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August 5, 1965

SATURN PROJECT FACT SHEET

Introduction

The National Aeronautics and Space Administration is developing two heavy space vehicles under the project name "Saturn." The main purpose of the Saturn project is to provide the launch vehicles for extended manned space flight including an expedition of astronauts to the moon before 1970.

The two vehicles under development are the Saturn IB and Saturn V rockets.

NASA's first vehicle in the Saturn family was the highly successful Saturn I. The program, which began in late 1958, was concluded July 30, 1965, with the launch of the tenth vehicle in the series. All flights were successful.

MORE

The NASA field center responsible for Saturn development is the Marshall Space Flight Center, Huntsville, Ala. The Manned Spacecraft Center, Houston, Texas, is in charge of developing the Apollo spacecraft, training the astronauts, and maintaining flight control. The Kennedy Space Center, Cape Kennedy, Fla., is in charge of preparing launch facilities and conducting the launchings. All three centers work under the direction of NASA Associate Administrator for Manned Space Flight.

First launch of a Saturn IB, middle member of the Saturn family, is planned for early 1966. Saturn IB, which is larger than the Saturn I, is a two-stage vehicle standing 225 feet tall. It will weigh 640 tons when fueled. Saturn IB's booster (S-IB), a modified Saturn I first stage, has a thrust of 1.6 million pounds -- 100,000 more than Saturn I. Its second stage (S-IVB) will generate 200,000 pounds thrust, or more than twice that of the Saturn I's second stage. This is an early "bonus" use of the S-IVB -- it was originally planned to serve as the third stage of the Saturn V.

Using the 200,000 pound-thrust S-IVB second stage, the Saturn IB's payload capability is increased 50 per cent over the Saturn I without the cost of a new development program. The Saturn IB will place 18 tons of payload into low earth orbit compared with up to 11 tons for Saturn I.

Saturn IB will be used for Apollo earth orbital missions necessary for Apollo spacecraft development and astronaut training.

The largest vehicle in the project is the three-stage Saturn V rocket. The 365-foot-tall launch vehicle is destined to send the Apollo spacecraft and its crew of three to the moon.

An addition to the Saturn family is under study -- the proposed Saturn IB/ Centaur combination. The Marshall Center has established a project office to plan the program.

The Saturn IB/Centaur would combine the two stage IB launch vehicle with the Centaur. Centaur would be the vehicle's third stage. Proposed missions for the newest Saturn include carrying Voyager spacecraft on its first leg of a journey to Mars.

The three stage Saturn IB/Centaur vehicle is expected to provide a flexible space transportation system capable of sending up to 14,000 pounds on earth escape missions.

While the first missions of the Saturn IB and Saturn V are in support of the Apollo moon landing program, the vehicles are expected to be used for extended space exploration and other missions in the 1970's. Improvement studies are already in progress for both vehicles. The main methods of increasing the vehicles' payload capabilities being considered include increasing the performance of present engines and the addition of strap-on solid rocket motors to augment booster thrust.

Saturn IB

NASA found that a launch vehicle with a payload capability somewhat greater than the Saturn I would be needed for earth orbital missions with the Apollo spacecraft. These earth orbital missions are for spacecraft development and astronaut training.

Detailed studies had shown that by combining elements of the then approved Saturn I and V programs, a vehicle of the desired capability could be obtained with a minimum cost and leadtime. This new vehicle -- initiated in mid-1962 and designated the Saturn IB -- uses the first stage of the Saturn I, with minor state-of-the-art improvements, the S-IVB third stage and instrument unit from the Saturn V, as well as the facilities which were available in both programs. The early development of the S-IVB stage was possible due to the technology gained from the S-IV stage development in the Saturn I program. Also, the instrument unit used on the Satum IB and V programs was a direct development outgrowth from the Saturn I instrument unit, thus again minimizing the development cost and leadtime.

The present Saturn IB program calls for the launching of 12 vehicles during the 1966-1968 period with the ability to continue at a rate of six to 12 flights per year thereafter.

S-IB Stage: The Saturn I first stage (S-I) was redesigned in several areas and designated the S-IB. However it remains basically the same configuration.

Booster weight is some 85,000 pounds, 16,000 pounds less than the Saturn I first stage. Weight was reduced by reducing the fin area, removing hydrogen vent pipes and brackets unnecessary to the new design, resizing machined parts in the tail section assembly, modifying propellant tanks, redesigning the spider beam and by reducing weight in the propellant, instrumentation and electrical systems.

The stage is 80 feet long and 21-1/2 feet in diameter.

S-IB stage's eight Rocketdyne H-1 engines each produce 200,000 pounds thrust. Total thrust of the stage is 1.6 million pounds. H-1 engines on the S-I stage were rated at 188,000 pounds thrust each but were uprated for use on the larger vehicle.

Chrysler Corp. is building S-IB stages at the NASA-Michoud Assembly Facility in New Orleans. The stages are being shipped by barge to the Marshall Center for static firings on a modified S-I test stand. The first two flight boosters -- S-IB-1 and S-IB-2 -- have been captive tested and are undergoing post static checkout at Michoud.

A Saturn IB dynamic test vehicle, a non-flight replica of the first Saturn IB flight vehicle, recently underwent "shake" tests at the Marshall Center to determine vibration characteristics and bending modes experienced in flight.

Studies designed to investigate possible S-IB improvements are underway. These studies including uprating the vehicle's engines and adding strap-on solid assist rockets.

S-IVB Stage: The S-IVB stage is the second stage of the Saturn IB launch vehicle. It will also be the third and final stage of the Saturn V.

This stage provides the final velocity increment on both vehicles, to put the Apollo spacecraft into earth orbit. In its Saturn V application the vehicle's one J-2 engine will restart in orbit and inject the Apollo into the translunar trajectory.

Since the S-IVB stage will be used on the Saturn IB launch vehicle, and this vehicle will precede the Saturn V, the larger rocket will fly with an upper stage proven in a flight program.

Douglas Aircraft Co. was assigned the prime development contract for the S-IVB because of the firm's experience with the Saturn I second (S-IV) stage.

The S-IVB, being developed by Douglas under the direction of the Marshall Center, is 22 feet (260 inches) in diameter, 60 feet long, carries approximately 230,000 pounds of usable propellants and is powered by a 200,000 pound thrust Rocketdyne J-2 engine.

The propellants are liquid oxygen and liquid hydrogen.

In the Saturn IB configuration, the S-IVB tankage is identical to that used on Saturn V. The forward and aft skirts are of lighter construction because of the lighter payloads carried and the lower thrust of the booster. The interstage is cylindrical to coincide with the 260 inch diameter of the S-IB booster rather than conical as in the Saturn V. Also, mission differences make it possible to use a smaller attitude control module as there is no restart requirement for the J-2 engine. These mission differences impose some different equipment and instrumentation requirements.

Saturn V

The need for a vehicle much larger than Saturn I was established when the late President Kennedy set as a national goal a manned lunar landing before 1970. NASA, after several months of extensive studies, announced on January 10, 1962, that the Marshall Center had been assigned the task of developing the Saturn V -- a goliath which would be about 365 feet tall, with Apollo payload.

This rocket will have three stages and will weigh more than six million pounds at liftoff. It will be capable of placing a payload of more than 250,000 pounds into earth orbit or sending about 95,000 pounds to the moon. This is the power needed to hurl the Apollo spacecraft to the moon for a manned landing using the lunar orbital rendezvous technique.

There are 15 flights presently planned in the Saturn V program.

S-IC Stage: The Marshall Center and the Boeing Co. are jointly designing and developing the Saturn V first stage, or S-IC booster. Boeing, as prime contractor, will do most of the manufacturing and assembly.

The stage is 138-feet-long and 33 feet in diameter. The cylindrical booster has separate propellant tanks with a capacity of about 4,400,000 pounds. Both the liquid oxygen and RP-1 (kerosene) tanks have baffles to control liquid sloshing at all levels.

Dry weight of the stage is 280,000 pounds.

Five F-1 engines are clustered to form this stage, and, with each developing 1.5 million pounds thrust, total thrust is 7.5 million pounds.

The F-1 engine, developed by Rocketdyne Division of North American, has been static fired many times at full thrust for full duration (about 2-1/2 minutes.)

Four of the engines are mounted on a 364-inch diameter ring and gimballed for control purposes. The fifth engine is rigidly mounted in the center.

The S-IC's engines drink liquid oxygen and kerosene at the rate of 15 tons per second. Total burning time in flight is two and one half minutes.

At lift-off, the S-IC stage will be lifting the entire Saturn V vehicle and the Apollo spacecraft for a combined weight of more than 6,000,000 pounds, which corresponds to the takeoff weight of 19 fully loaded Boeing jet airliners.

The Marshall Center completed in Huntsville the S-IC-T static test stage at its Manufacturing Engineering Laboratory and put the booster in the test stand in March of 1965. Short duration tests have been conducted and are leading to a full duration run.

Four S-IC stages will be assembled at the Marshall Center, including the S-IC-T. Other stages built here include the S-IC-S and the first two flight stages.

All other stages will be produced by Boeing at the Michoud Assembly Facility in New Orleans. Boeing-built stages will include a dynamic test vehicle (S-IC-D), a facility vehicle (S-IC-F) and the remaining flight stages. The flight stages will be tested at NASA's Mississippi Test Facility, Hancock County, Miss.

S-II Stage: The S-II stands 81-1/2 feet high, has a 33-foot diameter, and weighs 80,000 pounds empty and 1,025,000 pounds loaded.

The stage, being developed by the Space and Information Systems Division of North American Aviation, Inc., is constructed primarily of an aluminum alloy.

With its five Rocketdyne J-2 engines of 200,000 pounds thrust each, the S-II develops a total thrust of one million pounds.

The cylindrical stage is made up of two propellant tanks separated by an insulated common bulkhead. Starting at the top is the forward skirt to which the upper S-IVB (third stage) connects. Below it, occupying more than half the total length of the stage, is the 288,750-gallon liquid hydrogen tank. Below the common bulkhead is a 93,750 gallon liquid oxygen tank. A thrust structure holding the five engines and an interstage, which connects the S-II and S-IC booster, complete the stage.

S-II's propellant capacity is 930,000 pounds.

North American is conducting research and development static testing at its Static Test Lab at Santa Susana, Calif. The battleship test program has been underway for several months and a full duration run of nearly 400 seconds is planned soon.

All flight stages will be tested at the Mississippi Test Facility.

Instrument Unit

The instrument unit (IU) is the "brain" or "nerve center" of the Saturn vehicle. Commands for engine gimballing, inflight sequencing of engine propulsion system, staging operations and all primary timing signals originate in the IU.

Saturn IB and Saturn V IU's are almost identical. The instrument unit for these vehicles is a 260-inch diameter "wafer." Outside height is three feet, and it weighs about 4,000 pounds. Components are fastened on panels mounted to the inside perimeter of the IU skin.

The International Business Machines Corp., supplier of the guidance signal processor and guidance computer, has been named instrument unit "prime contractor." IBM had limited responsibilities in the integration of Saturn I instrument units will assume full integration responsibilities early in the Saturn IB program.

The Saturn IU has been developed from the instrumentation package flown on the last six Saturn I vehicles. Unpressurized instrument units were flown on the last three Saturn I vehicles. This IU was 154-inches in diameter, 34 inches high and weighed some 2,700 pounds. Components were also mounted on the inside perimeter of the IU wafer.

The six major systems of the IU are structural, environmental control, guidance and control, measuring and telemetry, radio frequency and electrical.

Major suppliers of instrument unit components are Electronics Communications Inc., St. Petersburg, Fla., control computer; Bendix Corp., Teterboro, N. J., ST-124 inertial platform; and IBM Federal Systems Division, Owego, N. Y., launch vehicle digital computer and launch vehicle data adapter.

Transportation

The size of Saturn rockets presents unique transportation problems. Most of the stages are too large for conventional highway, rail or air movement.

Special barges move the units produced and/or tested at Huntsville to the launching site via the Tennessee, Ohio and Mississippi Rivers, the Gulf of Mexico and intracoastal waterways to the NASA-Kennedy Space Center on the east coast of Florida, a distance of more than 2,200 miles.

The same system is being used for moving the stages produced at Michoud to the test site in Mississippi and to the Florida launching site. The larger stages produced on the West Coast will be moved by water via the Panama Canal.

The NASA barges "Promise" and "Palaemon" have been in use throughout the Saturn I program and are now being used to carry the Saturn IB. A new barge for carrying the S-IC stage is nearing completion. Other open deck vessels now being modified will be used in shuttle runs between Michoud and the Mississippi Test Facility.

Propellant will be carried to Mississippi Test Facility tests on specially built cryogenic barges.

On the West Coast, the NASA barge "Orion" now carries the S-IVB stage from Huntington Beach to Sacramento for static tests.

A sea-going vessel, the Point Barrow, will carry the S-II and S-IVB stages from Los Angeles to Cape Kennedy. The Point Barrow has made one such trip through the Panama Canal to date. The vessel is operated by the Military Sea Transportation Service of the Navy.

A modified aircraft, known as the "Pregnant Guppy," was used in the Saturn I program for flying the S-IV stage from the West Coast. The Guppy is also used for flying single F-1 engines and other small items.

Aerospace Lines Inc., builders of the Guppy, is presently completing a larger aircraft. This craft, to be called the "Very Pregnant Guppy," is being proposed as a carrier for the S-IVB.

Facilities

Saturns' size called for several new development, testing and launching facilities.

Saturn I ground testing program has ended and most of the Marshall Center facilities for this program have been converted to accommodate the Saturn IB.

MSFC's two-position S-I test stand has been modified to static test the S-IB and single F-1 engines. A dynamic test stand for completely assembled Saturn I vehicles is being used for the Saturn IB.

Marshall Center facilities for the Saturn V program are also completed, including the S-IC static test stand, an F-1 engine stand, and a Saturn V dynamic test tower. Various support facilities for the Saturn V program have been built. These include a J-2 engine test facility, an acoustic test facility and ground support equipment test facility.

At Cape Kennedy where the Kennedy Space Center and contractors launch the Saturn vehicles, several major construction projects are in progress.

Launch Complexes 34 37 are presently being readied for the Saturn IB.

A new 80,000-acre annex adjoining the present facilities -- Merritt Island Launch Area (MILA) -- is under development for launching the Saturn V and other large vehicles. MILA construction includes the vehicle assembly building, the world's largest building, and three launch umbilical towers.

Saturn V vehicles will be assembled in the vertical position on the transporters in the huge vehicle assembly building, then transported several miles to the launch area.

S-IC stages are being produced by the Boeing Co. at the NASA-Michoud Assembly Facility's main plant which has 40 acres under one roof. A vehicle assembly building for the S-IC stage is in use at Michoud and other support projects are in progress.

Construction is progressing on the new static testing site at the Mississippi Test Facility, Hancock County, Miss. The S-IC stages built in New Orleans and the S-II stages from the West Coast will undergo pre-flight static tests there.

New or modified testing facilities have been completed at contractor plants at Canoga Park, Edwards, Sacramento, Seal Beach and Santa Susana, California.

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