

The Apollo 8 Mission

Compiled by Daniel R. Adamo

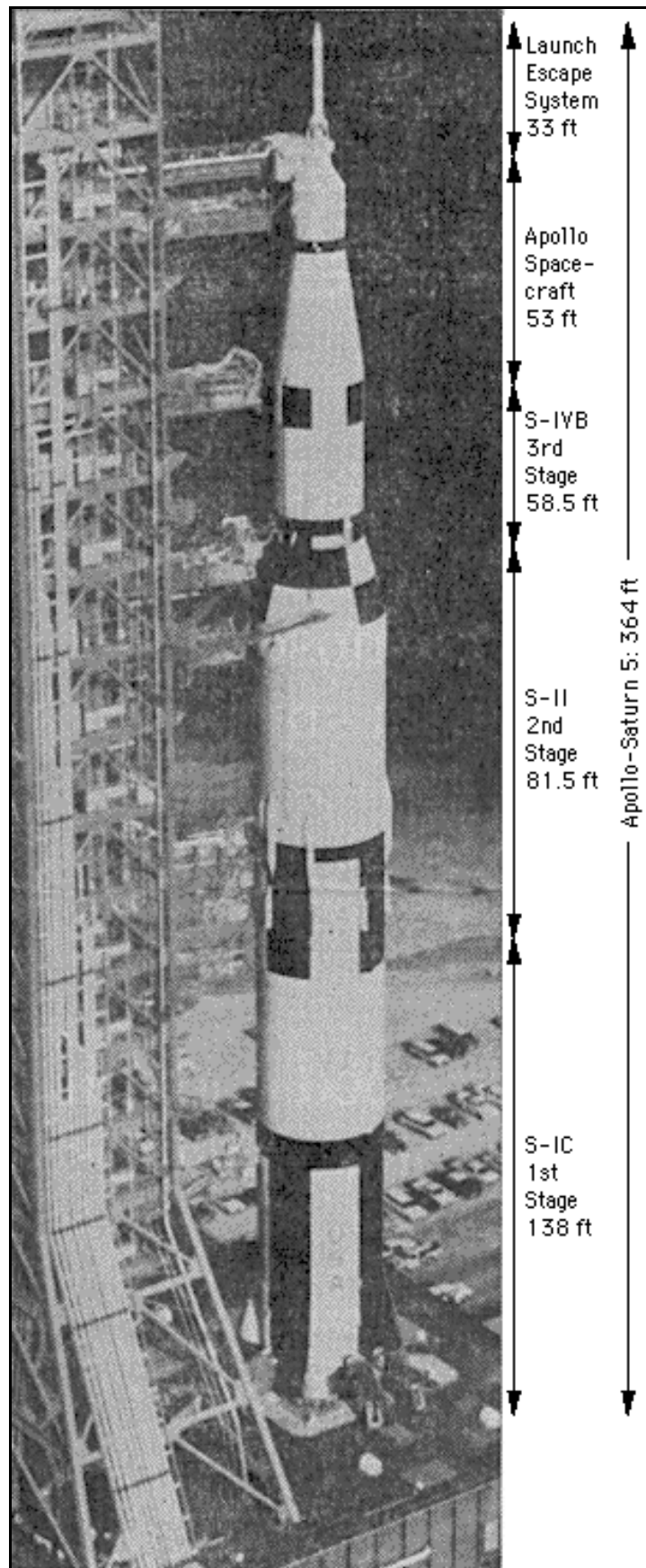
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Crew

Mission Commander Frank Frederick Borman II
Command Module Pilot James Arthur Lovell, Jr.
Lunar Module Pilot William Alison Anders

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Saturn V Launch Vehicle

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Notes

- 1) All distances are measured in statute miles (mi) units.
- 2) All speeds are measured in statute miles per hour (mph) units.
- 3) "Height" is distance from the earth's (assumed by default) or moon's center, minus the pertinent equatorial radius. "Altitude" is distance above an ellipsoid approximating earth's figure at mean sea level.
- 4) Apogee/perigee and apocyntheon/pericyntheon are maximum/minimum heights with respect to the earth and moon, respectively.
- 5) "Speed" is magnitude of inertial velocity with respect to the earth's (assumed by default) or moon's center.
- 6) "Flight path angle" and "heading" pertain to inertial velocity referenced to true north in a local horizontal plane whose normal points from the earth's (assumed by default) or moon's center.

26 December 1967

AS-503 launch vehicle begins arriving at KSC.

9 October 1968

AS-503 launch vehicle and CSM-103 spacecraft arrive at KSC LC 39A aboard MLP-1.

17 October 1968

Spacecraft CSM-103 arrives at LC 39A.

2 December 1968

Saturn IC RP-1 kerosene fuel loading is completed.

15 December 1968 EST

07:00 AM T-103:00 countdown begins.

19 December 1968 EST

08:51 PM T-028:00 terminal countdown begins.

20 December 1968 EST

02:51 PM T-010:00 SM LOX tanks are repressurized after reservicing to purge nitrogen contamination.

03:51 PM T-009:00 countdown is suspended for a 6-hour built-in hold.

09:51 PM T-009:00 countdown resumes.

10:51 PM T-008:00 launch vehicle cryogenic propellant loading begins.

21 December 1968 EST

03:21 AM T-003:30 countdown is suspended for a 1-hour built-in hold.

03:29 AM T-003:30 launch vehicle cryogenic propellant loading is complete.

04:21 AM T-003:30 countdown resumes.

04:58 AM T-002:53 crew enters CM.

07:47:50 AM T-000:03:10 Launch Director activates the automatic sequencer.

07:50:43 AM T-000:00:16.970 spacecraft is placed on internal guidance.

07:50:51 AM T-000:00:08.89 ignition sequence begins.

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07:50:53 AM T-000:00:06.585 Saturn IC inboard engine ignition.
07:50:58 AM T-000:00:01.387 all 5 Saturn IC engines running at full thrust.
07:51:00 AM T+000:00:00.27 hold-down arms are released.

T+000:00:00.67 latitude = 28.4470°N, longitude = 80.6041°W, altitude = 0.037 mi, flight path angle = 0, heading = 90° speed = 914.1 mph. Soft release mechanism is deactivated. Saturn V liftoff.



Apollo 8 Launch

07:51:01 AM T+000:00:01.76 tower clearance yaw maneuver is initiated.
07:51:09 AM T+000:00:09.72 tower clearance yaw maneuver is completed.
07:51:12 AM T+000:00:12.11 Saturn IC engines clear LC-39B tower. Control is switched from KSC to MSC. Launch vehicle begins pitch maneuver and roll from 90° azimuth.
07:51:31 AM T+000:00:31.52 roll maneuver complete.

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07:52:01 AM T+000:01:01.45 altitude = 4.570 mi, range = 1.493 mi, speed = 1417.1 mph. Launch vehicle attains local sonic speed.

07:52:18 AM T+000:01:18.9 altitude = 8.345 mi, range = 4.080 mi, speed = 1878.2 mph. Maximum dynamic pressure = 776.938 lbs/ft².

07:53:05 AM T+000:02:05.93 altitude = 25.775 mi, range = 26.127 mi, speed = 4236.67 mph. Saturn IC center engine shutdown.

07:53:25 AM T+000:02:25.50 pitch maneuver complete.

07:53:33 AM T+000:02:33.82 altitude = 40.856 mi, range = 55.590 mi, speed = 6068.02 mph. Saturn IC outboard engines shutdown.

07:53:34 AM T+000:02:34.47 altitude = 41.242 mi, range = 56.443 mi, speed = 6088.74 mph. Saturn IC jettison.

07:53:36 AM T+000:02:36.19 Saturn II ignition.

07:54:04 AM T+000:03:04.47 Saturn II aft interstage jettison.

07:54:08 AM T+000:03:08.6 LES jettison.

07:54:16 AM T+000:03:16.22 initiate IGM.

07:55:26 AM T+000:04:26.54 maximum Saturn IC altitude.

07:59:44 AM T+000:08:44.04 altitude = 119.018 mi, range = 934.740 mi, speed = 15258.5 mph. Saturn II shutdown.

T+000:08:44.90 altitude = 119.060 mi, range = 938.068 mi, speed = 15267.00 mph. Saturn II jettison.

07:59:48 AM T+000:08:48.29 Saturn IVB ignition.

07:59:56 AM T+000:08:56.8 Saturn IVB ullage case jettison.

08:00:00 AM T+000:09:00.410 latitude = 30.2040°N, longitude = 74.1090°W, distance downrange = 406.757 mi. Estimated Saturn IC splashdown.

08:00:20 AM T+000:09:20.34 maximum Saturn II altitude.

08:02:24 AM T+000:11:24.98 altitude = 118.903 mi, range = 948.839 mi, speed = 17428.93 mph. Saturn IVB shutdown.

08:02:34 AM T+000:11:34.98 latitude = 32.4741°N, longitude = 53.2923°W, altitude = 118.905 mi, range = 1646.032 mi, flight path angle = -2.072° heading = 87.47° speed = 17432.09 mph, apogee = 115.07 mi, perigee = 114.58 mi. Earth parking orbit insertion at inclination = 32.509°

08:02:45 AM T+000:11:45.19 maneuver to local horizontal attitude is initiated.

08:10:25 AM T+000:19:25.106 latitude = 31.8338°N, longitude = 37.2774°W, distance downrange = 2584.551 mi. Estimated Saturn II splashdown.

08:33:05 AM T+000:42:05 CM sextant optics cover is jettisoned for initial onboard navigation checks.

09:47 AM T+001:56 spacecraft systems are GO for TLI.

10:41:37 AM T+002:50:37.79 speed = 17426.3 mph. Saturn IVB ignition for a 5 min 17.72 sec TLI burn.

10:46:55 AM T+002:55:55.51 speed = 24226.64 mph, inclination = 30.639° Saturn IVB shutdown after an achieved DV = 6800.32 mph.

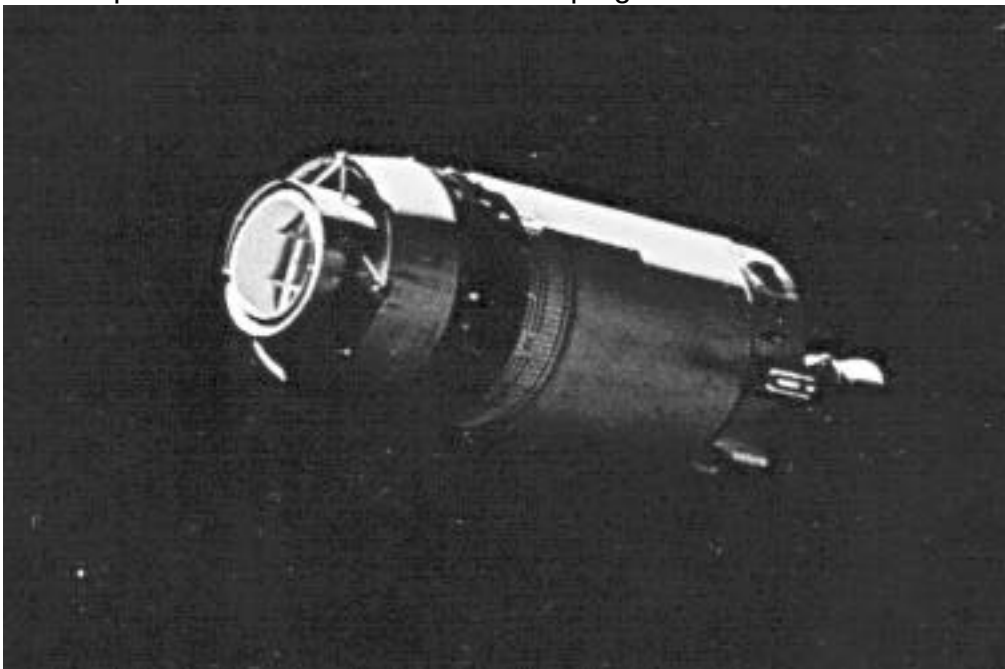
10:47:05 AM T+002:56:05.51 height = 215.450 mi, flight path angle = 7.897° heading = 67.494° speed = 24208.23 mph. TLI into an earth free-return trajectory.

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TLI Burn In Progress

- 10:47:15 AM T+002:56:15.77 Saturn IVB initiates LVLH attitude hold.
- 11:01:58 AM T+003:10:58.40 Saturn IVB initiates maneuver to spacecraft separation attitude.
- 11:11:59 AM T+003:20:59.3 height = 4370.401 mi, speed = 17028.34 mph. CSM separates from SLA for stationkeeping maneuvers with the Saturn IVB.



Jettisoned S-IVB and LTA-B

- 11:31:01 AM T+003:40:01 CSM RCS separation burn achieves initial opening rate of 0.75 mph with respect to the Saturn IVB.

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12:35:56 PM T+004:44:56.63 Saturn IVB initiates maneuver to lunar slingshot attitude.
12:36:01 PM T+004:45:01 a second CSM separation burn imparts DV = 5.2 mph.
12:46:56 PM T+004:55:56.02 Saturn IVB lunar slingshot maneuvers commence with liquid hydrogen vent initiation.
12:58:55 PM T+005:07:55.82 Saturn IVB liquid oxygen vent is initiated.
01:16:55 PM T+005:25:55.85 Saturn IVB APS ignition for a 12 min 38.15 sec burn to depletion, completing lunar slingshot maneuvers.
02:24:04 PM T+006:33:04 first communications through CSM high gain antenna.
06:50:59 PM T+010:59:59.2 height = 60724.8 mi, speed = 5582 mph, pericynthion = 527 mi. SPS ignition for a 2.4-sec midcourse correction burn. Targeted DV = 16.9 mph, achieved DV = 13.9 mph due to SPS underperformance. Height after burn = 60728.6 mi, flight path angle = 73.75° heading = 120.54° speed = 5572 mph, pericynthion = 76.3 mi.

22 December 1968 EST

03:01:36 PM T+031:10:36 height = 139000 mi, speed = 3100 mph. 23 min 37 sec telecast from CM begins.

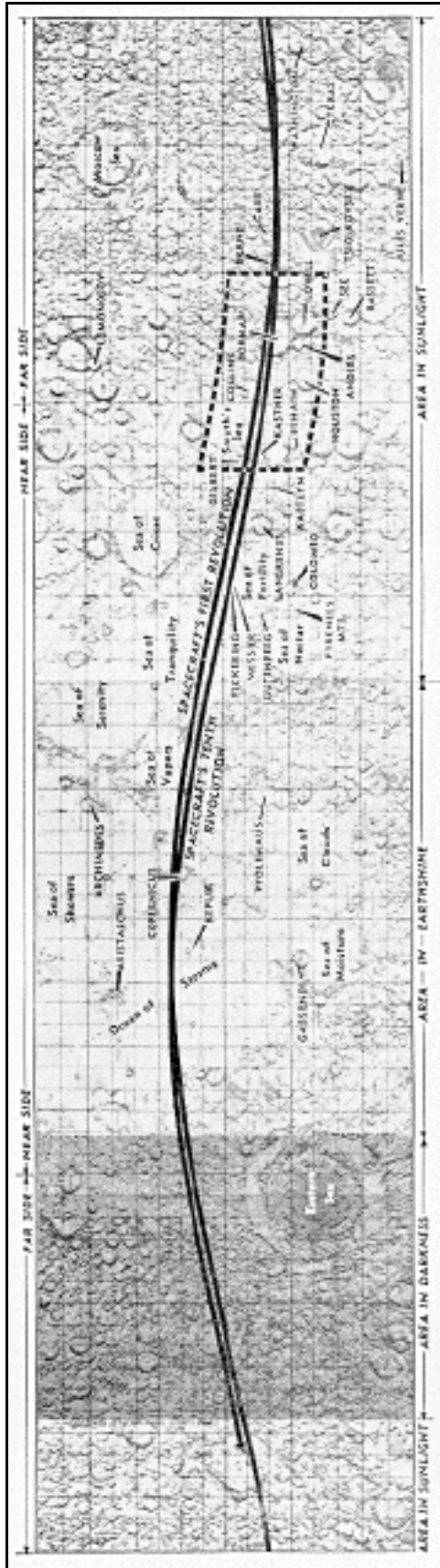
23 December 1968 EST

02:53:45 PM T+055:02:45 height = 212173 mi, speed = 2225 mph. 25 min 38 sec telecast from CM begins.
03:29:40 PM T+055:38:40 height = 202825 mi, speed = 2223 mph, lunar height = 38896 mi. CSM enters lunar gravitation sphere of influence.
08:50:55 PM T+060:59:55.9 lunar height = 24240.6 mi, speed = 2796 mph. RCS ignition for an 11.9-sec midcourse correction burn achieving DV = 0.95 mph. Lunar height after burn = 24234.5 mi, flight path angle = -84.41° heading = -87.01° speed = 2798 mph.

24 December 1968 EST

04:49:04 AM T+068:58:04 first lunar occultation LOS.
04:59:20 AM T+069:08:20.4 height = 231000 mi, lunar height = 87.0 mi, speed = 5721 mph. SPS ignition for a 4 min 6.9 sec LOI burn achieving DV = 2043 mph. Height after burn = 71.3 mi, speed = 3721 mph, apocynthion = 193.9 mi, pericynthion = 69.0 mi.

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Lunar Surface Coverage from LOI to TEI

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05:49:55 AM T+069:58:55.2 lunar latitude = 19.2°N, longitude = 88.0°E. Saturn IVB pericyynthion at 785 mi. Resulting aphelion = 91.798 million mi, perihelion = 85.722 million mi, inclination = 23.47°



First Earthrise

07:31:52 AM T+071:40:52 12-min telecast from CM begins.

09:26:06 AM T+073:35:06.6 lunar height = 68.2 mi, speed = 3736 mph. SPS ignition for a 9.6-sec circularization burn achieving DV = 91.9 mph. Lunar height after burn = 69.9 mi, speed = 3644 mph, apocynthion = 69.9 mi, pericynthion = 68.7 mi.

09:34:03 PM T+085:43:03 26 min 43 sec telecast from CM begins.

11:06 PM T+087:15 CSM maneuvers to TEI attitude.

25 December 1968 EST

01:10:16 AM T+089:19:16.6 lunar height = 69.3 mi, speed = 3642 mph, apocynthion = 73.2 mi, pericynthion = 67.4 mi. SPS ignition for a 3 min 23.7 sec TEI burn achieving DV = 2399.3 mph. Lunar height after burn = 76.1 mi, flight path angle = 5.10° heading = -115.00° speed = 6029 mph.

01:19:47 AM T+089:28:47 last lunar occultation AOS.

12:38 PM T+100:47 height = 202000 mi, speed = 2800 mph. CSM enters Earth gravitational sphere of influence.

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03:51:00 PM T+104:00:00.00 height = 190524.8 mi, speed = 2931 mph. RCS ignition for a 15.00-sec midcourse correction burn achieving DV = 3.3 mph. Height after burn = 192815.4 mi, flight path angle = -80.60° heading = 52.65° speed = 2930 mph.

04:15:04 PM T+104:24:04 height = 191750 mi, speed = 2939 mph. 9 min 31 sec telecast from CM begins.

26 December 1968 EST

03:36:33 PM T+127:45:33 height = 111550 mi, speed = 4100 mph. 19 min 54 sec telecast from CM begins.

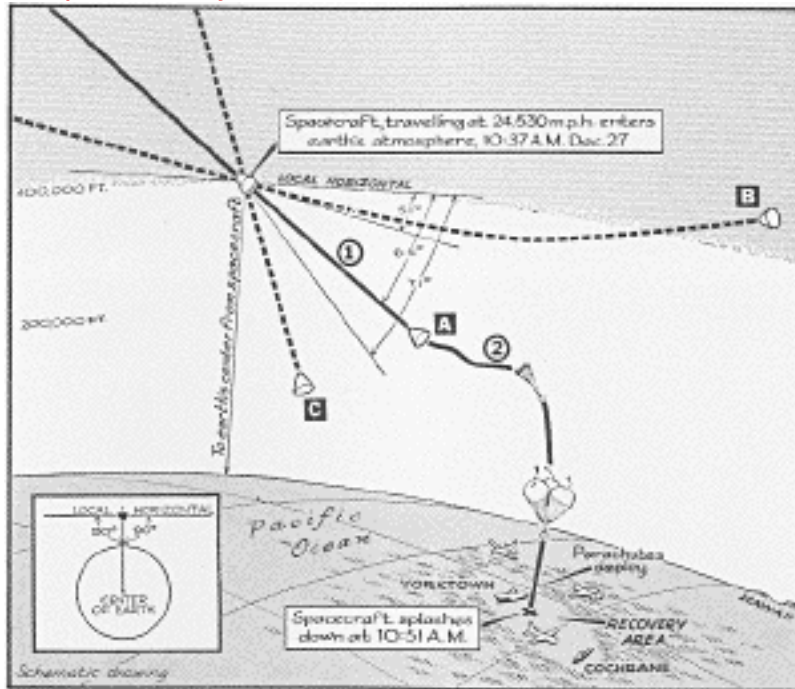
27 December 1969 EST

08:41 AM T+144:50 CSM achieves atmospheric entry attitude.

10:00 AM T+146:09 height = 7800 mi, speed = 14300 mph.

10:19:48 AM T+146:28:48 height = 1855 mi, speed = 20500 mph. SM jettison.

10:37:12 AM T+146:46:12.8 altitude = 400000 ft (72 mi), speed = 24696.2 mph. CM atmospheric entry.



Entry Corridor: $-5.1^\circ < \gamma < -7.1^\circ$

10:37:37 AM T+146:46:37 communication blackout begins.

10:38:38 AM T+146:47:38.4 altitude = 300000 ft, exterior temperature = 5000°F, maximum entry acceleration = 6.84 G. Entry steering phase is initiated.

10:40 AM T+146:49 recovery aircraft sight the CM and detect its radio beacon.

10:41 AM T+146:50 slant range = 311 mi. USS Yorktown establishes radar contact with CM.

10:42:42 AM T+146:51:42.0 CM exits communication blackout.

10:43 AM T+146:52 altitude = 60000 ft. CM computer guidance terminates.

10:45:47 AM T+146:54:47.8 altitude = 24000 ft. Drogue parachutes are deployed.

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10:46:38 AM T+146:55:38.9 altitude = 10000 ft. Drogue parachutes are released and main parachutes are deployed.

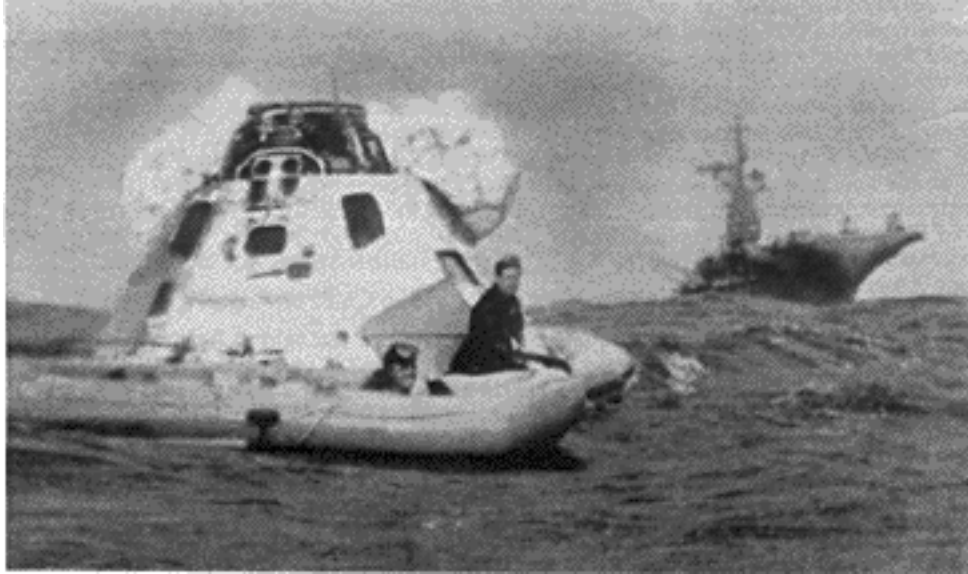
10:47 AM T+146:56 CM radio antenna and flashing beacons are deployed.

10:51:42 AM T+147:00:42 latitude = 8.12°N, longitude = 165.02°W, speed = 17 mph.
CM Stable 2 splashdown 1.6 mi from target and 3.0 mi from the USS Yorktown.

10:58:45 AM T+147:07:45 CM attains Stable 1.

11:35 AM T+147:44 sunrise. Recovery swimmers are deployed.

12:20 PM T+148:29 crew arrives aboard the USS Yorktown.



CM Awaiting USS Yorktown Recovery

01:20 PM T+149:29 CM arrives aboard the USS Yorktown.

The Apollo 8 Mission Acronym List: Compiled by Daniel R. Adamo

AOS: Acquisition Of Signal
APS: Auxiliary Propulsion System
AS: Apollo-Saturn
CM: Command Module
CSM: Command-Service Module
IGM: Iterative Guidance Mode
KSC: Kennedy Space Center
LC: Launch Complex
LES: Launch Escape System
LOI: Lunar Orbit Insertion
LOS: Loss Of Signal
LTA: Lunar module Test Article
MLP: Mobile Launch Platform
MSC: Manned Spacecraft Center
NASA: National Aeronautics and Space Administration
RCS: Reaction Control System
SLA: Spacecraft Lunar module Adapter
SM: Service Module
SPS: Service Propulsion System
TEI: Trans-Earth Injection
TLI: Trans-Lunar Injection
USS: United States Ship