M-932-69-09

FEB 24 1969

MEMORANDUM

To: A/Acting Administrator

From: MA/Apollo Program Director

Subject: Apollo 9 Mission (AS-504)

No earlier than 28 February 1969, we plan to launch the next Apollo/Saturn V mission, Apollo 9. This will be the second manned Saturn V flight, the third flight of a manned Apollo Command/Service Module, and the first flight of a manned Lunar Module.

The purpose of this mission is to demonstrate crew/space vehicle/mission support facilities performance during a manned Saturn V mission with CSM and LM, demonstrate LM/crew performance, demonstrate performance of nominal and selected backup Lunar Orbit Rendezvous mission activities, and assess CSM/LM consumables.

The launch will be the fourth Saturn V from Launch Complex 39A at Kennedy Space Center. The launch window opens at 11:00 EST, closes at 14:00 EST and is determined by lighting and ground station coverage requirements for rendezvous.

The nominal mission will include: ascent to orbit, CSM transposition and docking, CSM/LM separation from the S-IVB, five docked SPS burns, two unmanned S-IVB restarts, LM systems evaluation, a docked DPS burn, EVA, LM active rendezvous, an unmanned APS burn to propellant depletion, CSM solo activities and three SPS burns, CM reentry, and recovery in the Atlantic.

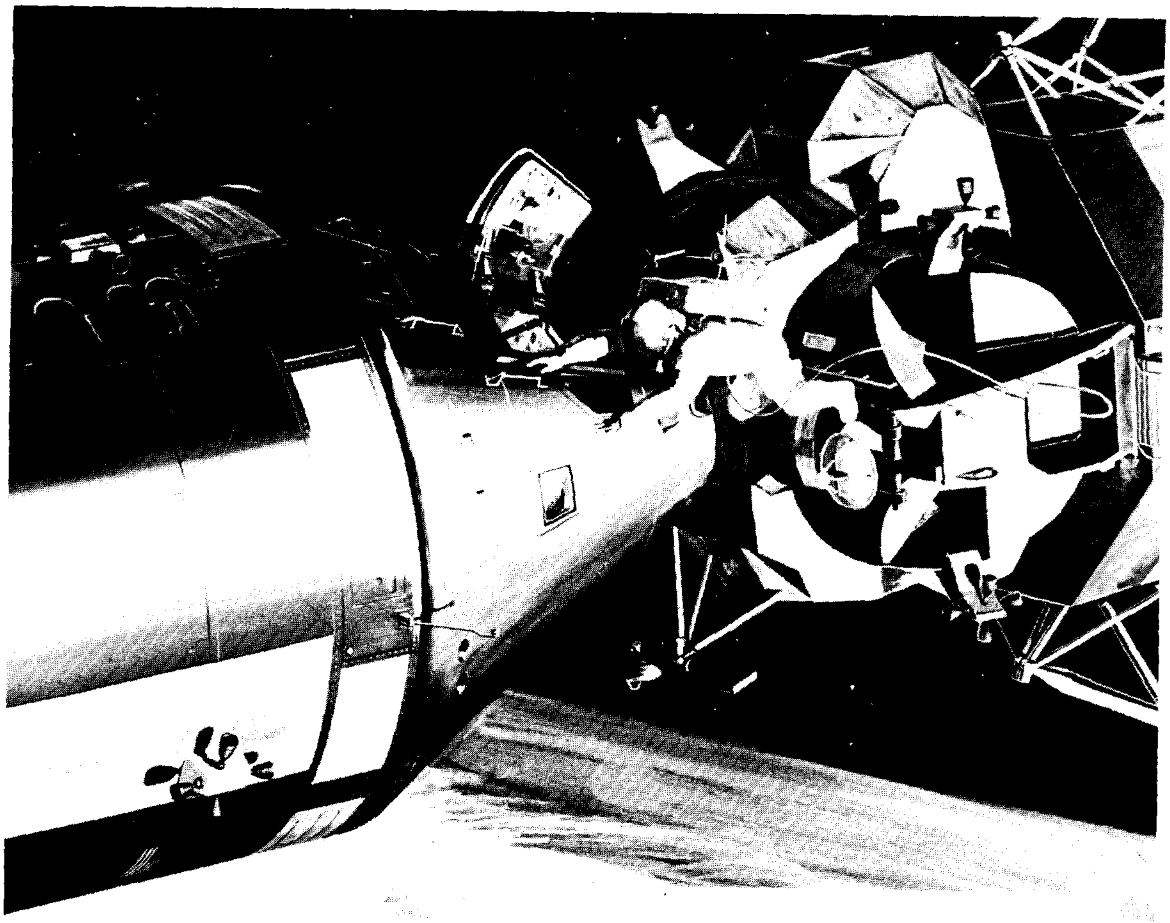
Sam C. Phillips
Lt. General, USAF
Apollo Program Director

APPROVAL:

George E. Mueller
Associate Administrator for
Manned Space Flight

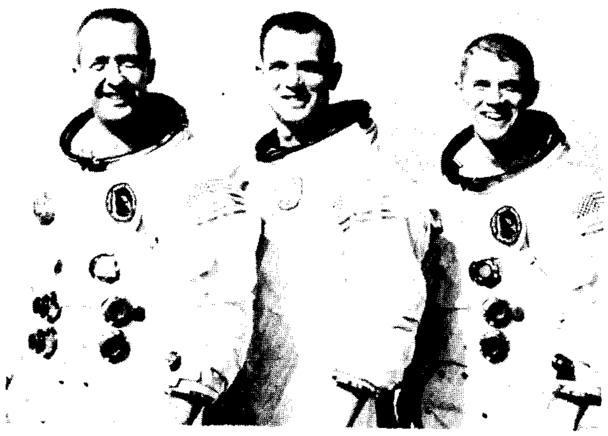
Report No. M-932-69-09

MISSION OPERATION REPORT



The Prime Crew Members are (Left to right)

JAMES A. MC DIVITT
DAVID R. SCOTT
RUSSELL L. SCHWEICKART



APOLLO 9 (AS-504) MISSION

OFFICE OF MANNED SPACE FLIGHT
Prepared by: Apollo Program Office-MAO
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FOREWORD

MISSION OPERATION REPORTS are published expressly for the use of NASA Senior Management, as required by the Administrator in NASA Instruction 6-2-10, dated August 15, 1963. The purpose of these reports is to provide NASA Senior Management with timely, complete, and definitive information on flight mission plans, and to establish official mission objectives which provide the basis for assessment of mission accomplishment.

Initial reports are prepared and issued for each flight project just prior to launch. Following launch, updating reports for each mission are issued to keep General Management currently informed of definitive mission results as provided in NASA Instruction 6-2-10.

Because of their sometimes highly technical orientation, distribution of these reports is limited to personnel having program-project management responsibilities. The Office of Public Affairs publishes a comprehensive series of pre-launch and post-launch reports on NASA flight missions, which are available for general distribution.

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APOLLO 9 MISSION OPERATION REPORT

The Apollo 9 Mission Operation Report is published in two volumes - I, The Mission Operation Report (MOR) and II, the Mission Operation Report Supplement.

This format was designed to provide a mission-oriented document in the MOR with only a very brief description of the space vehicle and support facilities. The MOR Supplement is a reference document with a more comprehensive description of the space vehicle, launch complex, and mission monitoring, support, and control facilities.

GENERAL

The goal of the Apollo Program is to enhance the manned space flight capability of the United States by developing, through logical and orderly evolution, the ability to land men on the moon and return them safely to earth.

To accomplish the goal of lunar landing and return in this decade, the Apollo Program has focused on the development of a highly reliable launch vehicle and spacecraft system. This has been done through a logical sequence of Apollo missions designed to qualify the flight hardware, ground support systems, and operational personnel in the most effective manner.

The Apollo 9 mission is the third manned flight of the Apollo Command and Service Module (CSM), the first manned flight of the Lunar Module (LM), and the second manned Saturn V mission. The mission is designed to test the space vehicle, mission support facilities, and crew with a complete Apollo spacecraft (CSM and LM) in earth orbit.

PROGRAM DEVELOPMENT

The first Saturn vehicle was successfully flown on 27 October 1961 to initiate operations of the Saturn I Program.

A total of 10 Saturn I vehicles (SA-1 to SA-10) was successfully flight tested to provide information on the integration of launch vehicle and spacecraft and to provide operational experience with large multi-engined booster stages (S-I, S-IV).

The next generation of vehicles, developed under the Saturn IB Program, featured an uprated first stage (S-IB) and a more powerful new second stage (S-IVB). The first Saturn IB was launched on 26 February 1966. The first three Saturn IB missions (AS-201, AS-203, and AS-202) successfully tested the performance of the launch vehicle and spacecraft combination, separation of the stages, behavior of liquid hydrogen in a weightless environment, performance of the Command Module heat shield at low earth orbital entry conditions, and recovery operations.

The planned fourth Saturn IB mission (AS-204) scheduled for early 1967 was intended to be the first manned Apollo flight. This mission was not flown because of a spacecraft fire, during a manned pre-launch test, that took the lives of the prime flight crew and severely damaged the spacecraft. The SA-204 launch vehicle was later assigned to the Apollo 5 mission.

The Apollo 4 mission was successfully executed on 9 November 1967. This mission initiated the use of the Saturn V launch vehicle (SA-501) and required an orbital restart of the S-IVB third stage. The spacecraft for this mission consisted of an unmanned Command and Service Module (CSM) and a Lunar Module Test Article (LTA). The CSM Service Propulsion System (SPS) was exercised, including restart, and the Command Module Block II heat shield was subjected to the combination of high heat load, high heat rate, and aerodynamic loads representative of lunar return entry.

The Apollo 5 mission was successfully launched and completed on 22 January 1968. This was the fourth mission utilizing Saturn IB vehicles (SA-204). This flight provided for unmanned orbital testing of the Lunar Module (LM-1). The LM structure, staging, and proper operation of the Lunar Module Ascent Propulsion System (APS) and Descent Propulsion System (DPS), including restart, were verified. Satisfactory performance of the S-IVB/Instrument Unit (IU) in orbit was also demonstrated.

The Apollo 6 mission (second unmanned Saturn V) was successfully launched on 4 April 1968. Some flight anomalies encountered included oscillation reflecting propulsion-structural longitudinal coupling, an imperfection in the Spacecraft LM Adapter (SLA) structural integrity, and certain malfunctions of the J-2 engines in the S-II and S-IVB stages. The spacecraft flew the planned trajectory, but pre-planned high velocity reentry conditions were not achieved. A majority of the mission objectives for Apollo 6 were accomplished.

The Apollo 7 mission (first manned Apollo) was successfully launched on 11 October 1968. This was the fifth and last planned Apollo mission utilizing Saturn IB launch vehicles (SA-205). The eleven-day mission provided the first orbital tests of the Block II Command and Service Module. All Primary Mission Objectives were successfully accomplished. In addition, all planned Detailed Test Objectives, plus three that were not originally scheduled, were satisfactorily accomplished.

The Apollo 8 mission was successfully launched on 21 December and completed on 27 December 1968. This was the first manned flight of the Saturn V launch vehicle and the first manned flight to the vicinity of the moon. All Primary Mission Objectives were successfully accomplished. In addition, all Detailed Test Objectives plus four that were not originally scheduled, were successfully accomplished. Ten orbits of the moon were successfully performed with the last eight circular at an altitude of 60 nautical miles. TV and film photographic coverage was successfully carried out, with telecasts to the public being made in real time.

THE APOLLO 9 MISSION

Apollo 9 (AS-504) will be the fourth Saturn V Mission and the first manned flight of the Lunar Module (LM). Mission duration is open-ended and currently planned for approximately ten days (239 hours). This CSM/LM Operations Mission is designed to achieve an evaluation of a manned LM and to demonstrate the compatibility of the CSM and LM to perform combined operations typical of lunar missions.

The mission has been divided into six activity periods over the ten-day mission duration. The first activity period will consist of launch and ascent to orbit, CSM transposition and docking with the LM/IU/S-IVB, separation of the CSM/LM from the IU/S-IVB, two unmanned S-IVB engine restarts, and one docked-CSM/LM SPS burn. The second activity period will be taken up primarily by three more SPS burns. The third activity period will see the first LM operation including extensive LM systems checkout and the first docked-CSM/LM DPS burn followed by the fifth SPS burn. The fourth activity period will be devoted to extravehicular activity (EVA) including a transfer from the LM to the CSM and return, and live TV of the CSM and LM by the EVA astronaut. The fifth activity period will complete LM activities with two DPS burns, LM descent stage jettison, LM-active rendezvous including the first APS burn, and finally APS burn to propellant depletion. The sixth activity period will be devoted to CSM solo operations including three SPS burns, navigation exercises, a multispectral terrain photography scientific experiment, CM reentry, and recovery.

NASA OMSF PRIMARY MISSION OBJECTIVES FOR APOLLO 9

PRIMARY OBJECTIVES

- Demonstrate crew/space vehicle/mission support facilities performance during a manned Saturn V mission with CSM and LM.
- Demonstrate LM/crew performance.
- Demonstrate performance of nominal and selected backup Lunar Orbit Rendezvous (LOR) mission activities, including:
  - Transposition, docking, LM withdrawal
  - Intervehicular crew transfer
  - Extravehicular capability
  - SPS and DPS burns
  - LM active rendezvous and docking
- CSM/LM consumables assessment.

Sam C. Phillips
Lt. General, USAF
Apollo Program Director

Date: 14 FEB 69

George E. Mueller
Associate Administrator for
Manned Space Flight

Date: 17 Feb 1969

DETAILED TEST OBJECTIVES

Mandatory and Principal Detailed Test Objectives (DTO's) amplify and define more explicitly those basic tests, measurements, and evaluations that are planned to achieve the Primary Objectives of the Apollo 9 Mission.

Launch Vehicle

- Demonstrate S-IVB/IU attitude control capability during transposition, docking, and LM ejection (T, D, & E) maneuver.

Spacecraft

- Perform LM-active rendezvous (20.27).
- Determine DPS duration effects and primary propulsion/vehicle interactions (13.12).
- Verify satisfactory performance of passive thermal subsystem (17.17).
- Demonstrate LM structural integrity (17.18).
- Perform DPS burn including throttling, docked; and a short duration DPS burn, undocked (11.6).
- Perform long duration APS burns (13.11).
- Demonstrate Environmental Control System (ECS) performance during all LM activities (14.0).
- Obtain temperature data on deployed landing gear resulting from DPS operation (17.9).
- Determine Electrical Power System (EPS) performance, primary and backup (15.3).
- Operate landing radar during DPS burns (16.7).
- Perform Abort Guidance System (AGS)/Central Electronics System (CES) controlled DPS burn (12.4).
- Perform Primary Guidance, Navigation, and Control System (PGNCS)/Digital Auto Pilot (DAP) controlled long duration APS burn (11.14).

- Demonstrate RCS control of LM using manual and automatic PGNCS (11.7).
- Demonstrate S-band and VHF communication compatibility (20.22).
- Demonstrate RCS control of LM using manual and automatic AGS/CES (12.3).
- Demonstrate CSM attitude control, docked, during SPS burn (1.23).
- Demonstrate LM-active docking (20.28).
- Demonstrate LM ejection from SLA with CSM (20.25).
- Demonstrate CSM-active docking (20.24).
- Demonstrate LM-CSM undocking (20.26).
- Verify Inertial Measurement Unit (IMU) performance (11.10).
- Demonstrate Guidance, Navigation, and Control System (GNCS)/Manual Thrust Vector Control (MTVC) takeover (2.9).
- Demonstrate LM rendezvous radar performance (16.4).
- Demonstrate LM/Manned Space Flight Network (MSFN) S-band communications capability (20.21).
- Demonstrate IVT (20.34).
- Demonstrate AGS calibration and obtain performance data in flight (12.2).
- Perform LM IMU alignment (11.5).
- Perform LM jettison (20.29).
- Obtain data on Reaction Control System (RCS) plume impingement and corona effect on rendezvous radar performance (16.19).
- Demonstrate support facilities performance during earth orbital missions (20.31).
- Perform IMU alignment and daylight star visibility check, docked (1.25).
- Prepare for CSM-active rendezvous with LM (20.33).
- Perform IMU alignment with sextant (SXT), docked (1.24).

- Perform landing radar self-test (16.6).
- Extravehicular Activity (20.35).

SECONDARY OBJECTIVES

Apollo secondary objectives are established by the development centers to provide additional engineering or scientific data.

Launch Vehicle

- Verify S-IVB restart capability.
- Verify J-2 engine modifications.
- Confirm J-2 engine environment in S-II stage.
- Confirm launch vehicle longitudinal oscillation environment during S-IC stage burn period.
- Demonstrate O_2H_2 burner repressurization system operation.
- Demonstrate S-IVB propellant dump and safing.
- Verify that modifications incorporated in the S-IC stage suppress low-frequency longitudinal oscillations.
- Demonstrate 80-minute restart capability.
- Demonstrate dual repressurization capability.
- Demonstrate O_2H_2 burner restart capability.
- Verify the onboard Command and Communications System (CCS)/ground system interface and operation in the space environment.

Spacecraft

- Obtain exhaust effects data from Launch Escape Tower (LET), S-II retro, and SM RCS on CSM (7.29).
- Evaluate crew performance of all tasks (20.32).
- Perform navigation by landmark tracking (1.26).

- Perform APS burn-to-depletion, unmanned (13.10).
- Obtain data on DPS plume effects on visibility (20.37).
- Perform CSM/LM electromagnetic compatibility test (20.120).

LAUNCH COUNTDOWN AND TURNAROUND CAPABILITY AS-504

COUNTDOWN

Countdown for the Apollo 9 mission will begin with a pre-count period starting at T-130.5 hours during which launch vehicle (LV) and spacecraft preparations will take place independently. Coordinated space vehicle (SV) launch countdown activities begin at T-28 hours. Table 1 shows the significant launch countdown events.

SCRUB/TURNAROUND

Scrub/turnaround times are based upon the amount of work required to return the space vehicle to a safe condition and to complete the recycle activities necessary to resume launch countdown for a subsequent launch attempt. Planning guidelines for the various scrub/turnaround plans are based upon no serial time for repairs or holds, or for systems retesting resulting from repairs; performing tasks necessary to attain launch with the same degree of confidence as for the first launch attempt; and, not requiring unloading of hypergolic propellants and RP-1 from the SV.

TURNAROUND CONDITIONS VS. TIME *

Scrub can occur at any point in the countdown when weather, launch support facilities or SV conditions warrant. For a hold that results in a scrub prior to T-22 minutes, turnaround procedures are initiated from the point of hold. Should a hold occur from T-22 minutes (S-II start bottle chilldown) to T-16.2 seconds (S-IC forward umbilical disconnect), then a recycle to T-24 minutes, hold, or scrub is possible under the conditions stated in the Launch Mission Rules. An automatic or manual cutoff after T-16.2 seconds will result in a scrub. For planning purposes, four primary cases are identified to implement the required turnaround activities for a subsequent launch attempt following a countdown scrub.

Post-LV Cryogenic Load (with Fuel Cell Cryogenic Reservicing)

Turnaround time is 70 hours, 15 minutes, consisting of 42 hours, 15 minutes for recycle time and 28 hours for countdown time. Turnaround time is based upon; scrub occurs between 16.2 seconds and 8.9 seconds during original countdown; reservicing of the CSM or LM water systems not required; all SV ordnance except Range Safety Destruct Safe and Arm (S&A) units remain connected; access into LM cabin not required. The

* Information in this section is based on KSC Scrub/Turnaround Plan for Apollo 9, dated 23 January 1969, and is subject to change.

TABLE 1

LAUNCH COUNTDOWN SEQUENCE OF EVENTS

COUNTDOWN HRS: MIN: SEC	EVENT
28: 00: 00	Start Countdown Clock
21: 30: 00 R	Start LM Stowage and Cabin Closeout
24: 30: 00 R	Start LM Systems Checks
19: 30: 00	Start SV EDS Test
13: 30: 00	Remove LM Platform
12: 15: 00	SLA Closeout Complete
11: 30: 00 R	CSM Pre-ingress Operations
09: 30: 00	CSM RF Voice Checks
09: 15: 00 R	LV Closeout Complete
09: 00: 00	Six-Hour Built-In Hold
09: 00: 00	Clear Blast Danger Area
08: 30: 00	Start MSS Move to Park Site
08: 15: 00	Start LV Propellant Loading
03: 38: 00	Start LV Propellant Replenishing
02: 40: 00	Start Flight Crew Ingress
02: 10: 00	Flight Crew Ingress Completed
01: 55: 00	Start MCC/CSM Command Checks
01: 15: 00	Release Final Jimsphere
00: 43: 00	Retract SA-9 to 12° Park Position
00: 42: 00	Arm LES
00: 30: 00	LM to Internal Power
00: 15: 00	CSM to Internal Power
00: 05: 00	SA-9 Fully Retracted
00: 03: 07	Start Terminal Count Sequencer
00: 00: 08.9	Ignition Command
00: 00: 00	First Motion

R = Reference times. These times are approximately when the event will occur and could be adjusted prior to start of countdown clock.

time required for this turnaround results from flight crew egress; LV cryogenic unloading; LV ordnance operations and battery removal; LM supercritical helium (SHe) reservicing; CSM cryogenic reservicing; CSM battery removal and installation, and countdown resumption at T-28 hours.

Post-LV Cryogenic Load (No Fuel Cell Cryogenic Reservicing)

Turnaround time is 38 hours, 30 minutes, consisting of 29 hours, 30 minutes for recycle time and 9 hours for countdown time. Turnaround time is based upon: scrub occurs between 16.2 seconds and 8.9 seconds during original countdown; the Range Safety Destruct S&A units will remain connected; the CSM batteries do not require replacement; reservicing of the CSM or LM water systems not required; access to LM cabin not required. The time for this turnaround results from flight crew egress, LV cryogenic unloading, LM SHe reservicing, LV loading preparations, and countdown resumption at T-9 hours.

Pre-LV Cryogenic Load (with Fuel Cell Cryogenic Reservicing)

Turnaround time is 53 hours, 30 minutes, consisting of 44 hours, 30 minutes for recycle time and 9 hours for countdown time. Turnaround time is based upon: scrub occurs at T-8 hours of the original countdown; the Range Safety Destruct S&A units remain connected; the required S-II servoactuator inspection is waivered; reservicing of CSM or LM water systems not required; and access into LM cabin not required. The time required for this turnaround results from CSM cryogenic reservicing, CSM battery removal and installation, LM SHe reservicing, and countdown resumption at T-9 hours.

Pre-LV Cryo Load (No Fuel Cell Cryo Reservicing)

The capability for a one-day turnaround exists at T-8 hours of the countdown. This capability provides for a launch attempt at the opening of the next launch window. Turnaround time is 32 hours, consisting of 23 hours for recycle time and 9 hours for countdown time. Turnaround time is based upon: scrub occurred at T-8 hours of the countdown; the required S-II servoactuator inspection is waivered; the Range Safety Destruct S&A units remain connected; CSM batteries do not require replacement; reservicing of CSM or LM water systems not required; access into LM cabin not required. The time required for this turnaround results from LM SHe reservicing and countdown resumption at T-9 hours.

DETAILED FLIGHT MISSION DESCRIPTION

NOMINAL MISSION

The Apollo 9 Mission Plan is divided into six activity periods which span eleven work days over eleven calendar days. The relationships among these periods and days, and the major scheduled activities are shown to scale in Figure 1. Each work day will terminate with completion of a crew sleep period.

A summary profile of the Apollo 9 mission is shown in Figure 2 and a detailed summary of the Apollo 9 Flight Plan is given in Figure 3.

The sequence of events for the Apollo 9 mission is given in Table 2. Launch vehicle (LV) time base (TB) notations are also included. Time bases may be defined as precise initial points upon which succeeding critical preprogrammed activities or functions may be based. The TB's noted in Table 2 are for a nominal mission and presuppose nominal LV performance. However, should the launch vehicle stages produce non-nominal performance, the launch vehicle computer will recompute the subsequent TB's and associated burns to correct LV performance to mission rules.

First Period of Activity (Figure 4)

The Apollo 9 mission will be launched from Kennedy Space Center, Launch Complex 39, Pad A, on a flight azimuth of 72°. The launch window opens at 1100 EST, closes at 1400 EST, and is determined by lighting and ground station coverage requirements for CSM/LM rendezvous.

The Apollo 9 mission will begin with full S-IC and S-II launch vehicle stage burns and partial burn of the S-IVB stage to insert the S-IVB, Instrument Unit (IU), Lunar Module (LM), and Command/Service Module (CSM) into a 103 nautical mile near-circular orbit.

Immediately after insertion, the crew will begin a series of CSM/S-IVB orbital operations. This activity is to configure the CSM for orbital operations, prepare for transposition, docking and ejection, and to evaluate the operations required to verify that the S-IVB/IU/LM/CSM would be ready for translunar injection (TLI) on a lunar mission. The actual TLI burn will not be performed on this mission. Venting of S-IVB after insertion will raise apogee to approximately 112 nautical miles and perigee to approximately 109 nautical miles after about 2 hours, 30 minutes GET (ground elapsed time). At about 2 hours, 40 minutes GET, the CSM will separate from the S-IVB/IU/LM and a visual inspection of the S-IVB/IU/LM will be performed from the CSM prior to docking the CSM to the LM/IU/S-IVB. Immediately after docking, the LM pressurization will begin and, upon full pressure verification, LM ejection from the SLA will be initiated. Following ejection, a small Service Module Reaction Control System (SM RCS) burn will be executed to separate the CSM/LM to a safe distance prior to the first unmanned S-IVB restart (second burn). After the second S-IVB burn, a small docked-CSM/LM Service

APOLLO 9 MISSION TIME AND EVENT CORRELATION

CALENDAR DAY	FIRST (LAUNCH)	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	ELEVENTH

GROUND ELAPSED TIME (GET)	0	19 HRS	40 HRS	67 HRS	87 HRS	114 HRS	139 HRS	162 HRS	185 HRS	208 HRS	231 HRS	238 HRS

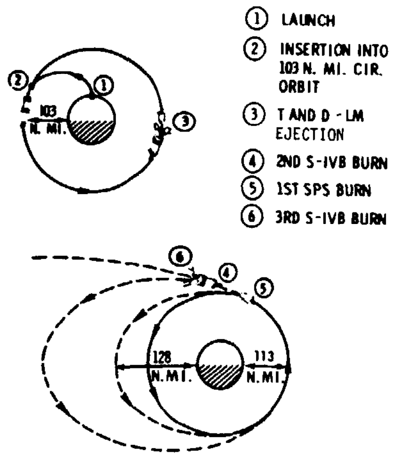
WORK DAY	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	ELEVENTH

ACTIVITY PERIOD	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH
	• LAUNCH AND INSERTION • SPACECRAFT CHECKOUT • T,D,& E • 2ND S-IVB BURN • 1ST SPS BURN • 3RD S-IVB BURN	• 2ND DOCKED SPS BURN • 3RD DOCKED SPS BURN • 4TH DOCKED SPS BURN	• LM SYSTEMS CHECK • DOCKED DPS BURN • 5TH DOCKED SPS BURN	• EVA	• LM ACTIVE RENDEZVOUS • APS BURN TO DEPLETION	• CSM SOLO ACTIVITIES • 6TH SPS BURN • 7TH SPS BURN • 8TH SPS BURN (DEORBIT) • SPLASHDOWN

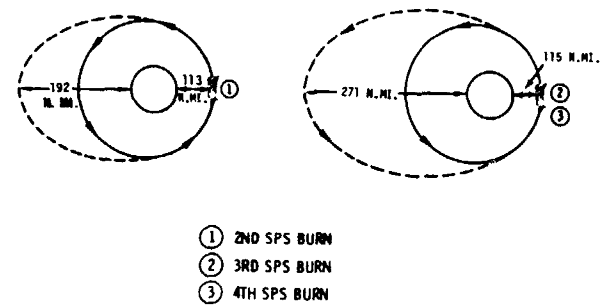
2/18/69

APOLLO 9 (AS-504) MISSION PROFILE

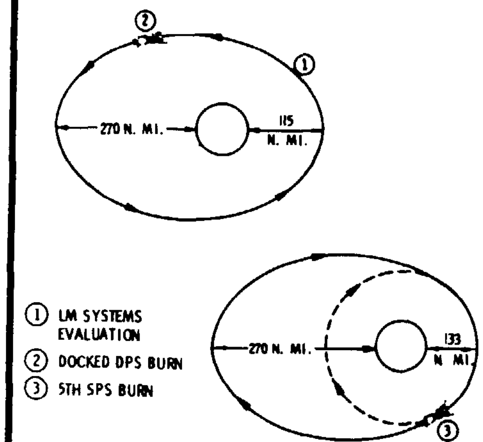
FIRST PERIOD OF ACTIVITIES



SECOND PERIOD OF ACTIVITIES



THIRD PERIOD OF ACTIVITIES



FOURTH PERIOD OF ACTIVITIES

EVA

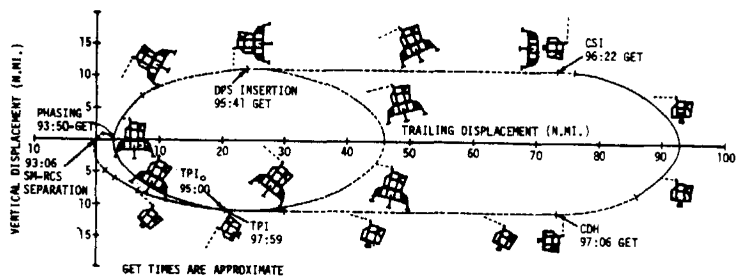
- PERIOD DURATION ABOUT 11 HOURS (GET 68:10 TO 78:50) INCLUDING:

DON/DOFF LCG AND PGA'S (1 HR. EA.)	~	2 HRS
TUNNEL HARDWARE AND IVT OPNS	~	2 1/2 HRS
EVA	~	2 HRS
EVA PREPARATIONS AND POST EVA	~	3 HRS
EAT	~	1 HR

- EVA DURATION ABOUT 2 HRS., 10 MIN (GET 73:10 TO 75:20) INCLUDES:

EGRESS, EVT TO CM, AND INGRESS CM	~	20 MIN.
RETRIEVE THERMAL SAMPLES AND REST	~	15 MIN.
EGRESS CM, EVT TO LM, AND RETRIEVE SAMPLES	~	15 MIN.
EVALUATE NIGHT LIGHTING	~	35 MIN.
PHOTOGRAPHY, TV AND INGRESS LM	~	45 MIN.

FIFTH PERIOD OF ACTIVITIES



- PERIOD TERMINATED BY APS BURN TO DEPLETION

SIXTH PERIOD OF ACTIVITIES

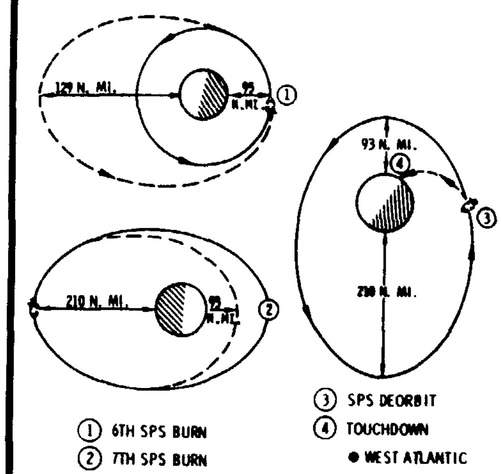


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Fig. 2

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APOLLO 9 SUMMARY FLIGHT PLAN

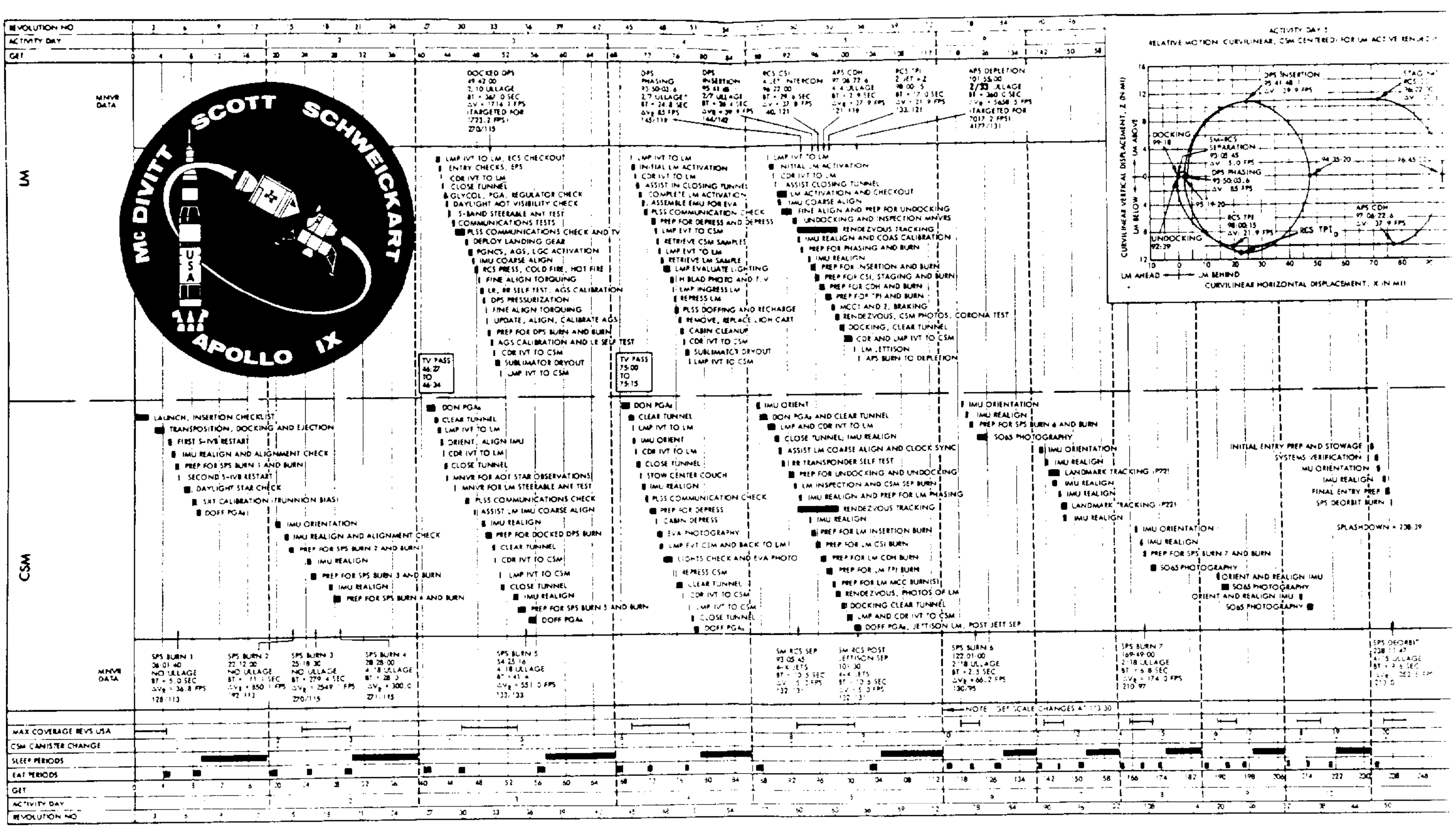


Fig. 3

TABLE 2

APOLLO 9

SEQUENCE OF EVENTS

*Ground Elapsed Time (GET) HR: MIN: SEC	Event
00: 00: 00	First Motion
00: 00: 00.391	Timebase 1
00: 01: 21	Maximum Dynamic Pressure
00: 02: 14	S-IC Center Engine Cutoff - TB2
00: 02: 40	S-IC Outboard Engine Cutoff - TB3
00: 02: 40	S-IC/S-II Separation
00: 02: 42	S-II Ignition
00: 03: 10	Jettison S-II Aft Interstage
00: 03: 16	Jettison Launch Escape Tower
00: 08: 51	S-II Engine Cutoff Command - TB4
00: 08: 52	S-II/S-IVB Separation
00: 08: 55	S-IVB Engine Ignition
00: 10: 49	S-IVB Engine Cutoff - TB5
00: 10: 59	Parking Orbit Insertion
02: 33: 49	Separation and Docking Maneuver Initiation
02: 43: 00	Spacecraft Separation
03: 05: 00	Spacecraft Docking (Approximately)
04: 08: 57	Spacecraft Final Separation
04: 36: 12	S-IVB Restart Preps. - TB6
04: 45: 50	S-IVB Reignition (2nd burn)
04: 46: 52	S-IVB Second Cutoff Signal - TB7
04: 47: 02	Intermediate Orbit Insertion
05: 59: 35	S-IVB Restart Preparations - TB8
06: 01: 40	SPS Burn 1
06: 07: 13	S-IVB Reignition (3rd burn)
06: 11: 14	S-IVB Third Cutoff Signal - TB9
06: 11: 24	Escape Orbit Injection
06: 12: 44	Start LOX Dump
06: 23: 54	LOX Dump Cutoff

* LV events based on MSFC LV Operational Trajectory, dated 31 January 1969.
SC events based on MSC SC Operational Trajectory, Revision 2, 20 February 1969.

06:	24:	04	Start LH_2 Dump
06:	42:	19	LH_2 Dump Cutoff
22:	12:	00	SPS Burn 2
25:	18:	30	SPS Burn 3
28:	28:	00	SPS Burn 4
46:	27:	00	TV Transmission, LM Interior
49:	42:	00	Docked DPS Burn
54:	25:	19	SPS Burn 5
75:	00:	00	TV Transmission, CSM/LM Exterior by EVA LMP
92:	39:	00	Undocking
93:	07:	40	CSM/LM Separation
93:	51:	34	DPS Phasing
95:	43:	22	DPS Insertion
96:	21:	00	Concentric Sequence Initiation - RCS Burn
97:	05:	27	Constant Delta Height - APS Burn
98:	00:	10	Terminal Phase Initiation
99:	13:	00	CSM/LM Docking (Approximately)
101:	58:	00	APS Burn to Propellant Depletion
121:	58:	48	SPS Burn 6
169:	47:	54	SPS Burn 7
238:	45:	00	SPS Burn 8 (Deorbit)
238:	59:	47	Entry Interface (400,000 feet)
239:	10:	38	Drogue Chute Deployment (25,000 feet Approximately)
239:	16:	--	Splashdown (Approximately)

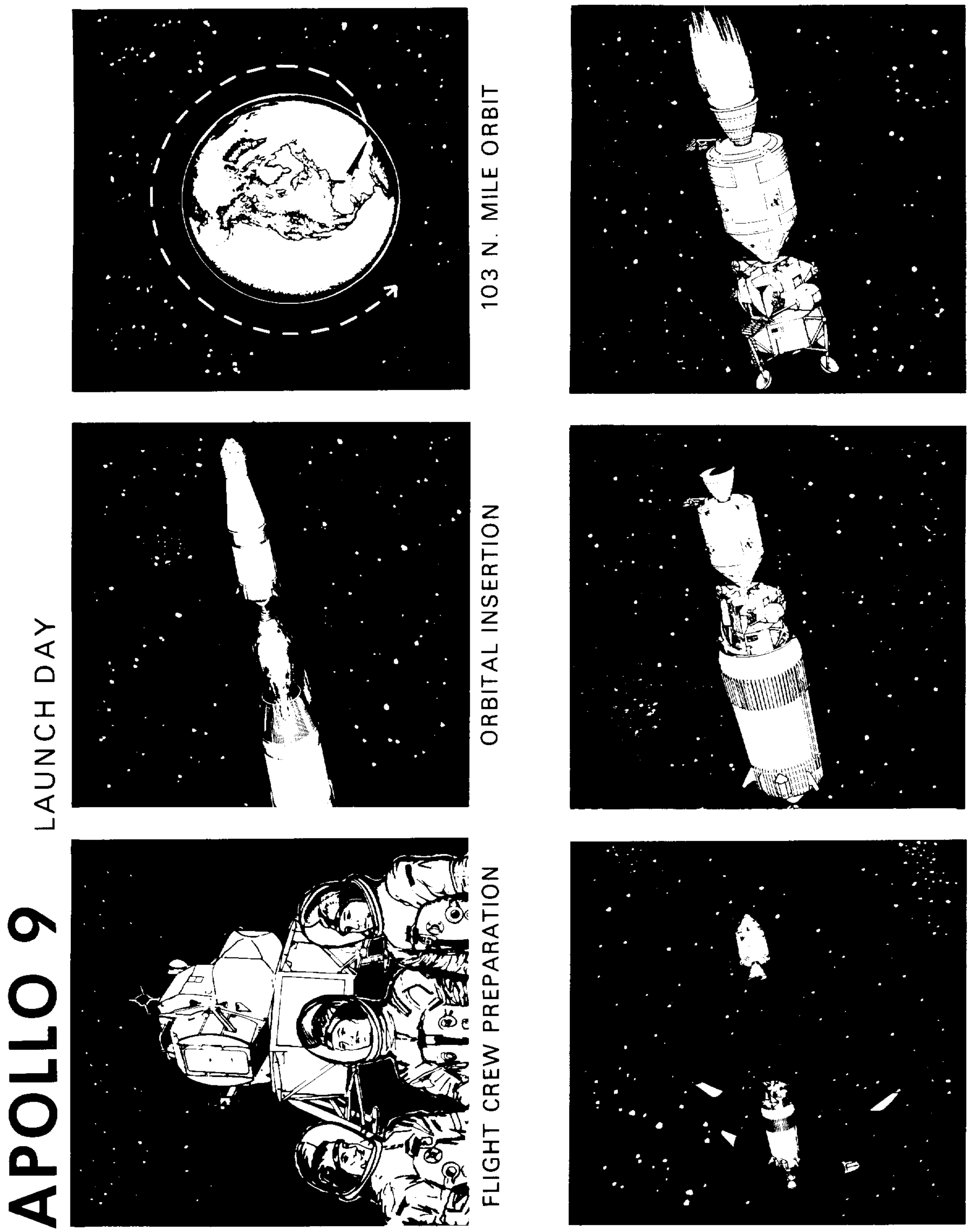

APOLLO 9
LAUNCH DAY
FLIGHT CREW PREPARATION
ORBITAL INSERTION
103 N. MILE ORBIT
SEPARATION
DOCKING
DOCKED SPS BURN

Fig. 4

Propulsion System (SPS) burn will be performed to raise apogee of the CSM/LM orbit to 128 nautical miles. The S-IVB and SPS burns will be spaced to take advantage of the MSFN ground coverage before the end of the first activity period. A little after six hours GET, the S-IVB will be ignited a third time producing a sufficient increase in velocity to go into solar orbit.

Second Period of Activity (Figure 5)

The second period of activity will be comprised of three docked-CSM/LM SPS burns. The first two burns in this period will be long duration, out-of-plane, and will adjust perigee to 115 nautical miles and apogee to 271 nautical miles. These burns will satisfy the CSM docked Digital Auto Pilot (DAP) stability margin test objective. These burns will also reduce the CSM weight to a level consistent with the SM RCS propellant requirements to deorbit or to effect a LM rescue if required during the fifth period LM-active rendezvous. The burns will also provide nodal shift to assure proper lighting and rendezvous tracking. The third SPS burn in this period will be used to adjust phasing conditions for the LM-active rendezvous but will not change orbital parameters.

Third Period of Activity (Figure 6)

This period will be devoted primarily to checkout and performance evaluation of the LM systems including a docked Descent Propulsion System (DPS) engine burn of sufficient duration to evaluate performance of the LM Primary Guidance, Navigation, and Control System (PGNCS) digital autopilot and manual throttling of the DPS engine. Activities will begin with the intervehicular transfer (IVT) of the Commander (CDR), the Lunar Module Pilot (LMP), and equipment from the CSM to the LM. The LM systems will then be activated and checked out for the first time in the mission, commencing the systems performance evaluation. Following the docked DPS burn, the LM will be powered down and the CDR and LMP will return from the LM to the CSM via the IVT tunnel. A docked SPS burn will then circularize the orbit at 133 nautical miles and at the same time adjust the nodal position for the LM-active rendezvous. This burn will also purge helium from the SPS propellant feed system introduced as a result of the docked DPS burn. The first of two scheduled TV transmissions will be made during this period and will be of the LM interior.

Fourth Period of Activity (Figure 7)

The fourth period will begin with IVT of the CDR and LMP to the LM, power-up and checkout of LM systems. Activities during this period will be in preparation for and accomplishment of the two-hour extravehicular activity (EVA) phase. The EVA phase will be initiated by the CDR and LMP performing IVT through the docking tunnel to the LM. The astronauts will next power up the LM and perform a systems check. All three astronauts will don their Pressure Garment Assemblies (PGA) subsequent to depressurizing the CM and LM. Upon depressurization, the LM forward hatch and the CM side hatch will be opened. The LMP with the Portable Life Support System (PLSS) will leave the

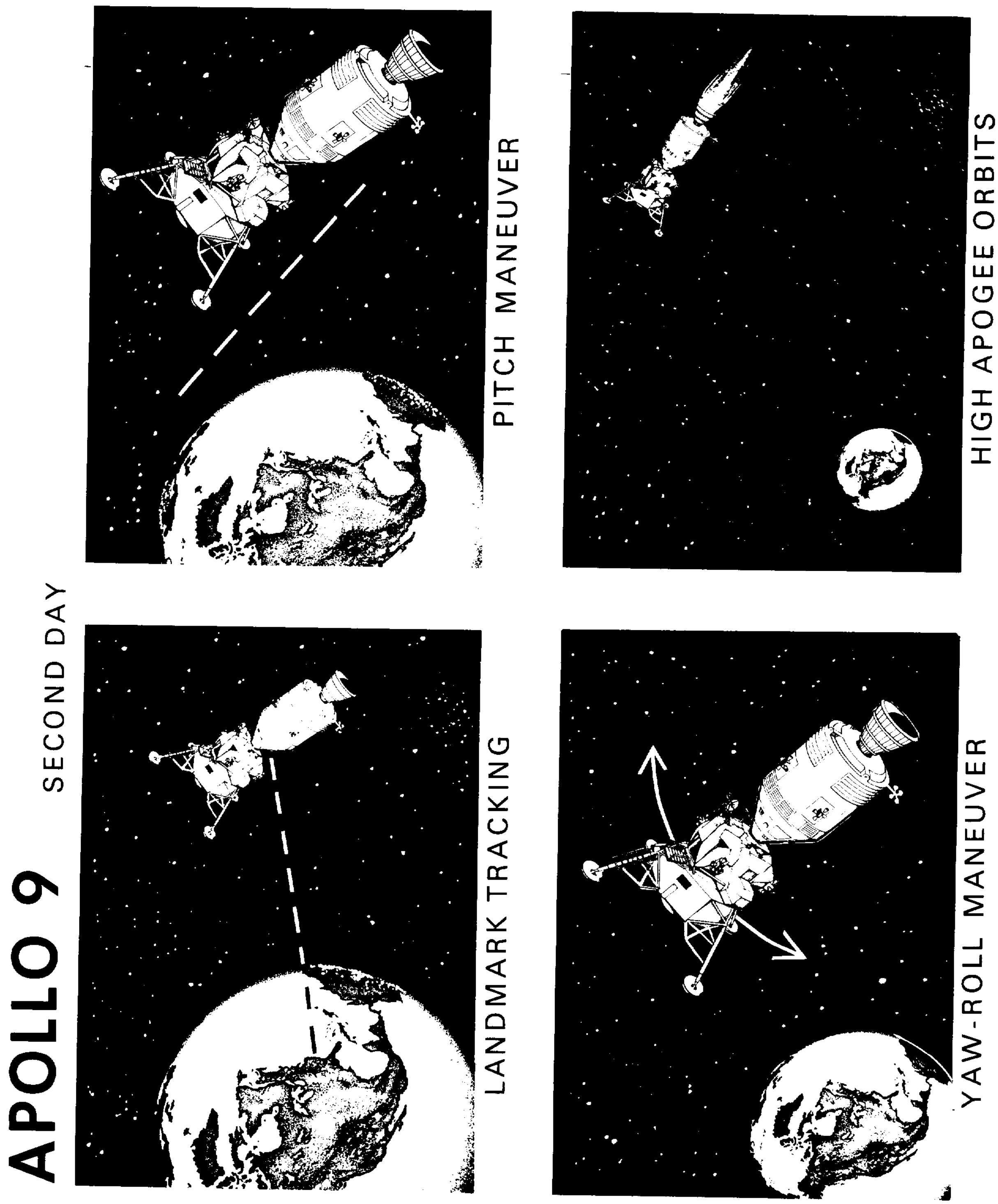
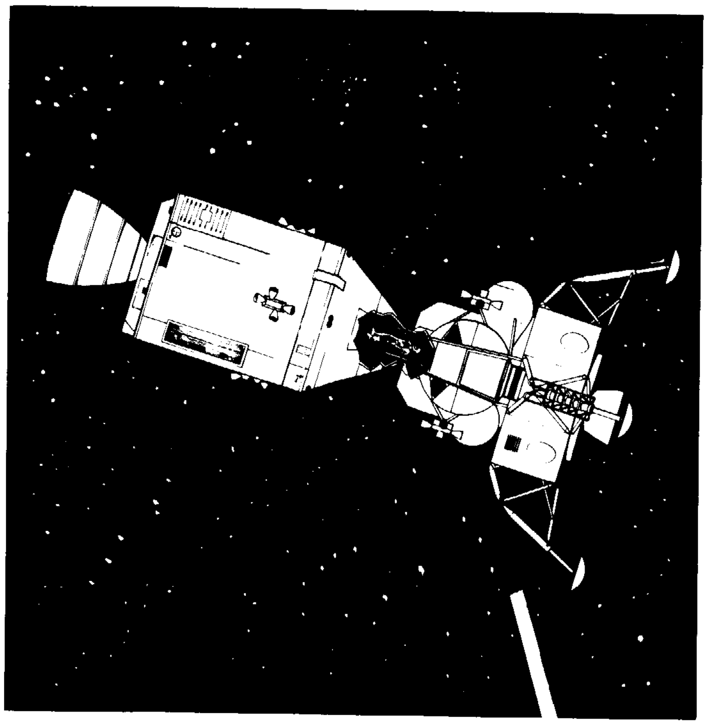
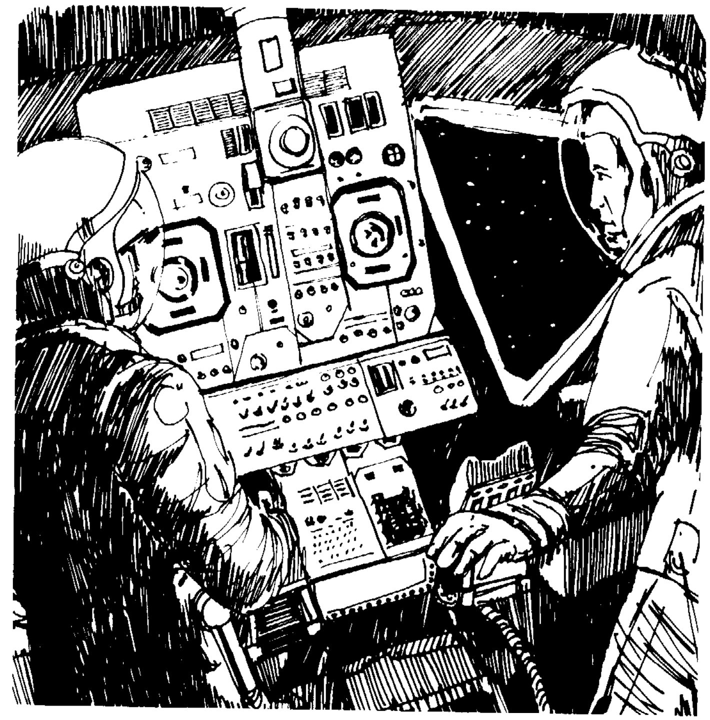

APOLLO 9
SECOND DAY
PITCH MANEUVER
HIGH APOGEE ORBITS
LANDMARK TRACKING
YAW-ROLL MANEUVER

Fig. 5

APOLLO 9 THIRD DAY



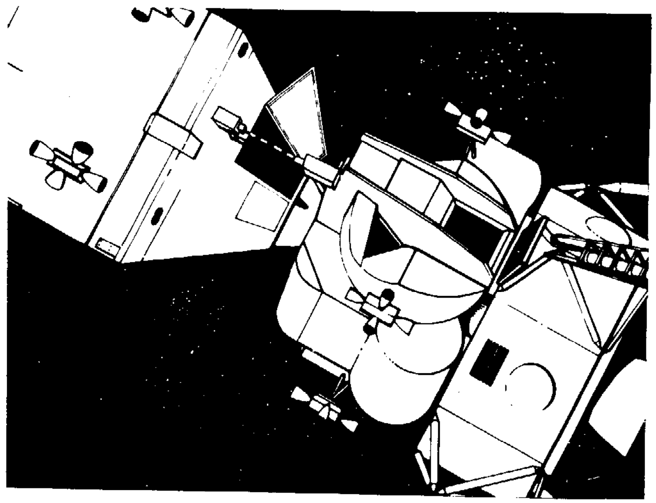
CREW TRANSFER



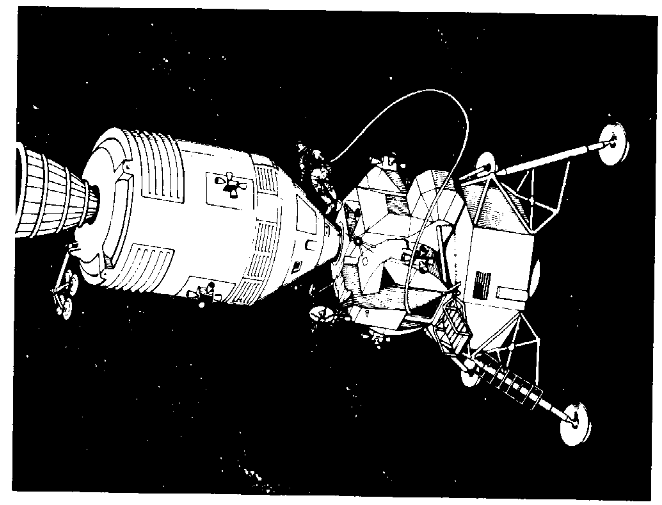
LM SYSTEM EVALUATION

Fig. 6

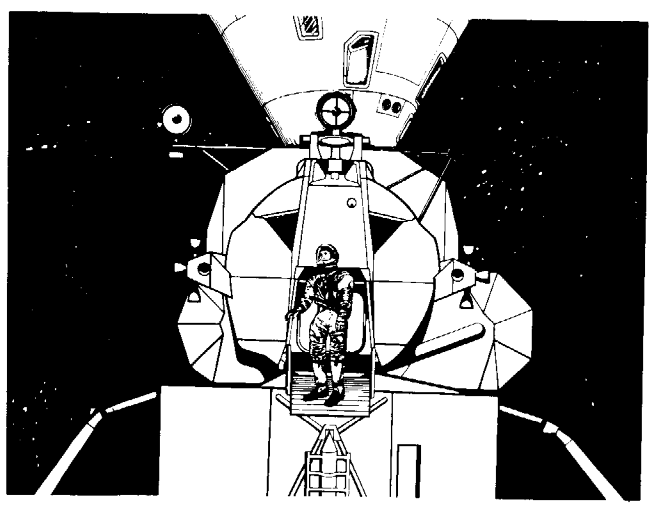
APOLLO 9 FOURTH DAY



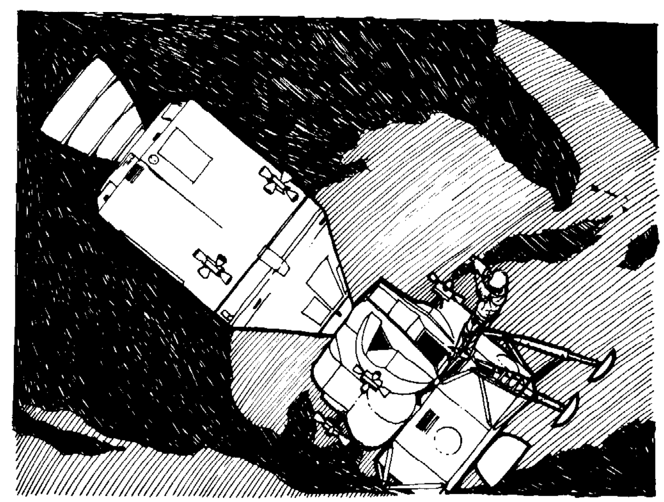
CAMERA



DAY-NIGHT EVA



GOLDEN SLIPPERS



TV - TEXAS, FLORIDA

Fig. 7

M-932-69-09

LM and attach a sequence camera to the LM handrail and another to the inside of the CM hatch. Both of these cameras will photograph the LMP's activities and will be remotely operated by the CDR and the Command Module Pilot (CMP).

Using the nominal transfer path, the LMP will transfer to the CM and partially enter through the side hatch after retrieving thermal samples from the SM and CM exterior. After a short rest period, the LMP will leave the CM and position himself on the LM porch. The LMP will remain outside of the LM and retrieve thermal samples, evaluate exterior lighting, photograph the LM and CSM, and operate the TV camera. At the end of these activities, the LMP will enter the LM through the forward hatch and subsequently transfer with the CDR to the CM through the docking tunnel.

Fifth Period of Activity (Figure 8)

The fifth period of activity will consist of the LM-active rendezvous and the unmanned long duration LM APS burn to propellant depletion. A schematic of the rendezvous is shown in Figure 3. The period will begin with the IVT of the LMP and CDR to the LM. The LM will be powered up and systems checked out prior to the LM being separated from the CSM for the first time in the mission. A short period of station-keeping will be performed prior to initiation of the phasing maneuver of the rendezvous. This phase of the rendezvous will begin with a short SM RCS burn directed in-plane and radially downward, placing the CSM and LM in small equiperiod orbits (mini-football) from which a rendezvous abort can easily be made. This is the first rendezvous abort situation when the LM can rejoin the CSM.

Approximately one-half revolution later, an AGS (Abort Guidance System) controlled DPS phasing burn will be made in-plane and in a radially outward direction, placing the LM on an equiperiod rendezvous trajectory (football) with the CSM. The purpose of performing the separation maneuver in this way is to expedite return to the CSM should the need arise. The second abort situation occurs at the first Terminal Phase Initiation (TPI_0) noted on Figure 3. At TPI_0 the LM can burn the RCS to effect an immediate rendezvous with the CSM or proceed to the nominal DPS insertion.

After approximately one and one-fourth revolutions, a PGNCS-controlled DPS insertion maneuver will be executed, placing the LM in a coelliptic orbit above and behind the CSM. The remainder of this phase will be a Concentric Flight Plan (CFP) rendezvous sequence approaching the CSM from below and behind. The LM will be staged just prior to the Concentric Sequence Initiation (CSI) RCS burn. This burn is followed by the Ascent Propulsion System (APS) Constant Delta Height (CDH) burn and the RCS TPI burn. The rendezvous is terminated after a short station-keeping period. The total time for the rendezvous will be approximately six and one-half hours.

APOLLO 9 FIFTH DAY

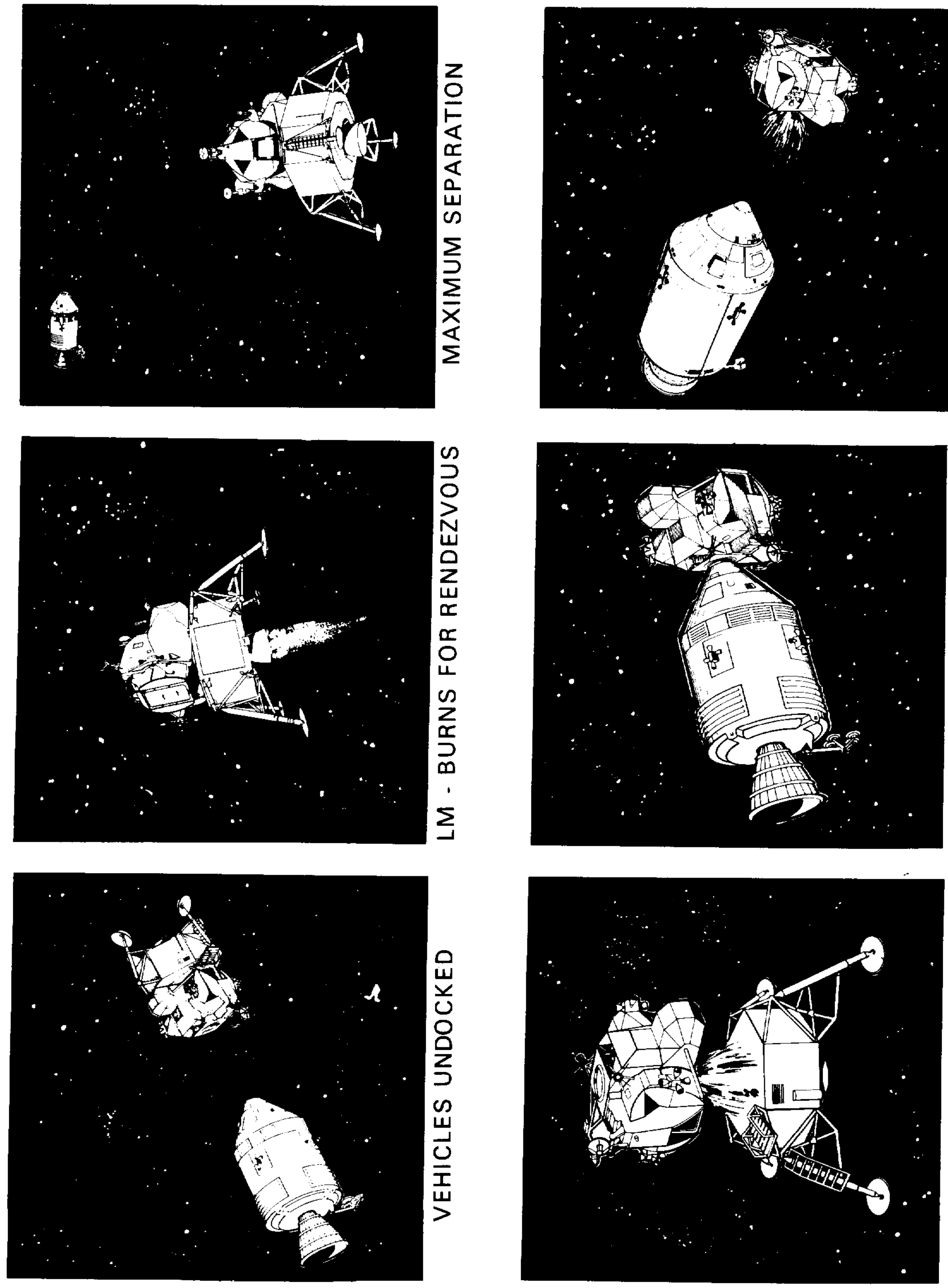


Fig. 8

Following LM docking, the LM Ascent Stage will be prepared for an unmanned long duration APS burn. The LM crewmen will transfer to the CSM and the CSM will be separated from the LM. The long duration APS burn will then be performed on initiation by ground control and will terminate by propellant depletion.

Sixth Period of Activity (Figure 9 & 10)

The sixth period includes the remainder of the mission and will be devoted to the CSM solo operations. The period will include two SPS orbit-shaping burns to lower perigee and raise apogee thereby establishing an orbit which permits SM RCS deorbit should a SPS malfunction occur later in the mission. The remainder of this period preceding deorbit will be devoted to navigation exercises and a multispectral terrain photography scientific experiment. This period and the mission will terminate with an SPS deorbit burn, reentry, and splashdown in the Atlantic recovery area, approximately 1000 nautical miles east of Kennedy Space Center.

The Apollo 9 crew will be picked up by the Prime Recovery Ship, USS GUADALCANAL, LPH 7 (Landing Platform Helicopter), and will be airlifted by helicopter the following morning to Norfolk, Virginia and subsequently to the Manned Spacecraft Center.

Multispectral Terrain Photography Experiment (SO65)

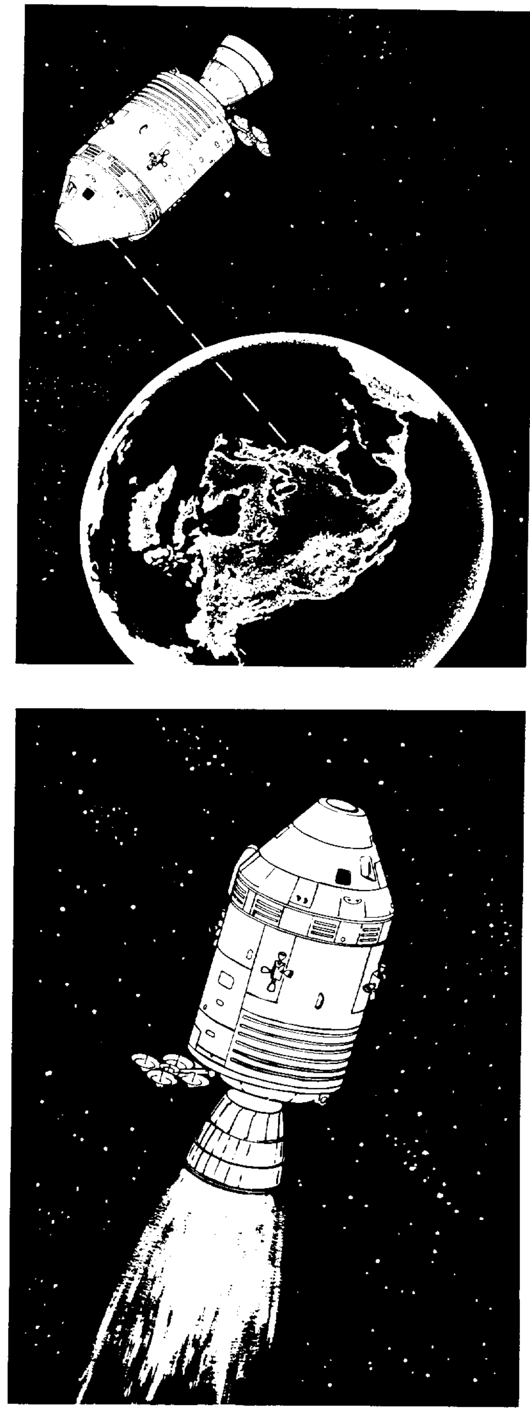
Photographic experiment SO65 will be conducted during the sixth period of the Apollo 9 mission. The general purpose is to obtain selective multispectral photographs with four different film/filter combinations of selected land and ocean areas. The equipment will consist of four Hasselblad cameras to be carried in the CM.

Photographs acquired during this experiment will be used for scientific analyses in the earth resources disciplines. These photographs are expected to yield information concerning such items as geologic features, water runoff, snow and ice cover, pollution, distribution of soil types, forestry resources, ocean currents, beach erosion, shallow water sediment migration, environmental variations, and weather.

CONTINGENCY OPERATIONS

If an anomaly occurs after lift-off that would prevent the AS-504 space vehicle from following its nominal flight plan, an abort or an alternate mission will be initiated. An abort would provide only for an acceptable CM/crew recovery while an alternate mission would attempt to achieve some of the mission objectives before providing for an acceptable CM/crew recovery.

APOLLO 9 SIXTH THRU NINTH DAYS

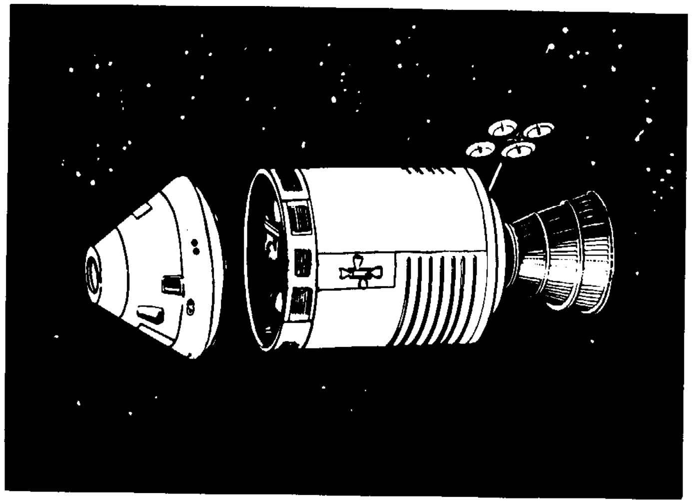


SERVICE PROPULSION BURNS

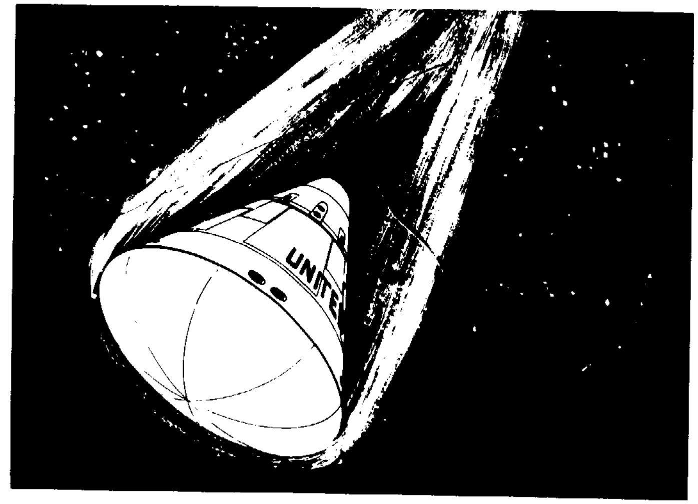
LANDMARK SIGHTINGS, PHOTOGRAPH
SPECIAL TESTS

Fig. 9

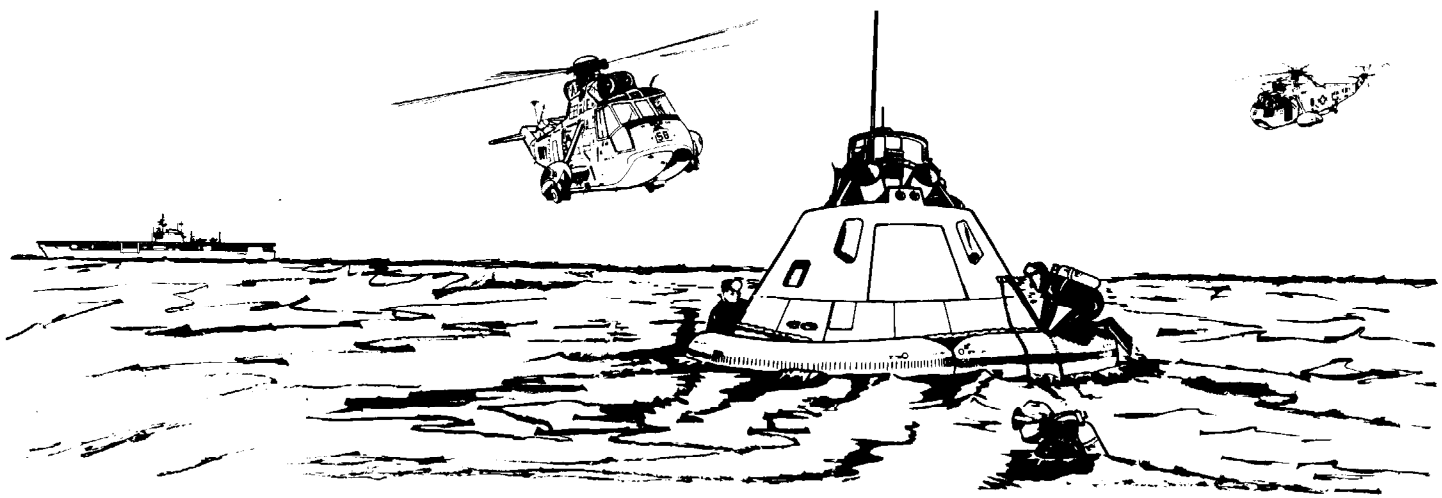
APOLLO 9 TENTH DAY



CM/SM SEPARATION



RE-ENTRY



ATLANTIC - SPLASHDOWN

Fig. 10

Aborts

Launch Aborts

During launch, the velocity, altitude, atmosphere, and launch configuration change rapidly; therefore, several abort modes, each adapted to a portion of the launch trajectory, are required.

Mode I abort procedure is designed for safe recovery of the CM following aborts occurring between Launch Escape System (LES) activation (approximately T minus 30 minutes) and Launch Escape Tower (LET) jettison, approximately 3 minutes GET. The procedure consists of the LET pulling the Command Module (CM) away from the remainder of the space vehicle and propelling it a safe distance down range. The resulting landing point lies between the launch site and approximately 490 nautical miles down range.

The Mode II abort would be performed from the time the LET is jettisoned until the full-lift CM landing point is 3200 nautical miles down range, approximately 10 minutes GET. The procedure consists of separating the CSM combination from the remainder of the space vehicle, separating the CM from the SM, and then letting the CM free fall to entry. The entry would be a full-lift, or maximum range trajectory, with a landing 400 to 3200 nautical miles down range on the ground track.

Mode III abort can be performed from the time the full-lift landing point range reaches 3200 nautical miles until orbital insertion. The procedure would consist of separating the CSM from the remainder of the space vehicle and then, if necessary, performing a retrograde burn with the SPS so that the half-lift landing point is no farther than 3350 nautical miles down range. A half-lift entry would be flown which causes the landing point to be approximately 70 nautical miles south of the nominal ground track between 3000 and 3350 nautical miles down range.

The Mode IV abort procedure is an abort to earth orbit, Contingency Orbit Insertion (COI), and could be performed anytime after the SPS has the capability to insert the CSM into orbit. This capability begins at approximately 10 minutes GET. The procedure would consist of separating the CSM from the remainder of the space vehicle and, two minutes later, performing a posigrade SPS burn to insert the CSM into earth orbit with a perigee of at least 75 nautical miles. The CSM could then remain in earth orbit for an earth orbital alternate mission, or if necessary, return to earth in the West Atlantic or Central Pacific Ocean after one revolution. This mode of abort is preferred over the Mode III abort and would be used unless an immediate return to earth is necessary during the launch phase.

The last abort procedure is an Apogee Kick (AK) Mode. This mode is a variation of the Mode IV wherein the SPS burn to orbit occurs at apogee altitude to raise the perigee to 75 nautical miles. The maneuver is executed whenever the orbital apogee at S-IVB cutoff is favorably situated and the corresponding Move IV ΔV requirement is greater than 100 feet per second. Like the Mode IV contingency orbit insertion, this maneuver is prime when the capability exists, except for those situations where an immediate return to earth is required.

Earth Orbit Aborts

Once the CSM/LM/IU/S-IVB is safely inserted into earth parking orbit, a return-to-earth abort would be performed by separating the CSM from the LM/IU/S-IVB and then utilizing the SPS for a retrograde burn to place the CM, after CM/SM separation, on an atmosphere-intersecting trajectory. After entry the crew would fly a guided flight path to a preselected target point if possible.

Rendezvous Aborts

A capability will be maintained throughout the rendezvous to provide for non time-critical and time-critical aborts by either the LM or by the CSM.

Alternate Missions

Seven alternate missions have been developed for Apollo 9 which provide for a maximum accomplishment of test objectives while adhering to mission constraints pertaining to mission ground rules, crew safety, and trajectory considerations. A summary of the alternate missions and the precipitating functional failures is shown on Table 3.

Alternate Mission A

Alternate Mission A is a CSM only mission and will be used in the event that a COI is necessary, the LM cannot be ejected from the SLA, or the LM Descent Stage is deemed unsafe. All SPS burns are planned to be accomplished in this alternate; however, duration and scheduling of the burns will be real time decisions.

Alternate Mission B

Alternate Mission B is designed for an SPS failure, CSM lifetime problems, or electrical problems in the LM. Should this alternate be necessary, real time evaluation of the mission will be performed and the crew and events activities will be rescheduled to accomplish a maximum of mission objectives. A SM RCS deorbit is planned into the prime recovery area.

TABLE 3
ALTERNATE MISSION SEQUENCE OF EVENTS
APOLLO 9

NOMINAL MISSION PERIOD OF ENTRY		FUNCTIONAL FAILURE PRECIPITATING ALTERNATE MISSION
	ALTERNATE MISSION A	
1	COI SPS 1	• COI • LM CANNOT BE EJECTED FROM SLA UNSAFE DESCENT STAGE
1 OR 2	SPS 2 SPS 3 SPS 4	
3	SPS 5	
6	SPS 6 SPS 7 SPS 8	
	ALTERNATE MISSION B	
1	T, D AND E	• SPS FAILURE
2 OR 3	LM SYSTEMS EVALUATION EXECUTE DOCKED DPS BURN	• CSM LIFETIME PROBLEM • DESCENT STAGE ELECTRICAL POWER PROBLEMS
3 OR 4	PERFORM EVA	
4 OR 5	STATION KEEPING (STAGE LM PRIOR TO DOCKING)	• ASCENT STAGE ELECTRICAL POWER PROBLEMS
4 OR 5	LONG APS BURN	
5 OR 6	DEORBIT	
	ALTERNATE MISSION C	
3 OR 4	PERFORM EVA	• UNSAFE DESCENT STAGE
	LONG APS BURN CONTINUE MISSION	• EVT TAKES LONGER THAN 15 MINUTES
	ALTERNATE MISSION D	
1	T, D, AND E	• CSM LIFETIME PROBLEM • EITHER CSM COOLANT LOOP FAILS
2 OR 3	LM SYSTEMS EVALUATION EXECUTE DOCKED DPS BURN	• DESCENT STAGE ELECTRICAL POWER PROBLEMS
3 - 5	STAGE DESCENT STAGE LONG APS BURN	• ASCENT STAGE ELECTRICAL POWER PROBLEMS
3 - 6	DEORBIT	
	ALTERNATE MISSION E	
5	E-5A STATION KEEPING CONTINUE NOMINAL MISSION TIMELINE	• LM PRIMARY COOLANT LOOP LOST • DESCENT STAGE ELECTRICAL POWER PROBLEM
	E-5B MINI-FOOTBALL RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE	• ASCENT STAGE ELECTRICAL POWER PROBLEM • PGNCS FAILURE • RENDEZVOUS RADAR FAILURE
	E-5C FOOTBALL RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE	• LM AGS LOST • UNSAFE DESCENT STAGE
	E-5D CSM ACTIVE RENDEZVOUS CONTINUE NOMINAL MISSION TIMELINE	
	ALTERNATE MISSION F	
3	DELETE DOCKED DPS BURN PERFORM SPS 5	• PGNCS LOST
4	PERFORM EVA	
5	STATION KEEP, STAGE LM AND DOCK EXECUTE CSM ACTIVE RENDEZVOUS (E-5D) DELETE LONG DURATION APS BURN CONTINUE MISSION	
	ALTERNATE MISSION G	
3	DELETE DOCKED DPS BURN	• DPS NONOPERABLE
4	PERFORM EVA	• LM PRIMARY COOLANT LOOP LOST
5	STATION KEEPING (E-5A) LONG APS BURN CONTINUE MISSION	

Alternate Mission C

Alternate Mission C is designed for an unsafe Descent Stage. With an unsafe Descent Stage, mission rules call for jettisoning the Descent Stage if the LM is manned or the entire LM if the LM is unmanned. Without the Descent Stage, the remainder of the LM activities are accomplished on Ascent Stage consumables. Therefore, in order to accomplish a maximum number of mandatory DTO's with the consumables available, undocking the LM is deleted in favor of accomplishing the long APS burn and the EVA. However, if the unsafe Descent Stage is discovered late in the fourth period of activities, sufficient Ascent Stage consumables might exist for the station-keeping and the long APS burn.

If EVT takes longer than 15 minutes, undocked manned LM activities will not be undertaken since a backup for IVT is not available.

Alternate Mission D

Alternate Mission D is designed for failure of a CSM coolant loop, CSM lifetime problems, or LM electrical power problems. This would be a time-critical alternate; therefore, all SPS burns would be deleted in order to accomplish a maximum number of high priority DTO's. Without the SPS burns, the docked DPS burn will be retargeted to provide a deorbit capability into the prime recovery area as soon as possible after the long APS burn. Real time decisions will be necessary to schedule crew activities and additional spacecraft events.

Alternate Mission E

Alternate Mission E is designed for several anomalous situations as listed in Table 3 and consists of a series of modified rendezvous that may be selected to replace the nominal rendezvous in activity period five. The events prior to and after the modified rendezvous are nominal. The selection of the modified rendezvous is made in real time and will depend on the failure precipitating the alternate mission and the resulting consumables status. The four modified rendezvous plans are:

- E-5a. Station-keeping
- E-5b. Mini-football rendezvous
- E-5c. Football rendezvous
- E-5d. CSM-active rendezvous

With the exception of the CSM-active rendezvous, the modified rendezvous are portions of the nominal rendezvous found in the Detailed Flight Mission Description. The LM is staged prior to docking with the CSM in the LM-active modified rendezvous in order to satisfy the test conditions of the LM-active docking DTO.

Alternate Mission F

Alternate Mission F is designed for a LM PGNCS failure. A slightly modified sequence of events results, with the docked DPS burn, LM-active rendezvous, and long APS burn deleted. A CSM-active rendezvous is added. The LM-active rendezvous is not attempted since a backup guidance system is not available. The docked DPS burn is deleted since the AGS lacks moment control of the Ascent Stage/CSM stacked configuration. The long APS burn is deleted as a result of the AGS lacking ground-commanded shutdown capability. The SPS-5 burn is executed to provide a circular orbit for the CSM-active rendezvous.

The unmanned LM is left as a target for the CSM in the CSM-active rendezvous. However, without a man in the secondary suit loop, the suit loop water boiler will freeze because of the lack of heat input to the boiler. This will eventually cause the AGS to fail. Hence, it is not known if the LM lights will be visible (LM might be tumbling) at TPI. A real time decision will have to be made at that point to continue or delete the terminal phase maneuvers.

Both the SPS-5 burn with a heavy LM and a CSM-active rendezvous result in a greater propellant usage than nominal. However, both SM RCS and SPS propellants should still be within their current redlines. A real time consumables analysis will be run if there is any off-nominal SPS or SM RCS performance prior to entry into the alternate mission.

The LM is staged just prior to docking with the CSM following the station-keeping exercise. This satisfies the test conditions of the LM-active docking DTO.

Alternate Mission G

Alternate Mission G is designed to accommodate a nonoperable DPS or a LM primary coolant loop failure. A nonsimultaneous eat-rest-eat cycle is included in the mission since there are specific systems failures that lead to the general functional failure that require continuous monitoring by at least one crewman. If the specific failure does not require this monitoring, the events can be rescheduled in real time.

The sequence of events is slightly modified with the docked DPS burn and the LM-active rendezvous deleted. The docked DPS burn is deleted in case of the LM coolant loop failure since the PGNCS would be uncooled during a manned burn. The long APS burn, however, is accomplished since the LM is unmanned and the ground has shutdown capability in case the PGNCS fails from overheating and the LM starts to tumble. Since this is an alternate mission designed for a LM failure, the nominal sequence of events is picked up following the long APS burn. The LM is staged just prior to docking with the CSM in the general Alternate Mission G.

SPACE VEHICLE DESCRIPTION

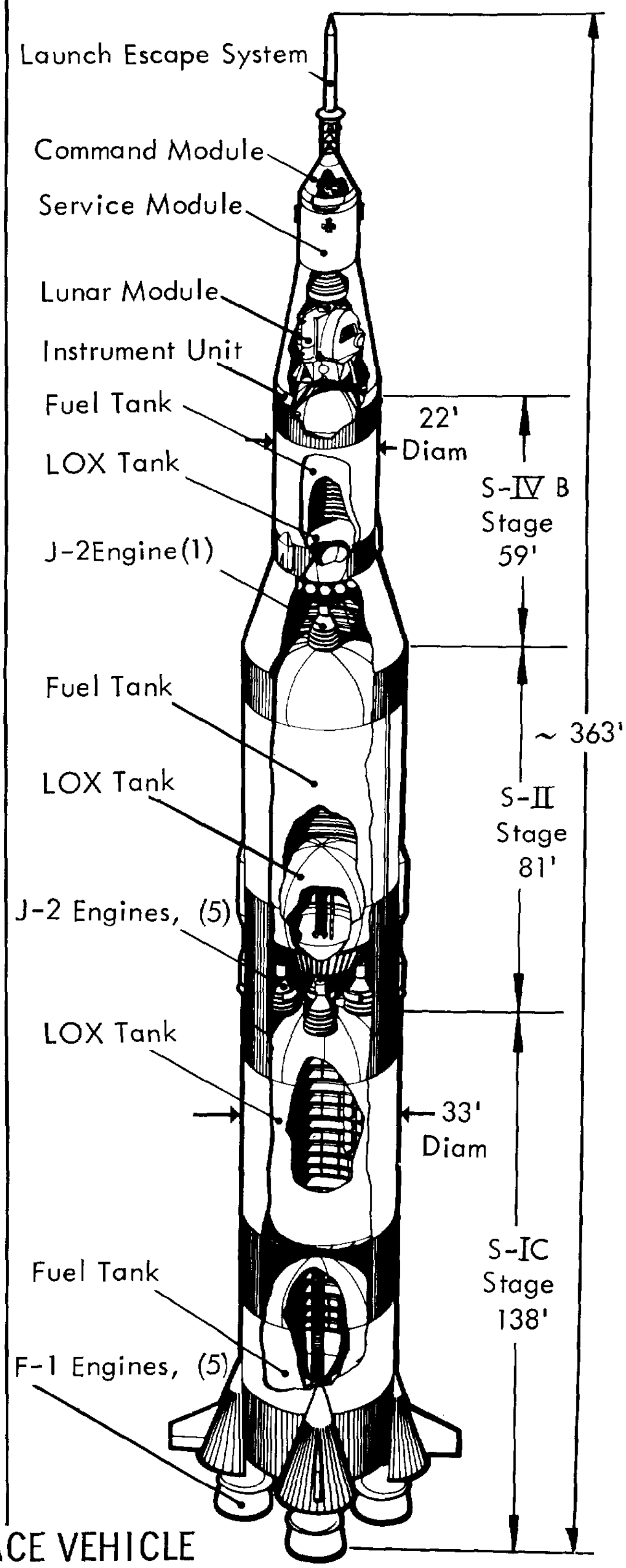
The Apollo 9 Mission will be performed by an Apollo Saturn V Space Vehicle (**Figure** 11) designated AS-504, which consists of a three-stage Saturn V Launch Vehicle, and a complete Apollo Block II Spacecraft. A more comprehensive description of the space vehicle and its subsystems is included in the Mission Operation Report Supplement. The following is a brief description of the various stages of Apollo 9.

The Saturn V Launch Vehicle (SA-504) consists of three propulsion stages (S-IC, S-II, S-IVB) and an Instrument Unit (IU). The Apollo Spacecraft payload for Apollo 9 consists of a Launch Escape System (LES), Block II Command and Service Module (CSM 104), a Spacecraft LM Adapter (SLA 12), and a Lunar Module (LM-3). A list of current weights for the space vehicle is contained in Table 4.

LAUNCH VEHICLE DESCRIPTION

First Stage (S-IC)

The S-IC is powered by five F-1 rocket engines each developing approximately 1,522,000 pounds of thrust at sea level and building up to 1.7 million pounds before cutoff. One engine, mounted on the vehicle longitudinal centerline, is fixed; the remaining four engines, mounted in a square pattern about the center line, are gimballed for thrust vector control by signals from the control system housed in the IU. The F-1 engines utilize LOX (liquid oxygen) and RP-1 (kerosene) as propellants.



APOLLO SATURN V SPACE VEHICLE

Fig. 11

TABLE 4

APOLLO 9 WEIGHT SUMMARY

(All Weights in Pounds)

STAGE/ MODULE	INERT WEIGHT	TOTAL EXPENDABLES	TOTAL WEIGHT	FINAL SEPARATION WEIGHT
S-IC Stage	295,200	4,736,330	5,031,530	369,640
S-IC/S-II Interstage	11,665	--	11,665	--
S-II Stage	84,600	979,030	1,064,630	96,540
S-II/S-IVB Interstage	8,080	--	8,080	--
S-IVB Stage	25,300	233,860	259,160	28,700
Instrument Unit	4,270	--	4,270	--
Launch Vehicle at Ignition			6,379,335	
SC/LM Adapter	4,105	--	4,105	--
Lunar Module	10,165	21,860	32,025	--
Service Module	11,295	35,305	46,600	13,075
Command Module	12,405	--	12,405	11,135
Launch Escape System	8,850	--	8,850	(Splashdown)
Spacecraft at Ignition			103,985	
Space Vehicle at Ignition			6,483,320	
S-IC Thrust Buildup			- 86,265	
Space Vehicle at Lift-off			6,397,055	
Space Vehicle at Orbit Insertion			289,970	

Second Stage (S-II)

The S-II is powered by five high-performance J-2 rocket engines each developing approximately 230,000 pounds of thrust in a vacuum. One engine, mounted on the vehicle longitudinal centerline, is fixed; the remaining four engines, mounted in a square pattern about the centerline, are gimballed for thrust vector control by signals from the control system housed in the IU. The J-2 engines utilize LOX and LH_2 (liquid hydrogen) as propellants.

The SA-504 is the first Saturn V to utilize the light weight S-II stage. This stage is approximately 4000 pounds lighter than the S-II stage flown on Apollo 8. This reduction is the result of a concerted effort to reduce the overall weight of the Saturn V Launch Vehicle.

Third Stage (S-IVB)

The S-IVB is powered by a single J-2 engine developing approximately 230,000 pounds of thrust in a vacuum. As installed in the S-IVB, the J-2 engine features a multiple start capability. The engine is gimballed for thrust vector control in pitch and yaw. Roll control is provided by the Auxiliary Propulsion System (APS) modules containing motors to provide roll control during mainstage operations and pitch, yaw, and roll control during non-propulsive orbital flight.

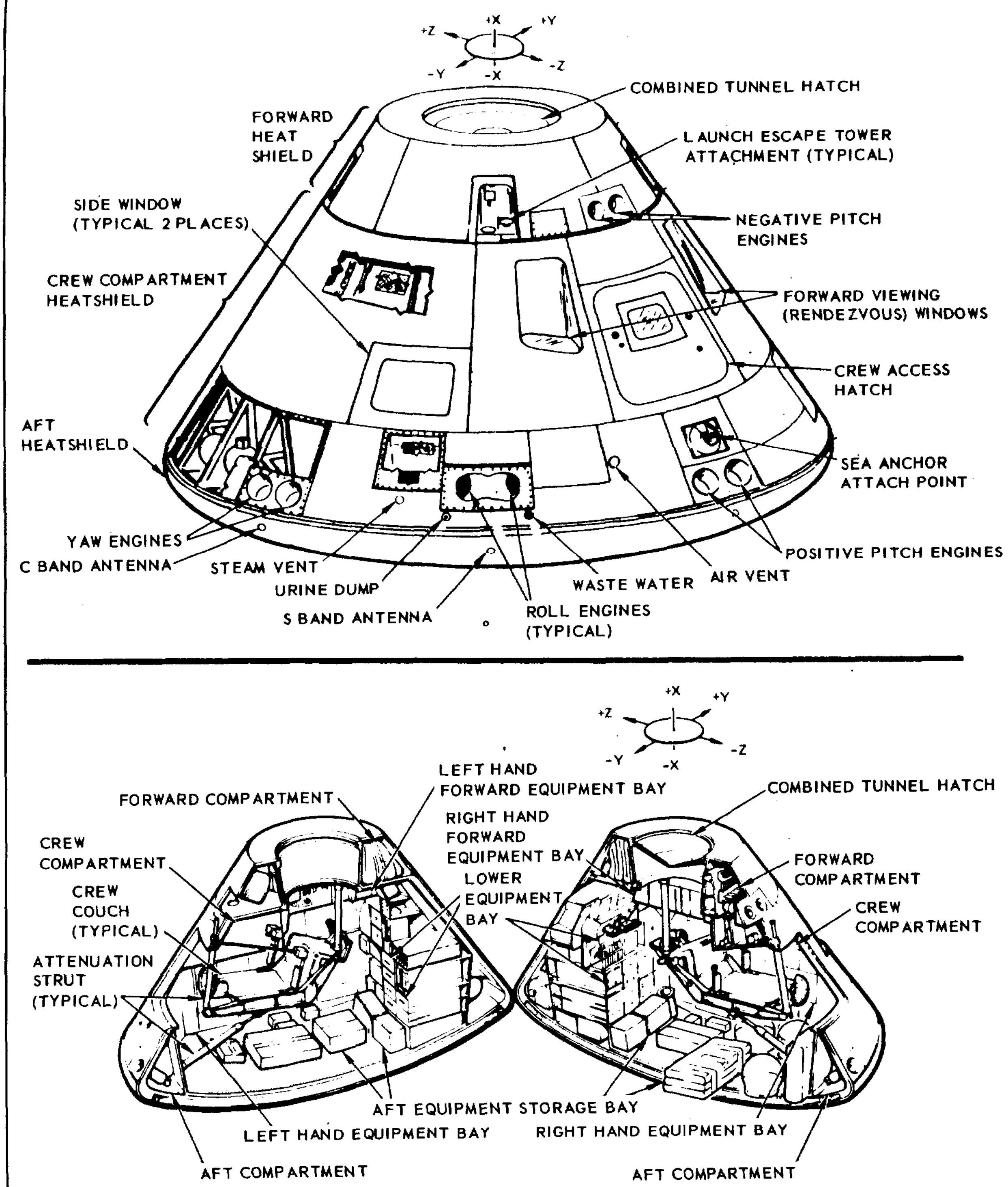
Instrument Unit

The Instrument Unit (IU) contains the following: Electrical system, self-contained and battery powered; Environmental Control System, provides thermal conditioning for the electrical components and guidance systems contained in the assembly; Guidance and Control System, used in solving guidance equations and controlling the attitude of the vehicle; Measuring and Telemetry System, monitors and transmits flight parameters and vehicle operation information to ground stations; Radio Frequency System, provides for tracking and command signals; components of the Emergency Detection System (EDS).

SPACECRAFT DESCRIPTION

Command Module

The Command Module (CM) (Figure 12) serves as the command, control, and communications center for most of the mission. Supplemented by the SM, it provides all life support elements for three crewmen in the mission environments and for their safe return to earth's surface. It is capable of attitude control about three axes and some lateral lift translation at high velocities in earth atmosphere. It also permits LM attachment, CM/LM ingress and egress, and serves as a buoyant vessel in open ocean.



BLOCK II COMMAND MODULE

Fig. 12

Service Module

The Service Module (SM) (Figure 13) provides the main spacecraft propulsion and maneuvering capability during the mission. The Service Propulsion System (SPS) provides up to 20,500 pounds of thrust in a vacuum. The Service Module Reaction Control System (SM RCS) provides for maneuvering about and along three axes. The SM provides most of the spacecraft consumables (oxygen, water, propellant, hydrogen). It supplements environmental, electrical power, and propulsion requirements of the CM. The SM remains attached to the CM until it is jettisoned just before CM entry.

Common Command and Service Module Systems

There are a number of systems which are common to the CM and SM.

Guidance and Navigation System

The Guidance and Navigation (G&N) System measures spacecraft attitude and acceleration, determines trajectory, controls spacecraft attitude, controls the thrust vector of the SPS engine, and provides abort information and display data.

Stabilization and Control System

The Stabilization and Control System (SCS) provides control and monitoring of the spacecraft attitude, backup control of the thrust vector of the SPS engine and a backup inertial reference.

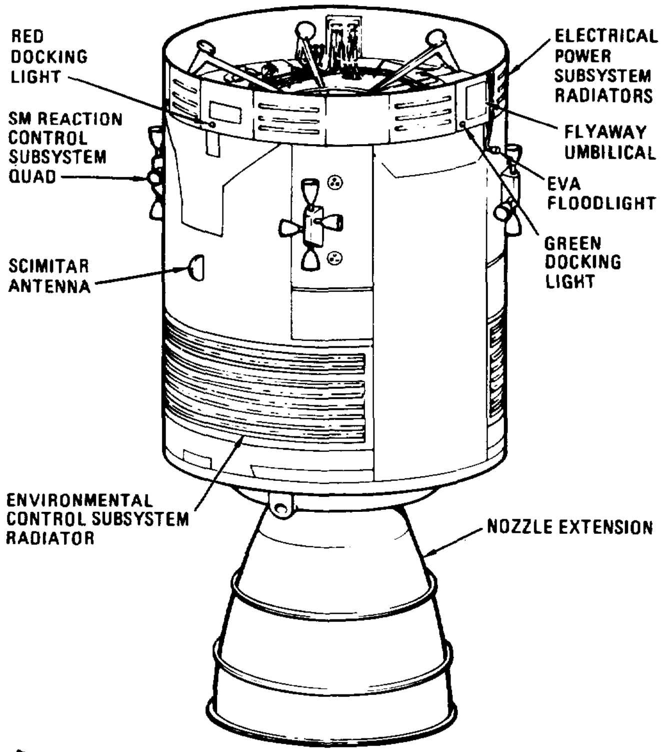
Reaction Control System

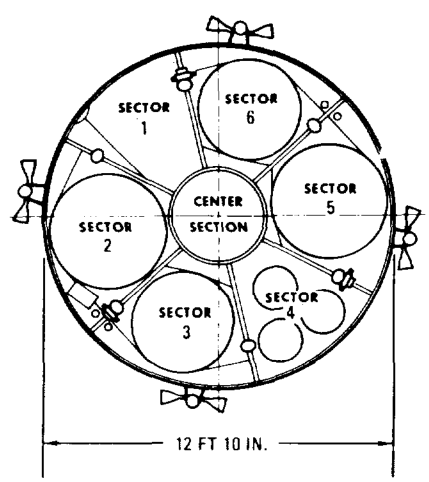
The Reaction Control System (RCS) provides thrust for attitude and small translational maneuvers of the spacecraft in response to automatic control signals from the SCS in conjunction with the G&N system. The CM and SM each has its own independent and redundant system, the CM RCS and the SM RCS respectively. Propellants for the RCS are hypergolic.

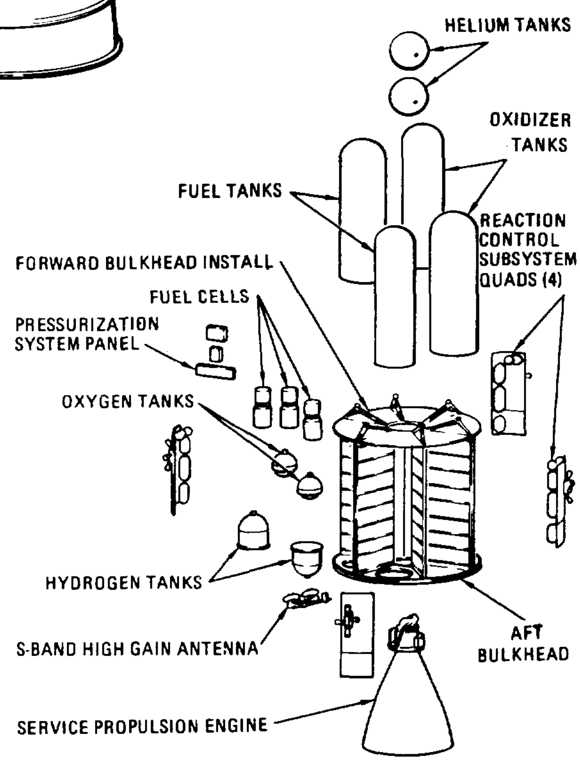
Electrical Power System

The Electrical Power System (EPS) supplies all electrical power required by the CSM. The primary power source is located in the SM and consists of three fuel cells which are the prime spacecraft power from lift-off through CM/SM separation. Five batteries -- three for peak load intervals, entry and post-landing, and two for pyrotechnic uses -- are located in the CM.

SERVICE MODULE





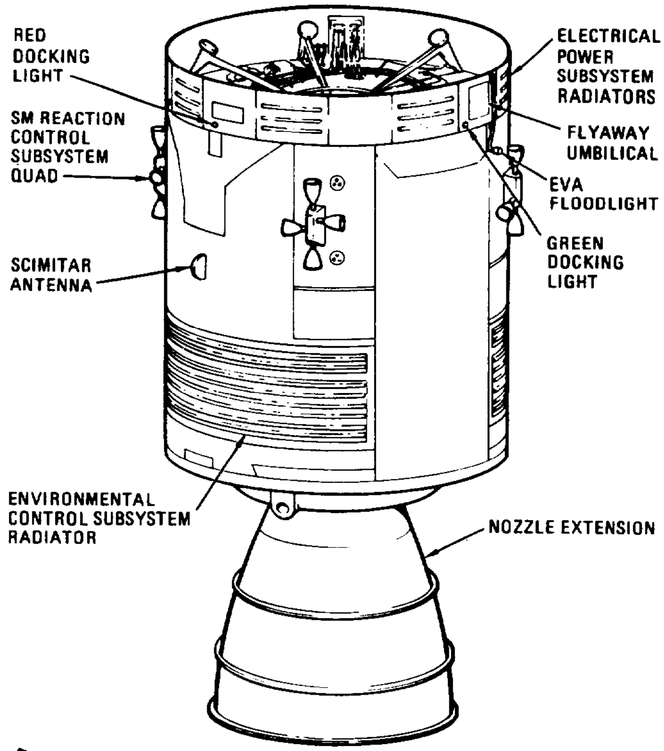


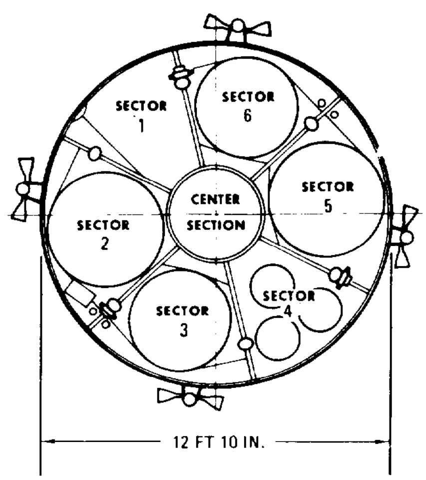
SECTOR 2 } SECTOR 3 }	SERVICE PROPULSION SUBSYSTEM OXIDIZER TANKS
SECTOR 4	OXYGEN TANKS, HYDROGEN TANKS, FUEL CELLS
SECTOR 5 } SECTOR 6 }	SERVICE PROPULSION SUBSYSTEM FUEL TANKS

CENTER SECTION - SERVICE PROPULSION ENGINE AND HELIUM TANKS

Fig. 13

SERVICE MODULE





SECTOR 2	}	SERVICE PROPULSION SUBSYSTEM
SECTOR 3		OXIDIZER TANKS
SECTOR 4		OXYGEN TANKS, HYDROGEN TANKS, FUEL CELLS
SECTOR 5	}	SERVICE PROPULSION SUBSYSTEM
SECTOR 6		FUEL TANKS

CENTER SECTION - SERVICE PROPULSION ENGINE AND HELIUM TANKS

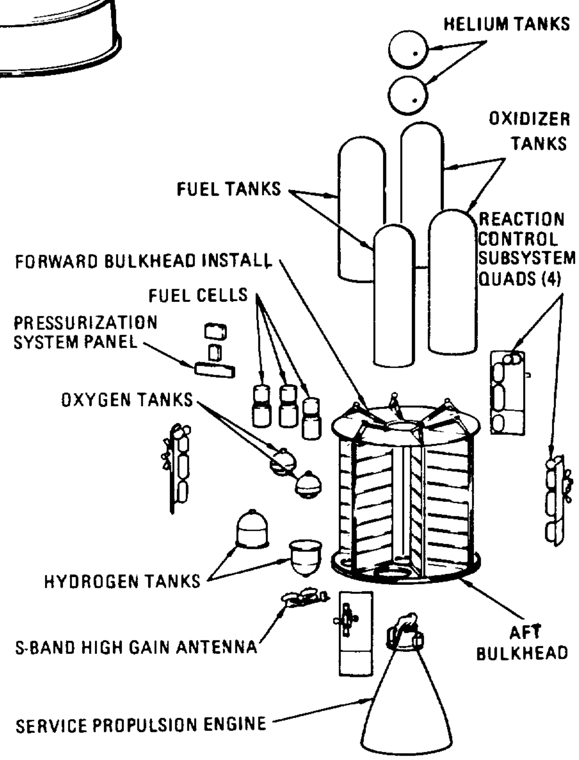


Fig. 13

Environmental Control System

The Environmental Control System (ECS) provides a controlled cabin environment and dispersion of CM equipment heat loads.

Telecommunications System

The Telecommunications (T/C) System provides for the acquisition, processing, storage, transmission and reception of telemetry, tracking, and ranging data among the spacecraft and ground stations.

Sequential System

Major Sequential Subsystems (SEQ) are the Sequential Events Control System (SECS), Emergency Detection System (EDS), Launch Escape System (LES), and Earth Landing System (ELS). The subsystems interface with the RCS or SPS during an abort.

Spacecraft LM Adapter

The Spacecraft LM Adapter (SLA) is a conical structure which provides a structural load path between the LV and SM and also supports the LM. Aerodynamically, the SLA smoothly encloses the SM engine nozzle and irregularly-shaped LM, and transitions the SV diameter from that of the upper LV stage to that of the SM. The upper section is made up of four panels that swing open at the top and are jettisoned away from the spacecraft by springs attached to the lower fixed panels.

Lunar Module

Lunar Module (LM) 3 for the Apollo 9 Mission will exercise, in earth orbit, many of the systems and capabilities of its prime mission as a lunar landing and launching vehicle. The LM (Figure 14) is a two-stage vehicle designed to transport two crewmen from a docked position with the CSM to the lunar surface, serve as a base for lunar surface crew operations, and to provide for their safe return to the docked position. The upper stage is termed the Ascent Stage (AS) and the lower stage, the Descent Stage (DS). In the nominal mission, the two stages are operated as a single unit until the lunar landing is accomplished. The Ascent Stage is used for ascent from the lunar surface and rendezvous with the CSM.

The LM's main propulsion includes a gimballed, throttleable Descent Propulsion System (DPS) engine and a fixed, non-throtteable Ascent Propulsion System (APS) engine. A 16-jet Reaction Control System on the Ascent Stage provides for stabilization and maneuvering. All propulsive systems utilize storable hypergolic propellants. The Guidance, Navigation, and Control System (GN&CS) has the capability to automatically

LUNAR MODULE

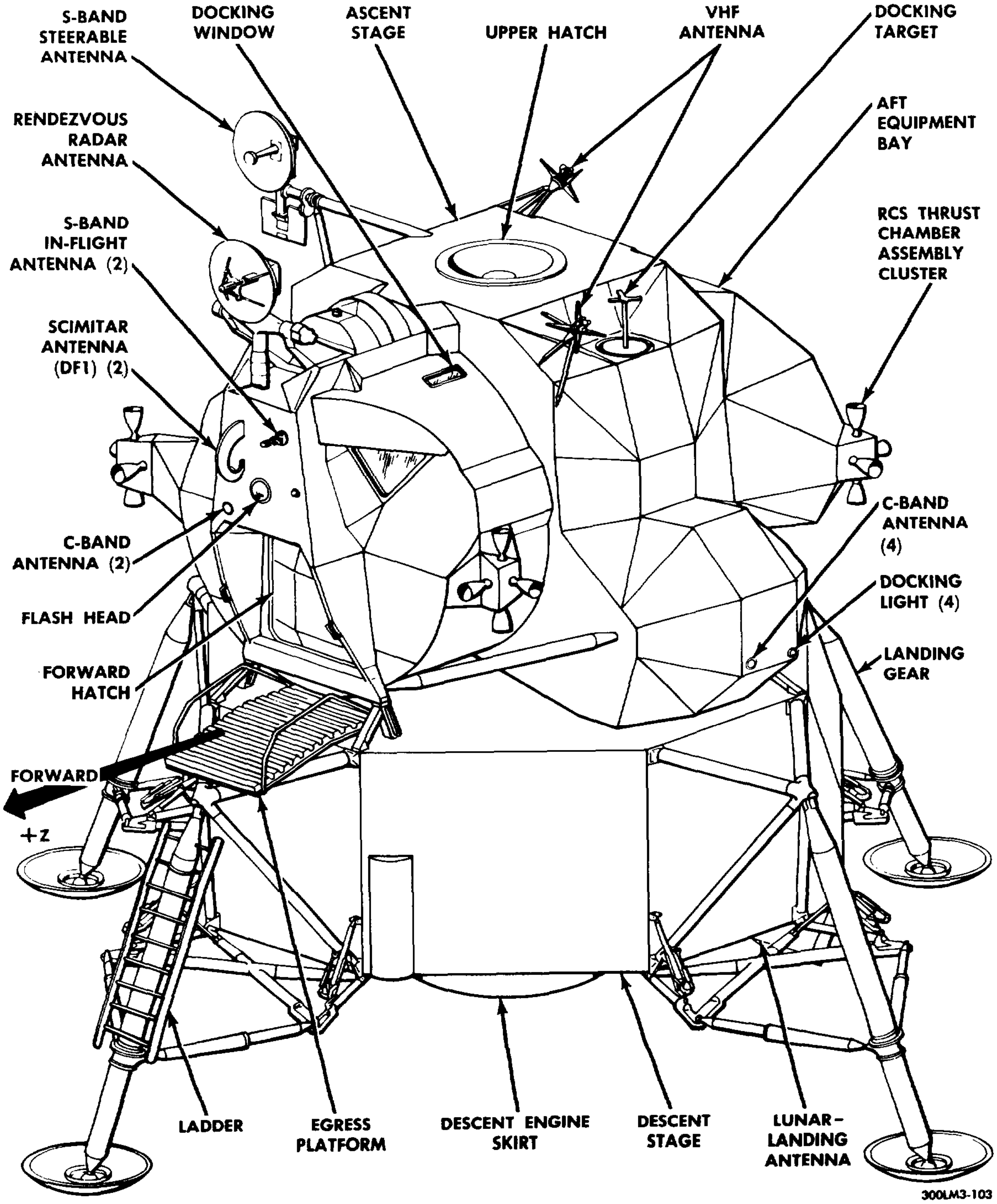


Fig. 14

implement all parameters required for safe landing from lunar orbit and accomplish a CSM-LM rendezvous from lunar launch. Landing and Rendezvous radar systems aid the GN&CS system. The Instrument System provides for LM systems checkout and displays data for monitoring or manually controlling LM systems. The environmental Control System provides a satisfactory environment for equipment and human life. The Electrical Power System relies upon four batteries in the Descent Stage and two batteries in the Ascent Stage when undocked from the CSM. Electrical Power is provided by the CSM when the LM is docked. Telecommunications is provided to the MSFN, the CSM, and an extravehicular astronaut.

The LM can operate for 48 hours after separation from the CSM. Insulation provides protection against 350°F temperatures and in certain required areas up to 1000°F. A detailed description of the LM and its systems is in the MOR Supplement.

Television Camera

Apollo 9 will provide the first operational test of the television camera designed for eventual use by the lunar landing crewmen. This is a new design camera that has not been flown on any previous mission. The camera will be carried in the ascent stage of the LM and will not be operated from inside the CM. The first of the two scheduled transmissions will be of the LM interior. In the second transmission, the camera will be operated by the LMP at the end of his extravehicular activity period and will feature pictures of the CSM/LM exterior.

Launch Escape System

The Launch Escape System (LES) provides the means for separating the CM from the LV during pad or suborbital aborts through completion of second stage burn. This system consists primarily of the Launch Escape Tower (LET), Launch Escape Motor, Tower Jettison Motor and Pitch Motor. All motors utilize solid propellants. A Boost Protective Cover (BPC) is attached to the LET and covers the CM from LES rocket exhaust and also from aerodynamic heat generated during LV boost.

CONFIGURATION DIFFERENCES

The space vehicle for Apollo 9 varies in its configuration from that flown on Apollo 8 and those to be flown on subsequent missions. These differences are the result of the normal growth, planned changes, and experience gained on previous missions. Following is a listing of the major configuration differences between AS-503 and AS-504. LM-3 is compared with LM-1, which was flown on Apollo 5.

S-IC STAGE

- Deleted film camera system
- Reduced R&D instrumentation
- Installed redesigned F-1 engine injector
- Removed television cameras
- Increased propulsion performance
- Reduced weight by removal of forward skirt insulation and revising "Y" rings and skin taper in propellant tanks

S-II STAGE

- First flight of lightweight structure
- Redesigned separation planes tension plates
- Uprated J-2 engines
- Reinforced thrust structure
- Changed PU system to closed loop

S-IVB STAGE

- Reduced Instrumentation battery capacity
- Deleted anti-flutter kit
- Uprated J-2 engine

INSTRUMENT UNIT

- Enlarged methanol accumulator
- Changed networks to disable spacecraft control of launch vehicle
- Removed one instrument battery
- Deleted S-band telemetry

COMMAND MODULE

- Added forward hatch emergency closing link
- Added general purpose timer
- Added precured RTV to side and hatch windows
- Added SO65 camera experiment equipment
- Added docking probe, ring, and latches
- Added RCS propulsion burst disc
- Added Solenoid valve to RCS propellant system
- Changed S-band power amplifier configuration to 0006 configuration
- Deleted flight qualification recorder

LUNAR MODULE

- First operational flight of Oxygen Supply Module
- First operational flight of Water Control Module
- First flight of VHF transceiver and Diplexer
- First flight to use exterior tracking light
- First flight to use ascent engine arming assembly
- First operational flight of the Abort Guidance Section

- First operational flight of the Rendezvous Radar
- First flight of the landing radar electronic and antenna assembly
- First flight using thrust translation controller assembly
- First flight to use Orbital Rate Drive
- Modified CO_2 partial pressure sensor to correct EMI, vibration, and outgassing problems
- Added high-reliability transformer for use with the S-band steerable antenna
- Added pressure switch to RCS
- Modified thermal insulation in the Rendezvous Radar Antenna Assembly
- Installed Landing gear
- Added high-efficiency reflective coated cabin and docking windows
- Added split AC bus
- Added more reliable Signal Processor Assembly
- Added manual trim shutdown to descent engine control assembly
- Modified Stabilization and Control Assembly No. 1 to eliminate single failure point
- Added fire preventive and resistive materials
- Added TV camera

SPACECRAFT LM ADAPTER

- Redesigned SLA panel charges
- Added spring ejector for LM
- Added LM separation sequence controllers
- Deleted POGO instrumentation
- Added "cookie cutter" emergency egress equipment (was included on Apollo 5)

HUMAN SYSTEM PROVISIONS

The major human system provisions included for the Apollo 9 mission are: Space Suits, Bioinstrumentation System, Medical Provisions, Crew Personal Hygiene, Crew Meals, Sleeping Accommodations, Oxygen Masks, and Survival Equipment. These systems provisions are described in detail in the Mission Operation Report Supplement.

LAUNCH COMPLEX

The AS-504 Space Vehicle (SV) will be launched from Launch Complex (LC) 39 at the Kennedy Space Center. The major components of LC 39 include the Vehicle Assembly Building (VAB), the Launch Control Center (LCC), the Mobile Launcher (ML), the Crawler Transporter (C/T), the Mobile Service Structure (MSS), and the Launch Pad.

The LCC is a permanent structure located adjacent to the VAB and serves as the focal point for monitoring and controlling vehicle checkout and launch activities for all Saturn V launches. The ground floor of the structure is devoted to service and support functions. Telemetry equipment occupies the second floor and the third floor is divided into firing rooms, computer rooms, and offices. Firing room 2 will be used for Apollo 9.

The AS-504 SV was received at KSC and assembly and initial overall checkout was performed in the VAB on the mobile launcher. Rollout occurred on 3 January 1969. Transportation to the pad of the assembled SV and ML was provided by the Crawler Transporter (C/T) which also moved the MSS to the pad after the ML and SV had been secured. The MSS provides 360-degree access to the SV at the launch pad by means of five vertically-adjustable, elevator-serviced, enclosed platforms. The MSS will be removed to its park position prior to launch.

The emergency egress route system at LC 39 is made up of three major components: the high speed elevators, slide tube, and slide wire. The primary route for egress from the CM is via the elevators and, if necessary, through the slide tube which exits into an underground blast room.

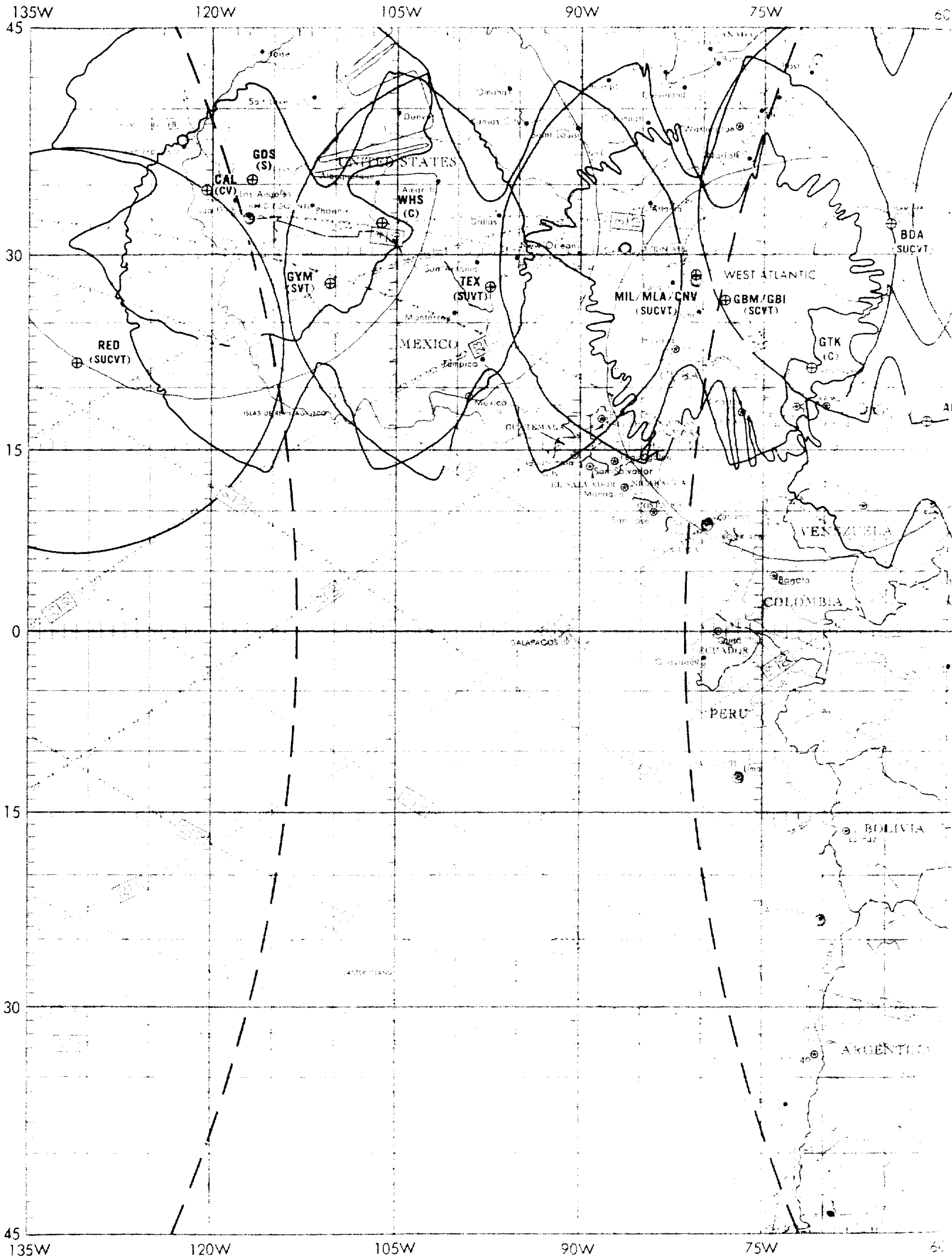
A more complete description of LC 39 is in the MOR Supplement.

MISSION SUPPORT

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 pre-launch checkout, countdown, and with launching the SV, while MCC located at Houston, Texas, provides centralized mission control from lift-off through recovery. 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). 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 is staffed with specialists in all aspects of the mission who provide the Mission Director and Flight Director with real time evaluations of mission progress.

The MSFN is a worldwide communications network which is controlled by the MCC during Apollo missions. The network is composed of fixed stations (Figure 15) and is supplemented by mobile stations (Table 5) which are optimally located within a global band extending from approximately 40° South latitude to 40° North latitude. Station capabilities are summarized in Table 6.

The functions of these stations are to provide tracking, telemetry, command and communications both on an updata link to the spacecraft and on a down data link to the MCC. Connection between these many MSFN stations and the MCC is provided by NASA Communications Network (NASCOM). More detail on Mission Support is in the MOR Supplement.



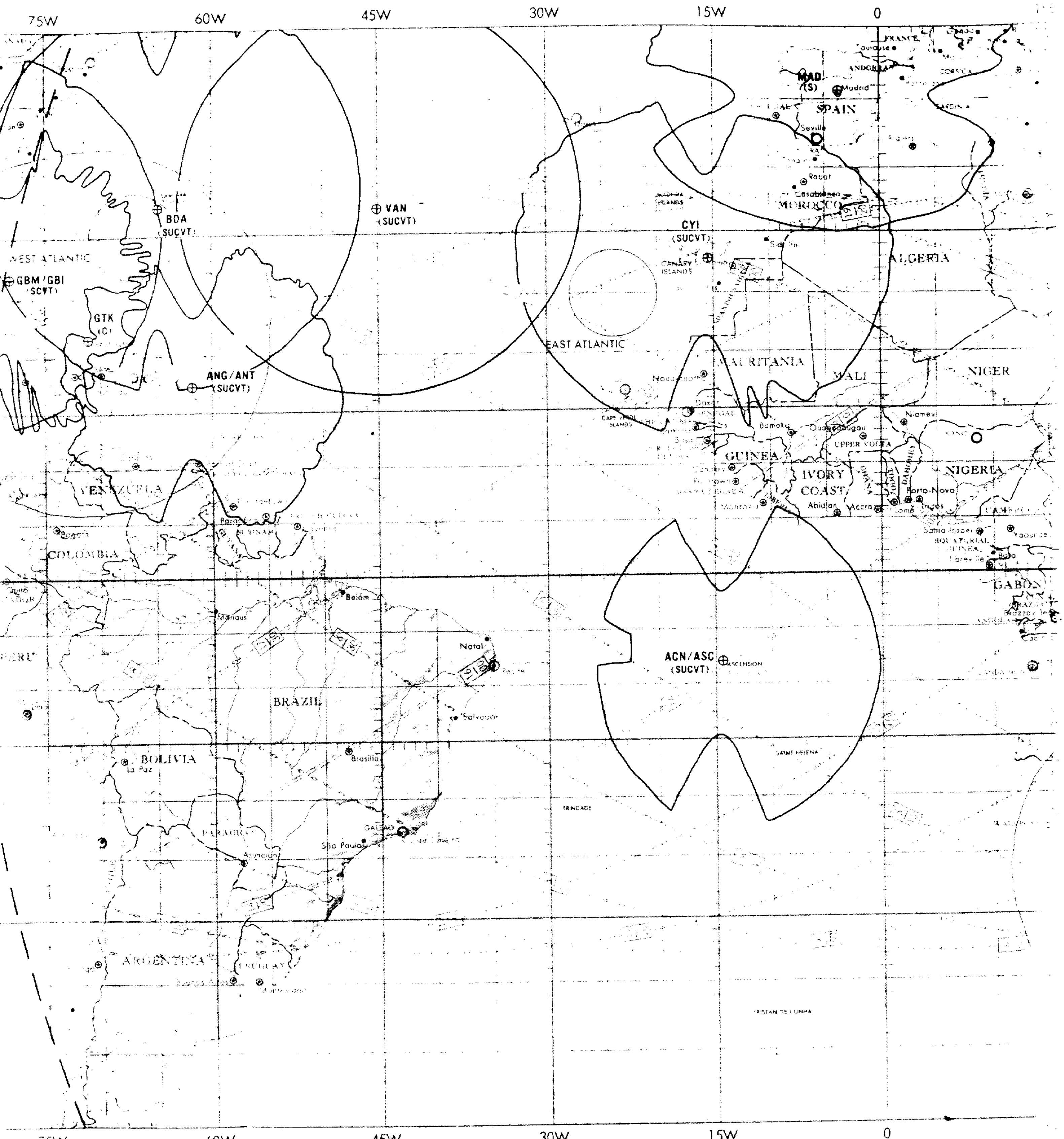
1st EDITION, 31 JANUARY 1969

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

Lithographed by ACIC 2-69

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

2/18/69

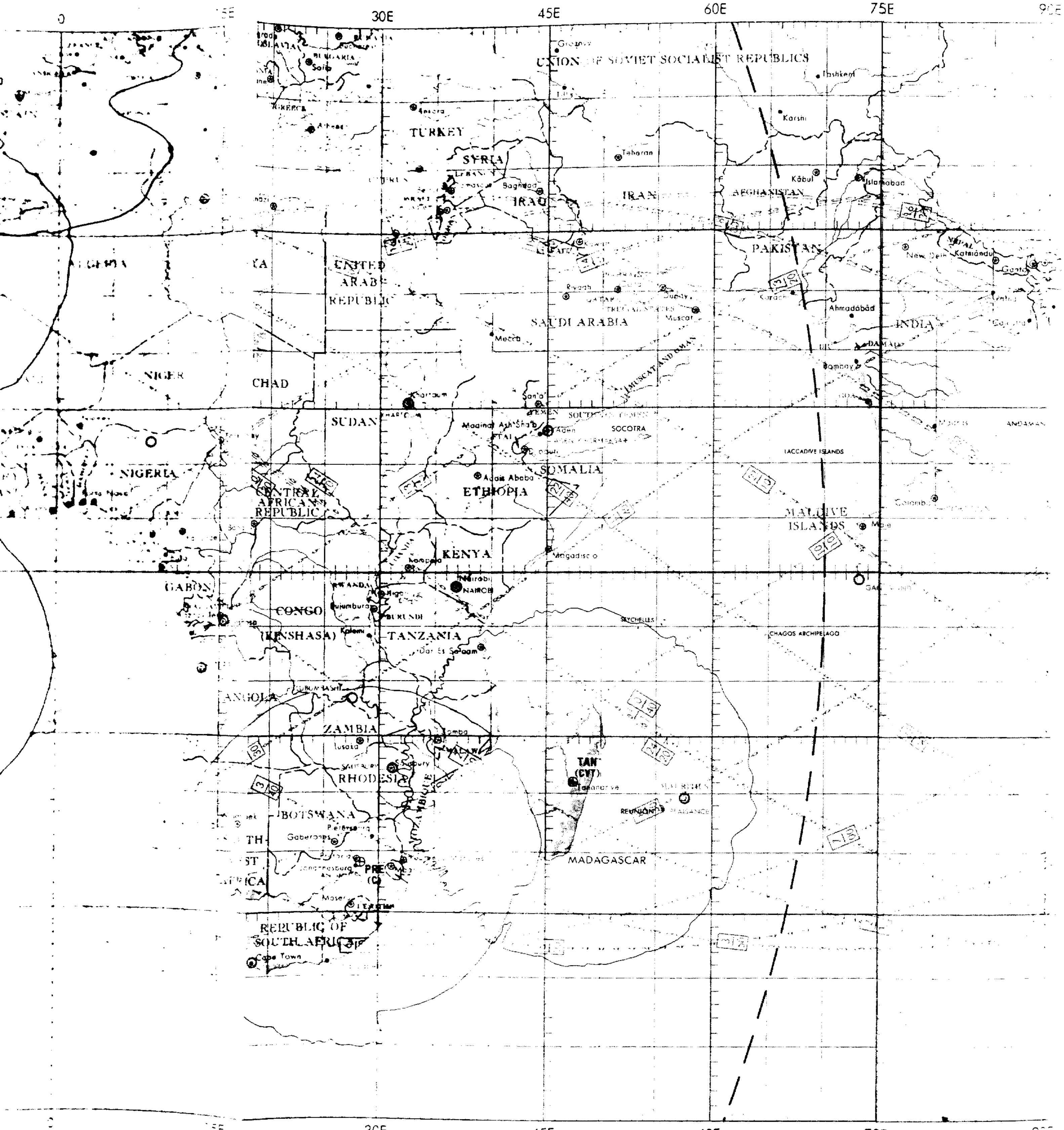


NOTE: The representation of international boundaries on this chart is not necessarily authoritative.

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

COMSAT COVERAGE
Approximate limits

International boundaries
Capital cities
Other cities
Airfields
HC 130 home base

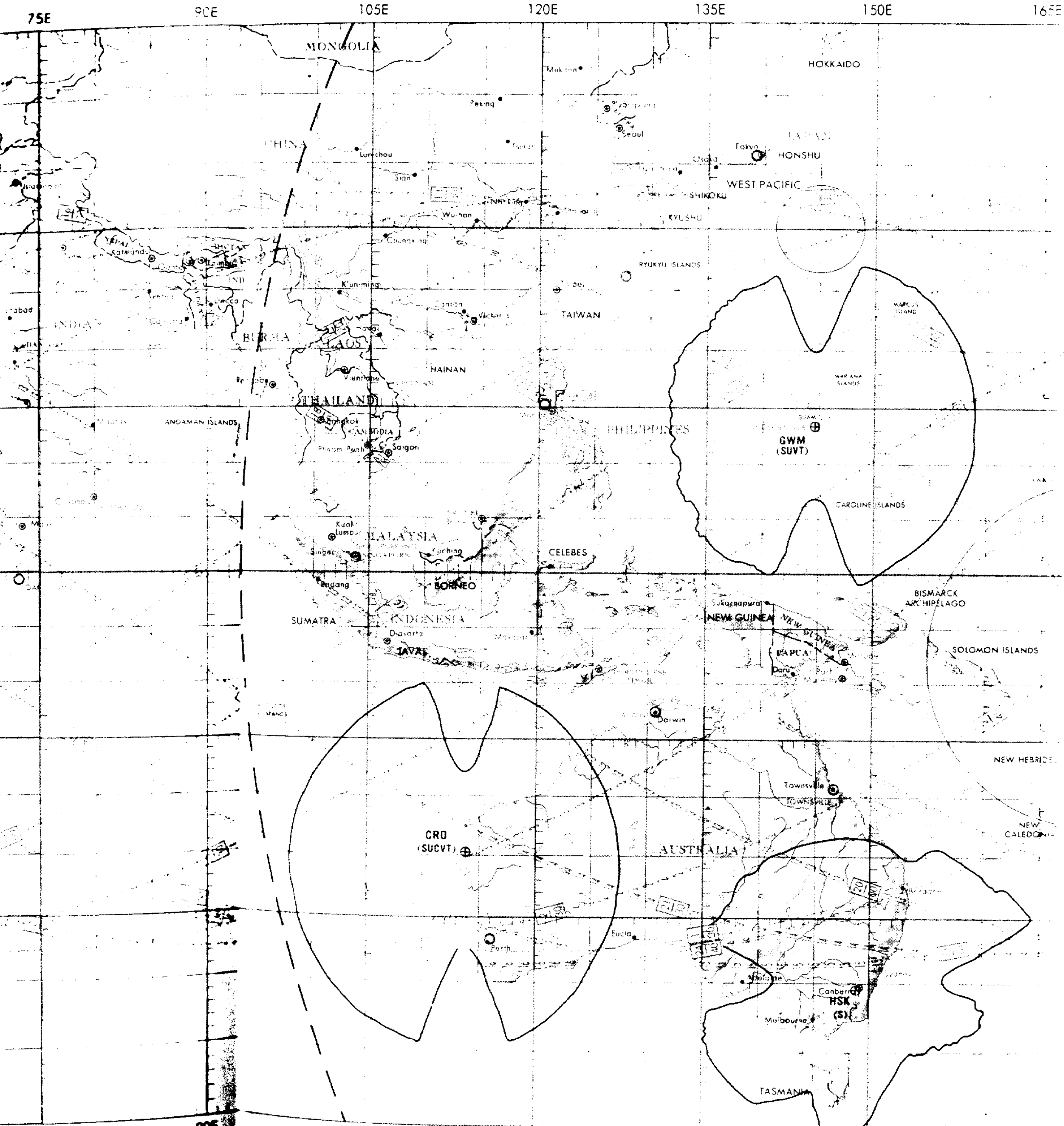


TRACKING STATION SYMBOLS

Location symbol and call letters . . . . ⊕ **MIL/MLA/CNV**
Station capabilities . . . . **(SUCVT)**
S. Unified S Band (Command, Radar Tracking, Telemetry, A-G Voice. NOTE: Ship HTV does not have command capability.)
U. UHF Command
C. C Band Radar Tracking
V. VHF A-G Voice
T. VHF Telemetry (**PRE, TAN, CAL** and **HTV** have record telemetry only.)

TRACKING LIM

Command capability
No command capability
Tracking limits are based upon 0° antenna elevation.



TRACKING LIMIT SYMBOLS

Command capability

No command capability

Tracking limits are based upon 1[illegible] spacecraft altitude for a 0° antenna elevation.

GROUND TRACK SYMBOLS

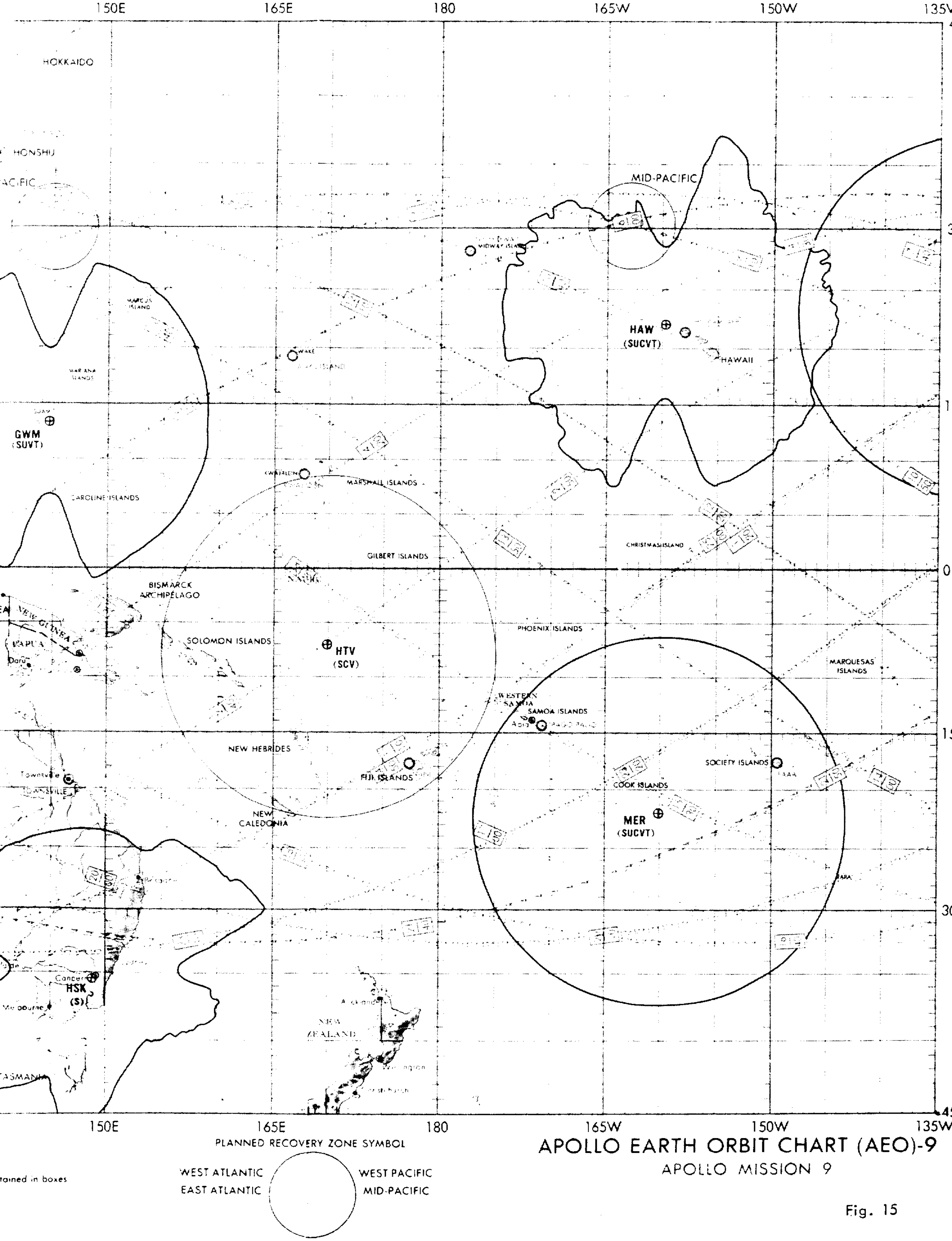
Apollo Spacecraft

Elapsed time from launch, in hours and minutes, is contained in boxes centered on the ground track

PLANNED RE

WEST ATLANTIC

EAST ATLANTIC



APOLLO EARTH ORBIT CHART (AEO)-9

APOLLO MISSION 9

Fig. 15

TABLE 5

MSFN MOBILE FACILITIES

APOLLO SHIPS (4 required)

FUNCTION	SUPPORT	LOCATION	NAME
Apollo Insertion Ship	Insertion, abort contingencies	32° N, 45°W	USNS VANGUARD
Apollo Injection Ship	Coverage for CDH and SPS-8	22° N, 131° W	USNS REDSTONE
Apollo Injection Ship	Coverage for phasing	22° S, 160° W	USNS MERCURY
Apollo Reentry Ship	Coverage for TPF	7°S, 170°E	USNS HUNTSVILLE

APOLLO AIRCRAFT (5 required)

ARIA will support the mission on specified revolutions from assigned Test Support Positions (TSP). In addition, ARIA will cover reentry (400,000 ft) thru crew recovery. ARIA #1, #2, and #3 will operate in the Pacific Ocean and ARIA #4 and #5 in the Atlantic Ocean.

TABLE 6

Network Configuration for the AS-504 Mission

Systems / Facilities	TRACKING					USB				TLM					CMD			DATA PROCESSING			COMM				OTHER		REMARKS
	C-band (High Speed)	C-band (Low Speed)	ODOP	USB	Optical	TV to MCC	Voice	TLM	Command	VHF Links	FM Remoting	MAG Tape Recording	Decoms	Displays	UHF Commanding	CMD Destruct	DRUL Remoting	642B TLM	642B CMD	CDP	High-Speed Data	TTY	Voice (SCAMA)	Voice VHF A/G	Recovery	SPAN	
PAT CNV	2 1	2 1	1		1										3	1											Note 1
MLA MIL	2	2		2		3	2	2	2	2	2	2	2				2	2	2		2	2	2	2			Note 1
GBI GBM	2	2		2			2	2	2	1 2	2	1 2	2		3 3	1	3	2	2		2	2	2	2			Note 1 Note 2
ANT ANG	3	3		2			2	2	2	2	2	2	2		3		2	2	2		2	2	2	2			
BDA CYI	2	2 3		2 3			2 3	2 3	2 3	2 3	2 3	2 3	2 3	2	2 3	1		2 3	2 3		2 3	2 3	2 3	2 3	1	3	Note 1
ASC ACN		3		3			3	3	3	3	3	3	3		3			3	3		3	3	3	3			
PRE TAN		3 3							3	3	3	3										3	3	3			
CRO GWM	3	3		3 3			3 3	3 3	3 3	3 3	3 3	3 3	3 3		3 3			3 3	3 3		3 3	3 3	3 3	3 3		3	
HAW CAL	3	3 3		3			3	3	3	3	3	3	3		3			3	3		3	3 3	3 3	3 3			
GDS GYM				3 3		3	3 3	3 3	3 3	3	3 3	3 3	3 3					3 3	3 3		3 3	3 3	3 3	3			
WHS TEX		3		3			3	3	3	3	3	3	3		3			3	3		3	3 3	3 3	3			
LIMA HSK				3			3	3	3		3	3	3					3	3		3	3	3		3		
MAD ARIA (8)				3 3		3	3 3	3 3	3	3	3	3 3	3					3	3		3	3	3				
RED VAN	2	3 2		3 2			3 2	3 2	3 2	3 2	3 2	3 2	3 2		3 2			3 2	3 2	3 2	3 2	3 2	3 2	3 2			Note 3 Note 3
MER HTV		3 3		3 3			3 3	3 3	3 3	3 3	3	3 3	3 3		3			3	3	3 3	3	3 3	3 3	3 3			Note 4 Note 5

Legend
1. Launch
2. Launch & Orbit
3. Orbit

Note
1. Launch Abort Contingency
2. Launch and 4 Revs
3. Insertion Ship
4. Alternate Re-entry/Injection
5. Re-entry Ship

RECOVERY SUPPORT PLAN

GENERAL

The primary responsibilities of the recovery forces in supporting the mission are:

A. Rapid location and safe retrieval of the flight crew and spacecraft.

B. The collection, preservation, and return of test data, test hardware, and information relating to the recovery operation.

This responsibility begins with lift-off and ends with safe return of the spacecraft and the flight crew to a designated point within the continental United States. The SM will probably break up during reentry and the landing areas will be chosen with this in mind to prevent land impact of parts of the SM.

The recovery planning has been based upon an approximately 10-day duration mission with recovery forces deployed in four recovery zones (1, 2, 3, and 4) as shown in Figure 16 with the primary landing area located in Zone 1. Table 7 provides a summary of recovery forces.

The recovery will be directed from the Recovery Control Room of the MCC, and will be supported by two satellite recovery control centers: The Atlantic Recovery Center located at Norfolk, Virginia, and the Pacific Control Center located at Kunia in the Hawaiian Islands. In addition to the recovery control centers, there will be NASA representatives deployed with recovery forces throughout the worldwide DOD recovery network, at vital staging bases, and in the landing areas to give on-scene technical support to the DOD forces.

RECOVERY GUIDELINES

Recovery guidelines are based upon lighting conditions and the weather in the recovery area. It is highly desirable to have as many daylight hours after landing as is possible in the planned landing area. In addition, it is desirable to have at least two hours of daylight remaining following a landing at the maximum extent of the launch abort area.

The weather guidelines for the launch site, primary, and secondary landing areas are as follows:

A. Surface winds - 25 knots maximum

B. Ceiling - 1500 feet minimum

NASA-S-68-6476

RECOVERY ZONES, CONTINGENCY AREA AND RECOMMENDED AIRCRAFT STAGING BASES

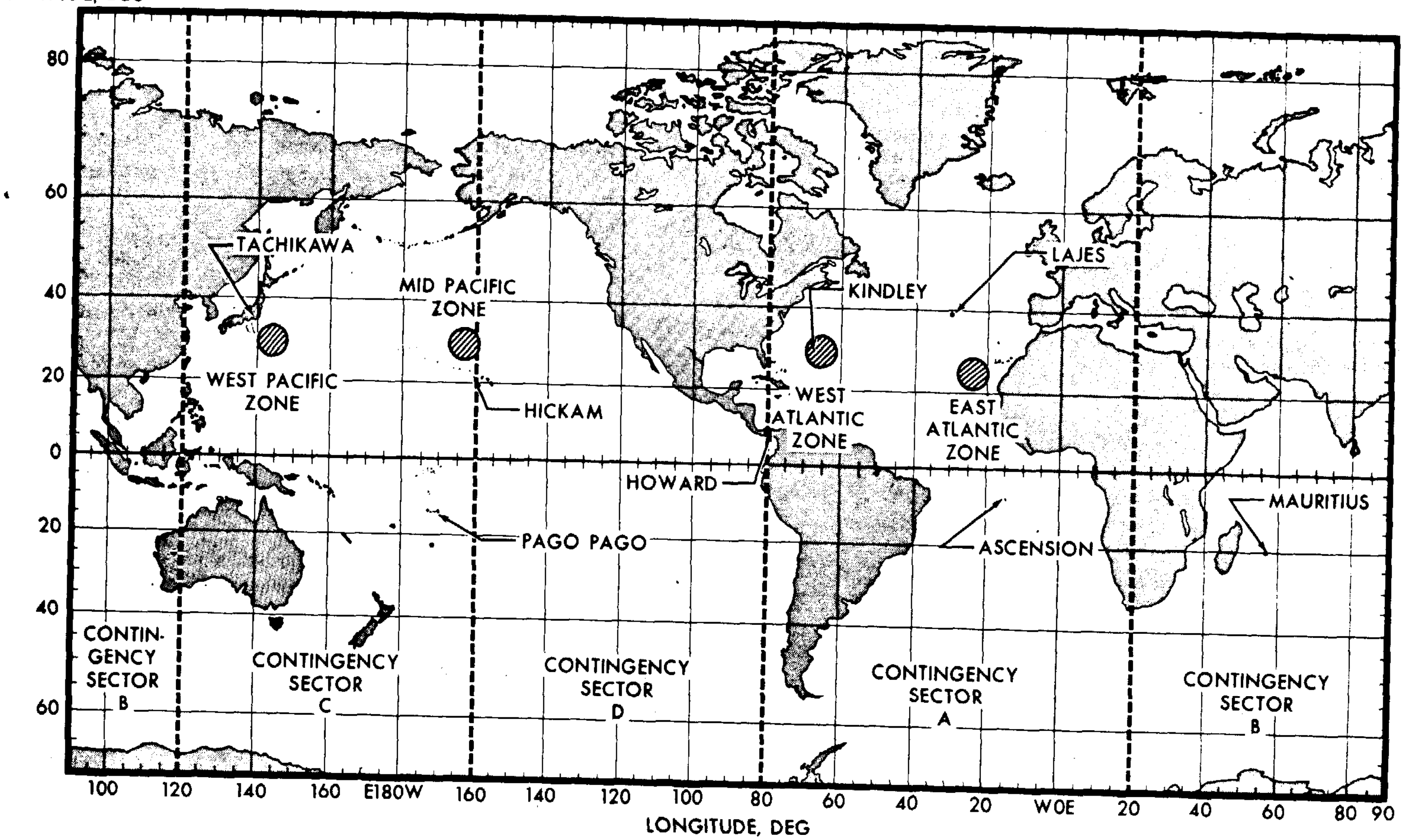


Fig. 16

M-932-69-09

TABLE 7

RECOVERY FORCES, APOLLO 9

RECOVERY DESIGNATION	TYPE OF SHIP AND HULL NO.	NAME OF SHIP	HOME PORT
ATLANTIC OCEAN SHIPS			
PRS	LPH-7	GUADALCANAL	NORFOLK
SRS-1	AIS	VANGUARD	PORT CANAVERAL
SRS-2	LKA-54	ALGOL	NORFOLK
PACIFIC OCEAN SHIPS			
SRS-3	DD-852	MASON	YOKOSUKA
SRS-4	DD-449	NICHOLAS	PEARL
SRS-5	DDG-21	COCHRANE	PEARL

18 HC-130 AIRCRAFT

1. KINDLEY AFB, BERMUDA
2. LAJES AFB, AZORES
3. ASCENSION ISLAND
4. MAURITIUS ISLAND
5. PERTH, AUSTRALIA
6. TACHIKAWA AB, JAPAN
7. PAGO PAGO, SAMOA
8. HICKAM AFB, HAWAII
9. HOWARD AFB, PANAMA

C. Visibility - 3 nautical miles minimum

D. Wave Height - 8 feet maximum

RECOVERY AREAS

To define levels of recovery support, spacecraft landing areas are discussed in five general categories: launch site, launch abort, primary, secondary, and contingency. Primary recovery ship support coverage will be required within the primary landing area.

Launch Site Landing Area

A landing could occur in the launch site landing area (Figure 17) if an abort occurred between LES activation and T+90 seconds which corresponds to approximately 41 nautical miles downrange. T+90 seconds is the interface between the launch site recovery forces and deep-water recovery forces. Launch site recovery forces, to the limit of their capability, will support the deep-water recovery forces if such assistance is required. The possible CM landing points lie in a corridor within the launch site area. This corridor, which is determined by the wind profile, will be defined at launch time.

Launch Abort Landing Area

The launch abort landing area is the area in which the CM will land following an abort initiated during the launch phase of flight (Figure 18). The launch abort landing area is a continuous area 50 nautical miles to either side of the ground track extending from the end of the launch site area to 3200 nautical miles downrange. It also includes an area centered approximately 60 nautical miles south of the ground track at 3200 nautical miles downrange which encompasses the Mode III abort landing points. The required access time for aircraft for the launch abort areas is four hours. The retrieval time for ships in the launch abort areas is 30 hours.

Primary Landing Area

The normal end-of-mission area is the primary landing area and requires primary recovery ship support (Figure 19). All aircraft in the end-of-mission area are required to be on-station 15 minutes prior to spacecraft reentry to provide direction-finding capability. Access time should not exceed two hours. The Atlantic recovery area will be prime for Apollo 9.

NASA-S-68-6463

LAUNCH SITE AREA AND RECOMMENDED FORCE DEPLOYMENT

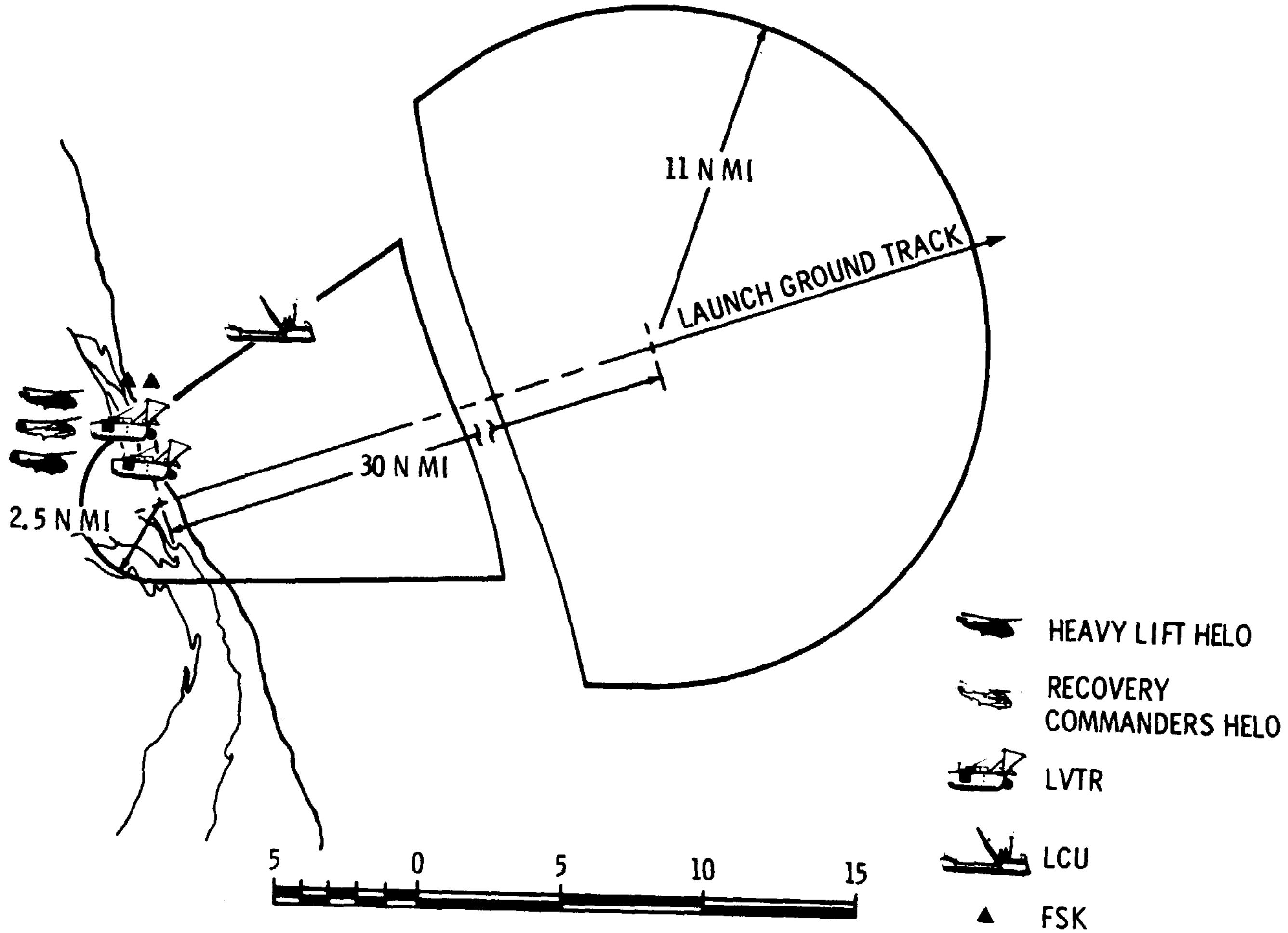


Fig. 17

NASA-S-68-6472

LAUNCH ABORT AREA AND RECOMMENDED FORCE DEPLOYMENT

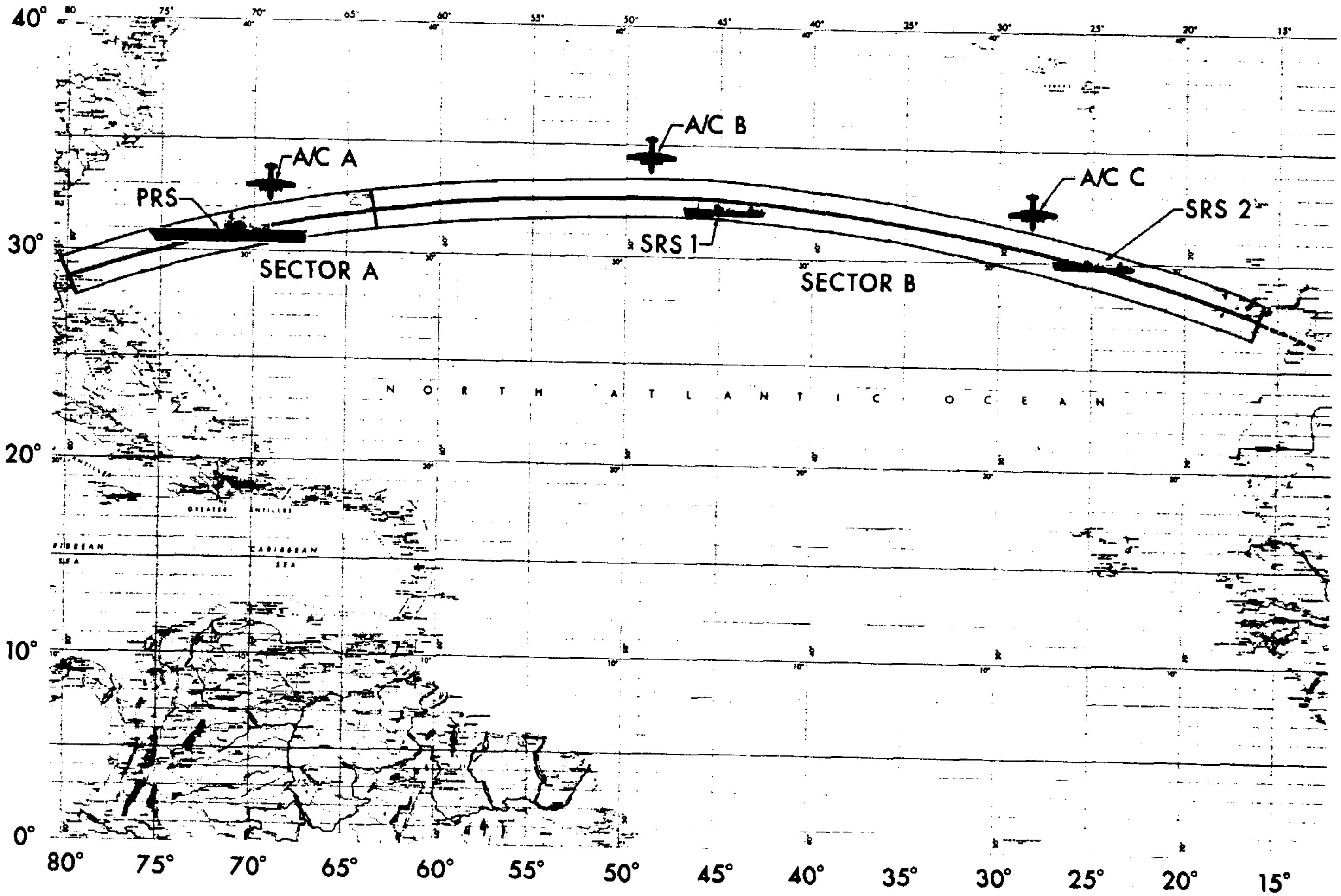
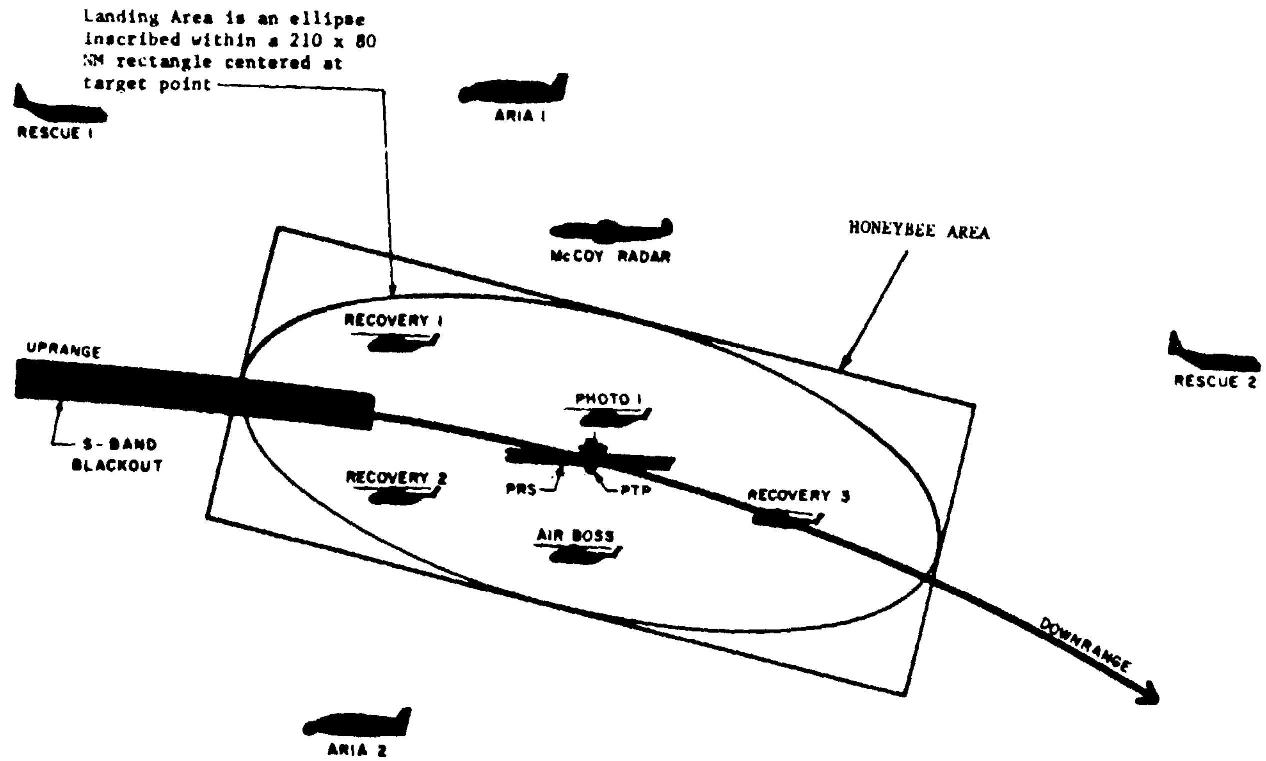


Fig. 18

Fig. 19

NASA-S-68-6467

RECOMMENDED PRIMARY RECOVERY FORCE DEPLOYMENT



Secondary Landing Area

A secondary landing area is an area in which a landing could occur after completion of the launch phase when the primary landing area cannot be reached. The probability of a landing in this area is sufficiently high to warrant a requirement for at least secondary recovery ship support. The majority of the secondary landing areas is located in the following recovery zones:

ZONE	ZONE CENTER COORDINATES		RADIUS (N.MI.)
West Atlantic	28°N	60°W	240
East Atlantic	28°N	25°W	240
West Pacific	28°N	140°E	240
Mid-Pacific	28°N	155°E	240

These zones are located so that generally there is a capability to land at a secondary landing area once in every revolution.

Contingency Landing Area

The contingency landing area is that area outside the launch site, launch abort, primary, and secondary landing areas within which a landing could possibly occur, and requiring only the support of land-based contingency aircraft. For Apollo 9 this includes all the earth's surface between 34° North latitude and 34° South latitude (outside the areas mentioned above). Although there is a remote possibility that an immediate emergency or catastrophic failure could result in a landing anywhere within these latitudes, it is expected that most emergencies will permit sufficient time to delay the deorbit burn in order to land at or near a preselected target point.

The area is divided into four sectors for identification purposes:

1. Sector A (Atlantic Ocean)
2. Sector B (Indian Ocean)
3. Sector C (Western Pacific Ocean)
4. Sector D (Eastern Pacific Ocean)

No planned ship support of the contingency area is required; however, contingency aircraft deployed to various staging bases around the world are required. The aircraft will be located at the following staging bases to provide an 18-hour access time to any contingency landing: Hickam Air Force Base (AFB), Hawaii; Kindley AFB, Bermuda;

Lajes Air Force Base (AFB) in the Azores; Tachikawa AB, Japan; Pago Pago, Samoa; Perth, Australia; Lima, Peru; the Ascension Islands; and the Mauritius Islands. Retrieval for a contingency area landing will be an after-the-fact operation.

Target Points

A preferred target point (PTP) will be selected each revolution to provide a landing opportunity at a desirable location. If possible, the PTP will be chosen in one of the four recovery zones supported by recovery ships and aircraft. If the ground track does not pass through a recovery zone, the PTP will be chosen near a recovery aircraft staging base.

Alternate Target Points (ATP's) will be selected approximately once every revolution in such a manner that they occur halfway between PTP's. As a result, there will be a PTP or an ATP approximately every 45 minutes during the flight. These preselected aiming points will be as close to search/rescue aircraft staging bases as practicable after considering such other things as weather, time of day of landing, and tracking capability.

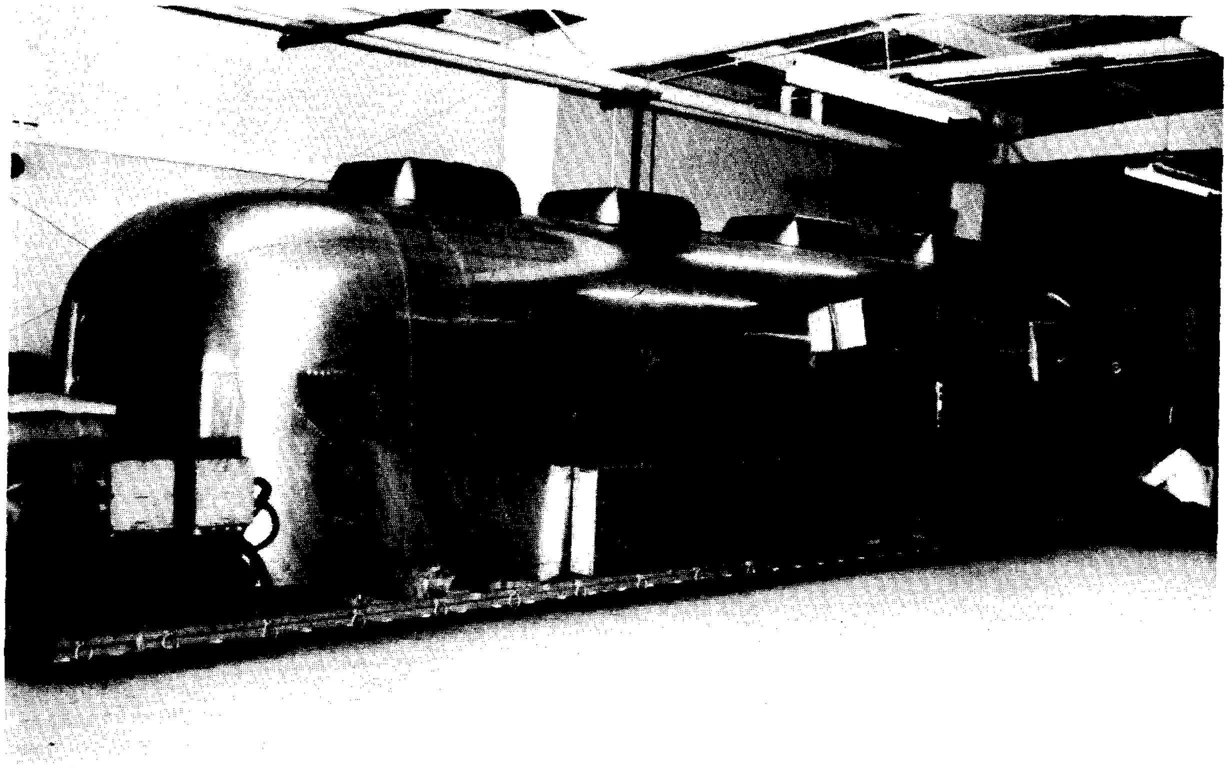
MOBILE QUARANTINE FACILITY (MQF) SIMULATION OPERATIONS

During the Apollo 9 mission, NASA desires to exercise as realistically as practicable the Mobile Quarantine Facility (MQF) and its interfaces with the recovery forces. The MQF is a mobile living facility, 35 feet long, 9 feet wide, and 9 feet high (Figure 20). It is specially designed to biologically isolate a flight crew during the recovery phase of a lunar landing mission. For a lunar landing mission, the flight crew, one NASA flight surgeon, and one or two NASA support personnel will be biologically isolated in the MQF during its transportation from the recovery area to the Lunar Receiving Laboratory (LRL) at MSC. Although this exercise will be conducted concurrently with the Apollo 9 mission, it will in no way interfere with mission activities.

For the MQF exercise, a simulated CM (referred to as the "CM egress trainer") and associated equipment will be deployed aboard the USS Guadalcanal. The following procedures are planned to be accomplished while at sea. Two recovery simulations with the CM egress trainer will be required. The first one will take place approximately 24 to 48 hours after launch, and the second one between approximately 48 to 96 hours before the planned Apollo 9 recovery time. For these simulations, three NASA personnel simulating the flight crew will be inside the CM egress trainer and, before retrieval by helicopter, will don biological isolation garments. These personnel will then be retrieved and flown to the USS Guadalcanal where they will enter the MQF. The CM egress trainer will then be retrieved and mated to the MQF so that the removal of equipment can be simulated.

At this point in the second simulation, the normal routine planned for actual lunar landing missions (including obtaining blood samples and passing samples and equipment into and out of the MQF) will be followed. This routine will be continued through the Apollo 9 recovery and while the ship is enroute to Norfolk, Virginia.

At approximately 24 hours after recovery of Apollo 9, the USS Guadalcanal will arrive at Norfolk. The MQF and associated equipment will then be transferred to a C-141 aircraft and flown to MSC. Upon arrival at MSC, the MQF will be transported to the Lunar Receiving Laboratory (LRL) and a simulated docking and transfer into the laboratory performed. The operation will be terminated with an end-of-mission stowage exercise.



MOBILE QUARANTINE FACILITY

Fig. 20

FLIGHT CREW

FLIGHT CREW ASSIGNMENTS

Prime Crew (Figure 14)

Commander (CDR) - J. A. McDivitt (Colonel, USAF)
Command Module Pilot (CMP) - D. R. Scott (Colonel, USAF)
Lunar Module Pilot (LMP) - R. L. Schweickart (Civilian)

Backup Crew (Fig. 15)

Commander (CDR) - C. Conrad (Commander, USN)
Command Module Pilot (CMP) - R. F. Gordon (Commander, USN)
Lunar Module Pilot (LMP) - A. L. Bean (Lieutenant Commander, USN)

PRIME CREW BIOGRAPHICAL DATA

Commander (CDR)

NAME: James A. McDivitt (Colonel, USAF)

DATE OF BIRTH: Born June 10, 1929, in Chicago, Illinois.

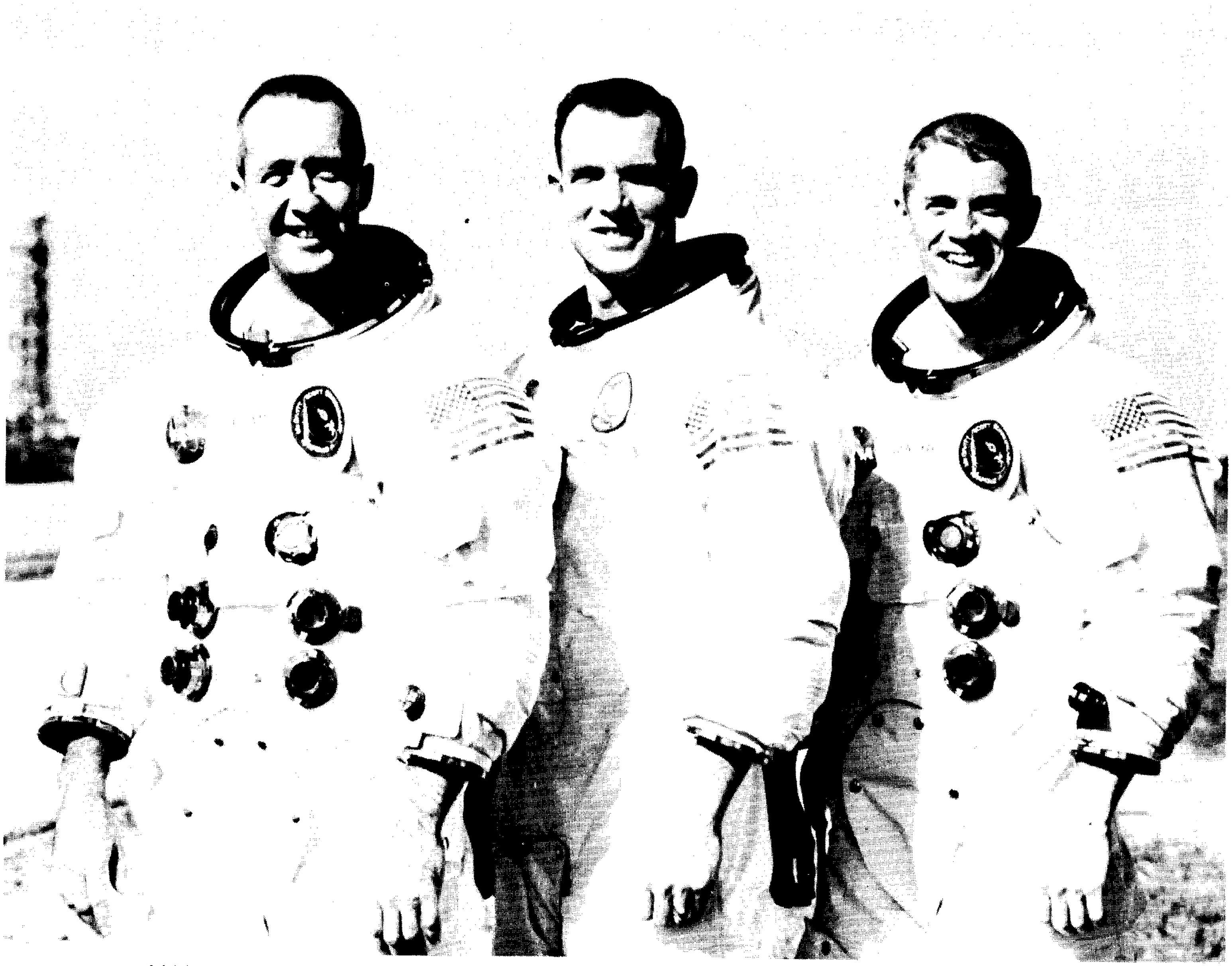
PHYSICAL DESCRIPTION: Brown hair; blue eyes; height: 5 feet, 11 inches; weight, 155 pounds.

EDUCATION: Graduated from Kalamazoo Central High School, Kalamazoo, Michigan; received a Bachelor of Science degree in Aeronautical Engineering from the University of Michigan (graduated first in class) in 1959 and an Honorary Doctorate in Astronautical Science from the University of Michigan in 1965.

ORGANIZATIONS: Member of the Society of Experimental Test Pilots, the American Institute of Aeronautics and Astronautics, Tau Beta Pi, and Phi Kappa Phi.

SPECIAL HONORS: Awarded the NASA Exceptional Service Medal and the Air Force Astronaut Wings; four Distinguished Flying Crosses; five Air Medals; the Chong Moo Medal from South Korea; the USAF Air Force Systems Command Aerospace Primus Award; the Arnold Air Society JFK Trophy; the Sword of Loyola; and the Michigan Wolverine Frontiersman Award.

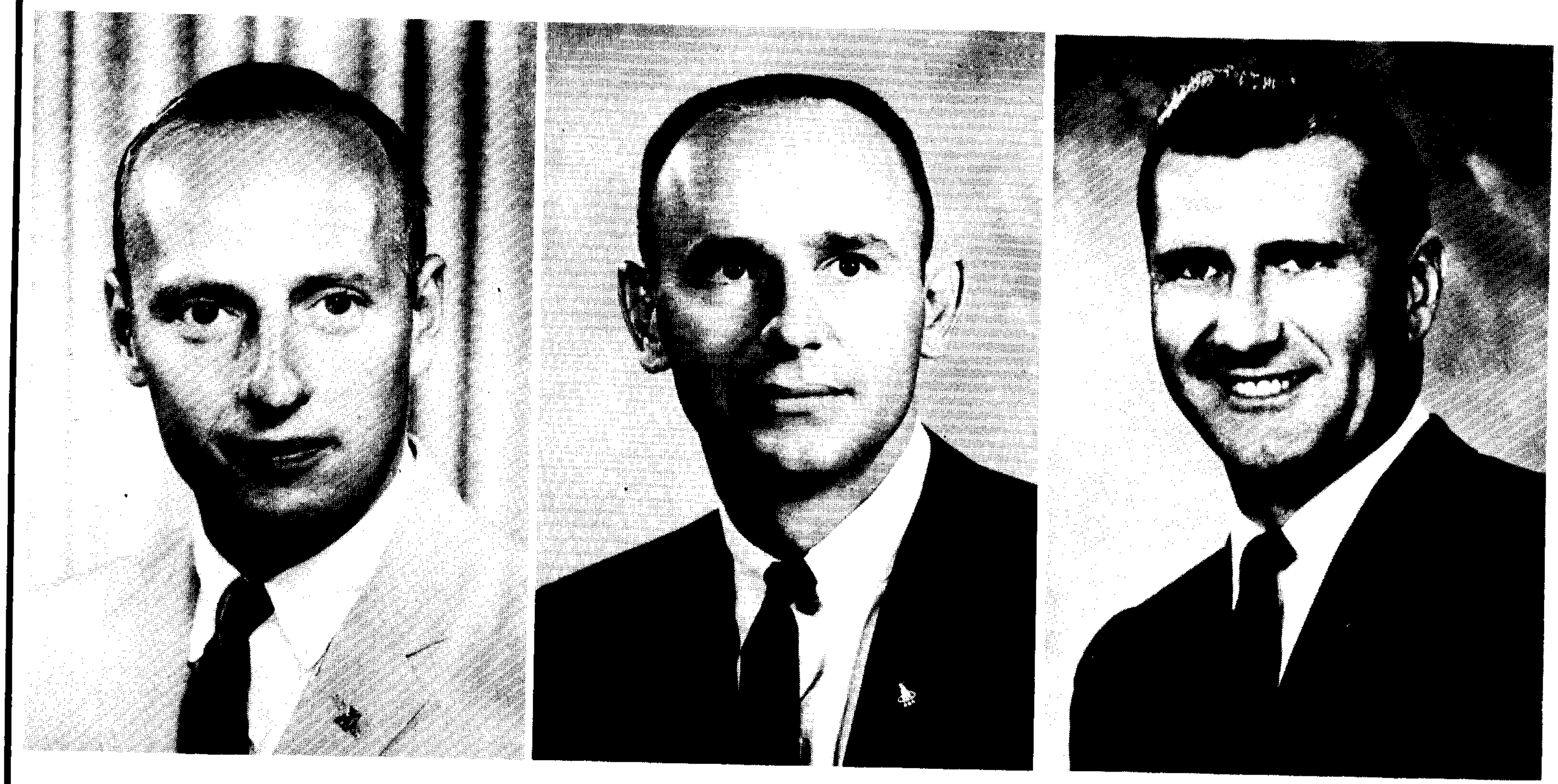
APOLLO 9 PRIME CREW



JAMES A. MC DIVITT   DAVID R. SCOTT   RUSSELL L. SCHWEICKART

Figure 21

APOLLO 9 BACKUP CREW



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

Figure 22

EXPERIENCE: McDivitt joined the Air Force in 1951 and holds the rank of Colonel. He flew 145 combat missions during the Korean War in F-80's and F-86s. He is a graduate of the USAF Experimental Test Pilot School and the USAF Aerospace Research Pilot course and served as an experimental test pilot at Edwards Air Force Base, California.

CURRENT ASSIGNMENT: Colonel McDivitt was selected as an astronaut by NASA in September 1962.

He was command pilot for Gemini 4, a 66-orbit 4-day mission that began June 3 and ended on June 7, 1965. Highlights of the mission included a controlled extravehicular activity period performed by pilot Ed White, cabin depressurization and opening of spacecraft cabin doors, and the completion of 12 scientific and medical experiments.

Command Module Pilot (CMP)

NAME: David R. Scott (Colonel, USAF)

DATE OF BIRTH: Born June 6, 1932, in San Antonio, Texas.

PHYSICAL DESCRIPTION: Blond hair; blue eyes; height: 6 feet; weight: 175 pounds.

EDUCATION: Graduated from Western High School, Washington, D.C.; received a Bachelor of Science degree from the United States Military Academy and the degrees of Master of Science in Aeronautics and Astronautics and Engineer in Aeronautics and Astronautics from the Massachusetts Institute of Technology.

ORGANIZATIONS: Associate Fellow of the American Institute of Aeronautics and Astronautics; member of the Society of Experimental Test Pilots; Tau Beta Pi; Sigma Xi; and Sigma Gamma Tau.

SPECIAL HONORS: Awarded the NASA Exceptional Service Medal, the Air Force Astronaut Wings, and the Distinguished Flying Cross; and recipient of the AIAA Astronautics Award.

EXPERIENCE: 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.

He was assigned to the 32d Tactical Fighter Squadron at Soesterberg Air Base (RNAF), Netherlands, from April 1956 to July 1960.

Upon completing this tour of duty, he returned to the United States for study at the Massachusetts Institute of Technology where he completed work on his Master's degree. 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 Pilot School.

CURRENT ASSIGNMENT: Colonel Scott was one of the third group of astronauts named by NASA in October 1963. On March 16, 1966, he and Command Pilot Neil Armstrong were launched on the Gemini 8 mission-- a flight originally scheduled to last three days but terminated early due to a malfunctioning OAMS 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.

Lunar Module Pilot (LMP)

NAME: Russel L. Schweickart (Civ.)

DATE OF BIRTH: Born October 25, 1935, in Neptune, New Jersey.

PHYSICAL DESCRIPTION: Red hair; blue eyes; height: 6 feet; weight: 161 pounds.

EDUCATION: Graduated from Manasquan High School, New Jersey; received a Bachelor of Science degree in Aeronautical Engineering and a Master of Science degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology.

ORGANIZATIONS: Member of the Sigma Xi.

EXPERIENCE: Schweickart served as a pilot in the United States Air Force and Air National Guard from 1956 to 1963.

He was research scientist at the Experimental Astronomy Laboratory at MIT, and his work there included research in upper atmospheric physics, star tracking, and stabilization of stellar images. His thesis for a Master's degree at MIT concerned stratospheric radiance.

CURRENT ASSIGNMENT: Mr. Schweickart was one of the third group of astronauts named by NASA in October 1963.

BACKUP CREW BIOGRAPHICAL DATA

Commander (CDR)

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

DATE OF BIRTH: Born on June 2, 1930, in Philadelphia, Pennsylvania.

PHYSICAL DESCRIPTION: Blond hair; blue eyes; height: 5 feet ,6 1/2 inches; weight: 138 pounds.

EDUCATION: Attended primary and secondary schools in Haverford, Pennsylvania, and New Lebanon, New York; received a Bachelor of Science degree in Aeronautical Engineering from Princeton University in 1953 and an Honorary Master of Arts degree from Princeton in 1966.

ORGANIZATIONS: Member of the American Institute of Aeronautics and Astronautics and the Society of Experimental Test Pilots.

SPECIAL HONORS: Awarded two Distinguished Flying Crosses, two NASA Exceptional Service Medals, and the Navy Astronaut Wings; recipient of Princeton's Distinguished Alumnus Award for 1965, and the American Astronautical Society Flight Achievement Award for 1966.

EXPERIENCE: 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 upon completing that course of instruction was 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.

CURRENT ASSIGNMENT: Commander Conrad was selected as an astronaut by NASA in September 1962. In August 1965, he served as Pilot on the 8-day Gemini 5 Flight. He and Command Pilot Gordon Cooper were launched on August 21 and proceeded to establish a new space endurance record of 190 hours and 56 minutes. The flight, which lasted 120 revolutions and covered a total distance of 3,312,993 statute miles, was terminated on August 29, 1965. It was also on this flight that the United States took over the lead in manhours in space.

On September 12, 1966, Conrad occupied the Command Pilot seat for the 3-day 44-revolution Gemini 11 mission. He executed orbital maneuvers to rendezvous and dock in less than one orbit with a previously launched Agena and controlled Gemini 11 through two periods of extravehicular activity performed by Pilot Richard Gordon.

Command Module Pilot (CMP)

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

DATE OF BIRTH: Born October 5, 1929, in Seattle, Washington.

PHYSICAL DESCRIPTION: Brown hair; hazel eyes; height: 5 feet 7 inches; weight: 150 pounds.

EDUCATION: Graduated from North Kitsap High School, Poulsbo, Washington; received a Bachelor of Science degree in Chemistry from the University of Washington in 1951.

ORGANIZATIONS: Member of the Society of Experimental Test Pilots.

SPECIAL HONORS: Awarded two Distinguished Flying Crosses, the NASA Exceptional Service Medal, and the Navy Astronaut Wings.

EXPERIENCE: Gordon, a Navy Commander, 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.

He served with Fighter Squadron 121 at the Miramar, California, Naval Air Station as a flight instructor in the F4H and participated in the introduction of that aircraft to the Atlantic and Pacific Fleets. Winner of the Bendix Trophy Race from Los Angeles to New York in May 1961, he established a new speed record of 869.74 miles per hour and a transcontinental speed record of 2 hours and 47 minutes.

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

CURRENT ASSIGNMENT: Commander Gordon was one of the third group of astronauts named by NASA in October 1963. He has since served as backup pilot for the Gemini 8 flight.

On Spetember 12, 1966, he served as Pilot for the 3-day 44-revolution Gemini 11 mission--on which rendezvous with an Agena was achieved in less than one orbit. He performed two periods of extravehicular activity which included attaching a tether to the Agena and retrieving a nuclear emulsion experiment package.

Lunar Module Pilot (LMP)

NAME: Alan L. Bean (Lieutenant Commander, USN)

DATE OF BIRTH: Born in Wheeler, Texas, on March 15, 1932.

PHYSICAL DESCRIPTION: Brown hair; hazel eyes; height: 5 feet, 9 1/2 inches; weight, 155 pounds.

EDUCATION: Graduated from Paschal High School in Fort Worth, Texas; received a Bachelor of Science degree in Aeronautical Engineering from the University of Texas in 1955.

ORGANIZATIONS: Member of the Society of Experimental Test Pilots and Delta Kappa Epsilon.

EXPERIENCE: Bean, a Navy ROTC student at Texas, was commissioned upon graduation in 1955. Upon completing his flight training, he was assigned to Attack Squadron 44 at the Naval Air Station in Jacksonville, Florida, for four years. He then attended the Navy Test Pilot School at Patuxent River, Maryland. Upon graduation he was assigned as a test pilot at the Naval Air Test Center, Patuxent River. He attended the school of Aviation Safety at the University of Southern California and was next assigned to Attack Squadron 172 at Cecil Field, Florida.

CURRENT ASSIGNMENT: Lt. Commander Bean was one of the third group of astronauts selected by NASA in October 1963. He served as backup Command Pilot for the Gemini 10 mission.

MISSION MANAGEMENT RESPONSIBILITY

Title	Name	Organization
Director, Apollo Program	Lt. Gen. Sam C. Phillips	NASA/OMSF
Director, Mission Operations	Maj. Gen. John D. Stevenson (Ret)	NASA/OMSF
Saturn V Vehicle Prog. Mgr.	Mr. Lee B. James	NASA/MSFC
Apollo Spacecraft Prog. Mgr.	Mr. George M. Low	NASA/MSC
Apollo Prog. Manager KSC	R. Adm. Roderick O. Middleton	NASA/KSC
Mission Director	Mr. George H. Hage	NASA/OMSF
Assistant Mission Director	Capt. Chester M. Lee (Ret)	NASA/OMSF
Assistant Mission Director	Col. Thomas H. McMullen	NASA/OMSF
Director of Launch Operations	Mr. Rocco Petrone	NASA/KSC
Director of Flight Operations	Mr. Christopher C. Kraft	NASA/MSC
Launch Operations Manager	Mr. Paul C. Donnelly	NASA/KSC
Flight Directors	Mr. Eugene F. Kranz Mr. Gerald D. Griffin Mr. M. P. Frank	NASA/MSC
Spacecraft Commander (Prime)	Col. J. A. McDivitt	NASA/MSC
Spacecraft Commander (Backup)	Cdr. C. Conrad	NASA/MSC

PROGRAM MANAGEMENT

NASA HEADQUARTERS

Office of Manned Space Flight

Manned Spacecraft Center

Marshall Space Flight Center

Kennedy Space Center

LAUNCH VEHICLE	SPACECRAFT	TRACKING AND DATA ACQUISITION
Marshall Space Flight Center The Boeing Co. (S-IC) North American Rockwell Corp. (S-II) McDonnell Douglas Corp. (S-IVB) IBM Corp. (IU)	Manned Spacecraft Center North American Rockwell (LES, CSM, SLA) Grumman Aircraft Engineering Corp. (LM)	Kennedy Space Center Goddard Space Flight Center Department of Defense MSFN

ABBREVIATIONS

AGS	Abort Guidance System
AK	Apogee Kick
APS	Ascent Propulsion System (LM)
APS	Auxiliary Propulsion System (S-IVB)
AS	Ascent Stage
ATP	Alternate Target Point
CCATS	Communications, Command, and Telemetry System
CDH	Constant Delta Height
CDR	Commander
CES	Central Electronics System
CFP	Concentric Flight Plan
CM	Command Module
CMP	Command Module Pilot
COI	Contingency Orbit Insertion
CSI	Concentric Sequence Initiation
CSM	Command Service Module
C/T	Crawler Transporter
DAP	Digital Auto Pilot
DOD	Department of Defense
DPS	Descent Propulsion System
DS	Descent Stage
DTO	Detailed Test Objectives
ECS	Environmental Control System
EDS	Emergency Detection System
EPS	Electrical Power System
EVA	Extravehicular Activity
GET	Ground Elapsed Time
G&N	Guidance and Navigation
GN&CS	Guidance, Navigation, and Control System
IMU	Inertial Measurement Unit
IU	Instrument Unit
IVT	Intervehicular Transfer
KSC	Kennedy Space Center
LC	Launch Complex
LCC	Launch Control Center
LES	Launch Escape System
LET	Launch Escape Tower
LH_2	Liquid Hydrogen
LM	Lunar Module
LMP	Lunar Module Pilot
LOR	Lunar Orbit Rendezvous

LOX	Liquid Oxygen
LRL	Lunar Receiving Laboratory
LTA	Lunar Module Test Article
LV	Launch Vehicle
MCC	Mission Control Center
MOCR	Mission Operations Control Room
MQF	Mobile Quarantine Facility
MTVC	Manual Thrust Vector Control
OMSF	Office of Manned Space Flight
PGA	Pressure Garment Assembly
PGNCS	Primary Guidance, Navigation, and Control System
PTP	Preferred Target Point
RCS	Reaction Control System
RF	Radio Frequency
RSO	Range Safety Officer
RTCC	Real Time Computer Complex
S&A	Safe and Arm
SCS	Stabilization and Control System
SEQ	Sequential System
SLA	Spacecraft LM Adapter
SM	Service Module
SPS	Service Propulsion System
SV	Space Vehicle
SXT	Sextant
TB	Time Base
TD&E	Transposition, Docking, and Ejection
TLI	Trans Lunar Injection
TPI	Terminal Phase Initiation
VAB	Vehicle Assembly Building

GPO 871-052

Post Launch
Mission Operation Report
No. M-932-69-09

MEMORANDUM

6 May 1969

To: A/Administrator

From: MA/Apollo Program Director

Subject: Apollo 9 Mission (AS-504) Post Launch Report #1

The Apollo 9 mission was successfully launched from the Kennedy Space Center on Monday, 3 March 1969 and was completed as planned, with recovery of the spacecraft and crew in the Atlantic recovery area on Thursday, 13 March 1969. Initial evaluation of the flight, based upon quick-look data and crew debriefing, indicates that all mission objectives were attained. Further detailed analysis of all data is continuing and appropriate refined results of the mission will be reported in Manned Space Flight Center technical reports.

Based on the mission performance as described in this report, I am recommending that the Apollo 9 mission be adjudged as having achieved agency preset primary objectives and be considered a success.

Sam C. Phillips
Lt. General, USAF
Apollo Program Director

APPROVAL:

George E. Mueller
Associate Administrator for
Manned Space Flight