOWING CONSTRUCTION IN JUNE 1965

APOLLO TEST REQUIREMENTS

In response to a request from NASA/MSFC, a Boeing task force was formed to determine the probable impact of NPC 500-10, "Apollo Test Requirements," on that portion of the S-IC test program for which Boeing is responsible. A preliminary technical evaluation of the impact of subjecting one stage component and one launch GSE end item to a test program in 100 percent compliance with the Apollo test requirements was submitted to NASA/MSFC. A request for proposal (RFP) was received in November, 1964, and the Boeing response was submitted in January, 1965. No further direction was provided by NASA.

DATA REDUCTION WORKING GROUP

The Michoud data reduction working group was formed by NASA. Boeing supported this group by assisting in planning operations of the data reduction facility at the

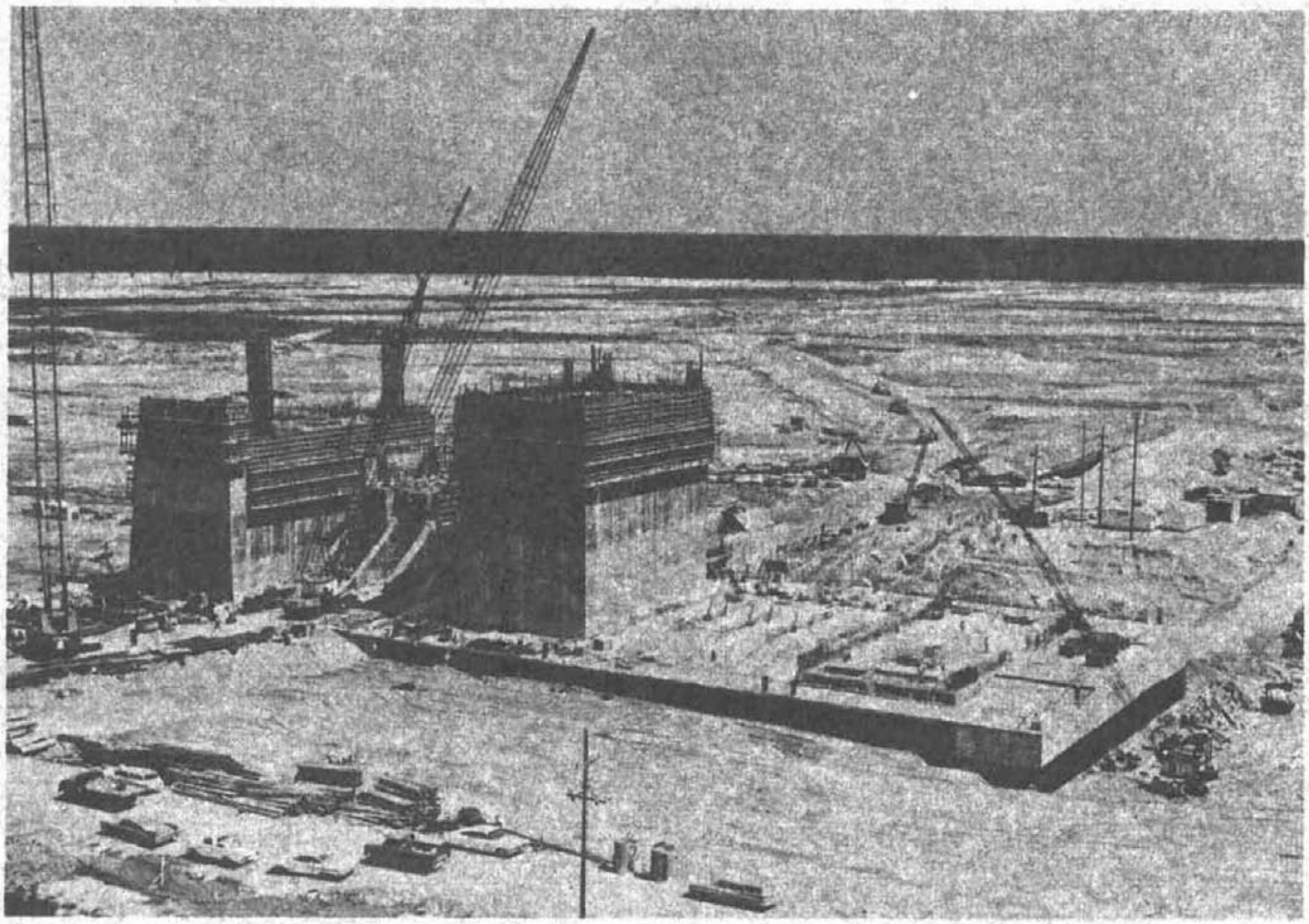


FIGURE V-11 STATUS OF THE S-IC STATIC TEST STAND AT MTF IN JUNE, 1965

Slidell Computer Center. Continued support was given to the Saturn data reduction subgroup, particularly in the development of a tape format for telemetry calibration data. A presentation was given to the flight evaluation working group on the need for contract clarification regarding S-IC stage flight evaluation.

AUTOMATED BOEING CALIBRATION DATA SYSTEM (ABCD)

During this report period work began on the development of an automated Boeing calibration data system. This system will provide S-IC stage calibration data, and test and checkout information in a complete and correlated manner to the using organizations. The type and order of curve fits for the S-IC transducer calibration data was determined for most classes of instruments.

TEST DATA MANAGEMENT PLAN

A preliminary Test Data Management Plan, Document D5-12987, covering all types of test data, was prepared. This plan provides a unified approach to management control of these data. It is scheduled for release in early FY 1966.

TEST DATA STORAGE AND RETRIEVAL PLAN

During this report period an investigation into existing or planned data storage systems and their indexes was started, including a review of system adequacy and response times. The use of machine aids to improve these systems is being considered.

Detailed attention was given to the requirements for an automated indexing system that would be compatible with the stage checkout system and the RCA-110A computer output data tape. Various microfilm techniques were considered for incorporating the best

FIGURE V-12 MTF HIGH PRESSURE GAS FACILITY

features of several systems into this program. SC-4020 digital plotter formats for listings and plots of computer-processed data were developed.

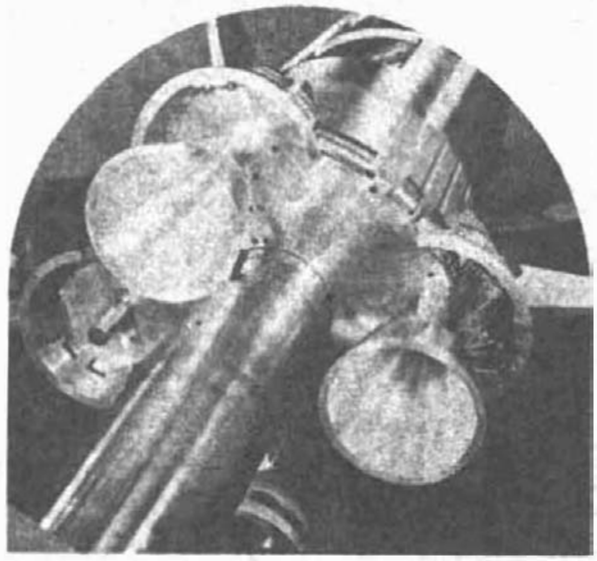
Stage checkout indexing will be oriented primarily by test procedure number and/or chronology. The static firing orientation will be by data channel and/or measurement parameter.

GENERAL TEST PLAN

The second coordination copy of the "Saturn S-IC General Test Plan" (In-I-V-S-IC-64-1) was distributed for review in August, 1964. Informal comments were received from the various NASA/MSFC organizations during November and December, 1964. Several comments require resolution within NASA/MSFC before this plan can be completed.

Boeing is waiting for further direction from NASA/MSFC in this matter.

SATURN V SYSTEMS SUPPORT



6

INTRODUCTION

This section indicates the assistance provided to NASA under Technical Assistance Orders (TAO) active during Fiscal Year 1965. All TAO's, if not previously terminated, were terminated December 31, 1964.

Continued effort on these TAO's is now covered by Statements of Work provided for by contract modifications except for TAO's 10, 19, 22, 23, 25, 28, 30, 31, 32, 36, 41, and 42.

The Contracting Officer's representative indicated satisfactory completion of all TAO's except TAO No. 42, in Letter I-CO-CHM dated March 24, 1965. Satisfactory completion of TAO No. 42 is expected shortly.

TAO NO. 1 - ASSISTANCE TO THE AERO-ASTRODYNAMICS LABORATORY (VEHICLE TECHNICAL STUDIES)

Assistance under this TAO included engineering studies, analysis and reporting. Significant studies concerned flight test data analysis, test systems analysis, Saturn V flight control system analysis, Saturn V flight performance study and aerothermodynamics analysis. This TAO terminated September 18, 1964. Contract Supplemental Agreement 160 provides for continuation of effort.

TAO NO. 2 - DEVELOPMENT OF QUALITY ASSURANCE DOCUMENTS AND PROCEDURES FOR MSFC MANUFACTURED S-IC GROUND TEST AND FLIGHT STAGES

Direct support was provided to the MSFC Quality and Assurance Laboratory, R-QUAL, in their development of documentation, inspection procedures, and other operations incidental to a comprehensive Quality Assurance Programs for the S-IC ground and test stages manufactured at MSFC. This TAO terminated December 31, 1964. Continuation of this effort is provided under Contract Change Order 200.

TAO No. 4 - THRUST VECTOR CONTROL SYSTEM ANALYSIS, DEVELOPMENT STUDIES, AND REPORT WRITING

MSFC Astrionics Laboratory was assisted in facility design, installation, and modification, test requirement and planning preparation, test procedure preparation, and testing incidental to the Thrust Vector Control System. This TAO terminated December 31, 1964. Follow-on effort is provided under Contract Change Order 199.

TAO NO. 5 - ELECTRICAL AND INSTRUMENT EQUIPMENT SYSTEM

This TAO provided engineering technical assistance to the Astrionics Laboratory. Work included range instrumentation and data requirements, antenna pattern synthesis technique development, emergency detection system, network design of the Saturn V Instrument Unit, evaluation and coordination of electrical system design for the S-II and S-IVB stages, electrical design and coordination of the emergency detection system for the Saturn V vehicle, system integration of the Saturn V switch selector, qualification and evaluation of electrical components, preparation of RFI test procedures, and development and analysis of guidance system and control problem studies. This TAO terminated December 31, 1964. The effort is being continued under Contract Supplemental Agreement MSFC-2.

TAO NO. 6 - SATURN V VEHICLE GSE MANAGEMENT SYSTEM

Assistance was provided to the Saturn V GSE Project Office, I-V-G. Under this TAO a technique for identification of GSE requirements for the Saturn V Program and a logistics support plan have been developed. A review of NPC 500-1 configuration management requirements for MSFC Saturn V ground support equipment resulted in a proposed documented program to bring GSE into compliance with applicable parts of NPC 500-1.

Preliminary maintenance analyses were conducted on the S-IC hydraulic unit, the S-IC pneumatic console, the inert prefill unit and the IU pneumatic console. Their purpose was to develop and refine the analytical technique for the Saturn V Program. This maintenance analysis effort was transferred to TAO No. 39 December 1, 1964.

TAO No. 6 terminated December 11, 1964. Continuation of effort begun under this TAO continues under Contract Supplemental Agreement 207V.

TAO NO. 7 - SATURN V LAUNCH OPERATIONS CENTER SUPPORT

Engineering assistance was provided to the Launch Support Equipment Engineering Division (KSC) in conducting studies, design, analysis, and reporting on Complex 39 systems, propellant and gases, crawler transporter, service arms, launch umbilical tower, and launch support handling and access hardware. Work included studies to identify equipment for the Saturn V MILA operations, a plan for the launch support equipment area, and an analysis of the low-bay handling and access operations in the VAB at MILA. An analyses of S-IVB and S-II stage handling and access for the low-bay area was completed. Also completed was an analyses of the instrument unit handling and access for the low-bay area. This TAO terminated December 31, 1964. Task Order 1008-65 provides for continuation of effort.

TAO NO. 8 - SATURN V SYSTEM SUPPORT

Assistance was provided to the Saturn V Test Office at NASA/MSFC under this TAO for development and preparation of the Test Program Management Plan, Saturn V Master Test Plan, Saturn T Test and Checkout Requirements Documentation, and a Test Reporting Plan. This TAO terminated on September 18, 1964. Continuation is provided under Contract Supplemental Agreement 160.

TAO NO. 10 - PERFORMANCE OF A FAILURE EFFECTS ANALYSIS AND CRITICALITY DETERMINATION OF AMR, S-IC GROUND HYDRAULIC SUPPLY CHECKOUT UNIT

Assistance was provided to the NASA/MSFC Propulsion and Vehicle Engineering Laborabory, P&VE, by performing a failure effects and criticality determination of the S-IC ground hydraulic supply checkout unit to be used at the Atlantic Missile Range. A determination of critical components for the S-IC pneumatic console was completed and an S-IC inert pre-fill unit failure mode and effect analysis and the determination of critical components was accomplished. A failure mode and effect analysis was performed also for the S-IC pneumatic checkout rack. Tasks associated with the S-IC Flush and Purge Unit and the RJ-1/N_aNO_2 Service Truck were deleted by TAO No. 10, Amendment No. 6. This TAO was terminated December 31, 1964 following completion of effort.

TAO No. 11 - SATURN V REQUIREMENTS AND PROCEDURES DOCUMENTATION

Assistance was provided to the MSFC Propulsion and Vehicle Engineering Laboratory, P&VE, for initiation of Saturn V System Engineering documentation tasks. These tasks included Saturn V requirements and procedures documentation, component engineering documentation, documentation control, and preparation of technical communications documentation. Upon termination of the TAO, September 18, 1964, this effort was continued under Contract Supplemental Agreement 160.

TAO NO. 12 - SATURN V SYSTEM FUNCTIONAL DESCRIPTION DOCUMENTATION

Assistance was provided to the MSFC Propulsion and Vehicle Engineering Laboratory, P&VE, for the initiation of Saturn V System functional description documentation. Preparation of functional descriptions for the LUT and Saturn V Vehicle RP-1 System, LUT and Saturn V Vehicle LOX System, and the Saturn V Vehicle Environmental Control System were started. Following termination of this TAO on September 18, 1964, this effort was continued under Contract Supplemental Agreement 160.

TAO NO. 13 - LAUNCH VEHICLE PERT SUPPORT FOR SATURN V

Assistance was provided to the MSFC Saturn V Project Office under this TAO by the development of a Saturn V PERT Network. A biweekly status report system was initiated. Since termination of this TAO on September 18, 1964, PERT System development and maintenance effort has been provided under Contract Supplemental Agreement 160.

TAO NO. 14 - LOGISTICS SUPPORT PLANNING AND DOCUMENTATION REVIEW

Assistance was provided to the Saturn V Project Office by initiating logistics planning, controlling, and reviewing functions. Basic Saturn V logistics requirements were documented in the "Saturn V Logistics Support Plan." Preparation of logistics exhibits (covering maintenance engineering, spares and supply, technical reporting data and training) initiated under this TAO, which terminated September 18, 1964, has continued under Contract Supplemental Agreement 160.

TAO NO. 15 - INTERFACE CONTROL

Under this TAO, assistance was provided to the MSFC Propulsion and Vehicle Engineering Laboratory. This assistance included the preparation of B-level mechanical interface control drawings for stage-to-stage interfaces, stage-to-engine interfaces, and stage-to-GSE interfaces. These were primarily physical interface drawings and environmental interface documentation. Upon cancellation of TAO No. 15, September 18, 1964, interface engineering tasks were continued under Contract Supplemental Agreement 160.

TAO NO. 16 - PERFORMANCE OF EXHAUST FLAME PROPAGATION EFFECTS STUDY

The Astrionics Laboratory was provided with a study of the exhaust flame propagation expected on the Saturn V Vehicle in flight. The initial phase of this work was completed with the release of a Program Plan which identified the potential problem area in loss of communications due to flame effects. Subsequent work consisted of computer program changes to incorporate electron generation from afterburning and subroutines for electron nonequilibrium conditions in the plume, development of an advanced electromagnetic propagation computer program, and investigation of afterburning or exhaust plumes. The Thiokol Test Plan to investigate the effects on radio transmission through Genie, Recruit, and TX 280 rocket engine exhaust plumes were analyzed. Exhaust plumes were calculated and electromagnetic analysis was performed to provide theoretical data for comparison with test results. This TAO was terminated on December 31, 1964. Follow-on effort is being provided under Contract Change Order 213V.

TAO NO. 17 - SATURN V TELEMETRY DOCUMENTATION

Under this TAO assistance was provided to the Astrionics Laboratory by preparation of procurement documentation for the Saturn V Telemetry System. This documentation consisted of performance specification, engineering drawings, qualification test procedures, qualification test reports, and maintenance instruction manuals. Technical support was also provided for the design of equipment, sustaining of documentation, and directing and monitoring of qualification tests. Upon completion of TAO No. 17, September 18, 1964, this effort was continued under Contract Supplemental Agreement 160.

TAO NO. 19 - STUDY - COORDINATION AND CONTROL CONCEPTS - SATURN V

Assistance was provided to the Saturn V Project Office in studies of configuration management requirements and concepts. Effort under TAO No. 19 was completed October 31, 1964, following submittal of a Program Development Plan to NASA.

TAO NO. 22 - FEASIBILITY OF FLOX FOR PERFORMANCE IMPROVEMENT ON S-IC

Assitance was provided to the Propulsion and Vehicle Engineering Laboratory, P&VE, with a preliminary study and evaluation concerning the possibility of using FLOX as a propellant for the S-IC Stage.

The feasibility study showed a Saturn V performance improvement of 10 percent is possible by direct substitution of FLOX for LOX. A 40 percent increase in payload results from the use of the full capability of the existing F-1 engine and the existing stage, if the stage is modified to accommodate higher structural loads. Further payload increases up to approximately 60 percent are possible by modifying the thrust chamber cooling system on the F-1 engine.

The design and material compatibility modification on the stage and GSE were determined as nominal. In general it is considered that basic structural materials are suitable for FLOX application without change from existing design.

Qualitative analysis shows the toxic cloud problem will prevent unrestricted use of FLOX; therefore, definitive studies and tests are recommended to determine toxic cloud behavior and safe launch possibilities.

This TAO was terminated September 30, 1964.

TAO NO. 23 - FEASIBILITY DEVELOPMENT PROGRAM ON THE SUBMERSION OF TITANIUM HIGH PRESSURE HELIUM STORAGE BOTTLES IN CRYOGENS

Assistance was provided under this TAO to the Propulsion and Vehicle Engineering Laboratory, P&VE. During the year, work was directed to evaluating an annealed 6AL4V titanium bottle. The weight problems and critical flow sizes for the annealed bottle were compared with those of the heat treated 6AL4V bottle and with several Ardeform bottles under study. The study revealed that use of the 6AL4V titanium bottle would result in a payload increase of 174 pounds. The study was completed and the TAO terminated December 31, 1964.

TAO NO. 25 - ELECTRO-INTERFERENCE PREDICTION STUDY

Assistance was provided under this TAO to the Quality and Assurance Laboratory, R-QUAL, by an engineering investigation to determine the feasibility of broadband near-field electromagnetic prediction by use of a computer program. The study, completed during the reporting period, demonstrated the feasilibility of using computer methods for predicting electromagnetic radiation coupling. Following completion of the study, the TAO was terminated on December 31, 1964.

TAO NO. 26 - SATURN V SYSTEM DEVELOPMENT BREADBOARD FACILITY

Assistance was provided to the MSFC Astrionics Laboratory pertinent to the activation of the Saturn V System Development Breadboard Facility. Work initiated under this TAO, which terminated September 18, 1964, has been continued under Contract Supplemental Agreement 160.

TAO NO. 27 - DYNAMIC TEST VEHICLE PROGRAM

This TAO provided assistance to MSFC in developing test requirements, preparing a test plan, preparing an evaluation plan for test results, scheduling total work, and initiating long-lead-time activities for the Saturn V Dynamic Test Program. Significant accomplishments during the year included, defining technical requirements, completion of design criteria for the cable spring suspension system, and completion of an outline of basic methods for pretest analysis. TAO 27 was terminated December 31, 1964. Dynamic Test Vehicle Program effort was continued under Contract Supplemental Agreement 217V.

TAO NO. 28 - S-IC FLIGHT CONTROL FAILURE MODES AND EFFECTS ANALYSIS

Under this TAO assistance was provided to the Astrionics Laboratory from July 1, 1964 to August 31, 1964. The work consisted of an analysis of telemetry system configuration contract requirements and preparation of draft procedures for telemetry components and systems configuration control. On August 31, 1964, this effort was transferred to TAO 17 which was subsequently replaced by Contract Supplemental Agreement 160.

TAO NO. 30 - RELIABILITY AND QUALITY ASSURANCE

Under this TAO a study program was initiated for the MSFC Saturn V Reliability and Quality Office, I-V-Q. This study compared NPC 250-1, 200-2, 500-5, and the Saturn V Reliability and Quality Program Plan with program plans of stage and GSE contractors. A preliminary outline of a reliability improvement program was prepared and reliability and quality scheduling and reporting analyses were initiated. The documentation effort authorized by this TAO was completed and the TAO terminated December 31, 1964.

TAO NO. 31 - PROPELLANT OVERLOAD - PERFORM ENGINEERING RELATED TO OVERLOADING OF SATURN S-IC PROPELLANT TANK

Assistance was provided under this TAO to the S-IC Stage Manager's Office, I-V-SIC. The study indicated an increase in LOX loading is possible without change of the LOX tank structure, as a result of a reduction of 11.5 psi in LOX tank ullage pressure caused by engine development problems. This study is complete and propellant overload resulting in a payload increase of 3167 pounds has been recommended. This TAO was terminated December 31, 1964.

TAO NO. 32 - INVESTIGATE THE FEASIBILITY OF EMPLOYING AND S-IC PROPELLANT UTILIZATION SYSTEM

This study, conducted for the S-IC Stage Manager's Office, dealt with improved propellant use through closer control of fuel-oxygen ratios in the engine, and considered various means of controlling propellant flow to engine for closer ratio control. This TAO was terminated November 6, 1964. It was discovered that the increased weight of equipment, reduced reliability and engine performance penalties defeated the advantage of a propellant utilization system.

TAO NO. 33 - GENERATE AN ANALYTICAL ROUTINE TO SIMULATE THE SATURN V PROPULSION SYSTEM

Effort was initiated under this TAO in support of the Propulsion and Vehicle Engineering Laboratory, P&VE, to provide a means to analyze transient and mainstage propulsion performance. Propulsion optimization studies for the Saturn V Vehicle were also performed. This TAO was terminated September 18, 1964. Continuation of effort has been authorized under Contract Supplemental Agreement 160.

TAO NO. 34 - DETERMINE SATURN V GUIDANCE AND CONTROL SYSTEM FILTER NETWORK CHARACTERISTICS

Under this TAO assistance to the Astrionics Laboratory was initiated to determine filter network characteristics and to analyze and simulate Saturn V filter control system performance. Upon cancellation of this TAO September 18, 1964, this effort was continued under Contract Supplement Agreement 160.

TAO NO. 35 - CONDUCT ANALYSIS TO DETERMINE BREAKUP ANGLE OF ATTACK VS FLIGHT TIME FOR THE SATURN V VEHICLE

Under this TAO the subject analysis was started for the Propulsion and Vehicle Engineering Laboratory, P&VE. This study is to provide data pertaining to the gimbal angles of $+5.9^{\circ}$ and -5.9°. This effort was limited to 12 stations along the LOR vehicle, use of rigid body analysis technique to determine loads, and the determination of loads at 5 second intervals during nominal first stage flight, starting at 20 seconds after launch. Upon termination of this TAO September 18, 1964, this effort was authorized and continued under Contract Supplemental Agreement 160.

TAO NO. 36 - INVESTIGATE THE FEASIBILITY OF USING STRAP-ON MINUTEMAN SOLID PROPELLANT ROCKET MOTORS ON THE S-IC LAUNCH VEHICLE

This study was to determine a feasible kit for installation on the S-IC launch vehicle at the launch site for maximum payload increase with minimum impact on resources and schedules. The study was expanded to include necessary launch complex changes and full-scale Minuteman tests. The configuration selected as a result of this study permitted a payload increase of 5234 pounds. Study results established the feasibility of using a Minuteman strap-on kit for installation on the S-IC at KSC with no production line modification to the S-IC stages. The use of a Minuteman strap-on kit is predicated on Saturn V thrust augmentation to deliver the required LOR payload. Current weight statements show margin that the strap-on kit will not be required. This TAO was terminated on December 31, 1964.

TAO NO. 37 - SUPPORT OF KENNEDY SPACE FLIGHT CENTER FUNCTIONS RELATED TO SATURN V OPERATIONS

Under this TAO, support was provided to the Kennedy Space Flight Center. This support included, facilities/equipment layout, design reviews, implementing and maintaining a Saturn V technical data file, aiding in the development of a hardware records plan, and developing training requirements. Following the termination of this TAO on December 31, 1964, this effort was continued under Contract Part VIII Task Order 1008-65.

TAO NO. 38 - DEVELOP A MODEL FLIGHT TEST DIRECTIVE

Assistance was provided to Systems Engineering Office, I-V-E, for development of Saturn V Flight Test Directives. Various documents have been studied to determine the relationship of the test directive to other test planning documentation. An outline of a Model Flight Test Directive was submitted to MSFC. Effort under this TAO, which terminated September 18, 1964, has been continued as authorized under Contract Supplement Agreement 160.

TAO NO. 39 - MECHANICAL GSE PROGRAM

Support provided to MSFC during the year included the development of vibration and acoustic criteria for LUT decks and rooms, development of structural loads for the lightweight engine actuator, development of umbilical assembly-to-stage interface loads for the S-IVB and the S-II stages, computer programming for loads at the S-IC intertank umbilical, and weight analysis for the three-stage internal vertical-position work platforms. MGSE requirements/operation analysis, criteria development, load, stress and weight studies initiated under this TAO, which was terminated December 31, 1964, are being continued as authorized under Contract Supplement Agreement 227V.

TAO NO. 40 - INVESTIGATE ENVIRONMENTAL CONTROL OF SATURN V INTERSTAGE VOLUMES AND COMPONENTS

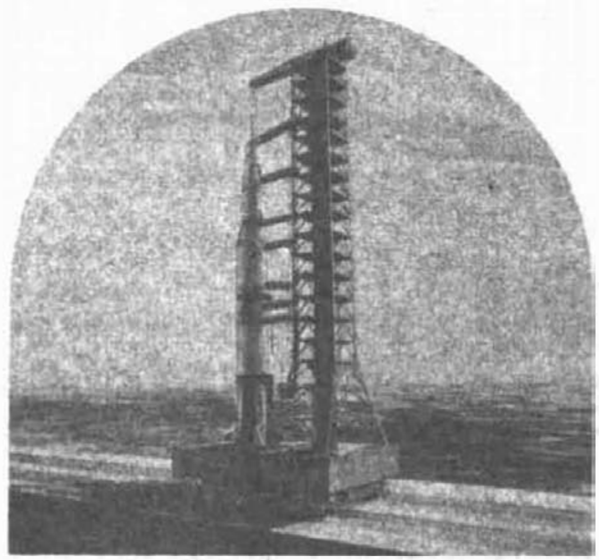
Support was provided under this TAO to the Propulsion and Vehicle Engineering Laboratory, P&VE, to commence studies to evaluate interstage inert purge and environmental systems performance for all Saturn V interstage compartment areas. Upon cancellation of this TAO on September 18, 1964, continuation of these studies was authorized under Contract Supplement Agreement 160.

TAO NO. 42 - EVALUATE PROPELLANT TANK PRESSURIZATION SYSTEMS OF THE S-IC

Support was provided to MSFC under this TAO to evaluate alternate system designs for the propellant tank pressurization system offering potential weight reduction and increased reliability. The objective of this study was to optimize a new pressurization system for the S-IC stage by removing the helium bottle from the LOX Tank. The study resulted in a system that would reduce cost and weight, and improve reliability. A helium-hydrazine pressurization system was recommended which would allow a payload increase of 1000 pounds. The study also defined an all-helium system that would be somewhat heavier and result in a payload increase of 900 pounds. This TAO was terminated December 31, 1965.

Satisfactory completion of effort under this TAO, however, required the submittal of a Firm Cost Proposal for an alternate Propellant Tank Pressurization System. A firm cost proposal was submitted for the developmental testing of the critical components required for the revised system. A delta budget proposal also was submitted for the incorporation of the system into potential flight stages SA511 through SA515. Both proposals were submitted by Letter 5-1133-M-69, dated June 29, 1965.

LAUNCH OPERATIONS SUPPORT



7

CONTRACTED WORK AUTHORIZATION SUMMARY

During FY 1965, Boeing provided Launch Operations support under Task Orders (TO) I-V-SIC-1003-65, 1004-65, 1006-65, and 1008-65. Support also was provided under Technical Assistance Orders (TAO) 6, 7, 8, 36, and 37.

At the beginning of FY 1965, S-IC operations supported NASA/KSC in the following areas:

a) Prelaunch operations plans;
b) Stage checkout and maintenance;
c) Facility/equipment layouts;
d) Design reviews;
e) Assembly and test procedures;
f) Hardware records system;
g) Configuration control;
h) Test data system requirements;
i) Safety, reliability and quality assurance.

TO 1008-65 realigned Boeing effort to three areas: launch operations, systems engineering, and launch support equipment design.

Supporting both NASA/MSFC and NASA/KSC, the TAO's involved relatively small levels of effort; primarily in documentation. TAO 7 covered launch support equipment and engineering design at Huntsville during CY 1964. It provided direct support through engineering studies, design analysis, and report writing applicable to Launch Complex 39 propellants, the launch system and umbilical tower, and launch support equipment reliability.

TAO 36 called for a facilities and operations study of a Minuteman thrust-augmented Saturn V vehicle. TAO 37 covered various Saturn V operations support functions.

TO 1008-66 was extended to cover the first quarter of FY 1966 and provides—for the first time—for direct support from the Resources and Contract Administration organizations.

LAUNCH OPERATIONS PARTICIPATION

FY 1965 was marked by intensive coordination and planning to continue improving Boeing Atlantic Test Center (BATC) working relationships with NASA Kennedy Space Center (NASA/KSC) counterparts.

On-the-job training was strongly emphasized throughout the year and much of it was provided by the NASA/KSC personnel who technically supervised the Boeing direct support efforts.

Electrical and Control Systems (E&CS) personnel received classroom training in 20 scheduled courses These ranged from F-1 engine system familiarization to RCA 110A computer programming

Quality and Reliability Assurance (Q&RA) personnel have been on loan in the fourth fiscal quarter to the Launch Systems Branch at Michoud to familiarize them with the S-IC stage and ground support equipment (GSE). These people have already had extensive field-test operation experience. Upon completion of their training, they will form the nucleus of the BATC Saturn inspection work force.

During the last quarter of FY 1965, emphasis was placed on hiring personnel with specific skills for the mechanical and technical work force that will support LC 39 receiving, assembly, installation, modification, refurbishment and repair activities. Thirteen mechanics and technicians are currently assigned in Boeing-Huntsville operations for on-the-job training, hardware familiarization, and NASA skill certification. Their return to KSC will coincide with the start of hardware processing at MILA.

Instrumentation and RF (I&RF) systems personnel developed preliminary checkout requirements and launch preparations for Complex 34 and Complex 37. These efforts provided experience in working with the elements of basic tests, work flow, and problems that may be encountered during these operations. At the same time, NASA's request for Boeing assistance with the basic design and systems development gave Saturn V personnel considerable experience in the areas of the hazardous gas detection system, the digital data acquisition system, the digital range safety command system, and associated instrumentation systems.

LAUNCH OPERATIONS SUPPORT

Planning and Scheduling

Boeing personnel served on the countdown operations committee, provided inputs to the launch preparations subgroup for making a flow sequence for SA-500-F, and assisted in the preparation of flow charts and countdown sequences for SA-501 and SA-505.

Plans were submitted to Launch Vehicle Operations (LVO) for lights and indicators for the S-IC test conductor's console in the Launch Control Center (LCC) firing rooms.

The documentation effort encompassed the following:

Status	Doc. No.	Title
Published	D5-12922	S-IC and Common GSE Systems Description Manual - MILA
Published 1st draft	D5-10064	S-IC-1 Stage Components Replacement Study
Published draft	D5-16201	S-IC/Saturn V Checkout and Procedure Requirements - MILA
Contributed to	D5-11830	MILA S-IC/Saturn V Launch Operations Records System
Published 1st draft	(Internal working document)	S-IC-F/SA-500F Catalog of Procedures
Published 1st draft	(Internal working document)	S-IC-1/SA-501 Catalog of Procedures

Level C PERT charts were developed showing GSE assembly and checkout activity during site activation at Complex 39.

Reliability and Quality Assurance

Assistance to NASA/KSC in defining their direct support requirements during pre-site activation was emphasized in the expanding Boeing direct-support efforts. During the year formal interface was established with the KSC Apollo Reliability and Quality Assurance staffs of the program management office (PA6) and of Launch Vehicle Operations (VT4).

The BATC S-IC/Saturn V quality program plan has been drafted and subjected to several in-house reviews.

A special configuration of the Quality Control Manual (D2-4800) will be prepared and will be identified as the BATC S-IC Saturn V Quality and Reliability Assurance Manual, (D2-4800-5). It will contain quality control directive supplements applicable only to BATC Saturn operations. Preliminary procedures have been drafted; major subsections are scheduled for completion during the second quarter, FY 1966.

Considerable effort was expended in assisting the NASA/KSC Reliability and Quality Assurance staff to compile a matrix showing the NASA/KSC - contractor working relationships relative to quality functions during the Saturn V operational phase.

Logistics Support

During the past year direct logistics support was expanded to include the Base Operations Division, Material Support Branch (CB7), in addition to the Launch Vehicle Operations, Component Logistics Branch (VL3).

Two significant documentation efforts were identified, and are being maintained on a sustaining basis: Documentation of on-order spare parts lists in support of Component Logistics Branch; and documentation of BATC portable capital and perishable hand tools and portable commercial test equipment bulk-item requirements in support of the Material Support Branch.

The first hardware for which BATC was assigned logistics responsibility arrived on-dock KSC December 31, 1964. Since that time, 185 line items have been received, recorded, and stored. The volume of hardware receipts has increased rapidly in the last fiscal quarter and is expected to remain high during the next two years. The significant achievement in this area is the understanding and tentative agreement with NASA/KSC on the scope of Boeing Logistics hardware responsibilities.

The initial allocation of permanent Logistics office and stores inside-space in the MILA Industrial and LC 39 areas was negotiated. Approximately 18,000 square feet (of which 10,600 square feet is air-conditioned) was assigned to Boeing Logistics.

Mechanical & Propulsion Systems (M&PS)

The first quarter of FY 1965 was a period of buildup of personnel to support KSC Mechanical & Propulsion Systems (VM). Boeing support was concerned with definition of the equipment and of general group responsibilities within VM.

Second quarter activities included a study of the LOX, LN_2 and GN_2 total requirements at LC 39, and a study to reduce the LOX and LH_2 loading time during the countdown. In addition, an in-house description, schematic and functional analyses of all LC 39 mechanical systems were completed.

Studies covering the Mechanical GSE activities at LC 39 resulted in two proposed operational changes: Reduction of the Mobile Launcher (ML) refurbishment time from 45 to 21 days; and use of VAB Bay 4 for ML refurbishment to reduce time lost because of inclement weather.

A major effort during the fourth fiscal quarter supported VM in preparing Level C PERT charts of mechanical activity at LC 39 from the installation-contractor completion date through the processing of vehicle SA-500F.

Cataloging of all test procedures required for the LC 39 mechanical areas was another major effort. Final drafts prepared on the NASA/KSC format were completed on schedule.

Boeing participation increased in design reviews for such items as the VAB-E&CS, service arm work platforms, pnuematic valve installation, propellant dispersion system, access platforms, LCC control panel layouts, instrumentation requirements, F-1 engine handling, and mobile launcher platform transporter movement.

Initial support of VM for installation contractor surveillance at LC 39 took place as the holddown arm installation on mobile launcher No. 3 got underway. Support was provided during testing of major items of GSE, propellants system, and vehicle GSE at vendor plants. This testing involved the 10,000 gpm main LOX pump and the S-IC pneumatic consoles.

Preparation of space layouts and equipment requirements for LC 39 was handled on a continuing basis. The mechanical lab layout in the VAB was completed, and listings of requirements to support the testing were prepared.

Electrical & Control Systems (E&CS)

During the past year, the E&CS group supported KSC Electrical Engineering Guidance and Control Systems (VG) in evaluating hardware design for Saturn V electrical support equipment (ESE). It provided operational criteria to design groups in scheduling, planning, coordinating LC 39 activation, and in advance planning for applicable SA-500F and SA-501 prelaunch and launch operations.

E&CS personnel prepared Level C PERT networks on LC 39 activation (SA-500F and SA-501) for systems that would subsequently be Boeing responsibilities, and also submitted detailed lists of all propellant loading ESE, launch support electrical equipment, and S-IC ESE which Boeing expects to receive, assembly, and verify during LC 39 activation.

Inputs provided to the operations analysis were a major support effort. Preparation of detailed procedures for ESE and S-IC stage checkout still in progress will complete the operations analysis effort.

Instrumentation & RF Systems (I&RF)

During the second fiscal quarter a preliminary draft of the Operations Analysis document was released. It defines general functional signal flow interfaces between S-IC stage systems: measuring, telemetry, ODOP, TV, command destruct, and associated GSE.

A functional description of the LCC measuring station was developed and later increased to include preparation of the LC 39/Saturn V measuring operations plan. A first draft was submitted to Electronic Engineering and Instrumentation Systems (VE) for review.

A catalog of tests was prepared, covering all I&RF procedures used in processing the SA-500F and 501 vehicles from on-dock at MILA through launch.

Modifications were made on the remote automatic calibration system/all systems (RACS) and digital data aquisitions systems (DDAS). Associated logic circuit breadboards were fabricated as required. A review of portable test equipment was completed.

Boeing participated in various KSC (VE) design activities. Design of a modification to the RACS distributor was completed and one distributor modified and checked out. Design of a RACS/ALL display panel for the blockhouse in Complex 34 was completed. Design of remote and local control panels for the Complex 34 mass spectrometer used in hazardous gas detection for SA-9 was completed. Considerable effort was devoted to the modification of the detection system for SA-8 launch. Generally, this effort also included prototype equipment developed for LC 34.

A design review of the hardwire digital link to the digital data computer systems (DDCS) buffer units found the initial design unacceptable. Working closely with the design contractor, Boeing designed and implemented modification, and maintained liaison during marriage of the buffer units with DDCS units for further evaluation. Design review and breadboard testing of special purpose circuits for the hardwire digital-to-DDCS buffer units has been completed.

Power distribution schematics for the Complex 39 LCC and the Complex 34 measuring station were prepared for critical and for utility power.

VE3 requested support in determining (in the Pad Terminal Connection Room -- PTCR) the rack layout, power and timing requirements, assignment numbers and responsibility areas; and in designing the timing distributor. The configuration of the distributor is complete and ready for VE3 review.

Another assignment invloved laying out the power, communications, timing, assembly numbers, and rack configurations for the four vehicle measuring ground equipment (VMGE) stations in Bay 1. This effort required originating and modifying station configurations. The completed assignment included evaluation and layout of the pressure calibration system, analog recording unit, pneumatic test station, VMGSE patch panel, and oscillograph recorder.

SYSTEMS ENGINEERING (Saturn V Systems Support)

Program Documentation

This effort for FY 1965 included the 14 KSC documents listed below:

a) Instrumentation Plan;
b) Flight Test Evaluation and Reports Plan;
c) Saturn V Facility Vehicle Test Requirements;
d) KSC Configuration Management Plan;
e) GSE Validation Test Requirements, Volume I;
f) GSE Validation Test Requirements, Volume II;
g) Post Flight Refurbishment Plan;
h) Facilities Activation Plan;
i) KSC Schedules and Control Plan;
j) Apollo/Saturn Project Development/Operations Plan;
k) Saturn V Facility Vehicle Test Plan;
l) Apollo/Saturn V LC 39 GSE Installation, Assembly and Test Plan;
m) Apollo/Saturn V Master Test Plan;
n) Apollo/Saturn Program Management and Support Plan.

BATC effort has been completed on the first three documents; final drafts were submitted for the next nine; and coordination drafts of the last two documents were delivered. The documentation effort is scheduled to be essentially completed during the second fiscal quarter, 1966.

Equipment Record System

The KSC equipment record system (ERS) is an outgrowth of the Saturn V equipment management system developed jointly by NASA/MSFC and NASA/KSC with Boeing support. The ERS was designed to fulfill Saturn V/Apollo GSE management requirements for activation of MILA Launch Complex 39.

During the last fiscal quarter BATC completed preparation of computer programs for local data processing of the basic ERS and the programming system became operational, producing satisfactory printouts of Volumes III, IV and V. Volume I was distributed by NASA/KSC early in June.

Equipment record system volumes are identified as follows:

Volume I	ERS Description
Volume II	ERS Input Instructions (D5-16203)
Volume III	1. ERS by Program Element 2. ERS by Organization by Program Element
Volume IV	ERS by Location by Program Element
Volume V	ERS by Installation Package and System Number by Program Element
Volume VI	ERS Package System Sort for Test Purposes

LAUNCH SUPPORT EQUIPMENT DESIGN SUPPORT

Planning and Scheduling

A pilot master parts list is being prepared for the launch service arms. This list will provide a basis for the preparation of a complete computer-developed master parts list for LC 39. Procedures were developed for preparing and processing Engineering Change Proposals (ECP). A systems specification tree for LC 39 also was prepared.

Work is progressing in configuration management on a KSC supplement to ANA (Army-Navy-Air Force) Bulletin 445, and on preparation of interface control documentation. Branch, detail, and summary launch support equipment (LSE) schedules were prepared, released and updated each month.

A Government Furnished Equipment (GFE) list was prepared and released, and is periodically updated to reflect the latest contract information.

Documentation

The Documentation Requirements Plan, K-AM-04-01, was released. This document established the authority and general procedure for defining KSC Launch Support Equipment Engineering Division (LSEED) documentation requirements. The plan was first implemented with the preparation and release of the Saturn V Documentation Requirements Summary, K-AM-04-02.

Mechanical and Propulsion Support

The Saturn V Launch Support Equipment General Criteria and Description document, SP-4-27-D, was reviewed and extensively revised to reflect the latest system and equipment configurations. This revision was completed on schedule by June 30, 1965.

The structure of the K-truss umbilical tower was analyzed, and the overall service arm system design was monitored. Currently, the service arm fabrication contract is being monitored, as is qualification and system testing.

In pneumatic testing, component requirements were evaluated and procurement of components for qualification testing begun. Test procedures and test reports were reviewed. The overall pneumatic component test program was monitored. Documentation and GSE installation design of the mobile launcher were also monitored.

Propulsion support included component and system fabrication and installation design reviews; component and system test planning; and monitoring of reliability and acceptance testing.

Electrical and mechanical component fabrication and procurement is well underway, and electrical system integration testing is in progress.

MERRITT ISLAND LAUNCH AREA LIAISON

PLANNING AND SCHEDULING

Planning continued in preparation for the movement of BATC personnel from Cape Kennedy to MILA, except those persons attached for training at Complexes 34 and 37. The first moves will take place in July, 1965, and are scheduled to be completed by October 1, 1965.

The Boeing Launch Support Equipment Design unit began its move from Huntsville to BATC in June, 1965. The move, coinciding with that of KSC-D (LSEED), is expected to be completed about July 1, 1966.

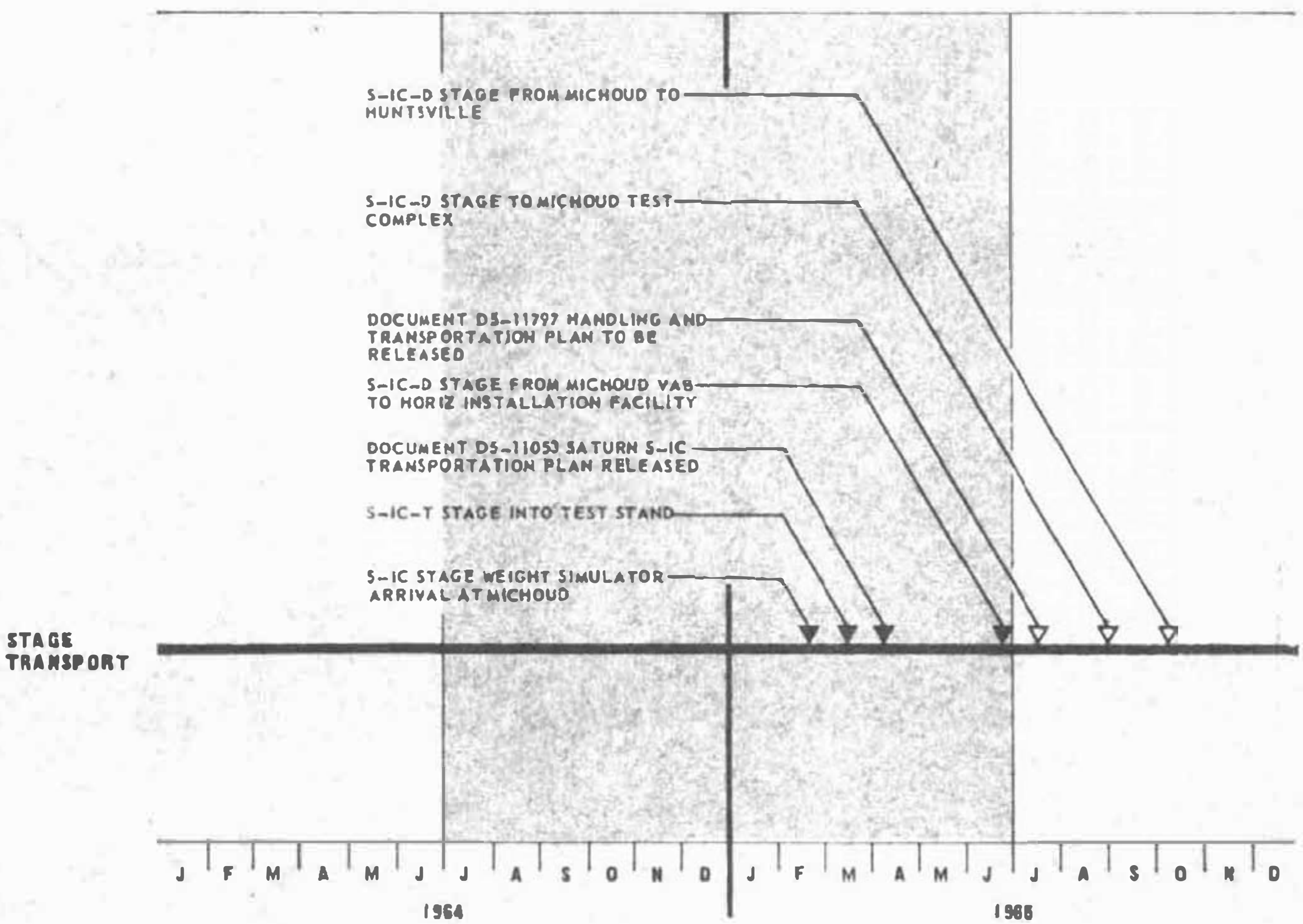
The Design Support section of the Test Engineering and Operations group provided full-time drafting support to handle BATC-originated Engineering Orders, PERT charts and combined mechanical schematics, and to maintain a reference drawing file. The Design Support section reviewed all engineering changes for impact and coordination. This involved 452 change action memos, twelve engineering change proposals, and four production revision requests during FY 1965.

Saturn Technology Support began preparation of the S-IC/MILA data handling plan and the S-IC/MILA analysis and reports plan. A BATC Saturn document control and release procedure was developed and released.

Stage instrumentation real-time monitoring requirements were coordinated and forwarded to NASA/KSC. Support was provided to the NASA/MSFC study on the use of Minuteman first-stage motors and 120-inch solid motors to augment Saturn S-IC thrust. This support included study of the impact on KSC facilities, GSE, and operations.

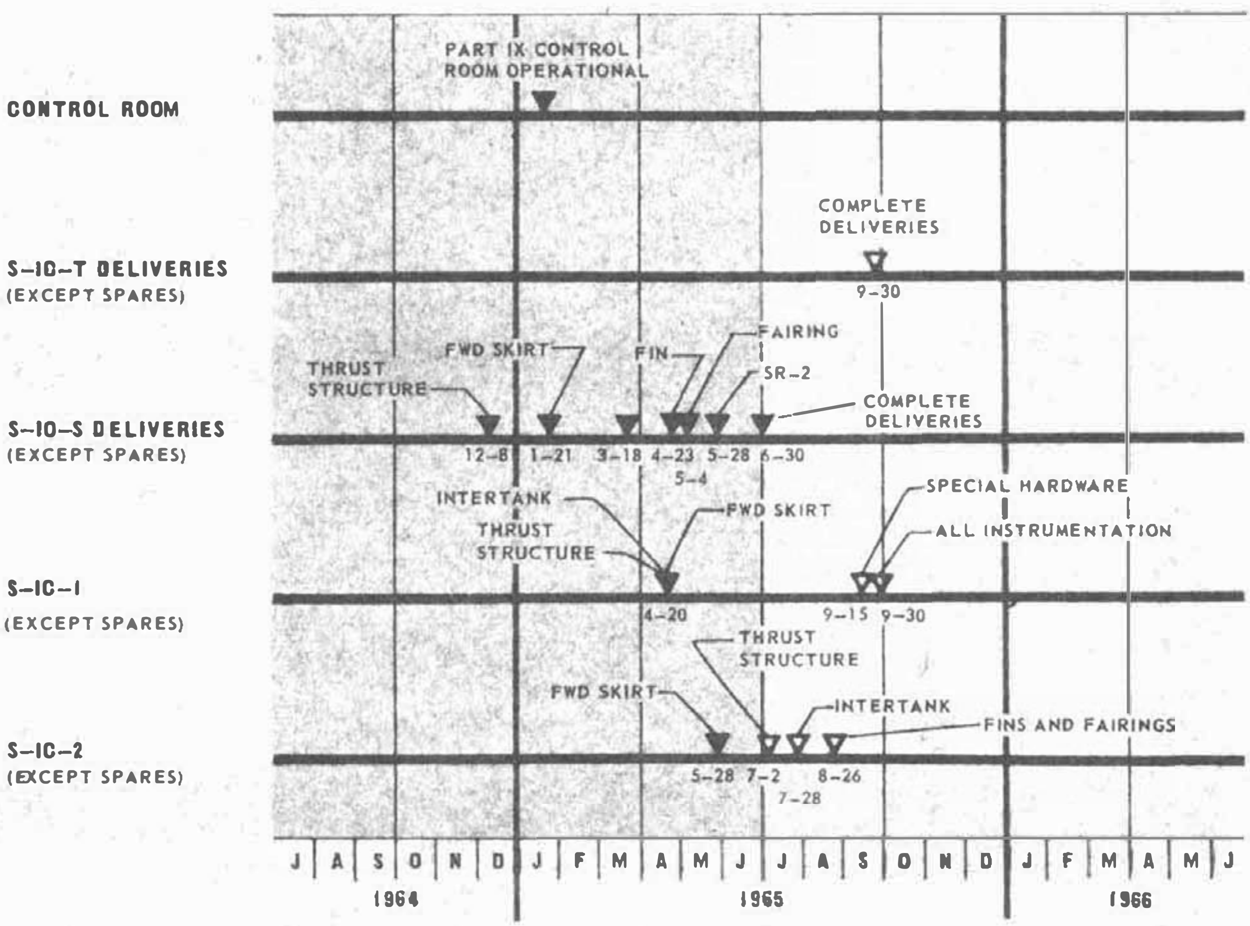
STAGE TRANSPORTATION MILESTONES

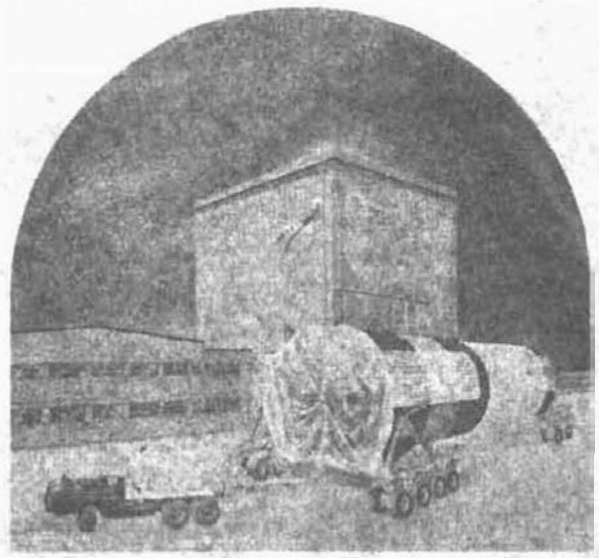
(PLAN VIII)



MANUFACTURING SUPPORT TO MSFC MILESTONES

(PLAN VIII)





TRANSPORTATION

8

INTRODUCTION

The availability of transportation equipment and the production of S-IC stages allowed transportation activity to progress during the year from solely planning, through familiarization and training operations, to actual stage handling and transportation.

DOCUMENTATION

Transportation planning continues as outlined in the following paragraphs.

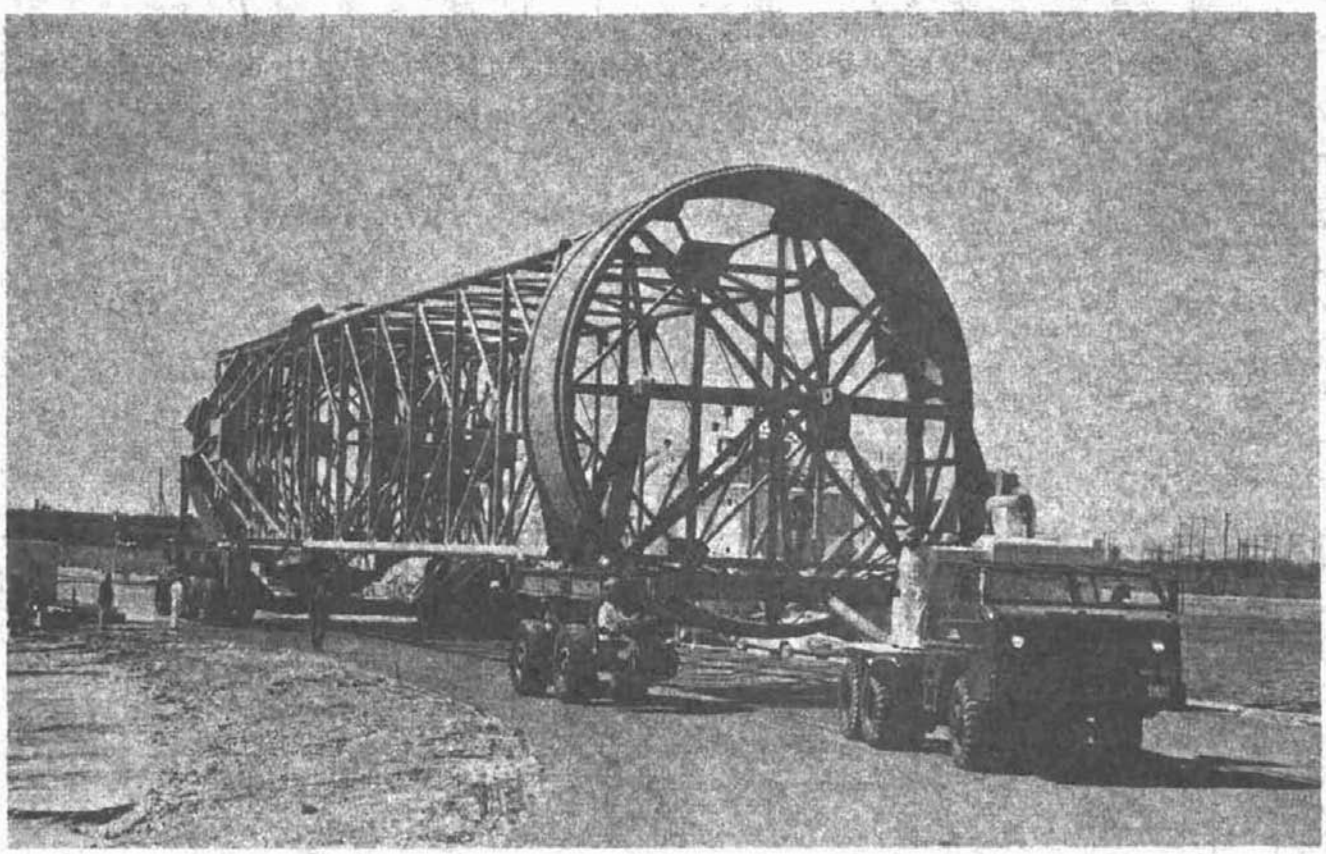
Revision A to Document D5-11053 "Saturn S-IC Stage Transportation Plan" was released during the third fiscal quarter. This document establishes the plan for transporting the S-IC-D and S-IC-F ground-test stages, and the S-IC-3 through S-IC-10 flight stages. The document defines the NASA/Boeing transportation interface, and the Boeing transportation responsibilities. It establishes schedules and sequential operations. It defines the operations involved in preparing the stages for shipment, loading and unloading the barge, monitoring the environmental protection and data recording systems, and preparing the transportation reports after each trip.

Document D5-11797, "Handling and Transportation Plan," is 98 percent complete and will be released in the first quarter of FY 1966. This document will interface with Document D5-11053. It covers the handling of the stage at MTF from the barge into the booster storage building, from the barge into the test stand, and from the storage building or test stand back to the barge. Transportation and handling at MTF of the F-1 engine and the GSE for the test control center and test stand are also covered.

FAMILIARIZATION AND TRAINING

Boeing personnel participated in the checkout of the stage transporters (three were delivered during the year) using the S-IC stage weight simulator at MSFC/Huntsville under NASA/MSFC supervision. This exercise included crew training, stage handling, facility checkout, and analysis of road movement. Another exercise consisted of lifting the weight simulator off the transporter into the test stand and replacing it on the transporter. Boeing personnel also participated in

FIGURE VIII-1 PRIME MOVER, S-IC STAGE TRANSPORTER AND WEIGHT SIMULATOR



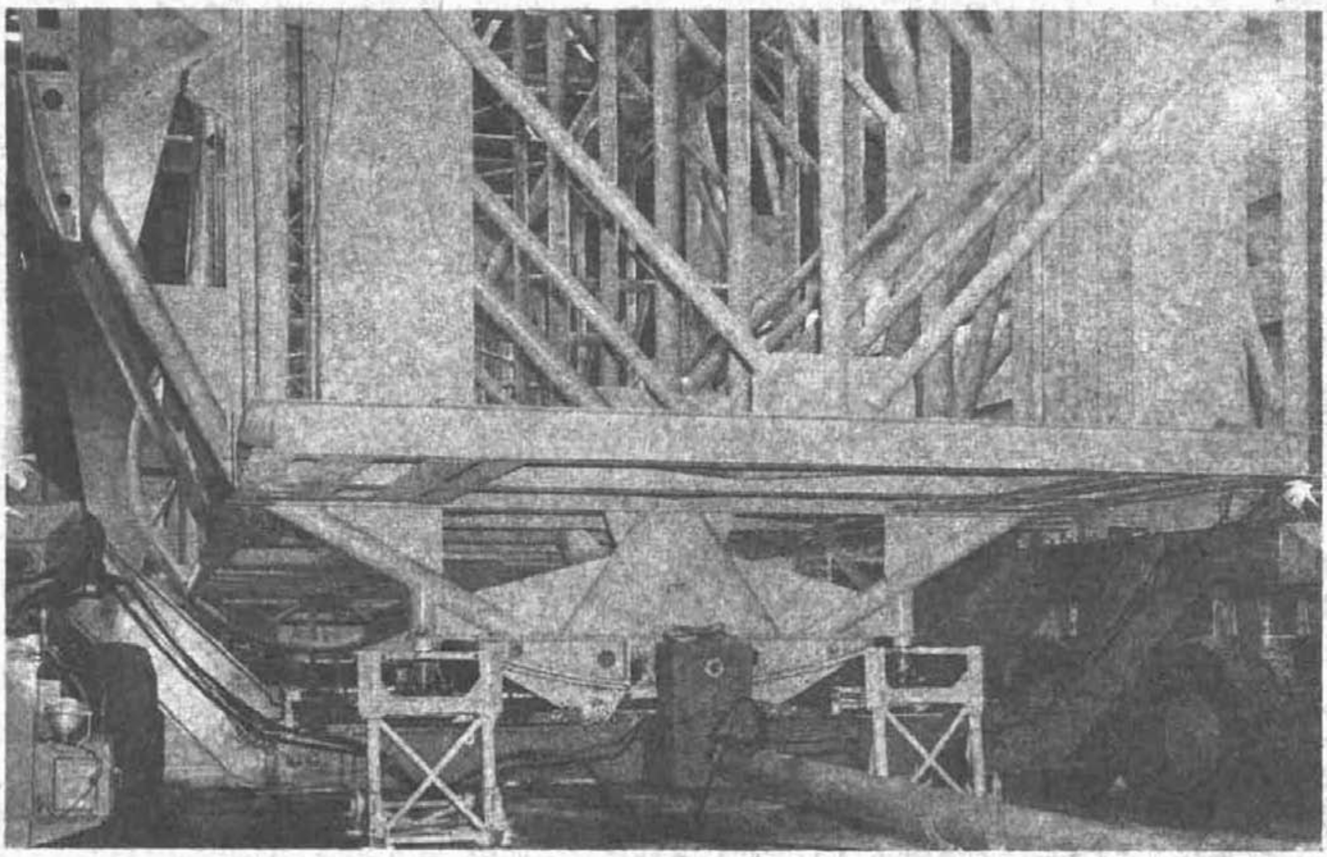


FIGURE VIII-2 THE TWO AFT WEIGHING STANDS IN USE DURING THE WEIGHING OF THE STAGE WEIGHT SIMULATOR

on-loading and off-loading of the transporter/simulator from the barge.

The transporter/weight simulator was shipped from Huntsville to Michoud on a partially modified MTF shuttle barge during the third fiscal quarter. It was used at Michoud for crew training, road movement analysis (Figure VIII-1) and facility checkout.

STAGE MOVEMENT

Boeing Systems Test personnel participated in the transportation of the S-IC-T stage from the MSFC/ME Laboratory to the static firing test stand at MSFC/Huntsville in March, 1965. The R&D instrumentation trailer was used for this move. Results were satisfactory. Participation included stage off-loading from the transporter and handling of the stage during installation and alignment in the test stand.

On June 27, 1965, the S-IC-D stage was removed from the final assembly position in the VAB at Michoud, placed on a transporter, and moved to the horizontal installation facility in the factory area (Figure III-8).

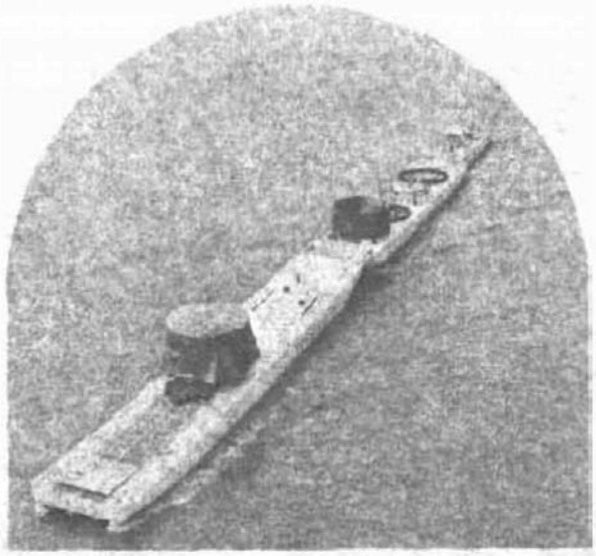
The S-IC-D stage will be moved from the factory area into the test cell at the Michoud Stage Test Building during the next quarter. Later in the fiscal year, the S-IC-D stage will be moved from Michoud to Huntsville; the weight simulator and the S-IC-F stage from Michoud to MILA; and the S-IC-I stage from Huntsville to MILA. All of these moves will be instrumented.

STAGE WEIGHT SIMULATOR WEIGHING

The S-IC stage weight simulator was used during the fourth fiscal quarter to evaluate the S-IC weighing procedure and the MSE stage weighing equipment (Figure VIII-2). Both test objectives were successfully accomplished. Two weighings of the stage weight simulator were performed in the test cell of Michoud Complex II. The weighing procedure was checked out and the weights obtained were within the tolerance of one tenth of one percent.

The weight simulator was also used to load test the test cell floors in Michoud Cells 1 and 2.

MANUFACTURING SUPPORT TO MSFC



9

INTRODUCTION

During FY 1965, manufacturing support to MSFC doubled. This consisted of manufacturing, purchasing, and assembly of structural hardware and specialty items. To cope with the problems associated with the manufacture and delivery of hardware, various management and technical task forces were established and manned by top Boeing personnel.

A task force was formed to improve supplier adherence to schedule requirements. This task force augmented resident teams with 26 additional management and technical personnel from Seattle, Wichita, and the Launch Systems Branch. To facilitate the additional management emphasis which was placed on delivery of Part IX hardware, a central control room was established January 18, 1965 for visibility status.

Another important management task force was the joint NASA/MSFC and Boeing management committee which scheduled a series of meetings to deal with problems affecting the S-IC-T. During some periods in the design, assembly and delivery of S-IC-T parts, these meetings were held biweekly in order to formulate decisions as required.

A welding task force was established during the ... fiscal quarter to find solutions to welding problems that developed during LOX and fuel tank assembly.

By the end of the second fiscal quarter, significant progress was made in solving the problems affecting the schedule position. The resultant improvement trend in hardware deliveries continued through FY 1965, largely due to efforts of these task forces.

S-IC-T STAGE

Activities during the reporting period were associated primarily with CAM replacement hardware. There were 56 line items remaining to be delivered on the S-IC-T, 14 of which were rework items. All items will be delivered in time to support the static firing schedules (Figure IX-1).

S-IC-T HARDWARE DELIVERY STATUS

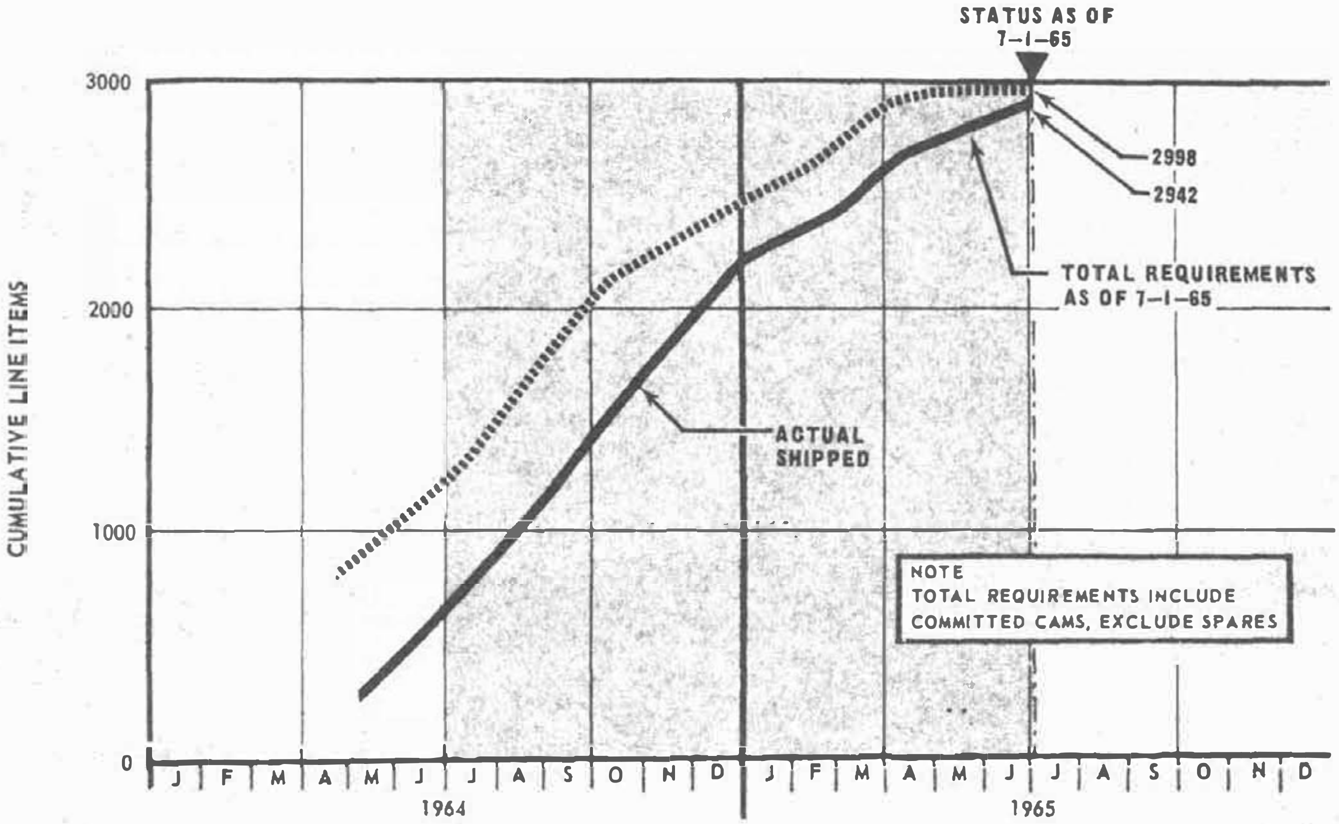


FIGURE IX - 1

STRUCTURAL HARDWARE

All S-IC-T propulsion and mechanical hardware is expected to be delivered by mid-September, 1965. The engine fairing heat shields, consisting of support structure, panels and boot assemblies, were delivered to MSFC during the fourth fiscal quarter.

SPECIALTY HARDWARE

The instrumentation for the S-IC-T was completed during FY 1965, and of the 95 cable items, three remained to be delivered. Ninety-three percent of the ducting was delivered.

The redesign of the armored harness assembly, resulting from the electrical connector shells failing during vibration tests, was completed. The qualification of the assembly will be completed July 17, 1965 and hardware delivery is planned for July 30, 1965.

S-IC-S STAGE

All contracted propulsion/mechanical hardware in support of the S-IC-S was delivered during FY 1965.

The main activity during the last quarter consisted of supplying hardware resulting from CAM's. The SR-2 intertank was delivered in May, 1965. The S-IC-S fin and fairing was completed (except for temporarily attached skins on one side of the fin to allow for instrumentation) and shipped to MSFC during this quarter. Boeing personnel will be sent to MSFC during the first quarter of FY 1966 to complete the S-IC-S fin and fairing installation (Figure IX-2).

S-IC-1 STAGE

The greatest growth in line item commitments during the fiscal year was for the S-IC-1 stage. These additions were due to CAM's as well as orders placed by NASA/MSFC. The latter category included 213 cables. (Figure IX-3)

STRUCTURAL HARDWARE

An all-out effort is being made to deliver all propulsion/mechanical hardware by mid-August, 1965, at which time the S-IC-1 horizontal assembly will be taking place. Boeing personnel from various opera-

S-IC-S HARDWARE DELIVERY STATUS

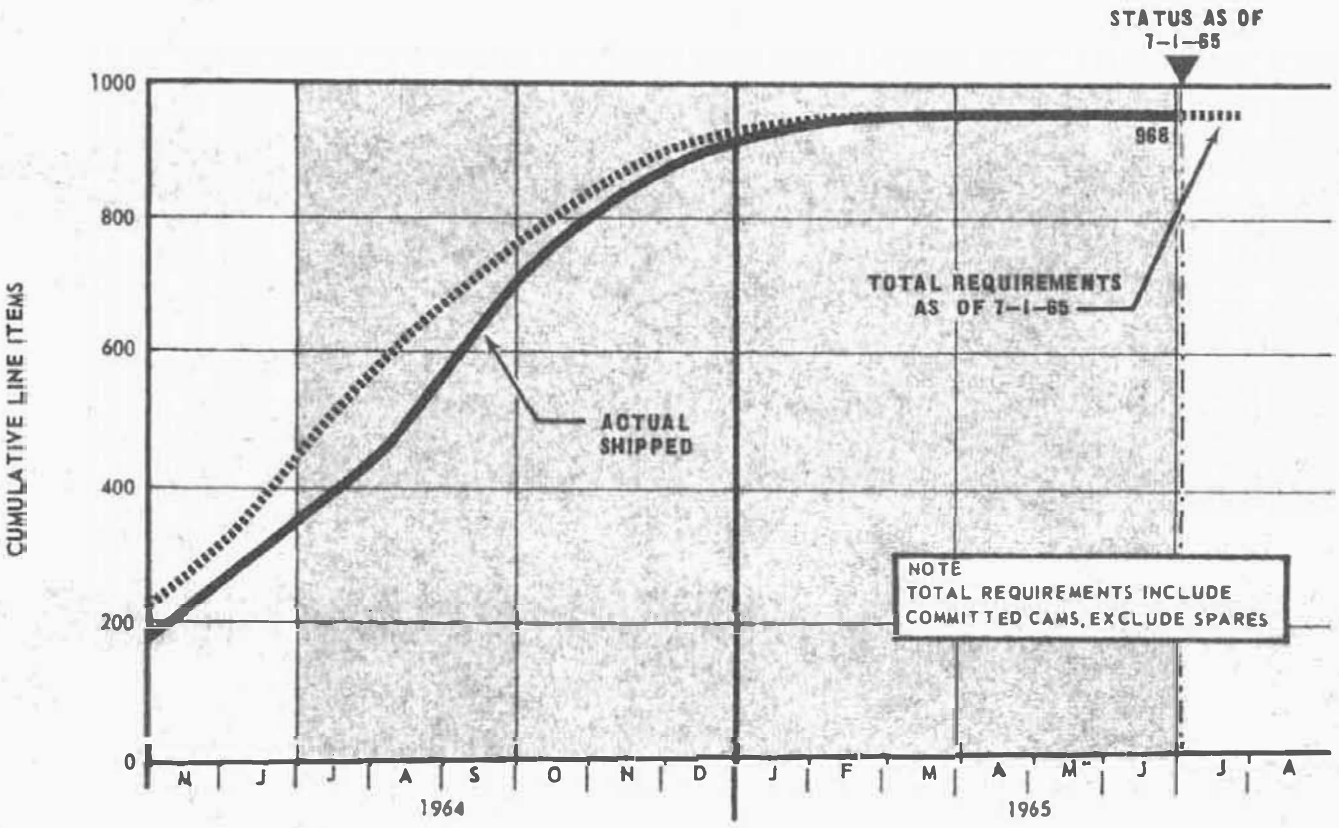


FIGURE IX - 2

S-IC-1 HARDWARE DELIVERY STATUS

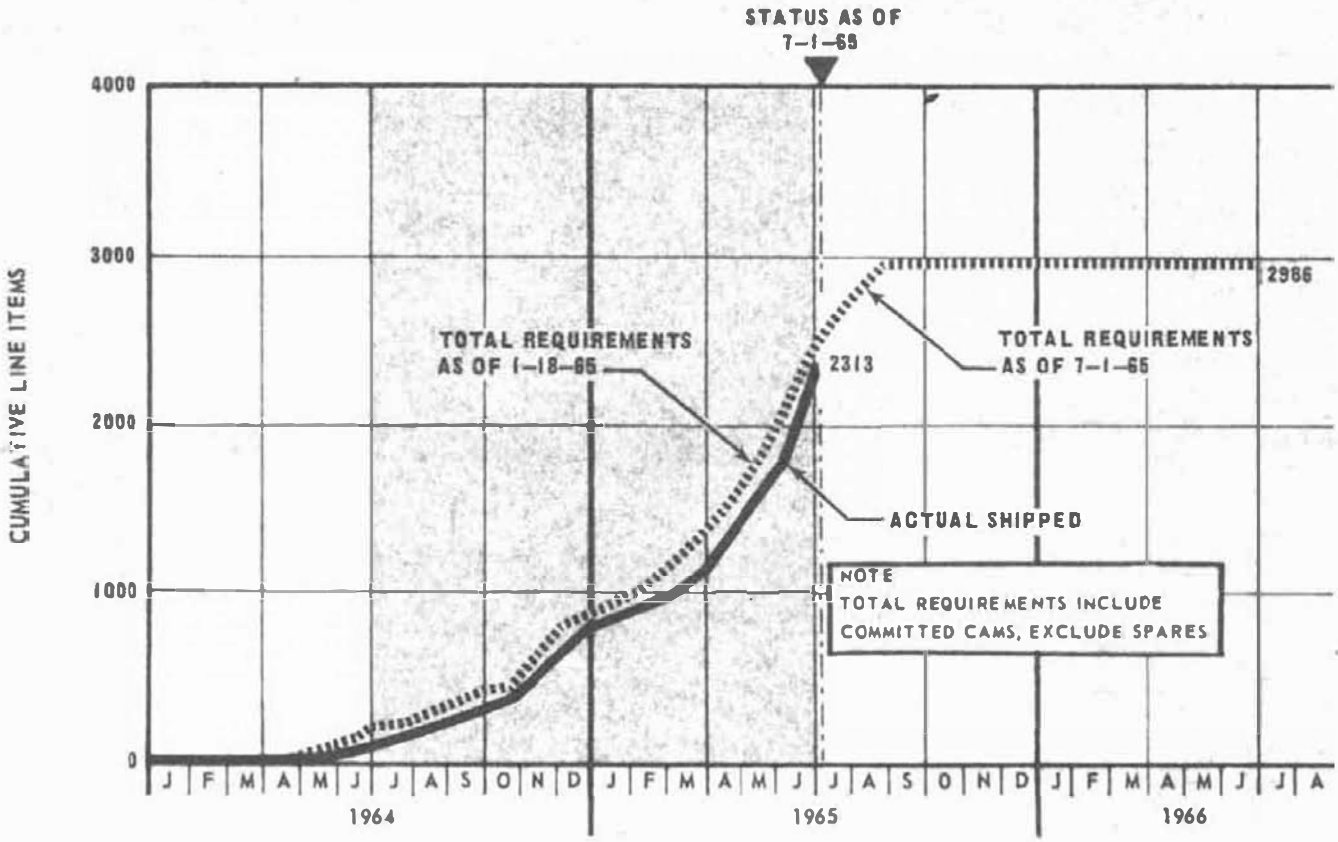


FIGURE IX - 3

tions units were assigned in direct support of the S-IC-1, to develop and assist in the planning and the implementation of crew loading, operations sequencing, level-of-effort estimates and a phasing analysis for installation hardware to be delivered after June 30, 1965. This plan was prepared, presented and accepted by NASA/MSFC management. The plan was initiated jointly by NASA/MSFC and Boeing Operations personnel during the fourth fiscal quarter. Similar effort will be initiated for the S-IC-2 during the next fiscal quarter.

Tho S-IC-1 thrust structure was shipped to MSFC where several CAM's were incorporated to update the configuration during April, 1965. Final assembly of the intertank was completed and delivered in April, 1965. A final assembly tool loading condition, resulting from late completion of the SR-1 intertank, delayed start of the S-IC-1 intertank. The forward skirt was completed and shipped to MSFC in April, 1965. One fin and the fairing subassemblies were diverted from the S-IC-S stage to be used for the S-IC-1.

SPECIALTY HARDWARE

At the end of the fiscal year, cumulative deliveries were ahead of schedule for all S-IC-1 instrumentation. Although some items were behind schedule, these do not pace the stage, nor are they anticipated to do so.

A decision was made, during the fourth fiscal quarter, to produce both stage instrumentation hardware and preflight certification test parts concurrently to accelerate availability of production parts. It is expected that all remaining instrumentation hardware for the S-IC-1 stage will be delivered during the first quarter of FY 1966 to meet demand dates.

Cabling deliveries were ahead of schedule during the fourth fiscal quarter. During the quarter, a complete development program for S-IC-1 thrust structure cabling was conducted using the S-IC stage mockup at Michoud. Due to the mockup having the latest changes, electrical wire routing and cable lengths could be quickly and accurately determined. All production cables for the thrust structure will be complete by the end of the first quarter of FY 1966 as a result of this program.

Eighty-two percent of the ducting and all except six valves for the S-IC-1 stage have been delivered. All specialty hardware currently on order will be shipped by mid-September, 1965.

S-IC-2 STAGE

The growth in support requirements of the S-IC-2 was similar in categories to the S-IC-1. It is anticipated that additional parts will be required by NASA/MSFC during the next fiscal year. However, it is not anticipated that the S-IC-2 line item requirements will be as high as those experienced on S-IC-1. This is due to incorporation of parts into the major assemblies before delivery to MSFC.

Since most of the S-IC-2 assemblies are identical to the S-IC-1, planning releases are nearly on schedule and significant schedule recovery is anticipated. (See Figure IX-4.)

STRUCTURAL HARDWARE

All basic planning and CAM rework orders were released for the S-IC-2 thrust structure. The S-IC-2 forward skirt was shipped to MSFC ahead of schedule.

Due to the redesign of the fairing heat shields, the S-IC-2 heat shield was furnished as a kit.

Completion of the intertank is forecast for July 14, 1965. The S-IC-F effectivity loading is delaying the S-IC-2 stage intertank.

The S-IC-2 forward skirt was completed May 28, 1965, and shipped to MSFC May 31, 1965, ahead of the schedule date of June 21, 1965.

The S-IC-2 fins and fairings are in various stages of subassembly buildup.

The wiring tunnel planning was released during the second quarter of FY 1965, and delivered during the third quarter.

S-IC-2 HARDWARE DELIVERY STATUS

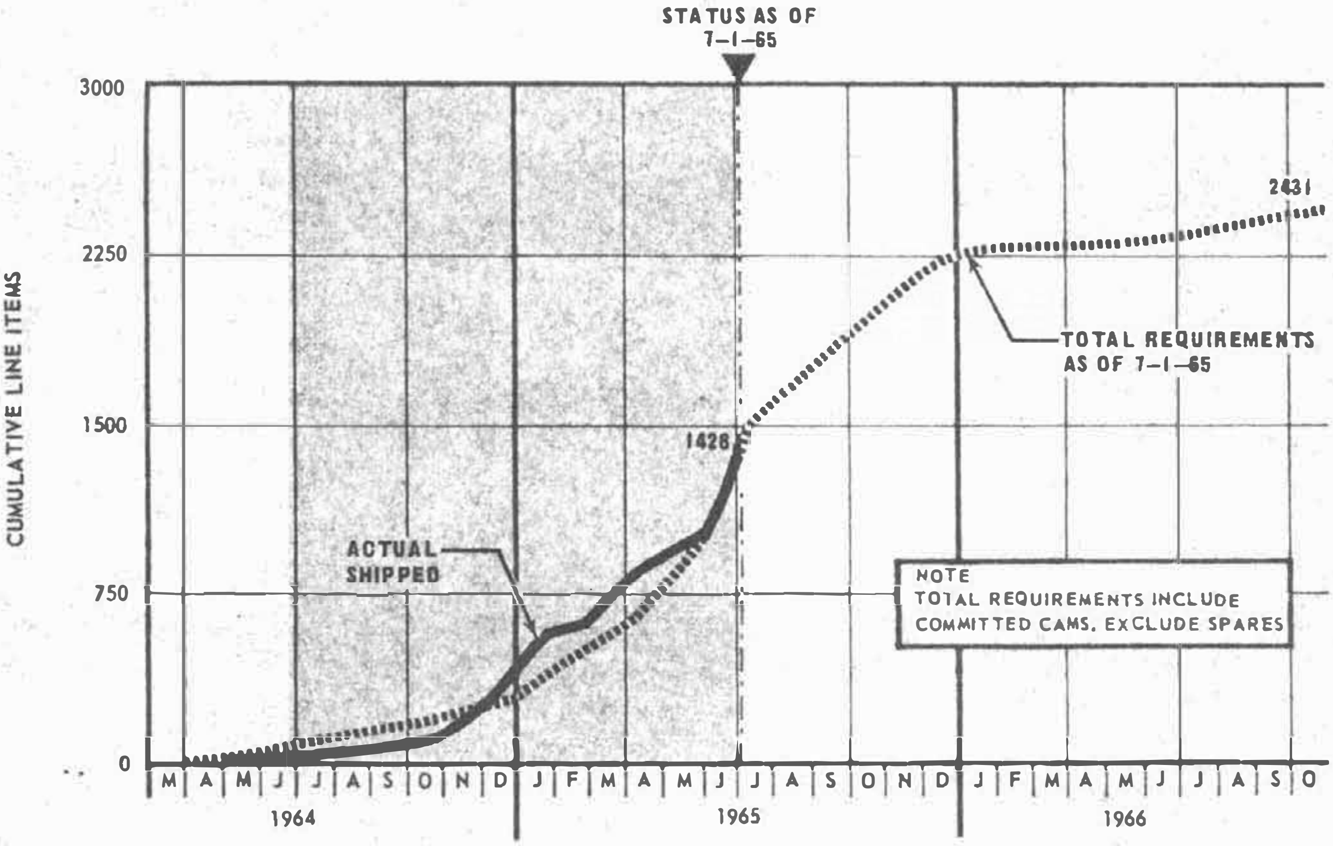


FIGURE IX - 4

Planning orders for subassemblies and final assemblies were released approximately three weeks behind schedule. The delay was created by late receipt of engineering for CAM 278, which is also effective on the S-IC-F and S-IC-1.

SPECIALTY HARDWARE

The specialty hardware requirements for the S-IC-2 are the same as those for the S-IC-1.

The initial deliveries of cabling and instrumentation were on schedule during the fourth quarter of FY 1965. It is expected that the remaining requirements for this vehicle will be completed on schedule by November 1, 1965.

NAS8-5606 (F) PROCUREMENT

FACILITIES EQUIPMENT—SUMMARY

Approximately 900 major items were procured during the year, including the 34-foot rotary table, welding equipment for the VAB and manufacturing areas, ovens, lift platforms, and various clean room and electronic equipment.

Many items temporarily were delayed during the third fiscal quarter due to lack of funds. Facilities items presently are being procured on a priority basis because funds are limited through October, 1965.

10,000 POUND THRUSTER SYSTEM

A purchase order was placed with MB Electronics in April, 1965, for the 10,000-pound thruster system. Delivery is scheduled for August 1, 1965.

60-TON GANTRY CRANE

Assembly and testing of the crane used in moving the thrust structure is underway, and will be in operation by mid-July.

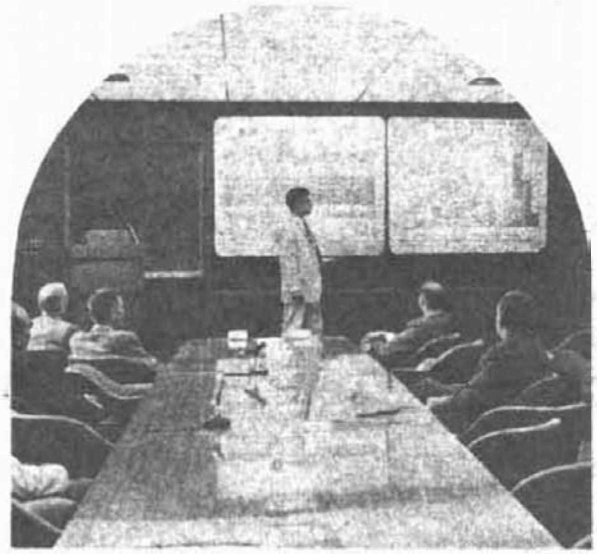
MISCELLANEOUS ITEMS FOR BOEING QUALIFICATION TEST PROGRAM

Purchase orders for the charge amplifiers, discriminators, analog computer, differential amplifiers, and transducers have been placed. These items are scheduled for delivery to meet the September 23, 1965 program activation date. The 600-Channel PCM System order is at NASA for approval. Requirements have not been received for the digital computer.

HIGH PRESSURE TEST FACILITY

The Air Products Company, Allentown, Pennsylvania, is furnishing a high pressure test facility for the Michoud plant under contract to Boeing. Completion is scheduled on September 3, 1965. This facility will test stage components using helium and nitrogen at high pressure.

PROGRAM MANAGEMENT



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PROGRAM ADMINISTRATION

SUMMARY

During FY 1965, The Boeing Company continued its activity in the following Saturn V/S-IC stage program contract areas with NASA/MSFC:

Contract NAS8-2577—"Preparatory Effort Leading to a Project for Engineering, Fabrication, Assembly, Checkout, Static Testing, Transportation, and Launch of tbe Saturn S-IC Stages."

Contract NAS8-5606(F)—"Facilities Required for Saturn S-IC Stage Program."

Contract NAS8-5608—"Long Range Saturn S-IC Stage Program."

Noteworthy items in the NAS8-5608 contracting area during FY 1965 were:

a) Change of Contract NAS8-5608 to reflect the change in the Saturn program from Plan VII to Plan VIII. This affects both Schedule I and Schedule II of the contract;

b) Establishment of the Saturn V systems engineering and integration and Saturn V GSE tasks as a major Boeing assignment on the Saturn program. This program is reflected in the contract as Schedule II with a separate Statement of Work;

c) Initial steps were taken to modify the S-IC stage design and development contract to reduce MSFC constraints on contractor performance and to create Contract End Item (CEI) specifications in accordance with NPC 500-1, "Apollo Configuration Management Manual," preparatory to converting the S-IC portion (Schedule I) of NAS8-5608 from a straight CPFF contract to an incentive contract based upon schedule, cost, and performance incentives.

CONTRACT NAS8-2577

Work under Contract NAS8-2577 was completed December 31,. 1962, except for Item 2, manufacturing support to MSFC (R-ME). Work under Item 2 was completed June 30, 1965. This contract is being phased out, the exact date depending on settlement of overhead through CY 1965.

CONTRACT NAS8-5606 (F)

This contract has been extended through October 31, 1965. Requirements are established by program needs and reflected in D5-12374, "Equipment Requirements, Contract NAS8-5606 (F)." These requirements after NASA approval were funded into the contract. During FY 1965, this funding increased by $4,741,777.

CONTRACT NAS8-5608

The Saturn V systems mission support effort was established September 18, 1964. as Schedule II of Contract NAS8-5608. Previously this effort came under Part VI of the Technical Statement of Work and tasks were performed as outlined in technical assistance orders issued from time to time. A new statement of work was negotiated in order to provide Boeing with a broader role in the Saturn V engineering and integration task. This defined discrete tasks that Boeing would perform. Modification 150 established Schedule I for the S-IC, and Schedule II for the Saturn V portion of the contract.

During FY 1965, NASA and Boeing combined efforts to reduce the contract constraints and to broaden Boeing S-IC program responsibilities under Contract NAS8-5608. Two approaches were used: (1) establishment of a Contract Operations Effectiveness Committee, and (2) implementation of the Apollo Progress Configuration Management Manual, NPC 500-1

The committee originally was composed of Colonel Yarchin of MSFC and Mr. Jendrick, representing Boeing. Colonel Yarchin subsequently was succeeded by Mr. Bramlet. It directed the joint investigation and resolution of operating constraints and the relaxation of certain customer controls. Twenty-nine constraints were identified by the committee. Twenty-one of these were resolved. The remaining are being worked in conjunction with the incentive contract conversion.

Implementation of the Apollo Program Configuration Management Manual, NPC 500-1, was initiated during FY 1965 with the updating of IN P&VE-V-62-5, "Saturn S-IC Stage Systems Description," and the submittal of an S-IC specification tree. The 62-5 document is being used as a design baseline pending NASA/MSFC adoption of the Contract End Item specifications.

After NASA/MSFC approval of the specification tree, preparation of CEI specifications began and is scheduled for completion during July, 1965.

An adaptation of ANA Bulletin 445, "Engineering Changes to Weapons, Systems, Equipments and Facilities" (Exhibit IX of NPC 500-1), was prepared as the system for processing changes to end-item specification. This has been scheduled for full implementation during July, 1965. In addition, a document requirement list and document requirement descriptions (DRL/DRD), authorized by Change Order 196, were prepared pursuant to NPC 500-6 and are being coordinated with NASA/MSFC to serve as the documentation baseline.

Part IX of Contract NAS8-5608, "Manufacturing Support to MSFC," which is a level of effort activity, is being missionized as a discrete task. A firm proposal for Part IX was submitted on March 19, 1965. An updated proposal to include sustaining effort was submitted on June 30, 1965, and at present coordination meetings with NASA are being conducted. The proposed period of performance is through November 1, 1966. Negotiation is expected to start soon.

A request for proposal (RFP) to missionize Part VII A, "Launch Operations Support," was expected during the fourth fiscal quarter, but was not received.

During the third quarter of FY 1965, a program plan for conversion to an incentive contract was developed and presented to Boeing/NASA/MSFC management. Joint task forces were established to study and agree on a revised contract work statement, resolution of outstanding change orders, incentive criteria, and contractual terms and conditions. Certain other tasks, such as government furnished property, support services, etc., that had been identified by the contract operations effectiveness committee, were also assigned to these task forces for resolution. The request for quotation (RFQ) has been schedule for August 1, 1965, with negotiations to start November 1. A contract submittal to NASA headquarters has been targeted for December 15, 1965.

A contracted business operations system was established which authorized, directs, and monitors the performance of all S-IC (Schedule I) work required by Contract NAS8-5608 within the agreed limits. This system is composed of interim work authorizations, program directives - operations, and a time/cost reporting program. Implementation is accomplished by branch management, Program Planning and Reporting and Contract Administration through a program directive coordination committee and the branch manager's cost review meetings.

Interim work authorizations are issued immediately upon receipt of direction from the contracting officer or branch management. These provide authorization and direction to all organizations. Details not immediately available are resolved in bi-weekly program directive coordination meetings described below.

The program directive coordination committee, with members from each branch organization, meets each Tuesday and Thursday to review the interim work authorizations and to resolve any question about scope of effort, assignment of responsibilities and interface between affected organizations.

Program Directive - Operations No. 200 (Work Authorization) defines by task the responsibilities of each branch organization for the S-IC program. Each task description is identified to the contract part, with a start and completion date, costs collection number, and evidence of completion and acceptance. The directive is updated periodically to reflect the latest work statements for each organization as authorized by IWAs.

The time/cost correlation program establishes a series of charts for tasks identified in Program Directive - Operations No. 200. Each of these charts indicates a time-phased budget for the task, actual expenditures charged to the task, estimates-to-complete, major milestones to be achieved, and a PERT indication of the schedule status of these milestones. Selected task charts are reviewed monthly at the manager's cost review meeting and unfavorable cost or schedule trends analyzed. Corrective actions are discussed and redirection issued by branch management.

A recently organized deliveries function located in the factory area is responsible for documenting delivery of all equipment to MSFC. After acceptance, the appropriate task in the work authorization portion of the Program Directive - Operations is closed.

Contract Change and Negotiation Activities of Major Significance

Modification 51 (Phase I Design Criteria for GSE S-IC Test and Checkout Complex) and Modification 67 (PLAN VII Implementation) were successfully negotiated during the latter part of FY 1965.

Modification 92 (Qualification and Reliability Test Program) negotiations were conducted on June 21 and 23, 1965. These negotiations were recessed because of a great difference in opinion on the cost of this modification and the need for further clarification of the work statement.

Modification MICH-5 (PLAN VIII Implementation) was received in April, 1965. The impact on the contract in terms of schedule and cost is under review by Boeing. A firm proposal on this contract change will be submitted in the first quarter of FY 1966. PLAN VIII extends the S-IC stage deliveries beyond those previously on contract.

CONTRACTING ACTIVITIES

Contract modifications received April 1 through June 30, 1965, are listed in Appendix A.

Proposals submitted to NASA from April 2 through June 30, 1965, are listed in Appendix B.

Negotiations completed in the fourth fiscal quarter are listed in Appendix C.

Documentation submitted in the fourth fiscal quarter is listed in Appendix D.

SATURN V/S-IC TEST & C/O EQUIPMENT SUMMARY

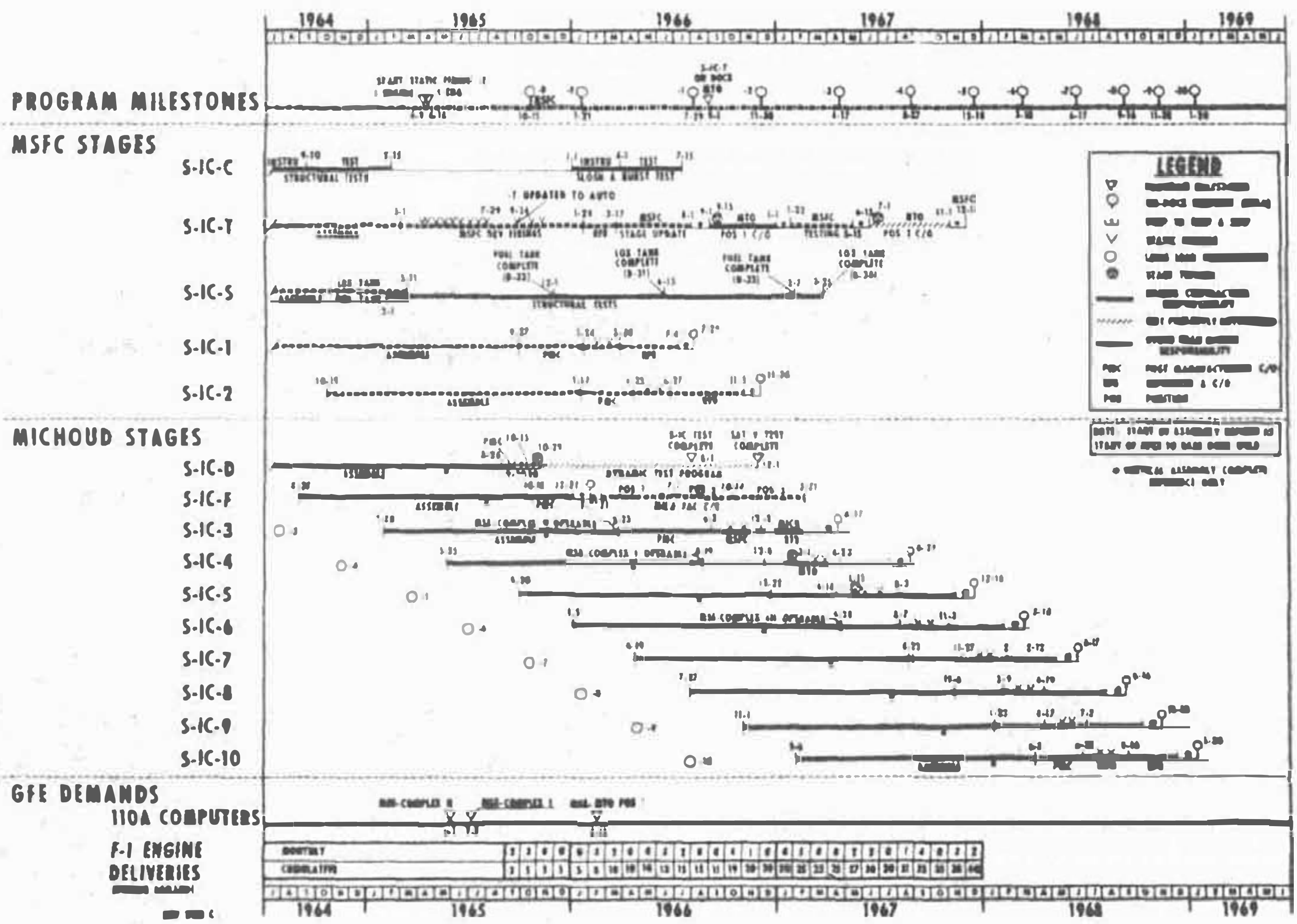


FIGURE X-1

GENERAL

PROGRAM SCHEDULES

April 26, 1965, marked the initial release of D5-11040-4, "Launch Systems Branch Plan VIII Program Schedules." This established the branch scheduling base for the S-IC research and development program currently under contract. Included in this document are: (1) A Saturn V/S-IC stage summary schedule (Figure X-1) that displays the assembly, testing, contractual delivery and planned utilization of each S-IC stage, an F-1 engine demand schedule, and other major Saturn V program milestones; and (2) A Saturn V/S-IC test and checkout equipment summary schedule (Figure X-2) depicting MSFC, Michoud, and MTF requirements.

Since its initial release, major revisions to D5-11040-4 have been made to reflect schedule changes. The purpose of Revision A, released on May 28, 1965, was: (1) to add a Saturn V program summary schedule that provided a preliminary base for planning purposes; (2) to add schedules that depict a geographical representation of major activities to be performed in support of the program; (3) to add a Saturn V/S-IC structural static load test schedule to depict the engineering structural test program; (4) to reflect August 1,

SATURN V/S-IC STAGE SUMMARY

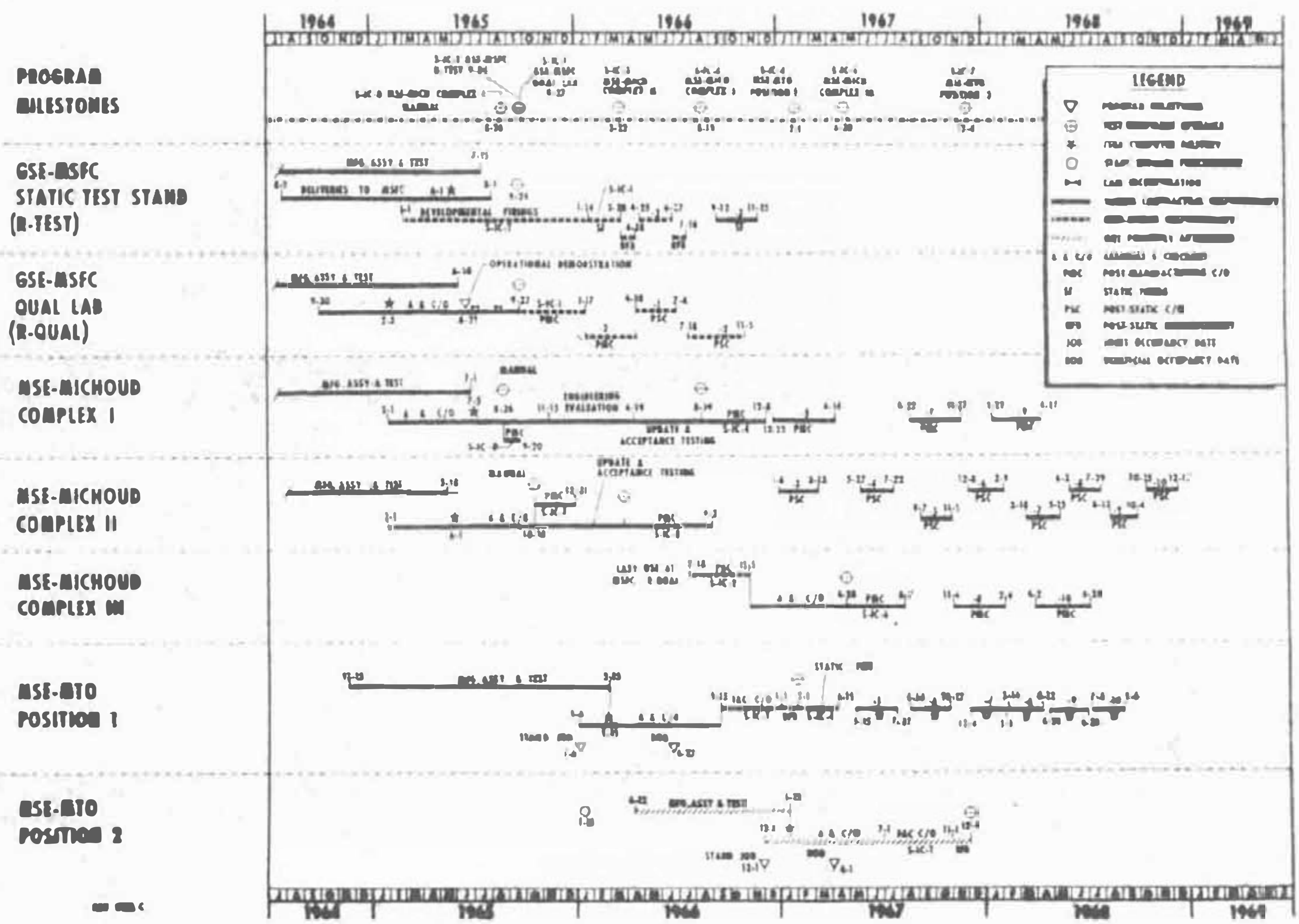


FIGURE X-2 SATURN V/S-IC TEST & CHECKOUT EQUIPMENT SUMMARY

1966, as the completion of the S-IC-D stage dynamic test program; and (5) to reflect completion of the equipment deliveries for R-QUAL on June 10, 1965 in support of the requirements for an operational demonstration of the station on June 21, 1965.

The purpose of Revision B, released on June 25, 1965, was: (1) to state that activation of MTF Position II is not required to support the current contract stage delivery program (Memo 5-1910-M-1-18, January 6, 1965); and (2) to revise the operable date for MSFC R-TEST static test stand from November 22, 1965, to September 24, 1965, due to the accelerated S-IC-T firing schedule (MA-2 Schedule - Plan VIII, June 11, 1965).

The purpose of Revision C, to be released on July 6, 1965, is: (1) to show an accelerated firing schedule for the S-IC-T stage and a change in the delivery of the S-IC-T to MTF from April 14, 1966, to September 1, 1966, and to reflect updating to the S-IC-T at MSFC instead of MTF (NASA Memo I-V-S-IC-2.431, June 10, 1965); (2) to modify F-1 engine delivery requirements (Memo 5-3000-M-139, June 7, 1965); and (3) to add the Saturn V/S-IC qualification and dynamic test program parameter schedule depicting major interface points for items affected by these test programs. Revision C also: (1) adds a composite listing of all end-item delivery commitments specifically called out in the NAS 8-5608 contract; (2) adds an F-1 engine demand and allocation schedule to present the latest engine information (NASA Memo I-L-F-153-M-65, May 3, 1965); and (3) adds an RCA 110A ground computer system allocation schedule to present the latest MSFC allocation and scheduling information.

Before the implementation of Launch System Branch Plan VIII program schedules, schedule direction was provided by Plan VII and subsequently by modified Plan VII, which reflects the MSFC assembly working schedule (Memo 5-1900-M-1-221, -223, and -233, January 27, 1965 and February 1, 1965, and NASA/Boeing memo of agreement 5-190-M-1-111, November 24, 1964). A comparison of these schedule changes is shown in Figure X-3.

PROGRAM MILESTONES

Revision C of D5-12535, "Launch Systems Branch Reporting Milestones," was released September 8, 1964. This document was developed to identify and define Program Planning and Reporting control milestones for the Saturn V/S-IC program described by the technical work statement in Contract NAS8-5608. The milestones included in this document provide time-orientated events with standard milestone titles and description against which program progress and performance can be measured. Certain milestones depict NASA/MSFC reporting milestone requirements; others are utilized for general branch management of the program.

Revision D to D5-12535 is being prepared to incorporate the new schedule dates provided under schedule Plan VIII. This revision is scheduled for release during the coming quarter.

SUMMARY PROGRAM PLAN

Revision A of D5-11960, "Saturn V/S-IC R&D Summary Program Plan," was released December 21, 1964, and reflects the adoption of Plan VII, changes in the scope of work, and changes in detailed planning. This revision expanded the summary plan to include major Apollo program objectives and parametrical information on the overall Saturn V/Apollo program.

The summary program plan describes the total Boeing task, providing a firm basis for Boeing Launch Systems Branch planning and management control. Because of the scope and complexity of the program, the summary program plan was made concise. It references detailed plans and other documentation.

Revision B is being prepared, in accordance with Part X, Item (A), Exhibit "A" to Contract NAS8-5608, to reflect the change made by Schedule Plan VIII. Release of this revision is expected during the next fiscal quarter.

PROGRAM ASSESSMENT AND PERT SYSTEM STATUS

During the past year, networks for the structural static load test program were developed and have been integrated into the S-IC PERT system. Structural static load test program information is currently being reported to NASA/MSFC, while qualification and reliability test program information is currently used for internal Boeing control.

The Saturn V/S-IC Program Assessment PERT Report , issued biweekly, depicts the current assessment of the program. During the past year, this report was modified to provide the customer with timely and accurate problem assessment while maintaining optimum efficiency in the report preparation and readability.

The PERT report provides milestone status as measured against the currently approved plan. The critical path analysis and schedule outlook trend charts comprise the major portion of this report. This analysis reflects the pacing item, as identified by the PERT system, for noted significant milestones. Schedule outlook trend charts visually display status activity of major milestones and trends of pacing items.

In addition to providing the customer with timely and accurate problem assessment, this document serves as an effective Boeing management tool in identifying critical problems. Each problem identified by PERT is worked independently at the appropriate management level to ensure effective problem resolution.

The Saturn V/S-IC Program Assessment PERT reports D5-12749-5 thru -27 were issued during FY 1965. (Reports D5-12749-20 thru -27 were issued during the last fiscal quarter, April 2, 1965 - July 1, 1965).

S-IC WEIGHT SIMULATOR

The simulator arrived at Michoud from MSFC Huntsville on February 24, 1965. Between then and March 18, 1965, it was used for driver training. On March 18, 1965, it was moved to the Vertical Assembly Building where it was placed into the vertical assembly position, lowered, and then replaced on the trans-

PHASING COMPARISON BETWEEN PLAN VII, VII MODIFIED, AND PLAN VIII

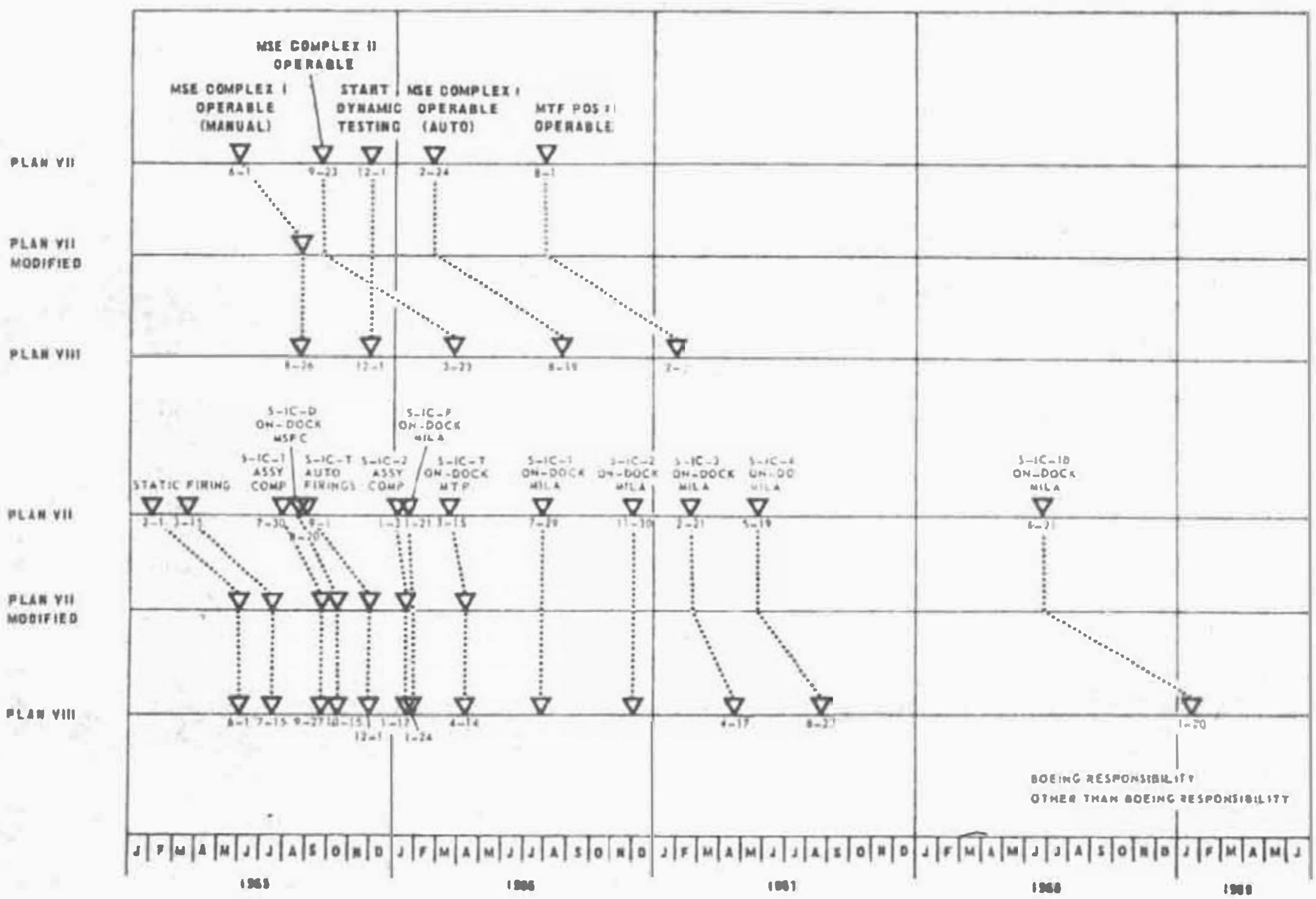


FIGURE X-3

porter. On April 19 and 20, 1965 the simulator was positioned in MSE 1 and 2 (Figure X-4). The purpose of all simulator activity was to acquire crew handling techniques, to load-test floors and roads, and to check roadway and stage dimensional clearances before transporting a completed S-IC stage.

EQUIPMENT CONTROL

The equipment control board (ECB) was established September 8, 1964. This board consists of members of each branch organization, its purpose being to review equipment requirements and to ensure that the proper items and quantities are delivered to the right places on schedule. The equipment control board completed the initial review of GSE/MSE and stage equipment. Requirements are now listed in D5-12888, "Master Equipment List." Tooling and facilities (SFC) equipment will be included in D5-12888 in the first quarter of FY 1966.

GOVERNMENT FURNISHED PROPERTY (GFP)

Government furnished property requirements have been reviewed, and approximately 98 percent of the

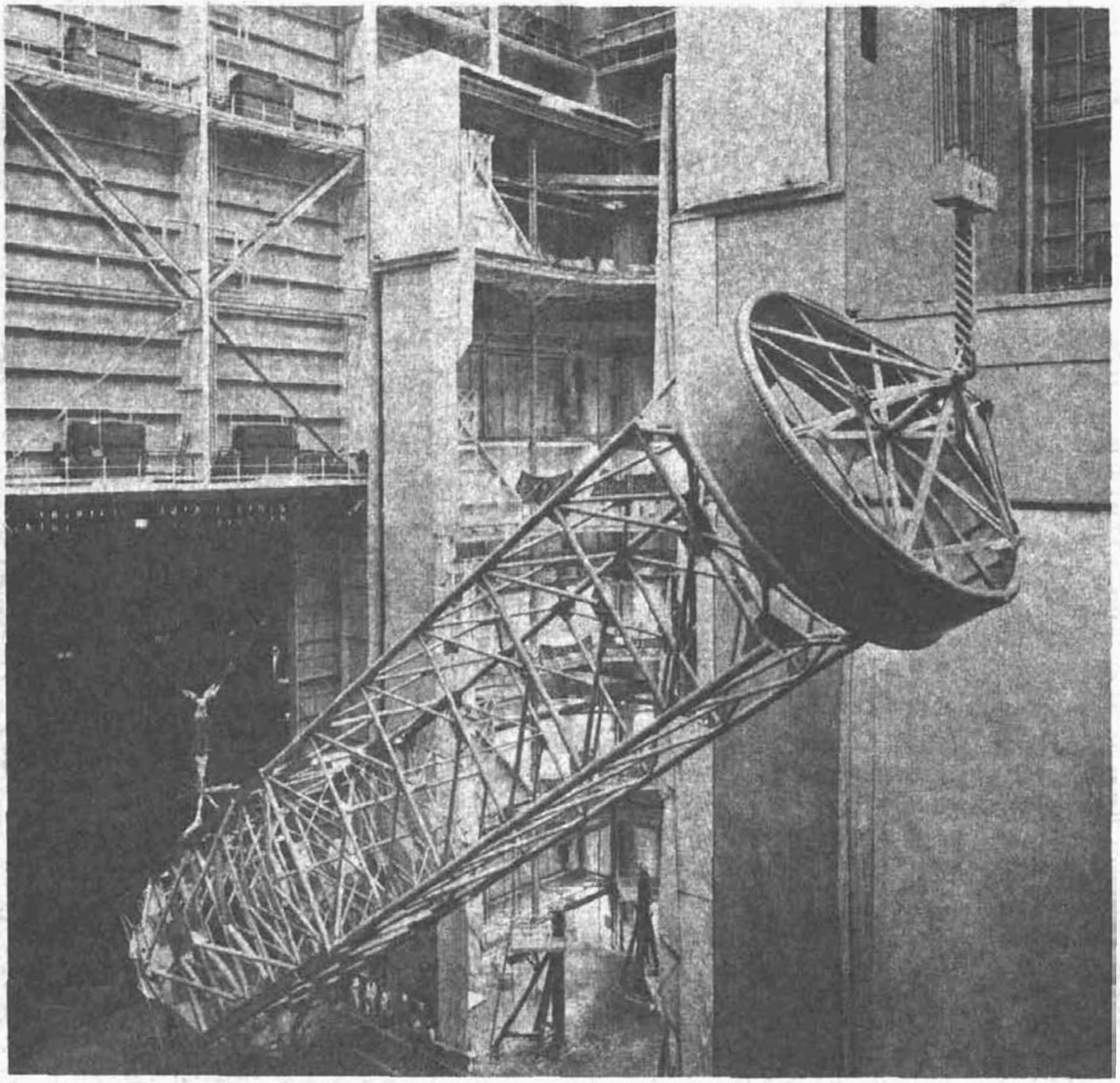


FIGURE X-4 THE OVERHEAD CRANE BEING USED TO HOIST THE WEIGHT SIMULATOR INTO A VERTICAL POSITION

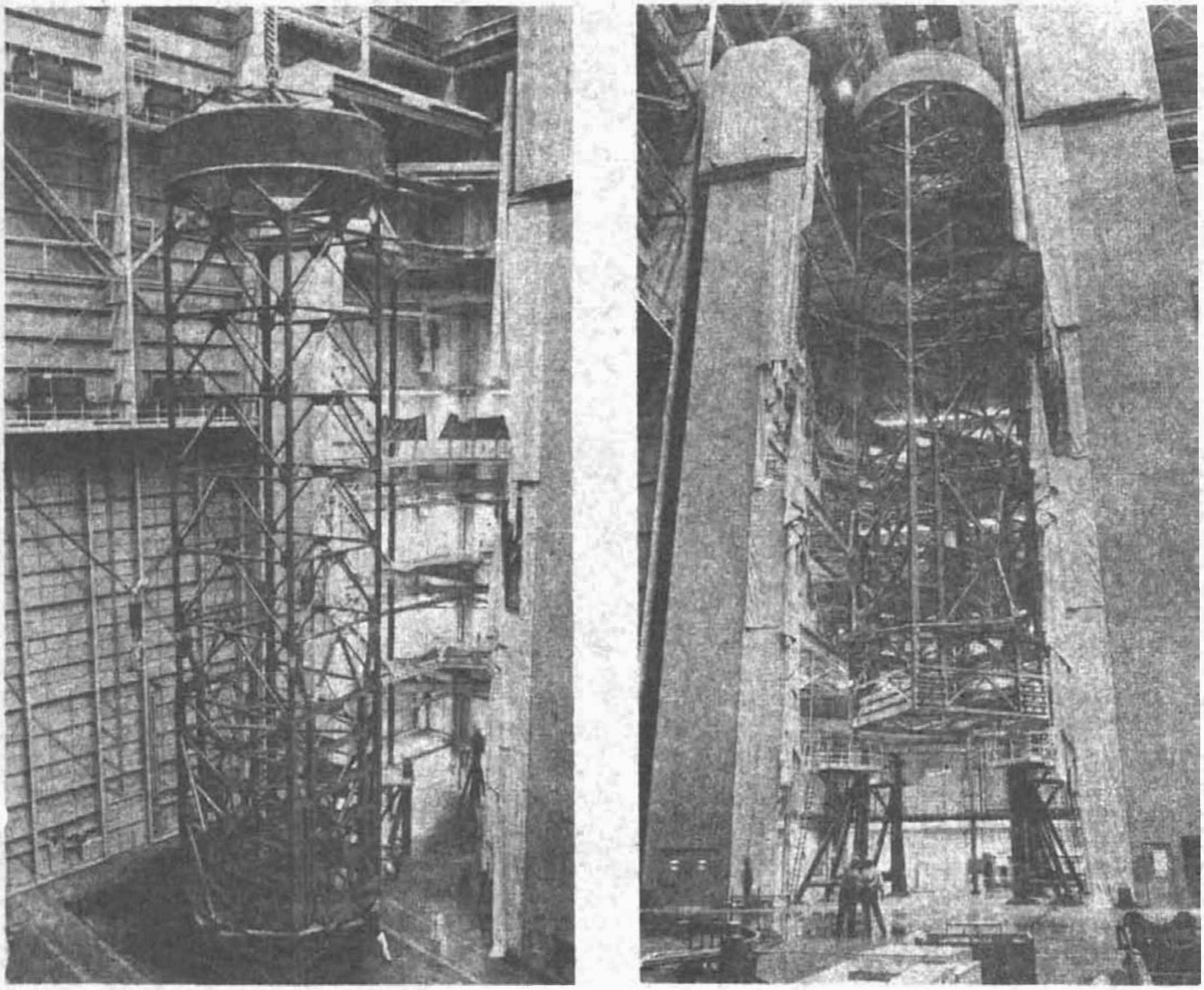


FIGURE X-4 (CONTINUED) THE SIMULATOR IS ROTATED, THEN LIFTED INTO POSITION IN THE VAB ASSEMBLY TOWER

known requirements have been approved by NASA/MSFC. All known GFP requirements are now listed in D5-11044, "Government Furnished Property and Equipment." Revision E of this document is scheduled for release in July, 1965. GSE/MSE delivery status is being maintained to show actual progress of deliveries against schedules.

MAKE-OR-BUY PLAN

The previous Annual Report cited joint NASA/Boeing efforts to reduce administrative costs and approval processing time for authorizing deviations from the "Make-Or-Buy Program Plan," D5-11413.

During the third quarter of FY 1965 a task force was formed to resolve make-or-buy problems. It was decided that:

a) The make-or-buy plan should be revised to be made more general;

b) It need not reflect exceptions and deviations associated with items subordinate to the major S-IC assemblies;

c) Adequate documentation of such deviations is contained in NASA approved purchase orders and program-executive-approved work authorizations and need not be duplicated;

CHANGE BOARD PROCESSING TIME
(PRESENTATION TO COMMITMENT)

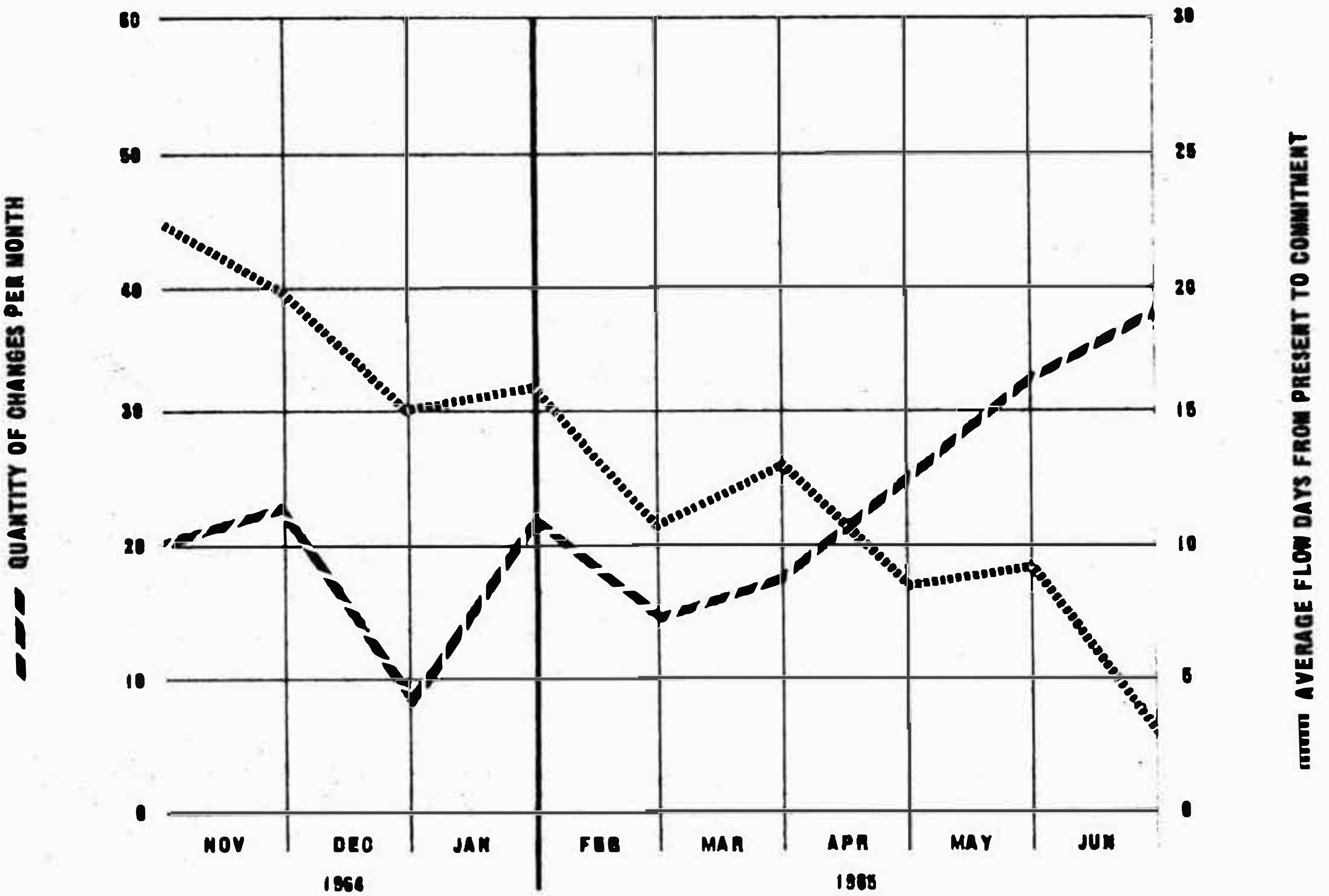


FIGURE X-5

d) The Boeing S-IC program executive has final approval authority for fabrication of parts at Boeing locations other than Wichita and Michoud.

As a result of the task force efforts, the make-or-buy program plan was revised during April and May, 1965, and reviewed with the NASA/S-IC stage manager during June, 1965. It is schedule to be formally transmitted for NASA contracting officer's approval during the first quarter of FY 1966.

CONFIGURATION MANAGEMENT

During the fiscal year Boeing acted to implement NPC 500-1, "Apollo Configuration Management Manual." This manual, dated May 18, 1964, introduced the Department of Defense standards of configuration management to all Saturn V contractors. Boeing's implementation efforts accomplished some of the provisions under the existing contract; others will require contract revision.

The configuration control board was activated in March, 1965, to establish a Boeing position on changes and to resolve change problems that require staff-level decisions. The Boeing S-IC program executive chairs the CCB; the Boeing S-IC configuration manager is the vice-chairman and secretary, and the managers of the various organizations are members.

In June, 1965, Boeing established the configuration management information center as a planning and work ing tool for change activities. This shows the current status of active changes on bar charts and the change impact on selected program elements. In addition, a number of change processing trend and forecast charts are displayed.

CHANGE REVIEW COMMITTEE (CRC)

During the fourth fiscal quarter The Boeing Company made a number of procedural revisions in processing engineering changes. These actions shortened overall processing flow time and generally postured change activity for easier transition to compliance with NPC 500-1 procedures. The average number of work days from presentation to change board to Boeing commitment was reduced from 13 days during the third fiscal quarter to six days in the fourth fiscal quarter (Figure X-5).

DOCUMENT CONTROL PROGRAM

Over the last fiscal year a savings of several million dollars has been realized because of the Launch Systems Branch document control program. A revised procedure that fulfills the need to enlarge the scope of document control by more clearly defining the publications to be included was completed. This procedure is ready for implementation. It will provide for maximum management visibility and will be responsive to NASA documentation program requirements.

Boeing delivered a document requirement list (DRL) and associated document requirement descriptions (DRD) in support of the NASA Apollo documentation system that is under development in accordance with NPC 500-6. Boeing has received concurrence from the contracting officer that the deliveries constituted complete fulfillment of contract requirement per Change Order No. 196. A follow-on exercise, in conjunction with NASA, was underway at the year-end to develop a data baseline for contractually deliverable documentation.

FORMS CONTROL

Increased emphasis was placed on forms control during the reporting period. Revised procedures, now under review, will effect increased management efficiency and result in a substantial overall cost reduction.

HEALTH AND SAFETY

EXECUTIVE SAFETY COUNCIL

The branch Executive Safety Council maintained surveillance to ensure that adequate emphasis is given to safety in all design, operations, and test functions. Results were:

a) A policy statement was developed to guide organizations in correcting safety deficiencies involving facilities, tooling, and equipment.

b) A committee was appointed to recommend a plan for system safety programs within the branch. This committee established branchwide coordination of safety policies and began evaluation of the effectiveness of the present systems safety programs.

c) The Michoud Safety Council conducted an extensive review and determined that all organizations have well documented safety programs and emergency plans.

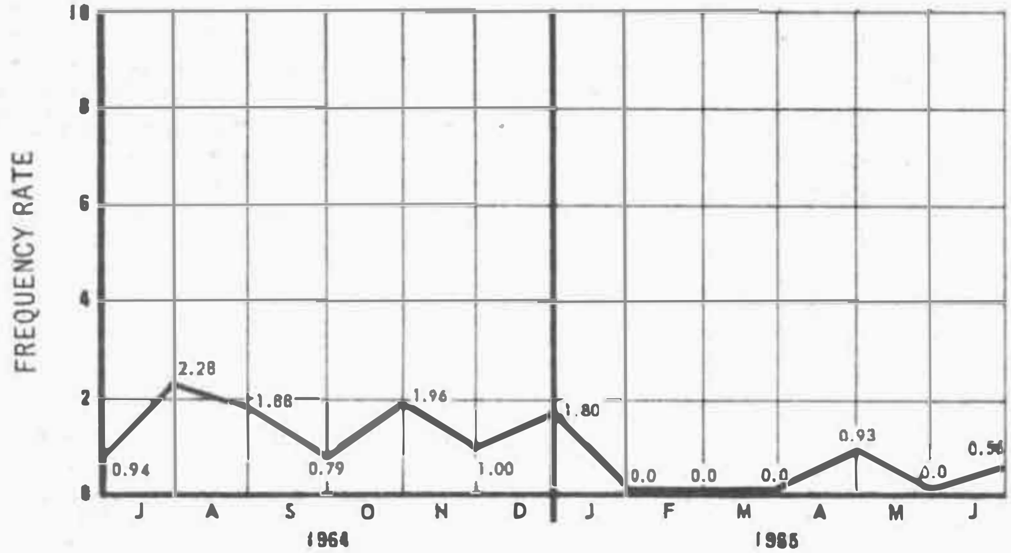
MICHOUD LINE CONTROL SAFETY PROGRAM

Under the direction of the Michoud Safety Council, this effort became an effective part of the branch accident prevention program (Figure X-6). Regular inspections were conducted by safety monitors, and action was taken by line supervision to correct any unsafe conditions reported. The effectiveness of the line control safety program is illustrated by the following statistics:

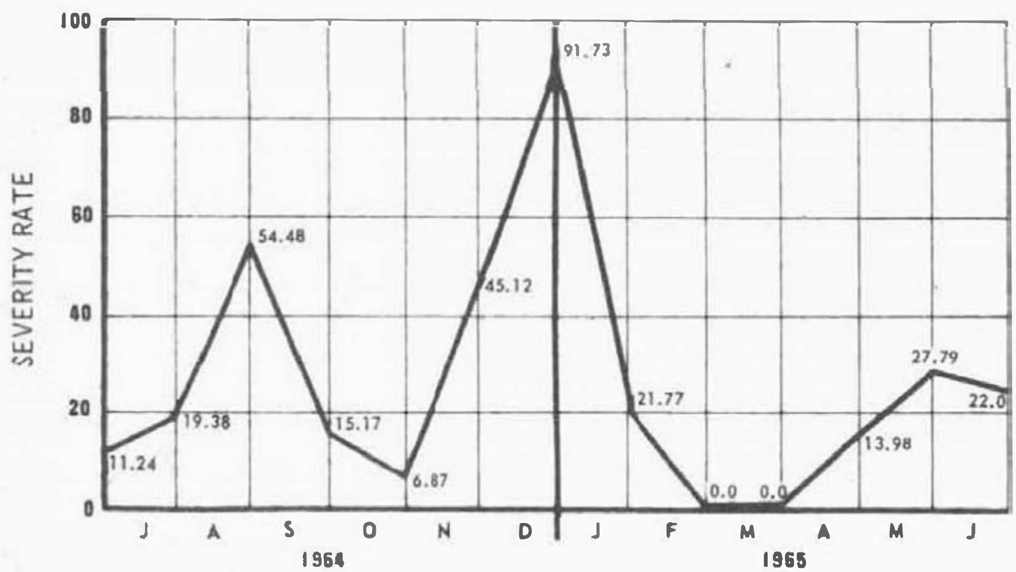
First Fiscal Quarter	
Original Industrial First-Aid Calls	1,079
Frequency Rate*	1.65
Second Fiscal Quarter	
Original Industrial First-Aid Calls	975
Frequency Rate*	1.59
Third Fiscal Quarter	
Original Industrial First-Aid Calls	851
Frequency Rate*	0
Fourth Fiscal Quarter	
Original Industrial First-Aid Calls	981
Frequency Rate*	.56

* Frequency Rate = Lost-time injuries per 1,000,000 manhours worked.

LSB ACCIDENT RATE AT MICHOUD FACILITY



* ACCIDENT FREQUENCY = $\frac{\text{NUMBER OF LOST TIME ACCIDENT} \times 1,000,000}{\text{ACTUAL MANHOURS WORKED}}$



* ACCIDENT SEVERITY = $\frac{\text{DAYS LOST FROM WORK (OR CHARGED)} \times 1,000,000}{\text{ACTUAL MANHOURS WORKED}}$

FIGURE X-6

CONSTRUCTION AND INSTALLATION SAFETY PROGRAM

The Facilities organization strengthened its construction and installation safety program. This resulted in a decrease in the severity and frequency of accidents among subcontractors.

Some innovations that Facilities implemented included:

a) Submitting Boeing Document D5-12397, "Safety

Standards for Boeing Construction and Installation Subcontractors - Saturn S-IC Stage," to all prospective subcontractors as part of the bid specifications. This document is now included in all construction and installation contracts.

b) Requiring, by contract, that all construction and installation subcontractors hold weekly safety meetings attended by a Boeing Facilities construction engineer.

c) Requiring the use of construction safety checklists prepared during routine inspections conducted by the job foreman and a Boeing Facilities construction engineer.

d) Holding quarterly safety meetings attended by management representatives of various construction and installation subcontractors. Health and Safety participates in these meetings.

FACILITY DESIGN REVIEWS

Health and Safety reviewed the plans for all major facilities completed at Michoud during this reporting period.

FACILITY HAZARD ANALYSES

Before activation, hazard analyses were made of the following facilities:

a) Hydrostatic Test Position (VAB);

b) Subsystems Test Facility;

c) Stage Test Building;

d) Vertical Final Assembly Position (VAB);

e) High Pressure Test Facility.

OPERATIONAL SAFETY ANALYSES

All major operational processes underwent a detailed engineering analysis for safety deficiencies. Special attention was given to handling operations (See Figure X-7) because of the size of the S-IC stage components. Operational safety analyses for the following areas were completed or are in progress:

a) Forward Handling Ring Dynamic Test Facility;

b) Component Dynamic and Static Test Facilities;

c) Hydrostatic Test Position (VAB);

d) Final Assembly Positions (VAB and Building 103);

e) Stage Test Building.

FIRE PROTECTION ENGINEERING

Engineering review of the following hazardous areas or equipment were conducted during the last fiscal quarter:

a) Stage Test Building;

b) LOX Impact Test Cells;

c) Installation and Use of Molten Salt Baths;

d) Engineering Laboratory Test Equipment;

e) Engine Test Cells and Hydraulic System;

f) Major Painting and Shipping Facility.

The support services contractor fire department was provided data covering materials and processes in Boeing areas to:

a) Ensure that the fire department is familiar with new or unusual fire hazards;

b) Point out personnel safety problems that may exist under fire conditions;

c) Encourage fire department planning for critical areas.

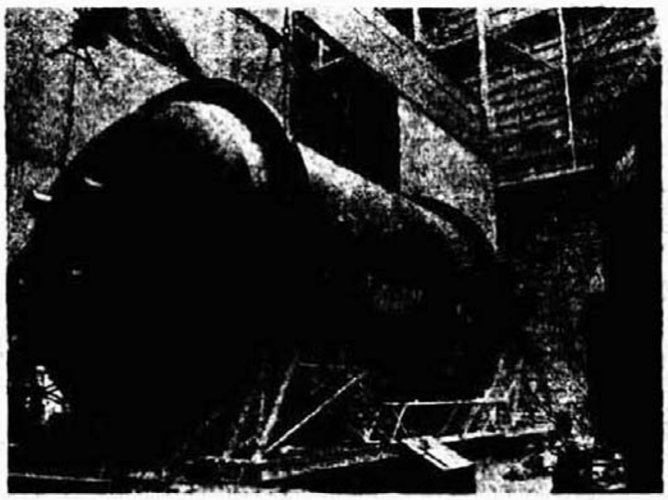


FIGURE X-7 OPERATIONAL SAFETY ANALYSIS BEING PERFORMED ON LOX TANK HANDLING EQUIPMENT

The major fire protection deficiencies at Michoud mentioned in the third fiscal quarter report were discussed in detail with NASA Facilities representatives on June 28. Long-range courses of action planned by NASA were outlined for correction of some deficiencies. These included fire alarm systems, cooling tower sprinklers and low hydrant pressure at Building 404. Other major fire protection measures in Buildings 130 and 303 depend on the ultimate use of these areas.

RADIATION PROTECTION PROGRAM

A total of 258 Boeing employees were continually monitored by film badge dosimetry during FY 1965. The average yearly dose recorded was 1-1/2 millirem. The highest individual yearly dose was 178 millirem. This compares with the maximum allowable dose of 5000 millirem per year according to the Code of Federal Regulations.

The safety certification program of the radiographic inspection operations was completed. There are now ten such certified operations that are recertified monthly.

The Atomic Energy Commission license to the Boeing Launch Systems Branch has been renewed for two years. This also has been amended to include the use of a 100-millicure Cobalt 60 source used for monitoring instrument calibration.

CIVIL DEFENSE PROGRAM

The Boeing industrial hygienist was designated by the NASA-Michoud Civil Defense Committee as Radiological Defense Officer. He attended the radiological monitoring for instructors course and the radiological defense officer course given by the Department of Defense. He presented the radiological defense portion of both the Boeing and Mason-Rust shelter manager's course given at Michoud and will teach the radiation monitors course planned for Boeing and Mason-Rust personnel.

Boeing has received the Training Set CDV-776 from the Civil Defense office. This includes the dosimeters, chargers, geiger counters and survey meters necessary for a class of thirty monitors.

A Boeing storage area for civil defense supplies and shelter areas were designated.

HUNTSVILLE SAFETY ACTIVITIES

Safety effort at Huntsville increased. Significant activities included:

a) Continued participation in design reviews and the establishment of test requirements for stage systems and ground support equipment;

b) Development of safety procedures for the S-IC structural test program. This included provision for a safety buy-off of new designs in handling equipment, work platforms, test facilities, and tank-entry operations;

c) Analysis of the R-QUAL stage test installation, calibration and checkout operation;

d) Coordination with the NASA Safety organization in controlling the hazards associated with the operation of the S-IC static test building. Since the MSFC Test Division is closely controlled by NASA/MSFC, it was necessary to establish a close working relationship with the NASA Safety Organization to control hazards in this area. This coordination was accomplished, and an efficient channel for achieving safety improvements was established;

e) Approval of all safety equipment and protective clothing used in the S-IC program.

SECURITY

Inspections by representatives of the Air Force cognizant security office and NASA security representatives from MSFC were conducted at Michoud during September, 1964, January, 1965, and April, 1965, and at the Huntsville facility during October, 1964, February, 1965, and June, 1965. All inspections resulted in satisfactory ratings.

An extensive security indoctrination program was conducted for all classified file keepers and other personnel handling classified material at Michoud. This emphasis on security has contributed to the fact that only one security violation was recorded against the Boeing Michoud Assembly Facility since December, 1964.

MANPOWER

A net total of 2236 permanent employees were hired for the branch during the first three fiscal quarters. The staffing of the Saturn V program in Huntsville accounted for 1431 of these employees. The major portion of the New Orleans increase was represented by a buildup of the hourly work force in support of the manufacturing activity at Michoud.

The total personnel for all branch locations was 10,920 as of April 1, 1965. Of this total, 6420 were new hires, and 4500 were transfers from within the company.

The branch total employment as of July 1, 1965 was 11,355. This represeented a net increase of 435 during the last fiscal quarter.

During the last quarter, the factory work force reached the program peak. Wichita loaned 140 hourly employees to support delivery of the S-IC-2 thrust structure to MSFC. Ninety of these loanees were returned to Wichita during June, with the balance scheduled for return the first week of July, 1965. A reduction in the number of manufacturing employees began in June, 1965.

TRAINING

ACCOMPLISHMENTS

Significant training accomplishments during FY 1965 included:

a) Establishment of a pre-employment training program under the auspices of the Department of Labor's Manpower Development and Training Act (MDTA);

b) Staffing of the Huntsville Training organization;

c) Initiation of a continuing education program for engineers and scientists.

CERTIFICATION

A total of 1239 employees were certified, and 423 were recertified in 13 skills during the first three fiscal quarters. Courses ranged from 8 to 200 hours in length. An additional 247 employees were certified and 178 recertified during the fourth fiscal quarter to bring the total certified and recertified for the year to 1486 and 601, respectively. Typical certification courses were: hand soldering (See Figure X-8); welding (manual and machine); insulation materials technology; manual conversion coating; and manual cadmium plating.

HUNTSVILLE TRAINING CENTER

The Huntsville training complex was activated in November, 1964, in the Blue Springs office facility, and includes an office area and nine classrooms.

MANPOWER DEVELOPMENT AND TRAINING ACT (MDTA) PROGRAM

A pre-employment training program was held under the Department of Labor's MDTA program. Under this program, 88 electronic assemblers and 13 welders were trained during FY 1965. During the fourth fiscal quarter, 17 were trained as electronic assemblers.

ITEMS OF INTEREST

In August, 1964, a potential contract overrun condition on the S-IC program was reported by branch management. One of the principal steps taken to reduce this condition was the appointment of an Aero-Space Division management survey team to review the nature and scope of the S-IC program; review cost-to-completion estimates and conduct an independent parametric evaluation to determine the validity of these estimates; evaluate organization and manning effectiveness; and recommend corrective actions to improve the functional and administrative management systems in the branch.

The A-SD survey team submitted 96 recommendations. These were reviewed by branch management, categorized into eight major packages of work, and assigned to specific branch organizations for accomplishment. Initially, a special staff was established to monitor the branch's progress, and daily meetings, attended by branch organization managers, were held to assess progress. Incorporation of the A-SD survey team recommendations into major Branch management systems was completed during the last fiscal quarter.

A new position was created in the branch manager's office, "Deputy for Business Management." Mr. F. A. Jendrick, a member of the A-SD survey team, was appointed to this position and has played a key role in the accomplishment of management actions.

Data Processing, previously diversified throughout the branch, was centralized with the intent of achieving cost savings through consolidation.

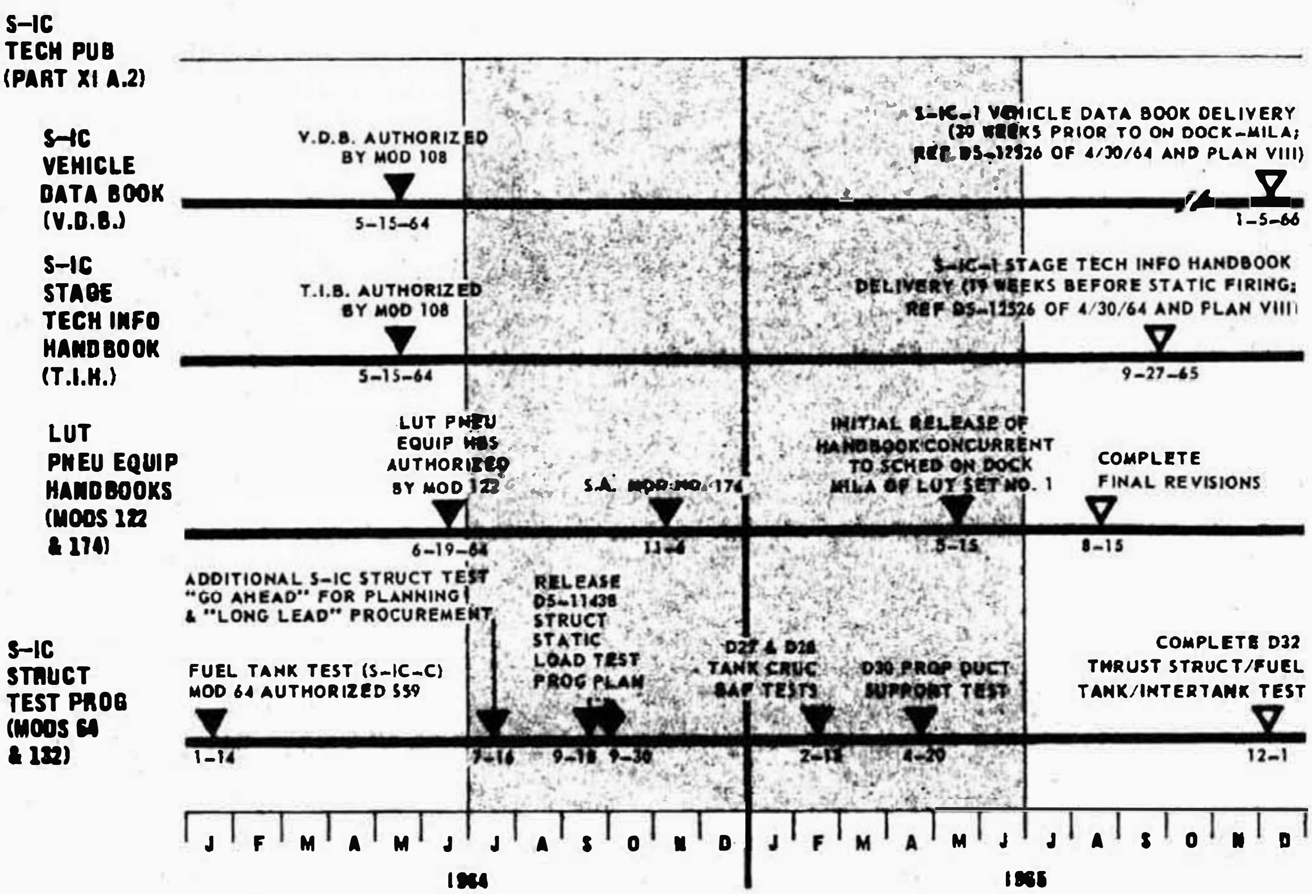
The Operations organization within the branch was realigned to achieve discrete identification of management responsibility on specific production elements of stage hardware.

The Huntsville operation, under Mr. B.F. Beckelman, achieved operating autonomy, indicating the business growth and near-term potential expansion within this section of the branch. All the Huntsville organizations report directly to Mr. Beckelman. Mr. Beckelman, in turn, reports directly to the branch manager's office.

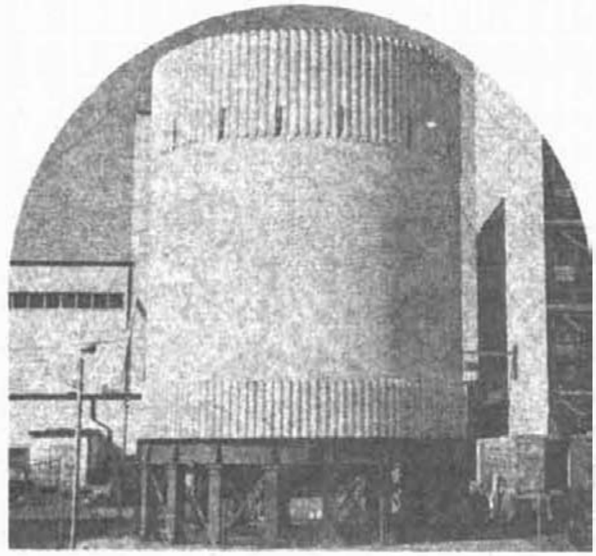
A series of time/cost correlation charts, established for top management visibility, were made a portion of the monthly cost review meeting. These charts measure the amount of direct manhours expended against PERT milestone prediction for a number of discrete S-IC program tasks. Establishment of this system within the branch has served as a catalyst in refining and improving many other systems, such as work authorization and cost accumulation of direct labor charges.

ENGINEERING MISSION SUPPORT MILESTONES

(PLAN VIII)



S-IC MISSION SUPPORT



11

STRUCTURAL TEST PROGRAM

The structural test program, initiated in FY 1964 with the issuance of Contract Modification 64, authorized Boeing to perform the testing of the S-IC-C test fuel tank at MSFC. Boeing's responsibility subsequently has been expanded by Contract Modification 132 received in early FY 1965, to cover planning and conduct of the full structural static load test program at MSFC. The range of testing includes all major structural components of the S-IC.

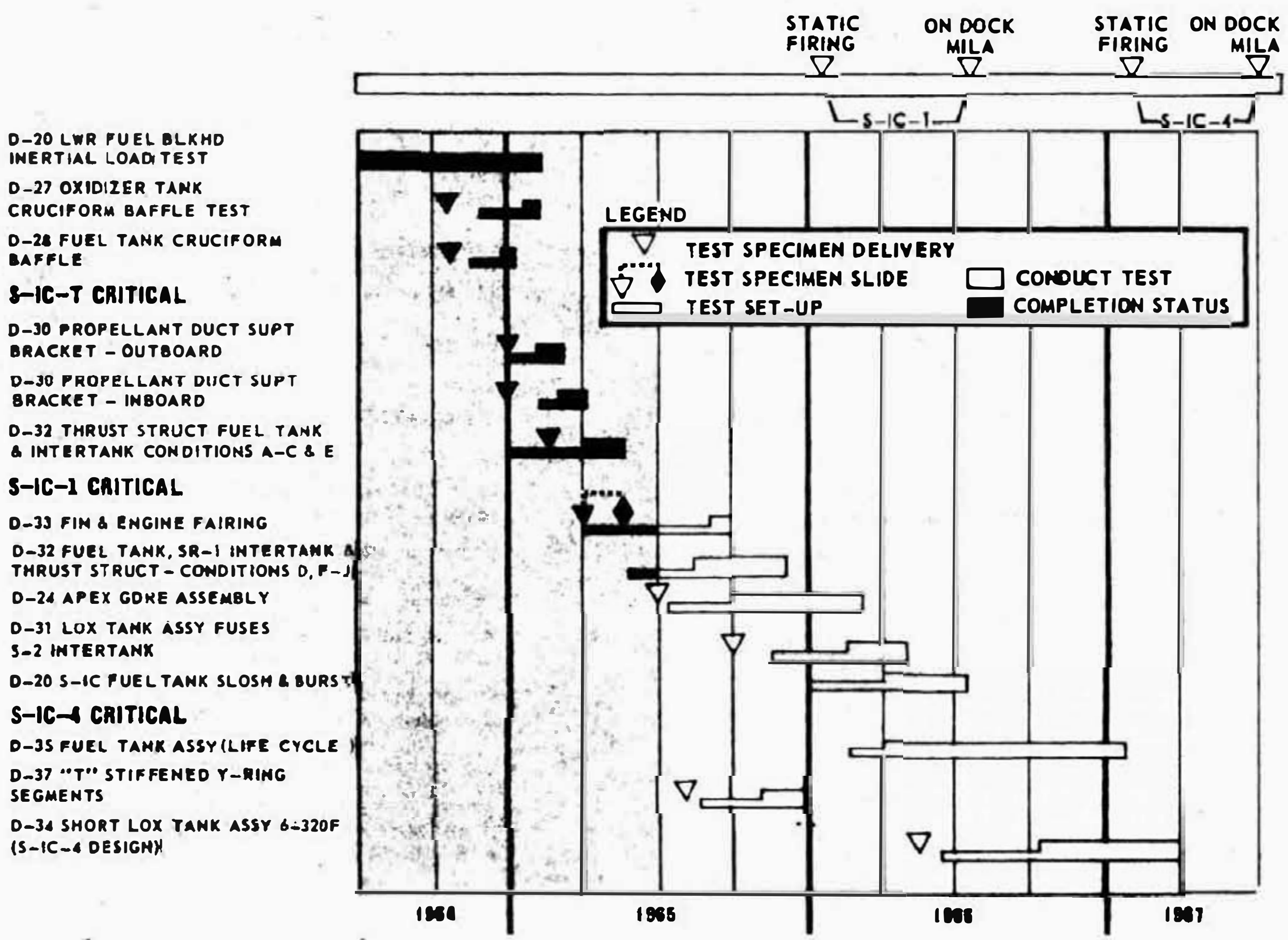
In support of the program, MSFC is providing test facilities and data systems, office and shop support areas, and all equipment and parts except raw materials. Originally, all test specimens were to be provided by NASA/MSFC; however, in March 1965, NASA/MSFC directed Boeing, by Contract Change Order MICH I-2, to provide the apex gore assembly and the T-stiffened Y-ring test specimens. Subsequently, by Change Order MICH I-19, Boeing was directed to provide the detail parts for the shortened oxidizer tank test program.

The original test program also called for testing of the lightweight Intertank scheduled for installation on S-IC-4 through -10 stages. However, as a result of NASA/MSFC decision to use the heavier S-IC-1 intertank on all later stages, testing of the S-IC-4 intertank has been eliminated from the program.

Testing necessary to ensure the structural integrity of the S-IC-T under static firing conditions (shown as

FIGURE XI-1

STRUCTURAL TEST PROGRAM SCHEDULE



S-IC-T critical items in Figure XI-1) was accelerated during the third and fourth quarters of the year and completed in time to support the accelerated schedule for the early -T static firings.

Test program progress has been satisfactory. A substantial part of the testing has been completed, as shown in Figure XI-1. With minor exception, the testing has verified the adequacy of the structural design. The results of testing to date are shown in Figure XI-2.

TECHNICAL MANUALS (MOD 108)

Technical Manuals were authorized under MODS 108, 122 and 174 to NAS8-5608, Paragraph A.2, Part XI, Exhibit A. Refer to Logistics, Part I for technical support data status summary.

FIGURE XI-2 SUMMARY OF STRUCTURAL TEST COMPLETION

SUMMARY OF STRUCTURAL TEST COMPLETION

TEST NO.	TEST TITLE	RESULTS
D-26	S-IC-C FUEL TANK TEST PROGRAM (A) HYDROSTATIC PROOF PRESSURE (B) LOX TUNNEL (C) LOWER BULKHEAD INERTIAL LOAD	THREE CONDITIONS COMPLETED DESIGN ADEQUATE DESIGN ADEQUATE DESIGN ADEQUATE SLOSH AND BURST TESTS ARE SCHEDULED FOR COMPLETION BY JULY 1966
D-27	OXIDIZER TANK CRUCIFORM BAFFLE TEST	COMPLETED DESIGN ADEQUATE
D-28	FUEL TANK CRUCIFORM BAFFLE TEST	COMPLETED STIFFENER REINFORCED REPAIR DESIGN ADEQUATE
D-30	OUTBOARD PROPELLANT DUCT SUPPORT BRACKET TEST	COMPLETED DESIGN ADEQUATE
	INBOARD PROPELLANT DUCT SUPPORT BRACKET TEST	DESIGN ADEQUATE
D-32	S-IC-S LOWER ASSEMBLY TEST (A) INBOARD ENGINE REBOUND TEST (B) OUTBOARD ENGINE REBOUND TEST (C) CENTER ENGINE CAPTIVE FIRING TEST (D) STATIC TEST BURNOUT WITH MAXIMUM ENGINE GIMBAL	FOUR CONDITIONS COMPLETED DESIGN ADEQUATE DESIGN ADEQUATE DESIGN ADEQUATE STA 116 GROUND HANDLING FITTING BEARING FAILURE AT 86 PERCENT LIMIT LOAD. FLIGHT STRUCTURE-DESIGN ADEQUATE. FITTING REDESIGNED ONE CAPTIVE FIRING CONDITION TWO LAUNCH CONDITIONS, AND TWO FLIGHT CONDITIONS SCHEDULED TO BE COMPLETED BY DECEMBER 1965

APPENDIXES

APPENDIX A

CONTRACT MODIFICATIONS

Outlined below are the contract modifications received from April 1 through June 30, 1965.

CONTRACT NAS8-5608

MODIFICATION NO. MICH-4 effective April 12, 1965, is a change order directing the contractor to prepare Part I of all the specifications listed in the Saturn V/S-IC specification tree. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-5 effective March 25, 1965, is a supplemental agreement to incorporate changes to the S-IC program delivery schedules and will be referred to as Plan VIII. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-6 effective April 1, 1965, is a change order increasing the incremental funding of Schedule I, Article IX.

MODIFICATION NO. MICH-7 was cancelled by NASA.

MODIFICATION NO. MICH-8 effective March 31, 1965, is a supplemental agreement. This modification accomplishes the following:

a) Incorporates the results of negotiations as full settlement of Change Order No. 210, "Changes" of the General Provisions.

b) Deletes DD Form 254, Security Requirements List, dated October 1, 1964 and substitutes DD Form 254, dated March 29, 1965.

c) Increases the estimated cost and fixed fee as provided for in Paragraph A, Article III of Schedule I.

MODIFICATION NO. MICH-9 effective April 6, 1965, is a change order to change the baseline for specifications and standards applicable to the S-IC stage system. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-10 effective April 7, 1965, is a change order to provide for contractor support to the MSFC Manufacturing Engineering Laboratory. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-11 effective April 1, 1965, is a supplemental agreement to revise the numbering System "I-1" through "I-10" to "MICH-1" through MICH-10." No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-12 was cancelled by NASA.

MODIFICATION NO. MICH-13 effective April 1, 1965, is a supplemental agreement directing the design and construction of a facility within Building 103 at Michoud Assembly Facility for use by the Government engine contractor. The estimated cost and fixed fee as provided for in Paragraph A, Article III of Schedule I is increased. Executed by The Boeing Company on June 22, 1965, this modification is currently undergoing review at NASA Headquarters.

MODIFICATION NO. MICH-14 effective May 3, 1965, is a change order directing the contractor to fabricate and deliver to MSFC "Test D-34 Test Specimen Components-S-IC Structural Static Load Test Program," in accordance with the specified documentation released under Part I, Exhibit "A". No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-15 effective May 19, 1965, is a change order issued to amend Change Order No. 130 as follows:

a) Discontinue work on the preferred design intended for incorporation with an effectivity of S-IC-4 through -10;

b) Discontinue effort to manufacture the S-Test intertank;

c) Proceed to released design and manufacture intertanks for stages S-IC-4 through -10 as previously directed for -1 through -3.

There is no change in estimated cost and fixed fee.

MODIFICATION NO. MICH-16 effective April 16, 1965, is a change order to revise the "Special Instructions" (Supplemental Agreement No. 136, R-ME-IS) applicable to the Contractor's S-IC-1 and S-IC-2 thrust structure assemblies effort. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-17 effective April 14, 1965, is a change order to direct the Contractor to perform activation support in addition to its existing MTO effort. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-18 effective May 3, 1965, is a supplemental agreement to incorporate into Schedule I full settlement for Change Order No. 93 and Change Order No. 146. This modification increases estimated cost and fixed fee.

MODIFICATION NO. MICH-19 effective April 28, 1965, is a change order to direct the Contractor to accomplish the following:

a) Provide and install at MSFC hydraulic research servo-actuator insulation brackets for the S-IC-T, S-IC-1, and S-IC-2 stages, and at Michoud for the S-IC-3 stage;

b) Provide the necessary released documentation for acceptance inspection and installation of this bracketry.

There is no change in estimated cost and fixed fee.

MODIFICATION NO. MICH-20 effective April 16, 1965, is a change order issued to direct the contractor to modify the S-IC-F stage hardware requirements without amendment of the released engineering documentation prepared under Part I of Exhibit "A". No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-21 effective April 26, 1965, is a supplemental agreement to incorporate into Schedule I of the contract full settlement for Change Order No. 105 as defined by CAM 801, Revisions 1 through 4 Work Statement, and Change Order No. 140. This modification increases the estimated cost and fixed fee.

MODIFICATION NO. MICH-22 is a supplemental agreement incorporating the results of negotiations as full settlement of Supplemental Agreement No. 67 and Change Orders 71, 84, and 88. This modification increases the estimated cost and fixed fee. Executed by The Boeing Company on May 4, 1965, it is currently undergoing NASA Headquarters review.

MODIFICATION NO. MICH-23 a change order, effective June 17, 1965, implements CAM 246 (Revision 1). There is no change in estimated cost and fixed fee.

MODIFICATION NO. MICH-24 effective May 5, 1965, is a change order to direct the contractor to perform a detailed survey of hydrogen explosion hazard in the S-IC stage forward skirt section. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-25 effective May 25, 1965, is a change order to direct the contractor to maintain the S-IC stage test and checkout station—Quality and Reliability Assurance laboratory after it is operationally ready for use. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-26 effective May 3, 1965, a change order to increase the incremental funding of Schedule I, Article III.

MODIFICATION NO. MICH-27 effective May 25, 1965, is a change order to provide for an additional flange drain system and leak measuring provisions. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-28 effective May 11, 1965, is a change order to implement CAM's 278 (Revision 1), 317, 319, and 322. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-29 effective May 18, 1965, is a change order to direct the contractor to evaluate and make a preliminary design of an S-IC gas injection system. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-30 effective June 22, 1965, is a supplemental agreement providing for the incorporation of additional manhours into Part IX, A., Exhibit "A". There is an increase in the estimated cost and fixed fee.

MODIFICATION NO. MICH-31 effective May 6, 1965, is a supplemental agreement to incorporate into Schedule I of the contract full settlement for Change Order No. 118. The estimated cost and fixed fee are decreased.

MODIFICATION NO. MICH-32 was cancelled by NASA.

MODIFICATION NO. MICH-33 effective May 18, 1965, is a change order to direct the contractor to design hydraulic research servo-actuator insulation brackets for the S-IC-T, S-IC-1 and acceptance inspection, and installation of this bracketry. This change order supersedes Change Order MICH-19 in its entirety. There is no change in estimated cost or fixed fee.

MODIFICATION NO. MICH-34 effective June 1, 1965, is a change order directing the Contractor to:

a) Amend the Delivery Schedule, Article V;

b) Rewrite Part I, Paragraph E, "Model Specifications and Contract End-Item Detail Specification."

This modification cancels and supersedes Change Order No. MICH-4 in its entirety. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-35 effective June 2, 1965, is a change order to eliminate the requirements for the electrical feedback of servo-actuators. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-36 effective May 25, 1965, is a change order to modify Specification 60B32046. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-37 effective May 21, 1965, is a change order to implement CAM's 294, 808 (Revision 1) 826, 827, 834, 853, 855, 858, and 872. No change in estimated cost and fixed fee.

MODIFICATION NO. MICH-38 effective May 28, 1965, is a change order directing the contractor to prepare a Contract End-Item (CEI) Detail Specification (Prime Equipment) Part I - Performance and Design Requirements for the Saturn V/S-IC Stage, in accordance with NPC 500-1. This modification cancels and supersedes Modification Nos. 156 and 219. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-39 effective May 21, 1965, is a change order to increase the incremental funding of Schedule I, Article III.

MODIFICATION NO. MICH-40 effective June 3, 1965, is a change order to delete the requirements for certain fuel and LOX prevalves and fuel and LOX pressure volume compensators in the S-IC-F stage. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-41 effective May 25, 1965, is a change order to increase the incremental funding of Schedule I, Article III.

MODIFICATION NO. MICH-42 effective June 15, 1965, is a supplemental agreement to provide for delivery of the umbilical hardware to MSFC, Huntsville, Alabama. Executed by The Boeing Company on June 17, 1965, the modification is currently undergoing NASA Headquarters review.

MODIFICATION NO. MICH-43 effective June 7, 1965, is a supplemental agreement incorporating into the contract the full and complete negotiated settlement of Change Order No. 139. The estimated cost and fixed fee is decreased.

MODIFICATION NO. MICH-44 effective June 3, 1965, is a change order to direct implementation of S-IC Logistics Program. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-45 effective June 14, 1965, is a change order implementing CAM's 283, (Revision 1), 309, 325, 330, 332, 333 (Revision 1) 361, 326, and363. There is no change in estimated cost or fixed fee.

MODIFICATION NO. MICH-46 effective June 11, 1965, is a change order incorporating the revised general criteria for the design and implementation of "Antenna Hats," which will be utilized at Kennedy Space Center. It also deletes the requirement for visual instrumentation equipment (SA 75) for the S-IC-T and replaces and deletes various items of equipment specified in Document IN-P&VE-V-62-5. This modification cancels and supersedes Change Order Nos. 216 and 239. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-47 effective June 22, 1965, is a supplemental agreement providing for the incorporation of additional manhours into Part IX, A., Exhibit "A".

MODIFICATION NO. MICH-48 has not been received.

MODIFICATION NO. MICH-49 has not been received.

MODIFICATION NO. MICH-50 has not been received.

MODIFICATION NO. MICH-51 effective June 16, 1965, is a change order to delete the requirements for four inboard air scoops on each engine fairing assembly of S-IC stages S-IC-1 through S-IC-10. The requirements for air scoops in other areas of the S-IC stage remain unchanged. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-52 effective June 16, 1965, is a change order to direct the contractor to provide the necessary released documentation for acceptance inspection and installation of hydraulic research servoactuatore for the S-IC-T and S-IC-1 through -3. No change in estimated cost and fixed fee. This modification supersedes Change Order No. MICH-33 in its entirety.

MODIFICATION NO. MICH-53 effective June 10, 1965, is a supplemental agreement that:

a) Increases the contract value by the addition of C of F effort in support of the component test facility;

2) Provides C of F incremental funding.

MODIFICATION NO. MICH-54 effective June 18, 1965, is a change order to implement CAM's 238, 279, 342, 344, 345, 347, and 364. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-55 effective June 18, 1965, is a change order to implement CAM's 247, 251, 269, and 340. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-56 effective June 18, 1965, is a change order to implement CAM's 169, 832, 833, 841, 873, 875, 880, 883, 886, 887, and 890. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-57 effective June 18, 1965, is a change order to implement CAM's 835, 864, 865, 866, 871, 879 and 891. No change in estimated cost or fixed fee.

MODIFICATION NO. MICH-58 has not been received.

MODIFICATION NO. MICH-59 has not been received.

MODIFICATION NO. MICH-60 effective June 28, 1965, is a change order directing the contractor to incorporate the MSFC designed teflon line for the S-IC stage servo-actuator return line into the S-IC stage.

CONTRACT NAS8-5606 (F)

MODIFICATION NO. 15 effective April 14, 1965, is a supplemental agreement that:

a) Incorporates, by reference, an addendum to Document D6-12438 listing FY 1965 requirements;

b) Provides for the acquisition of additional facilities representing a portion of FY 1965 requirements.

c) Increases the estimated cost of the contract;

d) Attaches a revised Appropriation Schedule;

e) Attaches a revised Schedule A;

f) Attaches a revised Schedule B.

MODIFICATION NO. 16 a supplemental agreement, was received, fully executed, on June 22, 1965. This authorizes the acquisition of additional facilities.

MODIFICATION NO. 17 effective June 25, 1965, is a supplemental agreement directing the Contractor to acquire additional facilities equipment. Executed by The Boeing Company on June 24, 1965, this modification is currently undergoing NASA Headquarters review.

CONTRACT NAS8-2577

MODIFICATION NO. 34 effective March 29, 1965, is a change order that incorporates the Final Security Requirements Check List (DD Form 254) into the contract.

APPENDIX B

PROPOSALS SUBMITTED

Proposals submitted to NASA from April 2, 1965 through June 30, 1965 were:

1) On April 5, 1965, in consequence of Change Order Modification 214, a proposal was submitted to NASA for providing four propellant measuring system electronic checkout units.

2) On April 6, 1965, in consequence of Change Order Modification 208, a proposal was submitted to NASA for providing vehicle configuration system data requirements for MSFC data center (MSFC-STD-417).

3) On April 9, 1965, in consequence of Change Order Modification 219, a proposal was submitted to NASA for preparing a contract end-item detail specification Part I - Performance and Design Requirements for the Saturn V/S-IC Stage, in accordance with NPC 500-1.

4) On April 12, 1965, in consequence of Change Order Modification 223, a proposal was submitted to NASA for design and manufacture of GOX flow control valves to modulate between 20 and 40 pounds per second.

5) On April 13, 1965, in consequence of Change Order Modification 196, a proposal was submitted to NASA for providing a Document Requirement List (DRL) that reflects data imposed by Contract NAS8-5608.

6) On April 13, 1965, in consequence of Change Order Modification 205, a proposal was submitted to NASA for providing an S-IC stage criteria document that incorporates the basic technical requirements of Document IN-P&VE-V-62-5.

7) On April 14, 1965, in consequence of Change Order Modification 230, a proposal was submitted to NASA for modifying fluid power ducting insulation and thrust vector control engine outrigger interfaces (Change Action Memo 305).

8) On April 19, 1965, in consequence of Change Order Modification 226, a proposal was submitted to NASA for modifying the Engine Test Programmer Tape Reader, Function Generator, Program Panel to add Electronic Parts, hardware, etc. (Change Action Memo 840).

9) On April 19, 1965, in consequence of Change Order Modification 238, a proposal was submitted to NASA for revising S-IC-F System Checkout Stage - Ground Test Stages.

10) On April 23, 1965, in consequence of Change Order Modification 195, a proposal was submitted to NASA for providing electromagnetic compatibilities.

11) On April 23, 1965, in consequence of Change Order Modification 228, a proposal was submitted to NASA for the initiation of dummy heat shield panels in lieu of honeycomb panels for the S-IC-D and S-IC-F

12) On April 23, 1965, in consequence of Change Order Modification MICH-17, a proposal was submitted to NASA for providing additional Mississippi Test Facility (MTF) Activation Support.

13) On April 26, 1965, in consequence of Change Order Modification 190, a proposal was submitted to NASA for implementation of Technical Directive I-V-SIC-253 - Replacing AN/DRW-13 command system with the secure command system.

14) On April 29, 1965, in consequence of Change Order Modification 165, a supplemental proposal was submitted to NASA for modifying the S-IC-S oxidizer and fuel tanks to simulate flight hardware (Change Action Memo 254).

15) On April 29, 1965, in consequence of Change Order Modification 184, a proposal was submitted to NASA for the implementation of Change Action Memos:

222 - Install Light Weight LOX Tunnel Bellows
257 - Replace the Range Safety System Controller
239 R2 - Add a Remote Digital Submultiplexer Assembly to the Stage PCM
198 - Modify Flak Curtain to Provide Lifting Fixture

16) On April 29, 1965, in consequence of Change Order Modification 232, a proposal was submitted to NASA for providing support during transportation of MSFC-built stages.

17) On April 29, 1965, in consequence of Change Order Modification MICH-16, a proposal was submitted to NASA for revised special instructions relative to S-IC-1 and S-IC-2 thrust structure assemblies.

18) On April 30, 1965, in consequence of Change Order Modification 206, a proposal was submitted to NASA for incorporating changes in Document IN-P&VE-V-62-5 relative to liquid-level voltage output and hardware signal.

19) On April 30, 1965, in consequence of Change Order Modification 218, a proposal was submitted to NASA covering the studies required for increasing the propellant load to 4,741,000 pounds at nominal density. Implementation proposal is being processed.

20) On April 30, 1965, in consequence of Change Order Modification 233, a proposal was submitted to NASA for providing F-1 engine peculiar handling equipment for use at Michoud.

21) On May 6, 1965, in consequence of Change Order Modification 235, a proposal was submitted to NASA for the capability of installing and removing the base heat shields without disrupting other stage systems.

22) On May 6, 1965, in consequence of Change Order Modification 245, a proposal was submitted to NASA for providing the capability of optically determining vehicle motion at liftoff.

23) On May 7, 1965, in consequence of Change Order Modification 246, a proposal was submitted to NASA for providing two skin panels in support of the S-IC aft umbilical tests.

24) On May 7, 1965, in consequence of Change Order Modification I-9, a proposal was submitted to NASA for cancellation of Document D5-11202 and substitution of Document MIL-STD-143, "Specifications and Standards, Order of Precedence for the Selection Of."

25) On May 7, 1965, in consequence of Change Order Modification 234, a proposal was submitted to NASA for the design, manufacture, installation, checkout and calibration of hydraulic load simulator into the MAB.

26) On May 10, 1965, in consequence of Change Order Modification MICH-24, a proposal was submitted to NASA for performing a survey of hydrogen explosion hazard in the S-IC stage.

27) On May 11, 1965, in consequence of Change

Order Modification 241, a proposal was submitted to NASA for reviewing interface control documentation and for preparing a cross-reference index in accordance with MSFC-STD-450.

28) On May 11, 1965, in consequence of Change Order Modification MICH-10, a proposal was submitted to NASA for providing manufacturing engineering to MSFC Manufacturing Engineering Laboratory.

29) On May 25, 1965, in consequence of Change Order Modification 234, a supplemental proposal was submitted to NASA for the design, manufacture and installation of a mechanical automated breadboard (MAB) weatherproofing provisions outside Building 4708 at MSFC.

30) On May 26, 1965, in response to NASA letter I-MICH-CB, dated February 16, 1965, a proposal was submitted to NASA for providing lightweight engine manual actuators.

31) On June 22, 1965, in response to NASA letter I-MICH-CB, dated April 15, 1965, a proposal was submitted to NASA for performing a full scale intertank test on the S_{R2} intertank unit.

32) On June 30, 1965, in response to NASA letter I-MICH-CB, dated March 23, 1965, a proposal was submitted to NASA for developmental testing of critical components for the alternate propellant tank pressurization system.

33) On June 30, 1965, in consequence of Change Order Modification 179, a proposal was submitted to NASA for implementing changes in Document IN-P&VE-V-62-5 relative to S-IC stage engine shutdown.

APPENDIX C

NEGOTIATIONS COMPLETED

The following is a summary of negotiations that were completed during the fourth fiscal quarter:

1) On April 1, the proposal for facilities for Rocketdyne was negotiated for an increase in contract value.

2) On April 9, Modification 118, EBW Firing Units, was negotiated for a decrease in contract value.

3) On April 21, Modification 139, Revise Fuel and LOX Drain Valves, was negotiated for a decrease in contract value.

4) On April 26, an additional 100,000 direct labor hours for PART IX A were negotiated for an increase contract value.

5) On May 17, Modification 164, GSE Pressure Control System was negotiated for an increase in contract value.

6) On May 17, Modification 87, Add Insulation to Servo-Actuator, was negotiated for an increase in contract value.

7) On May 17, Modification 183, CAM's 261, 258, and 272, was negotiated for an increase in contract value.

8) On May 17, Modification 214, Provide Propellant Measuring System, was negotiated for an increase in contract value.

9) On May 17, Modification 223, Revise GOX Flow Control Valve, was negotiated for an increase in contract value.

10) On May 17, Modification 205, S-IC Stage System Description Document, was negotiated for an increase in contract value.

11) On May 17, Modification 196, Preparation of DRL's and DRD's, was negotiated for an increase in contract value.

12) On May 17, Modification 226, CAM 840, was negotiated for an increase in contract value.

13) On May 17, Modification 184, Modification of Flak Curtain, was negotiated for an increase in contract value.

14) On May 17, Modification 233, F-1 Engine Peculiar Handling Equipment, was negotiated for an increase in contract value.

15) On May 19, Modification 128, Weight Saving CAM's, was negotiated for an increase in contract value.

16) On May 26, an additional 200,000 direct labor hours for PART IX A were negotiated for an increase in contract value.

17) On May 27, the proposal for test panel intertank

assembly was negotiated for an increase in contract value.

18) On May 21, Modification 199, Thrust Vector Control System Analysis and Test Program, was negotiated for an increase in contract value.

19) On June 8, Modification 103, F-1 Engine Specification Change, was negotiated for an increase in contract value.

20) On June 8, Modification 174, LUT S-IC Pneumatic Equipment, was negotiated for an increase in contract value.

21) On June 8, Modification 189, Add Remote Controlled Venting Capability to GSE Pressurization Ducts, was negotiated for an increase in contract value.

22) On June 8, Modification 190, Replace the AN/DRW-18 Command System with the Secure Command System, was negotiated for an increase in contract value.

23) On June 8, Modification 206, Increase Loading System Output Voltage and Additional Stage Propellant Loading Level Information, was negotiated for an increase in contract value.

24) On June 8, Modification 228, Deletion of Honeycomb Heatshield Panels, was negotiated for a decrease in contract value.

25) On June 8, Modification 230, Modify Fluid Power Ducting Insulation, was negotiated for no cost to the contract.

26) On June 8, Modification 238, S-IC-F Engine Weight Simulators, was negotiated for an increase to the contract value.

27) On June 8, Modification 245, Optical Targets on Engine Fairings, was negotiated for no cost to the contract.

28) On June 8, Modification I-9, Deletion of Document D5-11202, "Specifications and Deviations for the Saturn S-IC Systems," was negotiated for no cost to the contract.

29) On June 8, Modification I-10, Support to ME Lab - MSFC, was negotiated for an increase in contract value.

30) On June 8, Modification 246, Provide Skin Panels to Accommodate S-IC Aft Umbilical Tests, was negotiated for an increase in contract value.

31) On June 11, an additional 200,000 direct labor hours for PART IX A were negotiated for an increase in contract value.

32) On June 18, the proposal for internal access equipment (vertical position) for use at MILA, was negotiated for an increase in contract value.

33) On June 18, Modification 165, Modify the S-IC-S Oxidizer and Fuel Tanks to Simulate Flight Hardware, was negotiated for an increase in contract value.

34) On June 18, Modification MICH-24, Hydrogen Explosion Hazard in S-IC Stage, was negotiated for an increase in contract value.

APPENDIX D

DOCUMENTATION SUBMITTED

The following documentation was submitted to NASA during the last quarter of FY 1965.

DOCUMENTS

CONTRACT NAS8-6508

Accounting Technical Manual, Launch Systems Branch Revisions for D5-10001, D5-10001-1, -2 and -3

Eddy Current - Ultrasonic Surface Inspection Technique Development, Boeing Document D5-12937

Data Program Requirements - S-IC Structural Static Load Test, D5-11446

Design Analysis for S-IC-1 Malfunction Detection System, D5-12789 (Technical Directive No. 171)

Design Criteria for the Rocketdyne Area, D5-12839

Materials and Process Specification Selection and Control Plan - Saturn S-IC, D5-12993

Phase I Study - Launch Vehicle - Minuteman Strapon Boosters for Saturn V Vehicle, D5-11424-1, Rev. B

Program Assessment PERT Report, Saturn V - S-IC, D5-12749-21, -22, -23, -24, -25, and -26

Program Equipment Requirements - S-IC Structural

Static Load Test Program Plan, D5-11438-1

Propellant Duct Support Bracket Test Outboard, D5-6408-40

Qualification Test Procedures, D5-10065, D5-12996

Quality Control Manual, D2-4800, Revisions 18, 19, 20, 21, and 22

Quality Program Plan, D5-11005, Revision F

Quality Technical Instruction, D5-11997, Revisions G and H

Quarterly Management Report, D5-12490-15

Reliability Program Plan, D5-11013

Required Engineering Release Documentation, D5-11979, Revision D

Special Inspection Procedures, D5-11982, Revisions O and P

Structural Test D-27 - Technical Summary Report, T5-6408-20

Technical Progress Report, Quarterly, For: Period from January 1 through April 1, 1965, D5-11994-8

Qualification Status List, D5-12741, Revision I

Test Report, Inertial Loads Test, D-20, Saturn V, S-IC, T5-6408-12

Transportation Measurements Program Test Reporting, S-IC-T Move of March 1, 1965, T5-6538-011 (Modification 232)

Weight Status Report, Monthly, D5-11696-27, -28 and -29

CONTRACT NAS8-5606 (F)

Equipment Requirements, Contract NAS8-5608 (F), D5-12374, Revisions Y and Z

General Purpose Facilities Equipment Requirements, Document D5-12374-6

General Purpose Facilities Equipment Requirements for FY 1965 Funding, D5-12438, Revision B

REPORTS

CONTRACT NAS8-5608

Actual Direct Labor Data, Report for March and May, 1965

Analog Computer Study, BA0023 - Power Transfer Switch Saturn S-IC Contract

Calibration/Certification System Advanced Due and Overdue Reports for: March 25, April 1, April 8, April 15, April 22, April 29, May 6, May 13, May 20, May 27, June 3, June 10, June 17, and June 24, 1965

Calibration/Certification System Inventory Report for: March 25, April 29 and June 24, 1965

Calibration/Certification System Monthly Output Performance and Monthly Equipment Accountability Report for: March 25, and April 29, 1965

Calibration/Certification System Monthly Summary Report for: March 25, April 29, May 27, and June 24, 1965

Calibration/Certification Failure and Rejection Data Reports for: March 29, April 5, May 5, May 19, and June 3, 1965

Cancelled Drawings Report for: March and April, 1965

Construction of Facilities Status Report for March and May, 1965

Cross Reference Index of Interface Control Drawings

C-5 Stage Parts Critical Schedule Report for: March 31, April 7, April 14, April 21, April 28, May 5, May 19, May 26, and June 2, 1965

Development Test Report, SD-2 Motor Test Report; S-IC Retrorockets

Direct Overtime Expended During February, March, April and May, 1965

Document Requirements Lists, Document Requirement Descriptions and Document Survey Data Sheets (Modification 196)

End-Item Test Plan for R-Test Equipment (Modification 106)

Flash Reports for Unplanned Test Failure

Test Procedures

End-Item Test Plan, Stage S-IC-D (Modification 88)

Financial Management Report for First Quarter CY 1965 and for the Month of May, 1965

Funding by Parts of Contract NAS8-5608 and Saturn V (Except C of F) Report for March, April and May, 1965

Listing of Discrepancies between the ICD's and Associated Engineering Class I Documentation

Manpower and Pay Rates for May, 1965

MSE/GSE Schedules for: March 15, March 29, April 12, April 22, April 26, April 28, May 10, May 19, May 24, and June 4, 1965

Photographic Requirements on Saturn S-IC Progress, Monthly for: March, 1965; April, 1965; May, 1965

Propellant Requirements, Forecast of (NASA Form 1057 - Three Year Forecast) July 1, 1965 through July 1, 1968

Progress Report, Monthly for: March, 1965; May, 1965; (Modifications 99 and 220)

Qualification Test Reports

Quality Program Quarterly Audit Report for January through March, 1965

Quality Status Report, Monthly for: March and April

CONTRACT NAS8-5606 (F)

Schedule "A" and "B" Facilities Listings for the First Quarter, 1965

Facilities Design Drawings