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TECHNICAL INFORMATION BULLETIN

THE MANNED SPACE FLIGHT NETWORK

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# Astronauts Will Spend 31 Hours On Moon During AS-507 Mission

Apollo 12 (AS-507), man's second landing on the moon, is scheduled to be launched on November 14. The mission is projected for 10 days, 4 hours, and 41 minutes with lunar touchdown planned at 110:35:23 GET. Astronauts flying Apollo 12 are Charles Conrad Jr., commander; Richard F. Gordon Jr., lunar module pilot; and Alan L. Bean, command module pilot.

During Apollo 12, the spacecraft will spend over 90 hours in the lunar environment, including over 31 hours on the surface of the moon. Objectives announced for the lunar environment include 45 lunar revolutions of the CSM, LM separation and descent to the lunar surface; two 3.5 hour EVA periods by the LM crew, ascent from the lunar surface, rendezvous and docking with the CSM, and photography of future landing sites.

The first translunar insertion (TLI) opportunity for Apollo 12 will occur over the Pacific during the second revolution. The second opportunity will occur over the Pacific one revolution later. TLI is planned as a free-return circumlunar trajectory with a perilune altitude of 1850 nmi. The lunar module transfer maneuver will occur at about TLI plus 28 hours, at the same time as the second midcourse correction. The correction will place the CSM/LM in non-free return trajectory with a perilune of 60 nmi. Following the first lunar orbit insertion (LOI-1), the spacecraft will have two revolutions of 60 by 170 nmi. LOI-2 will place the spacecraft in a 54 by 66 nmi lunar orbit. This orbit will circularize before time for the planned CDH maneuver.

The TLI burn of 322 seconds will begin at 02:47:21 GET. Four Instrumented Aircraft (ARIA) will support the mission. No MSFN ground stations will have view at this time; however, HAW is expected to acquire just prior to the burn cutoff. Overlapping coverage will be provided by GDS, GYM, TEX, and MIL as the vehicle begins its translunar coast. Approximately 15 minutes after TLI cutoff, the S-IVB/IU/LM/CSM will maneuver to an inertial attitude for CSM separation. The CSM will separate from the S-IVB/IU at 03:17:43 GET, transpose, dock and extract the LM from the launch vehicle. In this mission there is no bias for the TLI burn cutoff to compensate for the evasive maneuver. This maneuver, (after LM extraction), will be performed by a burn of the auxiliary propulsion system of the S-IVB on command from the ground. The S-IVB will initiate a LOX dump 21 minutes after the evasive maneuver that will place it in a "slingshot" trajectory to avoid recontact with the CSM/LM and to ensure that it passes behind the trailing edge of the moon.

At TLI plus 24 hours, a transfer maneuver is performed, using the Service Module service propulsion system. This will result in a non-free return translunar trajectory with a 60-nmi perilune altitude. The first lunar orbit insertion burn will place the CSM/LM into a 60 by 170 nmi lunar parking orbit at 83:28:47 GET.

The second burn begins near perilune of the second revolution 87:47:37 GET. During revolution 2 the crew enters the

Continued on Next Page

## Engineers Notes

By Don Kaufman
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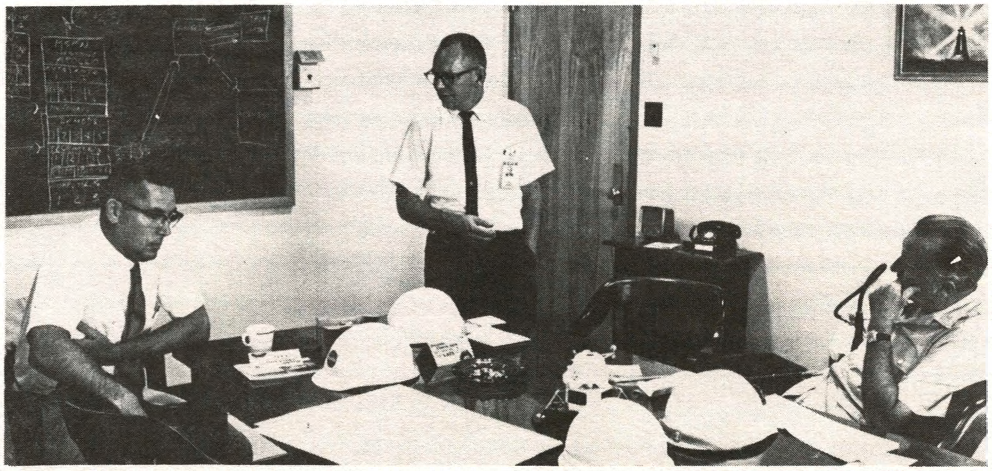
Since just prior to the first lunar excursion, AS-503, the Hewlett-Packard model CO-2-5061A Cesium Beam Frequency Standard has been the on-line frequency source of the Apollo Timing System and, in fact, the heart beat of each of the stations in the MSFN. Not only is accurate and stable time information developed from this source, but it represents the primary frequency source for the ranging/range rate instrumentation.

The particularly stable transitions of the hyperfine levels in the CS 133 atom coupled with its relative insensitivity to external magnetic and electric fields make it the most accurate and highly stable frequency source readily available for large scale field use. It is a self-calibrating device with long term stability that is five times better than the previous frequency standard normally used as the primary frequency source in the Apollo Timing System.

The cesium beam tube in which the evaporation of the CS 133 atoms takes place is the major factor in the life and proper operation of the standard. For this reason periodic monitoring of the health of the tube is mandatory. Measuring the signal-to-noise ratio at the output of the cesium beam tube provides a figure of merit for the tube. Periodic measurements of this type enable the life of the tube to be predicted and also provide the means for establishing a preventive maintenance program.

The manufacturer has accumulated failure rate reports on 65 units in the

Continued on Next Page



Television newscaster Walter Cronkite receives a briefing fro T. Turnbull Goldstone-Apollo M&O Supervisor and R. Kephart (NASA) Assistant Station Director on the makeup of the Goldstone Complex during Apollo 11.

## AS-507 Mission

Continued from Page One

LM. In revolution 4 landmark tracking is accomplished before the crew returns to the CSM for a 9 hour rest period. They return to the LM following the rest period.

During orbit 13, 2.5 hours before landing, the LM and CSM will undock and station keep 40 feet apart. The LM will rotate about its longitudinal axis so the CM pilot can observe the landing gear. Thirty minutes after undocking the CSM maneuvers downward toward the moon, separating from the LM to 10,571 feet (1.7 nmi) at descent orbit insertion.

Descent orbit insertion will begin one-half revolution after separation and will place the LM in a 60-nmi by 50,000-foot altitude orbit. Powered descent of the lunar module begins at perilune of the descent transfer orbit (50,000 feet). The approach phase, starting at 7000 feet (high gate), allows the pilot to visually monitor the approach to the lunar surface. The approach phase operationally ends at 500 feet (low gate) when the landing phase begins. During landing the pilot visually checks the landing site so that he can take over manually from the automatic control, if necessary. The vertical descent part of the landing phase begins at 150 feet and ends with touchdown.

Touchdown will be at 110:35:23 GET on lunar orbit 14. For two hours, will make a series of checks and report on the landing location. A Go/No-Go decision will be made for a lunar stay during this time. The surrounding terrain will be photographed and a landmark description will be sent to MCC. The LM crew will prepare for the first EVA at approximately 112:45:00 GET and at 114:15L22 GET, the CDR will begin EVA on the lunar surface.

About 30 minutes later (115:15:00) the LMP will leave. The crew will deploy the S-band antenna; position TV camera for view of the EVA area; inspect the LM; and photograph the area. Then, the Apollo Lunar Surface Experiment Packages (ALSEP), including solar wing component, lunar surface magnetometer, passive seismic, suprathermal ion detector, and cold cathode ion gauge experiments, will be deployed and activated. The crew will then collect selected lunar samples and terminate EVA-1 at 117:35:00 GET, after a 3 hour, and 30 minute EVA. EVA-1 will be followed by a post-EVA systems and configuration checks, a crew eat period, a debriefing period, and a 9-hour rest period. At 133:20:00 GET the CDR leaves the LM. Ten minutes later the LMP descends to the surface. EVA-2 objectives include collection of documented core tube, and environmental samples; observe lunar surface penetration; photograph contrast charts; and make general observations of the landing site area. In the event that the LM lands within range of Surveyor III, investigation of this satellite is a possibility. EVA-2 will end at approximately 136:35:00 GET. At 142:04:37 GET the ascent propulsion system is fired for a 431 second burn and the LM liftoff will occur while the CSM is in lunar orbit revolution 30.

The ascent is in two phases. The first is the vertical-rise phase to achieve terrain clearance. The vertical-rise phase ends 10 seconds after

Approximately 50 minutes after insertion, the CSM will maneuver so that the LM will be in an orbit 150 nmi below the CSM orbit at the time of the Constant Differential Height Sequence (CDH). CDH, a small radial burn performed with the Reaction Control System (RCS) four-jet thrusters, is designed to coellipticize the LM orbit with the orbit of the CSM.

Final approach and stationkeeping will occur at approximately 145:24:31 GET, some 25 minutes after the vehicles enter sunlight on the backside of the moon. Docking begins at approximately 145:40:00 GET to complete 3.5 hours of rendezvous activities. The LM will be jettisoned at 148:00:00 GET.

The CSM will be acquired by the MSFN approximately 10 minutes after the TEI cutoff burn, and the last station to lose signal will be HSK (5-degree minimum elevation); LOS occurring at 244:23:27 GET, approximately 3 minutes before the CM enters the earth's atmosphere.

Entry interface (244:26:36 GET), the CM will be at 400,095 feet. The CM RCS thrusters are used for the separation and attitude hold maneuvers before the spacecraft reaches 400,000-foot altitude. The RCS is also used to perform the guidance commands during the remainder of the entry.

The drogue-parachute deployment will begin at 23,300 feet, which is 8 minutes 8 seconds after entry interface. The two drogue parachutes will be deployed two seconds later. At 10,500 feet, the drogue parachutes will disconnect. The three main parachutes deploy one second later. The CM will splash down 13 minutes 50 seconds after entry interface at 244:40:26 GET.

## Four ALSEP Experiments

ALSEP 1 will be carried on the AS-507 Mission for deployment on the lunar surface. The four parts in this package consist of the Passive Seismic Experiment (PSE), a Magnetometer Experiment (ME), a Solar Wind Experiment (SWE), and the Suprathermal ion Detector Experiment (SIDE).

The lunar surface magnetometer measures the magnetic field of the moon.

The solar wind spectrometer experiment will measure positive ion and electron flux variations with energy, time, and direction.

The suprathermal ion detector experiment consists of two curved plate analyzers (basically a mass spectrometer) with velocity filter, ground plane, and a supplemental cold cathode ion guage for measurement of neutral particles.

The passive seismic experiment will be carried on future Apollo Missions through AS-509. It's purpose is to measure natural seismic wave velocity, frequency, amplitude and attenuation, free oscillation, and tidal deformation.

The ALSEP antenna is a modified axial-helix design which receive and transmit a right-hand circularily polarized S-band signal. The helix is 23 inches long and 1.5 inches in diameter. Antenna receive gain is 15.2 dB and transmit gain is 16 dB. The beamwidth is approximately 33 degrees.

MSFN stations will support both the Apollo flight and the ALSEP lunar surface activity. A certain amount of reconfiguration will be necessary when stations change from one to the other. The Mission Supplements provide explicit instructions for network configurations, updated by the SCMs.

## Engineers' Notes

Continued from Page One

field, and these reports suggest a typical life of approximately 30,000 hours for a cesium beam tube. However, in the event of the catastrophic failure of any unit in the field, Manned Flight Engineering Division maintains three Cesium Beam Frequency Standards in the "on-ready" status at Goddard Space Flight Center.

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