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JOHN F. KENNEDY SPACE CENTER

TR-1283
May 9, 1974

(NASA-TM-X-70135) DELTA-102 SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS-A): OPERATIONS SUMMARY (NASA) ~~43~~ 41 p HC $5.25 CSCL 22B

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DELTA-102

SYNCHRONOUS METEOROLOGICAL SATELLITE

(SMS-A)

OPERATIONS SUMMARY

Prepared by
Spacecraft and Support Operations Division, KSC-ULO

TR-1283
May 9, 1974

DELTA-102

SMS-A

OPERATIONS SUMMARY

Approved by

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MISSION

A. SUMMARY AND OBJECTIVE

1. Summary. The Synchronous Meteorological Satellite (SMS) program is a joint effort of the National Aeronautics and Space Administration and the Department of Commerce. This program is intended to provide systematic worldwide weather coverage on an operational basis. The pilot SMS program is expected to launch three spacecraft: two prototype spacecraft designated SMS-A and SMS-B and one operational spacecraft designated SMS-C. The SMS program will use spacecraft in synchronous orbit to obtain day and night information on the earth's weather by means of earth imaging instruments, retransmission of image data, data collection, data relay, and space environmental monitoring.

2. Objective. The objectives of this mission are:

a. To extend the knowledge and understanding of the atmosphere and its processes by viewing the evolution and motion of storms and other atmospheric phenomena.

b. To help develop a domestic and international environmental network that can receive, process, and distribute routine observations and early weather warnings in realtime.

c. To improve National Oceanographic and Atmospheric Administration's (NOAA) ability to forecast and warn of solar disturbances in realtime.

d. To increase the kind, quantity, and quality of environmental-parameter measurements.

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. Launch Vehicle. Delta-102, Model 2914 (figure 1-1), is a three-stage vehicle with nine solid strap-on motors for thrust augmentation. It consists of a DSV-3P-1A extended long tank Thor first stage with a Rocketdyne RS-27 engine system augmented by nine low-drag Thiokol TX-354-5 Castor II solid motors, a DSV-3P-5 second stage with a TRW TR-201 engine, and a Thiokol TE-M-364-4 powered third stage. The prime contractor for the launch vehicle is the McDonnell Douglas Astronautics Company (MDAC). Pertinent vehicle data are presented in table 1-1.

2. Spacecraft. The SMS-A spacecraft (figure 1-2) manufactured by Philco-Ford has a designed lifespan of five years. It is a cylindrical shaped satellite with solar cells mounted around the periphery. The primary structural member is a thrust tube located in the center of the cylinder. The radiometer/telescope instrument, extending the length of the spacecraft, is located in and supported

by the thrust tube. The scanning mirror looks out through an opening in the cylindrical solar array of the spacecraft with a clear field of view of the earth. The radiation cooler is mounted on the end of the spacecraft with a clear view of space. Solar panels form the outer walls of the spacecraft. An equipment shelf contains most of the spacecraft electronics. Refer to table 1-2 for pertinent spacecraft data.

Table 1-1. Delta-102 Vehicle Data

	Boosters	Stage I	Stage II	Stage III
Length	6.0 m (19.7 ft)	22.5 m (74.0 ft)	568.9 cm (288 in.)	188 cm (74 in.)
Diameter	78.74 cm (31 in.)	243.8 cm (96 in.)	139.4 cm (55 in.)	94 cm (37 in.)
Engine type	Solid	Liquid	Liquid	Solid
Engine manufacturer	Thiokol	Rocketdyne	TRW	Thiokol
Designation	TX-354-5	RS-27	TR-201	TE-M-364-4
Number of engines	9	1 (+2VE)	1	1
Specific impulse	237.6	262.4	302	285.5
Thrust (per engine)	231,974 N (52,150 lb)	911,840 N (205,000 lb)	42,923 N (9,650 lb)	64,049 N (14,400 lb)
Burn time	35.5 (sec)	228 (sec)	315 (sec max)	43.6 (sec)
Propellant	TP-H-7036	-	-	TP-H-3062
Fuel	-	RP-1	A50	-
Oxidizer	-	Lox	N O	-
Nitrogen gas	-	3,000 psig	4,250 psig	-
Helium gas	-	-	4,350 psig	-
Serial number	414, 425, 426, 428, 429, 430, 432, 433, 434	20008	20007	40020

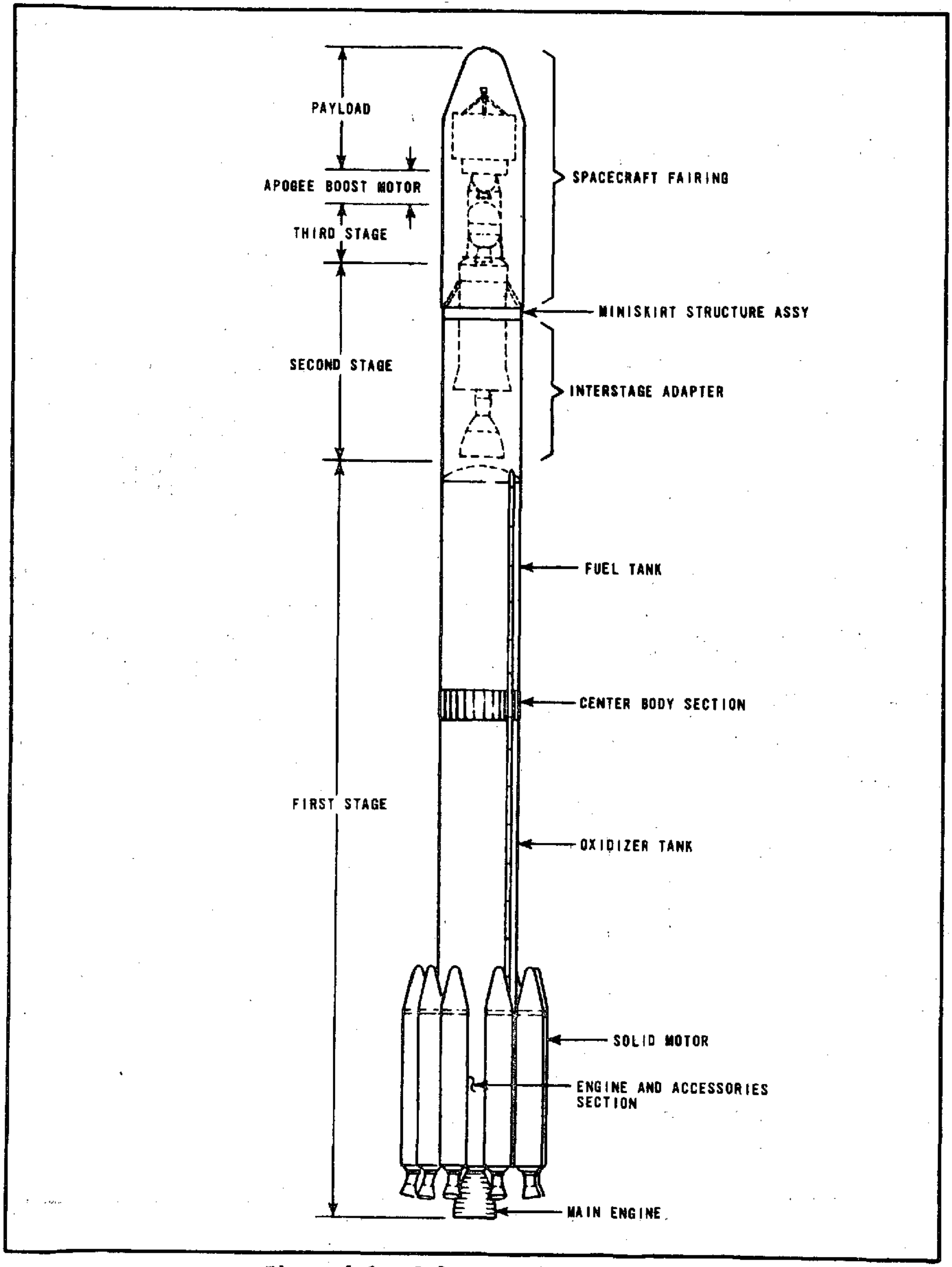


Figure 1-1. Delta-102 Launch Vehicle

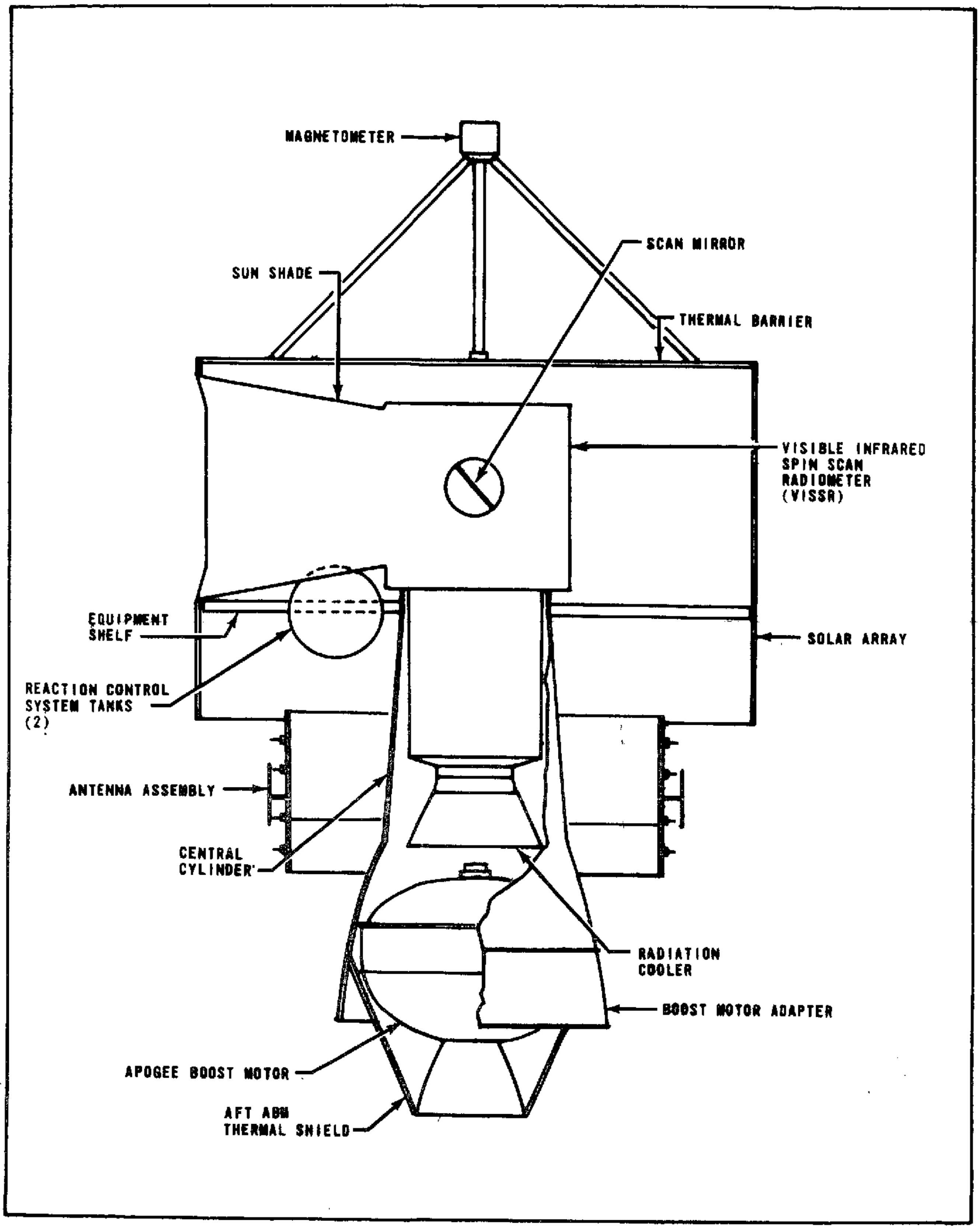


Figure 1-2. SMS-A Spacecraft

Table 1-2. SMS-A Spacecraft Data

Diameter	190.5 cm (75 in.)
Height (top of magnetometer to bottom of apogee boost motor)	344 cm (135.5 in.)
Height (less apogee boost motor)	259 cm (102 in.)
Weight (at launch)	628 kg (1385 lbs)
Weight (after apogee boost motor ejected)	278.4 kg (614 lbs)
Electrical power	140 watts (min)
Life expectancy	5 years (min)

An apogee boost motor (ABM) is attached to the thrust tube and covers the radiation cooler area. The ABM places the spacecraft into a near circular drift orbit, removes orbital inclination, and places the spacecraft in a quasi-synchronous equatorial orbit. Immediately after the spacecraft is boosted into a synchronous orbit, the apogee motor will be ejected. Refer to table 1-3 for pertinent apogee boost motor data.

Table 1-3. Apogee Boost Motor Data

Manufacturer	Aerojet
Model	AJ SVM-5
Thrust	22,507N (5060 lbs)
Burn time	35 sec (approx)
Fuel type	ANB-3066 aluminized polybutadiene ammonium-perchlorate
Fuel weight	288 kg (635 lbs)
Gross weight	319 kg (703 lbs)
Size	
Top of safe/arm device to bottom of nozzle	88.3 cm (34.8 in.)
Diameter of mushroom	80.3 cm (31.6 in.)

A brief description of the spacecraft systems follows:

a. Communications. The communication system consists of a redundant S-band, UHF and VHF transmitters and receivers, associated antennas, couplers, and control circuitry.

b. Command. The command system is comprised of redundant command sampling units and command processors and a central command processing unit which has the capability to receive, decode, and execute the spacecraft commands. The entire system is packaged into one assembly, referred to as the command unit.

c. Telemetry. The telemetry system processes and multiplexes the analog and binary telemetry input signals from the spacecraft systems for transmission to the ground stations. The analog inputs are digitized and combined with binary data inputs to generate a serial split-phase (Manchester coding) PCM output.

d. Attitude Control. Attitude and stabilization control of the SMS spacecraft will be maintained through the operation of an attitude determination and control (ADAC) system and an auxiliary propulsion system (APS) on-board the spacecraft. These systems will be operated either automatically on the spacecraft or by commands from the ground stations. Spacecraft attitude and stabilization control will consist of active and passive nutation control, injection velocity correction, fine and coarse spin-axis precession, fine and coarse attitude control, spin-rate and spin-speed control, station acquisition and changing, and east-west stationkeeping.

e. Electrical Power. Spacecraft electrical power is supplied from solar cells. The system is designed so that the normal operation, plus battery charging, is supplied by the solar array output. The power system provides a regulated +29.4 ± 0.2-volt dc output.

The power system consists of solar cell arrays, two nickel-cadmium (Ni-Cd) batteries, and power supply electronics. Power generation is accomplished by means of an array of body-mounted silicon solar cells. The output of the solar cell array is provided to a main bus. The main part of the solar array is capable of providing a minimum of 140 watts output for 5 years.

Power storage to support spacecraft operations during eclipse modes is provided by two 20-cell, 3 ampere-hour, nickel-cadmium batteries. During the sunlight modes of operation, the batteries are charged to full charge status and maintained there. The batteries are sized to provide for the essential loads during the eclipse period. They are charged from a separate section of the solar array appropriately sized to provide a constant, safe level of charge.

f. Instrumentation. The basic payload of the spacecraft consists of a visible and infrared spin scan radiometer (VISSR) system to obtain infrared (thermal) and high resolution visible photography and a space environmental monitoring system (SEMS).

C. MISSION PLAN

1. Launch Constraints.

a. Launch Window. The actual times of the launch windows from May 15 through May 19, 1974 are presented in table 1-4. Launch is scheduled for May 16, 1974.

Table 1-4. Launch Windows

Date	Opens (EDT)	Closes (EDT)
May 15	0523	0547
May 16	0523	0547
May 17	0523	0547
May 18	0523	0547
May 19	0523	0547

b. Launch Vehicle. All vehicle in-line subsystems must be operational at launch as required by the operations parameters in the countdown manual. Since all primary test objectives are associated with the spacecraft, there are no mandatory vehicle requirements on telemetry; however, if a telemetry channel carrying critical information becomes inoperative during the countdown, it is sufficient cause for a hold to review the possible effects on vehicle readiness and performance.

c. Allowable Wind Conditions. The maximum allowable wind velocity which the vehicle in any configuration can safely withstand when it is erected on the pad with the gantry around it is 64 knots. The maximum wind velocity which the vehicle can safely withstand when it is erected and with the gantry removed is 43 knots.

The Go-No Go decision for upper wind conditions is based on a computer program at MDAC, Santa Monica and is a combination of wind shear, velocity, and direction factors.

2. Flight Plan.

The SMS-A spacecraft will be launched from the Eastern Test Range Complex 17, Pad B, Cape Canaveral Air Force Station (CCAFS), Florida no earlier than May 16, 1974. The pad azimuth is 115 degrees but the vehicle will roll to 90 degrees from true North shortly after liftoff.

The spacecraft will be injected into an elliptical transfer orbit (figure 1-3). It will be spin stabilized at a spin rate of 90 rpm as provided by the vehicle third stage spin table. On the second apogee of the transfer orbit the apogee boost motor will be fired to place the satellite into a near circular drift orbit above the equator.

After the apogee motor burn, the spin axis will be oriented normal to the orbit plane and the orbit adjusted for drift onto station.

When on station in synchronous orbit, the spin rate will be adjusted to 100 rpm with an accuracy of ± 1 rpm. The spacecraft spin axis relative to the orbit plane will be controlled by the thruster engines to a maximum accuracy of 0.05 degree (.3 arcs-minutes). Orbit parameters are listed in table 1-5.

Table 1-5. SMS-A Orbit Parameters

Parameters	Transfer Orbit	Mission Orbit
Apogee	36,182 km (22,483 mi)	35,900 km (22,300 mi)
Perigee	185 km (115 mi)	
Inclination	23.8 degrees	1 degree (and decreasing)
Anomalistic Period		1436 min

The nominal sequence of events from liftoff through SECO No. 3 is presented in table 1-6. Times are in seconds after liftoff (T+ seconds); those events which occur after Main Engine Cutoff (MECO) and Second Stage Engine Cutoff (SECO) are also referenced as M+ seconds, S1+ seconds, and S2+ seconds.

D. POST LAUNCH OPERATIONS

The initial Project Operations Control Center (POCC) for the SMS mission is the Multi-satellite Operations Control Center (MSOCC) located in Building 14 at Goddard Space Flight Center. The MSOCC is the central control facility for all SMS operations during the prelaunch, launch and transfer orbit, drift and 90-day checkout phases of the mission. Thereafter, the MSOCC will provide control center support on a scheduled basis as requested by the National Oceanographic and Atmospheric Administration (NOAA). The MSOCC will coordinate and monitor the spacecraft operations support and will function as the organization by which the SMS Project will control the spacecraft during the support phases.

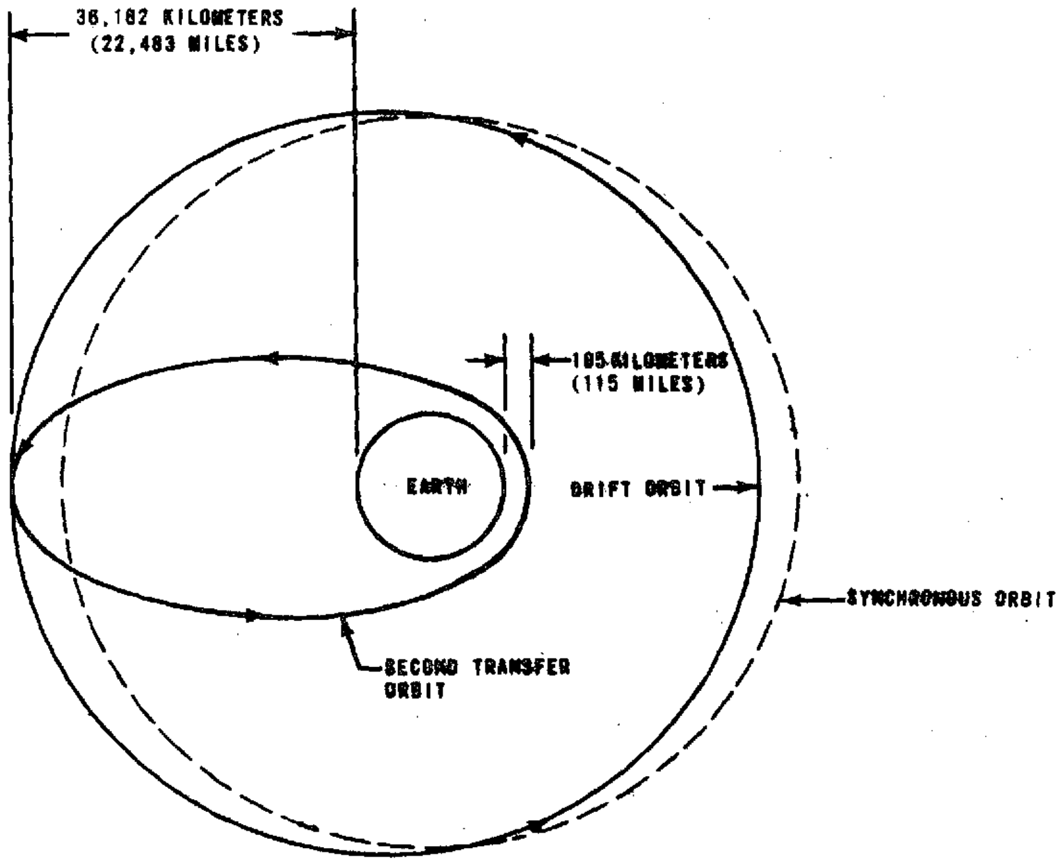


Figure 1-3. SMS-A Orbital Paths

Table 1-6. Sequence of Flight Events

T+Sec	Min:Sec	Event
T-0.2	-00:00.2	Pitch and yaw vernier engines locked out
		Start solid motor separation command timer
		Solid motor ignition (4,5,6,7,8,9)
T+0	00:00.0	Liftoff
T+2.0	00:02.0	Begin first roll program
T+8.0	00:08.0	Begin first pitch program
		End first roll program
T+13.5	00:13.5	End first pitch program
		Begin second pitch program
T+15.5	00:15.5	End second pitch program
		Begin third pitch program
T+20.0	00:20.0	End third pitch program
		Begin fourth pitch program
T+30.0	00:30.0	End fourth pitch program
		Begin fifth pitch program
T+38.0	00:38.0	Gain change - pitch, yaw, roll, feedback shaping network
T+38.2	00:38.2	Solid motor burnout (4,5,6,7,8,9)
T+39.0	00:39.0	Solid motor ignition (1,2,3)
T+40.0	00:40.0	End fifth pitch program
		Begin sixth pitch program

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event
T+60.0	00:60.0	End sixth pitch program
		Begin seventh pitch program
		Gain change - pitch, yaw
T+70.0	01:10.0	End seventh pitch program
		Begin eighth pitch program
T+77.4	01:17.4	Solid motor burnout (1,2,3)
T+80.0	01:20.0	End eighth pitch program
		Begin ninth pitch program
T+87.0	01:27.0	Solid motor separation command
		Gain change - pitch, yaw, roll
T+90.0	01:30.0	End ninth pitch program
		Begin tenth pitch program
T+120.0	02:00.0	Start Guidance
		Gain change - pitch, yaw
T+180.0	03:00.0	Gain change - pitch, yaw
T+207.6	03:27.6	Switch to velocity only steering
T+222.6	03:42.6	Stop computing guidance steering corrections
T+223.6	03:43.6	Stop first stage closed loop guidance
		Enable MECO
T+225.0	03:45.0	End tenth pitch program
		MECO command

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event
T+227.6 (M+0)	03:47.6	MECO
		VE enable/main engine lockout (enable pitch and yaw vernier engines)
		Stage II hydraulic pump on (back-up)
		Arm stage II ignition and pyro power
		Gain change - pitch, yaw
T+229.6 (M+2.0)	03:49.6	Pressurize tanks
T+233.6 (M+6.0)	03:53.6	Remove tank pressurization discrete
		Close tank pressurization valve
		VECO
T+235.6 (M+8.0)	03:55.6	Blow stage I/II separation bolts
		Remove SECO discrete
T+236.6 (M+9.0)	03:56.6	Remove stage I discrete
		Gain change - pitch, roll, yaw
T+239.6 (M+12.0)	03:59.6	Remove separation discretes
		Pressurize tanks
T+240.6 (M+13.0)	04:00.6	Start stage II engine
		Gain change - pitch, yaw
T+240.9 (M+13.3)	04:00.9	Start of steady state burn

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Events
T+241.5 (M+13.9)	04:01.5	Begin eleventh pitch program
T+241.6 (M+14.0)	04:01.6	Remove tank pressurization and engine start discretes
T+251.5 (M+23.9)	04:11.5	End eleventh pitch program Begin twelfth pitch program
T+274.0 (M+46.4)	04:34.0	Fairing unlatch
T+275.0 (M+47.4)	04:35.0	Fairing separation
T+277.0 (M+49.4)	04:37.0	Remove fairing separation discrete
T+280.0 (M+52.4)	04:40.0	Start guidance
T+479.6 (M+252.0)	07:59.6	Switch to velocity only steering
T+526.6 (M+299.0)	08:46.6	Stop computing guidance steering corrections
T+528.4 (M+300.8)	08:48.4	Stop guidance
T+529.6 (M+302.0)	08:49.6	SECO No. 1 (stage II engine cutoff) End twelfth pitch program Turn off hydraulic pump
T+539.0 (S1+9.4)	08:59.0	Begin first coast guidance
T+579.0 (S1+49.4)	09:39.0	End first coast guidance Begin second roll program

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event
T+589.0 (S1+59.4)	09:49.0	End second roll program
T+589.6) (S1+60.0)	09:49.6	Enable CDR turnoff
T+590.6 (S1+61.0)	09:50.6	Turn off CDRs
T+591.0 (S1+61.4)	09:51.0	Begin thirteenth pitch program
T+662.0 (S1+132.4)	11:02.0	End thirteenth pitch program
T+667.0 (S1+137.4)	11:05.0	Begin third roll program
T+1287.0 (S1+757.4)	21:27.0	End third roll program
T+1290.0 (S1+760.4)	21:30.0	Begin fourteenth pitch program
T+1342.0 (S1+812.4)	22:22.0	End fourteenth pitch program
T+1345.0 (S1+815.4)	22:25.0	Begin second coast guidance
T+1375.0 (S1+845.4)	22:55.0	End second coast guidance
T+1376.2 (S1+846.6)	22:56.2	Initiate ullage jets
T+1406.2 (S1+876.6)	23:26.2	Turn on hydraulic pump
T+1433.2 (S1+903.6)	23:53.2	Stage II engine restart No. 1
T+1433.5 (S1+903.9)	23:53.5	Start of steady state burn

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event
T+1434.2 (S1+904.6)	23:54.2	Ullage jets off
		Initiate stage II restart guidance
T+1439.3 (S1+909.7)	23:59.3	Stop computing guidance steering corrections
T+1440.1 (S1+910.5)	24:00.1	End stage II restart guidance
T+1441.3 (S1+911.7)	24:01.3	SECO No. 2 (Stage II engine cutoff)
T+1442.3 (S2+1.0)	24:02.3	Turn off hydraulic pump
T+1445.0 (S2+3.7)	24:05.0	Begin third coast guidance
T+1485.0 (S2+43.7)	24:45.0	End third coast guidance
T+1487.3 (S2+46.0)	24:47.3	Fire spin rockets
		Start stage III ignition time delay
		Start stage III sequence timer
T+1488.3 (S2+47.0)	24:48.3	Fire stage III wire cutter
		Remove spin rocket discrete
T+1489.3 (S2+48.0)	24:49.3	Remove stage III wire cutters discrete
		Blow stage II/III separation bolts
		Fire retros
T+1530.8 (S2+89.5)	25:30.8	Stage III ignition
T+1574.4 (S2+133.1)	26:14.4	Stage III burnout
T+1647.3 (S2+206.0)	27:27.3	Payload separation

Table 1-6. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event
T+1649.3 (S2+208.0)	27:29.3	Release YO weight
T+1750.0 (S2+308.7)	29:10.0	Begin fifteenth pitch program
T+1850.0 (S2+408.7)	30:50.0	End fifteenth pitch program
T+1950.0 (S2+508.7)	32:30.0	Begin fourth coast guidance
T+2229.0 (S2+787.7)	37:09.0	Turn on hydraulic pump
T+2230.0 (S2+788.7)	37:10.0	End fourth coast guidance
T+2231.0 (S2+789.7)	37:11.0	Initiate ullage jets
T+2250.0 (S2+808.7)	37:30.0	Stage II engine restart No. 2
T+2250.3 (S2+809.1)	37:30.3	Start of steady state burn
T+2251.0 (S2+809.7)	37:31.3	Ullage jets off
T+2265.0 (S2+823.7)	37:45.0	SECO No. 3 (stage II engine cutoff)
T+2291.0 (S2+849.7)	38:11.0	Fire yaw jets
T+2306.0 (S2+864.7)	38:26.0	Turn off yaw jets
T+2366.0 (S2+924.7)	39:26.0	Fire pitch and roll jets
T+2381.0 (S2+939.7)	39:41.0	Turn off pitch and roll jets

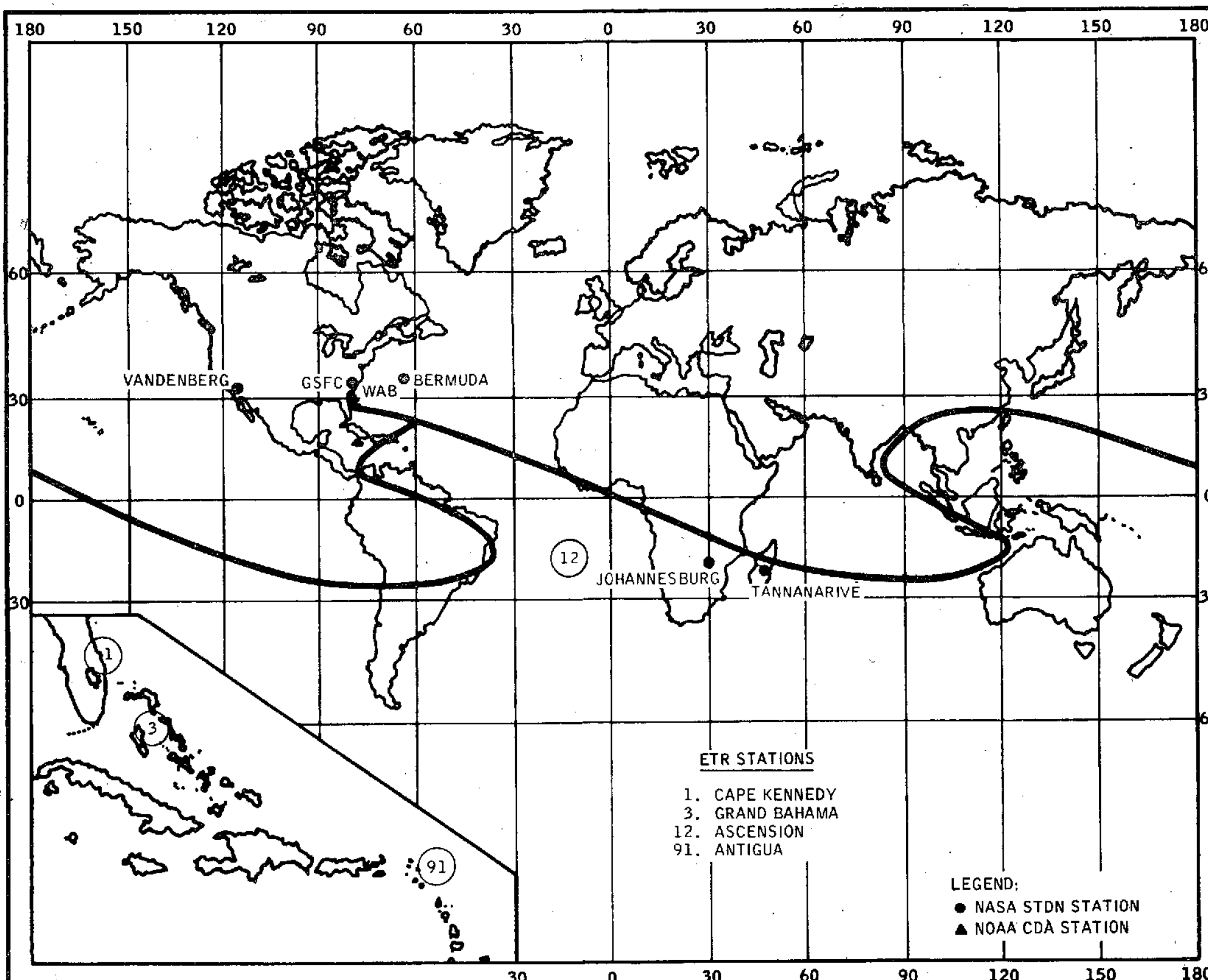


Figure 1-4. Spacecraft Tracking and Trajectory

SECTION II
LAUNCH OPERATIONS PLAN

A. OPERATIONAL AREAS

1. Complex 17. All launch and pad operations during final countdown are conducted from the blockhouse at Complex 17 by the MDAC Test Conductor. Countdown readiness and status of the booster and spacecraft stages are the responsibility of the appropriate contractor test conductors. Overall management of launch operations is the responsibility of the Unmanned Launch Operations (ULO) Directorate. The ULO Test Controller functions as the official contact between test personnel and the Eastern Test Range (ETR). The ULO Spacecraft Operations Engineer in the blockhouse coordinates spacecraft activities and reports spacecraft status to the test conductor.

2. Building AE. The mission operational areas in Building AE consist of the Mission Director's Center (MDC), including an observation area located behind the MDC for observing overall mission progress, and the Launch Vehicle Telemetry Ground Station. Figure 2-1 shows the location of the launch and operational areas and figure 2-2 shows the layout of Building AE.

The launch operations and overall mission activities are monitored by the Mission Director in the MDC (figure 2-3) where he is informed of launch vehicle, spacecraft, and tracking network flight readiness. From the information presented, the Mission Director will determine whether or not the mission will be attempted. Appropriate prelaunch and realtime launch data are displayed to provide a presentation of vehicle launch and flight progress. The MDC also functions as an operational communications center during launch operations.

The front of the MDC consists of large illuminated displays including a list of tracking stations, Range stations in use, plotting boards, and a sequence of events after liftoff.

Three plotting boards are located at the center of the displays and are used to show present position and Instantaneous Impact Prediction (IIP) plots. These displays, when plotted with the theoretical plots, give an overall representation of the launch performance.

The following information will also be displayed in the MDC during SMS-A launch operations:

a. TV

b. ETR test number

c. Greenwich Mean Time (GMT) and Eastern Daylight Time (EDT) synchronized to WWV

d. Time remaining in launch window

e. Predicted liftoff time

f. Built-in hold time

g. Countdown progress

h. Range readiness

i. Countdown task summary

j. Spacecraft stations readiness

k. Impact prediction

l. Doppler

m. Launch azimuth

n. Post liftoff vehicle events

o. Present position

The ULO Launch Vehicle Telemetry Ground Station monitors, evaluates, and records launch vehicle telemetry signals during prelaunch checkout to assist in determining vehicle launch readiness. After liftoff, realtime analysis of telemetry data will be used to determine vehicle performance and for display in the MDC.

A Launch Vehicle Data Center is located in room No. 135 within the low bay of Building AE (figure 2-4). Range Safety displays and complex television pictures are presented in this room during Delta launches.

3. Building S. The spacecraft Test Complex (STC), located in Building S (figure 2-1) uses the south clean room for spacecraft checkout and assembly, the north clean room as an airlock operational area, and the control room adjacent to the south clean room for a telemetry ground station. Total spacecraft checkout is performed in this area.

B. DATA ACQUISITION

Telemetry, optical, and radar data will be supplied by a composite of ETR, Goddard Space Flight Center (GSFC), and Kennedy Space Center (KSC) stations. The support requirements of various stations are described in the following paragraphs; the geographical location of the various stations is presented in figure 1-4. An anticipated telemetry coverage chart is presented in figure 2-5.

1. Vehicle Telemetry.

a. There will be only two links of telemetry on Delta 102; 2244.1 MHz on stage I, and 2241.5 MHz on stage II. Both links will have 45 X 20 PDM systems on VCO C and E. The 2241.5 MHz link will also have a PCM signal on VCO G.

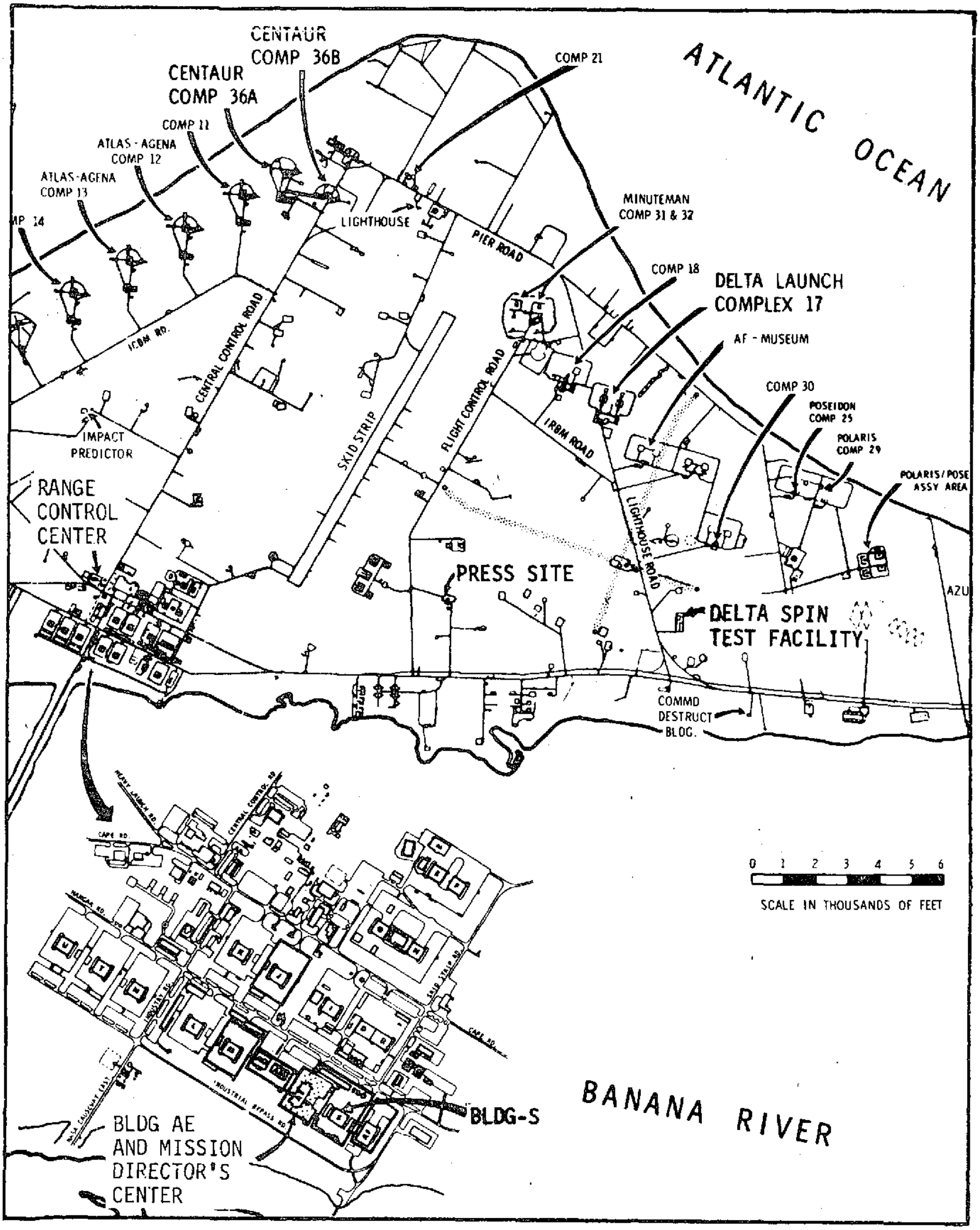


Figure 2-1. Launch and Operational Areas

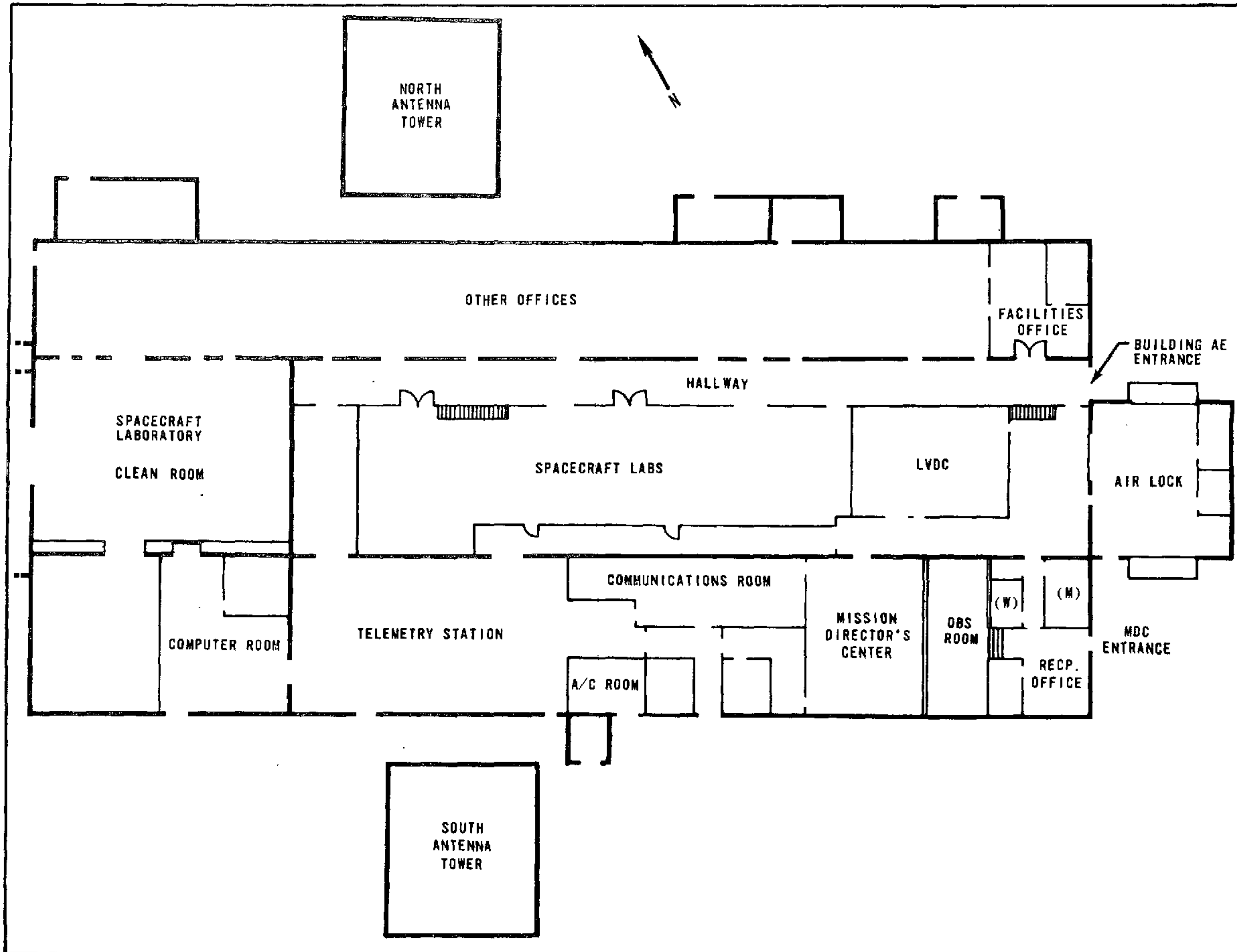
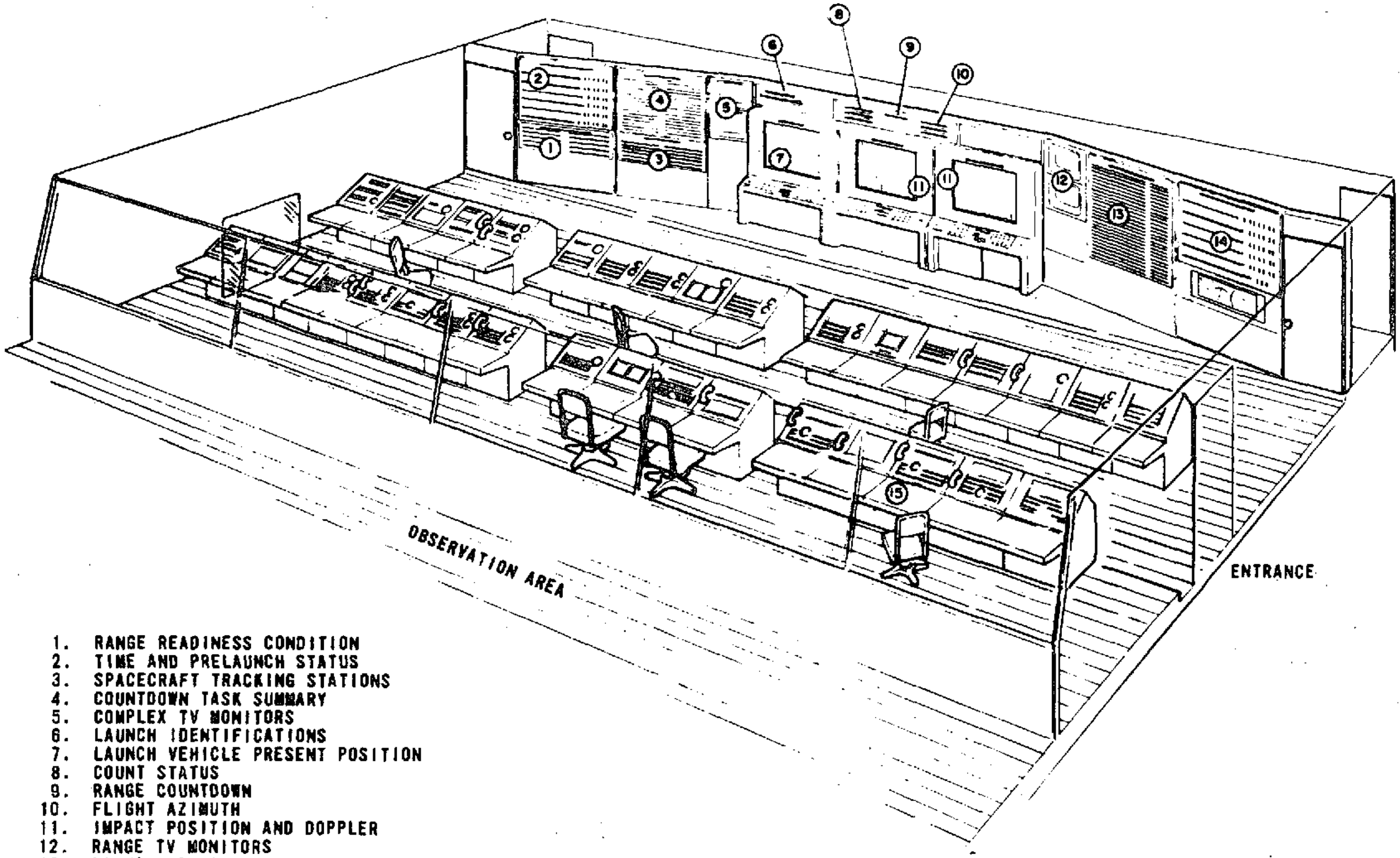


Figure 2-2. Building AE



1. RANGE READINESS CONDITION
2. TIME AND PRELAUNCH STATUS
3. SPACECRAFT TRACKING STATIONS
4. COUNTDOWN TASK SUMMARY
5. COMPLEX TV MONITORS
6. LAUNCH IDENTIFICATIONS
7. LAUNCH VEHICLE PRESENT POSITION
8. COUNT STATUS
9. RANGE COUNTDOWN
10. FLIGHT AZIMUTH
11. IMPACT POSITION AND DOPPLER
12. RANGE TV MONITORS
13. LAUNCH VEHICLE EVENTS
14. TIME AND POST LAUNCH STATUS
15. MISSION DIRECTOR

Figure 2-3. Mission Director's Center

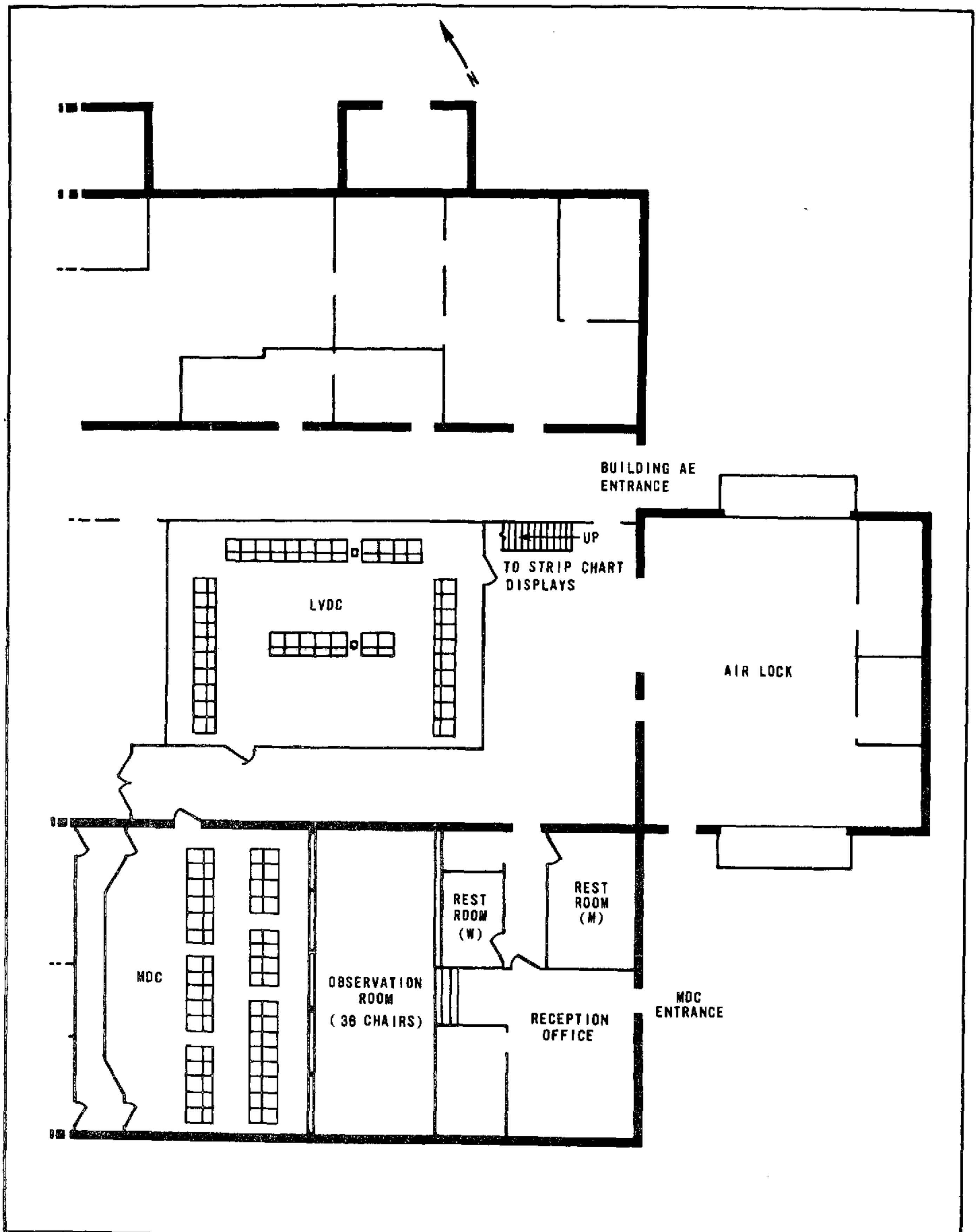


Figure 2-4. Building AE, LVDC and MDC Areas

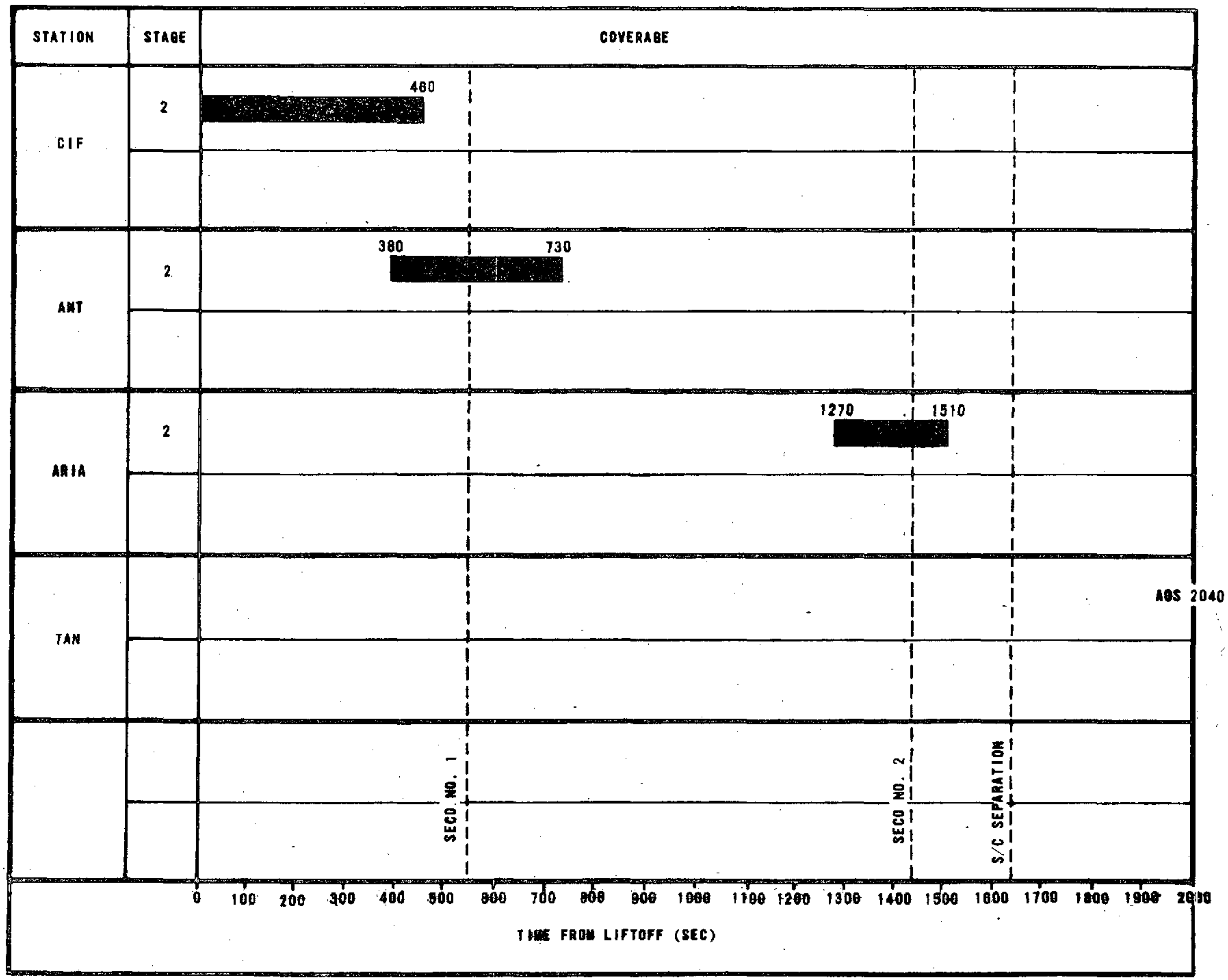


Figure 2-5. Anticipated Telemetry Coverage, SMS-A

b. Uprange Telemetry. During the prelaunch operations, the checkout data will be received, recorded, and displayed in realtime at both the Complex 17 station, operated by MDAC, and the Building AE station, operated by KSC. The Building AE station will display all channels telemetered and the Complex 17 station will display as many measurements as recorders permit. System engineers will observe the data at both sites to determine the flight readiness of the vehicle. Both stations will display the realtime data post-test for flight evaluation prior to the post-flight critique.

Building AE and Complex 17 telemetry stations will use hardline data throughout most of the prelaunch testing, but will switch to Central Instrumentation Facility (CIF) received data shortly before liftoff. The CIF data should provide 100 percent coverage until well into the Antigua acquisition period.

c. Downrange Telemetry.

(1) Both Merritt Island Unified S-band site (MIL) and Bermuda (BDA) stations will remote selected data to GSFC for GSFC display and to ULO/WTR and MDAC A3 for analysis via the 7.2 k bit STDN format. These data will be routed to Building AE on the Tananarive circuit prior to Tananarive acquisition of signal (AOS) and may be displayed at Building AE if circumstances warrant.

(2) Antigua (ANT) (ETR station 9.1) is the prime downrange station for the early portion of the launch. The entire stage II data except for VCO C (PDM No. 2) (see table 2-1) will be remoted to the Cape via two subcable circuits. The Pulse Code Modulation (PCM) will be on the highest frequency subcable circuit remodulated on an International Business Machines (IBM) data modem. These data will be demodulated at Tel-4 and sent to Building AE for display and relay to Complex 17. Other channels will be directly placed on the lower frequency circuit. These data will be sent to Building AE and Complex 17 for realtime flight analysis and to Tel-4 for the Range Safety display. Antigua should be the only ETR station viewing second stage engine cutoff (SECO) No. 1.

Antigua will also remote spacecraft data to Hangars AE and S via 202D data modem.

(3) Ascension Island (ACN) has no coverage of any kind. Ascension STDN site may be required on a contingency basis to send back ARIA data after ARIA landing to provide early analysis information via the 7.2 k bit STDN format.

(4) An Apollo Range Instrumentation Aircraft (ARIA) will provide the only coverage for the events associated with second burn of stage II, spinup, and separation of stage III. An ARIA with realtime retransmission capabilities is available; therefore, some realtime data will be received at Building AE from the aircraft. If problems occur, the tape may be delivered to the STDN station on Ascension for relay of selected measurements to Building AE at about T+5 hours. ARIA realtime retransmission is planned to be the entire stage II, VCO G, PCM signal via LES-6 and five selected VCO's via HF radio (see table 2-2).

(5) Tananarive will provide 7.2 k bit STDN format data in realtime to AE, GSFC, WTR, and MDAC to provide realtime analysis of the experimental reburn of the second stage.

Table 2-1. Antigua Retransmission

Transmit System	Vehicle VCO	Data
	High Freq Subcable	
IBM Modem	2-G	PCM
	Low Freq Subcable	
VCO-C	2-E	PDM
-A	2-A	Flow Rates
-13	2-13	Triax-pitch
-12	2-12	Triax-yaw
-11	2-11	Triax-thrust
-10	2-10	Pitch Control Signal
-9	2-9	Engine Chamber Pressure
-8	2-8	Roll/Pitch Jets
-7	2-7	Pitch/Roll Jets
-6	2-6	Yaw Jets
-5	2-5	Control Battery Current

Table 2-2. ARIA Realtime Retransmission

Retransmit VCO	Link	Vehicle VCO	Data
3	2241.5	2-5	Control Battery Current
4	2241.5	2-6	Yaw Jets
5	2241.5	2-7	Pitch/Roll Jets
6	2241.5	2-8	Roll/Pitch Jets
7	2241.5	2-9	Engine Chamber Pressure

2. Tracking. ETR radars will track the vehicle from liftoff through SECO No. 1. Final stage III/spacecraft orbits will be obtained from the GSFC tracking network using spacecraft systems.

ETR radars 0.18, 1.16, 19.18, 3.18, 7.18, and 91.18 may be used for vehicle tracking.

STDN radars at Tananarive (TAN), Carnarvon(CRO), Hawaii (HAW), and Guam (GWM) may be used to provide final stage II orbital parameters.

3. Miscellaneous Other Support.

a. CIF will send the digital countdown indication (sequencer) to GSFC.

b. The spacecraft 136.38 MHz signal will be radiating from prior to liftoff so Doppler will be available. Spacecraft data will be provided by CIF, Antigua, and STDN stations to GSFC and the STC equipment in Hangar S.

c. Building AE will remote some data to GSFC for display at GSFC using eight VCOs and a switching conference and monitoring arrangement (SCAMA) circuit. See Table 2-3.

d. A block diagram of the overall data flow is presented in figure 2-4.

Table 2-3. AE to GSFC Retransmission

Retransmit VCO	Vehicle VCO	Data
1	1-11	Main Engine Chamber Pressure
2	1-E-14	Solid Motor No. 4 Chamber Pressure
3	1-E-37	Solid Motor No. 1 Chamber Pressure
4	2-9	Thrust Chamber Pressure
5	2-12	Triax Accel-yaw
6	2-13	Triax Accel-pitch
7	2-11	Triax Accel-thrust
8	---	Time

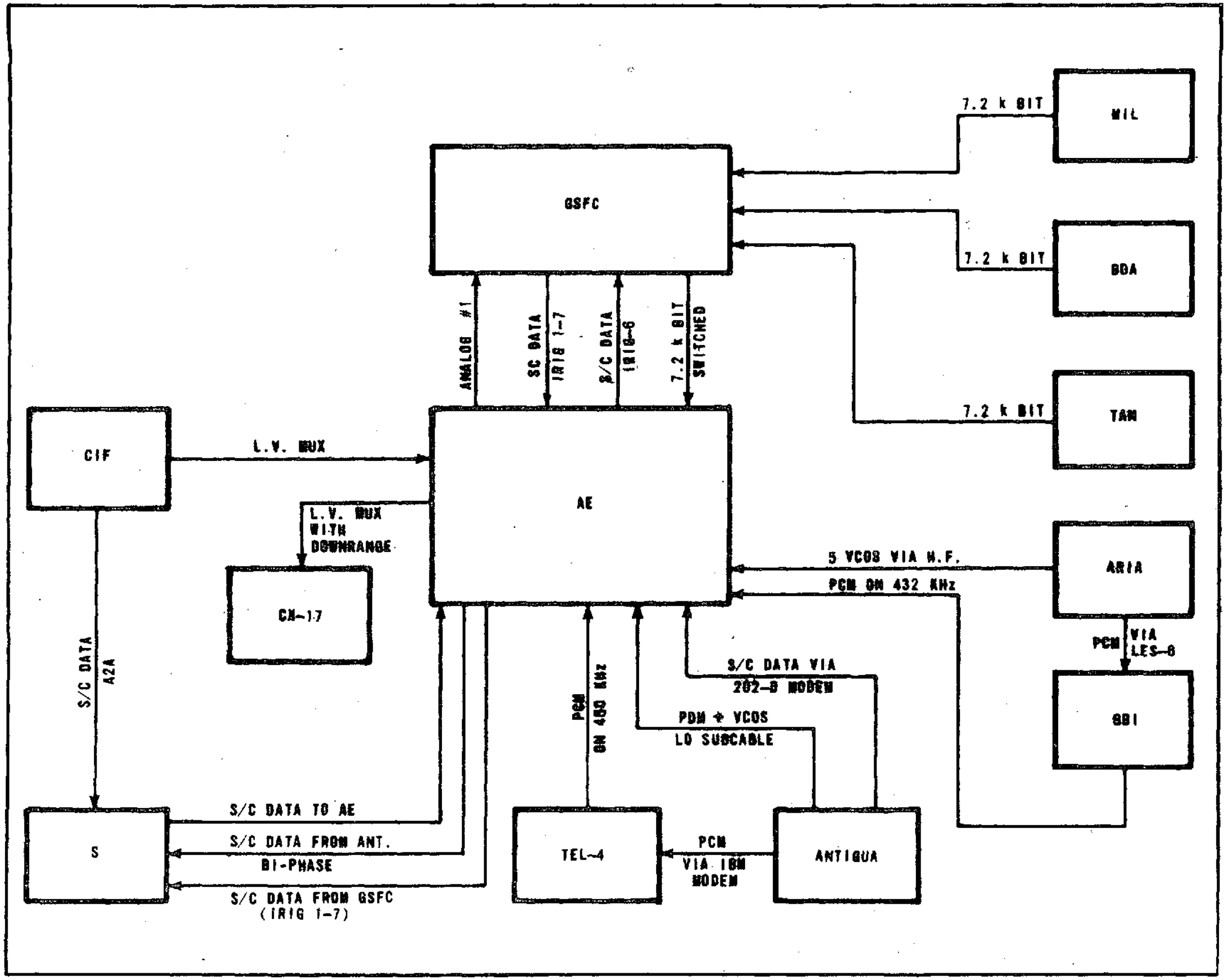


Figure 2-6. SMS-A Realtime Data Flow

SECTION III
COMMUNICATIONS

A. GENERAL

The operational communications facilities which will be available for support of the SMS-A launch are described in this section. These facilities will be available for prelaunch checkout and early post-flight intercommunications. The ULO MDC located in Building AE is the principal center of communications for launch activities.

B. MISSION DIRECTOR'S CENTER COMMUNICATIONS

Consoles in the MDC (figure 2-2) provide the Mission Director and assigned MDC personnel with all the communications systems required to monitor and participate in vehicle and mission progress. The communications facilities provide the means for communicating with Cape stations (Blockhouse 17 and Range Control Center), downrange stations, NASA Headquarters, GSFC, and other NASA centers, and the worldwide tracking stations.

1. Black Telephones. The telephones used in this system are special dial telephones installed in the consoles. The black telephones enable MDC personnel to place or receive local and long distance calls. Each individual assigned to a console may listen to or participate in more than one call if required.

2. Green Telephones. The ETR green phone system utilizes individual phones on key panels with a limited number of users. It provides rapid, direct communications between all sites participating in the launch operation. The system has standby batteries and cannot be incapacitated by commercial power failure.

3. Operational Intercommunication System (OIS). The OIS is a Range intercom system which operates on a channel-select basis rather than on an individual station-to-station basis. All end instruments in the same working area are connected in parallel. Access to individual channels may be limited to certain operators. When an operator selects a channel and talks, all other operators who have previously selected the same channel will hear him, conversely, he will hear all other operators talking on the same channel.

During launches, various operations are assigned a specific OIS channel. Because of this assignment system and the limited number of channels available at some of the outlying stations, it is mandatory that only assigned channels be used. After vehicle liftoff, flight performance will be summarized in realtime on OIS Channel 2. All personnel may switch to Channel 2 on a listen only basis.

4. Operations Conducted on OIS. The operations to be conducted on OIS channels during the SMS-A launch are listed in table 3-1.

Table 3-1. OIS Prelaunch Operations Channel Assignments

Complex 17 Channels	Complex 17 Channel Title	Operation
1	Test Conductor	Countdown, including terminal count
2	Chatter 1	Post liftoff oral account of flight events
3	Paging	
4	Chatter 2	
5	General Test	Doppler Coordination
6	First Stage	Ordnance and RF systems destruct checks
7	Second Stage	
8	Tower Removal	
9	Digs Alignment	
10	Spare-1	
11	Spare-2	Building AE TLM account of flight events
12	Spacecraft-1	Spacecraft checks
13	Spacecraft-2	
14	Eyeball	Post liftoff, Project Officer to MDC
15	SRO	
16	NASA TC	
17	NASA Project	Project Official's use
18	Spare-3	
19	Spacecraft-3	
20	NASA Chatter	

5. <u>Special Circuits</u>. The following special circuits will be utilized as designated in table 3-2.

Table 3-2. Special Circuits

From		To	Name	Use
1	MDC TLM	NASCOM Network	Network Conference	Tracking Station Coordinator
2	MDC TLM	Data Station Conference	Launch Coordinator	Launch Data Coordinator
3	MDC	NOCC	Launch Status	Launch Information
4	MDC TLM	GSFC	Launch Vehicle	Launch Vehicle Data Coordinator
5	MDC	GSFC	Mission Director	Project Coordinator
6	Hangar S MDC	GSFC	Spacecraft	Data Coordinator

SECTION IV
TEST OPERATIONS

A. GENERAL

Prior to F-3 Day, significant spacecraft and vehicle milestones are accomplished preliminary to final prelaunch operations. These events are presented in tables 4-1 and 4-2.

Table 4-1. Spacecraft Prelaunch Milestones

Event	Location	Date
Spacecraft ETR arrival	Hangar S	4-25-74
Spacecraft performance checks	Hangar S	4-26-74 to 5-1-74
Spacecraft moved to Explosive Safe Facility	ESA-60	5-2-74
Spacecraft apogee boost motor installed	ESA-60	5-5-74
Mated to launch vehicle	Complex 17B	5-9-74

Table 4-2. Vehicle Prelaunch Milestones

Event	Location	Date
Stage I ETR arrival	Hangar M	3-7-74
Stage I ETR Inspection	Hangar M	3-8-74
Stage II ETR arrival	Hangar M	3-13-74
Stage I erection	Complex 17B	4-18-74
Stage I solid motors erected	Complex 17B	4-19-74 4-22-74

Table 4-2. Vehicle Prelaunch Milestones (Cont'd)

Event	Location	Date
Stage II erection	Complex 17B	4-24-74
Stage III available	DSTF	4-29-74
Stage III erection	Complex 17B	5-1-74
Simulated Flight Test	Complex 17B	5-6-74

B. F-3 DAY

The milestone activities accomplished during F-3 day are listed in table 4-3.

Table 4-3. F-3 Day Milestone Countdown

Time (EDT)	Event
0400	Contractor countdown initiation
	S&A pin removal
0415	Stage III inspection
0430	Spacecraft cover removal and inspection
	Spacecraft final preps
0515	Disconnect spacecraft battery charger
0530	Remove spin table safety
0540	Remove catch net
0545	Remove DIGS insulation
0600	Fairing installation
0945	Stage II propellant servicing preps
	Spacecraft inert S&A functional

Table 4-3. F-3 Day Milestone Countdown (Cont'd)

Time (EDT)	Event
1030	Spacecraft S&A functional
1130	Fairing ordnance installation and hookup
	Solid motor initiator installation
1330	Stage I solid motor ordnance stray voltage checks and hookup
1530	Fairing final shim installation

C. F-2 DAY

The milestone activities accomplished during F-2 day are listed in table 4-4.

Table 4-4. F-2 Day Milestone Countdown

Time (EDT)	Event
0200	Final propellant servicing preps
0400	Stage II propellant servicing
0930	Stage II propellant securing
	Stage I fuel preps
1030	Stage I fueling
1230	Stage I fuel leak check and securing
1300	Stage I engine preps

D. F-1 DAY

The milestone activities accomplished during F-1 day are listed in table 4-5.

Table 4-5. F-1 Day Milestone Countdown

Time (EDT)	Event
0000	Preps for guidance and beacon checks
0130	Stage II power on
0215	Azimuth determination
0230	Tower removal preps
0240	Communications check
0250	Guidance and control and beacon system
0330	Pad securing
0430	Class A ordnance installation
0630	Pressurize stage II oxidizer tank
	Spacecraft functional test
0700	Tower removal preps
0830	Spacecraft VISSR cover removed
0930	Built-in hold (12 hrs)
2130	Built-in hold ends
2130	Lox system setup
	Stage II pressurization setup
	LN_2 load
2330	Move tower

E. F-0 DAY

The milestone activities accomplished during F-0 day are listed in table 4-6.

Table 4-6. F-0 Day Milestone Countdown

Time (EDT)	Count (Min)	Event
0000		Lanyard and umbilical securing
0020		Solid motor single point arming stray voltage checks
0045		LCE warmup
0120		Gantry removal
0145		Single point arming
0220		Stage I power on
0240		Guidance and command turn on and beacon checks
		Hold fire checks
		Pad securing
0323	T-60H	50-minute built-in hold
0333	T-60H	Sound warning horn, clear complex
0343	T-60H	Preliminary He and N_2 loading (2500 psig)
0353	T-60H	Roll call and test conductor briefing
0413	T-60H	End built-in hold and begin terminal count

F. TERMINAL COUNTDOWN

The terminal countdown starts at T-60 minutes and includes one built-in hold totaling 10 minutes at T-7 minutes. After completion of the hold, the countdown picks up at T-7 minutes and continues through liftoff.

The milestone activities accomplished during the terminal countdown are listed in table 4-7.

Table 4-7. Terminal Countdown

Time (EDT)	Count (Min)	Event
0413	T-60	Start terminal count
0413	T-60	Lox loading
0418	T-55	Helium and nitrogen loading (4000 psig)
0433	T-40	Beacon and TM transmitters external
0433	T-40	Stage I hydraulics on
0433	T-40	Stage II hydraulics on and auto slews
0443	T-30	C-band interrogation
0457	T-16	Command carrier on
0500	T-13	Range arm check on internal
0504	T-9	Range ready
0506	T-7H	Built-in hold (10 minutes)
0513	T-7H	Stage III TM external
0516	T-7	And counting
0518	T-5	Arm stage III S&A
0521	T-2	Pressurize lox tank
	T-90 sec	Hyd pump on, S/C final report
	T-80	Hyd pump on internal
	T-30	Lox tanking 100 percent
	T-15	Final stopping report
	T-10	Arm igniters
0523	T-0	Engine start
		Lift off