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SATURN AND LUNAR FLIGHT

In May 1961, President Kennedy established, as a national objective, manned lunar landings within this decade. Responsibility was assigned to the National Aeronautics and Space Administration to carry out this formidible and challenging task.

To do this, it has been necessary to initiate development of sophisticated launch vehicles and spacecraft.

Moreover it has been necessary to extend our technological capability in every area to meet requirements of the advanced NASA missions.

To date, the results have been gratifying.

In the field of spacecraft development, MERCURY flights have progressed from three-to six earth orbits. The program for a two-man spacecraft -- the GEMINI -- is well underway. And design development has begun for the APOLLO, the three-man spacecraft which will be used to land men on the moon.

Here, at the Marshall Space Flight Center, we are developing the heavy launch vehicles required to support the NASA advanced missions. These --

the SATURN class vehicles -- are the latest steps in a distinguished line of launch vehicles, used by NASA during the past several years.

I should like to review with you, a few of these vehicles. Then, I will outline for you some of our present activities and some of our plans.

May we have the lights down, and the first slide, please.

SLIDE 1 - Vehicle Trend (C-a-30)

Here to your left, is the REDSTONE, developed by the U. S. Army and modified for use as a launch vehicle. In January 1958, the Army launched the first US satellite, EXPLORER 1, using this vehicle.

REDSTONE-type propellant containers are now used in the SATURN first stage. And, REDSTONE technology paved the way for the JUPITER 1500-mile missile.

The JUPITER, second from the left, was used as a booster with solid propellant upper stages. Much JUPITER technology -- and a number of components, including basic engine designs -- fed into the SATURN program. The Air-Force-developed THOR was another step forward. THOR-based launch vehicles have been used as carriers for many NASA launches.

ATLAS, fourth in the lineup, is an Air Force booster adapted for use as the MERCURY carrier.

The TITAN-ICBM is being modified for use as a booster of the GEMINI spacecraft. GEMINI is intermediate between the one man MERCURY and the three-man APOLLO.

The next three SATURN vehicles are a part of my subject for this evening. These will be discussed later.

Last is the NOVA, now undergoing detailed design studies.

SLIDE 2.- ATLAS/MERCURY (MSA-b-5)

As I said, the ATLAS vehicle is now used for MERCURY orbital missions. Initial flights proved out vehicle-spacecraft compatibility, ground facilities, and the world-wide tracking network.

SLIDE 3 - MERCURY Capsule (MSA-a-12a)

In February of this year, John Glenn made the first MERCURY orbital flight. He circled the earth three times in a 100-mile orbit and returned safely to earth. He was followed closely by Scott Carpenter. On October 3, Astronaut Walter Schirra made the first day-long trip of six orbits.

SLIDE 4 - TITAN II-GEMINI (MSB-a-5)

A modified TITAN II will be used to orbit the two-man GEMINI spacecraft --- the next phase of our man-in-space program. GEMINI is the same general shape and has many similar systems of the

MERCURY, but is one foot larger in diameter, and weighs twice as much --- 6,000 pounds.

SLIDE 5 - GEMINI Mockup (MSB-a-12)

Initial GEMINI flights will begin in late 1964, and continue for about two years. A full-size mockup of GEMINI is shown in this slide. The spacecraft will provide experience over long flight periods --- as long as 10 days in duration. The spacecraft will be used in development of rendezvous techniques, which are basic in accomplishing the lunar landing.

SLIDE 6 - APOLLO Spacecraft (MSC-c-4a)

The three-man APOLLO spacecraft will be used for circumlunar flights and manned lunar landings.

The spacecraft is composed of three sections. To your left, at the bottom, is the Lunar Excursion Module, or bug for reaching the moon's surface. The bug will carry two of the crew members to the lunar surface, along with scientific instruments, communications and guidance systems, and propulsion required to return to the orbiting Command Module.

The Service Module, in the center section, contains the propulsion and power unit necessary for maneuvering into and escaping from lunar orbit.

At the top, is the three-man compartment. Of all these segments, the Command Module is the only portion to return to earth.

SLIDE 7 - McD (MSC-a-27)

The Command Module, shown here, will carry the three-man crew, plus guidance, communications, and life support system. One man will remain within the orbiting module, while the other two astronauts descend to the lunar surface.

This, the APOLLO spacecraft, is the latest step in spacecraft research and development. First, came sub-orbital MERCURY-REDSTONE flights. Second, the MERCURY-ATLAS flights. And third, are the forthcoming GEMINI flights.

SLIDE 8 - C-1 (MSC-b-6)

To support the APOLLO program, three heavy launch vehicles of the SATURN class are under development. This is the present SATURN C-1. The early configuration -- live booster, inert upper stages — is being tested now to flight qualify the booster. The SATURN shown here will launch early models of the first earth-orbital APOLLO, composed of the Command and Service Modules only.

SLIDE 9 - SI/SIV Sep (MSC-b-8a)

In this slide, the booster has separated. The SATURN second stage -- now being developed by industry -- has ignited. The six-engine second stage accelerates the spacecraft to orbital velocity.

SLIDE 10 - SIV/APOLLO Sep (MSC-b-9a)

The second stage now falls away, leaving the two-segment spacecraft in orbit. First flights will test performance of the unmanned spacecraft. On later, manned, flights, the astronauts will further perfect flight techniques begun in the GEMINI program.

SLIDE 11 - C1B (MSC-c-5)

The C-1B will have a even greater payload capability, about 32,000 pounds. The C-1B will flight test the complete APOLLO lunar landing configuration spacecraft in earth-orbit. This includes the Command, Service, and Lunar Excursion modules.

SLIDE 12 - C5/APOLLO (C5-c-2)

The three-stage SATURN C-5, shown here, is now under intensive development. All stages and engines have been contracted to industry. The vehicle will stand near the height of a 35-story building, and will weigh about 6 million pounds. The Advanced SATURN C-5, will propel the complete spacecraft on the lunar trajectory.

SLIDE 13 - Barge (T-c-22)

The extreme size and weight of SATURN stages presents many problems -- fabrication, handling, test, and, of course, transportation. As shown here, the problem of transporting has been solved by use of barges, which will move the stages from the manufacturing and test areas to the launch site. Other problems were encountered in providing facilities for the extremely large Advanced SATURN.

SLIDE 14 - Vert. Assembly Bldg. (C5-b-13)

For example, a radically new approach was taken in the assembly and launch of the C-5. In this 48-story building, the C-5 will be erected, mated to the spacecraft, and automatically checked out on a launch rack which also supports a 400-foot umbilical tower.

SLIDE 15 - Crawler (C5-b-11a)

When checkout is complete, a 2,500-ton crawler vehicle -- such as shown here -- will pick up the rack with the complete vehicle and umbilical tower, and carry them some 2 miles to the launch site. At the site, the rack with vehicle will be lowered to the launch platform.

SLIDE 16 - C5/APOLLO 2nd Stage (MSC-c-14)

This, as now planned, is a typical lunar excursion. A single C-5 will launch the complete APOLLO spacecraft on the lunar mission. Here, the S-II separation is followed by a short third stage burn, which places the stage and spacecraft into a low-earth, circular orbit. On approaching the launch window, the stage is re-ignited, and will burn for about 7 minutes, accelerating the spacecraft to escape velocity and placing it in an earth-lunar trajectory.

SLIDE 17 - Docking (MSC-c-16)

A few minutes after injection, the panels surrounding the bug are jettisoned. Then, the bug will be mated with the Command Module in a nose-to-nose position. This will be done by flying the module to its new position. The third stage then separates from the spacecraft.

SLIDE 18 - Enter Lunar Orbit (MSC-c-17)

On approaching the moon, the Service Module propulsion will be briefly ignited, decelerating the spacecraft to a predetermined 100-kilometer lunar orbit.

SLIDE 19 - Entering Landing Ellipse (MSC-c-18)

Two astronauts will enter the "bug" through a hatch in the nose of the Command Module. The "bug" then separates from the spacecraft, which remains in a two-hour lunar orbit.

SLIDE 20 - Lunar Descent (MSC-c-19)

The main engine of the "bug's" land stage is fired, decelerating the module. Through a combined manual/automatic control system, the "bug" will be brought close to the lunar surface. About 200 pounds of scientific equipment will be carried for exploration and experiments on the moon. At any point in the descent, the crew can abort the landing and return to the mother ship.

SLIDE 21 - Landing Maneuver (MSC-c-22)

At about 100 feet above the lunar surface, the "bug" will hover while final selection of a landing site is made. The vehicle will have the capability of hovering for about one minute, and will be able to move laterally to the best touchdown point.

After landing, the explorers will immediately prepare for re-launch by a thorough vehicle inspection, test, and checkout. They can be assisted by instrumentation in the orbiting APOLLO spacecraft and, possibly, by information obtained from monitoring stations on the earth. Exploration will begin only after checkout has been completed.

SLIDE 22 - Lunar Liftoff (MSC-c-23)

To re-launch, the crew will fire the upper portion of the "bug" into a transfer ellipse. The APOLLO spacecraft will be in line of sight, but will travel with the "bug" part way around the moon until the Lunar Orbital Rendezvous is accomplished.

SLIDE 23 - Lunar Orbit Rendezvous (MSC-c-24)

Docking of the "bug" and APOLLO will be very critical maneuver. This must be practiced extensively in earth orbit, prior to the lunar excursion, and may be one of the later C-1B missions.

After docking, the "bug's" crew transfers to the Command Module.

SLIDE 24 - Leaving Lunar Orbit (MSC-c-25)

After final checkout, the Service Module propulsion is ignited and the spacecraft modules are accelerated into escape trajectory. The "bug" will be left in lunar orbit. Later, after completion of mid-course correction and before re-entry, the Service Module will be jettisoned. The Command Module will be oriented for re-entry.

SLIDE 25 - Parachute Re-entry (MSC-c-31)

Shortly thereafter, the main parachute will deploy, lowering the module to an earth, rather than a sea landing.

LIGHTS UP

That was the lunar flight as envisioned today. Of course, changes can -- and often do -- come tomorrow.

We in NASA are confronted with a tremendous challenge by the range of problems in space vehicle research and technology. To meet this challenge, we are using the talents and skills of industry, research institutions, and the NASA Centers.

The scope of this effort requires the best scientific & technical skills this country can secure. And, it will also require the support and understanding of each and every American. For, as President Kennedy said, this is not one man going to the moon, but an entire nation.

SLIDE LIST, Mr. K. K. Dannenberg, American Society of Civil Engineers, Huntsville, Alabama

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