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SATURN I STATUS REPORT

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Gentlemen, I will present today the status of NASA's SATURN I program. In doing this, I will cover NASA's requirement for SATURN I, the scope of the job being undertaken and a brief summary of the SATURN development history. I will also give a brief review of the vehicle configuration, the schedule and development status, our flight test objectives and accomplishments, and will close with a short film of our last test flight, vehicle SA-4.

Let us first look at the NASA requirement for SATURN (fig. 1). SATURN I will give us our first large orbital payload capability. NASA will specifically use this capability for inflight qualification of the APOLLO command and service module and provide crew training. Further, SATURN I gives us the basic first stage for the SATURN IB vehicle and pioneers hydrogen technology for SATURN IB and SATURN V.

How big a job is SATURN I? Today (fig. 2) at the Chrysler Corporation Michoud Operations at the NASA Michoud plant, we have some 3,000 persons engaged in manufacture of the S-I stage. This number will rise to 4,000 as the SATURN IB program begins to be felt. At Douglas Aircraft in Santa Monica, 2,200 people are engaged in the development and production of the S-IV stage, while an additional 500 engineers and technicians are handling the static test program at Sacramento. At Marshall, we have 2,500 civil service people engaged in the systems integration, design, booster assembly and checkout, and instrument unit assembly and checkout. Engines, the H-1 from Rocketdyne and the RL-10 at Pratt and Whitney, employ an additional 4,500 persons at these companies. These major centers of activities are supported by a large complex of subcontractors, suppliers, and vendors.

To develop SATURN I and complete the ten vehicle development launch program will cost the country some 795 millions (fig. 3). This includes the flight test of ten SATURN I vehicles, development and manufacture of thirteen S-I stages, the establishment of the Chrysler Michoud operation, the development and flight testing of the guidance system, and the development and manufacture of eight instrument units, and the establishment of two launch complexes at the AMR. Further, significant steps are being taken in vehicle launch automation which give early development progress toward the SATURN V vertical assembly and launch concept.

Historically (fig. 4), SATURN I started as an ARPA project in 1958, the objective being to static test a multi-engine booster of 1.5 million pounds of thrust. ARPA next initiated a series of studies on upper stage configurations and mission requirements. In May of 1959, a modified Titan first stage was selected. This lasted some six months, and in December of 1959, the Silverstein Committee recommended a lox-hydrogen stage for higher payload and long-range goals. This stage, a four engine S-IV, was intended as a third stage of the C-2 vehicle but was developed first due to the availability of the RL-10 A-3 engine. In April of 1961, we modified the vehicle design by adding two engines to the four engine S-IV stage, eliminating the third stage, improving the first stage and today we have this SATURN I vehicle.

The SATURN I has two stages. (See fig. 5.) The first stage, the S-I, has eight H-1 engines, uses lox-kerosene for propellants, is 80 feet long, and carries 850,000 pounds of propellants. The second stage, the S-IV, has six RL-10 A-3 engines, uses lox-liquid hydrogen for propellants, is 41 feet long and carries 100,000 pounds of propellants.

In a standard flight, the S-I stage is ignited and held down for 3.5 seconds to assure satisfactory H-1 engine operation. Prior to initiation of the tilt program, the vehicle is rolled into its flight azimuth from a fixed launch azimuth. Ten seconds after lift-off, we begin a gravity tilt program achieving a 66 degree path angle at 146 seconds, the burn-out of the first stage. After staging, the S-IV stage burns some 470 seconds, injecting the payload into orbit at some 1,400 miles from the launch point.

NASA has 16 SATURN I flight vehicles scheduled. (See fig. 6.) Ten of these vehicles are considered as launch vehicle development flights. The remainder are considered operational flights and will carry a manned APOLLO mission. Our flight test program began in October 1961 and we have had four successful flights of the Block I, or single live stage, configuration. Our next flight, a two-stage vehicle, is scheduled for launch in August of this year. If all goes well, this flight will put some 17,000 pounds payload in orbit. We have five additional two-stage flights scheduled for the period December 1963 through December 1964, prior to our first manned flight on vehicle 111 in March 1965.

The H-1 engine used in the S-I stage has an extensive test history. (See fig. 7.) We have accumulated approximately 29,000 seconds of firing time on production H-1 engines.

On the S-I stage, the cluster of H-1 engines, we have accumulated approximately 3,000 seconds of static test time (fig. 8).

The RL-10 engine history has over 100 hours of hot firing time to date (fig. 9).

The S-IV stage has 3,160 seconds of static test time to date and we project some 1,400 additional seconds prior to the first flight and some 22,360 seconds prior to the first manned flight.

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I would like to cover, in somewhat more detail, flight mission plans for the next seven SATURN I vehicles. (See fig. 10.) As we see from the chart, we are talking about vehicles SA-5 through SA-111. All these will be two-stage vehicles. All will be programed to achieve an orbit with the spacecraft. On SA-5, we will fly our guidance system, with principle components being a Bendix stable platform and an IBM guidance computer as a passenger. Our goal is to have active guidance on SA-6 and thereafter.

On SA-5, we will have a standard nose cone. SA-6 and subsequent vehicles will carry either APOLLO boilerplate or flight spacecraft modules.

As previously mentioned, we consider the vehicle R&D program to end at SA-10. Vehicle SA-111 will be identical to SA-10 but will have a major portion of the R&D instrumentaion removed. The SA-6 and SA-7 are intended to secure APOLLO spacecraft launch phase environmental data, SA-8 and SA-9 will test the crew abort system, SA-10 will be a complete flight test of an unmanned APOLLO command module and service module, and SA-111 is planned for the first manned orbital flight of APOLLO. Other missions we will undertake will be a tape recorder in SA-5 and a micrometeorite detection satellite flown on vehicles SA-8 and SA-9.

This is where we stand today:

1. The S-I stage is in an advanced development state.

2. The S-IV stage has had good static and ground test results. The flight test program remains to be accomplished.

3. Guidance components passenger flights have been successful. Full system tests remain.

4. Flight and dynamic control systems tests have been successful and give no indication of potential problems.

5. Industrial, test, and launch facilities required to support the total program will be completed by the end of this year.

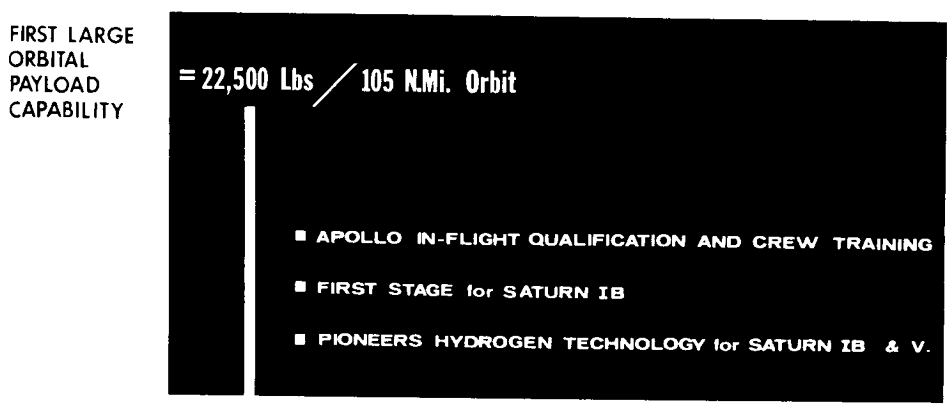

Figure 1. - NASA requirements for Saturn I.

LOCATION	NO. EMPLOYED
CHRYSLER MICHOUD	3,000
DAC, SANTA MONICA	2,200
DAC, SACRAMENTO	500
MSFC, HUNTSVILLE	2,500
ROCKETDYNE, CANOGA PARK AND NEOSHO, MO.	1,500
P&W, PALM BEACH AND HARTFORD	3,000

Figure 2. - Scope of activities.

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ESTIMATE TOTAL COST 795.0 MILLIONS.

WHAT DOES IT INCLUDE:

- TEN LAUNCHES
- DEVELOPMENT AND MANUFACTURE OF 13 S-I STAGES
- DEVELOPMENT AND MANUFACTURE OF 10 S-IV STAGES
- ESTABLISHMENT OF CSD MICHOUD OPERATIONS
- DEVELOPMENT AND PROCUREMENT OF THE GUIDANCE SYSTEM
- DEVELOPMENT AND MANUFACTURE OF 11 INSTRUMENT UNITS
- SIGNIFICANT STEPS IN AUTOMATION LEADING TO SATURN V LAUNCH CONCEPT

Figure 4. - History.

AUGUST 1958	ARPA AUTHORIZES STATIC TEST, 1.5 MILL. LBS THRUST, CLUSTERED ENGINES.
MAY. . . 1959	TITAN I FIRST STAGE SELECTED AS SECOND STAGE, CENTAUR AS THIRD STAGE.
DEC. . . 1959	SILVERSTEIN COMMITTEE, S-IV REPLACES TITAN AS SECOND STAGE.
APRIL . . 1961	S-IV STAGE TO SIX ENGINES, THIRD STAGE DEFERRED FROM EARLY DEVELOPMENT.

Figure 3. - Saturn I development program.

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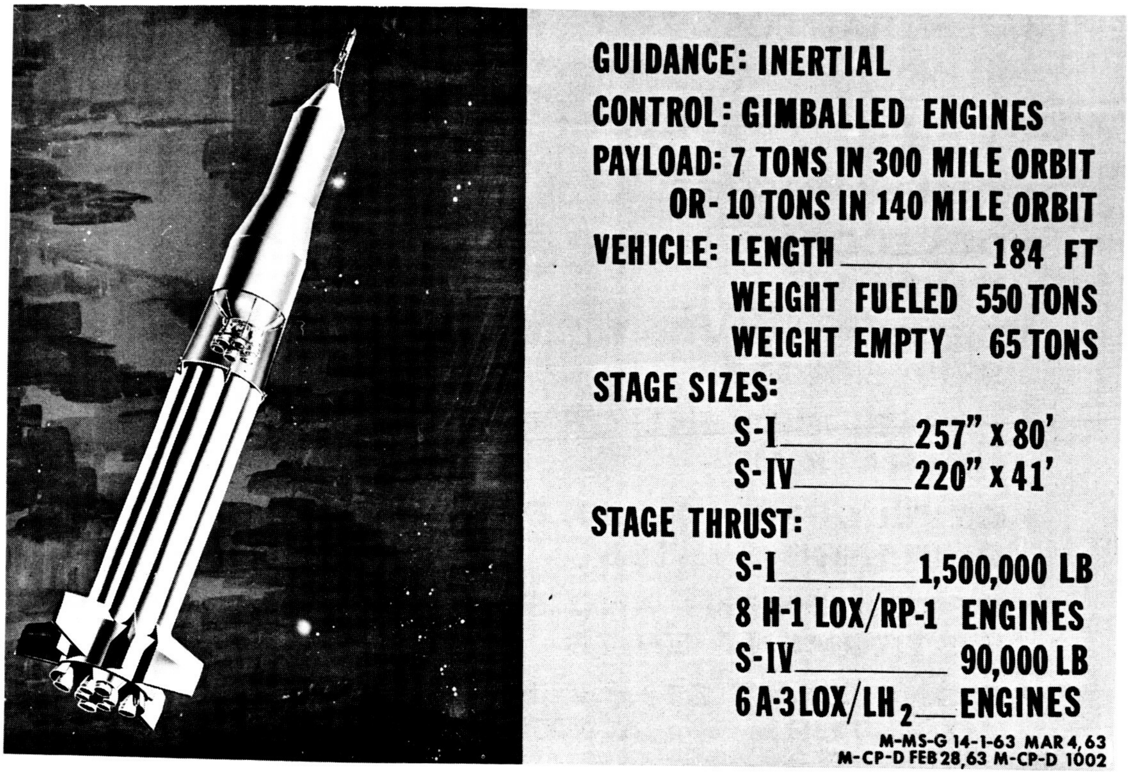

Figure 5. - Saturn I (Block II) characteristics.

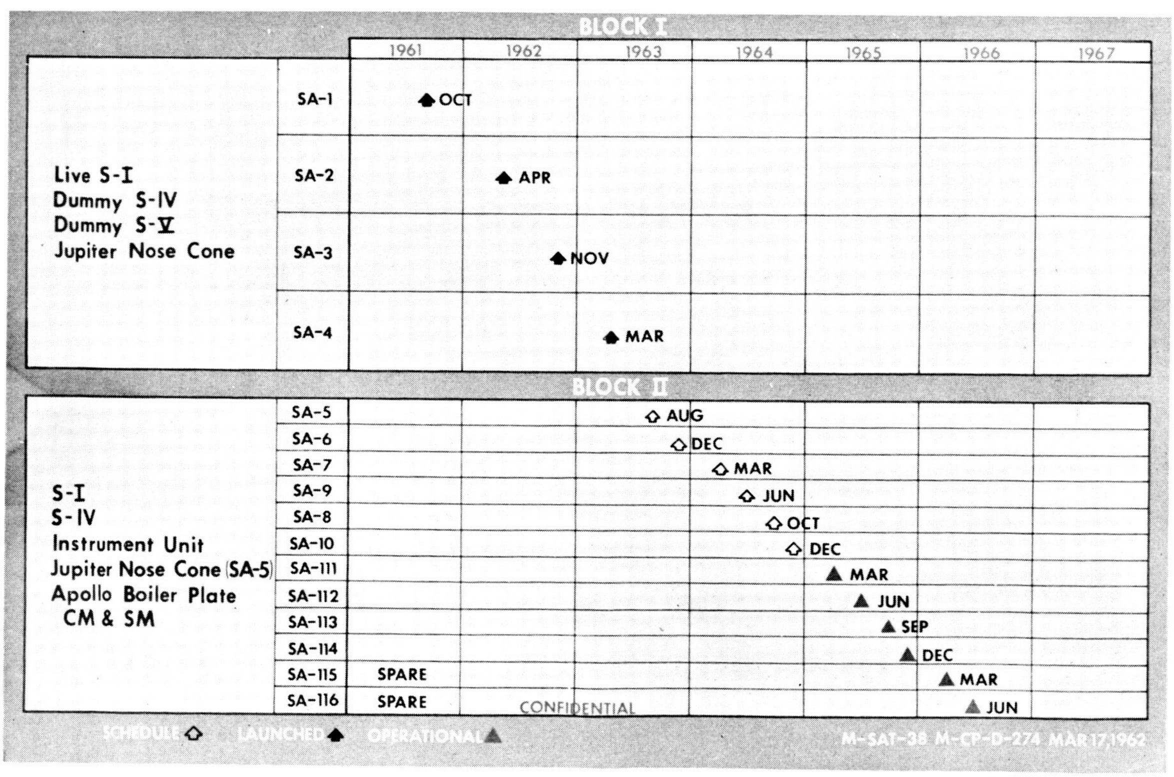

Figure 6. - Saturn I launch schedule.

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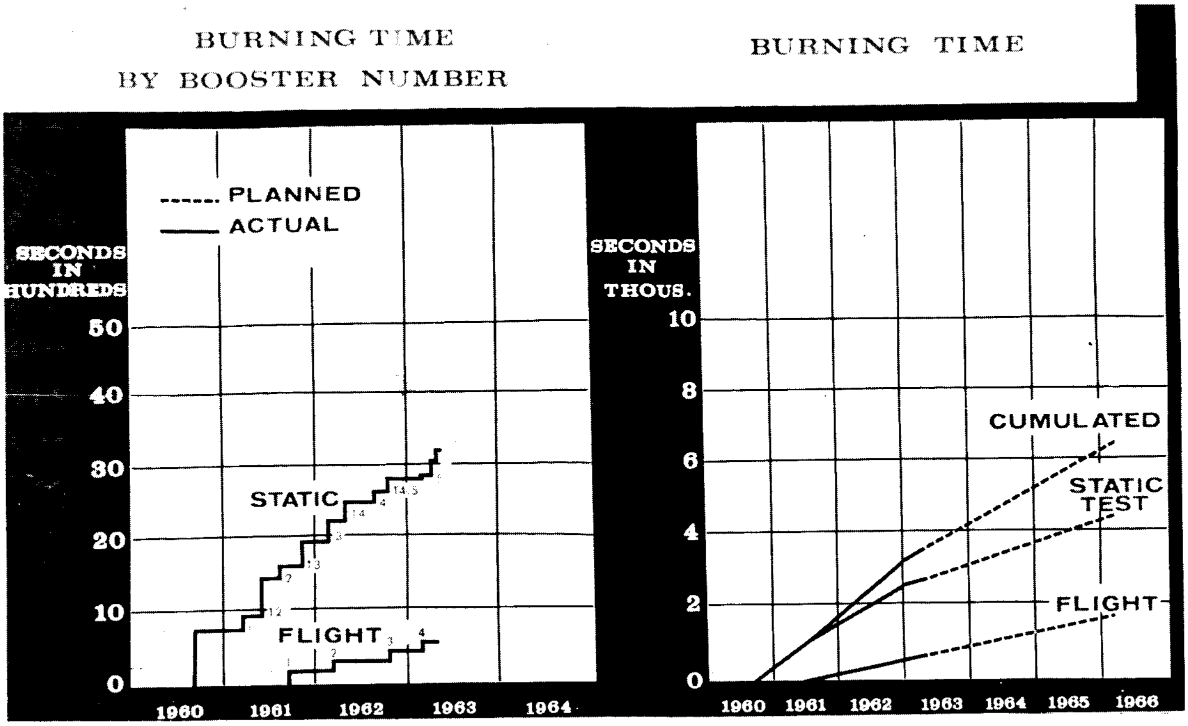

Figure 7. - S-I stage engine burning time.

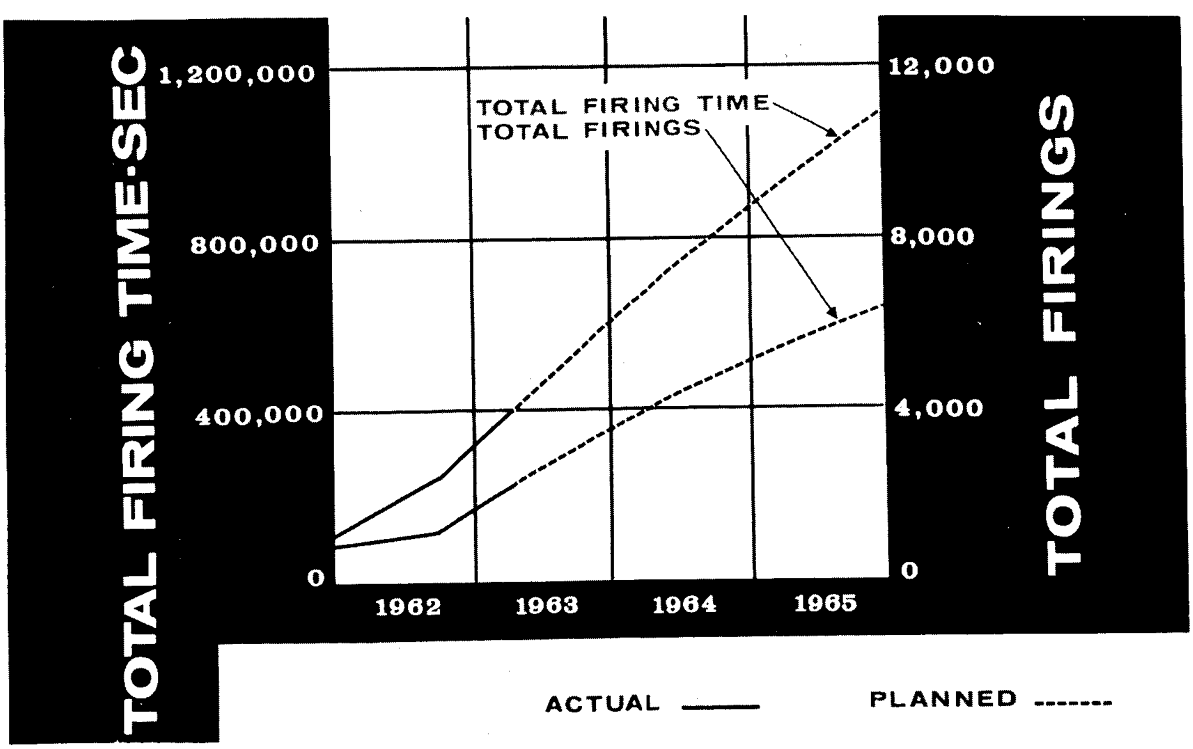

Figure 8. - RL-10 total firing time.

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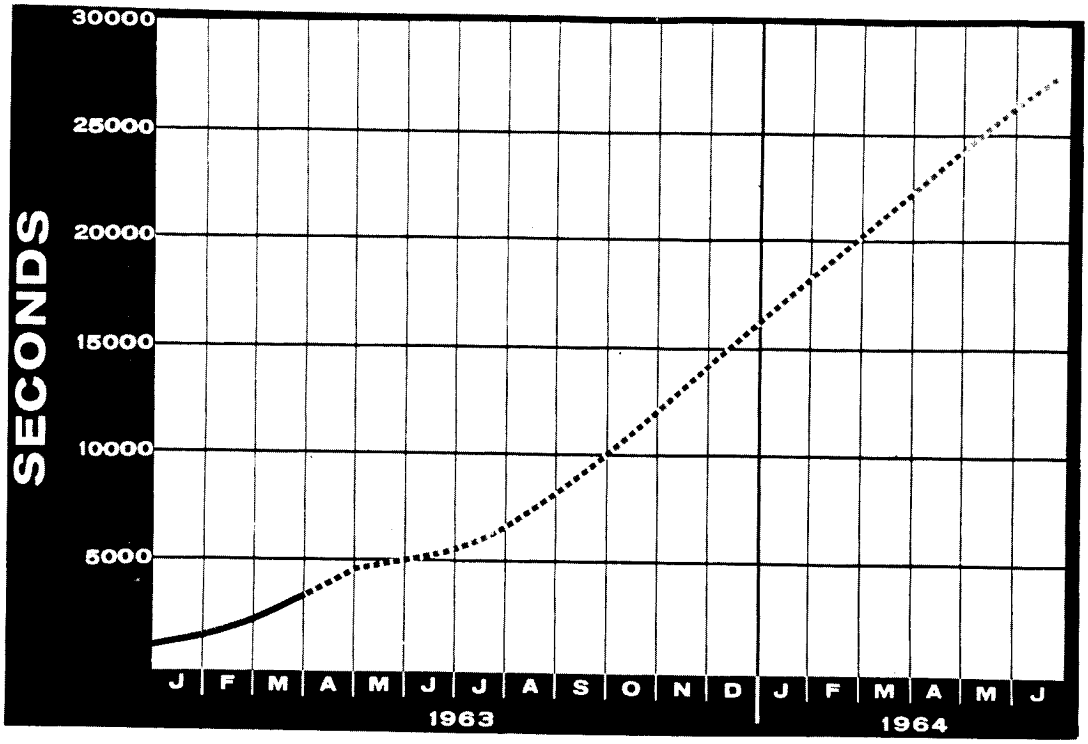

Figure 9. - S-IV stage static test times.

SATURN I VEHICLE	LAUNCH VEHICLE DEVELOPMENT	GUIDANCE		APOLLO			
		PASSENGER	ACTIVE	ENVIRONMENT	ABORT SYSTEM	SPACE CRAFT QUALITY	MANNED FLIGHT
SA - 5	▲	▲					
SA - 6	▲		▲	▲			
SA - 7	▲		▲	▲			
SA - 8	▲		▲		▲		
SA - 9	▲		▲		▲		
SA - 10	▲		▲		▲	▲	
SA - 111			▲		▲		▲
& SUB.			▲		▲		▲
OTHER MISSIONS	1. VOICE TRANSMISSION FROM SA-5 IN ORBIT 2. MICROMETEOROID SATELLITE, SA-8, SA-9						

Figure 10. - Saturn I missions.

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