The spacecraft will be returned to port by the recovery ship where a team will deactivate pyrotechnics, and flush and drain fluid systems (except water). This operation will be confined to the exterior of the spacecraft. The spacecraft will then be flown to the Lunar Receiving Laboratory (LRL) and placed in a special room for storage. Lunar sample release from the LRL is contingent upon spacecraft sterilization. Contingency plans call for sterilization and early release of the spacecraft if the situation so requires.

Apollo 11/12 Mission Differences

The major differences between the Apollo 11 and 12 flight missions are summarized in Table 5.

TABLE 5
COMPARISON OF MAJOR DIFFERENCES
APOLLO 11 vs. APOLLO 12

EVENT	APOLLO 11	APOLLO 12
1. LAUNCH AZIMUTH	72 - 108°	72 - 96°
2. TRAJECTORY	FREE-RETURN	HYBRID
3. EVASIVE MANEUVER	CSM	S-IVB APS
4. NAVIGATION		PROCEDURAL CHANGES
5. EVA	1:(2 HR 32 MIN)	2:(3 HR 30 MIN EACH)
6. EVA RADIUS (MAX)	250 FT	OPS PURGE CAPABILITY
7. LUNAR SURFACE STAYTIME	21.6 HR	~31.5 HR
8. LUNAR ORBIT STAYTIME	59.6 HR	~89 HR
9. EXPERIMENTS	EASEP	ALSEP
10. PHOTOGRAPHY		MULTISPECTRAL TERRAIN 500MM LENS LUNAR LANDING SITES
11. SLEEPING (LM)		HAMMOCK ARRANGEMENT
12. LUNAR SURFACE TV	BLACK & WHITE	COLOR
13. ASCENT STAGE	IN ORBIT	DEORBIT
14. TRANSEARTH FLIGHT	59.4 HR	72.2 HR
15. TOTAL MISSION TIME	195.3 HR	244.6 HR

CONTINGENCY OPERATIONS

GENERAL

If an anomaly occurs after liftoff that would prevent the space vehicle from following its nominal flight plan, an abort or an alternate mission will be initiated. Aborts will provide for an acceptable flight crew and Command Module (CM) recovery while alternate missions will attempt to maximize the accomplishment of mission objectives as well as provide for an acceptable flight crew and CM recovery. Figure 26 shows the Apollo 12 contingency options.

ABORTS

The following sections present the abort procedures and descriptions in order of the mission phase in which they could occur.

Launch

There are six launch abort modes. The first three abort modes would result in termination of the launch sequence and a CM landing in the launch abort area. The remaining three abort modes are essentially alternate launch procedures and result in insertion of the Command/Service Module (CSM) into earth orbit. All of the launch abort modes are the same as those for the Apollo 11 Mission.

Earth Parking Orbit

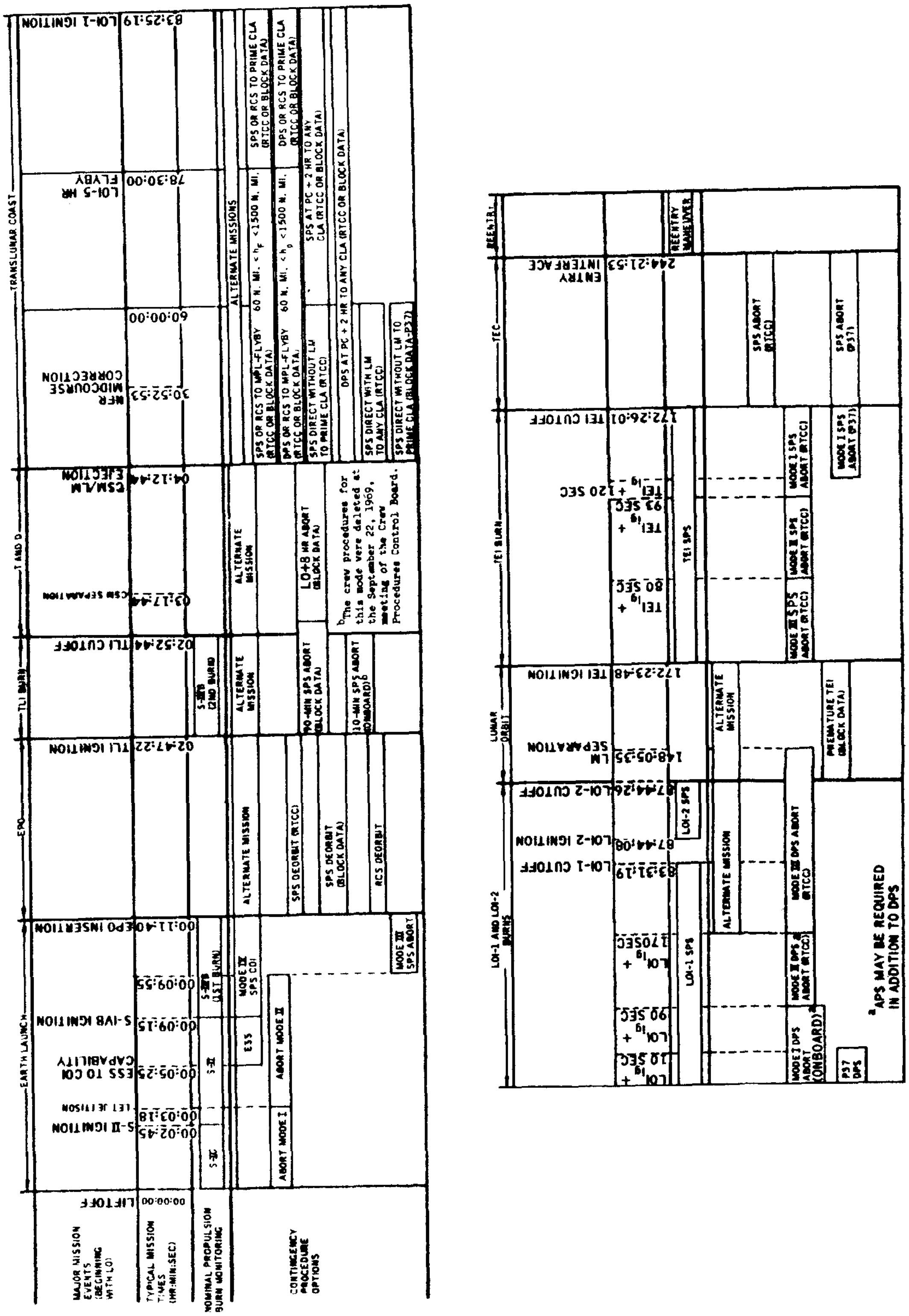
A return to earth abort from earth parking orbit (EPO) will be performed by separating the CSM from the remainder of the space vehicle and performing a retrograde Service Propulsion System (SPS) burn to effect entry. Should the SPS be inoperable, the Service Module Reaction Control System (SM RCS) will be used to perform the deorbit burn. After CM/SM separation and entry, the crew will fly a guided entry to a pre-selected target point, if available.

Translunar Injection

Translunar injection (TLI) will be continued to nominal cutoff, whenever possible, in order for the crew to perform malfunction analysis and determine the necessity of an abort.

Translunar Coast

If ground control and the spacecraft crew determine that an abort situation exists, differential velocity (ΔV) targeting will be voiced to the crew or an onboard abort program will be used as required. In most cases, the Lunar Module (LM) will be jettisoned prior to the abort maneuver if a direct return is required. An SPS burn will be



APOLLO 12 CONTINGENCY OPTIONS

Fig. 26

initiated to achieve a direct return to a landing area. However, a real-time decision capability will be exploited as necessary for a direct return or circumlunar trajectory by use of the several CSM/LM propulsion systems in a docked configuration.

For a nominal spacecraft trajectory, an abort at TLI plus 90 minutes will require approximately 5160 feet per second ΔV to return the spacecraft to a contingency landing area.

Lunar Orbit Insertion

An early shutdown of the SPS may result from a manual shutdown due to critical SPS problems or from an inadvertent shutdown. If an inadvertent shutdown occurs early in the first lunar orbit insertion (LOI) burn, an immediate restart of the SPS should be attempted provided specified performance "limits" are not exceeded. If restart of the SPS is not required, the LM Descent Propulsion System (DPS) will be the primary abort propulsion system. The LM Ascent Propulsion System (APS) will be required to supplement the DPS in order to meet the propulsion requirements of some abort conditions when a hybrid trajectory is used.

Mode I (LOI-1 ignition to 90 seconds): Initiate a DPS abort at 30 minutes after LOI ignition. If a satisfactory transearth coast is not achieved because of DPS ΔV limitations, initiate an SPS burn 2.5 hours after LOI ignition. If the SPS is not available, the APS should be used.

Mode II (90-170 seconds after LOI-1 ignition): Initiate a DPS first burn under Real-Time Computer Complex (RTCC) control 2 hours after LOI-1 ignition. Initiate a DPS second burn after one revolution in an intermediate ellipse. Between 90 and 144 seconds after the LOI burn, the second DPS burn will be followed by an APS burn to inject the spacecraft into the desired transearth trajectory.

Mode III (170 seconds to end of LOI): Initiate a DPS abort (RTCC) after one revolution.

Transearth Injection

An SPS shutdown during transearth injection (TEI) may occur as the result of an inadvertent automatic shutdown. Manual shutdowns are not recommended. If an automatic shutdown occurs, an immediate restart will be initiated. If immediate reignition of the SPS is not possible, the following aborts apply if the SPS problems can be resolved.

Mode I (93 seconds to end of TEI burn): Initiate one SPS burn 2 hours after TEI ignition. The preabort trajectory will be a hyperbola.

Mode II (80 to 93 seconds into TEI burn): Two SPS burns are required. Initiate the first burn 2 hours after TEI ignition. The preabort trajectory will be a hyperbola.

Mode III (TEI ignition to 80 seconds): Initiate one SPS burn after one or more revolutions. The preabort trajectory will be a stable ellipse.

ALTERNATE MISSION SUMMARY

The two general categories of alternate missions that can be performed during the Apollo 12 Mission are (1) earth orbital, and (2) lunar. Both of these categories have several variations which depend upon the nature of the anomaly causing the alternate mission and the resulting systems status of the LM and CSM. A brief description of these alternate missions is contained in the following paragraphs.

Earth Orbital Alternate Missions

Contingency: No TLI or partial TLI.

Alternate Mission: The first day in earth orbit will consist of extraction and crew entry of the LM, separation of the CSM and S-IVB maneuver, and performance of a photographic mission in the CSM/LM docked configuration.

During the second day, the LM will be deorbited for ocean impact and a CSM plane change along with a maneuver to achieve an elliptical orbit will be made. The photographic mission will continue during the third through the fifth day in orbit. If the photographic mission is complete by 100 hours Ground Elapsed Time (GET), the spacecraft will enter and land.

Lunar Orbit Alternate Missions

Contingency: Failure to eject LM from S-IVB.

Alternate Mission: Perform landmark tracking and photographic mission with the CSM with special emphasis on obtaining photographs of the bootstrap sites of the nominal mission.

The first activity day in lunar orbit will consist of LOI-1, LOI-2, landmark tracking, and high resolution and vertical stereo photography followed by a 6-hour sleep cycle.

The second activity day will consist of two plane changes with landmark tracking, vertical stereo photography, and high resolution photography of selected science sites followed by a 10-hour sleep cycle.

The third activity day will consist of one plane change, landmark tracking, vertical stereo photography, high resolution photography of selected science sites, and S-158 strip photography for two revolutions.

TEI will then be performed and the nominal mission timeline will be reentered.

Contingency: DPS No-Go for burn (DPS is only failure).

Alternate Mission: The Commander and Lunar Module Pilot will return to the CSM and the LM will be jettisoned. A CSM plane change will be initiated at approximately 116 hours GET which will move the line of nodes backward allowing photographic and landmark tracking of Apollo science sites. During the CSM coast in this orbit, the crew will obtain coverage of eight sites. TEI will be performed on the 41st revolution.

Contingency: LM No-Go for undocking (system failure, not connected with DPS, is discovered during LM checkout).

Alternate Mission: A DPS plane change will be performed. The LM will be jettisoned and landmark tracking and photography of the Apollo science sites will be started. A plane change by the CSM will be initiated at approximately 136 hours GET which will move the line of nodes westward and will allow additional photographic and landmark tracking. This alternate mission will cover ten sites and TEI will be performed on the 40th revolution.

MISSION SUPPORT

GENERAL

Mission support is provided by the Launch Control Center (LCC), the Mission Control Center (MCC), the Manned Space Flight Network (MSFN), and the recovery forces. The LCC is essentially concerned with prelaunch checkout, countdown, and with launching the SV; while the MCC, located at Houston, Texas, provides centralized mission control from tower clear through recovery. The MCC functions within the framework of a Communications, Command, and Telemetry System (CCATS); Real-Time Computer Complex (RTCC); Voice Communications System; Display/Control System; and a Mission Operations Control Room (MOCR) supported by Staff Support Rooms (SSR's). These systems allow the flight control personnel to remain in contact with the spacecraft, receive telemetry and operational data which can be processed by the CCATS and RTCC for verification of a safe mission, or compute alternatives. The MOCR and SSR's are staffed with specialists in all aspects of the mission who provide the Mission Director and Flight Director with real-time evaluation of mission progress.

MANNED SPACE FLIGHT NETWORK

The MSFN is a worldwide communications and tracking network which is controlled by the MCC during Apollo missions (Table 6). The network is composed of fixed stations (Figure 27) and is supplemented by mobile stations. Figure 28 depicts communications during lunar surface operations.

The functions of these stations are to provide tracking, telemetry, updata, and voice communications both on an uplink to the spacecraft and on a downlink to the MCC. Connection between these many MSFN stations and the MCC is provided by NASA Communications Network. More detail on mission support is in the MOR Supplement.

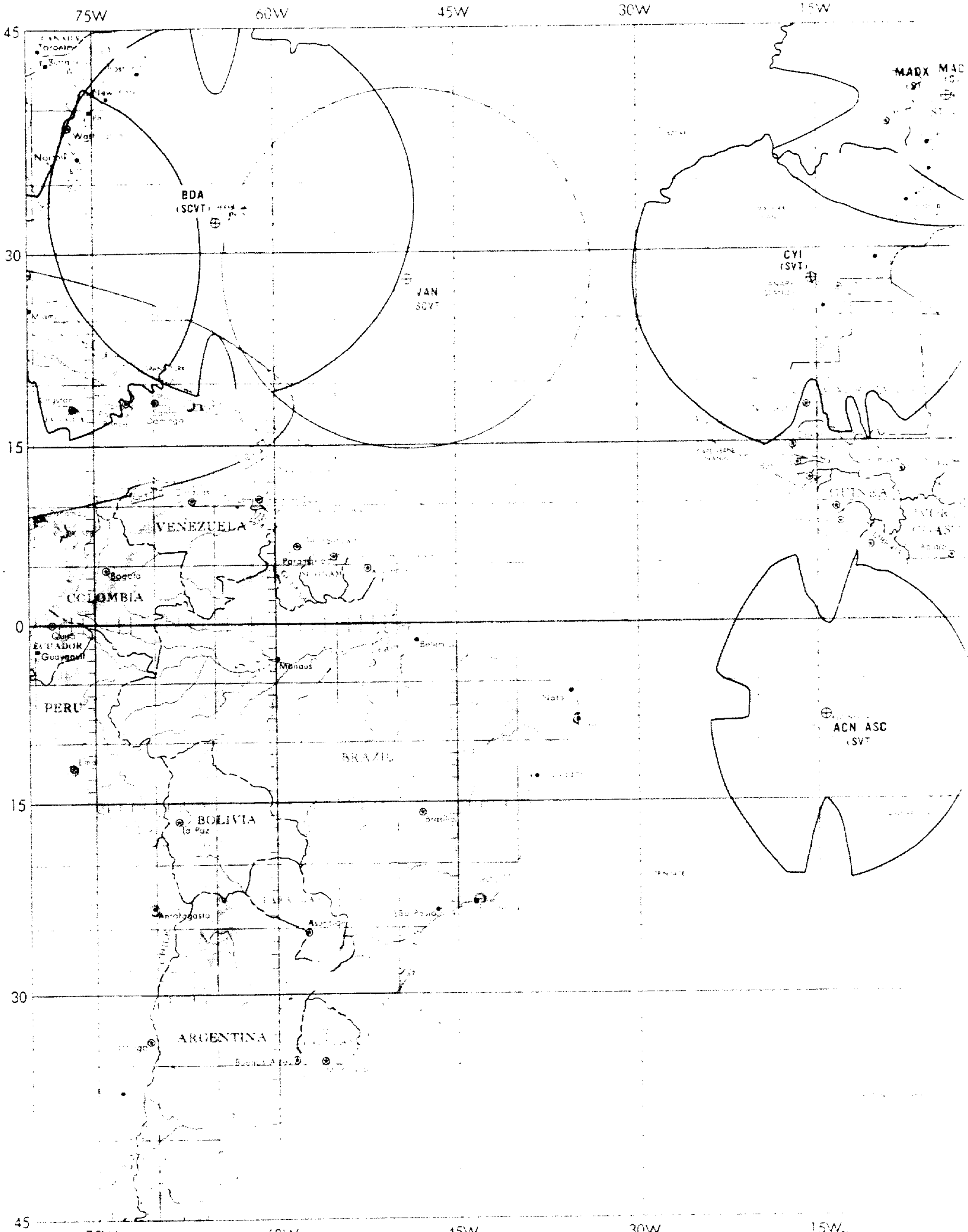
TABLE 6

NETWORK CONFIGURATION FOR APOLLO 12 MISSION

Systems	TRACKING			USB				TLM				DATA PRO-CESSING				COMM				OTHER			REMARKS
	C-band (High Speed)	C-band (Low Speed)	USB	TV to MCC	Voice	TLM	Command	VHF Links	FM Remoting	Mag Tape Recording	Decoms	642B TLM	642B CMD	CDP	1218	High Speed Data	TTY	Voice (SCAMA)	Video VHF A/G	Range Safety	Riometer	SPAN	
ACN			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
ANT																				X			
ARIA(4)			X		X	X		X		X							X	X	X				Note 1
ASC																				X			
AOCC																	X		X				
BDA	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X			
CNV																				X			
CRO	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	
CYI			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	
GBI																				X			
GDS			X	X	X	X	X		X	X	X	X	X		X	X	X	X					
GDS-X			X		X	X	X								X								Note 2
GTK																				X			
GWM			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
GYM			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
HAW			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
HSK			X	X	X	X	X		X	X	X	X	X		X	X	X	X					
HSK-X			X		X	X	X								X								Note 2
MAD			X	X	X	X	X		X	X	X	X	X		X	X	X	X					
MAD-X			X		X	X	X								X								Note 2
MARS				X	X	X			X														Note 3
MIL			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
MLA	X																			X			
PAT																				X			
TEX			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X				
VAN	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
PARKES				X	X	X			X														NOTE 3

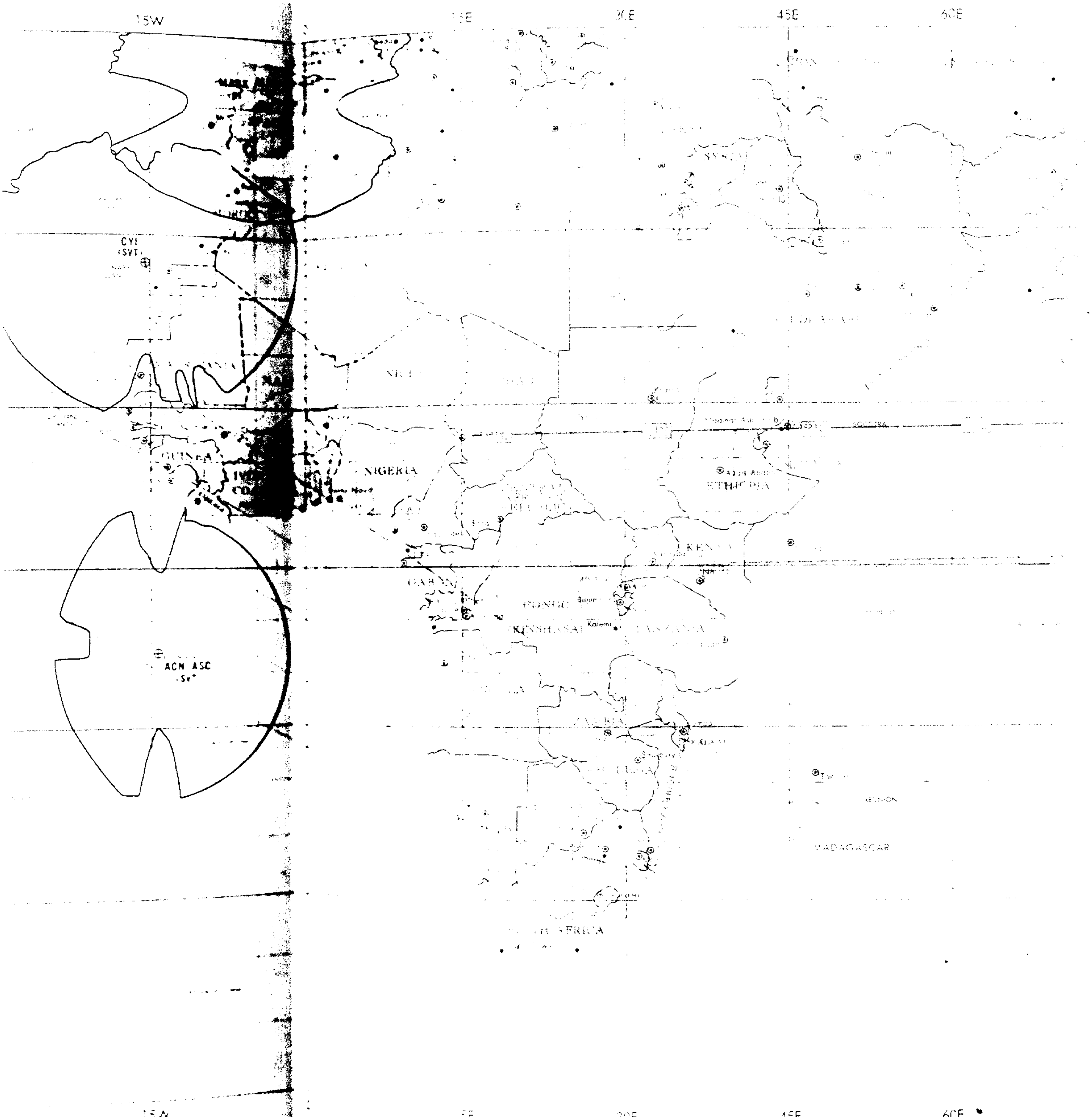
Note

1. TLI and reentry
2. Post TLI coverage
3. Lunar surface operations only



1ST EDITION, 6 OCTOBER 1969
PREPARED UNDER THE DIRECTION OF THE DEPARTMENT OF DEFENSE BY THE
AERONAUTICAL CHART AND INFORMATION CENTER, UNITED STATES AIR FORCE
FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

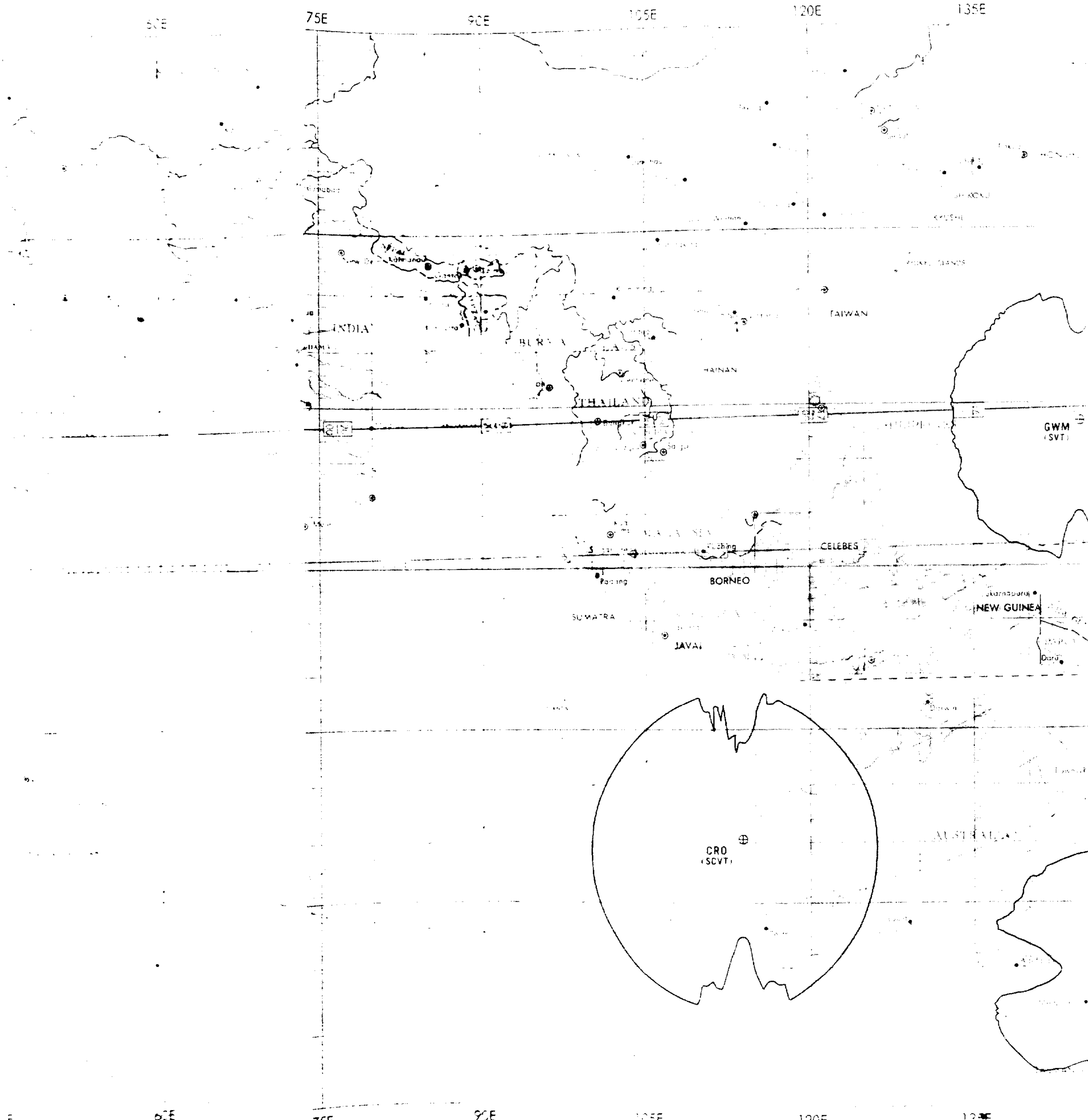
NOTE: The representation of international boundaries on this chart is not necessarily authoritative



NOTE: The representation of international boundaries on this chart is not necessarily authoritative

MERCATOR PROJECTION
SCALE 1:40,000,000 AT THE EQUATOR

LEGEND
International boundary
Capital cities
Other cities
Airfields
HC 130 home base airfields



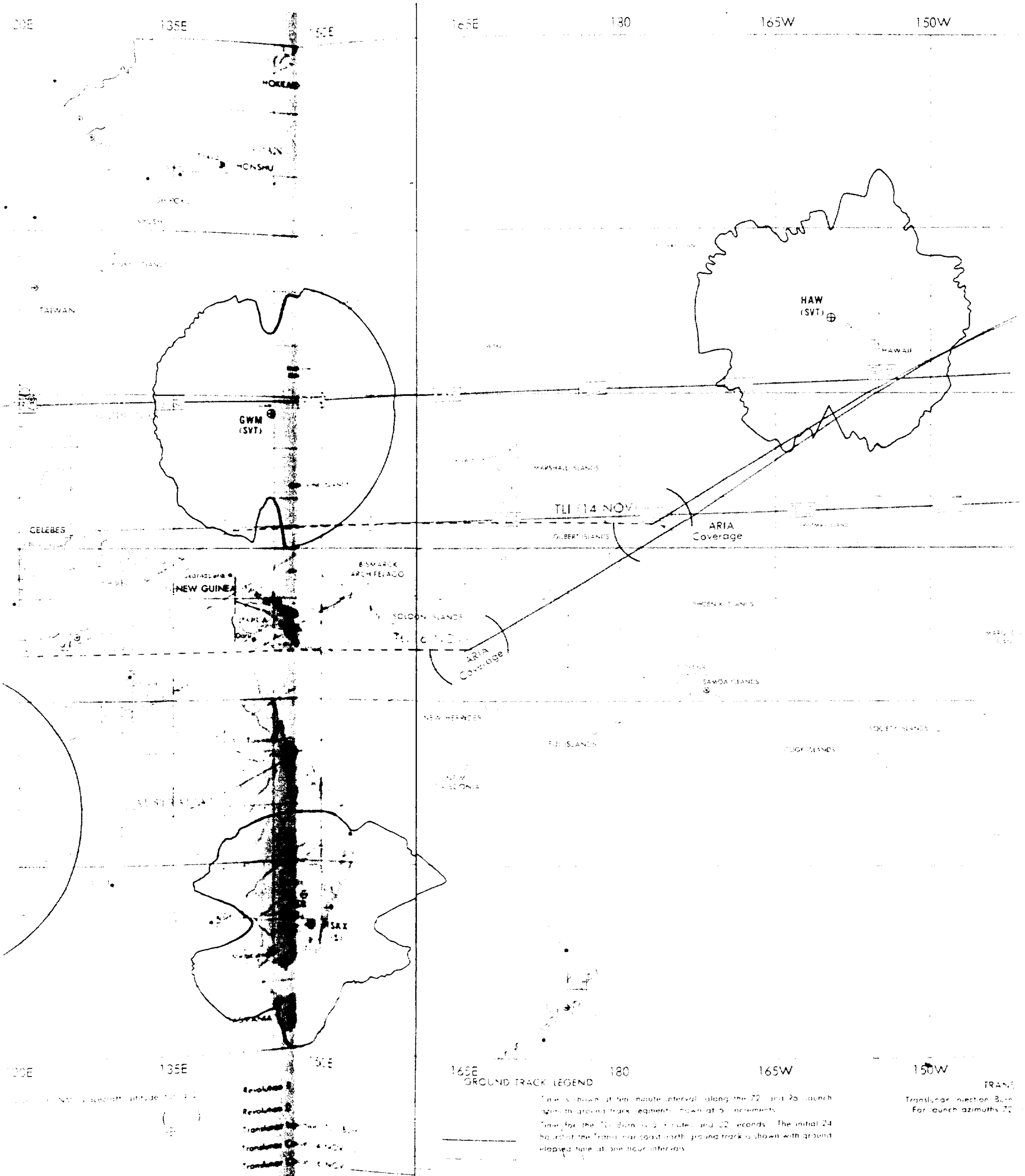
LEGEND

International boundary
Capital cities
Other cities
Airfields
HC-130 home base airfields

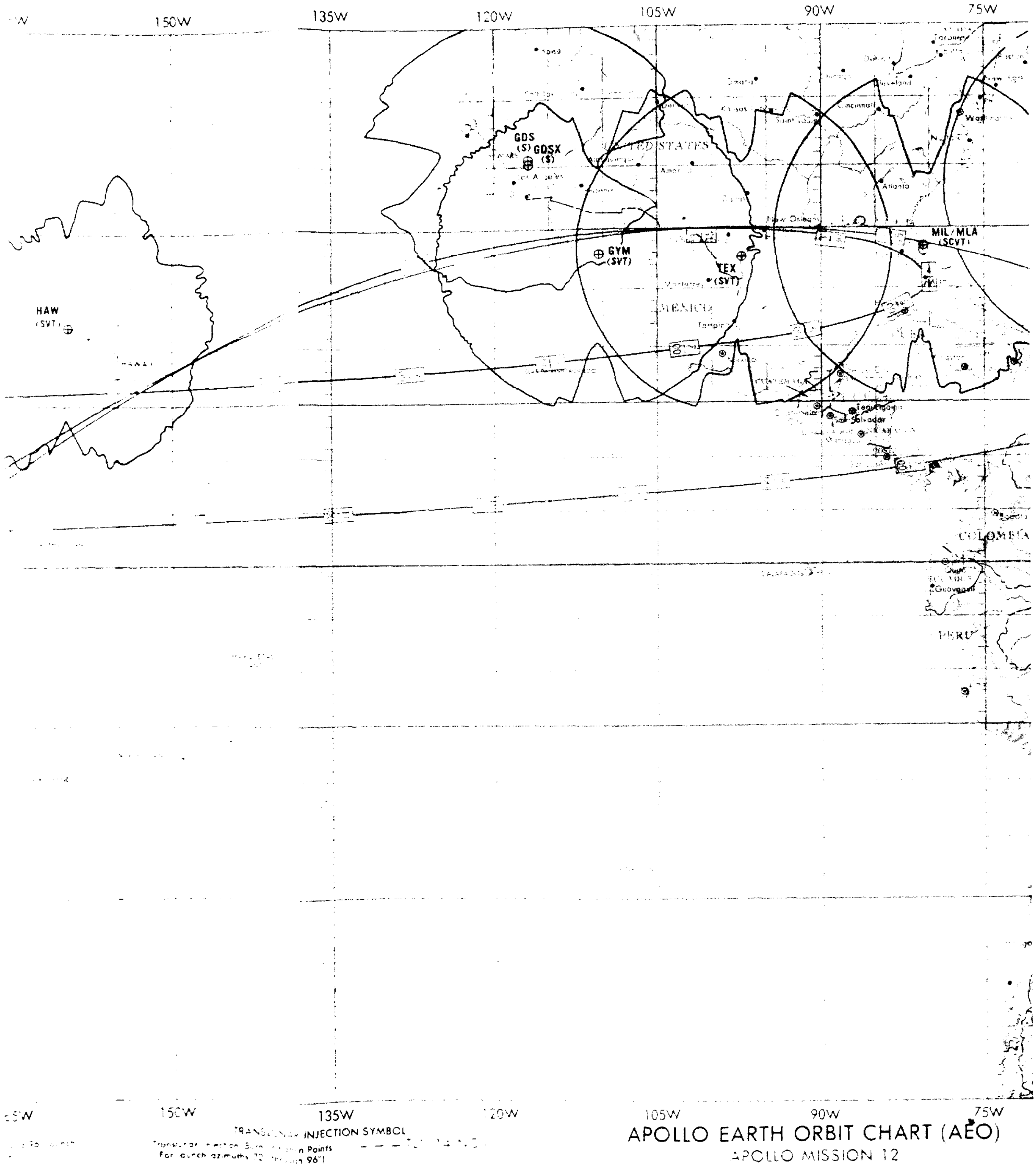
Location symbol and call letters ⊖ MIL MLA
Station capabilities (SCVT)
S. Unified S Band Radar Tracking, A/G Voice and Telemetry
C. C Band Radar Tracking
V. VHF A/G Voice
T. VHF Telemetry

MANNED SPACE FLIGHT NETWORK

ARIA TLI Coverage



135E
165E
180
165W
150W
HONSHU
TAIWAN
CELEBES
GWM
(SVT)
HAW
(SVT)
HAWAII
MARSHALL ISLANDS
TLI (14 NOV)
ARIA
Coverage
ARIA
Coverage
GILBERT ISLANDS
NEW GUINEA
BISMARCK
ARCHIPELAGO
SOLOMON ISLANDS
PHOENIX ISLANDS
SAMOA ISLANDS
NEW HEBRIDES
FIJI ISLANDS
COOK ISLANDS
SOCIETY ISLANDS
GROUND TRACK LEGEND
Revolution 1
Revolution 2
Translunar Injection Burn
For launch azimuths 72



APOLLO EARTH ORBIT CHART (AEO)

APOLLO MISSION 12

FOR NOVEMBER 1969 LAUNCH DATES

Fig. 27

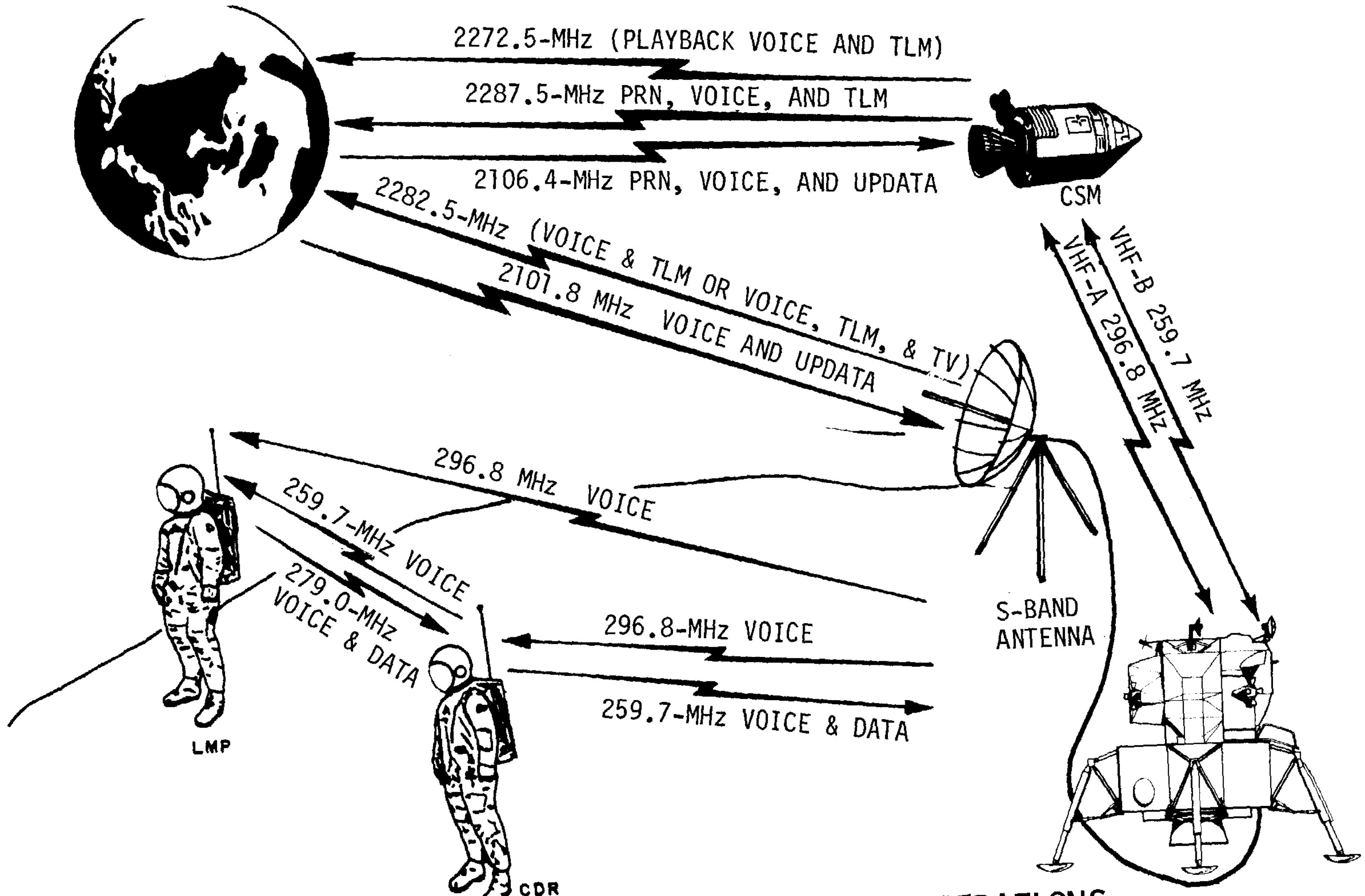


Fig. 28

COMMUNICATIONS DURING LUNAR SURFACE OPERATIONS
WITH ERECTABLE ANTENNA DEPLOYED

RECOVERY SUPPORT

GENERAL

The Apollo 12 flight crew and Command Module (CM) will be recovered as soon as possible after landing, while observing the constraints required to maintain biological isolation of the flight crew, CM, and materials removed from the CM. After locating the CM, first consideration will be given to determining the condition of the astronauts and to providing first-level medical aid when required. Unlike previous spacecraft, the Apollo 12 CM will not deploy the sea dye into the water after landing. The sea dye container and swimmer interphone connector are permanently attached to the upper deck of the CM. If a sea dye marker is requested by the recovery forces, the flight crew will deploy a tethered container of dye through the side hatch of the CM. The container will emit a yellow-green streak in the wake of the CM for approximately 1 hour. The crew has two markers that may be deployed. If the Apollo swimmer radio fails and it becomes necessary to use the interphone to communicate with the crew, the swimmer will have to climb to the top of the CM to reach the interphone connector.

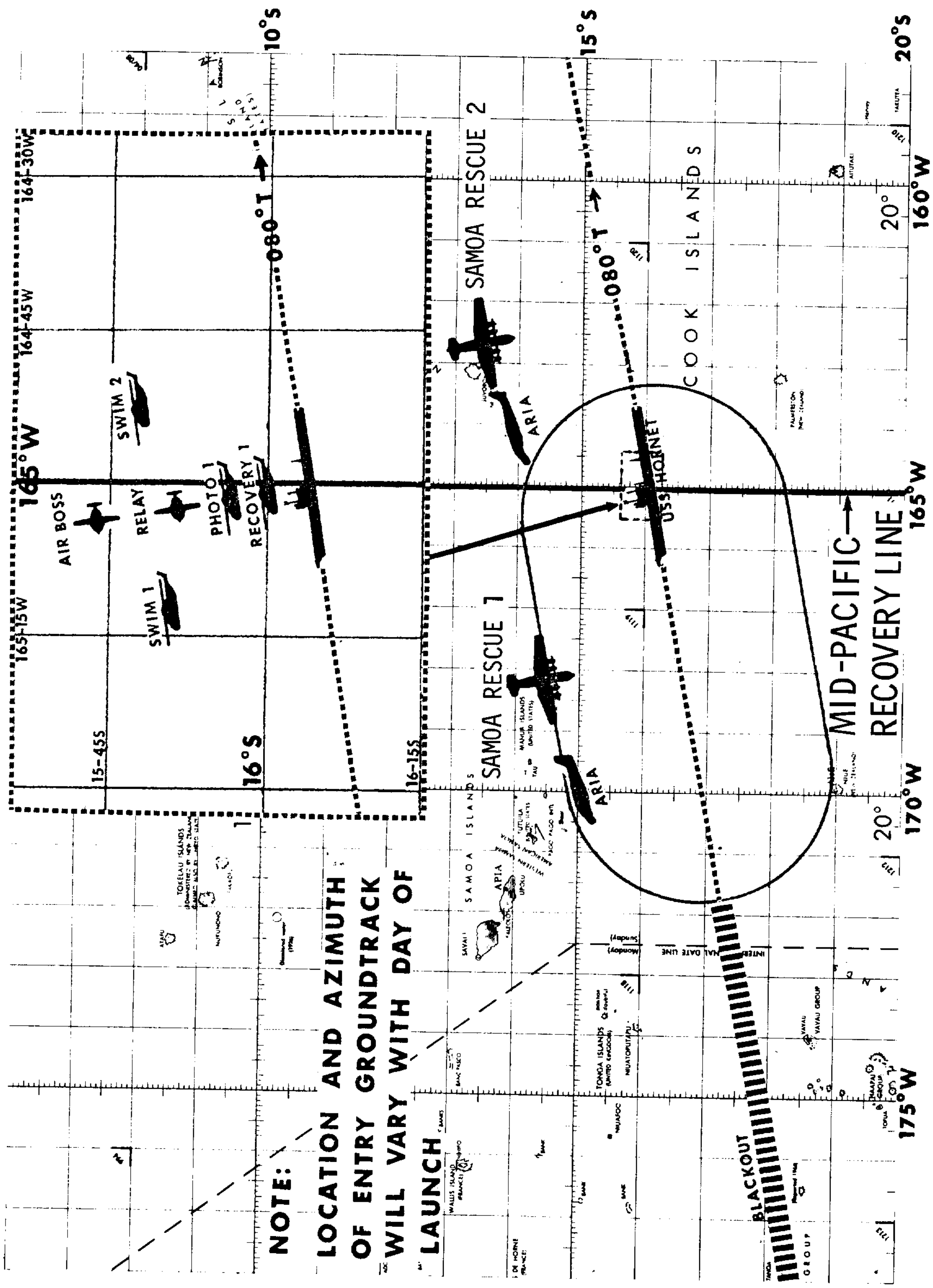
The second consideration will be recovery of the astronauts and CM. Retrieval of the CM main parachutes, apex cover, and drogue parachutes, in that order, is highly desirable if feasible and practical. Special clothing, procedures, and the Mobile Quarantine Facility (MQF) will be used to provide biological isolation of the astronauts and CM. The lunar sample rocks will also be isolated for return to the Manned Spacecraft Center.

PRIMARY LANDING AREA

The primary landing area, shown in Figure 29, is that area in which the CM will land following circumlunar or lunar orbital trajectories that are targeted to the mid-Pacific recovery line. The target point will normally be 1250 nautical miles (NM) downrange of the entry point (400,000 feet altitude). If the entry range is increased to avoid bad weather, the area moves along with the target point and contains all the high probability landing points as long as the entry range does not exceed 2000 NM.

Recovery forces assigned to the primary landing area are:

- The USS HORNET will be on station at the end-of-mission target point.
- Four SARAH-equipped helicopters, two carrying swimmer teams to conduct electronic search, will be provided. At least one of the swimmers on each team will be equipped with an underwater (Calypso) 35mm camera. Station assignments for these helicopters are:
  - One helicopter will be stationed 10 NM uprange from the target point and 15 NM north of the CM ground track.



PRIMARY LANDING AREA AND FORCE DEPLOYMENT

Fig. 29

    - One helicopter will be stationed 10 NM downrange from the target point and 15 NM north of the CM ground track.
    - One helicopter will be provided for astronaut recovery in the vicinity of the USS HORNET.
    - One helicopter carrying photographers as designated by the NASA Recovery Team Leader will be stationed in the vicinity of the USS HORNET.

- One aircraft will fly overhead of the primary recovery ship to function as on-scene commander.
- One aircraft will be on station in the vicinity of the USS HORNET to function as on-scene relay of the recovery commentary.
- Two HC-130 aircraft, each with operational AN/ARD-17 (Cook Tracker), three-man pararescue team, and complete Apollo recovery equipment, will be stationed 100 NM north of the CM ground track. One will be stationed 165 NM uprange, the other 165 NM downrange from the target point.
- Prior to CM entry, two EC-135 Apollo Range Instrumentation Aircraft will be on station near the primary landing area for network support.

The recovery forces will provide the following access and retrieval times:

- A maximum access time of 2 hours to any point in the area.
- A maximum crew retrieval time of 16 hours to any point in the area.
- A maximum CM retrieval time of 24 hours to any point in the area.

Recovery forces will also be provided for support of the launch abort landing area, the secondary landing area, and the contingency landing area. The secondary landing area and the contingency landing area would be used for landing from the earth parking orbit and following aborts during the deep space phase of the mission.

CONFIGURATION DIFFERENCES

SPACE VEHICLE	REMARKS
Command/Service Module (CSM-108)	
• Incorporate S-158 Experiment and window modification.	Changes side hatch window pane and adds camera equipment for lunar mission multi-spectral photography.
• Suppressed Reaction Control System (RCS) engine arc.	Protects Guidance and Navigation System from electromagnetic interference produced by RCS heater switching cycle transients.
• Added Inertial Measurement Unit (IMU) power switch guard.	Prevents loss of IMU due to inadvertent turn off of switch.
• Modified stowage.	Provides for return of Surveyor III samples and increased lunar surface samples.
Lunar Module (LM-6) (Ascent Stage)	
• Modified Display and Keyboard Assembly (DSKY) table and support.	Enhances one-handed operation by the flight crew to actuate and release the DSKY table from the stowed to operating position.
• Redesigned ascent stage propellant tanks to all welded configuration.	Eliminates a leak source for propellants and alleviates vehicle weight.
• Added stowable hammocks and blankets.	Increases crew comfort.
• Deleted bacteria filter from forward hatch valve.	Eliminates a potential cause of reduced cabin venting.
• Modified stowage.	Provides for return of Surveyor III samples and increased lunar surface samples.

Lunar Module (LM-6) (Descent Stage)

• Reduced landing gear and plume deflector thermal insulation.	Reduces vehicle weight by approximately 3.6 lb.
• Modified extravehicular activity (EVA) equipment stowage.	Provides for current mission requirements.
• Replaced Early Apollo Scientific Experiments Package (EASEP) with Apollo Lunar Surface Experiments Package (ALSEP)/Radioisotope Thermoelectric Generator (RTG).	Provides for current mission requirements.

Spacecraft-LM Adapter (SLA-15)

- (No significant differences.)

LAUNCH VEHICLE

Instrument Unit (S-IU-507)

• Added underwater location devices.	Increases recovery potential.

S-IVB Stage (SA-507)

• Changed the telemetry system for the S-IVB stage of vehicle SA-507 to consist of one SSB/FM link and one PCM/DDAS link — SA-506 consisted of one PCM/DDAS link.	Provides for 12 acoustic and 3 vibration measurements to S-IVB 507 which necessitates the use of a Saturn MSFC-designed single sideband/FM system similar to those used on research and development flights.

S-II Stage (S-II-507)

- (No significant differences.)

S-IC Stage (SA-507)

- (No significant differences.)

MANNED SPACE FLIGHT NETWORK

C-Band Radar

• Deleted PAFB, GBI, GTI, ANT, ASC, PRE, TAN, HAW, CAL.	Eliminates unnecessary duplication of unified S-band.

Unified S-Band

• Deleted GBM, ANG.	Eliminates unnecessary coverage beyond 96° launch azimuth.
• Added pulse modulation capability to PARKES.	Required to support LM descent.
• Added capability to handle LM color TV.	Provides for color TV transmission.

VHF Telemetry

• Deleted GBM, ANG, TAN.	Eliminates unnecessary coverage beyond 96° launch azimuth.

A/G Voice (VHF)

• Deleted GBM, ANG, CAL (GDS being added), TAN.	Eliminates unnecessary coverage beyond 96° launch azimuth.

Instrumentation Ships and Aircraft

• Deleted USNS REDSTONE, MERCURY, and HUNTSVILLE.	Eliminates unnecessary real-time coverage of translunar injection (TLI) and recovery.
• Deleted four Apollo Range Instrumentation Aircraft.	Eliminates unnecessary real-time coverage of TLI.

FLIGHT CREW

FLIGHT CREW ASSIGNMENTS

Prime Crew (Figure 30)

Commander (CDR) - Charles Conrad, Jr. (Commander, USN)
Command Module Pilot (CMP) - Richard F. Gordon, Jr. (Commander, USN)
Lunar Module Pilot (LMP) - Alan L. Bean (Commander, USN)

Backup Crew (Figure 31)

Commander (CDR) - David R. Scott (Colonel, USAF)
Command Module Pilot (CMP) - Alfred Merrill Worden (Major, USAF)
Lunar Module Pilot (LMP) - James Benson Irwin (Lieutenant Colonel, USAF)

The backup crew follows closely the training schedule for the prime crew and functions in three significant categories. One, they receive nearly complete mission training which becomes a valuable foundation for later assignments as a prime crew. Two, should the prime crew become unavailable, they are prepared to fly as prime crew up until the last few weeks prior to launch. Three, they are fully informed assistants who help the prime crew organize the mission and check out the hardware.

During the final weeks before launch, the flight hardware and software, ground hardware and software, and flight crew and ground crews work as an integrated team to perform ground simulations and other tests of the upcoming mission. It is necessary that the flight crew that will conduct the mission take part in these activities, which are not repeated for the benefit of the backup crew. To do so would add an additional costly and time consuming period to the prelaunch schedule, which for a lunar mission would require rescheduling for a later lunar launch window.

PRIME CREW DATA

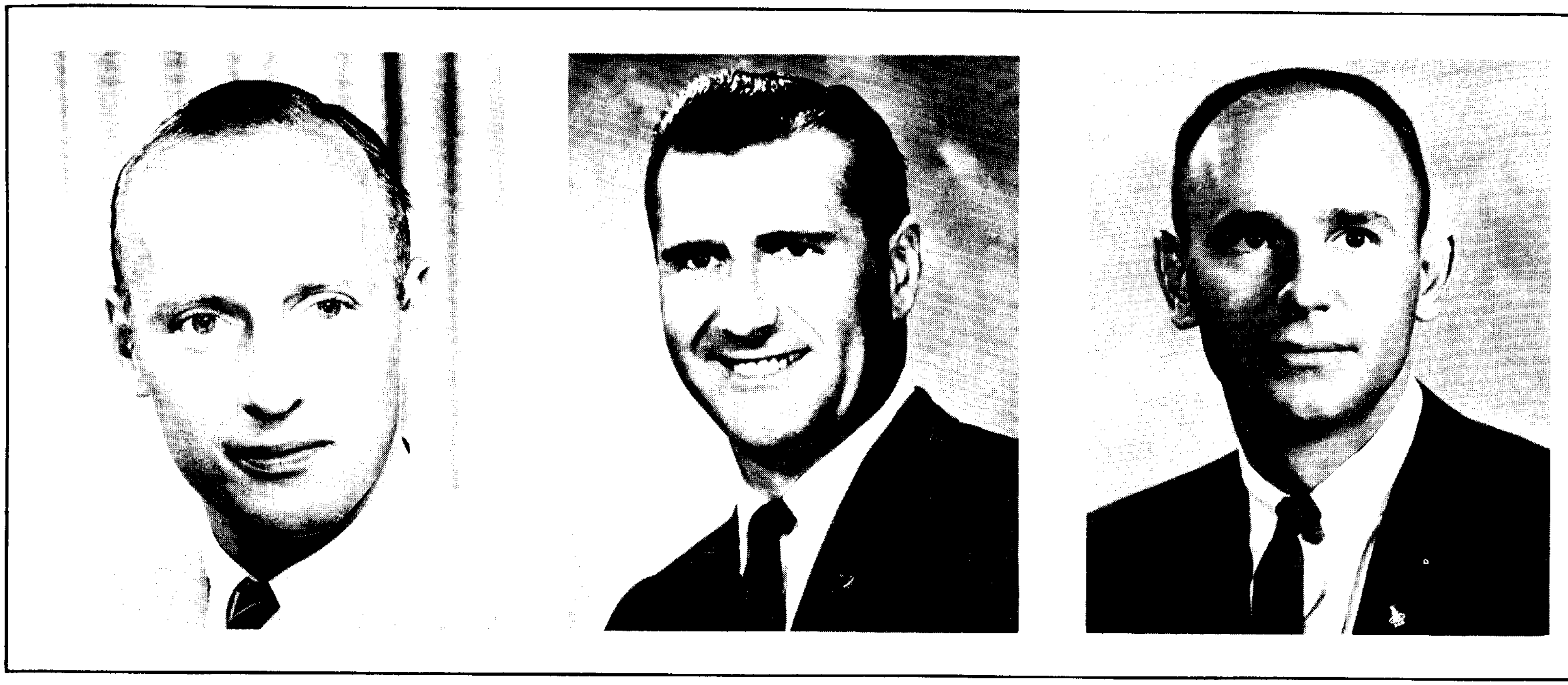
Commander

NAME: Charles Conrad, Jr. (Commander, USN)

EDUCATION: Bachelor of Science degree in Aeronautical Engineering from Princeton University in 1953; Honorary Master of Arts degree from Princeton University in 1966.

EXPERIENCE: Commander Conrad was selected as an astronaut by NASA in September 1962.

APOLLO 12 PRIME CREW



CHARLES CONRAD, JR. | RICHARD F. GORDON, JR. | ALAN L. BEAN

COMMANDER | COMMAND MODULE PILOT | LUNAR MODULE PILOT

Fig. 30

APOLLO 12 BACKUP CREW

DAVID R. SCOTT

COMMANDER

ALFRED M. WORDEN

COMMAND MODULE PILOT

JAMES B. IRWIN

LUNAR MODULE PILOT

Fig. 31

APOLLO: Conrad served as the backup Commander for the Apollo 9 Mission.

GEMINI: On 12 September 1966, Conrad occupied the Command Pilot seat for the 3-day, 44-revolution Gemini 11 Mission. Highlights of the flight included orbital maneuvers to rendezvous and dock in less than one orbit with a previously launched Agena, the retrieval of a nuclear emulsion experiment package during the first extravehicular activity, and the successful completion of the first tethered station keeping exercise, in which artificial gravity was produced.

In August 1965, he served as Pilot on the 8-day Gemini 5 Mission. He and Command Pilot Gordon Cooper were launched into orbit on 21 August and proceeded to establish a new space endurance record by which the U.S. took over the lead in manhours in space.

OTHER: Conrad entered the Navy following his graduation from Princeton University and became a naval aviator. He attended the Navy Test Pilot School at Patuxent River, Maryland, and was then assigned as a project test pilot in the armaments test division there. He also served at Patuxent as a flight instructor and performance engineer at the Test Pilot School.

Command Module Pilot

NAME: Richard F. Gordon, Jr. (Commander, USN)

EDUCATION: Bachelor of Science degree in Chemistry from the University of Washington in 1951.

EXPERIENCE: Commander Gordon was one of the third group of astronauts named by NASA in October 1963.

APOLLO: Gordon served as backup Command Module Pilot for the Apollo 9 Mission.

GEMINI: On 12 September 1966, he served as Pilot for the 3-day Gemini 11 Mission, on which rendezvous with an Agena was achieved in less than one orbit. He executed docking maneuvers with the previously launched Agena and performed two periods of extravehicular activity which included attaching a tether to the Agena and retrieving a nuclear emulsion experiment package. Another highlight of the mission was the successful completion of the first closed-loop controlled entry.

OTHER: Commander Gordon received his wings as a naval aviator in 1953. He then attended All-Weather Flight School and jet transitional training and was subsequently assigned to an all-weather fighter squadron at the Naval Air Station at Jacksonville, Florida.

In 1957, he attended the Navy's Test Pilot School at Patuxent River, Maryland, and served as a flight test pilot until 1960. During this tour of duty he did flight test work on the F8U Crusader, F11F Tigercat, FJ Fury, and A4D Skyhawk and was the first project test pilot for the F4H Phantom II.

He served as a flight instructor in the F4H with Fighter Squadron 121 at the Miramar, California, Naval Air Station and was also flight safety officer, assistant operations officer, and ground training officer for Fighter Squadron 96 at Miramar.

He was also a student at the U.S. Naval Postgraduate School at Monterey, California.

Lunar Module Pilot

NAME: Alan L. Bean (Commander, USN)

EDUCATION: Bachelor of Science degree in Aeronautical Engineering from the University of Texas in 1955.

EXPERIENCE: Commander Bean was one of the third group of astronauts selected by NASA in October 1963.

APOLLO: Bean served as backup Lunar Module Pilot for the Apollo 9 Mission.

GEMINI: Bean served as backup Command Pilot for the Gemini 10 Mission.

OTHER: Bean, a Navy ROTC student at Texas, was commissioned in 1955 upon graduation from the University. After completing his flight training, he was assigned to Attack Squadron 44 at the Naval Air Station in Jacksonville, Florida, for 4 years. He then attended the Navy Test Pilot School at Patuxent River, Maryland, and was assigned as a test pilot at the Naval Air Test Center, Patuxent River. Commander Bean participated in the trials of both the A5A and the A4E jet attack airplanes. He then attended the Aviation Safety School at the University of Southern California and was next assigned to Attack Squadron 172 at Cecil Field, Florida.

BACKUP CREW DATA

Commander

NAME: David R. Scott (Colonel, USAF)

EDUCATION: Bachelor of Science degree from the United States Military Academy; degrees of Master of Science in Aeronautics and Astronautics and Engineer of Aeronautics and Astronautics from the Massachusetts Institute of Technology.

EXPERIENCE: Colonel Scott was one of the third group of astronauts selected by NASA in October 1963.

APOLLO: Scott served as Command Module Pilot for Apollo 9, 3-13 March 1969. The 10-day flight encompassed completion of the first comprehensive earth-orbital qualification and verification tests of a "fully configured Apollo spacecraft" and provided vital information previously not available on the operational performance, stability, and reliability of Lunar Module propulsion and life support systems.

GEMINI: On 16 March 1966, he and Command Pilot Neil Armstrong were launched into space on the Gemini 8 Mission — a flight originally scheduled to last 3 days but terminated early due to a malfunctioning spacecraft thruster. The crew performed the first successful docking of two vehicles in space and demonstrated great piloting skill in overcoming the thruster problem and bringing the spacecraft to a safe landing.

OTHER: Scott graduated fifth in a class of 633 at West Point and subsequently chose an Air Force career. He completed pilot training at Webb Air Force Base, Texas, in 1955 and then reported for gunnery training at Laughlin Air Force Base, Texas, and Luke Air Force Base, Arizona.

He was assigned to the 32nd Tactical Fighter Squadron at Soesterberg Air Base (RNLAF), Netherlands, from April 1956 to July 1960. He then returned to the U.S. and completed work on his masters degree at MIT. His thesis at MIT concerned interplanetary navigation.

After completing his studies at MIT in June 1962, he attended the Air Force Experimental Test Pilot School and then the Aerospace Research School.

Command Module Pilot

NAME: Alfred Merrill Worden (Major, USAF)

EDUCATION: Bachelor of Military Science from the United States Military Academy in 1955; Master of Science degrees in Astronautical/Aeronautical Engineering and Instrumentation Engineering from the University of Michigan in 1963.

EXPERIENCE: Major Worden was one of the 19 astronauts named by NASA in April 1966.

APOLLO: Worden served as a member of the astronaut support crew for the Apollo 9 Mission.

OTHER: Major Worden received flight training at Moore Air Base, Texas; Laredo Air Force Base, Texas; and Tyndall Air Force Base, Florida.

Prior to his arrival for duty at the Manned Spacecraft Center, he served as an instructor at the Aerospace Research Pilot's School, from which he graduated in 1965. He is also a graduate of the Empire Test Pilot's School in Farnborough, England, and completed his training there in February 1965.

He attended Randolph Air Force Base Instrument Pilots Instructor School in 1963 and served as a Pilot and Armament Officer from March 1957 to May 1961 with the 95th Fighter Interceptor Squadron at Andrews Air Force Base, Maryland.

Lunar Module Pilot

NAME: James Benson Irwin (Lieutenant Colonel, USAF)

EDUCATION: Bachelor of Science degree in Naval Sciences from the United States Naval Academy in 1951; Master of Science degrees in Aeronautical Engineering and Instrumentation Engineering from the University of Michigan in 1957.

EXPERIENCE: Lt. Colonel Irwin was one of the 19 Astronauts selected by NASA in April 1966.

APOLLO: Irwin was crew Commander of Lunar Module LTA-8; this vehicle finished the first series of thermal vacuum tests on 1 June 1968. He also served as a member of the support crew for Apollo 10.

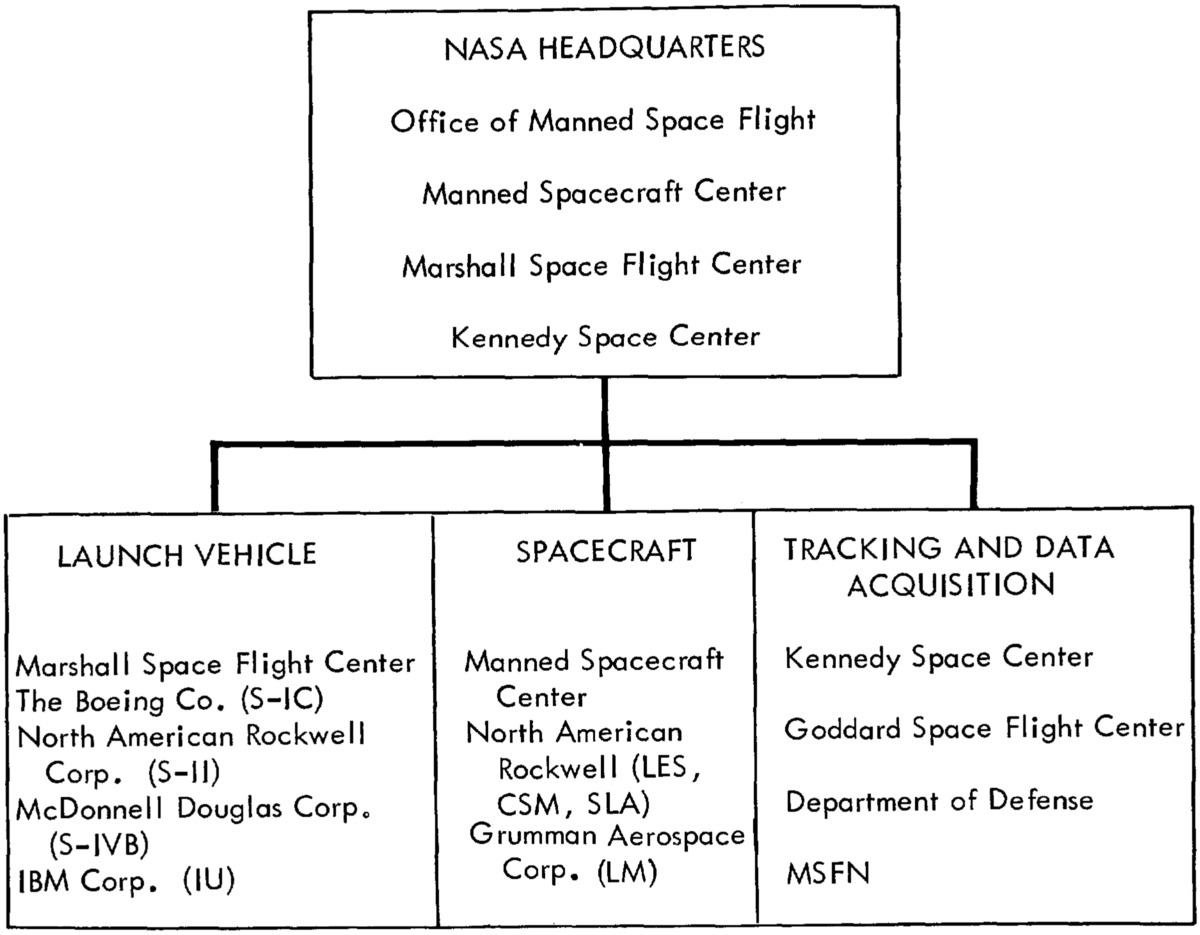
OTHER: Irwin was commissioned in the Air Force on graduation from the Naval Academy in 1951 and received his flight training at Hondo Air Base, Texas, and Reese Air Force Base, Texas.

He also served with the F-12 Test Force at Edwards Air Force Base, California, and with the AIM 47 Project Office at Wright-Patterson Air Force Base, Ohio.

MISSION MANAGEMENT RESPONSIBILITY

Title	Name	Organization
Director, Apollo Program	Dr. Rocco A. Petrone	NASA/OMSF
Director, Mission Operations	Maj. Gen. John D. Stevenson (Ret)	NASA/OMSF
Saturn Program Manager	Mr. Roy E. Godfrey	NASA/MSFC
Apollo Spacecraft Program Manager	Col. James A. McDivitt	NASA/MSC
Apollo Program Manager KSC	Mr. Edward R. Mathews	NASA/KSC
Mission Director	Capt. Chester M. Lee (Ret)	NASA/OMSF
Assistant Mission Director	Col. Thomas H. McMullen	NASA/OMSF
Director of Launch Operations	Mr. Walter J. Kapryan	NASA/KSC
Director of Flight Operations	Dr. Christopher C. Kraft	NASA/MSC
Launch Operations Manager	Mr. Paul C. Donnelly	NASA/KSC
Flight Directors	Mr. Gerald D. Griffin Mr. M. P. Frank Mr. Glynn S. Lunney Mr. Clifford E. Charlesworth	NASA/MSC
Spacecraft Commander (Prime)	Cdr. Charles Conrad, Jr.	NASA/MSC
Spacecraft Commander (Backup)	Col. David R. Scott	NASA/MSC

PROGRAM MANAGEMENT



ABBREVIATIONS AND ACRONYMS

ACN	Ascension Island
A/G	Air To Ground
AGS	Abort Guidance System
ALSEP	Apollo Lunar Surface Experiments Package
ANG	Antigua Island (MSFN)
ANT	Antigua Island (DOD)
APS	Ascent Propulsion System (LM)
APS	Auxiliary Propulsion System (S-IVB)
ARIA	Apollo Range Instrumentation Aircraft
AS	Apollo/Saturn
ASC	Ascension Island
BDA	Bermuda
BIG	Biological Isolation Garment
CAL	Point Arguello, California
CCATS	Communications, Command, and Telemetry System
CD	Countdown
CDH	Constant Delta Height
CDR	Commander
CM	Command Module
CMD	Command
CMP	Command Module Pilot
CNV	Cape Canaveral
CRO	Carnarvon
CSI	Concentric Sequence Initiation
CSM	Command/Service Module
CYI	Grand Canary Island
DDAS	Digital Data Acquisition System
DOD	Department of Defense
DOI	Descent Orbit Insertion
DPS	Descent Propulsion System
DSKY	Display and Keyboard Assembly
EASEP	Early Apollo Scientific Experiments Package
EI	Entry Interface
EMU	Extravehicular Mobility Unit
EPO	Earth Parking Orbit
EST	Eastern Standard Time
ETB	Equipment Transfer Bag
EVA	Extravehicular Activity
FM	Frequency Modulation
fps	Feet Per Second
FT	Feet
FTP	Full Throttle Position
GBI	Grand Bahama Island (USAF)
GBM	Grand Bahama Island (NASA)
GDS	Goldstone, California
GET	Ground Elapsed Time
GTI	Grand Turk Island (NASA)
GTK	Grand Turk Island (DOD)
GYM	Guaymas, Mexico

HAW	Kauai, Hawaii
HR	Hour
HTC	Hand Tool Carrier
IMU	Inertial Measurement Unit
IU	Instrument Unit
IVT	Intravehicular Transfer
KSC	Kennedy Space Center
LCC	Launch Control Center
LEC	Lunar Equipment Conveyor
LES	Launch Escape System
LH_2	Liquid Hydrogen
LiOH	Lithium Hydroxide
LM	Lunar Module
LMP	Lunar Module Pilot
LOI	Lunar Orbit Insertion
LOX	Liquid Oxygen
LPO	Lunar Parking Orbit
LR	Landing Radar
LRL	Lunar Receiving Laboratory
LV	Launch Vehicle
m	Meter
mm	Millimeter
MAD	Madrid
MAX	Maximum
MCC	Midcourse Correction
MCC	Mission Control Center
MESA	Modularized Equipment Stowage Assembly
MHz	Megahertz
MIL	Merritt Island (NASA)
MLA	Merritt Island (DOD)
MIN	Minute
MOCR	Mission Operations Control Room
MOR	Mission Operations Report
MQF	Mobile Quarantine Facility
MSC	Manned Spacecraft Center
MSFC	Marshall Space Flight Center
MSFN	Manned Space Flight Network
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network
NM	Nautical Mile
OMSF	Office of Manned Space Flight
OPS	Oxygen Purge System
PAFB	Patrick Air Force Base
PAT	Patrick AFB
PCM	Pulse Code Modulation
PDI	Powered Descent Initiation
PGNCS	Primary Guidance, Navigation, and Control System
PLSS	Portable Life Support System
PRE	Pretoria
PRN	Pseudorandom Noise

psi	Pounds Per Square Inch
QUAD	Quadrant
RCS	Reaction Control System
RLS	Radius Landing Site
RNLAF	Royal Netherlands Air Force
RTCC	Real-Time Computer Complex
RTG	Radioisotope Thermoelectric Generator
S/C	Spacecraft
SEA	Sun Elevation Angle
S-IC	Saturn V First Stage
S-II	Saturn V Second Stage
S-IVB	Saturn V Third Stage
SLA	Spacecraft-LM Adapter
SM	Service Module
SPAN	Solar Particle Alert Network
SPS	Service Propulsion System
SRC	Sample Return Container
SSB	Single Side Band
SSR	Staff Support Room
SV	Space Vehicle
SWC	Solar Wind Composition
TAN	Tananarive, Malagasy Republic
TEI	Transearth Injection
TEX	Corpus Christi, Texas
TFI	Time From Ignition
TLM	Telemetry
TLI	Translunar Injection
TPF	Terminal Phase Finalization
TPI	Terminal Phase Initiation
TRAJ	Trajectory
T-time	Countdown Time (referenced to liftoff time)
TTY	Teletype
TV	Television
USB	Unified S-band
USN	United States Navy
USAF	United States Air Force
VAN	Vanguard
VHF	Very High Frequency
ΔV	Differential Velocity

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