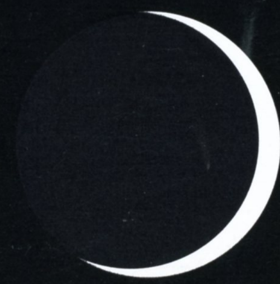
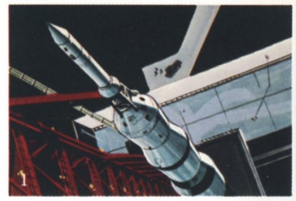
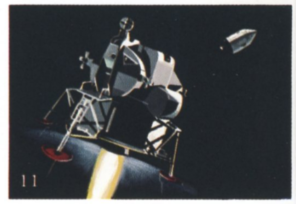


"No single space project . . . will be more exciting . . . or more important, and none will be so difficult . . . to accomplish."

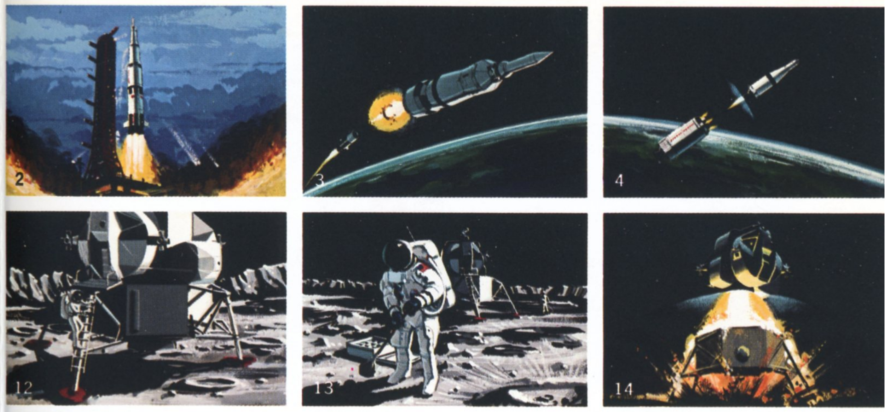
PRESIDENT JOHN F. KENNEDY, MAY 25, 1961

And so a program to land men on the moon began. First came the manned probings into space with Mercury, and later with the even more spectacular successes of Gemini. Both these spacecraft, products of what is now the McDonnell Douglas Astronautics Company, were trail-blazers for the Saturn/Apollo program to follow. Then came the early Saturn shots, each providing new information and technology. As with Mercury and Gemini, McDonnell Douglas was deeply involved in the drive for the Moon, building the upper stage S-IV for the Saturn I and Saturn IB boosters, and the S-IVB for the giant Saturn V Moon vehicle. The Saturn/Apollo list of accomplishments continued to grow with every flight, each more impressive than the last. But, like Mercury and Gemini, they were prologues. The payoff would be a specific mission . . . known as Apollo XI.





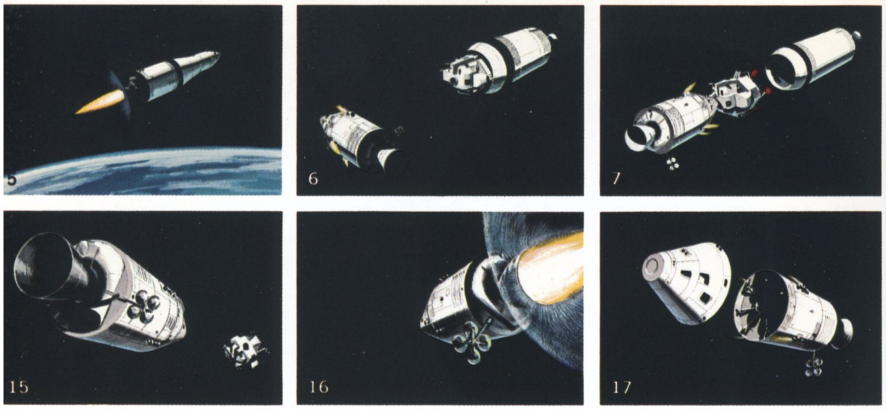
1. Apollo 11 ready for moon journey
11. LM descends and CSM stays in orbit



2. Apollo 11, all systems go . . . liftoff
12. First astronaut descends from LM

3. 2nd stage fires, 1st stage falls away
13. Astronauts collect samples

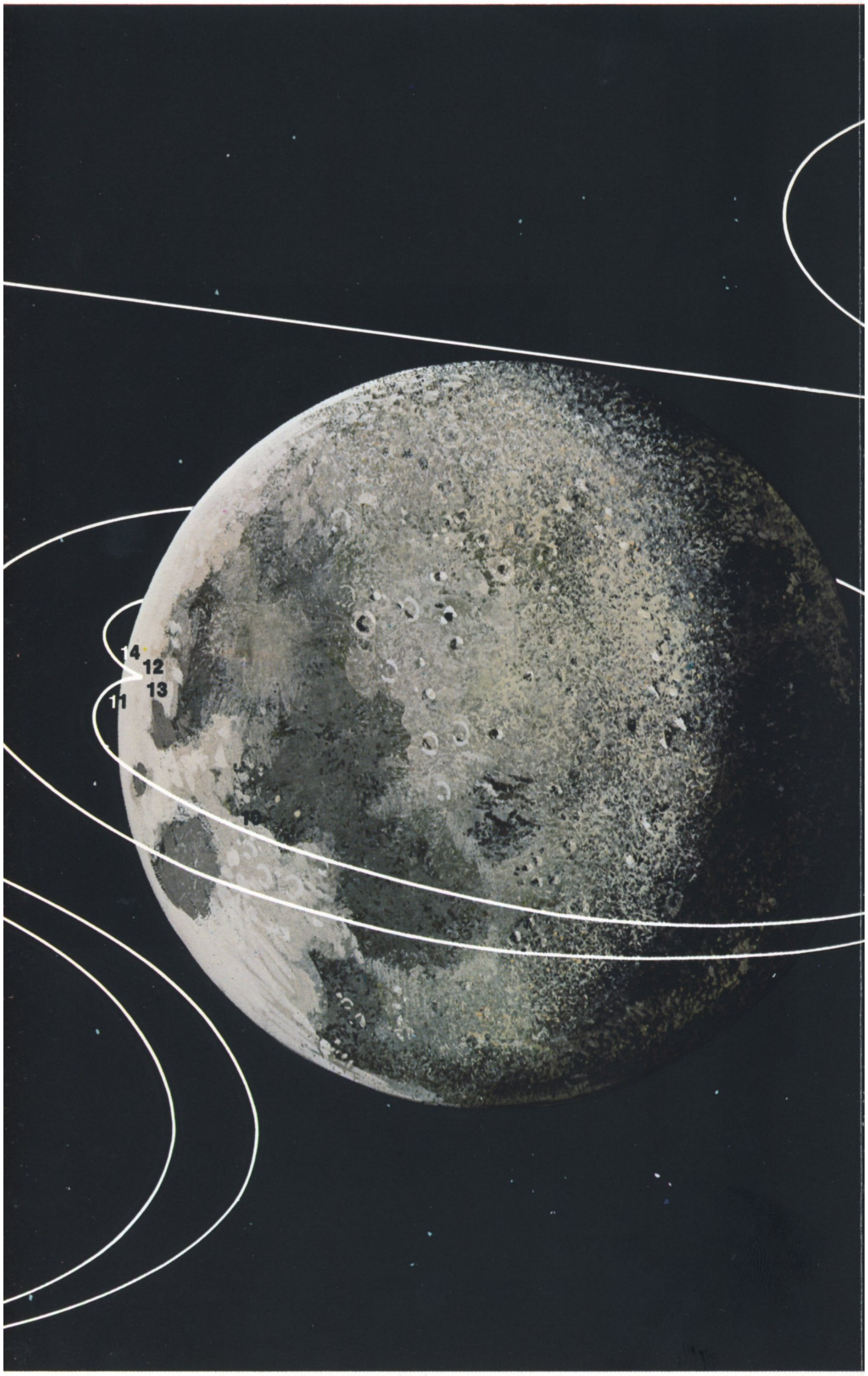
4. 3rd stage fires, 2nd stage falls away
14. Astronaut fires ascent stage to leave moon

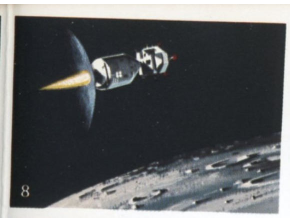
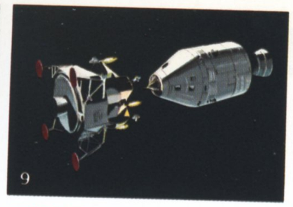
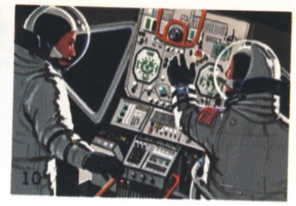
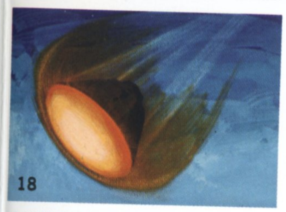
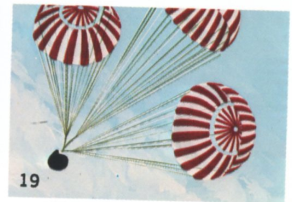
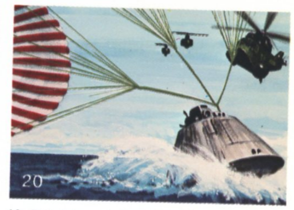


5. 3rd stage S-IVB fires for translunar injection
15. LM ascent stage; CSM in rendevous orbit

6. CSM turns around for docking with LM
16. After LM jettison CSM heads for earth

7. LM separates from S-IVB third stage
17. The CM separates from the SM

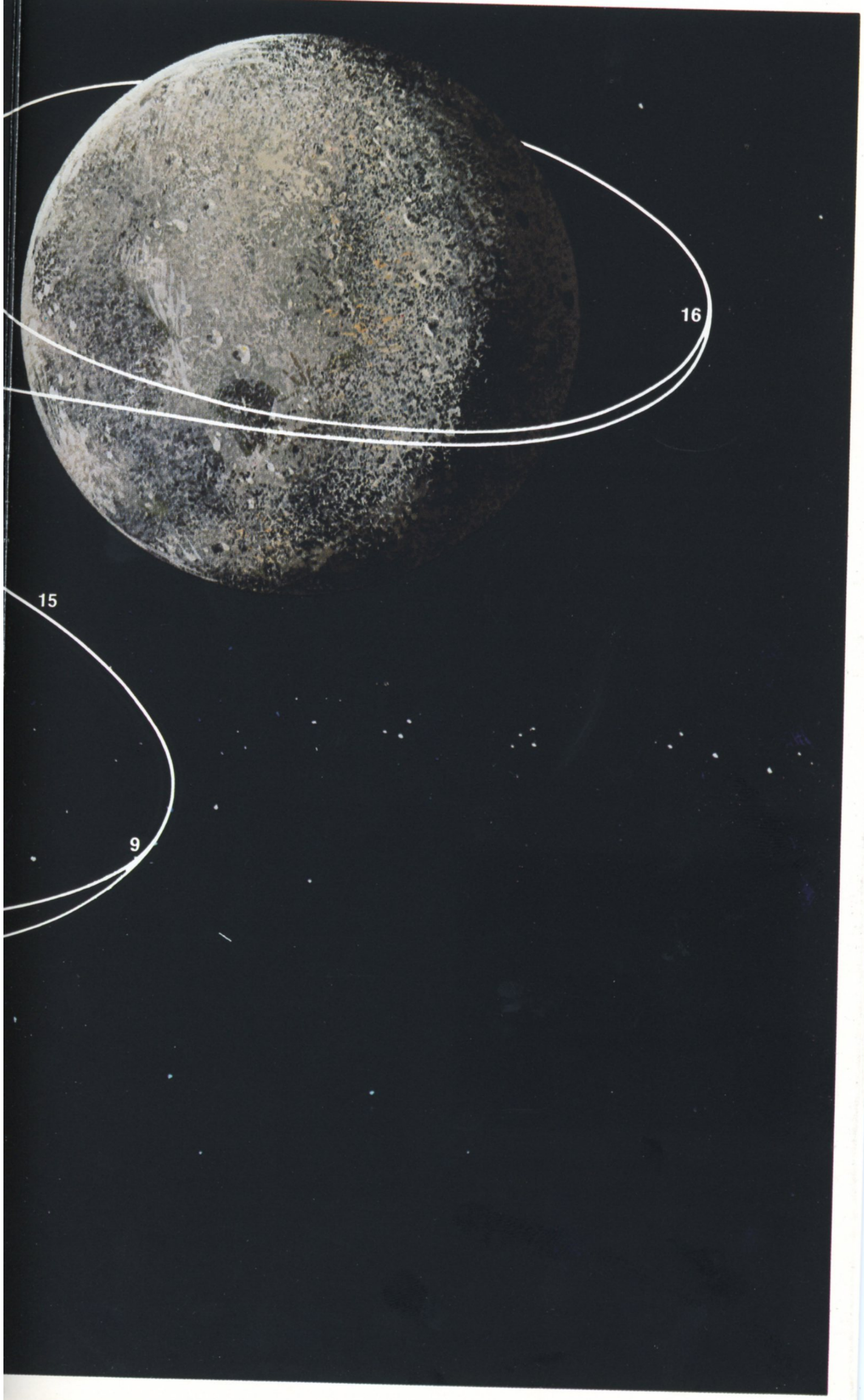


8. CSM retro fires for lunar orbit
18. The CM in the earth entry corridor

9. LM with two astronauts separates from CSM
19. All chutes out; CM heads for splashdown

10. Two astronauts in LM manuever
20. Splashdown with helicopter standing by



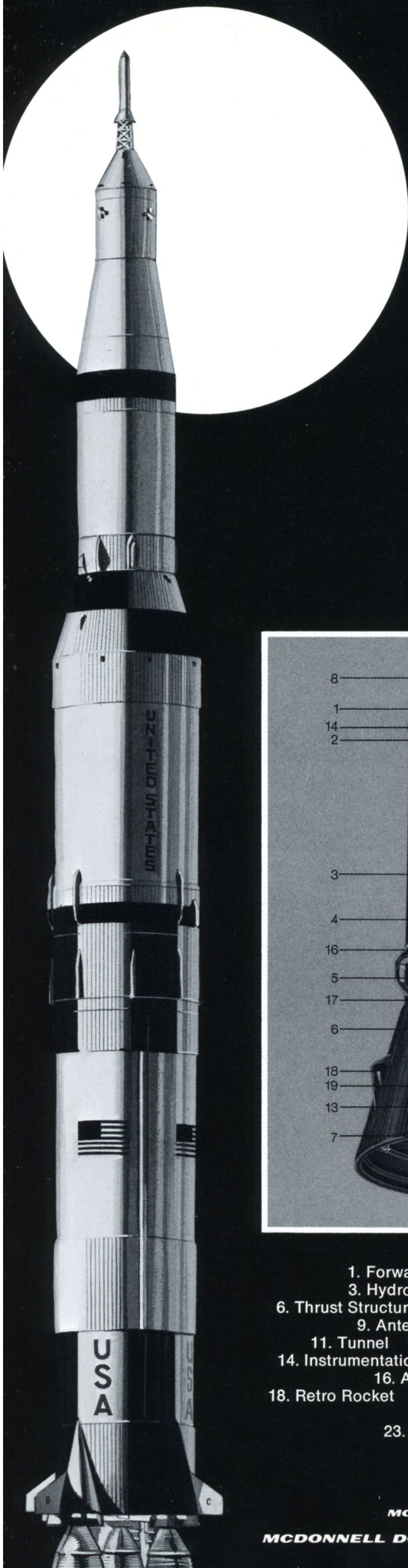
As third stage of the mighty Saturn V lunar vehicle, the S-IVB — 58 feet, 7 inches high and 21 feet, 8 inches in diameter — is powered by a 200,000-pound-thrust liquid hydrogen-liquid oxygen engine. The basic configuration is cylindrical, with an insulated common bulkhead separating the forward hydrogen tank from the oxygen tank. Propellant capacity for orbital operations is approximately 230,000 pounds. Dry weight of the stage is 34,000 pounds.

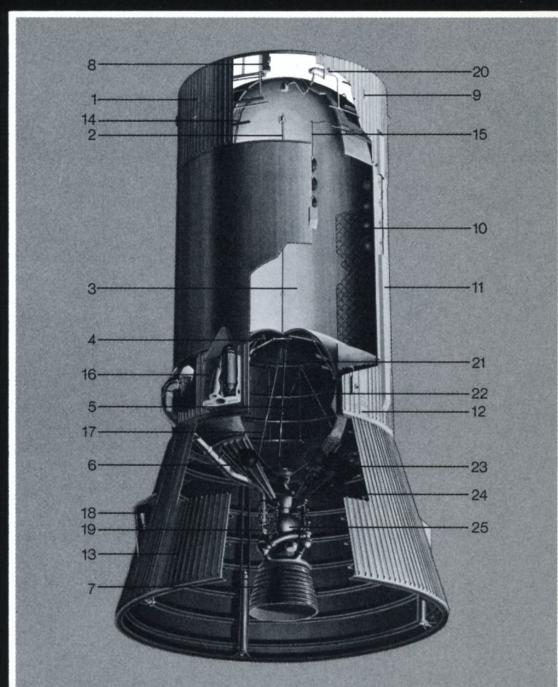
In the Saturn V lunar missions, the S-IVB performs a dual role. During launch, it provides the final, two-minute-plus thrust to place the Apollo spacecraft and its three-man crew into Earth orbit. After a coasting period, the S-IVB is refired for five minutes-plus to break free of Earth gravity and propel the Apollo and Lunar Module on their quarter-million-mile journey to the Moon. As the astronauts speed away from Earth at more than 24,600 miles per hour, the S-IVB separates from the Apollo and continues on its own trajectory past the Moon and on to an orbit around the Sun.

The S-IVB is designed and built by the McDonnell Douglas Astronautics Company (MDAC), which was created in June 1968 through the merging of the Douglas Missile & Space Systems Division and the McDonnell Astronautics Company, which produced both the Mercury and Gemini spacecraft. MDAC is a member of the McDonnell Douglas Corporation family of companies, and is headquartered in Huntington Beach, California.

The company's space beginnings date back to the 1940s. As early as 1946, engineers were looking toward the space age. In that year, a Douglas study — "Preliminary Design of an Experimental World-Circling Spaceship" — was published, a full 11 years before the first Sputnik was launched.

A leader in missilery, rocketry and spacecraft, McDonnell

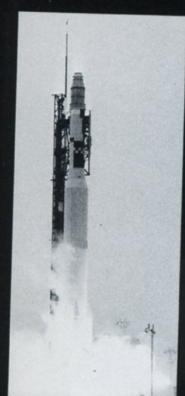




1. Forward Skirt Structure 2. P.U. Probe (Hydrogen)
3. Hydrogen Tank 4. Anti-Slosh Baffle 5. Lox Tank
6. Thrust Structure 7. J-2 Engine 8. Electrical Module Panel
9. Antenna-Range Safety 10. Cold Helium Spheres
11. Tunnel 12. Lower Umbilical Panel 13. Aft Interstage
14. Instrumentation Probe (Hydrogen) 15. Pressurization Line
16. APS Module 17. Instrumentation Probe (Lox)
18. Retro Rocket 19. Hydrogen Feed Line 20. Hydrogen Vent
21. P.U. Probe (Lox) 22. Ullage Rocket
23. Ambient Helium Spheres 24. Lox Feed Line
25. Engine Restart Sphere

MCDONNELL DOUGLAS CORPORATION
MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
5301 Bolsa Avenue, Huntington Beach, CA 92647
GC-1768 JULY 1969 PRINTED IN U.S.A.

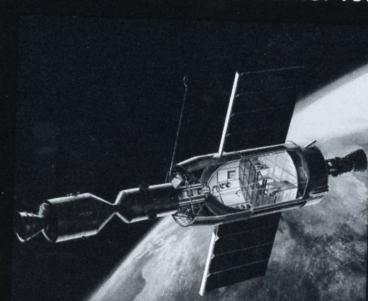
DESIGN: COLONNA, GILBERT, HATZER / DESIGN




Douglas Astronautics Company builds the famed Thor and Thor-Delta boosters. Since its first launch in 1958, the workhorse Thor has maintained a 95-plus per cent reliability rate in more than 260 launches. Delta, which served as the boost vehicle for more than half of NASA's spacecraft launches in 1968, has a record of 65 successes in 67 launches, including a string of 25 consecutive successes.

MDAC also builds the Saturn I Workshop, a modified S-IVB which will carry three astronauts on Earth-orbital missions of up to 56 days duration. Launches are planned for 1971 and 1972.

An airlock linking the workshop to an Apollo spacecraft is under development in St. Louis. It will be the nerve center for all subsystems controls and monitoring.



With more than 25,000 employes from Cape Kennedy on the Atlantic to Kwajalein Island in the Pacific, McDonnell Douglas Astronautics Company has facilities in 49 communities in 17 states, occupying more than five million square feet of floor area.

From basic research in the physical, chemical and biological nature of the universe to the design, manufacture and testing of manned and unmanned space systems, McDonnell Douglas Astronautics Company is dedicated to meeting the challenges of exploring and understanding the vast frontier beyond Earth, for the benefit of mankind.

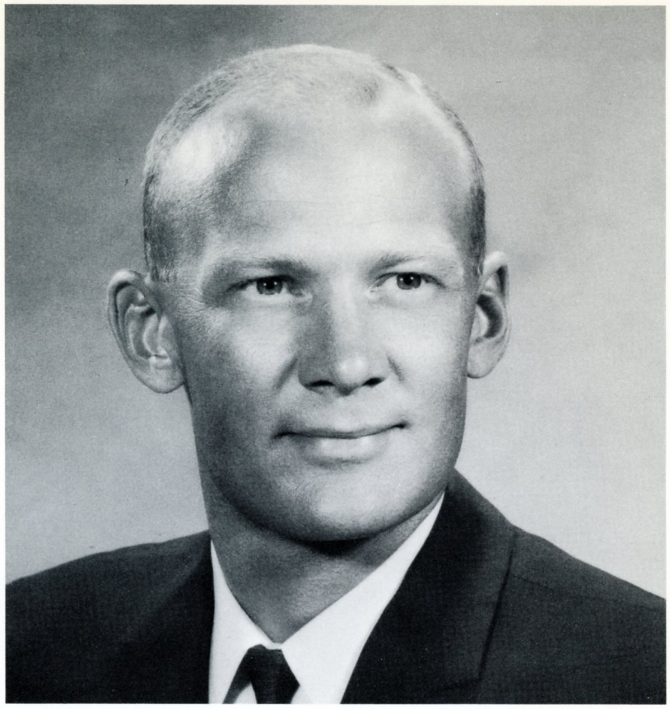
EDWIN E. ALDRIN, JR., LUNAR MODULE PILOT

MICHAEL COLLINS, COMMAND MODULE PILOT

NEIL A. ARMSTRONG, COMMANDER

ACRONYMS AND ABBREVIATIONS

MILEAGE AND SPEED CONVERTER/S-IVB FACTS



EDWIN E. ALDRIN, JR. (Colonel, USAF)

NASA Astronaut

Birthplace and Date:

Born in Montclair, New Jersey, on January 20, 1930, and is the son of the late Marion Moon Aldrin and Colonel (USAF Retired) Edwin E. Aldrin, who resides in Brielle, New Jersey.

Physical Description:

Blond hair; blue eyes; height: 5 feet 10 inches; weight: 165 pounds.

Education:

Graduated from Montclair High School, Montclair, New Jersey; received a Bachelor of Science degree from the United States Military Academy at West Point, New York, in 1951 and a Doctor of Science degree in Astronautics from the Massachusetts Institute of Technology in 1963; recipient of an Honorary Doctorate of Science degree from Gustavus Adolphus College in 1967.

Marital Status:

Married to the former Joan A. Archer of Ho-Ho-Kus, New Jersey, whose parents, Mr. and Mrs. Michael Archer, are residents of that city.

Children:

J. Michael, September 2, 1955; Janice R., August 16, 1957; Andrew J., June 17, 1958.

Other Activities:

He is a Scout Merit Badge Counsellor and an Elder and Trustee of the Webster Presbyterian Church. His hobbies include running, scuba diving, and high bar exercises.

Organizations:

Associate Fellow of the American Institute of Aeronautics and Astronautics; member of the Society of Experimental Test Pilots, Sigma Gamma Tau (aeronautical engineering society), Tau Beta Pi (national engineering society), and Sigma Xi (national science research society); and a 32 Degree Mason advanced through the Commandery and Shrine.

Special Honors:

Awarded the Distinguished Flying Cross with one oak leaf cluster, the Air Medal with two oak leaf clusters, the Air Force Commendation Medal, the NASA Exceptional Service Medal and Air Force Command Pilot Astronaut Wings, the NASA

Group Achievement Award for Rendezvous Operations Planning Team, an Honorary Life Membership in the International Association of Machinists and Aerospace Workers, and an Honorary Membership in the Aerospace Medical Association.

Experience:

Aldrin, an Air Force Colonel, was graduated third in a class of 475 from the United States Military Academy at West Point in 1951 and subsequently received his wings at Bryan, Texas, in 1952.

He flew 66 combat missions in F-86 aircraft while on duty in Korea with the 51st Fighter Interceptor Wing and was credited with destroying two MIG-15 aircraft. At Nellis Air Force Base, Nevada, he served as an aerial gunnery instructor and then attended the Squadron Officers' School at the Air University, Maxwell Air Force Base, Alabama.

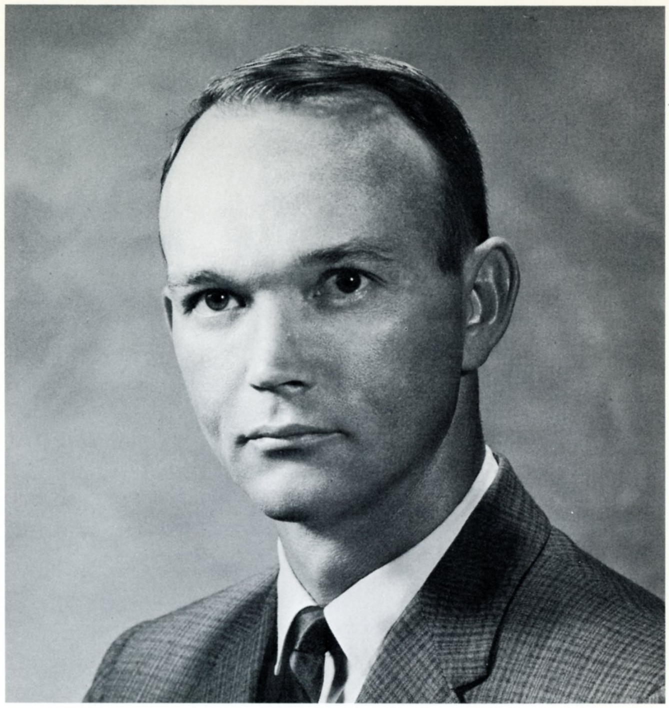
Following his assignment as Aide to the Dean of Faculty at the United States Air Force Academy, Aldrin flew F-100 aircraft as a flight commander with the 36th Tactical Fighter Wing at Bitburg, Germany. He attended MIT, receiving a doctorate after completing his thesis concerning guidance for manned orbital rendezvous, and was then assigned to the Gemini Target Office of the Air Force Space Systems Division, Los Angeles, California. He was later transferred to the USAF Field Office at the Manned Spacecraft Center which was responsible for integrating DOD experiments into the NASA Gemini flights.

He has logged approximately 3,500 hours flying time, including 2,853 hours in jet aircraft and 139 hours in helicopters. He has made several flights in the lunar landing research vehicle.

Colonel Aldrin was one of the third group of astronauts named by NASA in October 1963. He has since served as backup pilot for the Gemini 9 mission and prime pilot for the Gemini 12 mission.

On November 11, 1966, he and command pilot James Lovell were launched into space in the Gemini 12 spacecraft on a 4-day 59-revolution flight which brought the Gemini Program to a successful close. Aldrin established a new record for extravehicular activity (EVA) by accruing slightly more than 5½ hours outside the spacecraft. During the umbilical EVA, he attached a tether to the Agena; retrieved a micro-meteorite experiment package from the spacecraft; and evaluated the use of body restraints specially designed for completing work tasks outside the spacecraft. He completed numerous photographic experiments and obtained the first pictures taken from space of an eclipse of the sun.

Other major accomplishments of the 94-hour 35-minute flight included a third-revolution rendezvous with the previously launched Agena, using for the first time backup onboard computations due to a radar failure, and a fully automatic controlled reentry of a spacecraft. Gemini 12 splashed down in the Atlantic within 2½ miles of the prime recovery ship USS WASP.



MICHAEL COLLINS (Lieutenant Colonel, USAF)

NASA Astronaut

Birthplace and Date:

Born in Rome, Italy, on October 31, 1930. His mother, Mrs. James L. Collins, resides in Washington, D.C.

Physical Description:

Brown hair; brown eyes; height: 5 feet 11 inches; weight: 165 pounds.

Education:

Graduated from Saint Albans School in Washington, D.C.; received a Bachelor of Science degree from the United States Military Academy at West Point, New York, in 1952.

Marital Status:

Married to the former Patricia M. Finnegan of Boston, Massachusetts.

Children:

Kathleen, May 6, 1959; Ann S., October 31, 1961; Michael L., February 23, 1963.

Other Activities:

His hobbies include fishing and handball.

Organizations:

Member of the Society of Experimental Test Pilots.

Special Honors:

Awarded the NASA Exceptional Service Medal, the Air Force Astronaut Wings, and the Air Force Distinguished Flying Cross.

Experience:

Collins, an Air Force Lt. Colonel, chose an Air Force career following graduation from West Point.

He served as an experimental flight test officer at the Air Force Flight Test Center, Edwards Air Force Base, California, and, in that capacity, tested performance and stability and control characteristics of Air Force aircraft — primarily jet fighters.

He has logged more than 4,000 hours flying time, including more than 3,200 hours in jet aircraft.

Lt. Colonel Collins was one of the third group of astronauts named by NASA in October 1963. He has since served as backup pilot for the Gemini 7 mission.

As pilot on the 3-day 44-revolution Gemini 10 mission, launched July 18, 1966, Collins shares with command pilot John Young in the accomplishments of that record-setting flight. These accomplishments include a successful rendezvous and docking with a separately launched Agena target vehicle and, using the power of the Agena, maneuvering the Gemini spacecraft into another orbit for a rendezvous with a second, passive Agena. Collins' skillful performance in completing two periods of extravehicular activity, including his recovery of a micrometeorite detection experiment from the passive Agena, added greatly to our knowledge of manned space flight.

Gemini 10 attained an apogee of approximately 475 statute miles and traveled a distance of 1,275,091 statute miles — after which splashdown occurred in the West Atlantic 529 statute miles east of Cape Kennedy. The spacecraft landed 2.6 miles from the USS GUADALCANAL and became the second in the Gemini program to land within eye and camera range of a prime recovery vessel.

MR. NEIL A. ARMSTRONG

NASA Astronaut

Birthplace and Date:

Born in Wapakoneta, Ohio, on August 5, 1930; he is the son of Mr. and Mrs. Stephen Armstrong of Wapakoneta.

Physical Description:

Blond hair; blue eyes; height: 5 feet 11 inches; weight: 165 pounds.

Education:

Attended secondary school in Wapakoneta, Ohio; received a Bachelor of Science degree in Aeronautical Engineering from Purdue University in 1955. Graduate School — University of Southern California.

Marital Status:

Married to the former Janet Shearon of Evanston, Illinois, who is the daughter of Mrs. Louise Shearon of Pasadena, Calif.

Children:

Eric, June 30, 1957; Mark, April 8, 1963.

Other Activities:

His hobbies include soaring (for which he is an FAI gold badge holder).

Organizations:

Associate Fellow of the Society of Experimental Test Pilots; Associate Fellow of the American Institute of Aeronautics and Astronautics; and member of the Soaring Society of America.

Special Honors:

Recipient of the 1962 Institute of Aerospace Sciences Octave Chanute Award; the 1966 AIAA Astronautics Award; the NASA Exceptional Service Medal; and the 1962 John J. Montgomery Award.

Experience:

Armstrong was a naval aviator from 1949 to 1952 and flew 78 combat missions during the Korean action.

He joined NASA's Lewis Research Center in 1955 (then NACA Lewis Flight Propulsion Laboratory) and later transferred to the NASA High Speed Flight Station (now Flight Research Center) at Edwards Air Force Base, California, as an aeronautical research pilot for NACA and NASA. In this capacity, he performed as an X-15 project pilot, flying that aircraft to over 200,000 feet and approximately 4,000 miles per hour.

Other flight test work included piloting the X-1 rocket airplane, the F-100, F-101, F-102, F-104, F5D, B-47, the paraglider, and others.

As pilot of the B-29 "drop" aircraft, he participated in the launches of over 100 rocket airplane flights.

He has logged more than 4,000 hours flying time.

Mr. Armstrong was selected as an astronaut by NASA in September 1962. He served as backup command pilot for the Gemini 5 flight.

As command pilot for the Gemini 8 mission, which was launched on March 16, 1966, he performed the first successful docking of two vehicles in space. The flight, originally scheduled to last three days, was terminated early due to a malfunctioning OAMS thruster; but the crew demonstrated exceptional piloting skill in overcoming this problem and bringing the spacecraft to a safe landing.

ABBREVIATIONS AND ACRONYMS

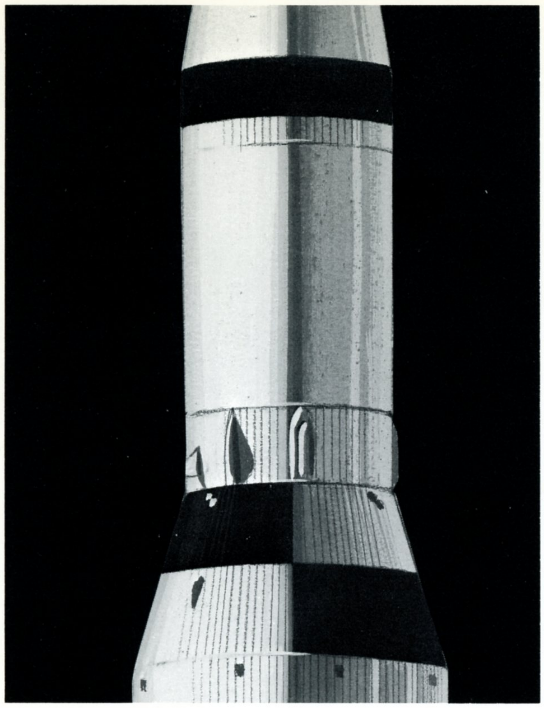
AGS	Abort Guidance System
ACCEL	Acceleration
ACE	Acceptance Checkout Equipment
ACM	Actuation Control Module
ACN	NASA MSFN Station, Ascension Island
ACS	Attitude Control and Stabilization Systems Engineer (Booster Systems)
AF	Air Force
AFB	Air Force Base
AFD	Assistant Flight Director
AFETR	Air Force Eastern Test Range
A/G COMM	Air to Ground and Ground to Air Communications
AGCU	Apollo Guidance Control Unit
ALDS	Apollo Launch Data System
Alt	Altitude
AM	Amplitude Modulation
amp	Ampere or Amplifier
AMR	Atlantic Missile Range
ANG	NASA MSFN Station, Antigua
Ant	Antenna
ANT	DOD-ETR MSFN Station, Antigua
AOA	Angle of Attack
AOS	Atlantic Ocean Ships or Acquisition of Signal
APS	Auxiliary Propulsion System (S-IVB) or Ascent Propulsion System (LM)
AS	Ascent Stage (Lunar Module) or Apollo-Saturn
ASC	DOD-ETR MSFN Station, Ascension Island
ASI	Augmented Spark Igniter
ATT	Attitude
AUTO	Automatic
BDA	NASA MSFN Station, Bermuda
BIOMED	Biomedical
BSE	Booster Systems Engineer (MSC Controller)
CAPCOM	Spacecraft Communicator
CASTS	Countdown and Status Transmission System
CCATS	Command, Communications and Telemetry System
CCS	Command Communications System
CCW	Counterclockwise
CDDT	Countdown Demonstration Test
CDF	Confined Detonating Fuse
C/D	Chilldown
CDR	Spacecraft Commander
CECO	Center Engine Cutoff
CG	Center of Gravity
CIF	Central Instrumentation Facility (Located at Kennedy Space Center)
CM	Command Module (Apollo Spacecraft)
CMC	Command Module Computer
CMD	Command
CO	Checkout
C/O	Cutoff
COFW	Certificate of Flight Worthiness
COM	Common
CSM	Command and Service Module (Apollo Spacecraft)
C-T	Crawler-Transporter (Saturn V Vehicle)
CTN	NASA MSFN Station, Canton Island
CVS	Continuous Vent System
CW	Clockwise
CYI	NASA MSFN Station, Canary Islands
DAP	Digital Auto Pilot
DCS	Digital Computer System
DDAS	Digital Data Acquisition System
DEE	Digital Event Evaluator
deg	Degree
DPS	Descent Propulsion System (Lunar Module)
DS	Descent Stage (Lunar Module)
DSKY	Display and Keyboard (Spacecraft Guidance and Control)
DTS	Data Transmission System
ΔV	Delta V (Velocity Change)
EAO	Experiment Activities Officer
EBW	Exploding Bridgewire
ECA	Electrical Control Assembly
ECC	Engine Cutoff Command
ECO	Engine Cutoff
ECS	Environmental Control System
ECU	Environmental Control Unit
EDS	Emergency Detection System
EECOM	Electrical, Environmental, and Communications Engineer
ELS	Earth Landing System
EMR	Engine Mixture Ratio
EMU	Extravehicular Mobility Unit
ENG	Engine
EPO	Earth Parking Orbit
ESC	Engine Start Command
ETR	Eastern Test Range
EVA	Extravehicular Activity
EVT	Extravehicular Transfer
F	Fahrenheit
FAO	Flight Activities Officer
FC	Flight Controller
FCO	Flight Control Office
FD	Flight Director
FET	Flight Evaluation Team
FIDO	Flight Dynamics Officer
FM	Frequency Modulation
FPR	Flight Performance Reserves
FRR	Flight Readiness Review
FTS	Flight Termination System
G	Acceleration of Gravity
GAL	Gallon(s)
GBM	NASA MSFN Station, Grand Bahama Island
GCC	Ground Control Computer
GDS	NASA MSFN Deep Space Station, Goldstone, California
GET	Ground Elapsed Time
GG	Gas Generator
GH_2	Gaseous Hydrogen
GN_2	Gaseous Nitrogen
G&N	Guidance and Navigation
GNC	Guidance, Navigation, and Control Engineer
GOX	Gaseous Oxygen
gpm	Gallons per Minute
GSE	Ground Support Equipment
GUID	Guidance
GUIDO	Guidance Officer
GWM	NASA, MSFN Station, Guam
H_2	Hydrogen
HAW	NASA MSFN Station, Hawaii
He	Helium
HOSC	Huntsville Operations Support Center (Huntsville, Alabama)
HSD	High-Speed Data

IAS	Initiation of Automatic Sequence (Launch)
ICD	Interface Control Document
ICO	Inboard Cutoff
IECO	Inboard Engine Cutoff
IGM	Iterative Guidance Mode
IOS	Indian Ocean Ships
IP	Impact Predictor (Located at Kennedy Space Center)
IU	Instrument Unit
IVT	Intravehicular Transfer
KSC	Kennedy Space Center (Coco Beach, Florida)
LCC	Launch Control Center
LES	Launch Escape System
LET	Launch Escape Tower
LH_2	Liquid Hydrogen (−423°F approx.)
LLM	Lunar Landing Mission
LM	Lunar Module
LO OR L/O	Liftoff
LOI	Lunar Orbit Insertion
LOR	Lunar Orbital Rendezvous
LOS	Loss of Signal
LOX	Liquid Oxygen (−297°F approx.)
LVDA	Launch Vehicle Data Adapter
LVDC	Launch Vehicle Data Computer
LSC	Linear Shaped Charge
LSD	Low-Speed Data
LV	Launch Vehicle
MAD	NASA MSFN Deep Space Station, Madrid, Spain
MCC	Mission Control Center (MSC)
MDC	McDonnell Douglas Corporation
MDF	Mild Detonating Fuse
MFCO	Manual Fuel Cutoff
MFV	Main Fuel Valve (Engine)
MIL	NASA MSFN Station, Merritt Island, Florida
MILA	Merritt Island Launch Area
MMH	Monomethyl Hydrazine
MOC	Mission Operations Computer
MOCR	Mission Operations Control Room (MSC)
MOV	Main Oxidizer Valve (Engine)
MR	Mixture Ratio
M/S	Main Stage
MSC	Manned Spacecraft Center (Houston, Texas)
MSFC	Marshall Space Flight Center (Huntsville, Alabama)
MSFN	Manned Space Flight Network
MSFNOC	Manned Space Flight Network Operations Center
MSS	Mobile Service Structure
MTVC	Manned Thrust Vector Control
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network
NMI	Nautical Mile
N_2O_4	Nitrogen Tetroxide
NPSH	Net Positive Suction Head
NPV	Non Propulsive Vent
OBECO	Outboard Engine Cutoff
OCO	Outboard Cutoff
OECO	Outboard Engine Cutoff
O_2	Oxygen
O_2H_2	Oxygen-Hydrogen
PCM	Pulse Code Modulation
PDFRR	Program Director's Flight Readiness Review
PDS	Propellant Dispersion System
PFR	Preflight Review
PLSS	Portable Life Support System
POI	Parking Orbit Insertion
POS	Pacific Ocean Ships or Position
POT	Potentiometer
PU	Propellant Utilization System
PUEA	Propellant Utilization Electronics Assembly
PUGS	Propellant Utilization and Gauging System
QLDS	Quick Look Data Station
R	Roll
RCS	Reaction Control System
RF	Radio Frequency
RI	Radio Interference
RIS	Range Instrumentation Ship
RNG	Range
R&QA	Reliability & Quality Assurance
RR	Rendezvous Radar
R&R	Receive and Record
RSO	Range Safety Officer
RTC	Real Time Command
RTCC	Real Time Computer Complex
S&A	Safety and Arming
SC	Spacecraft
SCS	Stabilization and Control System
SECO	Single Engine Cutoff
SEP	Separation
SIT	Systems Interface Test
SLA	Spacecraft-LM Adapter
SLV	Saturn Launch Vehicle
SM	Service Module (Apollo Spacecraft)
SPS	Service Propulsion System
SS	(Module) Switch Selector
SSR	Staff Support Room (MSC)
STDV	Start Tank Discharge Valve
T (With Subscript)	Mission Time Base
T_A	Alternate Time Base
TAN	NASA MSFN Station, Tananarive, Malagasy
TCS	Thermal Conditioning System
T&D	Transposition and Docking
TD&E	Transposition, Docking and Ejection
TEI	Transearth Injection
Teltrac	Telemetry Tracking
TEX	NASA MSFN Station, Corpus Christi, Texas
TLI	Translunar Injection
TM	Telemetry
TOI	Transfer Orbit Injection
TPF	Terminal Phase Finalization
TPI	Terminal Phase Initiation
TVC	Thrust Vector Control
UDMH	Unsymmetrical Di-Methyl Hydrozine
VAB	Vehicle Assembly Building
VHF	Very High Frequency
WTR	Western Test Range
XLUNAR	Translunar

APOLLO MILEAGE AND SPEED CONVERTER

NAUTICAL MILES	STATUTE MILES
1	1.1508
2	2.3016
3	3.4524
4	4.6032
5	5.7540
6	6.9048
7	8.0556
8	9.2064
9	10.3572
10	11.5080
15	17.2620
20	23.0160
25	28.7700
30	34.5240
35	40.2780
40	46.0320
45	51.7860
50	57.5400
55	63.2940
60	69.0480
65	74.8020
70	80.5560
75	86.3100
80	92.0640
85	97.8180
90	103.5720
95	109.3260
100	115.0800
200	230.1600
300	345.2400
400	460.3200
500	575.4000
600	690.4800
700	805.5600
800	920.6400
900	1035.7200
1000	1150.8000
2000	2301.6000
3000	3452.4000
4000	4603.2000
5000	5754.0000
6000	6904.8000
7000	8055.6000
8000	9206.4000
9000	10,357.2000
10,000	11,508.0000
20,000	23,016.0000
30,000	34,524.0000
40,000	46,032.0000
50,000	57,540.0000
60,000	69,048.0000
70,000	80,556.0000
80,000	92,064.0000
90,000	103,572.0000
100,000	115,080.0000
200,000	230,160.0000
300,000	345,240.0000
400,000	460,320.0000
500,000	575,400.0000
600,000	690,480.0000
700,000	805,560.0000
800,000	920,640.0000
900,000	1,035,720.0000
1,000,000	1,150,800.0000

FT PER SEC	STATUTE MPH
1	.6818
2	1.3636
3	2.0454
4	2.7272
5	3.4090
10	6.8180
15	10.2270
17	11.5906
20	13.6360
25	17.0450
30	20.4540
35	23.8630
40	27.2720
50	34.0900
60	40.9080
75	51.1350
85	57.9530
100	68.1800
125	85.2250
150	102.2700
175	119.3150
200	136.3600
300	204.5400
400	272.7200
500	340.9000
1000	681.8000
2000	1363.6000
3000	2045.4000
4000	2727.2000
5000	3409.0000
10,000	6818.0000
15,000	10,227.0000
20,000	13,636.0000
25,000	17,045.0000
30,000	20,454.0000
35,000	23,863.0000
40,000	27,272.0000
45,000	30,681.0000
50,000	34,090.0000



S-IVB FACT SHEET

Weight: 34,000 lb. (dry) including 7,700-lb. aft interstage 270,000 lb. (loaded)

Diameter: 21 ft. 8 in.

Height: 58 ft. 7 in.

Burn Time: 1st burn—2.33 min. (approx.)
2nd burn—5.15 min. (approx.)

Velocity: 1st burn—17,500 miles per hour at burnout (approx.)

2nd burn—24,500 miles per hour (approx. typical lunar mission escape velocity)

Altitude At Burnout: 115 miles after 1st burn and into a translunar injection on 2nd burn

MAJOR STRUCTURAL COMPONENTS

Aft Interstage THRUST STRUCTURE
COMMON BULKHEAD
Aft Skirt: PROPELLANT TANK
FORWARD SKIRT

MAJOR SYSTEMS

Propulsion: One bipropellant J-2 engine
Total Thrust: 225,000 lb. (maximum)
Propellants: LH_2—74,000 gal. (43,500 lb.)
LOX—20,000 gal. (192,000 lb.)

Hydraulic: Power for gimbaling J-2 engine

Electrical: One 56 VDC and three 28 VDC batteries, providing basic power for all electrical functions

Telemetry and Instrumentation: Two modulation subsystems, providing transmission of flight data to ground stations

Environmental Control: Provides temperature-controlled environment for components in aft skirt, aft interstage, and forward skirt

Ordnance: Provides explosive power for stage separation, retrorocket ignition, ullage rocket ignition and jettison, and range safety requirements

Flight Control: Provides stage attitude control and propellant ullage control

LUNAR MISSION EVENT SEQUENCE

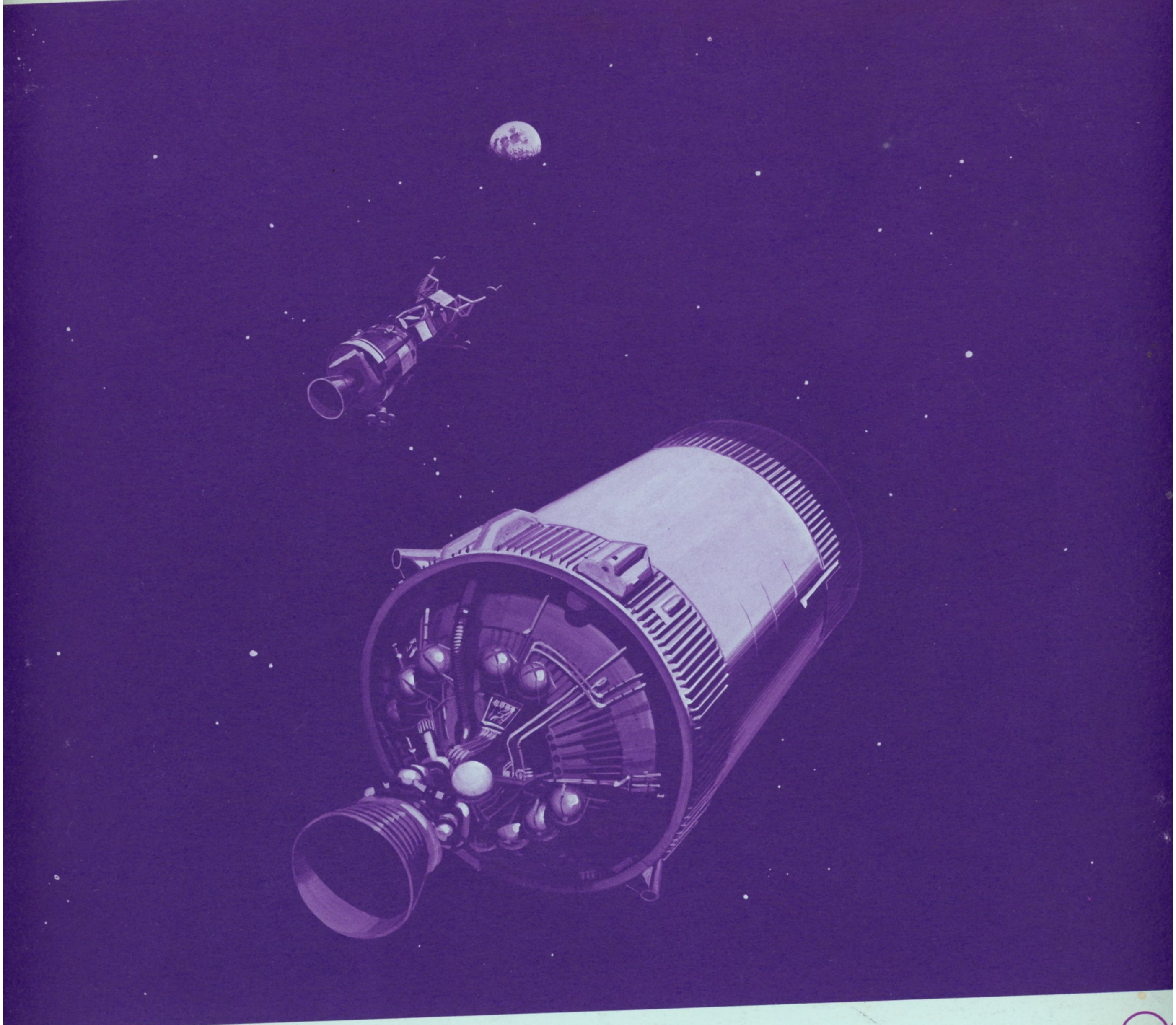
Date ______________________ Commander ______________________

Location ______________________ Command Module Pilot ______________________

Complex No. ______________________ Lunar Module Pilot ______________________

EVENT	PREDICTED MISSION TIMES FROM LIFTOFF 1ST OPPORTUNITY	2ND OPPORTUNITY	ACTUAL
Liftoff	0:00:00		________
Mach 1	0:01:05.0		________
Maximum Dynamic Pressure	0:01:20.6		________
S-IC Center Engine Cutoff	0:02:14.6		________
S-IC Outboard Engine Cutoff	0:02:40.4		________
S-IC/S-II First Plane Separation Complete	0:02:41.2		________
S-II Ignition (Start Tank Discharge Valve Opens)	0:02:41.8		________
S-II Aft Interstage Drop, Second Plane Separation	0:03:11.1		________
Escape Tower Jettison	0:03:16.8		________
S-II Center Engine Cutoff	0:07:39.4		________
S-II Outboard Engine Cutoff	0:09:11.0		________
S-II/S-IVB Separation	0:09:11.9		________
S-IVB Engine Start Sequence — First Burn	0:09:12.2		________
S-IVB Engine Mainstage Signal	0:09:15.2		________
S-IVB Cutoff, First Burn	0:11:39.5		________
S-IVB/Spacecraft Parking Orbit Insertion (POI)	0:11:49.5		________
S-IVB Continuous Hydrogen Vent Open	0:12:39.7		________
Initiate S-IVB Restart Preparations*	2:34:36.4	4:03:15.4	________
S-IVB O_2H_2 Burner (Helium Heater) On	2:35:18.4	4:03:57.4	________
S-IVB Second Burn Ignition	2:44:08.4	4:12:45.4	________
S-IVB Engine Start Sequence — Second Burn	2:50:03.4	4:18:25.5	________
Translunar Injection (TLI)	2:50:13.4	4:18:35.5	________
Initiate Maneuver to S-IVB/CSM Separation Attitude	3:05:03.4	4:33:25.5	________
CSM Separation	3:15:03	4:43:24	________
CSM Docking to S-IVB/LM	3:25:03	4:53:24	________
CSM/LM Separation from S-IVB	4:20:03	5:48:26	________
CSM/LM Evasive Maneuver, SPS Burn	4:40:03	6:08:25.5	________
Initiate Maneuver to S-IVB Slingshot Attitude	4:50:03.6	6:18:25.7	________
LOX Dump On	5:02:03.6	6:30:25.7	________
LOX Dump Off	5:03:51.6	6:32:13.7	________
APS Ullaging On	5:36:43.6	7:05:05.7	________
APS Ullaging Off	5:41:23.6	7:09:45.7	________
Midcourse Correction No. 1 (MCC1)	11:34:06.4	11:18:35.5	________
MCC2	26:44:06.4	28:18:35.5	________
MCC3	53:55:01	55:23:12	________
MCC4	70:55:01	72:23:22	________
Lunar Orbit Insertion (LOI)	75:55:01	77:23:22	________
Circularization of Lunar Parking Orbit at 60 n.mi. (SPS)	80:11:59	81:40:39	________
LM/CSM Undock	98:13:14	99:41:42	________
LM/CSM Separation	98:43:14	100:11:39	________
LM Descent Burn	99:42:26	101:10:54	________
Lunar Landing Touchdown	100:50:49	102:19:17	________
LM Staging and Ascent Burn	122:28:11	123:56:39	________
Dock with CSM	126:28:11	127:56:39	________
Final LM Jettison	128:24:26	129:52:53	________
CSM Transearth Injection (TEI)	131:28:46	132:57:13	________
MCC5	146:28:46	147:57:13	________
MCC6	180:01:07	181:29:34	________
MCC7	192:01:07	193:29:34	________
CM/SM Separation	194:46:07	196:14:34	________
Apollo Spacecraft Splashdown	195:15:04	196:43:31	________

*Times shown for on time launch July 16, 1969. First restart opportunity occurs during 2nd parking orbit revolution. 2nd opportunity one revolution later.



MCDONNELL DOUGLAS
CORPOR

MISSION TO THE MOON

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

News From McDONNELL DOUGLAS CORPORATION

DOUGLAS NEWS BUREAU Santa Monica, California 90406
(213) 399-9311, extension 2566

69-88B
PHOTO CAPTION

FOR IMMEDIATE RELEASE

NEXT STOP: THE MOON -- McDonnell Douglas S-IVB rocket generates fiery exhaust as it ignites to push Apollo 11 out of earth orbit and into a trajectory which will carry spacecraft to man's first landing on the moon. Dual role of the liquid hydrogen, liquid oxygen-powered S-IVB begins with a 2½-minute burn during earth-to-parking orbit phase, providing the final thrust to insert the rocket and Apollo 11 into a path around the earth. Several hours later, S-IVB restarts and burns for about five minutes, accelerating the Apollo 11 to a velocity of 24,200 m.p.h. for the long trip to the moon. Following shutdown of S-IVB engine, Apollo and lunar module separate from S-IVB and continue on to moon. S-IVB, its mission completed, passes moon en route to going into solar orbit. S-IVB, third stage of Saturn V launch vehicle, is built by McDonnell Douglas at Huntington Beach, California, facility of its McDonnell Douglas Astronautics Company for National Aeronautics and Space Administration's Marshall Space Flight Center

News From McDONNELL DOUGLAS CORPORATION

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FOR IMMEDIATE RELEASE

69-88

KENNEDY SPACE CENTER, Florida -- The McDonnell Douglas S-IVB stage -- "Big Moose" to the astronauts -- will have a dual role during the historic Apollo 11 mission to land man on the moon for the first time.

As third stage of the giant Saturn V launch vehicle, the S-IVB will fire twice in helping to generate the velocity necessary to propel Apollo 11 and its crew of three astronauts into orbit about the earth and then into the trajectory to the moon.

McDonnell Douglas Corporation produces the S-IVB for the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center. The company was the builder of the Mercury and Gemini spacecraft which first carried United States astronauts into space and which paved the way for the Apollo program.

Liftoff of the Saturn V is scheduled for 9:32 a.m. (E.D.T.) on July 16 from the Kennedy Space Center. At 2:17 a.m. (E.D.T.) on July 21 Commander Neil Armstrong, a civilian astronaut, is to descend from the lunar module and step onto the moon's Sea of Tranquillity.

He will be followed about 40 minutes later by Air Force Col. Edwin E. Aldrin, Jr., lunar module pilot. While Armstrong

(more)

and Aldrin explore the lunar surface, the third astronaut, Air Force Lt. Col. Michael Collins, will be orbiting the moon alone in the command module.

After Armstrong and Aldrin rejoin Collins, the three will head back for earth, with splashdown and recovery scheduled for 12:49 p.m. (E.D.T.) July 24.

As in previous manned Apollo flights, the S-IVB will ignite for the first time approximately eight minutes after liftoff of the Saturn V. The S-IVB will burn for about 2½ minutes to provide the final push to place itself and the attached Apollo 11 into parking orbit about the earth.

For the next few hours, McDonnell Douglas engineers assigned to Mission Control in Houston, Texas, will assist NASA during orbital checkout of the Apollo and of the S-IVB systems in preparation for restart of the S-IVB.

Once all systems are pronounced "go," the command to enter the next crucial phase of the moon flight will be given.

The McDonnell Douglas S-IVB will then restart and fire for about five minutes, boosting Apollo 11 from its earth orbit into a lunar trajectory at a velocity of 24,200 m.p.h.

During the next several hours, the S-IVB -- still attached to the Apollo command and service modules and to the lunar module -- will be involved in a series of vital maneuvers.

First, the Apollo will separate from the S-IVB and will turn around to dock with the lunar module, attached to the forward portion of the rocket.

At 1:42 p.m. (E.D.T.), slightly more than four hours after launch, the lunar module and Apollo will be ejected from the

S-IVB and the stage, its mission completed, then is scheduled to pass by the moon en route to going into orbit about the sun.

Apollo 11 will be the eleventh launch of an S-IVB stage. Five were as second stage of the Saturn IB launch vehicle and six, including Apollo 11, as top stage of the more powerful Saturn V.

McDonnell Douglas Astronautics Company (MDAC), a division of the St. Louis corporation, is responsible for producing the S-IVB.

Engineering, assembly and management of the program are assigned to the company's Space Systems Center in Huntington Beach. Overall direction of the program is provided by H. E. Bauer, MDAC Western Division director-assistant general manager of Saturn/Apollo and Apollo Applications Programs.

Major fabrication of Saturn parts is performed at the firm's Santa Monica facility.

S. D. Truhan is director of the MDAC Florida Test Center team which assists NASA in the pre-launch checkout and launch at Cape Kennedy.

K. J. Patelski, MDAC manager, Mission Operations, Saturn/Apollo Programs and Apollo Applications Programs, is responsible for the key group of engineers who assist NASA at the Manned Spacecraft Center's Mission Control.

The S-IVB for Apollo 11 was successfully static fired at the company's Sacramento Test Center near Sacramento, California, prior to shipment to Cape Kennedy. H. E. Felix is director of the Sacramento facility.

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News From MCDONNELL DOUGLAS CORPORATION

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MCDONNELL DOUGLAS S-IVB ROCKET
FOR NASA'S SATURN LAUNCH VEHICLE

Background Information

The powerful S-IVB rocket, produced by the McDonnell Douglas Astronautics Company, a division of McDonnell Douglas Corporation, is the top stage of both the Saturn IB and Saturn V launch vehicles.

S-IVB, 58 feet 7 inches in length and 21 feet 8 inches in diameter, is powered by a single Rocketdyne J-2 engine burning liquid hydrogen and liquid oxygen propellants and generating 225,000 pounds of thrust.

McDonnell Douglas was selected by the National Aeronautics and Space Administrations's (NASA) Marshall Space Flight Center, Huntsville, Alabama, to develop and produce the S-IVB, utilizing experience and techniques from its earlier Saturn S-IV program in designing the S-IVB systems, tooling and test equipment.

The S-IVB serves as second stage of NASA's two-stage Saturn IB, which is capable of delivering over 18 tons to earth orbit. Initially the Saturn IB was assigned the mission of launching manned Apollo spacecraft into orbit about the earth in order to check out and test the Apollo system in preparation for flights to the moon.

Launch vehicle for the manned lunar missions is the more powerful three-stage Saturn V. As third stage of the Saturn V, the S-IVB provides the final thrust to insert the Apollo spacecraft and its astronaut crew into earth orbit and then restarts and boosts the spacecraft from its parking orbit into a trans-lunar trajectory.

Saturn V is capable of placing over 125 tons into orbit around the earth and sending more than 45 tons to the vicinity of the moon.

Newest assignment for the S-IVB is as an orbital manned space workshop in NASA's Apollo Applications Program. Designated the Saturn I Workshop, the modified S-IVB will provide shelter and working space for three astronauts inside its empty 21.7-foot-diameter, 10,000-cubic foot hydrogen tank. The hydrogen fuel is depleted when the S-IVB fires to achieve earth orbit.

The Saturn I Workshop will be launched as part of a Saturn IB for rendezvous in orbit with a subsequently launched manned Apollo spacecraft. The astronauts will transfer from the Apollo to the Workshop through an airlock being built by McDonnell Douglas Astronautics in St. Louis, Missouri. During the initial workshop mission, the flight crew will live inside the stage for up to 28 days while conducting space flight experiments.

The initial S-IVB development contract was signed with NASA in August 1962, and the first S-IVB flight stage was turned over to NASA on August 31, 1965 -- just three years later.

Earlier, McDonnell Douglas had delivered two ground-test stages and had completed an extensive series of test

(more)

firings of the J-2 engine, with prototype hardware and systems, on a non-flight "battleship" stage built of heavy stainless steel in the configuration of an actual flight stage.

The full-duration acceptance test firing of the first S-IVB flight stage marked the first time that a fully automatic system was used to perform the complete checkout, propellant loading and static firing of a space vehicle.

The automatic checkout system, utilizing a general purpose computer, was developed by Douglas for the S-IVB. It performs all the complex operations of the final factory checkout on the vehicle, conducting the item-by-item countdown before testing and controlling the propellant loading and the actual firing. It then is used again in the post-firing checkout.

Similar systems installed at the Kennedy Space Center by NASA provide for automated checkout of the complete Saturn IB and Saturn V vehicles.

Basic configuration of the S-IVB is cylindrical, with an insulated common bulkhead forming a structural thermal barrier, separating the forward liquid hydrogen tank from the liquid oxygen tank. The common bulkhead design, consisting of two aluminum domes, with fiber glass honeycomb bonded to each to form a rigid "sandwich," was developed by McDonnell Douglas for the Saturn S-IV program.

Interior of the aluminum alloy tanks is milled in a "wafflelike" pattern. Insulation is installed along the interior of the liquid hydrogen tank to prevent excessive

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loss of this super-cold (boiling point about -423 degrees Fahrenheit) liquid from "boil-off."

During powered flight of the S-IVB, pitch and yaw control is accomplished by gimbaling the main engine, and roll control is maintained through the firing of the 150-pound-thrust attitude control engines of the auxiliary propulsion system (APS).

When the S-IVB is coasting in orbit, the APS engines are fired by the flight computer to provide pitch, yaw and roll stabilization.

Propellant capacity for orbital operations is over 230,000 pounds -- 64,000 gallons of liquid hydrogen and 20,000 gallons of liquid oxygen.

Significant milestones in the S-IVB program began with the highly successful first flight of the rocket on February 26, 1966, as second stage of NASA's first Saturn IB, which launched an unmanned Apollo spacecraft on a 5000-mile suborbital test.

First launch of the S-IVB as third stage of the giant Saturn V was on November 9, 1967. This successful launch marked the debut of the Saturn V and the first restart of the S-IVB propulsion system in space.

Initial manned launch for a Saturn vehicle and for the S-IVB stage occurred on October 11, 1968, when a Saturn IB lofted Apollo 7 and its crew of three astronauts into earth orbit. As its contribution to the highly successful mission, the S-IVB fired for about 7½ minutes to insert the spacecraft into its orbital path.

An even more demanding assignment for the S-IVB was the historic Apollo 8 mission which carried three astronauts on man's first lunar flight. Performing flawlessly, the S-IVB third stage fired for about two minutes during the launch on December 21, 1968, inserting Apollo 8 into earth orbit.

After a two-orbit coasting period, the S-IVB restarted and burned for more than five minutes, propelling Apollo 8 to a speed of 24,610 m.p.h. toward its rendezvous with the moon. After 10 orbits of the moon, Apollo 8 returned to earth on December 27, 1968. The depleted S-IVB ultimately went into solar orbit. The launch was the first manned mission for the Saturn V.

Another historic Saturn/Apollo mission was Apollo 10, which carried three astronauts on a 500,000-mile voyage to the moon and back. Launched by a Saturn V on May 18, 1969, the Apollo 10 returned eight days later, splashing down in the south Pacific May 26, 1969.

The Apollo 10 circled the moon 31 times at an altitude of about 69 miles. During this period the Lunar Module (LM) was separated from the command and service modules and two astronauts descended in it to within 9.4 miles of the moon's surface. Purpose of Apollo 10 flight was to demonstrate all the steps required for an actual lunar landing with the exception of touchdown and to scout possible lunar landing sites.

The S-IVB stage of the Saturn V functioned successfully during Apollo 10, igniting to push itself, the LM and the

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command and service modules into earth orbit and then restarting to propel the Apollo and LM on their way to the moon.

Major components and subassemblies of the S-IVB are fabricated at McDonnell Douglas Astronautics in Santa Monica and Huntington Beach, California. Final assembly and checkout of the vehicle are performed at the company's Space Systems Center in Huntington Beach, and ground test firings are conducted at its Sacramento Test Center near Sacramento, California.

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(7/69)

News *From* **MCDONNELL DOUGLAS CORPORATION**

DOUGLAS NEWS BUREAU *Santa Monica, California 90406*
(213) 399-9311, extension 2566

FROM MERCURY TO THE MOON -- A DECADE OF ACHIEVEMENT

The historic Apollo 11 lunar landing mission climaxes a decade during which McDonnell Douglas products have played a major role in America's manned space flight program.

The Mercury and Gemini spacecraft demonstrated man's ability to fly, live and work in a space environment up to two weeks and to rendezvous and dock with another spacecraft. And the Saturn S-IV and S-IVB stages have performed faithfully while helping to boost the Apollo astronauts into orbit and later refiring to propel them on their way to the moon.

NASA's Mercury, Gemini and Apollo advances into the unknown have encompassed many dimensions, but from the beginning, the McDonnell Douglas Corporation has contributed to their success.

Manned spaceflight in the Free World had its beginning in 1959 when NASA selected McDonnell as the prime contractor for the design, development and construction of Project Mercury spacecraft. The successful testing and orbiting of Mercury provided NASA and McDonnell with the basic knowledge on which America's manned space programs to follow were built. In Project Mercury, six manned flights were successfully completed for a total flight time of 51 hours and 40 minutes.

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Project Gemini was the second chapter in the Free World's history of space exploration. Gemini was a 20-month program that provided the building blocks for man's landing on the moon. In Project Gemini, 10 flights, each with a two-man crew, were successfully completed for a total space flight time of 969 hours and 56 minutes. Project Gemini achieved the following objectives:

- Orbital flights of up to 14 days duration.
- Rendezvous and docking in earth orbit using various rendezvous techniques.
- Development of spacecraft countdown techniques and operational procedures.
- Demonstration of controlled reentry and landing to a predetermined touchdown area.

McDonnell Douglas Corporation has made additional, substantial contributions to the United States space program with the design and production of the powerful S-IVB rocket, which serves as the top stage of both the Saturn IB and Saturn V launch vehicles used in Project Apollo. As the third stage of the Saturn V, the S-IVB provides the final thrust to insert the Apollo spacecraft and its astronaut crew into earth orbit and then restarts and speeds the spacecraft from its parking orbit toward the moon's surface. Performance of the S-IVB on all Apollo flights has been near perfect.

This wide spectrum of expertise in all phases of space research and development has strengthened the position of the United States in its long-range program of manned space exploration.

The following chronologies identify some milestones along the way:

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MERCURY

21 October 1958 - NASA announced a competition for a manned spacecraft, to be launched by an Atlas, placed in orbit around the earth and returned safely. A McDonnell study team, which had been working on manned orbital spacecraft for 11 months under company funding, was assigned to prepare the proposal.

12 January 1959 - NASA announced selection of McDonnell to build the Mercury spacecraft.

13 February 1959 - Contract was signed with McDonnell for the design and construction of 12 Mercury spacecraft. As the program expanded, subsequent orders were received for eight additional spacecraft, two procedural trainers, an environmental trainer, seven check-out trailers and much of the prelaunch operation at Cape Canaveral, including the mating of the spacecraft to the launch vehicle, check-out and countdown.

4 October 1959 - First of four Little Joe firings from Wallops Station, Virginia. Little Joe, a 48-foot high, solid fuel launch vehicle, was used in the development phase of Project Mercury to provide an early evaluation of spacecraft performance at low altitudes.

25 January 1960 - McDonnell delivered first production spacecraft (#4) less than a year after signing of contract.

2 April 1960 - First instrumented spacecraft (#1), with escape tower, delivered by McDonnell.

9 May 1960 - Spacecraft #1 fired in an off-the-pad abort escape rocket test at Wallops Station, Virginia.

29 July 1960 - Mercury-Atlas 1. Objective of the first Atlas-launched flight was to qualify the production spacecraft under maximum airloads and afterbody heating rate during re-entry conditions.

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Spacecraft (#4) carried no escape system or test subject. Test objectives were not achieved due to launch system malfunction.

21 November 1960 - Mercury-Redstone 1 was the first unmanned Redstone flight. Premature engine cutoff at launch terminated the test. The emergency escape system was jettisoned. Spacecraft (#2) was not damaged and test was rescheduled.

19 December 1960 - Mercury-Redstone 1A was a repeat of November attempt. Successful flight reached an altitude of 135 statute miles and a horizontal distance of 236 statute miles. Spacecraft (#2) was recovered.

31 January 1961 - "Ham," the 37-pound astro-chimp, was rocketed into space aboard Mercury-Redstone 2. "Ham" and spacecraft (#5) were recovered after reaching an altitude of 155 miles and landing 420 miles downrange. Flight demonstrated ability of primate to react normally in weightless flight. "Ham" was recovered safe and well.

21 February 1961 - Mercury-Atlas 2 reached an altitude of 108 miles and speed of 13,000 m.p.h. Flight checked maximum heating during worst possible re-entry conditions. Spacecraft (#6) was recovered 1425 miles downrange.

5 May 1961 - Astronaut Alan B. Shepard Jr. rode Mercury-Redstone 3 into history with his 15-minute, 22-second ballistic flight which reached an altitude of 116 statute miles and was recovered 302 miles downrange.

21 July 1961 - Mercury-Redstone 4 was a successful downrange flight lasting 15 minutes, 37 seconds by Astronaut Virgil I. "Gus" Grissom. This was the first flight with an enlarged window, greatly improving the astronaut's observation capability. Premature loss of the escape hatch caused spacecraft (#11) to take on water and sink. Grissom was recovered by helicopter.

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Corporation, would be similar in shape to the Mercury capsule but larger and two to three times heavier.

3 January 1962 - NASA announced that the two-man spacecraft would be named "Gemini", after the third constellation of the zodiac featuring the twin stars Castor and Pollux. Gemini would be used in development of the rendezvous technique and launched into orbit by a Titan II launch vehicle.

29 March 1962 - McDonnell displays Gemini mockup at St. Louis plant.

2 April 1963 - NASA announced the signing of a $456.6 million contract for Project Gemini with McDonnell. Development of the spacecraft began in December 1961 under a preliminary letter contract, which called for 13 flight-rated spacecraft, 12 to be used for space flight and one for ground testing. McDonnell would provide other services and equipment under the contract, including two mission simulator trainers, a docking simulator trainer, five boilerplate spacecraft and three "static articles" -- spacecraft for ground test evaluation in vibration and impact tests.

4 October 1963 - The first flight-rated Gemini spacecraft was delivered to Cape Canaveral to be used for the first Gemini mission. It structurally simulated weight, center of gravity and the aerodynamic form of the manned Gemini spacecraft.

13 December 1963 - McDonnell shipped the first of two Gemini mission simulators to Cape Kennedy to provide astronauts and ground crews with realistic training before launching of the manned spacecraft.

8 April 1964 - The first mission of the Gemini program was successfully conducted at Cape Kennedy, Florida. This unmanned mission used the first production Gemini spacecraft and Gemini launch vehicle. Spacecraft separation from the second stage of the GLV was not planned;

The mission contributed additional knowledge about spacecraft control and space vision.

15-16 May 1963 - Four years, four months and four days after the announcement of the selection of McDonnell to build the Mercury spacecraft, L. Gordon Cooper flew his Faith 7 spacecraft (#20) through more than 21 revolutions to a touchdown 4.4 miles from the recovery carrier U.S.S. Kearsarge. The mission began 34 hours, 19 minutes earlier, lifting off from Cape Canaveral only four minutes from the earliest possible launch time. Following a "textbook" insertion into orbit, the astronaut began a series of experiments involving eating, exercising and sleeping during weightlessness; took photographs of the earth and space; allowed his spacecraft to drift without attitude control through most of the flight without difficulty and experimented with space vision with reference to flashing lights in space and on the ground. He passed over an area of the globe which included parts of five continents and more than 100 countries, islands and possessions. Cooper manually controlled the spacecraft throughout the entire reentry and landing sequence to splash down 70 miles southeast of Midway Island in the Pacific.

12 June 1963 - NASA announced the completion of the Project Mercury program. McDonnell and NASA manned spacecraft engineers already were devoting their full energies to Project Gemini, the two-man orbital rendezvous spacecraft being designed and built as the second step in America's program of space exploration.

GEMINI

7 December 1961 - Plans for the development of a two-man spacecraft were announced by Robert R. Gilruth, director of the NASA Manned Spacecraft Center. The spacecraft, to be built by McDonnell Aircraft

Corporation, would be similar in shape to the Mercury capsule but larger and two to three times heavier.

3 January 1962 - NASA announced that the two-man spacecraft would be named "Gemini", after the third constellation of the zodiac featuring the twin stars Castor and Pollux. Gemini would be used in development of the rendezvous technique and launched into orbit by a Titan II launch vehicle.

29 March 1962 - McDonnell displays Gemini mockup at St. Louis plant.

2 April 1963 - NASA announced the signing of a $456.6 million contract for Project Gemini with McDonnell. Development of the spacecraft began in December 1961 under a preliminary letter contract, which called for 13 flight-rated spacecraft, 12 to be used for space flight and one for ground testing. McDonnell would provide other services and equipment under the contract, including two mission simulator trainers, a docking simulator trainer, five boilerplate spacecraft and three "static articles" -- spacecraft for ground test evaluation in vibration and impact tests.

4 October 1963 - The first flight-rated Gemini spacecraft was delivered to Cape Canaveral to be used for the first Gemini mission. It structurally simulated weight, center of gravity and the aerodynamic form of the manned Gemini spacecraft.

13 December 1963 - McDonnell shipped the first of two Gemini mission simulators to Cape Kennedy to provide astronauts and ground crews with realistic training before launching of the manned spacecraft.

8 April 1964 - The first mission of the Gemini program was successfully conducted at Cape Kennedy, Florida. This unmanned mission used the first production Gemini spacecraft and Gemini launch vehicle. Spacecraft separation from the second stage of the GLV was not planned;

both were inserted into orbit. The mission was concluded approximately four hours and 50 minutes after liftoff -- at the end of the third orbital pass over Cape Kennedy.

19 January 1965 - Unmanned suborbital flight, successfully tested the effect of maximum reentry heat and stress conditions on the spacecraft and its systems.

23 March 1965 - First manned flight (Gemini 3) with Virgil I. Grissom and John W. Young. This successful three-orbit flight demonstrated the operation of all major systems and the maneuverability of the spacecraft. It was the first space flight in history during which the astronauts changed both their orbital plane and the size of the orbit.

3-7 June 1965 - Gemini 4, the first mission controlled from the NASA Manned Spacecraft Center, Houston, Texas, with astronauts James A. McDivitt and Edward H. White. During this mission, White became the first astronaut to maneuver in space through the use of a hand-held maneuvering unit.

21-29 August 1965 - Gemini 5, with L. Gordon Cooper Jr. and Charles P. Conrad Jr. made an eight-day, 120-revolution mission that marked the first space flight application of electrical power produced by fuel cell.

4-18 December 1965 - Gemini 7, flown by Frank Borman and James A. Lovell made a 206-revolution flight during which their spacecraft served as a rendezvous target vehicle for Gemini 6, manned by Walter M. Schirra Jr. and Thomas P. Stafford, in the world's first spacecraft rendezvous on Wednesday, 15 December.

16 March 1966 - Gemini 8, piloted by Neil A. Armstrong and David R. Scott, rendezvoused with an Agena vehicle and performed the world's first successful docking of two orbiting spacecraft.

3-6 June 1966 - Gemini 9, flown by Thomas P. Stafford and Eugene A. Cernan, rendezvoused three times with a McDonnell Augmented Target Docking Adapter.

18-21 July 1966 - In Gemini 10, John W. Young and Michael Collins completed a dual rendezvous with two different Agena vehicles and docked with one.

12-15 September 1966 - In Gemini 11, Charles Conrad Jr. and Richard F. Gordon Jr. established an altitude record of 850 statute miles, docked and redocked with an Agena target and accomplished the first Gemini-Agena tethered flight.

11-15 November 1966 - Gemini 12, the final mission in the program, during which James A. Lovell Jr. and Edwin E. Aldrin Jr. successfully rendezvoused and docked with an Agena target.

APOLLO

July 1960 - NASA selected Douglas from among 11 competing manufacturers to build the S-IV, the second stage of the Saturn I, the first in a line of Saturn launch vehicles which would increase in power until they proved capable of landing a man on the moon. Ten S-IV stages were produced at the company's Santa Monica facility, under the direction of the newly built Space Systems Center at Huntington Beach, Calif. The S-IV was static fired at the company's Sacramento Test Center prior to delivery to Cape Kennedy.

August 1962 - Douglas signed a contract with NASA to develop the S-IVB, the upper stage of the more powerful Saturn IB, precursor to the giant Saturn V. The Saturn V moon rocket would also use the S-IVB as the top boost stage.

January 24, 1964 - The Saturn I was launched with an active S-IV second stage. In this flawless first flight, the S-IV placed a record payload of 38,000 pounds in earth orbit.

May 22, 1964 - July 30, 1965 - During the series of Saturn I launches, the S-IV vehicles were used as second stages in five space missions, including three launches which placed giant Pegasus micro-meteoroid satellites in orbit. Saturn I was the first totally successful large launch vehicle ever built.

August 31, 1965 - The first S-IVB flight stage was turned over to NASA.

February 26, 1966 - Apollo Saturn IB was launched with an S-IVB stage for the first time in an unmanned suborbital test. Command and service module subsystems were tested, and the space vehicle reentered safely.

July 25, 1966 - Saturn IB placed in earth orbit an S-IVB stage containing about 10 tons of liquid hydrogen as "payload" to test the S-IVB propulsion system in the zero gravity of space.

August 25, 1966 - Saturn IB launch tested the integrity of the entire space vehicle. The command module successfully reentered the earth's atmosphere at a speed of 28,500 feet per second.

November 9, 1967 - The Apollo 4 flight was the first to employ the Saturn V launch vehicle. This unmanned launch marked the first restart of the S-IVB propulsion system in space. Again the S-IVB performed with complete reliability and precision.

January 22, 1968 - Unmanned Apollo 5 utilized the S-IVB in an earth orbital flight to test the operation of the Apollo Lunar Module and to verify the propellant venting system of the S-IVB.

(more)

April 4, 1968 - Apollo 6, an unmanned shot, achieved partial success when the command and service module was lofted 12,000 miles from earth followed by entry at 32,800 feet per second.

October 11, 1968 - Apollo 7, the first manned launch by a Saturn IB and an S-IVB, was a complete success. The S-IVB fired exactly on schedule to propel Apollo 7 and its three astronauts into earth orbit. After 10.8 days in orbit, Apollo 7 splashed down in the Pacific. During the flight, the S-IVB also served as a rendezvous target.

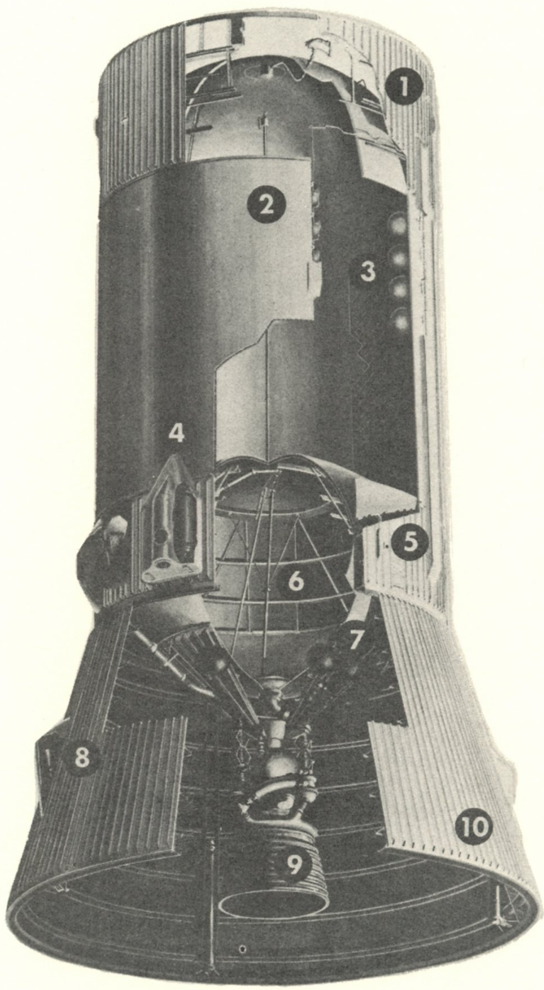
December 21, 1968 - Apollo 8 was launched as the first manned mission for a Saturn V. The historic Apollo 8 flight carried three astronauts on man's first lunar trip. The S-IVB performed flawlessly, firing for about two minutes during the launch from Cape Kennedy and inserting Apollo 8 into earth orbit. After a two-orbit coast period, the S-IVB restarted and burned for more than five minutes, propelling the spacecraft to a speed of 24,610 miles per hour toward its rendezvous with the moon. After 10 moon orbits, Apollo 8 returned safely to earth on December 27, 1968, completing a roundtrip of over 500,000 miles.

March 3, 1969 - Apollo 9 was launched into 151 earth orbits for checkout of the command and service modules and the lunar excursion module. The S-IVB continued its record of excellent performance throughout the flight.

May 18, 1969 - The historic Apollo 10 mission captured the world's imagination with a successful trip to within 50,000 feet of the moon's surface, culminating in a safe return of the three-man crew to earth. The S-IVB stage operated perfectly to place the spacecraft in earth orbit and then to boost it into the translunar trajectory.

-0-

S IVB/V



1. FORWARD SKIRT
2. LH_2 TANK
3. COLD HELIUM SPHERES
4. APS MODULE
5. AFT SKIRT
6. LOX TANK
7. AMBIENT HELIUM SPHERES
8. RETROROCKET
9. J-2 ENGINE
10. AFT INTERSTAGE

MCDONNELL DOUGLAS
CORPORATION

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

MCDONNELL DOUGLAS
CORPORATION

APOLLO 11

NASA-KSC

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

FLORIDA TEST CENTER

MCDONNELL DOUGLAS
CORPORATION

AS-506
Launch Information

Prepared by: A41 TEST PLANNING & EVALUATION

Illustrated by: A41 LOGISTICS SUPPORT PUBLICATIONS

MISSION DESCRIPTION

GENERAL

THE PRIMARY PURPOSE OF THE APOLLO 11, MISSION G IS TO LAND ASTRONAUTS ON THE LUNAR SURFACE FOR THE FIRST TIME, AND RETURN THEM SAFELY TO EARTH. THE INITIAL BURN OF THE S–IVB–506 STAGE WILL PROVIDE THE FINAL IMPULSE TO INJECT THE PAYLOAD, COMMAND SERVICE MODULE (CSM) 107 AND LUNAR MODULE (LM) 5 INTO EARTH PARKING ORBIT. OVER THE PACIFIC OCEAN DURING THE SECOND REVOLUTION, THE S–IVB STAGE WILL RE–IGNITE AND INJECT THE CSM/LM INTO A TRANSLUNAR TRAJECTORY. AFTER PAYLOAD SEPARATION , THE S–IVB STAGE WILL BE "SAFED", AND THE RESULTING IMPULSE WILL BE DIRECTED TO SLOW THE STAGE AND CAUSE IT TO PASS BEHIND THE MOON. THE EFFECT OF LUNAR GRAVITY WILL PROPEL THE STAGE INTO SOLAR ORBIT VIA A "SLINGSHOT" TRAJECTORY.

THE CSM/LM WILL BRAKE INTO LUNAR ORBIT, AND THE LM WILL SEPARATE FROM THE CSM AND LAND ON THE LUNAR SURFACE. AFTER A PERIOD OF CHECKOUT AND LUNAR EXPLORATION, THE LM WILL ASCEND, RENDEZVOUS AND DOCK TO THE CSM. THE LM WILL THEN BE JETTISONED AND THE CSM WILL RETURN THE ASTRONAUTS TO EARTH. A PROFILE OF THE MISSION IS SHOWN ON PAGE 23.

LAUNCH WINDOW

THREE DAYS IN EACH OF THE MONTHS OF JULY, AUGUST, AND SEPTEMBER ARE COMPATIBLE WITH MISSION G LAUNCH. FOR SOME OF THESE DAYS AN SPS BURN WILL BE REQUIRED SHORTLY AFTER LM EJECTION FROM THE LAUNCH VEHICLE TO PLACE THE CSM/LM IN A "HYBRID" TRAJECTORY FOR SUBSEQUENT LUNAR INSERTION. A SUMMARY OF LAUNCH WINDOWS AND TYPE OF TRAJECTORY IS SHOWN ON PAGE 24.

LAUNCH PHASE

THE AS–506 SPACE VEHICLE WILL BE LAUNCHED FROM LAUNCH COMPLEX 39A ON AN AZIMUTH OF 90 DEGREES AND WILL ROLL TO A FLIGHT AZIMUTH WHICH IS VARIABLE BETWEEN 72 DEGREES AT THE OPENING OF EACH LAUNCH WINDOW AND 108 DEGREES AT THE CLOSING. THE S–IVB/IU/LM/CSM WILL BE INSERTED INTO A 108 NM CIRCULAR PARKING ORBIT AT APPROXIMATELY 11:32 GROUND ELAPSED TIME (GET) BY NEAR DEPLETION BURNS OF THE S–IC AND S–II STAGES AND AN APPROXIMATE 162 SECOND S–IVB STAGE BURN.

PARKING ORBIT PHASE

FOLLOWING INSERTION, THE S–IVB WILL MAINTAIN CUTOFF ATTITUDE FOR 20 SECONDS, MANEUVER TO LOCAL HORIZONTAL WITH POSITION 1 DOWN AND ESTABLISH AN ORBITAL PITCH RATE. ANY ATTITUDE MANEUVERS WILL BE CONTROLLED MANUALLY BY THE ASTRONAUTS. THE LAUNCH VEHICLE WILL BE RECONFIGURED FOR THE PARKING ORBIT PHASE AND THE LH_2 CONTINUOUS VENT VALVE WILL BE OPENED TO PROVIDE A SMALL CONTINUOUS ACCELLERATION FOR PROPELLANT CONTROL.

THE LAUNCH VEHICLE WILL CONTINUE TO COAST IN PARKING ORBIT WHILE LAUNCH VEHICLE AND SPACECRAFT SYSTEMS READINESS FOR TRANSLUNAR INJECTION (TLI) IS VERIFIED. THE FIRST OPPORTUNITY FOR TLI WILL OCCUR DURING THE SECOND REVOLUTION, AND THE SECOND OPPORTUNITY FOR TLI WILL OCCUR DURING THE THIRD REVOLUTION.

SECOND BURN

THE PRE–IGNITION SEQUENCE WILL BEGIN 570 SECONDS PRIOR TO THE ENGINE START COMMAND WHEN THE RESTART EQUATION IS SOLVED BY THE ONBOARD COMPUTER. IN A LOCAL HORIZONTAL ATTITUDE, THE LH_2 CONTINUOUS VENT WILL BE CLOSED, WITH AXIAL ACCELLERATION PROVIDED BY THE H_2–O_2 BURNER. COLD HELIUM WILL BE EXPANDED WITHIN THE BURNER TO EFFECT PROPELLANT TANK RE–PRESSURIZATION. PROPELLANT CIRCULATION WILL BE INITIATED TO CHILL THE ENGINE, AND THE ULLAGE ENGINE WILL BE IGNITED PRIOR TO MAIN ENGINE IGNITION. ENGINE CUTOFF WILL BE COMMANDED WHEN THE VEHICLE ATTAINS TLI VELOCITY. SECOND BURN DURATION (APPROXIMATELY 349 SECONDS) IS A FUNCTION OF LAUNCH DATE AND TIME.

TRANSLUNAR COAST

AFTER CUTOFF, BOTH S–IVB STAGE PROPELLANT TANKS WILL BE VENTED TO SAFE LEVELS AND THE VEHICLE WILL MANEUVER TO AND MAINTAIN A LOCAL HORIZONTAL ATTITUDE. BY CUTOFF PLUS 15 MINUTES ALL VENTING WILL HAVE BEEN TERMINATED AND THE VEHICLE WILL MANEUVER TO AN INERTIAL HOLD TO PERMIT CSM SEPARATION, DOCKING, AND LM EJECTION. AFTER THE CSM/LM HAS ATTAINED SUFFICIENT SEPARATION FROM THE S–IVB/IU, THE CREW WILL GIVE A "GO" FOR THE SLINGSHOT SEQUENCE, WHICH WILL BE INITIATED APPROXIMATELY 2 HOURS AFTER S–IVB SECOND CUTOFF.

THIS SEQUENCE WILL PROVIDE IMPULSE TO SLOW THE S–IVB STAGE AND PERMIT THE MOON TO PASS IN FRONT OF IT. THIS IMPULSE WILL BE PROVIDED BY THE LH_2 CONTINUOUS VENTS, LOX RESIDUAL DUMP THROUGH THE J–2 ENGINE, AND BY BURNING OF THE APS ULLAGE ENGINES. AFTER THE LOX DUMP, LOX AND LH_2 TANK NON–PROPULSIVE VENTS (NPV) ARE PERMANENTLY OPENED, AND THE HELIUM SPHERES ARE VENTED THROUGH THE NPV'S TO COMPLETELY SAFE THE VEHICLE. AS THE S–IVB APPROACHES THE TRAILING EDGE OF THE MOON, THE MOON'S MASS WILL ACCELLERATE THE STAGE AND "SLING" IT AROUND BEHIND THE MOON AND INTO SOLAR ORBIT.

SPACECRAFT MISSION

FOR THOSE LAUNCH DAYS REQUIRING A "HYBRID" TRAJECTORY AN SPS BURN WILL BE REQUIRED SHORTLY AFTER LM/CSM EJECTION FROM THE LAUNCH VEHICLE, TO TARGET THE TRAJECTORY FOR A PERICYNTHOIN (LUNAR PERIGEE) OF 60 NM. DURING THE 3–DAY TRANSLUNAR COAST, FOUR MIDCOURSE CORRECTIONS (MCC) ARE SCHEDULED AND WILL BE ACCOMPLISHED AS REQUIRED. AT APPROXIMATELY 76 HOURS GET, AN APPROXIMATE 380 SECOND LUNAR ORBIT INSERTION (LOI) SPS BURN WILL PLACE THE CSM/LM IN A 60 BY 170 NM ORBIT. IF LOI IS NOT ATTEMPTED, THE CSM/LM WILL RETURN TO EARTH ON A FREE RETURN TRAJECTORY; HOWEVER, FOR HYBRID TRAJECTORIES, A BURN IS REQUIRED AFTER PERICYNTHION FOR EARTH RETURN.

AFTER COMPLETION OF 2 LUNAR REVOLUTIONS, A 15 SECOND SPS BURN WILL CIRCULARIZE THE ORBIT AT 60 NM. DURING THE NINTH REVOLUTION IN THIS ORBIT THE LM WILL SEPARATE FROM THE CSM, BRAKE INTO THE LANDING TRAJECTORY, APPROACH THE LANDING SITE AND PERFORM THE LANDING. AFTER THE LANDING, THE LM WILL BE CHECKED TO ASSESS ITS LAUNCH CAPABILITY AND WILL THEN BE DEPRESSURIZED TO PERMIT EGRESS. EXTRAVEHICULAR ACTIVITY (EVA) WILL BE CONDUCTED WITHIN A 300 FOOT RADIUS OF THE LM AND WILL LAST APPROXIMATELY 2.5 HOURS. AFTER EVA AND A REST PERIOD, THE ASTRONAUTS WILL PREPARE FOR LUNAR ASCENT. PRIORITY FOR SURFACE ACTIVITY IS:

1. PHOTOGRAPHY THROUGH LM WINDOW.
2. CONTENGENCY LUNAR SAMPLE COLLECTION.
3. ASTRONAUT LIMITATION AND CAPABILITY ASSESSMENT.
4. LM INSPECTION
5. BULK LUNAR SAMPLE COLLECTION.
6. EXPERIMENT DEPLOYMENT
7. DOCUMENTED LUNAR SOIL SAMPLE COLLECTION.

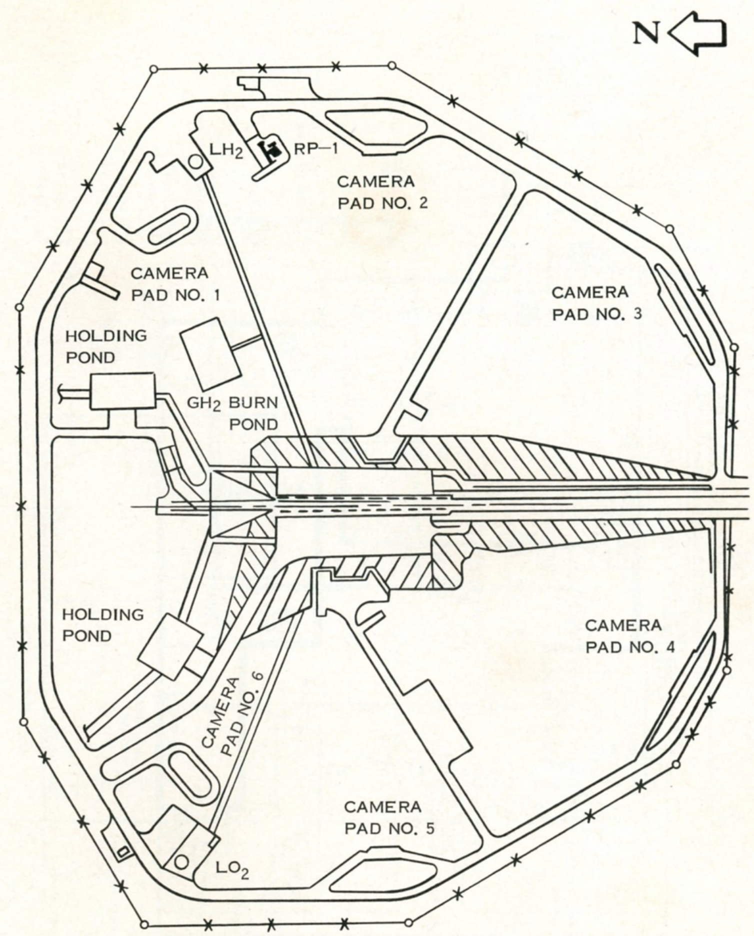
APPROXIMATELY 2.5 HOURS PRIOR TO LM ASCENT, THE CSM WILL MAKE AN ORBITAL PLANE CHANGE TO PREPARE FOR A COPLANER RENDEZVOUS. AT APPROXIMATELY 122.5 HOURS GET THE LM ASCENT STAGE WILL LIFT FROM THE LUNAR SURFACE AND ACHIEVE A 9 BY 45 NM ORBIT FROM WHICH IT WILL RENDEZVOUS AND DOCK WITH THE CSM. AFTER THE ASTRONAUTS RE–ENTER THE [redacted] CSM AND JETTISON THE LM, A 133 SECOND SPS BURN AT APPROXIMATELY 131.5 HOURS GET WILL EFFECT TRANSEARTH INJECTION (TEI).

DURING THE 64 HOUR TRANSEARTH COAST, THREE MIDCOURSE CORRECTIONS ARE SCHEDULED AND WILL BE ACCOMPLISHED AS REQUIRED. THE COMMAND MODULE WILL SEPARATE FROM THE SERVICE MODULE 15 MINUTES PRIOR TO RE–ENTRY WITH SPLASH–DOWN IN THE PACIFIC OCEAN SCHEDULED TO OCCUR APPROXIMATELY 195 HOURS AFTER LIFTOFF.

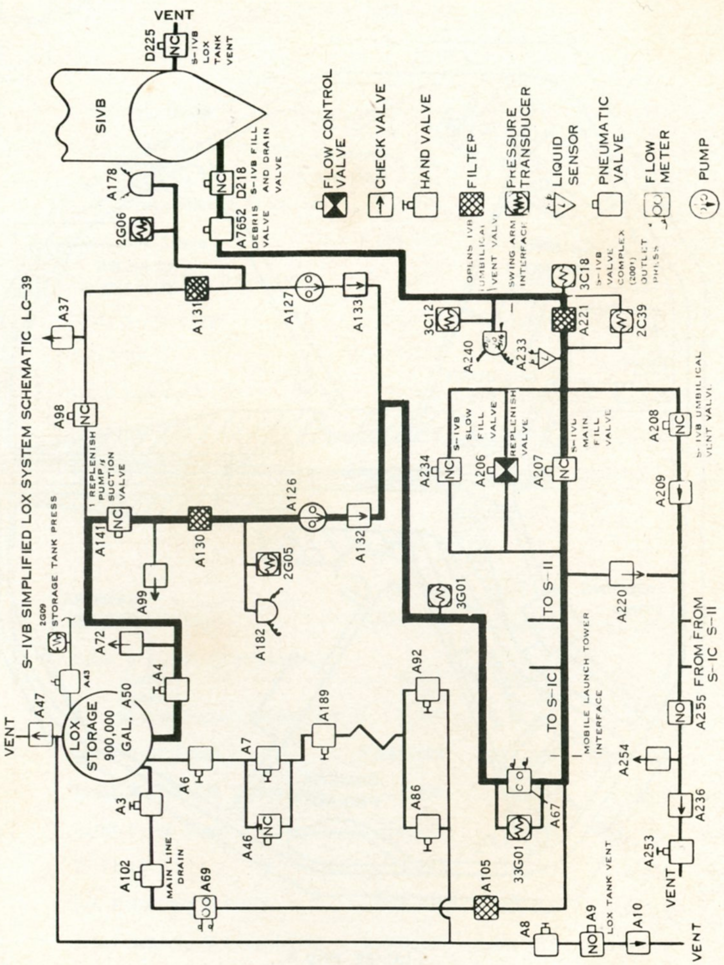
SATURN V
VEHICLE MASS COMPARISON (LBS)

	501	502	503
Total SIC Stage	4,702,022	4,690,295	4,795,423
Total SIC/SII Interstage			
(Large)	10,650	16,751	9,800
(Small)	1,476	1,476	1,450
Ullage Rocket Propellant	2,720	2,720	1,360
Total SII Stage	1,035,852	1,033,497	1,038,312
Total SII/S-IVB Interstage	7,627	7,660	8,735
Total S-IVB Stage	262,659	263,864	264,015
Total IU	4,750	4,763	4,880
S/C @ Booster Liftoff	93,600	93,660	96,575
Total Vehicle @ Ground Ign.	6,220,704	6,108,687	6,220,550
Total Vehicle @ Ground L/O	6,121,356	6,208,949	6,134,666

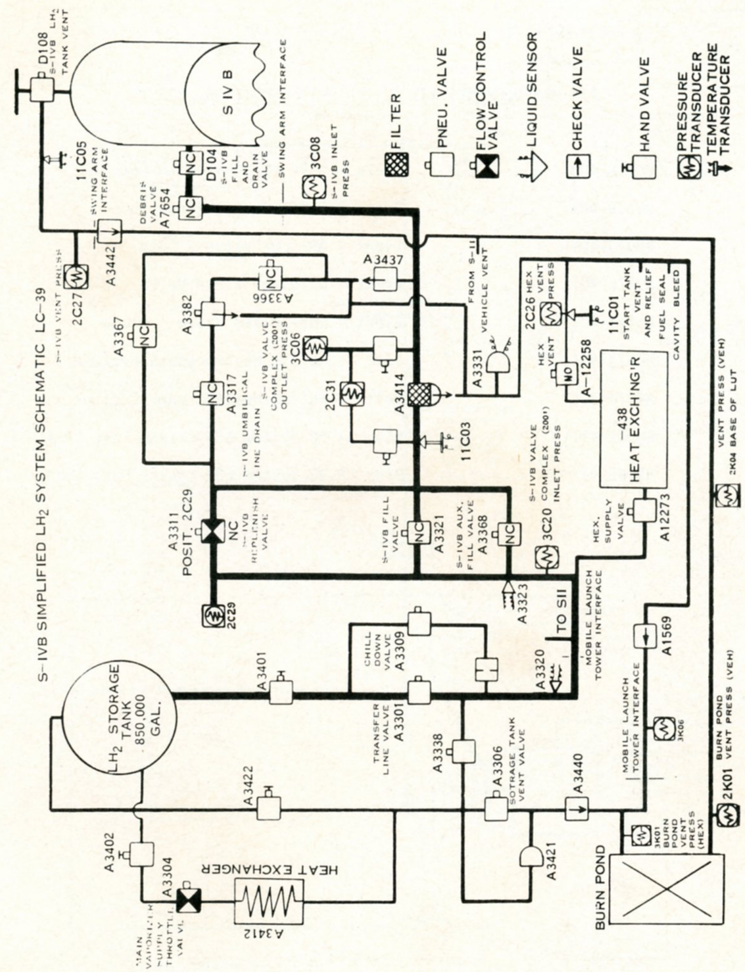
	504	505	506
Total S-IC Stage	5,031,533	5,031,023	5,037,487
Total S-IC/SII Interstage			
(Large)	8,952	8,890	8,750
(Small)	1,353	1,350	1,353
Ullage Rocket Propellant	1,360	1,360	1,360
Total S-II Stage	1,064,629	1,068,694	1,060,897
Total S-II/S-IVB Interstage	7,996	8,046	8,035
Total S-IVB Stage	259,178	262,014	262,062
Total IU	4,295	4,269	4,306
S/C @ Booster Liftoff	103,834	107,433	109,749
Total Vehicle @ Ground Ign.	6,483,130	6,492,016	6,493,999
Total Vehicle @ Ground L/O	6,396,863	6,405,918	6,408,237



LC–39 PAD A



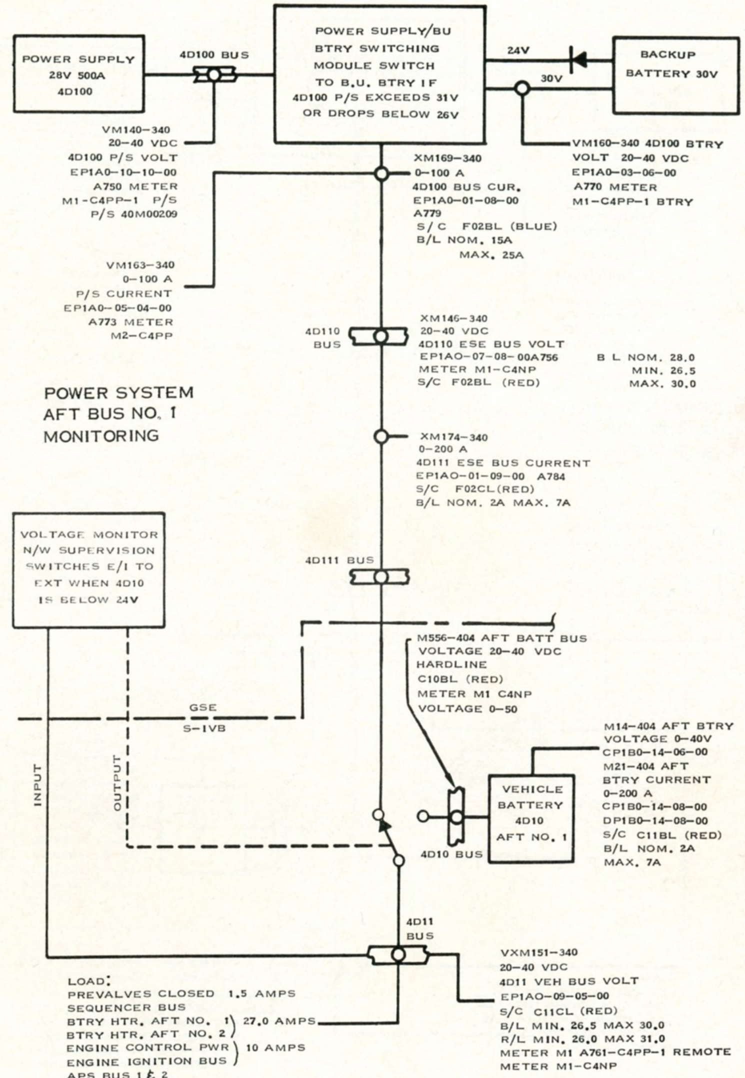
PAD 39A LOX LOADING FACILITY



PAD 39A LH_2 LOADING FACILITY

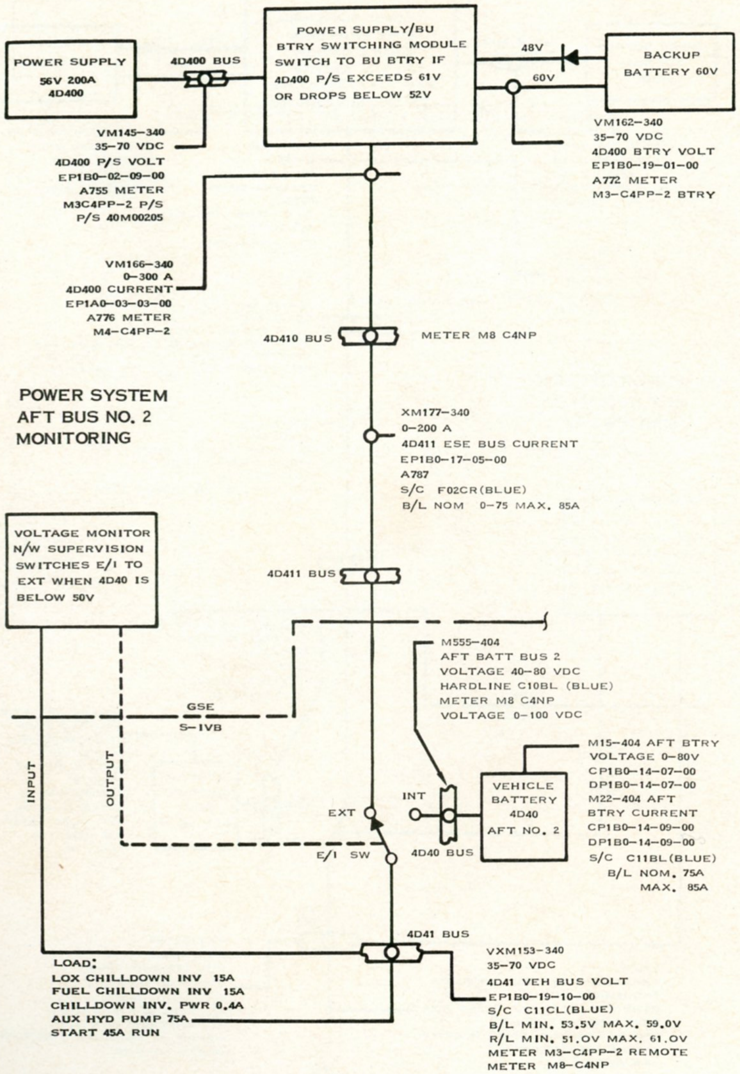
T/M MEASUREMENTS NOT ACTIVE UNTIL UMBILICAL EJECT

D0218-403	Press - Diff LH2 Chilldown Pump
D0219-403	Press - Diff LOX Chilldown Pump
K0020-401	Event - ASI LOX Valve - Open
K0126-401	Event - Oxidizer Bleed Valve - Close
K0127-401	Event - Fuel Bleed Valve - Close
M0073-404	Volt - Helium Heater Spark Exciter 2
M0074-404	Volt - Helium Heater Spark Exciter 1
N0001-411	Misc - PU System LH2 Coarse Mass Volt
N0003-411	Misc - PU System LOX Coarse Mass Volt

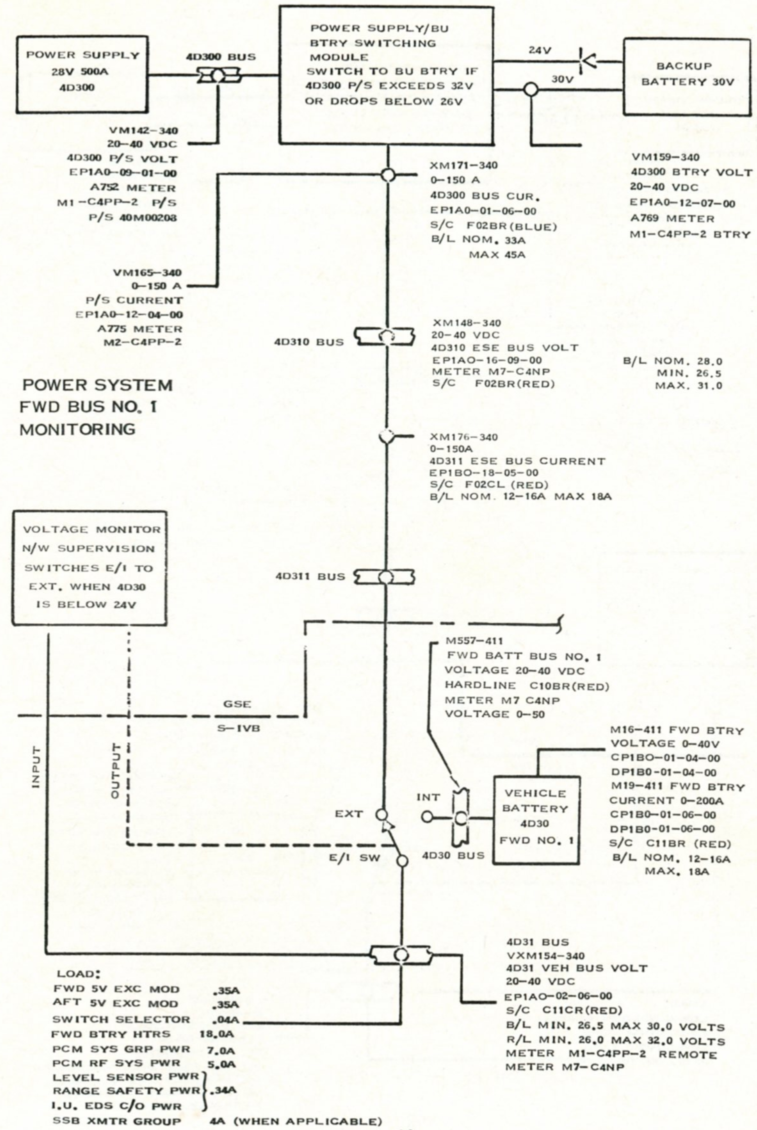


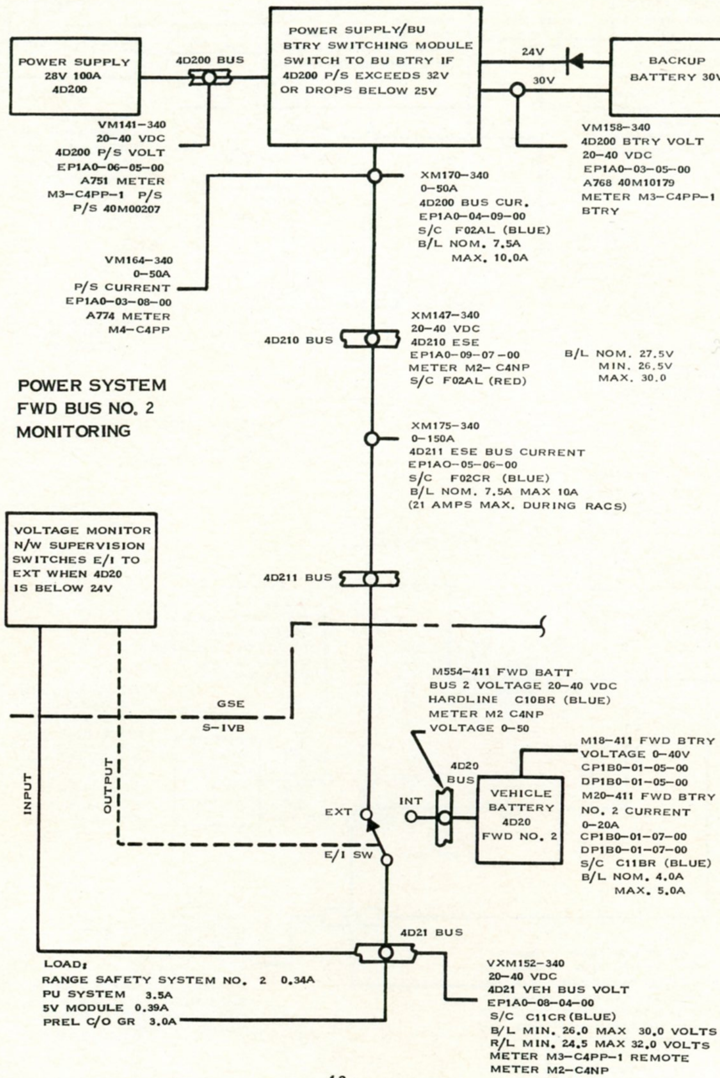
POWER SYSTEM
AFT BUS NO. 1
MONITORING

POWER SYSTEM AFT BUS NO. 2 MONITORING



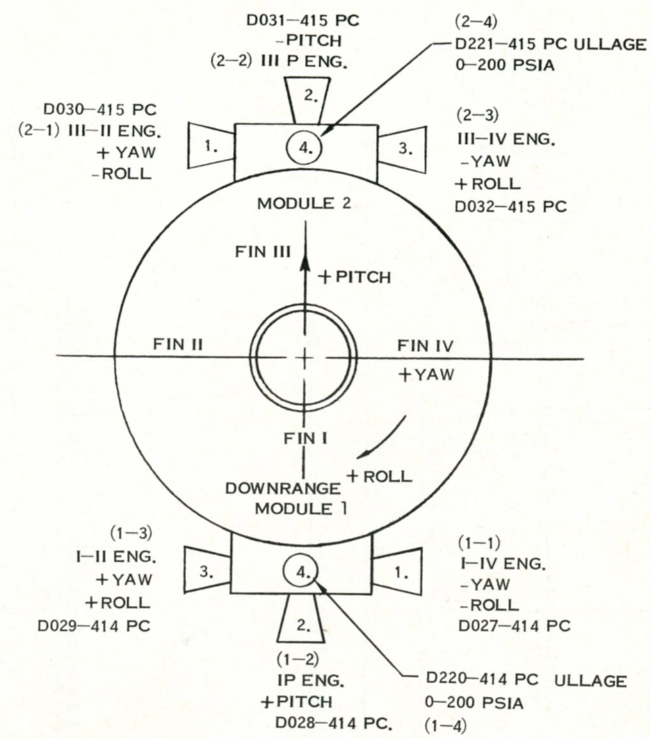
POWER SYSTEM FWD BUS NO. 1 MONITORING





POWER SYSTEM
FWD BUS NO. 2
MONITORING

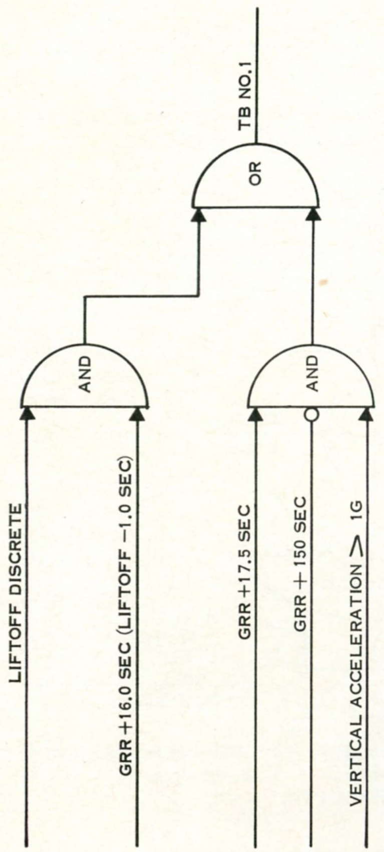
VIEW LOOKING FROM REAR OF S-IVB/V



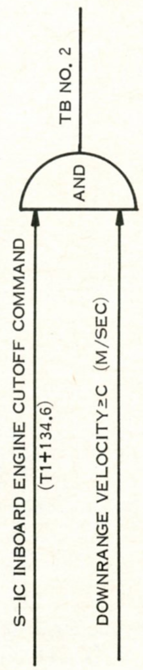
TERMINOLOGY: (FLIGHT CONTROL)

1. A + PITCH COMMAND CORRECTS A +PITCH CONDITION.
2. A + YAW COMMAND CORRECTS A +YAW CONDITION.
3. A + ROLL COMMAND CORRECTS A +ROLL CONDITION.

APS ORIENTATION SATURN S-IVB V



TIME BASE NO. 1



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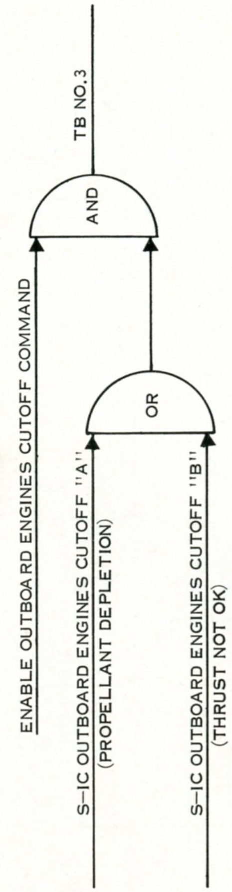

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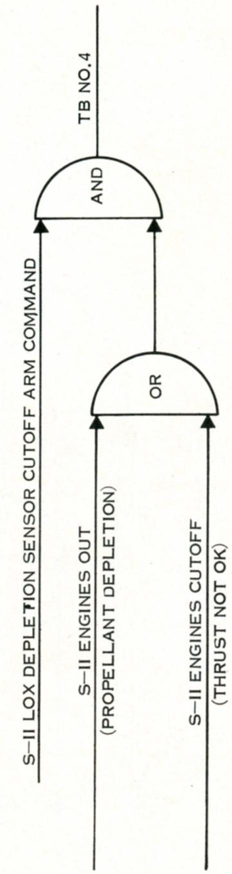

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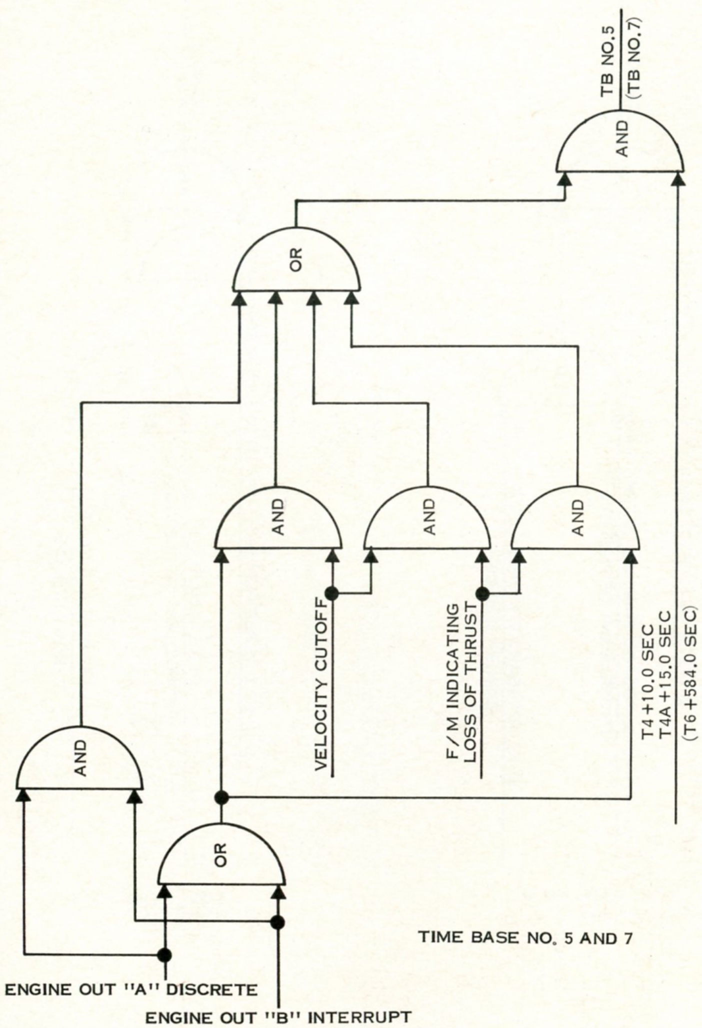
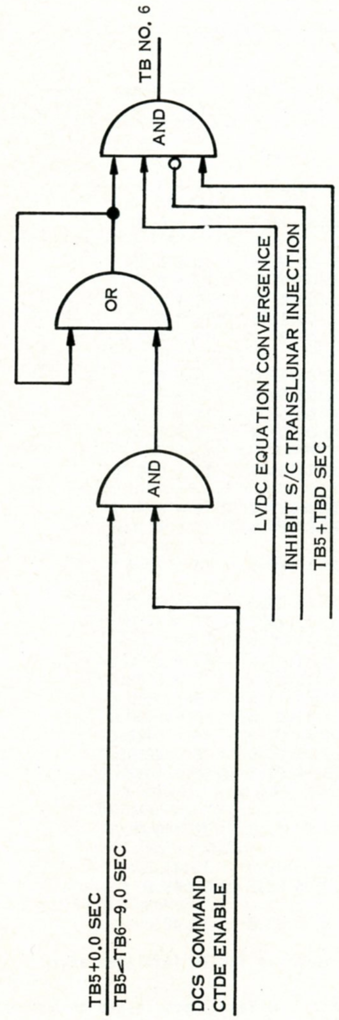


TIME BASE NO. 5 AND 7



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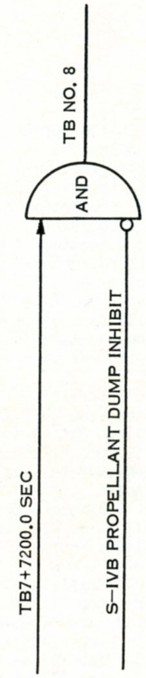


TIME BASE NO. 8

S-IVB-506 FLIGHT SEQUENCE OF EVENTS

Event	Flight Time (Hr:Min:Sec:)	Time From Base (Sec)	Actual Flight Time
1. Liftoff - Start of Time Base No. 1 (TI)	00:00:00.4	T1 + 0.0	
2. Inboard Engine Cutoff - Start of Time Base No. 2 (T2)	00:02:14.7	T2 + 0.0	
3. Outboard Engines Cutoff - Start of Time Base No. 3 (T3)	00:02:40.6	T3 + 0.0	
4. S-IC/S-II Separation (No. 1)	00:02:41.3	T3 + 0.7	
5. S-II Engines Start	00:02:42.0	T3 + 1.4	
6. S-II Aft Interstage Separation	00:03:11.3	T3 + 30.7	
7. S-II Inboard Engine Cutoff	00:07:39.6	T3 + 299.0	
8. S-II Engines Cutoff - Start of Time Base No. 4 (T4)	00:08:50.0	T4 + 0.0	
9. S-II/S-IVB Separation	00:08:50.8	T4 + 0.8	
10. S-IVB Engine Start On	00:08:51.0	T4 + 1.0	
11. Fire Ullage Jettison On	00:09:02.8	T4 + 12.8	
12. Velocity Cutoff of S-IVB Engine - Start of Time Base No. 5 (T5)	00:11:21.5	T5 + 0.0	
13. S-IVB Ullage Engine No. 1 On	00:11:21.8	T5 + 0.3	
14. Aux. Hyd. Pump Flight Mode Off	00:11:25.6	T5 + 4.1	
15. Begin Maneuver to Local Horizontal	00:11:41.5	T5 + 20.0	
16. LH2 Tank Continuous Vent Orifice Shutoff Valve Open On	00:12:20.5	T5 + 59.0	
17. S-IVB Ullage Engine No. 1 Off	00:12:48.5	T5 + 87.0	
18. PU Inverter and D. C. Power Off	00:19:41.5	T5 + 500.0	
19. Aux. Hyd. Pump Flight Mode On	00:54:41.5	T5 + 2600.0	
20. Aux. Hyd. Pump Flight Mode Off	00:55:29.5	T5 + 2648.0	
21. PU Inverter and DC Power On	01:34:41.5	T5 + 5000.0	
22. Aux. Hyd. Pump Flight Mode On	01:41:21.5	T5 + 5400.0	
23. Aux. Hyd. Pump Flight Mode Off	01:42:09.5	T5 + 5448.0	
24. Aux. Hyd. Pump Flight Mode On	03:06:21.5	T5 + 10500.0	
25. Aux. Hyd. Pump Flight Mode Off	03:14:21.5	T5 + 10980.0	
**26. Begin Restart Preparations - Start of Time Base No. 6 (T6)	02:34:41.0	T6 + 0.0	
*27. Burner LH2 Propellant Valve Open On	02:35:22.3	T6:41.3	
*28. Burner Exciters On	02:35:22.6	T6:41.6	
*29. Burner LOX Shutdown Valve Open On	02:35:23.0	T6:42.0	

*Will not be issued during second restart attempt if T6C is initiated after T6 + 41.3 seconds.

**Restart preps initiation time (and subsequent Time Base Times) based on nominal first opportunity conditions.

Event	Flight Time (Hr:Min:Sec:)	Time From Base (Sec)	Actual Flight Time
*30. LH2 Tank Continuous Vent Valve Close On	02:35:23.2	T6 + 42.2	
*31. Burner Automatic Cutoff System Arm	02:35:29.0	T6 + 48.0	
*32. LH2 Tank Repressurization Control Valve Open On	02:35:29.1	T6 + 48.1	
*33. LOX Tank Repressurization Control Valve Open On	02:35:29.3	T6 + 48.3	
34. Aux. Hyd. Pump Flight Mode On	02:38:28.0	T6 + 219.0	
35. LOX Chilldown Pump On	02:38:58.0	T6 + 249.0	
36. Fuel Chilldown Pump On	02:39:03.0	T6 + 254.0	
37. PU Mixture Ratio 4.5 On	02:42:11.1	T6 + 450.1	
38. S-IVB Ullage Engine No. 1 On	02:42:57.4	T6 + 496.3	
*39. LOX Tank Repressurization Control Valve Open Off	02:42:57.7	T6 + 496.6	
*40. LH2 Tank Repressurization Control Valve Open Off	02:42:57.8	T6 + 496.7	
*41. Burner LH2 Propellant Valve Close On	02:42:57.9	T6 + 496.8	
42. Ambient Repressurization System Mode Selector On and Cryo Off	02:42:58.7	T6 + 497.6	
43. LOX Tank Repressurization Control Valve Open On	02:43:01.1	T6 + 500.0	
*44. Burner LOX Shutdown Valve Close On	02:43:02.4	T6 + 501.3	
45. LH2 Tank Repressurization Control Valve Open On	02:43:21.1	T6 + 520.0	
46. Fuel Chilldown Pump Off	02:44:10.5	T6 + 569.4	
47. LOX Chilldown Pump Off	02:44:10.7	T6 + 569.6	
48. S-IVB Engine Start On	02:44:11.1	T6 + 570.0	
49. S-IVB Ullage Engine No. 1 Off	02:44:14.1	T6 + 573.0	
50. LOX Tank Repressurization Control Valve Open Off	02:44:18.3	T6 + 577.2	
51. LH2 Tank Repressurization Control Valve Open Off	02:44:18.5	T6 + 577.4	
52. PU Programmed Mixture Ratio Off - 2nd Opportunity	02:44:24.6	T6 + 583.5	
53. PU Programmed Mixture Ratio Off - First Opportunity	02:46:17.3	T6 + 696.2	

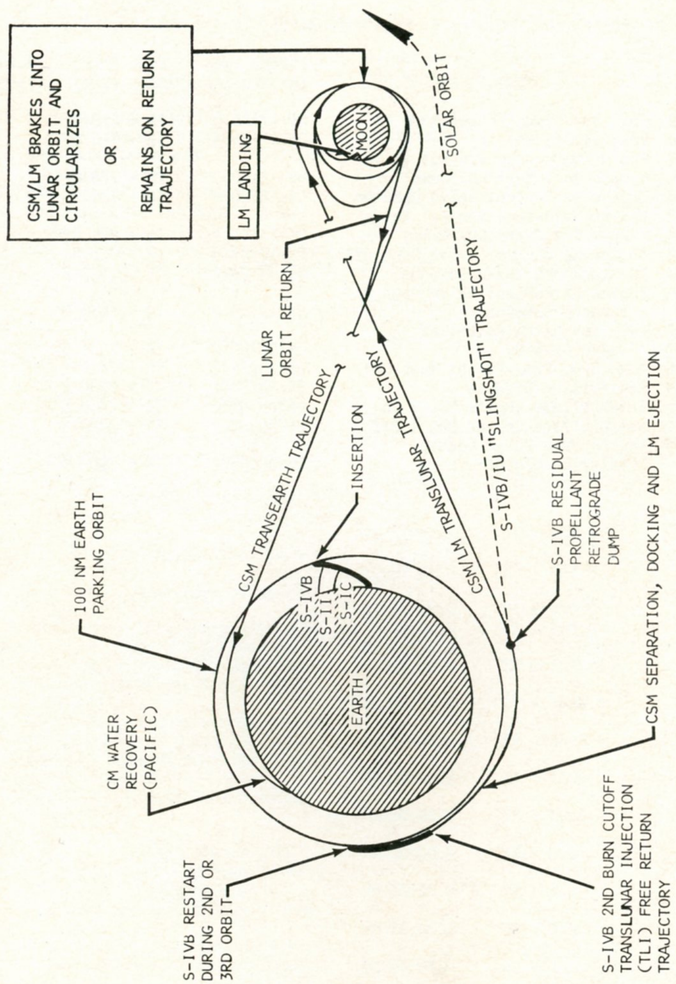
*Will not be issued during second restart attempt if T6C is initiated after T6 + 41.3 seconds.

S-IVB-506 Flight Sequence of Events (Cont'd)

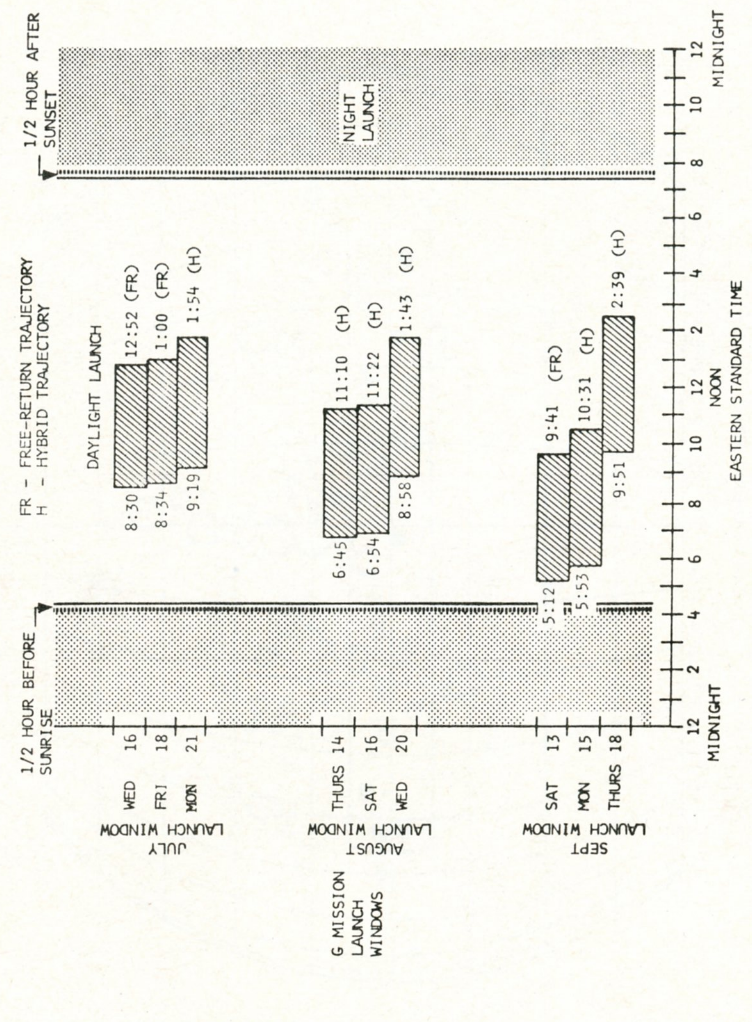
Event	Flight Time (Hr:Min:Sec:)	Time From Base (Sec)	Actual Flight Time
54. S-IVB Engine Cutoff - Start of Time Base No. 7 (TB7)	02:50:00.0	T7 + 0.0	
55. LH2 Tank Continuous Vent Orifice Shutoff Valve Open On	02:50:00.5	T7 + 0.5	
56. LOX Tank NPV Valve Open On	02:50:00.7	T7 + 0.7	
57. LH2 Tank Latching Relief Valve Open On	02:50:00.8	T7 + 0.8	
58. LH2 Tank Repressurization Control Valve Open On (Ambient He Dump)	02:50:01.3	T7 + 1.3	
59. Start Bottle Control Valve Open On	02:50:02.0	T7 + 2.0	
60. Aux. Hyd. Pump Flight Mode Off	02:50:04.2	T7 + 4.2	
61. Maneuver to Local Horizontal	02:50:20.0	T7 + 20.0	
62. Ambient Repress System Mode Selector Off and Cryo On (Stop Ambient He Dump; Start Cold He Dump)	02:51:01.0	T7 + 61.0	
63. LOX Tank NPV Valve Open Off	02:52:30.7	T7 + 150.7	
64. Start Bottle Vent Control Valve Open Off	02:52:32.0	T7 + 152.0	
65. LH2 Tank Repressurization Control Valve Open Off (Stop Cold He Dump)	03:04:59.6	T7 + 899.6	
66. LH2 Tank Continuous Vent Valve Close On	03:04:58.8	T7 + 899.8	
67. LH2 Tank Latching Relief Valve Open Off	03:05:00.0	T7 + 900.0	
68. Maneuver to Separation Attitude	03:05:00.0	T7 + 900.0	
69. Aux. Hyd. Pump Flight Mode On	03:43:20.0	T7 + 3200.0	
70. Aux. Hyd. Pump Flight Mode Off	03:44:08.0	T7 + 3248.0	
71. LH2 Tank Latching Relief Valve Open On	03:50:00.4	T7 + 3600.4	
72. LH2 Tank Repressurization Control Valve Open On (Cold He Dump)	03:50:00.6	T7 + 3600.6	
73. LH2 Tank Repressurization Control Valve Open Off	04:04:59.2	T7 + 4499.2	
74. LH2 Tank Latching Relief Valve Open Off	04:05:00.0	T7 + 4500.0	
75. Start of Time Base No. 8 (T8)	05:00:00.0	T8 + 0.0	
76. LH2 Tank Continuous Vent Orifice Shutoff Valve Open On	05:00:00.4	T8 + 0.4	
77. Engine Pump Purge Control Valve Enable On	05:00:00.8	T8 + 0.8	
78. LH2 Tank Repressurization Control Valve Open On (Cold He Dump)	05:00:01.0	T8 + 1.0	

S-IVB-506 Flight Sequence of Events (Cont'd)

Event	Flight Time (Hr:Min:Sec:)	Time From Base (Sec)	Actual Flight Time
79. Aux. Hyd. Pump Flight Mode On	05:11:30.0	T8 + 690.0	
80. Passivation Enable	05:11:50.0	T8 + 710.0	
81. Engine Mainstage Control Valve Open On (Start LOX Dump)	05:12:00.0	T8 + 720.0	
82. Engine He Control Valve Open On	05:12:00.2	T8 + 720.2	
83. Engine Mainstage Control Valve Open Off (Stop LOX Dump)	05:13:48.2	T8 + 828.2	
84. Engine He Control Valve Open Off	05:17:00.4	T8 + 828.4	
85. LOX Tank NPV Valve Open On	05:17:03.2	T8 + 1023.2	
86. Engine He Control Valve Open On (Ground Command)	05:17:09.0	T8 + 1030.0	
87. LH2 Tank Latching Relief Valve Open On	05:33:51.0	T8 + 2031.0	
88. Aux. Hyd. Pump Flight Mode Off	05:33:52.2	T8 + 2032.2	
89. Passivation Disable	05:38:50.2	T8 + 2330.2	
90. S-IVB Ullage Engine No. 1 On	05:46:40.0	T8 + 2800.0	
91. S-IVB Ullage Engine No. 1 Off	05:50:80.0	T8 + 3080.0	
92. Engine Pump Purge Control Valve Enable Off	06:00:00.0	T8 + 3600.4	



MISSION PROFILE FOR LUNAR LANDING MISSION.



LAUNCH WINDOW SUMMARY FOR JULY, AUGUST AND SEPTEMBER, 1969.

LUNAR LANDING SITES

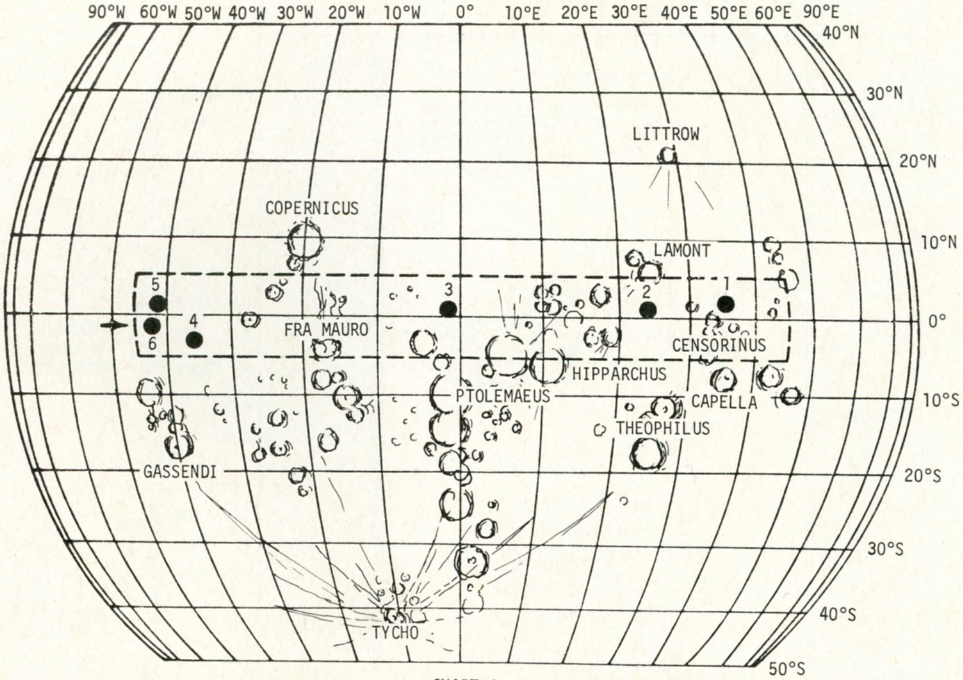
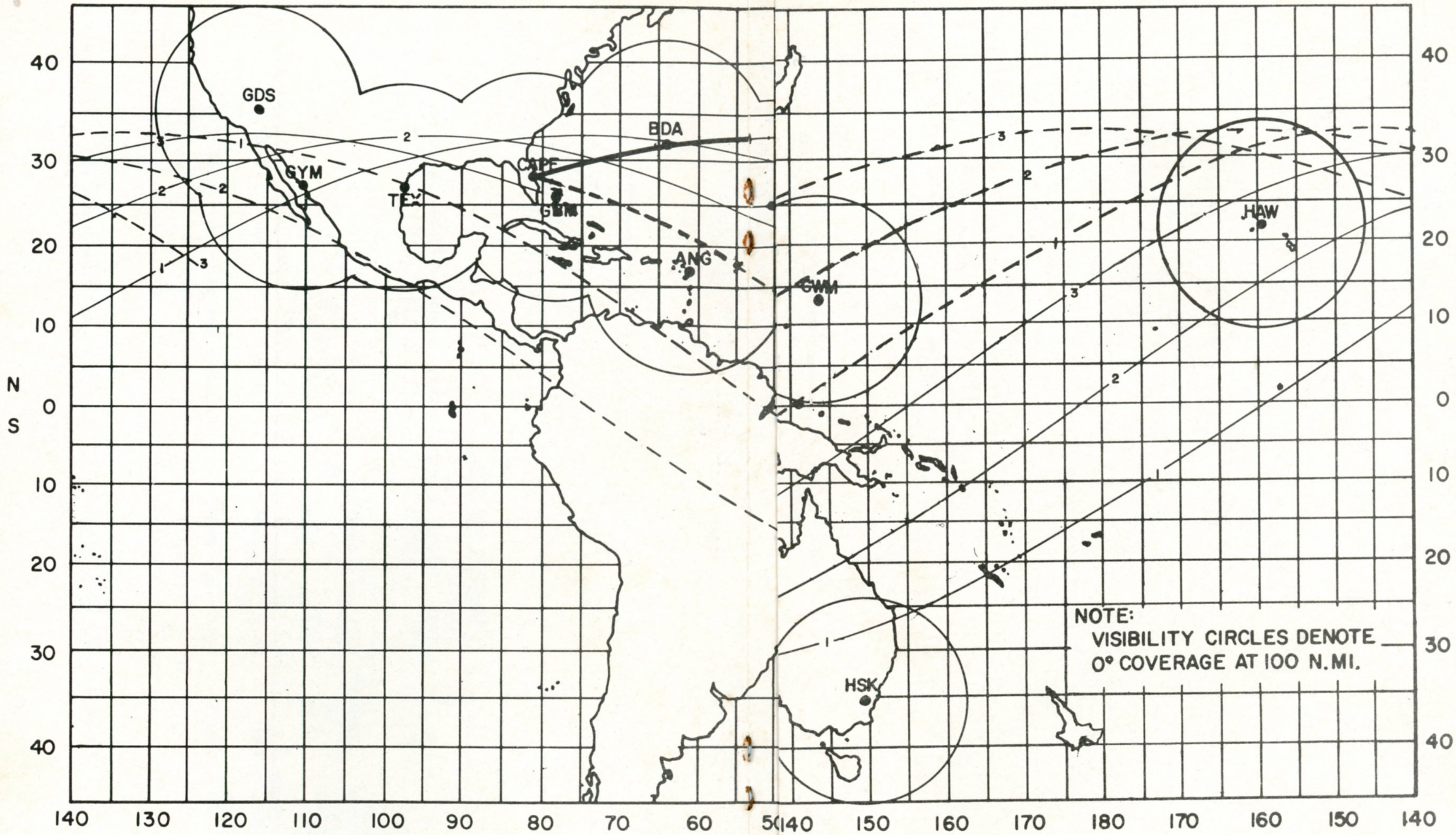


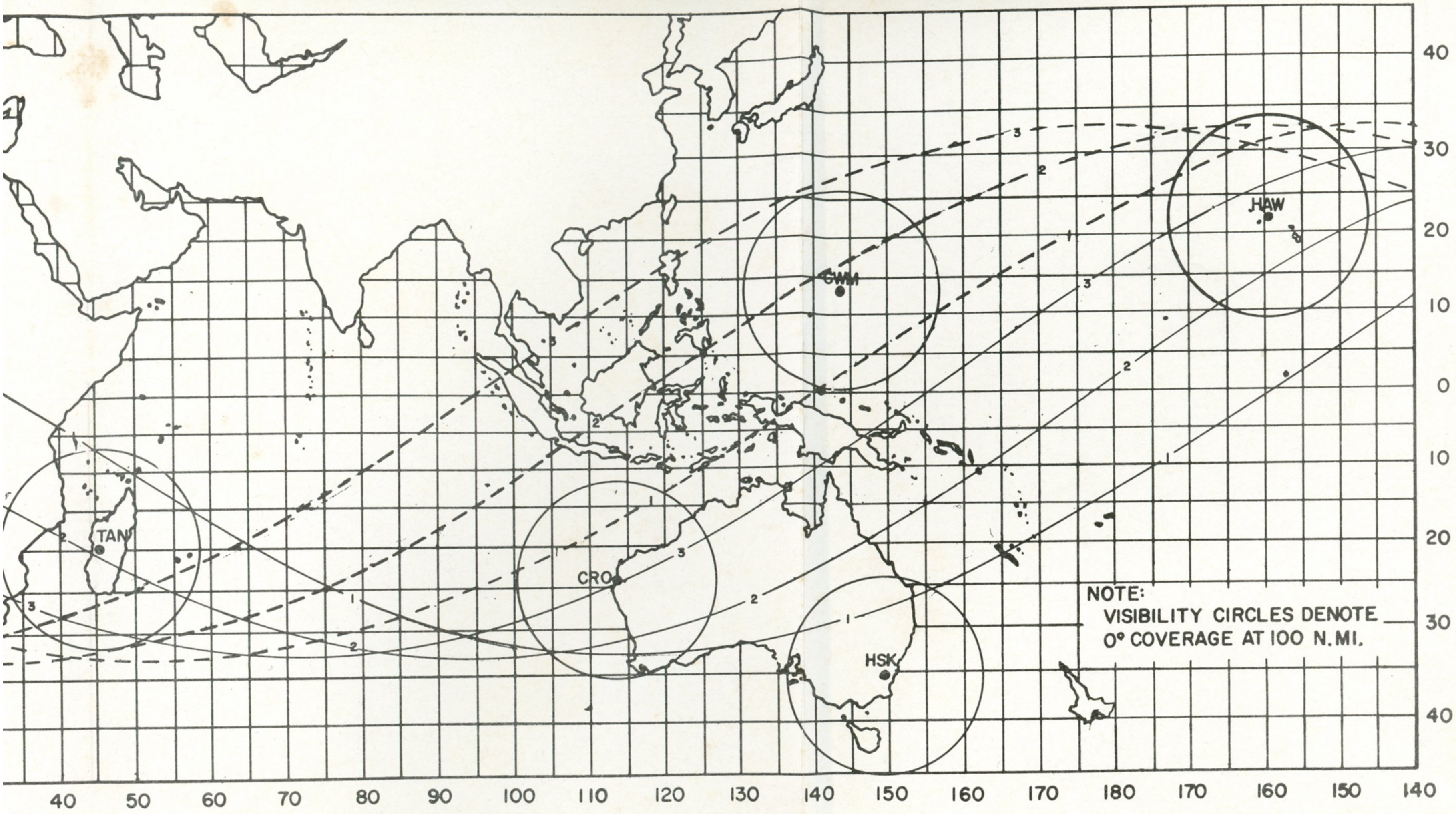
CHART 3

TRAJECTORY CONDITIONS

	TIME (SEC.)	ALTITUDE (NM)	INERTIAL VELOCITY (FT/SEC)	RANGE (NM)	APOGEE (NM)	PERIGEE (NM)	INCLINATION (DEG)
SII/SIVB SEPARATION	552.259	101.3	22,755	887.4	---	---	---
S-IVB FIRST CUTOFF	699.95	103.2	25,562	1,423.7	100	97	32.53
S-IVB SECOND IGNITION	9,847	105.3	25,562	6,454.9	113	105	32.57
TRANSLUNAR INJECTION	10,212.97	179.7	35,545	4,801.4	296,463	118	31.52



NOMINAL BOOST AND EARTH PARKING ORBITS.

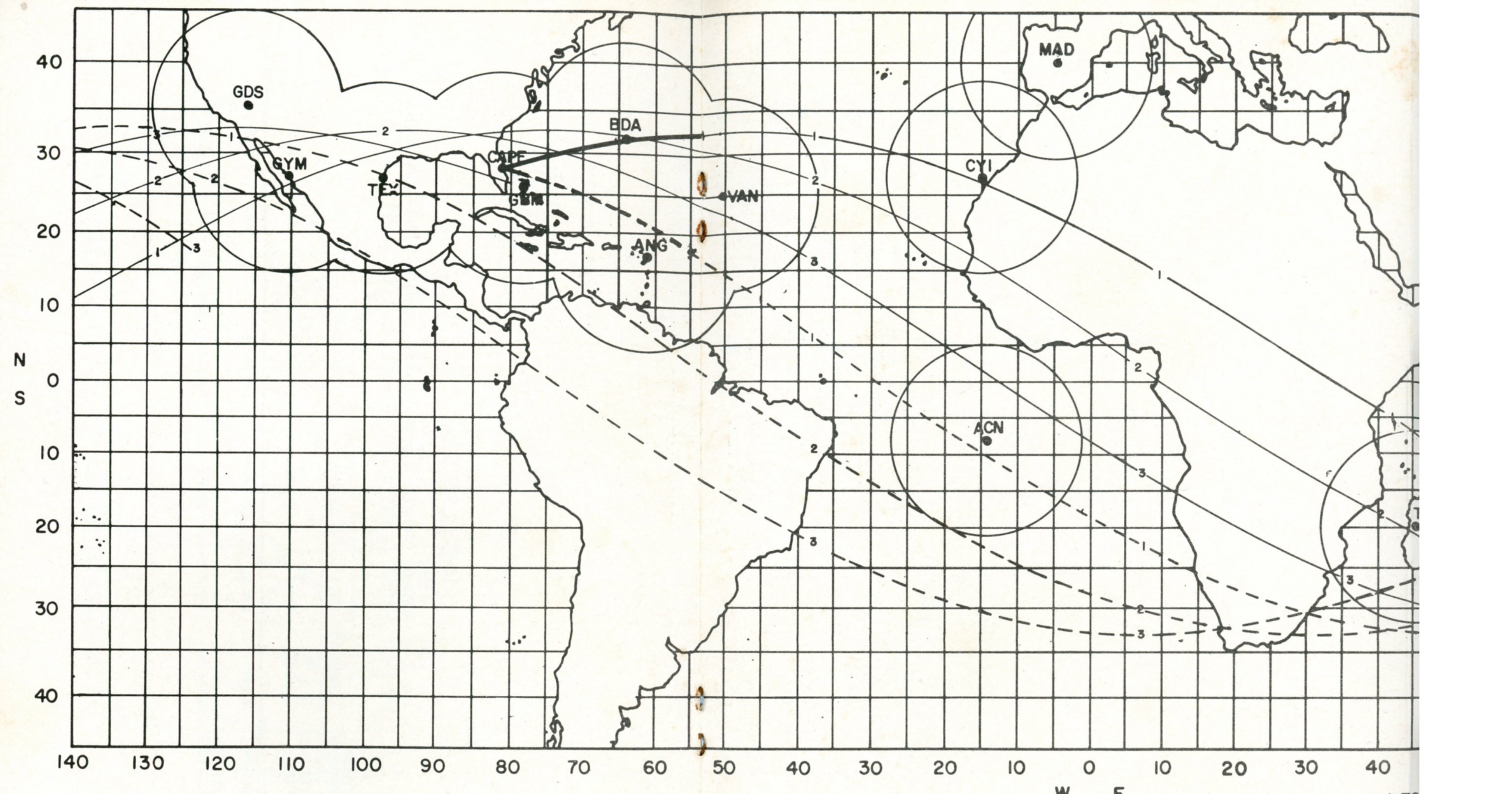


LEGEND:

—— I —— 72° LAUNCH AZIMUTH

- - - I - - - 108° LAUNCH AZIMUTH

NOMINAL BOOST AND EARTH PARKING ORBITS.



GDS
GYM
TEX
CAPE
GBM
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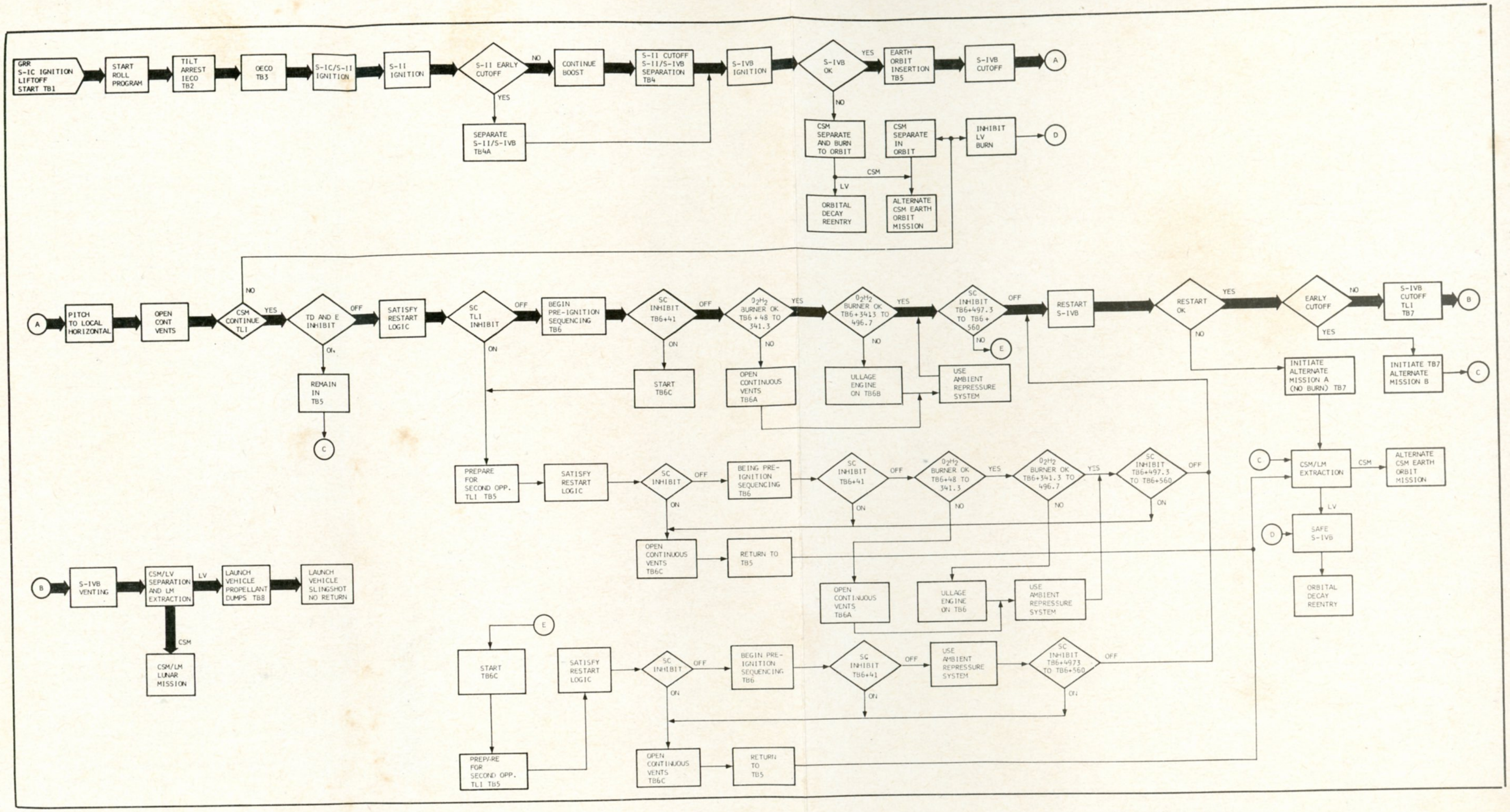
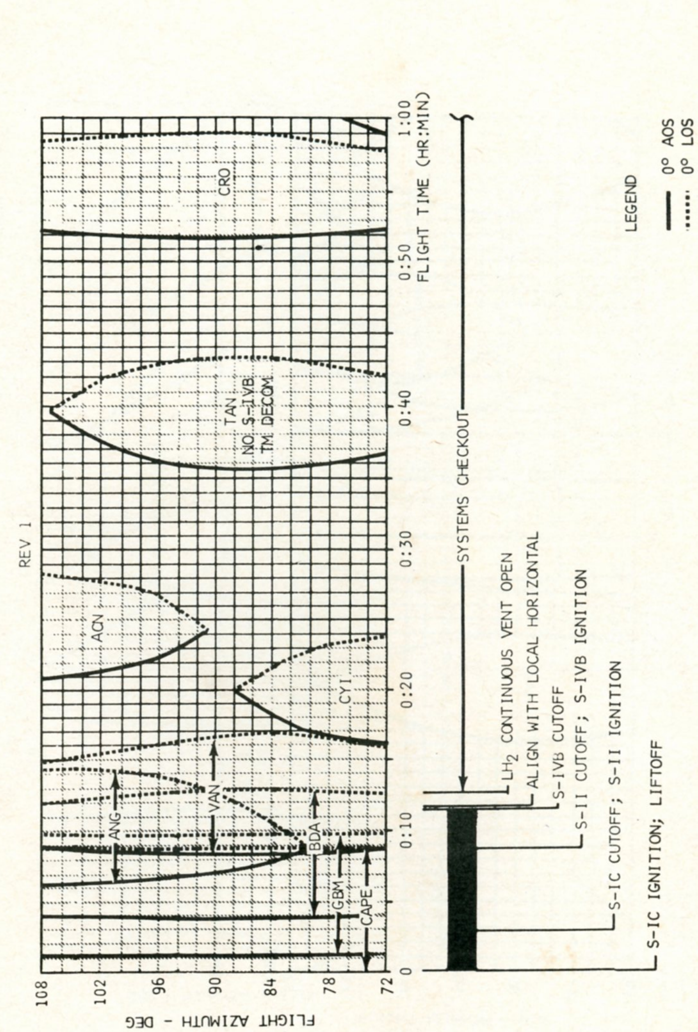
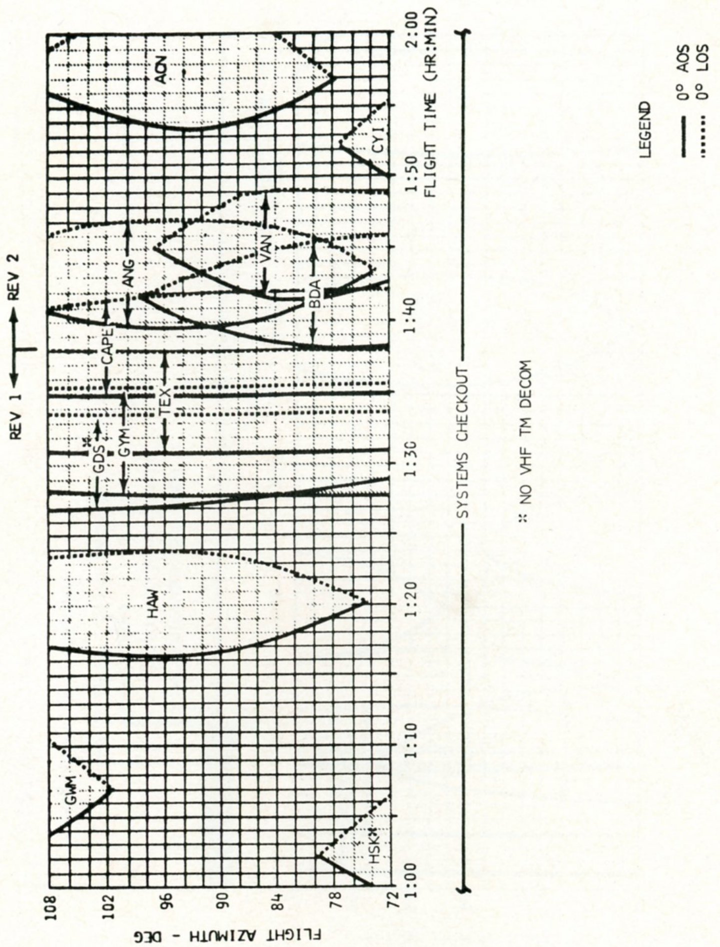


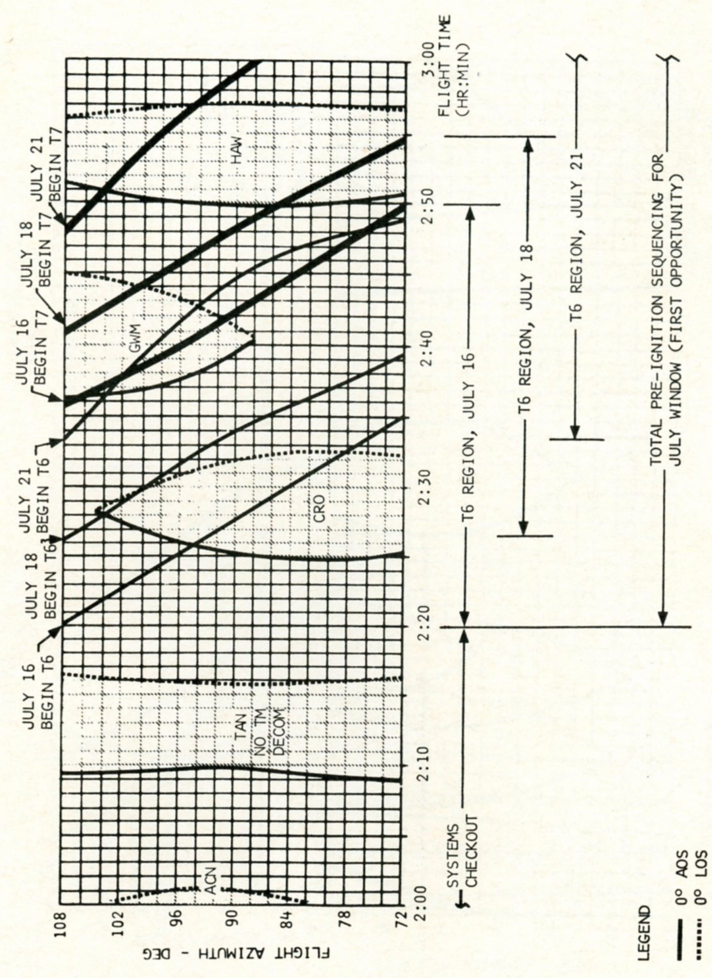
MISSION LOGIC



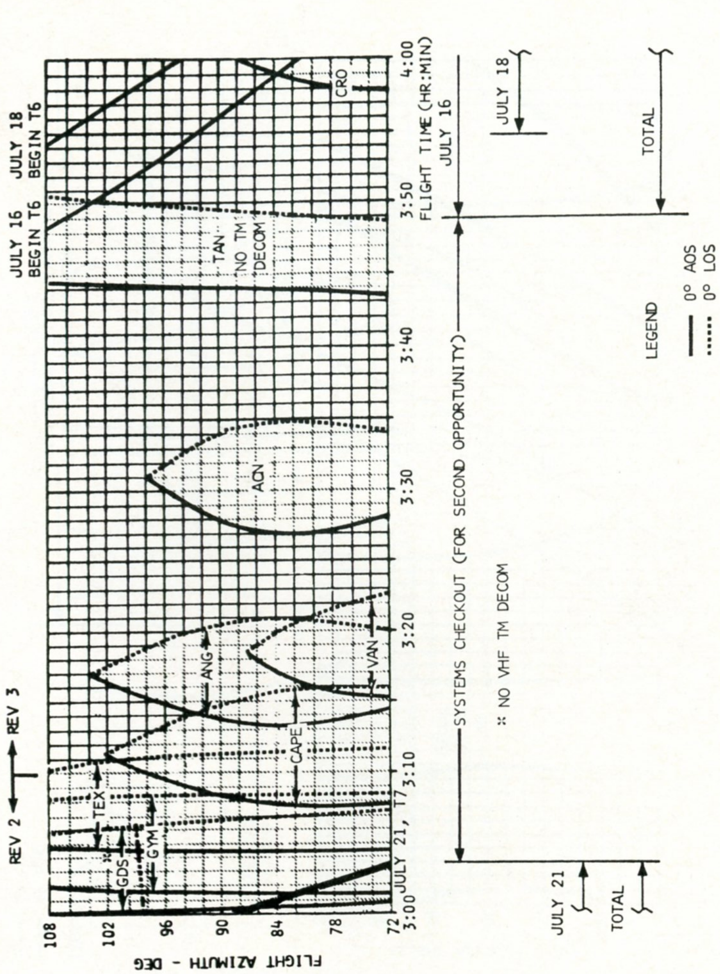
PARKING ORBIT COAST MISSION TIMELINE (SHEET 1 OF 5).



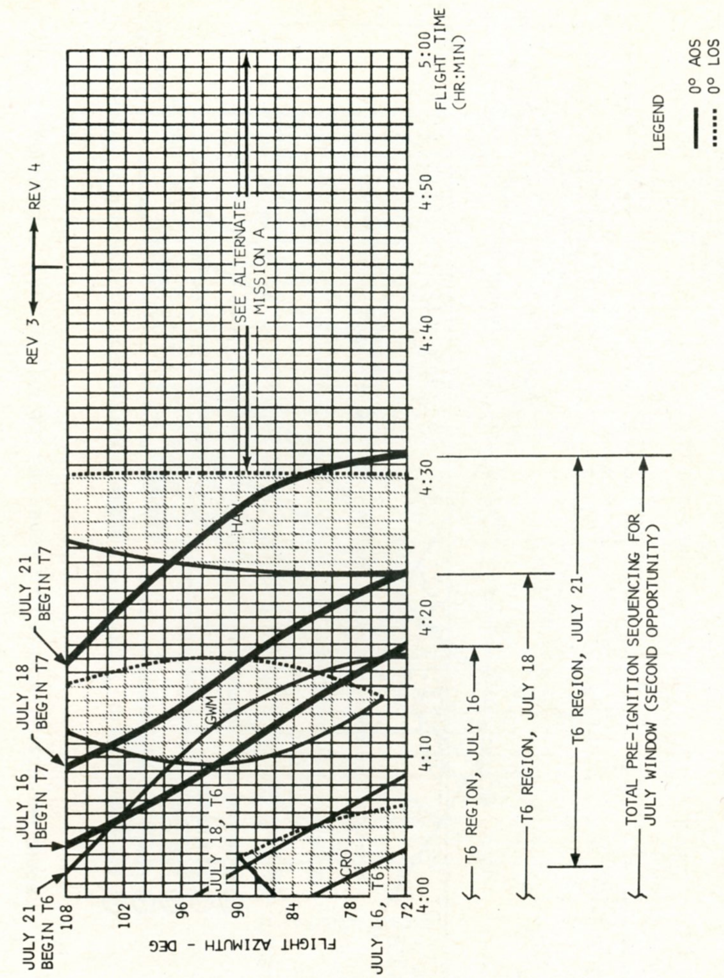
PARKING ORBIT COAST MISSION TIMELINE (SHEET 2 OF 5).



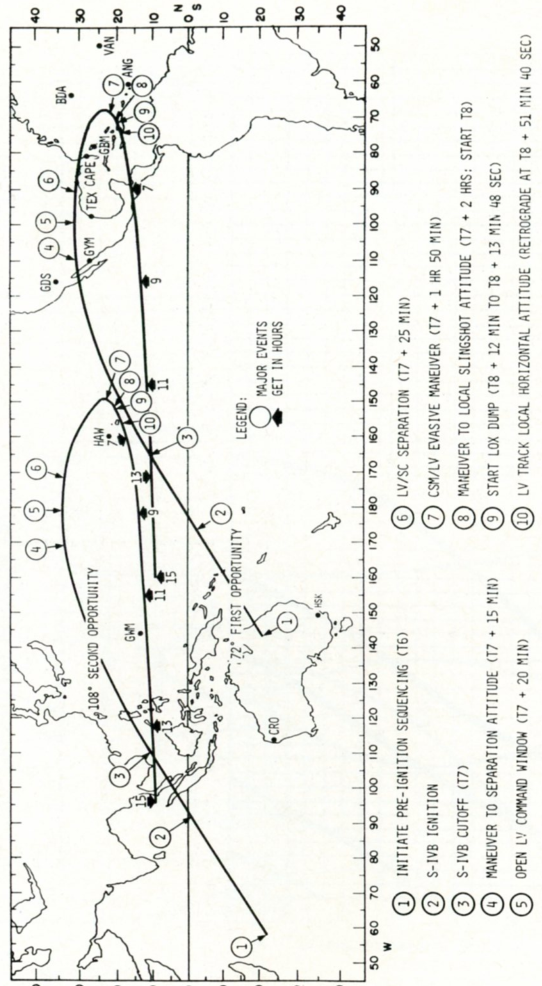
PARKING ORBIT COAST MISSION TIMELINE (SHEET 3 OF 5).



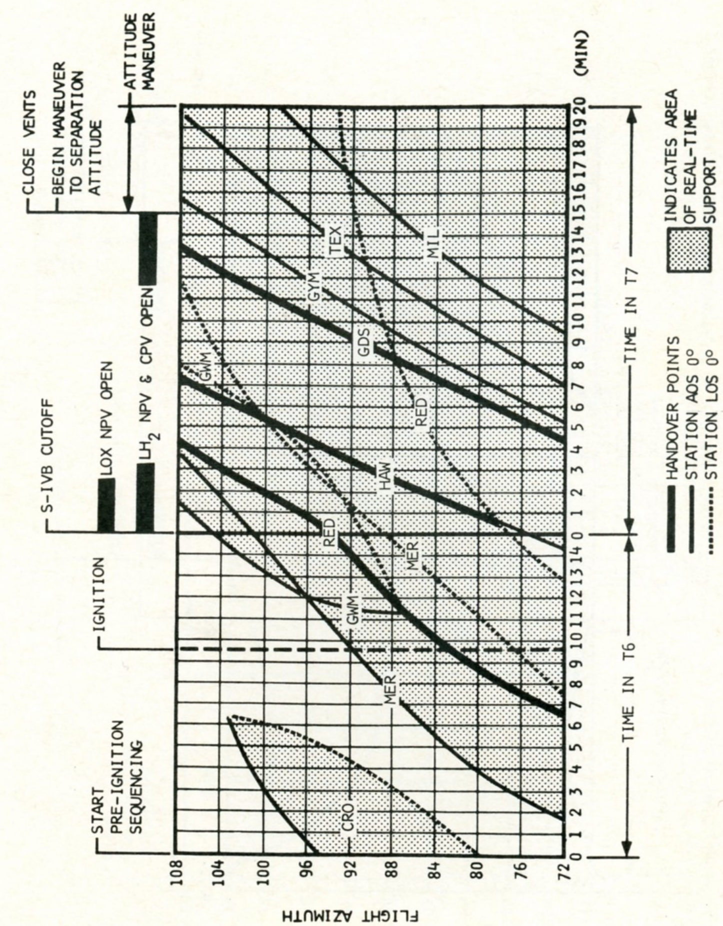
PARKING ORBIT COAST MISSION TIMELINE (SHEET 4 OF 5).



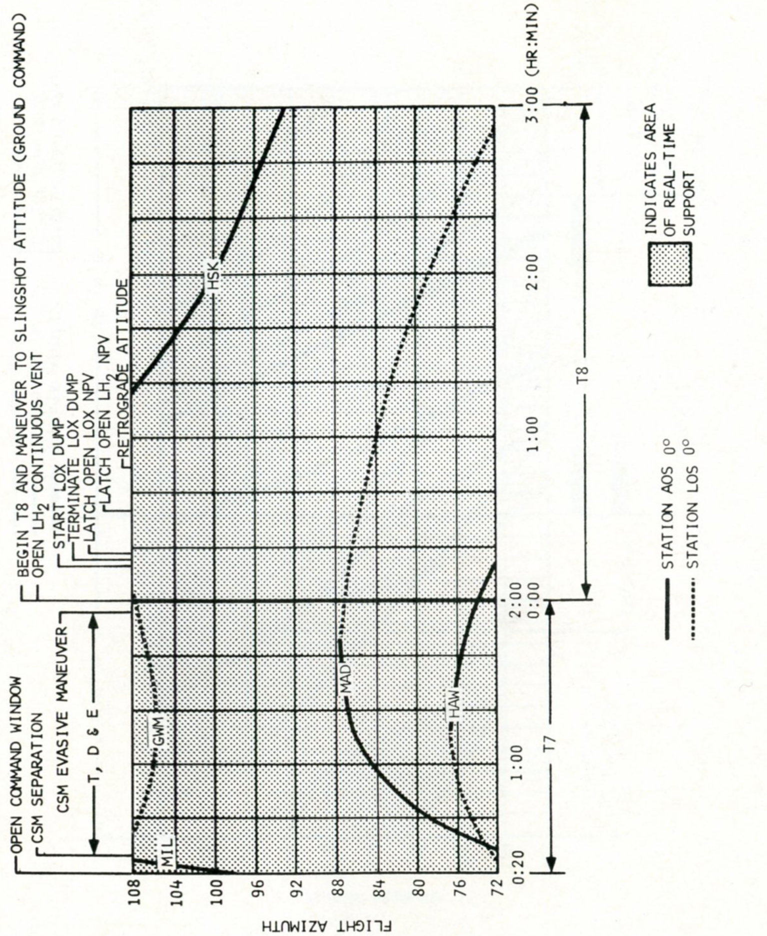
PARKING ORBIT COAST MISSION TIMELINE (SHEET 5 OF 5).



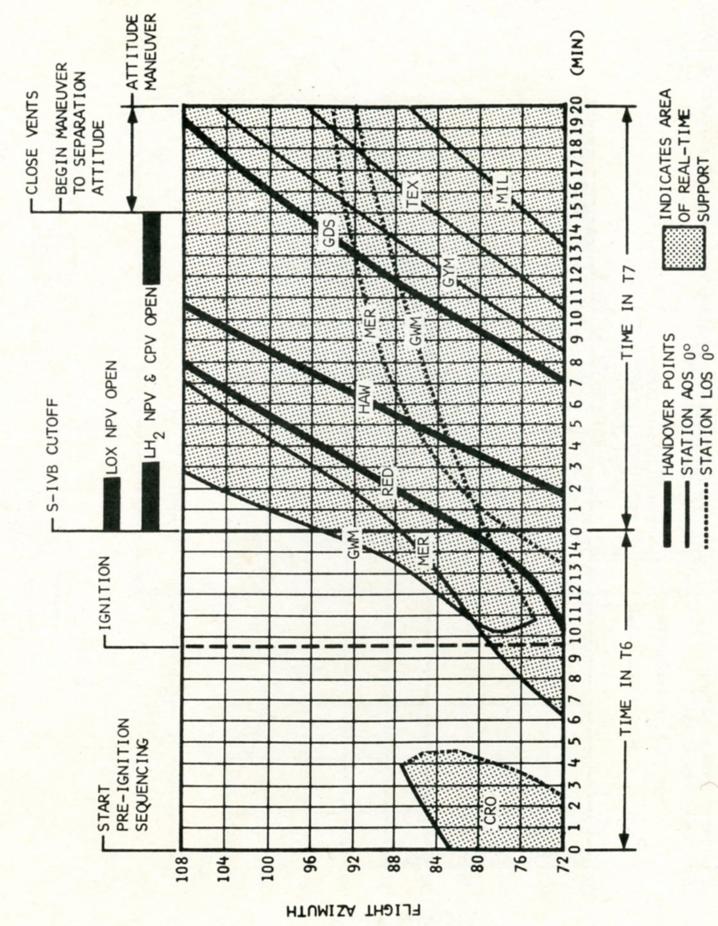
GROUND PROJECTION FROM T6 TO 15 HOURS GET FOR JULY 16, 1969 LAUNCH WINDOW.



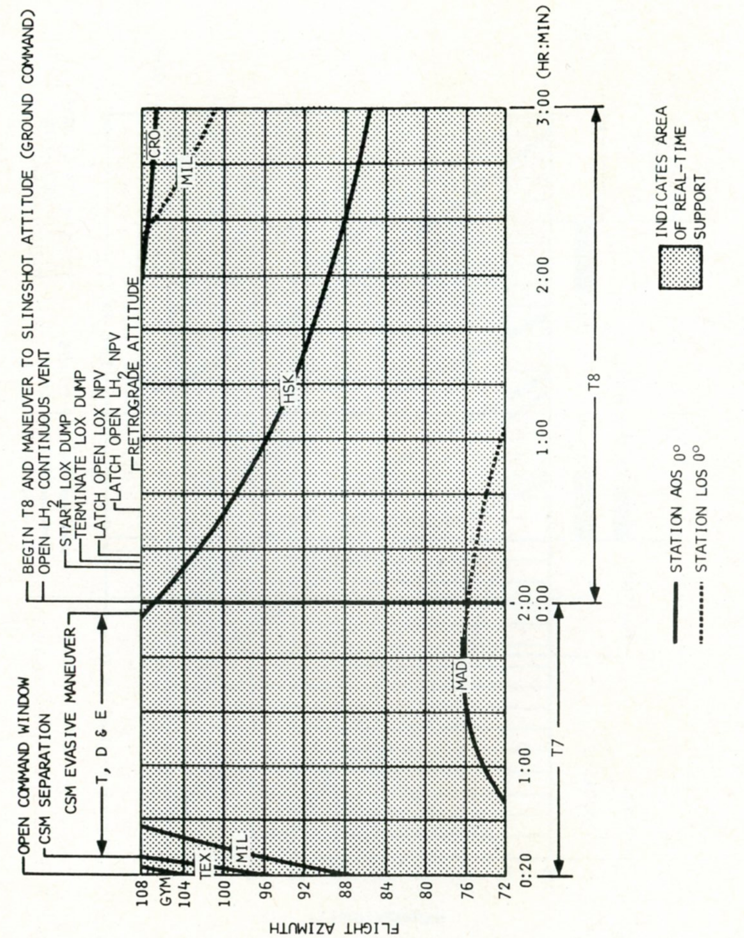
NETWORK SUPPORT FROM T6 TO T7+20 MINUTES FOR JULY 16, 1969 FIRST OPPORTUNITY.



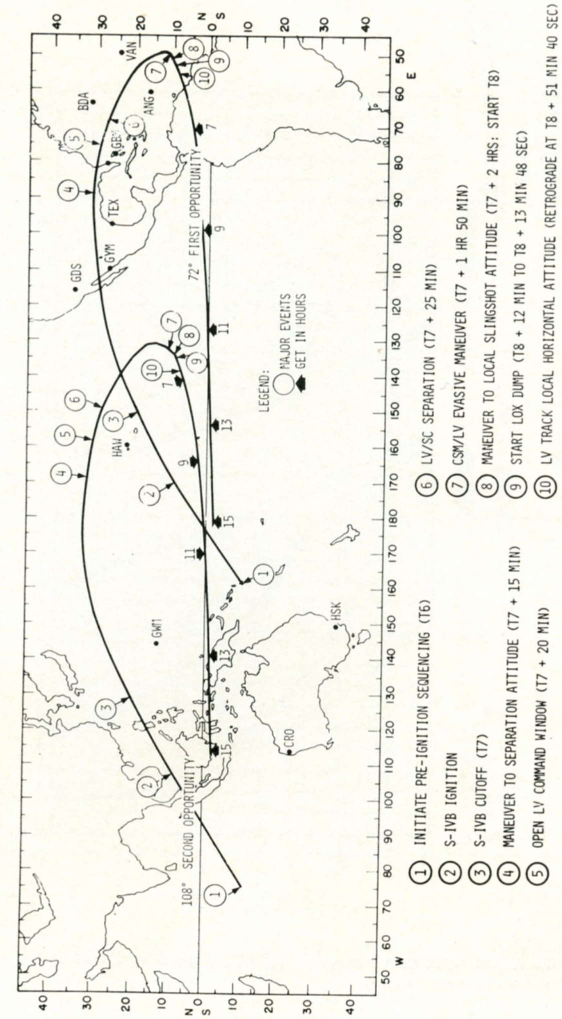
LINE—OF—SIGHT NETWORK SUPPORT FROM T7+20 MINUTES TO T8+3 HOURS FOR JULY 16, 1969 FIRST OPPORTUNITY.



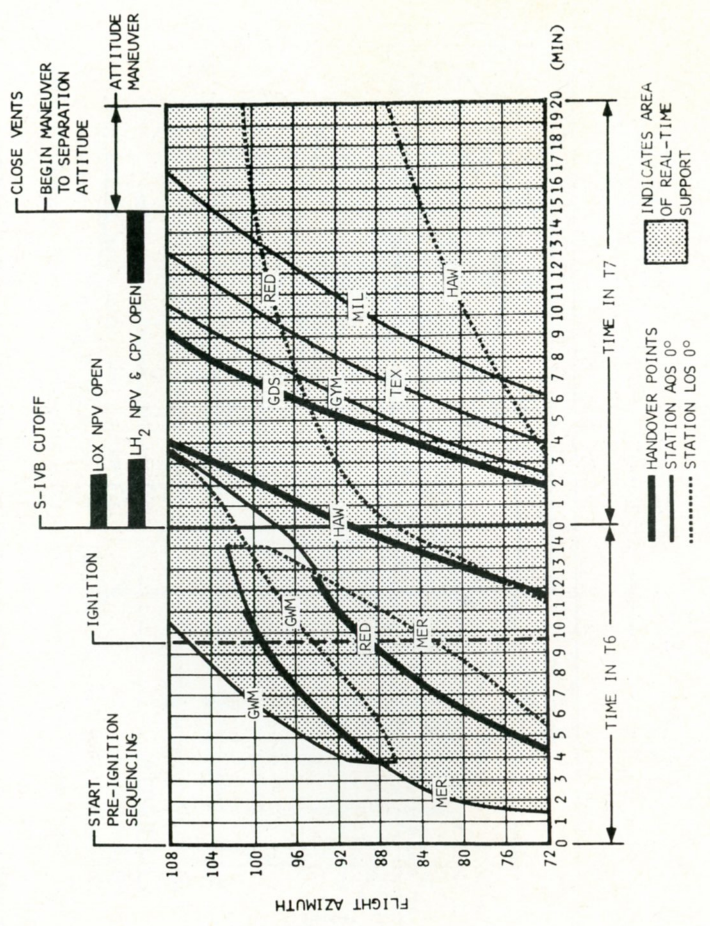
NETWORK SUPPORT FROM T6 TO T7+20 MINUTES FOR JULY 16, 1969 SECOND OPPORTUNITY.



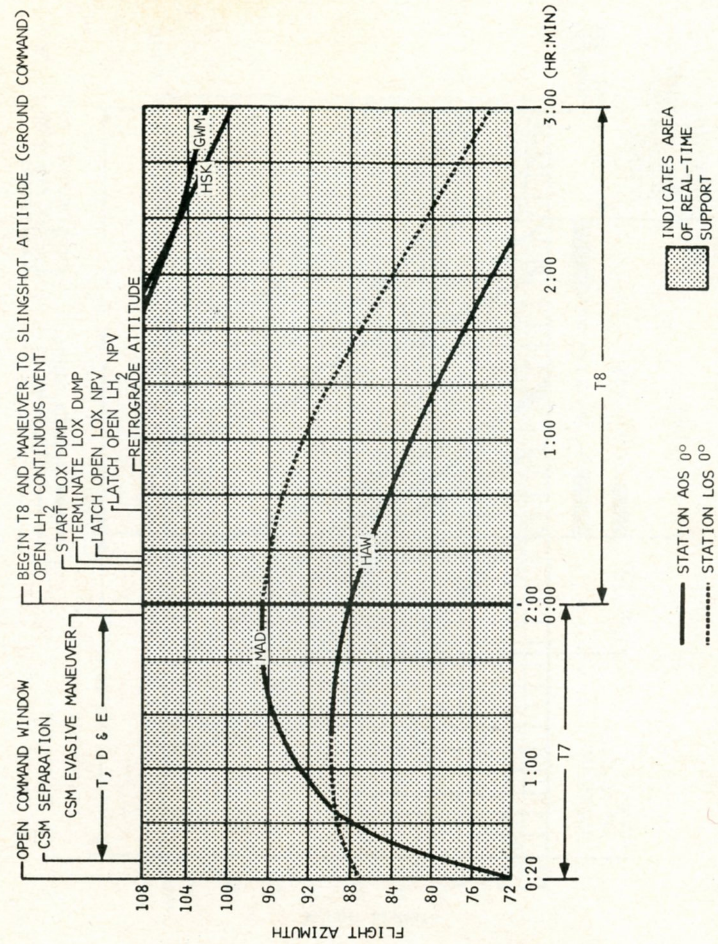
LINE–OF–SIGHT NETWORK SUPPORT FROM T7+20 MINUTES TO T8+3 HOURS FOR JULY 16, 1969 SECOND OPPORTUNITY.



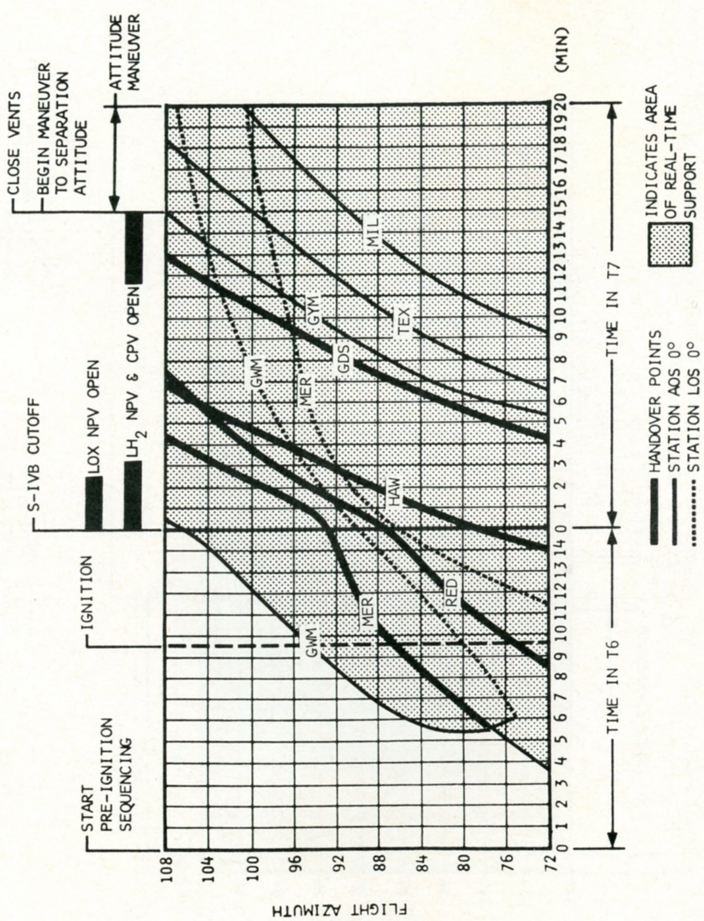
GROUND PROJECTION FROM T6 TO 15 HOURS GET FOR JULY 18, 1969 LAUNCH WINDOW.



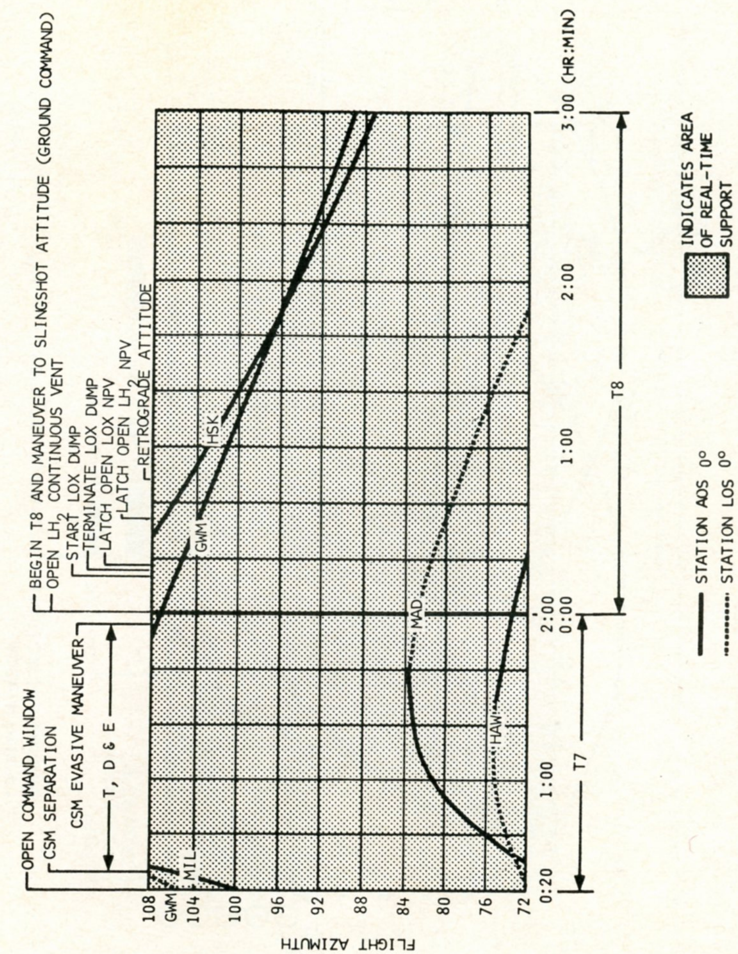
NETWORK SUPPORT FROM T6 TO T7+20 MINUTES FOR JULY 18, 1969 FIRST OPPORTUNITY.



LINE-OF-SIGHT NETWORK SUPPORT FROM T7+20 MINUTES TO T8+3 HOURS FOR JULY 18, 1969 FIRST OPPORTUNITY.



NETWORK SUPPORT FROM T6 TO T7+20 MINUTES FOR JULY 18, 1969 SECOND OPPORTUNITY.



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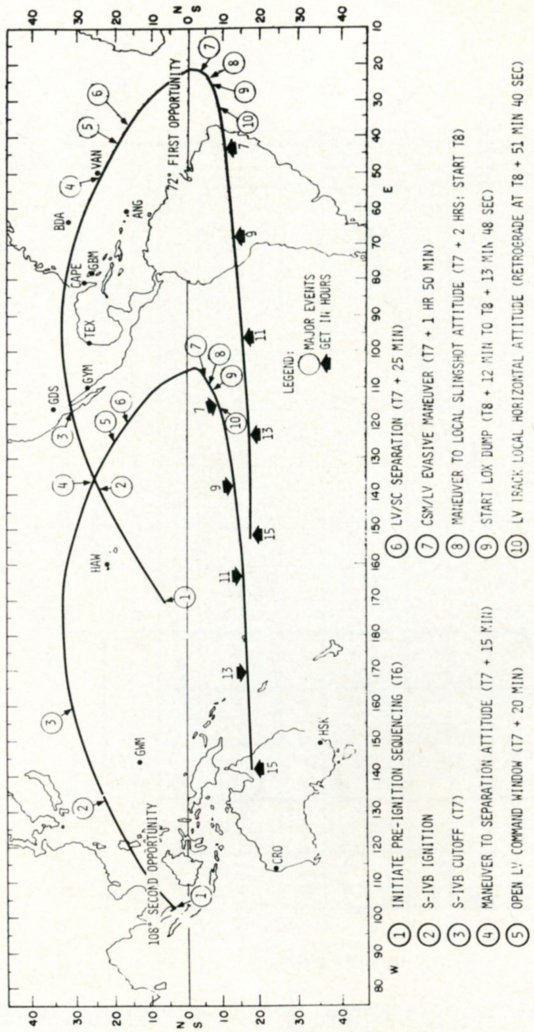
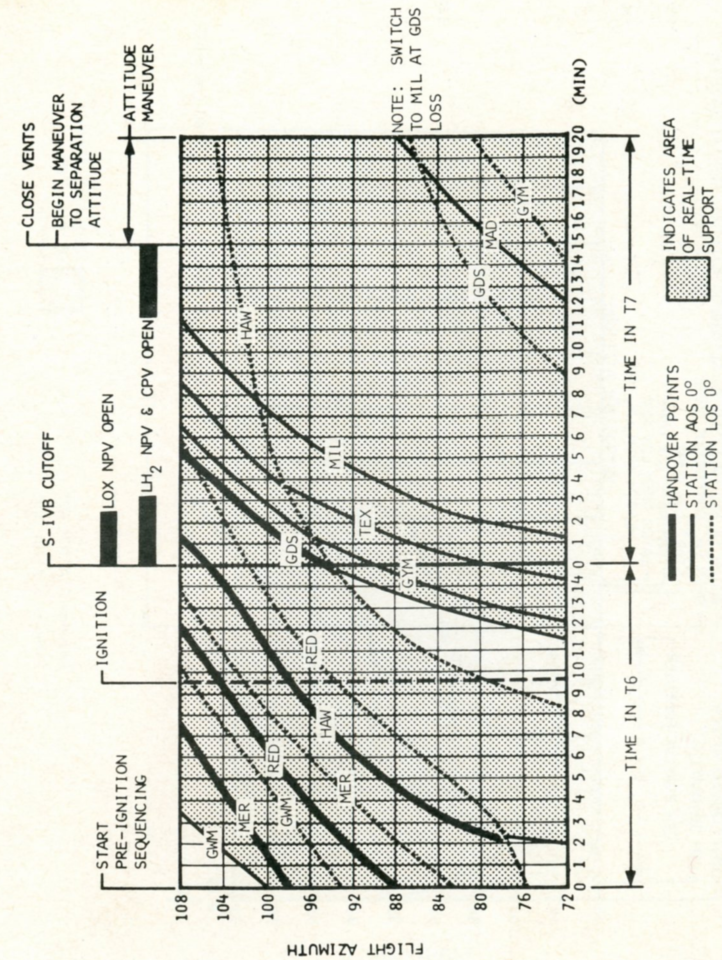
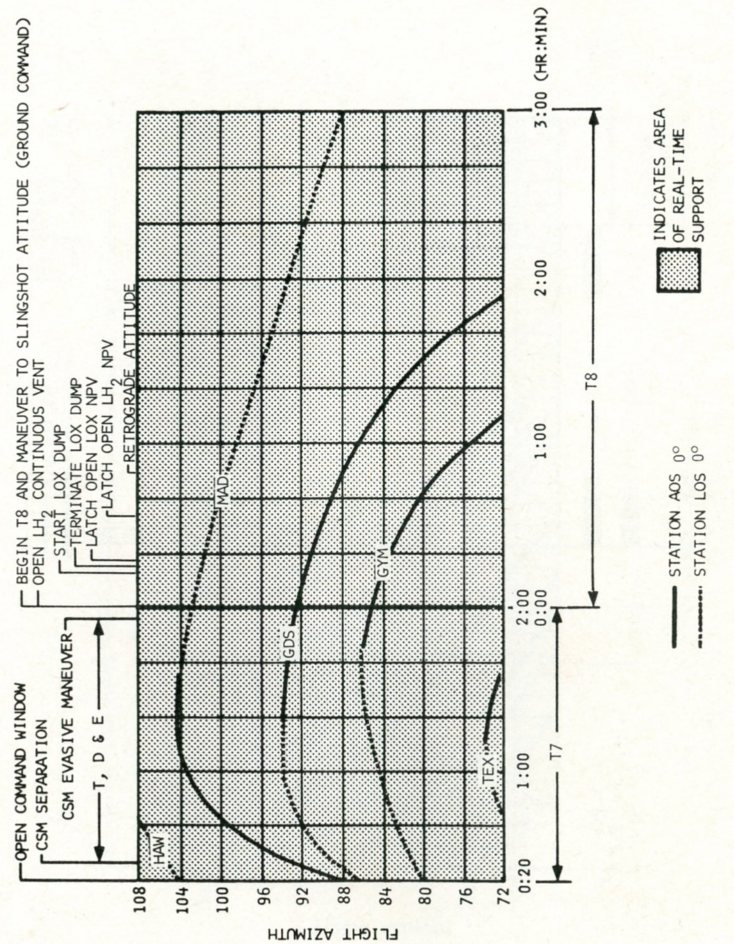


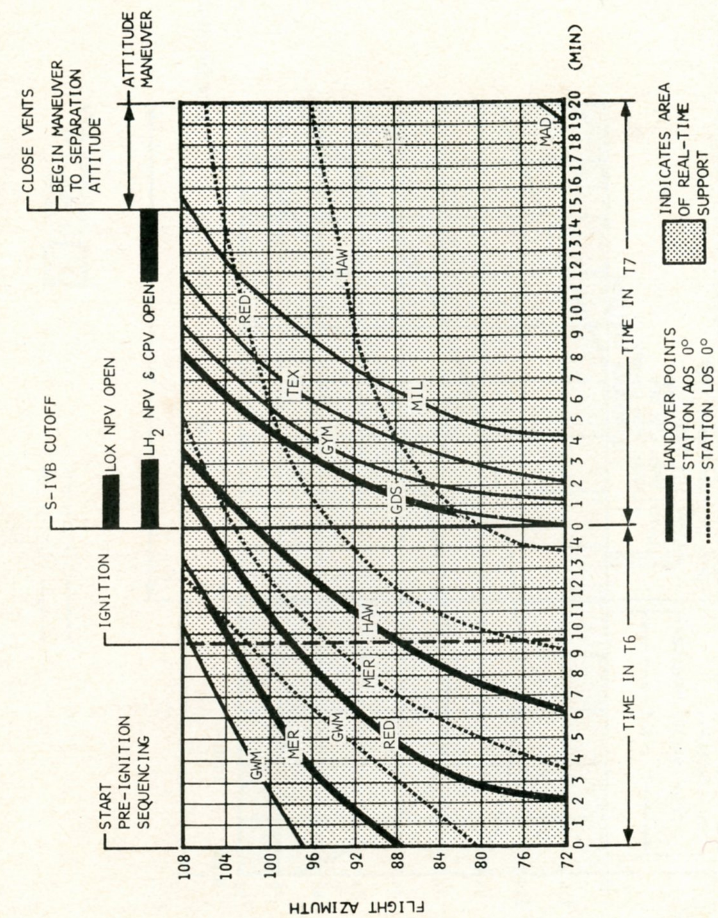
GROUND PROJECTION FROM T6 TO 15 HOURS GET FOR JULY 21, 1969 LAUNCH WINDOW.



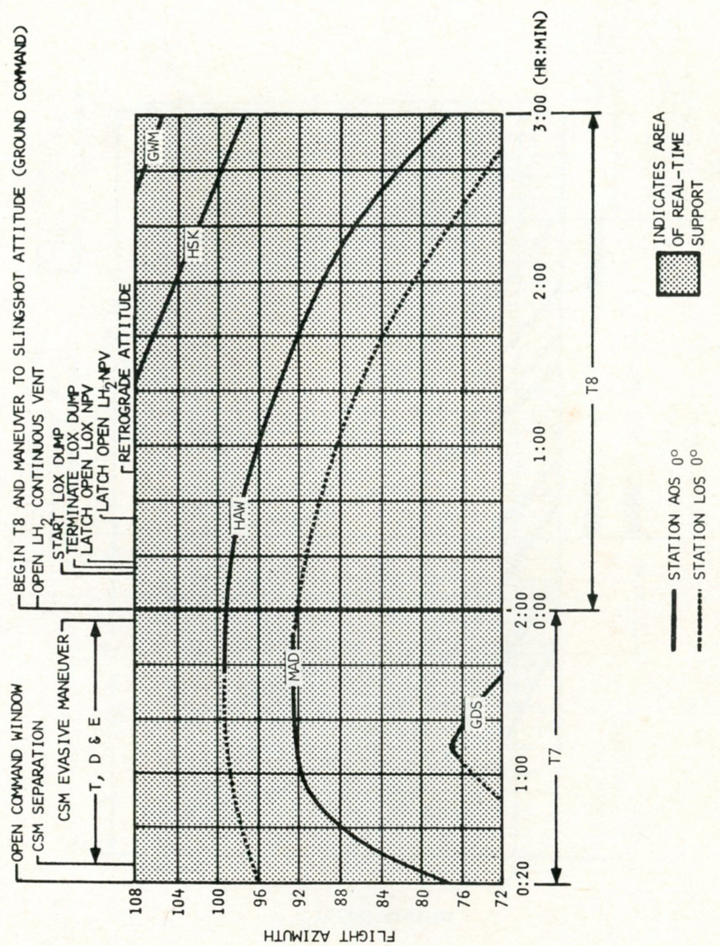
NETWORK SUPPORT FROM T6 TO T7+20 MINUTES FOR JULY 21, 1969 FIRST OPPORTUNITY.



LINE–OF–SIGHT NETWORK SUPPORT FROM T7+20 MINUTES TO T8+3 HOURS FOR JULY 21, 1969 FIRST OPPORTUNITY.



NETWORK SUPPORT FROM T6 TO T7 + 20 MINUTES FOR JULY 21, 1969 SECOND OPPORTUNITY.



LINE—OF—SIGHT NETWORK SUPPORT FROM T7+20 MINUTES TO T8+3 HOURS FOR JULY 21, 1969 SECOND OPPORTUNITY.