Release After Oct. 15, 1967
National Aeronautics and Space Administration
400 Maryland Ave., S.W., Washington, D.C. 20546
(202) 963-6928

SPACE SHEET

Public Information Division

Vol. 5, No. 19

FYI *By substituting your own floating masthead in this space, you may use this Sheet as your own bi-weekly Space Page.*

Beginning of Saturn V Dates Back A Decade

WASHINGTON, D.C. — In August, 1958, nearly a year after Sputnik I spun over the horizon—ushering in the space era—America's research and development effort set out to create a 1.5 million pound thrust rocket booster by clustering previously developed engines.

Test Flight

And these efforts have culminated today in the Apollo/Saturn V space vehicle, which this quarter is scheduled to make a test flight from the National Aeronautics and Space Administration's John F. Kennedy Space Center, Fla.

Even before NASA, in July, 1960, first proposed a program for manned flight to the moon—Project Apollo—work had begun on development of high-performance boosters for advanced space missions.

In October 1958, the Army team had developed a booster tentatively called Juno V and finally designated Saturn which was turned over to NASA late in 1959.

A manned lunar landing and return by the end of this decade was set as a national goal by President John F. Kennedy on May 25, 1961, when he proposed that the United States accelerate its space program.

Firm Commitment

"Let it be clear . . . that I am asking Congress and the country to accept a firm commitment to a new course of action, a course which will last for many years and carry very heavy costs . . . If we are to go only halfway, or reduce our sights in the face of difficulty, in my judgment it would be better not to go at all," he stated.

Commitment to this goal created an immediate need for a considerably more powerful booster—later designated the Saturn V.

The lifting power for the lunar landing, it was announced in January, 1962, would be provided by the Saturn V, using a cluster of five engines, generating 7.5 millions pounds of thrust.

Later that same year, in July, 1962, NASA selected the lunar orbital rendezvous mode for the moon flight.

A year later, the first Apollo command module was flown at White Sands Missile Range in a launch pad abort test. The first high altitude abort was successfully demonstrated on May 13, 1964. Fifteen days later a Saturn I placed the first Apollo command module into orbit from Cape Kennedy.

The command module's reentry heat shield was successfully tested in February, 1966, during the first flight of the Uprated Saturn I.

Rocket Record

An unprecedented record in rocket development was established when the first phase of the Saturn launch vehicle program was completed in 1965. In 10 flights of Saturn I, 10 were successful and much technology was proven in the program.

Three successful flights in three attempts were made by the Uprated Saturn I launch vehicle in 1966.

Then, on Jan. 27, 1967, tragedy struck the national space effort when a fire erupted inside an Apollo spacecraft during ground testing at Cape Kennedy, resulting in the deaths of three astronauts.

Set back by this tragedy, the Apollo program once again is heading towards its goal of manned lunar landing.

"Moonport U.S.A."

Complex 39—Where the Action Is

KENNEDY SPACE CENTER, Fla. — Complex 39, "Moonport, U.S.A.," is 3,000 people working in close harmony to assemble this nation's largest launch vehicles.

They are checking out for the National Aeronautics and Space Administration the myriad mechanical and electronic systems that together can hurl 125-ton payloads (equivalent to the weight of a diesel railway locomotive) into earth orbit at 17,500 miles per hour or send a 47-ton payload on a 25,000 mile-per-hour trajectory to the moon.

Huge Structures

Complex 39, where the first flight test of the Apollo/Saturn V space vehicle is scheduled this quarter, is also seven immense structures, the likes of which can be seen nowhere else on earth. These are: vehicle assembly building; mobile launcher; crawlerway; mobile service structure; transporters; launch site; and launch control center.

Dominating the skyline of Florida's east coast, the VAB is visible for many miles, and no wonder. It covers eight acres and is 716 feet long and 518 feet feet wide. Inside, its high bay area, 525 feet high, is large enough to accommodate four Saturn V launch vehicles at one time.

Just adjacent to the VAB is the launch control center. Here the final countdown and launch of Saturn V will be conducted.

Two separate, automated computer systems are used to check out and conduct the countdown for the Saturn V. One is used to check out the Apollo spacecraft and the other to check out the various stages of the rocket vehicle.

Communications

Sixty television cameras, positioned around the Saturn V, transmit pictures on 10 channels to the control center and innumerable intercommunications channels keep the launch team and launch director in contact with one another.

Basically, the mobile launcher is a platform with a floor area of about one-third of an acre on which the Saturn V is assembled, serviced and launched.

Supporting the Saturn V on the launcher is an open steel-work tower, 398 feet high. Below the launcher's platform are computer systems, equipment for propellant loading, hydraulic test sets, pneumatic lines, electrical power and water systems.

About the width of an eight-lane highway, the crawlway from the VAB to the launch site is just 3.5 miles long.

Transporter

The Apollo/Saturn V travels over this crawlway aboard a transporter, one of the largest land vehicles ever constructed. It weighs about six million pounds and can carry a 12-million-pound load.

Moving on four double-tracked crawler links like those of an army tank, the transporter has a maximum speed of one mile per hour. In operation, a transporter slips under the mobile launcher with its Saturn V burden, raises the entire mass off the ground and carries it to or from the launch site.

Once the Saturn V and its mobile launcher have been deposited at the launch site, the transporter brings in the mobile service structure. The five work platforms of the service structure close around the launch vehicle providing access for final connection of certain ordnance items, checkout functions and servicing systems of the Apollo spacecraft.

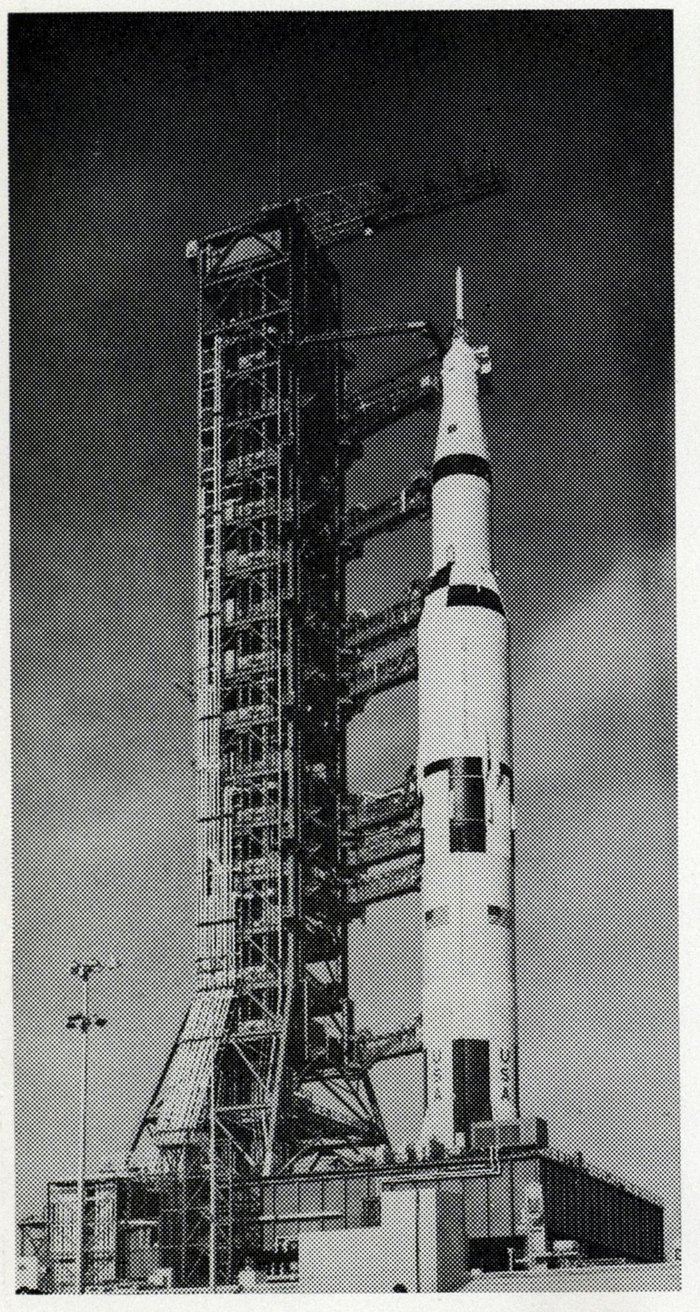
Launch Pads

Like everything else connected with Complex 39, the two launch sites are gargantuan in size. Polygon shaped Pad 39A is about 3,000 feet wide and covers about a quarter mile of ground.

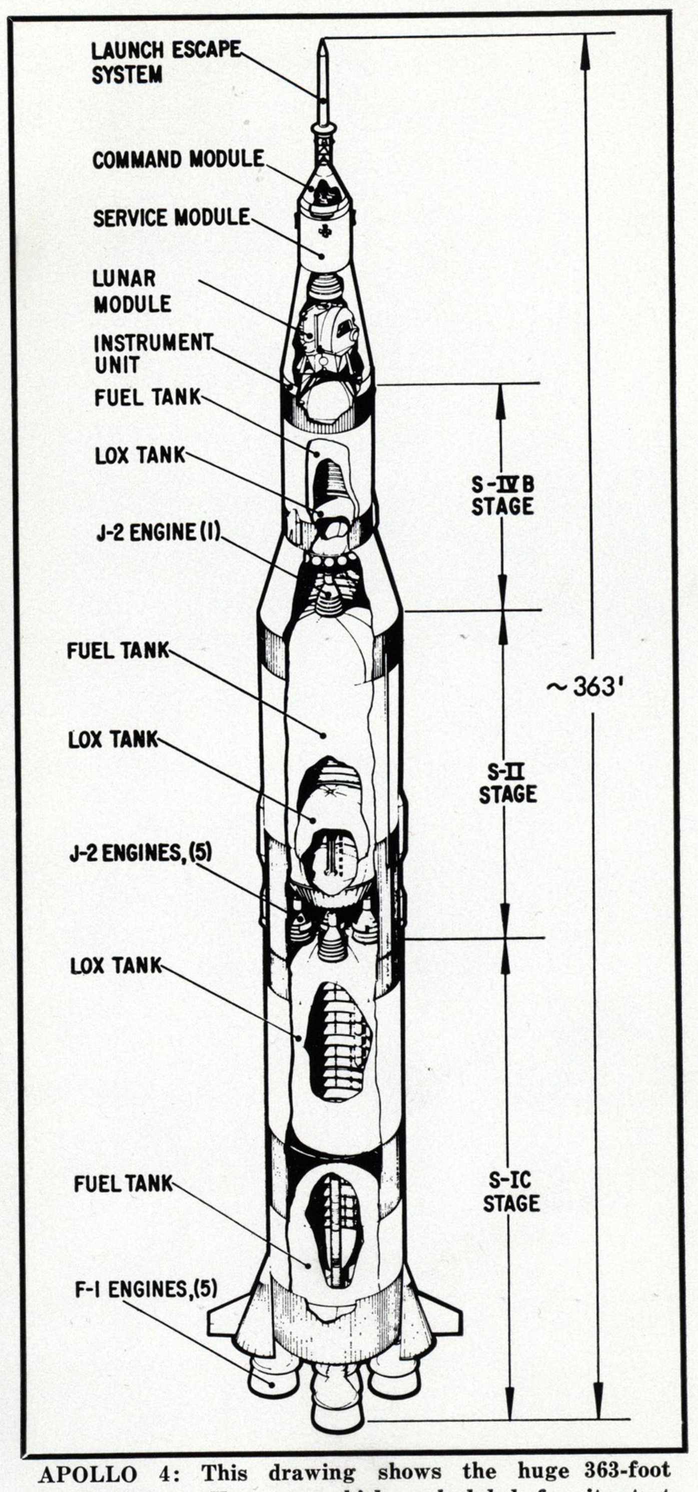
A deep flame trench partially bisects each pad and prior to launch a huge flame deflector will be moved into position directly beneath Saturn V.

The flaming energy ejected following ignition of the Saturn V engines is deflected in two directions along the flame trench. To further dissipate the flames, a water deluge system can pump 40,000 gallons of water per minute into the trench.

There is a small bronze plaque — tribute to all of Complex 39—on a wall of the Launch Control Center. Erected by the American Society of Civil Engineers, it states very simply Complex 39 "demonstrates the greatest engineering skills and the greatest contribution to civil engineering and mankind." It does indeed.



SITTING ON THE PAD: Ready for its first test flight later this quarter, the National Aeronautics and Space Administration's Apollo/Saturn V now waits at Pad A of Complex 39 at Kennedy Space Center, Fla.



APOLLO 4: This drawing shows the huge 363-foot Apollo/Saturn V space vehicle, scheduled for its test flight this quarter. The elements making up the National Aeronautics and Space Administration vehicle are shown in this drawing.

Commercial Potential of Rocket Technology

HUNTSVILLE, Ala. — Thanks to technical advances used to build the 180 million-horsepower Saturn V moon rocket, scheduled for its first flight test this quarter, tomorrow's home electrical products will last longer, doctors can keep closer watch on critically ill patients and complicated highway interchanges can be designed more quickly and cheaply.

Broad Advances

Many of the engineering achievements that made the National Aeronautics and Space Administration's Saturn V possible add up to broad advances in commercially important technical fields, such as:

- Low-temperature alloys—Saturn's upper stages carry liquid hydrogen at 423 degrees below zero;
- High-speed turbopumps—Saturn's five first-stage engines gulp 15 tons of propellant per second;
- Parts reliability— Saturn contains more than 160,000 electronic components with service lifetimes measured in centuries rather than hours.

Nearly 1,000 individual technical innovations from the laboratories and shops of the George C. Marshall Space Flight Center here, whose biggest job is the Saturn program, have been announced by NASA as potentially useful in non-aerospace industry.

For example:

A new kind of hammer, using gentle but powerful magnetomotive force, was invented to smooth out welded seams in the aluminum skin and 33-foot-diameter bulkheads of Saturn's first-stage tanks. It can shape, cut, punch or straighten metal without touching it.

A 24-ounce, battery-powered television camera, as small as a king-size pack of cigarettes, will observe the separation of Saturn's stages in flight. A commercial model is now on sale for monitoring industrial processes.

In medicine, the principle of an air bearing in a Saturn V guidance gyroscope has been used in the design of a table that floats on a thin film of air, supporting a patient free of vibration while the force of his heartbeat is measured.

Designers of bridges and freeway interchanges also benefit from Saturn technology, quickly evaluating hundreds of alternative designs by means of the same computer programs used to determine the best combinations of materials and structural shapes and sizes for the big rocket.

Other technical fields in which Saturn V has produced widely useful industrial advances include high-strength, lightweight alloys of magnesium, titanium and lithium; metal machining and forming; precision tooling; high-pressure tubing, connections, valves and seals; gas and liquid leak detection; vibration control; computer-controlled milling; flow metering; temperature and pressure measurement and non-destructive testing by ultrasonic analysis, X-ray television and infrared light.

Maze of Electronic Equipment

Newest Blockhouse Ready for Apollo Launch

KENNEDY SPACE CENTER, Fla.—When the final countdown on Apollo 4 begins here this quarter nearly 500 engineers, technicians and specialists will be participating from the newest model in the space age "blockhouse" line.

One of Four

This blockhouse for the first of the Saturn 5 "big shots" is called a firing room, Firing Room One to be exact. There will be three others. All are a part of the National Aeronautics and Space Administration's Launch Control Center at Launch Complex 39.

Unlike the circular concrete and steel blockhouses that dot nearby Cape Kennedy like giant mushrooms, Firing Room One is long and rectangular.

The east end of the room faces pads A and B of Launch Complex 39 and large windows will allow the launch crew to see the rocket lift from the pad three and a half miles away.

Men who work in Firing Room One are quick to point out, however, that there are few differences in the operational use of old and new. It has been said the difference is only more room, another stage to check out and more people.

Yet, the Apollo 4 space vehicle, ingloriously referred to as "the stack," stands 363 feet tall and develops seven and a half million pounds of thrust at lift off.

In the first two furious minutes the first stage alone must lift the entire vehicle 38 miles into the sky and ram it forward at a speed of 5,360 miles per hour.

Firing Room One is much bigger than its mushroom ancestors. Behind the windows are four rows of electronic consoles, with flashing lights and buttons enough to satisfy the most avid proponent of electronic wizardry.

Hub of Activity

In all, there are 218 individual console positions and 238 separate measurements racks.

At the back of the room, nearest the windows, is the hub around which the launch activity spins. It is here, at 10 consoles, where the launch director, and other key mission personnel will eavesdrop on last minute preparations, will make the decision that will launch Apollo 4 into its mission . . . 8 hours, 43 minutes and 30 seconds when America will hold its breath.

In front of the launch director will be the space vehicle test supervisor and launch operations manager consoles, flanked by launch vehicle and spacecraft test conductors from the Kennedy Space Center.

The five rows of consoles on the main floor include first and second stage propulsion and networks, third stage propulsion and instruments unit, stability and guidance and umbilical swing arms, flight control and mechanical ground support equipment, measurement, radio frequency and propellant consoles.

The eight rows of instrumentation measurement racks that extend to the end of the firing room will record various ground functions.

Four large visual displays are offered high over the fifth row of main floor consoles. Data on these monitors are for use by the test supervisors, test conductors, and systems engineers.

Scattered throughout the firing room are large countdown clocks, which will wink off seconds in Eastern Daylight and Greenwich Mean Time. There are also clocks for indicating the precise liftoff time and for recording any holds which may be encountered during the 83 hour countdown.

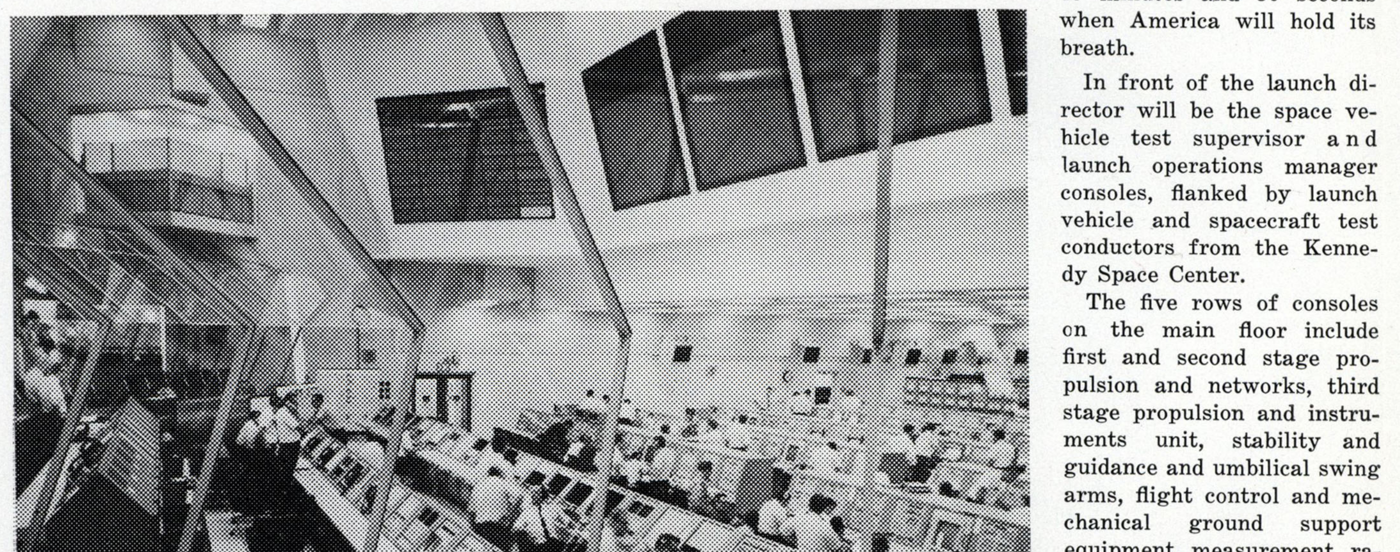
Communications

There will be 112 different communications channels available to key personnel during critical points in the launch. This is nearly triple the number used to date for a given launch.

Midway down each side of the firing room is a bank of nine television monitors, which will display distance and closeup scenes of the launch vehicle and spacecraft.

One of the most interesting consoles in Firing Room One is in the first row of the main floor. On this console is a red firing command switch. With slightly more than 10 seconds remaining in the countdown this switch will be activated, placing the remainder of the count on automatic sequence. Once this command is issued, the count can still be stopped by either automatic or, if necessary, manual cutoff.

This then, is not "just other engineers." They will have a special interest — these men of Firing Room One — when they watch launch of the first of the "big shots."



FIRING ROOM: Nearly 500 engineers, managers, technicians and specialists will be taking part when the final countdown on Apollo 4 begins. The first test flight of the space vehicle is scheduled for this quarter at the National Aeronautics and Space Admnistration's Kennedy Space Center, Fla.

History of Spaceport

KENNEDY SPACE CENTER, Fla.—The vision of a national Spaceport took shape on May 25, 1961, when the late President Kennedy asked Congress to approve a national goal of landing Americans on the moon by the end of this decade.

Joint Study

Taking immediate action, the National Aeronautics and Space Administration and the Department of Defense began a joint study to select a site for the lunar launch facilities.

Eight locations were in the running including sites in Hawaii, Christmas Island, Texas, Georgia, and the Cape Kennedy area in Florida.

By late August, 1961, the Merritt Island area adjacent to Cape Kennedy was officially selected as the launch site for the manned lunar landing program and acquisition of 88,000 acres of land began in late 1961.

The Space Center facilities are located in two basic areas. The Industrial Area houses administrative and engineering personnel and provides test facilities for Apollo spacecraft. Launch Complex 39, five miles north of the Industrial Area, contains facilities for the assembly, checkout and launch of Apollo/Saturn V space vehicles used for the manned lunar mission.

The first flight test for Apollo 4 is scheduled for later in this quarter from Complex 39.

Of the more than 50 buildings in the Industrial Area, the largest, the Manned Spacecraft Operations Building, was the first built. Construction began in January, 1963, and the main facility was completed in November, 1964.

At Complex 39, clearing and fill operations for the VAB began in late 1962 and work on the foundation began the following July. The building was topped out on April 15, 1965, and was ready to receive its first Saturn V rocket by mid-January, 1966.

By May 25, 1966, an Apollo/Saturn V facilities checkout model was moved from its assembly area in the VAB to Launch Pad A, verifying the launch and launch support facilities at Complex 39.

When the Merritt Island area was acquired, it had about 69 miles of paved road, none of them considered suitable for heavy duty use.

Road building operations on major arteries began early in 1963 and the Spaceport today has a road network totaling almost 150 miles.

Command Control Set In Houston

HOUSTON — When the Apollo/Saturn V space vehicle makes its first test flight this quarter from Kennedy Space Center, Fla., command control for the mission will be centered many miles away in Houston.

Support Crew

Nearly 400 people will be actively supporting the National Aeronautics and Space Administration mission in the Mission Control Center, Houston.

The first of two shifts of flight controllers for the mission — the countdown team—report at T-11 hours and 40 minutes and they begin checking their consoles and documentation in preparation for the mission.

Monitoring of data from the launch site by the flight controllers begins at T-11 hours and continues through the terminal count. In this period, the controllers establish trends in the data received which helps them check any tendency toward degradation of the system.

The prime team of controllers go on duty at T-3 hours. At T-1 hour, the flight director holds a final mission rules review with the controllers.

At liftoff, all command transfers to Houston. The launch vehicle is scheduled to clear the launch pad tower at T plus 10 seconds.

Helping the Houston Center in its control function and determining the progress of the flight will be tracking and telemetry from the world-wide tracking network.

After liftoff, the job of the flight controllers is basically one of making sure the mission adheres to the flight plan and taking corrective action if the mission varies from the plan.

APOLLO 8 PRIME CREW: Manning the Apollo 8 spacecraft on its flight to the moon, scheduled for Dec. 21, will be: left to right, Command Module Pilot James A. Lovell Jr., Lunar Module Pilot William A. Anders and Commander Frank Borman.

First Manned Use of Saturn V

Alternate Mission Plans Allowed For on Apollo 8

KENNEDY SPACE CENTER, Fla. — The first manned flight aboard the powerful Saturn V launch vehicle, will be the historic Apollo 8 flight around the moon and back on Dec. 21.

Apollo 8 will be a six-day open-ended mission, conducted in steps referred to as plateaus or commit points. Conducting the mission in this manner provides both maximum crew safety and maximum benefit since it permits alternate mission selection as the flight proceeds.

Each plateau includes a thorough check of crew, system and equipment operations. Only when all conditions are satisfactory will the National Aeronautics and Space Administration make the decision to commit to the next plateau.

Major commit points in the mission will include: prelaunch checkout terminating in launch; earth parking orbit, which ends with translunar injection; and translunar coast, preceding lunar orbit injection.

Alternate mission plans include a low earth orbit flight, a high apogee mission up to 60,000 miles or a circumlunar operation.

Astronaut Frank Borman will be commander of the flight and his crew will include Command Module Pilot James A. Lovell Jr. and Lunar Module Pilot William A. Anders.

No lunar module will be carried on this mission but Anders will fly in the position reserved for the lunar module pilot on fully configured Apollo missions.

Launch will be from Complex 39A at Kennedy Space Center. The Saturn V launch vehicle, which develops a 7,500,000-pound thrust, will place the spacecraft and third stage of the launch rocket into a 115-mile high parking orbit around the earth. The third stage and spacecraft will be checked out in this orbit.

The third stage will be reignited during the second or third parking orbit to place the space vehicle on a path to the moon. This path would swing the spacecraft around the moon and back if no further engines were fired.

Once on the way to the moon, the command and service module will separate from the rocket's third stage. The trip to the moon will take about 66 hours.

As it coasts to the moon the main propulsion engine of Apollo 8 will be fired to put it into a 196 by 70-mile lunar orbit. After two trips around the moon, the main engine will be refired to change the orbit to a circular one 70 miles above the surface of the moon.

In their 10 trips around the moon (each orbit lasting about two hours), the astronauts will be kept busy with navigation and landmark sightings and photography.

The spacecraft will be boosted out of lunar orbit onto a transearth trajectory by its service propulsion system.

The flight back to earth will take about 57 hours.

Just before reentering the earth's atmosphere the command module will separate from the service module using the latter's reaction control system.

Apollo 8 is scheduled to splashdown in the Pacific just a little more than six days after its launch date.

MOON ORBIT: This artist's concept shows the Apollo 8 spacecraft, its nose pointed down towards the lunar surface, as it photographs the moon and makes landmark sightings and other observations. A cutaway section shows one of the astronauts at work. Apollo 8 is scheduled to be launched Dec. 21 from NASA's Kennedy Space Center, Fla., on a six-day mission.

Apollo 8 to Lead Way For Series of Manned Missions

KENNEDY SPACE CENTER, Fla. — Apollo 8 will lead the way for a series of manned space flight missions of increasing complexity by the National Aeronautics and Space Administration.

Following the Apollo 8 flight this month will be Apollo 9, scheduled for launch in the first quarter of 1969, the first manned operation of the entire Apollo spacecraft including the lunar module.

While this mission will be in low earth orbit it will include the first manned operation of the lunar module in space and an extravehicular activity (EVA).

The extravehicular activity will be a development exercise to test an emergency method of transferring from the lunar module to the command module in the event that the primary method cannot be followed. The lunar module pilot in the lunar module will go out the side hatch of the lunar module, proceed hand - over - hand along the lunar module to the command module which he will enter through the side hatch.

The primary mode of transfer is through a tunnel connecting the two modules through the docking collar and the top of each vehicle.

The Apollo 9 crew includes Astronauts James A. McDivitt, Commander; David R. Scott, Command Module Pilot; and Russell L. Schweickhart, Lunar Module Pilot. McDivitt and Schweickhart would maneuver the lunar module. Back-up Crew is Charles Conrad, Jr., Richard F. Gordon and Alan Bean.

Apollo 10, scheduled for launch in the second quarter of 1969 will be a lunar orbit mission using the entire Apollo spacecraft. In this mission the lunar module will leave the command module in a 70-mile circular orbit of the moon and descend to 50,000 feet above moon's surface before rejoining the command module. No actual landing will be attempted but the mission will give the astronauts an opportunity to operate the lunar module around the moon.

Apollo 10 crew members are Astronauts Thomas P. Stafford, Commander; John W. Young, Command Module Pilot; and Eugene A. Cernan Lunar Module Pilot. Stafford and Cernan would maneuver the lunar module to 50,000 feet above the moon. Back-up crew is L. Gordon Cooper, Donn F. Eisele and Edgar D. Mitchell.

The missions as described above will be carried out if the previous flights have been successful. If necessary, an earlier mission may be repeated if it is not fully successful.

Assuming, however, that everything does progress well in the Apollo 8, 9 and 10 missions, it is conceivable that Apollo 11, in the summer or fall of 1969 might be America's first attempt at a manned lunar landing. No astronaut crew has been named for this mission.

Apollo 8 Window Is Not One That You See Through

KENNEDY SPACE CENTER, Fla. — When scientists, engineers, astronauts and other personnel working on the Apollo 8 mission refer to the Christmas window they are not talking about the gaily decorated show window at the local department store.

They are referring to the December launch window — that week-long period around Christmas during which a mission around the moon launched from NASA's Kennedy Space Center will accomplish the objectives of the Apollo 8 mission.

Because of the relative positions of the Earth, Moon and Sun and the performance capabilities of the Apollo rocket and spacecraft and the safety requirements, the Apollo 8 moon-orbiting mission can only be carried out during the period from December 21 through 27.

If the opportunity in December is missed then the next chance to carry out the mission would not be until January 18 through 24. Such a delay, of course, would result in similar delays in subsequent Apollo missions.

The factors that determine the launch window for Apollo 8 are:

—The moon's monthly swing around the earth.

—A daylight launch is desired so that it may be viewed, photographed and optically tracked for engineering purposes.

—The mission can be carried out on a free-return trajectory. This means that after the spacecraft is placed on a path to the moon it will return to earth if for some reason no additional engine operations are made.

—Two opportunities should exist in earth orbit so that if the first opportunity is missed the spacecraft can be placed on the path to moon on a subsequent earth orbit.

—Proper lighting conditions in the area of interest on the Moon. The Apollo 8 mission calls for observation of selected Apollo landing sites in preparation for landing on later Apollo missions.

—Launch along an azimuth of between 72 degrees and 108 degrees. This is in an easterly direction.

Release After Dec. 12, 1968

National Aeronautics and Space Administration
400 Maryland Ave., S.W., Washington, D.C. 20546
(202) 963-6928

SPACE SHEET

Public Information Division
Vol. 6, No. 23

FYI *By substituting your own floating masthead in this space, you may use this Sheet as your own bi-weekly Space Page.*

Special Facilities To Handle Apollo Flights

KENNEDY SPACE CENTER, Fla. — Assembly, checkout and launching of such sophisticated space vehicles as the Apollo 8, scheduled for launch on Dec. 21, demands special facilities and handling techniques.

The rocket stages arrive at the National Aeronautics and Space Administration's center by barge, ship and aircraft.

The parts come together for assembly in the 525-foot tall Vehicle Assembly Building, one of the world's largest structures in volume. It covers eight acres of land and contains 129 million cubic feet of space.

Work-platform halves, suspended on opposite walls in each high-pay area, move together to form small buildings—some three stories high—encircling the space vehicle inside the VAB.

The mobile launcher on which the giant rocket stages are erected, tested and launched weighs 10 and a half million pounds. It is a movable launch platform with 440-foot high umbilical tower to support electrical servicing and fuel lines to the space vehicle. Platform area covers more than half an acre.

A slow-moving monster—the transporter—carries the mobile launcher with the 363-foot high Apollo/Saturn V space vehicle aboard to the launch pad. Combined weight of the transporter and its load is 18 million pounds.

The transporter moves at about one mile-per-hour over a specially built eight-foot thick roadbed, the crawlerway, between the VAB and launch pad.

The transporter also delivers to the pad a nine and a half million pound mobile service structure. This 400-foot tall structure nearly surrounds the space vehicle, providing work platform for servicing and fueling the space vehicle.

UNMANNED FLIGHTS

WASHINGTON, D. C. — Sixteen unmanned Saturn launch vehicle flights confirmed Apollo engineering concepts and qualified all systems for manned missions.

TV Programs Planned From Apollo 8 Craft

WASHINGTON, D. C. — Television programming for the Christmas holidays may include live television views of the earth and moon.

As many as seven live TV transmissions are being considered on the National Aeronautics and Space Administration's Apollo 8 scheduled for launch from Kennedy Space Center on Dec. 21.

Up to three transmissions are being planned on the way to the moon, one or two from lunar orbit and possibly two more as the spacecraft heads back to earth.

Frequency and duration of transmissions depend upon various other mission activities and the availability of the spacecraft's high gain antenna. This antenna is used primarily to transmit engineering data, which has priority over TV transmissions.

The television signals will be sent from the spacecraft to ground stations at Goldstone, Calif., and Madrid, Spain, where the signal will be converted to commercial frequencies.

At NASA's Mission Control Center in Houston, the TV signal will be released live to public networks.

Because of crew activities from launch through translunar injection, TV operations are not planned until about 12 hours into the flight, the translunar coast phase of the mission.

Purpose of the Apollo 8 programming is to evaluate TV transmission at lunar distances to help in planning future lunar missions.

A tiny four-and-a-half pound camera will be used. A 12-foot power-video cable permits the camera to be hand-held at the command module windows.

The little camera takes 10 frames per second. This slow scan means the pictures are not expected to as high quality as normal broadcast programs.

Lunar Features Won't Draw Tourist Trade

WASHINGTON, D. C. — Orbiting just 70 miles above the lunar surface, the Apollo 8 astronauts will give the moon man's closest personal inspection in December.

But there is much we know about the moon both from centuries of astronomical observations and from space missions by the National Aeronautics and Space Administration.

The terrain is mountain- and crater-pitted. Peaks rise thousands of feet and the craters range from a few inches to 180 miles in diameter. These craters are thought to have been formed by meteorite impacts. The lunar surface is covered with a layer of fine-grained material resembling silt or sand and is littered with small rocks.

The environment leaves something to be desired—no air, no wind, no moisture. Extremes of temperatures are the rule going from 250 degrees F during the two-week-long lunar day to 280 degrees below zero in the two-week-long lunar night.

The gravity is only one-sixth that on earth and the moon is constantly being pelted by micrometeoroids.

Space missions have thrown new light on the dark or hidden side of the moon. It was first photographed by a Russian craft and since then has been photographed many times, particularly by NASA's Lunar Orbiter spacecraft.

One mystery about the moon still remaining concerns its origin. There are three main scientific theories. One is that the moon was once part of earth and split off into its own orbit. Another school of scientific thought believes it evolved as a separate body at the same time as earth. The third theory is that the moon formed elsewhere in space and wandered until it was captured by earth's gravitational field.

Earth Techniques For Apollo 8 Navigation

WASHINGTON, D. C. — The Apollo 8 astronauts will be able to navigate their trip around the moon in December with a precision unfamiliar to most earthbound navigators.

This, despite the fact that both their departure point and arrival point are in motion with respect to each other unlike trips on earth where man moves between points which remain fixed in relation to one another.

Yet the techniques the NASA astronauts will use are essentially the same as those used by navigators on earth.

Aboard the spacecraft, the guidance and navigation station is equipped with scanning telescope, sextant, digital computer and an inertial measurement unit.

The crew can either maneuver the spacecraft directly with manual controls or select programs in the computer for automatic maneuvers.

This system permits all navigation functions for the lunar journey to be performed on board, independent of earthbased tracking or computing facilities if necessary.

The navigator will make repeated sightings to confirm his position and trajectory. However, throughout the entire moon trip he will have tracking information from earth available for use in his own computer.

Aboard the spacecraft, the navigator acquires both the earth and a selected star through the scanning telescope. Then he maneuvers the spacecraft until the earth landmark is centered at zero and rotates the telescope until the hairline mark falls across the star which also turns the sextant.

Noting the angle of the star, the navigator sets the sextant at that angle. Now, looking through the sextant. both images appear enlarged and superimposed. When they line up, he pushes the "mark" button which feeds precise time and angle information to the computer.

The computer also receives tracking data from earth which, with the observed data, keeps the navigator informed of his current position and actual trajectory.

The computer determines the exact amount and direction of thrust needed after it is instructed by the navigator to make necessary trajectory corrections.

A sense of direction is furnished the computer by the inertial measurement unit, enabling the spacecraft to be oriented correctly. The rocket is fired and the inertial measurement unit measures the acceleration, feeding the data to the computer.

Once the desired speed change is accomplished, the computer cuts the engine and the spacecraft is on its corrected course. More than one correction may be needed.

As the spacecraft nears the moon, sextant readings may be made between known lunar landmarks and appropriate stars to determine the final course correction.

Independently both onboard and earth computers will determine maneuvers required to put the Apollo craft into lunar orbit. The familiar landmark tracking technique will then be used to confirm the lunar orbit.

Navigational experience gained in the Apollo program will contribute information needed for future trips of greater complexity.

SPACE METHODS

WASHINGTON, D. C. — Methods developed by the National Aeronautics and Space Administration to build and assemble biologically sterile spacecraft for exploring the planets are now being used in the design of hospital operating and recovery rooms.

Apollo 8 Menus

MEAL	Day 1*, 5, 9	Day 2, 6, 10	Day 3, 7, 11	Day 4, 8, 12*
A	Peaches Bacon Squares (8) Cinn Tstd Bread Cubes (8) Grapefruit Drink	Canadian Bacon & Applesauce Sugar Coated Corn Flakes Apricot Cereal Cubes (8) Grapefruit Drink Orange Drink	Fruit Cocktail Bacon Squares (8) Cinn Tstd Bread Cubes (8) Cocoa Orange Drink	Canadian Bacon & Applesauce Toasted Bread Cubes (8) Strawberry Cereal Cubes Cocoa Orange Drink
B	Corn Chowder Chicken & Gravy Toasted Bread Cubes (6) Sugar Cookie Cubes (6) Cocoa Orange Drink	Tuna Salad Chicken & Vegetables Cinn Tstd Bread Cubes (8) Pineapple Fruitcake (4) Pineapple-Grapefruit Drink	Cream of Chicken Soup Beef Pot Roast Toasted Bread Cubes (8) Butterscotch Pudding Grapefruit Drink	Pea Soup Chicken & Gravy Chesse Sandwiches (6) Bacon Squares (6) Grapefruit Drink
C	Beef & Gravy Beef Sandwiches (4) Cheese-Cracker Cubes (8) Chocolate Pudding Orange-Grapefruit Drink	Spaghetti & Meat Sauce Beef Bites (6) Bacon Squares (6) Banana Pudding Grapefruit Drink	Potato Soup Chicken Salad Turkey Bites (6) Graham Cracker Cubes (6) Orange Drink	Shrimp Cocktail Beef Hash Cinn Tstd Bread Cubes (8) Date Fruitcake (4) Orange-Grapefruit Drink
DAYS TOTAL CALORIES	2485	2537	2522	2441

* Day 1 consists of Meals B and C only; Day 12 consists of Meal A only.

Each crewmember will be provided with a total of 33 meals.