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June 7, 1972

JOHN F. KENNEDY SPACE CENTER

ATLAS/CENTAUR - 29
INTELSAT IV (F5)

OPERATIONS SUMMARY

Prepared by
Spacecraft and Vehicle Support Operations Branch, KSC-ULO

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Support Operations Branch

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MISSION

A. MISSION OBJECTIVE

The INTELSAT IV (F5) spacecraft is the fourth of a series of fourth generation commercial satellites designed by the International Telecommunications Satellite (INTELSAT) Consortium to provide expanded worldwide telecommunications services. The INTELSAT Consortium is currently a 83-nation organization sponsoring the global communications network. The INTELSAT IV (F5) spacecraft will be launched by an ATLAS SLV-3C first stage and a CENTAUR second stage vehicle designated ATLAS/CENTAUR-29 (figure 1).

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. <u>Launch Vehicle</u>.

a. ATLAS. The ATLAS stage (S/N 5009C) for the AC-29 mission is the SLV-3C. Propulsion of the ATLAS is provided by an MA-5 Rocketdyne engine group consisting of a booster engine with two thrust chambers, a sustainer engine, and two vernier engines. All are single-start, fixed-thrust, liquid propellant engines which provide a combined thrust of 403,383 pounds at liftoff. Liquid oxygen and RP-1 are used as propellants. The vernier engines are free to gimbal in the pitch plane only for roll control thrust during sustainer flight. The ATLAS autopilot system will roll the vehicle to the proper flight azimuth during the first 2 to 15 seconds of the flight after which the ATLAS autopilot system in conjunction with the CENTAUR guidance computer controls the flight trajectory. The guidance steering will be determined by prelaunch upper air wind soundings. The complete CENTAUR guidance system is enabled for trajectory control at 8 seconds after Booster Engine Cutoff (BECO). One lightweight telemetry package to monitor inflight performance and two Avco MK III command receivers for Range Safety purposes will be aboard the ATLAS.

b. CENTAUR. The CENTAUR stage is S/N 26D. Flight trajectory is controlled by an improved Honeywell all-inertial guidance system which utilizes the main engines for thrust vector control, and an improved hydrogen peroxide system for attitude control. The hydrogen peroxide system also provides continuous propellant settlement during the coast phase. The main engines are the Pratt and Whitney production model RL10A3-3 improved performance type.

2. <u>Spacecraft.</u> The INTELSAT IV (F5) spacecraft (figure 2) is approximately 93 inches in diameter and 208 inches in overall height. The spacecraft is a rotor stabilized, earth-oriented platform, with the spinning section consisting of a cylindrical solar cell array, positioning and orientation subsystems which include redundant radial and axial hydrazine thrusters that supply impulse for spacecraft spinup and station-keeping requirements, and a solid propellant apogee motor. The despun platform contains the communications repeaters, the antennas,

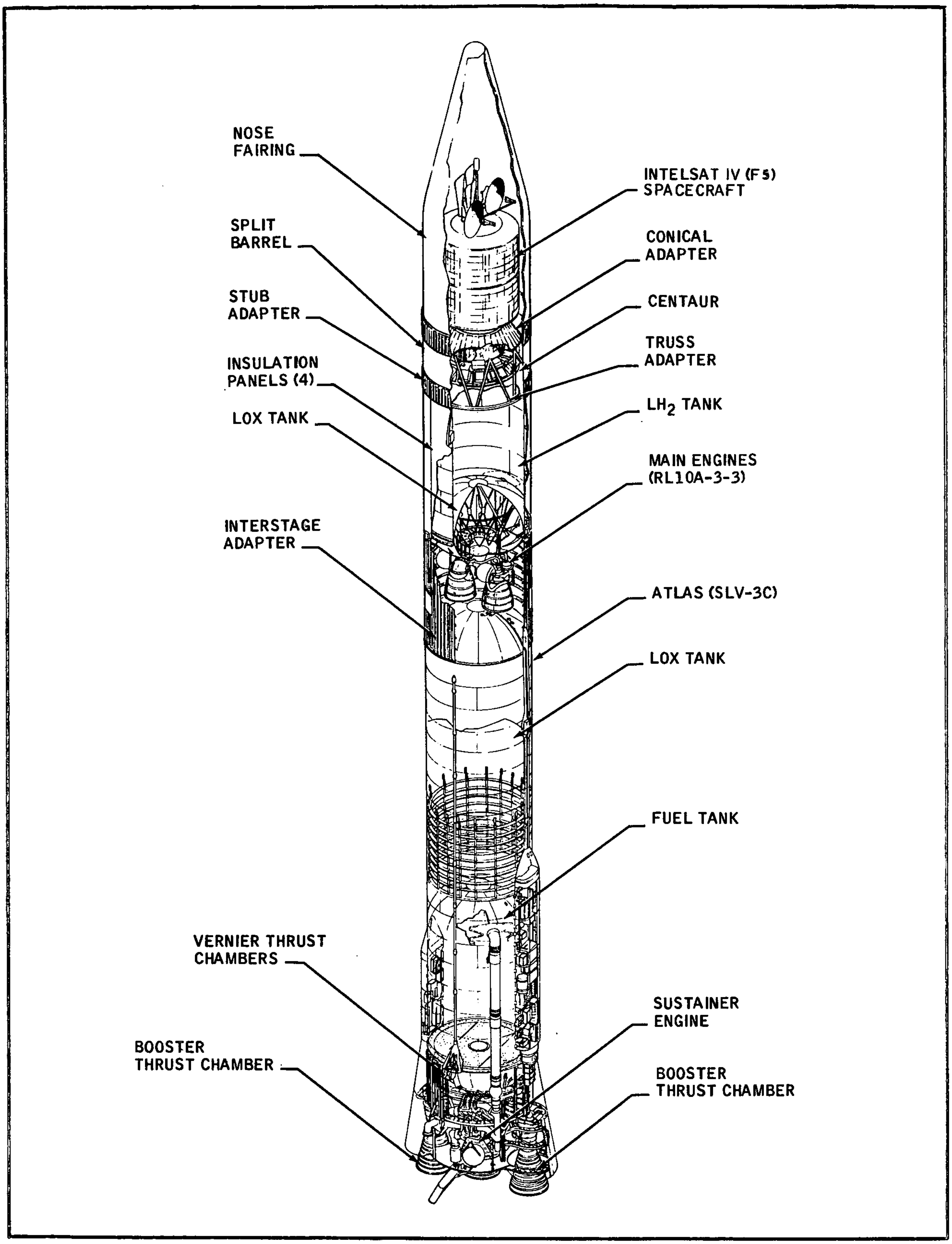


Figure 1. ATLAS/CENTAUR-29 Launch Vehicle

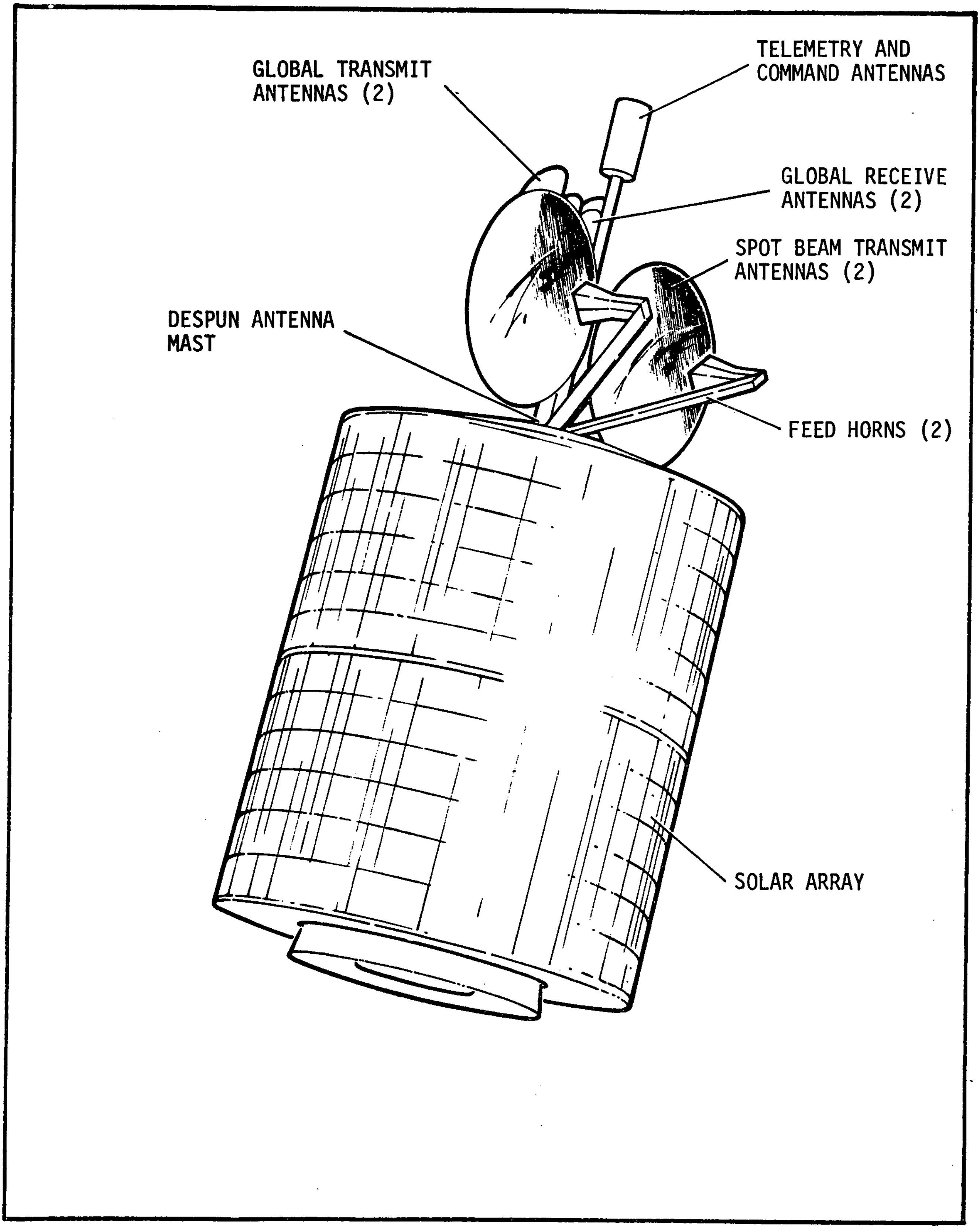


Figure 2. INTELSAT IV (F5) Spacecraft

and the telemetry and command systems. Electrical power to operate the spacecraft is provided by 42,240 solar cells around its spinning drum shaped body. During solar eclipse periods, power is provided by two nickel cadmium batteries that are charged by a separate array of about 2,770 cells. A Bearing and Power Transfer Assembly acts as the rotary interface between the counter-rotating elements and permits power and signals to flow between the two sections.

The spacecraft will weigh approximately 3,000 pounds at launch and about 1,600 pounds at apogee motor burnout. The spacecraft contains 12 transponders, providng 12 television channels or from 3,000 to 9,000 telephone circuits (depending upon the mode of operation). The spacecraft has a design lifetime of seven years.

The INTELSAT IV (F5) spacecraft was built by Hughes Aircraft Company (HAC) for the Communications Satellite Corporation (COMSAT), who functions as manager on behalf of the INTELSAT Consortium.

3. Nose Fairing. The INTELSAT IV (F5) nose fairing is a conical-cylindrical shroud incorporating a cork thermal barrier and a spring jettison system. The nose fairing extends approximately 11 feet above the top of the spacecraft to the bottom of the interstage adapter and is retained around the spacecraft until after CENTAUR engine start to protect the spacecraft during flight through the atmosphere and from ATLAS retrorocket exhaust.

C. MISSION PLAN

1. Launch Constraints.

a. Launch Opportunities. The launch period for INTELSAT IV (F5) will commence on June 13, 1972 and run through June 19, 1972. Although the launch is not confined to a specific number of calendar days, these dates have been established as an optimum launch period. There is one launch window for any given day during this time with the window opening at 1753 EDT and closing at 1913 EDT.

b. Wind Conditions. Wind velocity and direction, as measured at a 90-foot altitude by an anemometer and recording system, as well as the output of the ATLAS pitch and yaw rate gyros, will be continuously monitored during the countdown by meters and an oscillograph recorder in the blockhouse. In the event ground winds and/or gyro indications exceed the maximum allowable limits, appropriate action will be taken to obtain a safe configuration. The most restrictive conditions for wind velocity occur during the later tanking operations.

Vehicle aerodynamic loads, which are calculated from upper wind observations, must be within specified design limits. In particular, wind shears at flight levels around maximum Q are critical. Starting at T-18 hours, periodic sounding will be obtained from the Eastern Test Range (ETR), Rising Observation Sounding Equipment (ROSE) and Windsonde balloons, and data received will be transmitted to San Diego for computer processing. The results will then be relayed to the Mission Director's Center (MDC) for use in determining if the resultant aerodynamic loads, which are expressed in percentage of maximum allowable loads, are acceptable for launch.

2. ATLAS/CENTAUR Requirements. All vehicle systems must be operational at the time of launch. Priorities and requirements for telemetry measurements are available on prepared forms in the CENTAUR operations office.

3. Spacecraft Requirements. All spacecraft subsystems must be functioning prior to launch as required by the operational parameters of the F-0 day countdown. In addition, spacecraft telemetry required for the conduct of inflight operations must be in an operational status at the time of launch.

4. Range Safety. Range Safety requires a line-of-sight visibility extending from the radars and skyscreens to the vehicle on the launch pad.

5. Flight Plan. The ATLAS/CENTAUR vehicle will rise vertically from Launch Complex 36B until 15 seconds of flight time has elapsed. During the interval from 2 to 15 seconds, the ATLAS flight control system rolls the vehicle from the launch pad azimuth (115 degrees) to the desired launch azimuth of 101 degrees. The vehicle then executes a preprogrammed pitch maneuver in the downrange direction. Termination of the booster phase of flight is initiated by a staging discrete (BECO) issued by CENTAUR guidance when an acceleration level of 5.7g is sensed. The booster engine package is jettisoned 3.1 seconds after the staging discrete is issued.

CENTAUR guidance steering signals are admitted to the ATLAS stage autopilot eight seconds after BECO, and the system operates in a closed-loop mode throughout the remainder of the flight. During the sustainer phase of flight, the insulation panels are jettisoned. The sustainer phase is terminated by a discrete (SECO) from a pressure sensor in the fuel manifold in response to oxidizer depletion and causes the sustainer and vernier engines to be shut down. Two seconds later the ATLAS stage programmer energizes the electrical disconnect, fires the flexible linear-shaped charge to separate the CENTAUR stage, and fires the eight ATLAS retrorockets to back the ATLAS away from the CENTAUR. Prior to SECO, the ATLAS programmer initiates the CENTAUR stage prestart sequence: the boost pumps are started and brought up to speed and propellants flow through the CENTAUR fuel and oxidizer system, chilling down the hardware to preclude cavitation at CENTAUR first main engine start (MES 1).

The signal for starting the CENTAUR main engines is issued by the guidance programmer. Guidance steering commands are nulled at SECO and readmitted at MES 1 plus 4 seconds, after the engine start transient has passed. The nose fairing is jettisoned at MES 1 + 12 seconds. During the burn, CENTAUR performs a slight yaw maneuver to the left to reduce the parking orbit inclination. CENTAUR first main engine cutoff (MECO 1) is commanded by the guidance system when the required elliptical orbit insertion conditions for a 100 by 1,200 nautical mile parking orbit are achieved. Starting at MECO 1, two 50-pound thrust rockets provide propellant settling for 76 seconds. After the initial propellant settling phase is completed, a set of two 3-pound thrust rockets provide a continuous propellant level control through the parking orbit coast phase until initiation of the prestart events for CENTAUR second main engine burn. While traversing the elliptical parking orbit, the thrust axis of the CENTAUR and spacecraft is aligned with the current inertial velocity vector via steering commands issued by the guidance system. At 300 seconds prior to the second main engine ignition, the CENTAUR performs a reorientation maneuver to achieve the required second burn firing attitude as specified by the guidance system.

CENTAUR second main engine start (MES 2) occurs at approximately 15 minutes after MECO 1 and is preceded by operation of two 50-pound rockets to ensure positive propellant settling. During the propellant settling phase, the boost pumps are restarted and the main engines again chilled down. MES 2 occurs near the first equatorial crossing, which is the first descending mode. Guidance steering commands are nulled during the first four seconds of main engine operation and then readmitted. The CENTAUR second burn performs a plane change maneuver (reducing the orbit inclination) and accelerates the CENTAUR and spacecraft into the required transfer ellipse. CENTAUR second main engine cutoff (MECO 2) is commanded by the guidance system when the required transfer orbit injection conditions are achieved. After termination of the CENTAUR second powered phase, the programmer provides timed discretes for the following:

a. Performing an orientation maneuver to align the roll axis to a specific direction.

b. Separating the spacecraft from the CENTAUR.

c. Reorienting the CENTAUR along the desired attitude alignments.

d. Settling the propellants and firing the ullage motors.

e. Venting propellants through the engine thrust chambers for retrothrust.

After the spacecraft has been separated from CENTAUR, it will undergo free body spin-up by hydrazine blowdown through tangentially located thrusters on the surface of the spacecraft. Active control will be maintained throughout the transfer ellipse to maintain or alter spacecraft spin axis attitude. The spacecraft solid motor is fired near apogee of the transfer orbit to obtain the desired final inclination and to achieve the required circular synchronous orbit (figure 3). To achieve the desired orbital position with respect to Earth, several revolutions in the transfer ellipse (apogee phasing) are generally required.

6. <u>Nominal Sequence of Flight Events</u>. A nominal sequence of flight events is listed in table 1. Events after BECO are computed in time from BECO (B+time). Events after ATLAS sustainer engine cutoff are computed in time from SECO (C+time). CENTAUR first burn cutoff and events thereafter until, but not including, the sending of guidance discrete L1 are computed in D+time. Events from the start of the CENTAUR B timer (L1 discrete) until the enabling of CENTAUR second burn cutoff are computed in E+time. CENTAUR second burn cutoff and events thereafter until power changeover are computed in F+time.

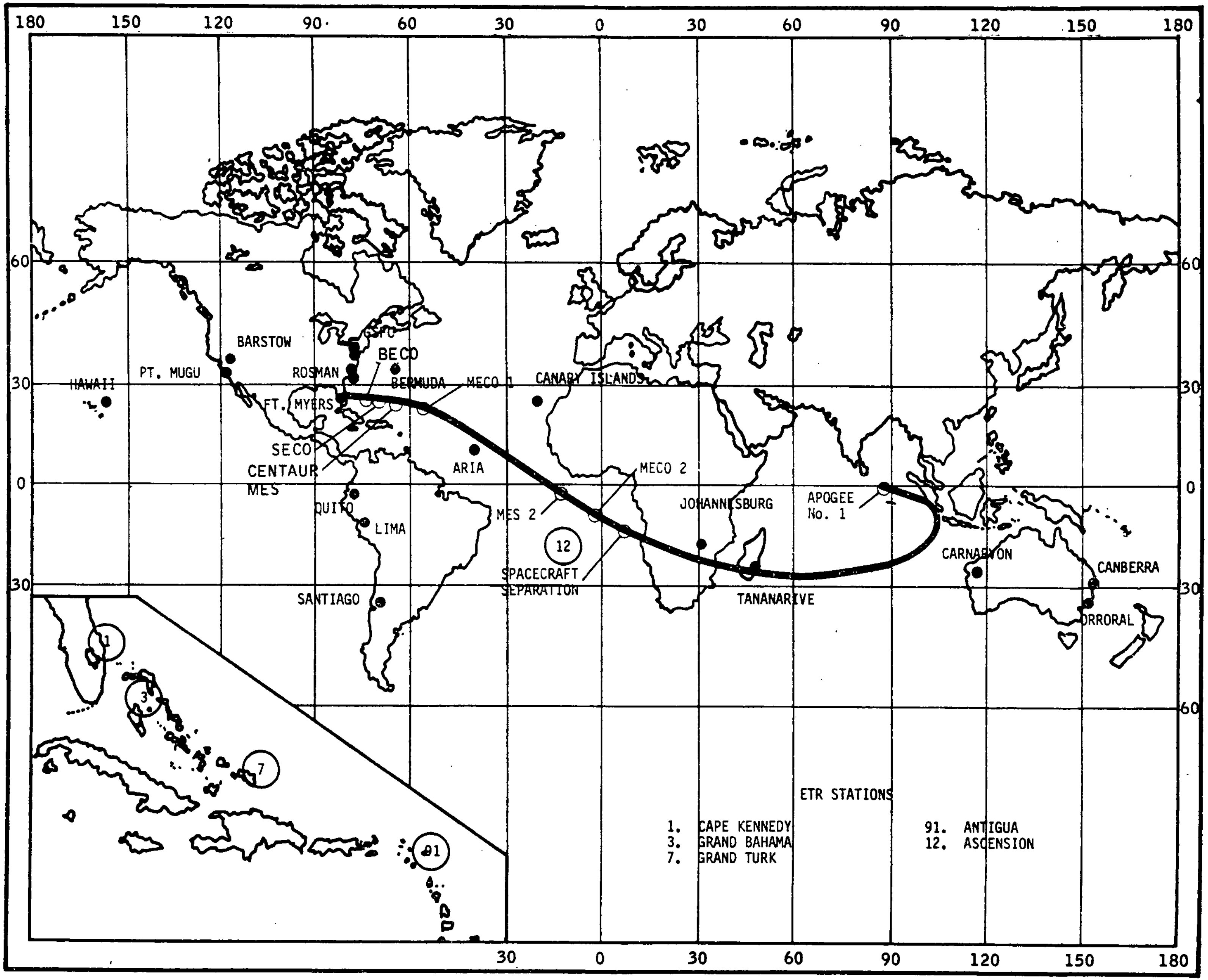


Figure 3. Spacecraft Tracking and Trajectory

Table 1. Sequence of Events (Nominal Times)

Event	Time in Seconds	Time in Seconds
Two-inch motion (liftoff)	A+0	T+0
Start roll	A+2	T+2
End roll	A+15	T+15
Admit guidance pitch and yaw programs	A+15	T+15
Enable booster staging	A+141	T+141
Booster engine cutoff (guidance discrete, staging acceleration 5.7 g)	B+0	T+151.4
Jettison booster package	B+3.1	T+154.5
Admit guidance steering	B+8	T+159.4
Jettison insulation panels	B+45	T+196.4
Start CENTAUR boost pumps	B+60	T+211.3
Enable ATLAS/CENTAUR separation	B+69	T+220.3
Sustainer engine cutoff by propellant depletion	C+0	T+241.2
Inhibit guidance	C+0	T+241.7
ATLAS/CENTAUR separation	C+1.9	T+243.1
Fire ATLAS retrorockets	C+2	T+243.2
First prestart (CENTAUR engine childown, MES 1 -8 sec)	C+3.5	T+244.7
First CENTAUR main engine start (MES 1)	C+11.5	T+252.7
Admit guidance	C+15.5	T+256.7
Jettison nose fairing	C+23.5	T+264.7
Enable first CENTAUR main engine cutoff	C+300	T+541.2

Table 1. Sequence of Events (Nominal Times) (Cont'd)

Event	Time in Seconds	Time in Seconds
First CENTAUR main engine cutoff (MECO 1, guidance discrete)	D+0	T+626.6
First CENTAUR main engine cutoff backup (MECO 1 BU)	D+0	T+626.6
Start ullage motors	D+0	T+626.2
Stop ullage motors and start propellant settling motors	D+76.0	T+702.2
CENTAUR reorient for second burn	D+592.8	T+1219.0
Guidance discrete (L1)	E+0	T+1459.0
Stop propellant settling motors and start ullage motors	E+20	T+1479.0
Start CENTAUR boost pumps	E+32	T+1491.0
Second prestart (CENTAUR engine childown)	E+43	T+1502.0
Second CENTAUR main engine start (MES 2)	E+60	T+1519.0
Stop ullage motors	E+60	T+1519.0
Inhibit guidance	E+60	T+1519.0
Admit guidance	E+64	T+1523.0
Enable second CENTAUR main engine cutoff	E+64	T+1523.0
Second CENTAUR main engine cutoff (MECO 2)	F+0	T+1593.6
Second CENTAUR main engine cutoff backup (MECO 2 BU)	F+0	T+1593.6
Separate spacecraft	F+135	T+1728.6
Spacecraft spinup	F+138	T+1731.6
Admit guidance	F+140	T+1733.6

C

Table 1. Sequence of Events (Nominal Times) (Cont'd)

Event	Time in Seconds	Time in Seconds
Start retromaneuver	F+140	T+1733.6
Start blowdown	F+305	T+1898.6
End blowdown	F+555	T+2148.6
Start ullage motors	F+555	T+2148.6
Energize power changeover	F+605	T+2198.6

D. POST LAUNCH OPERATIONS

The ETR has the responsibility for tracking and KSC has responsibility for telemetry coverage of the launch vehicle from liftoff through spacecraft separation. The Space Flight Tracking Data Network (STDN) will provide GSFC and KSC with additional vehicle tracking and telemetry data, starting at acquisition of signal and continuing for the duration of the contacts.

SECTION II
LAUNCH OPERATIONS PLAN

A. OPERATIONAL AREAS

1. Complex 36. All INTELSAT IV (F5) launch vehicle and pad operations during the launch countdown are conducted from the blockhouse at Complex 36 (figure 4) by the Launch Conductor. Countdown readiness and status of the ATLAS and CENTAUR stages are the responsibility of the appropriate contractor test conductor. The Spacecraft Controller in the blockhouse controls spacecraft activities and reports on the countdown readiness and status of the spacecraft to the Launch Conductor. Overall management of launch operations is the responsibility of the Operations and Launch Director. The Test Controller functions as the official contact between test personnel and the ETR.

2. Building AE. Two major operational areas for the INTELSAT IV (F5) mission are located in Building AE. These operational areas are the MDC and the Launch Vehicle Telemetry Ground Station. Figure 4 shows the location of the launch and operational areas.

a. Mission Director's Center. The launch operations and overall mission activities are monitored by the Mission Director in the MDC (figure 5) 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 real-time 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 display and are used to show present position and Instantaneous Impact Prediction (IIP) plots and, in most cases, doppler information. These displays, when plotted with the theoretical plots, give an overall representation of launch vehicle performance.

b. Launch Vehicle Telemetry Ground Station. The launch vehicle telemetry ground station receives, monitors, 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 for display in the MDC.

3. Building AM. The INTELSAT IV (F5) spacecraft countdown will be conducted from the Spacecraft Control Center (SCC) located in Building AM by the Spacecraft Test Conductor and the INTELSAT IV (F5) crew. Spacecraft data, received in response to program functions generated by the SCC, are stored and analyzed to determine the launch readiness and status of the spacecraft.

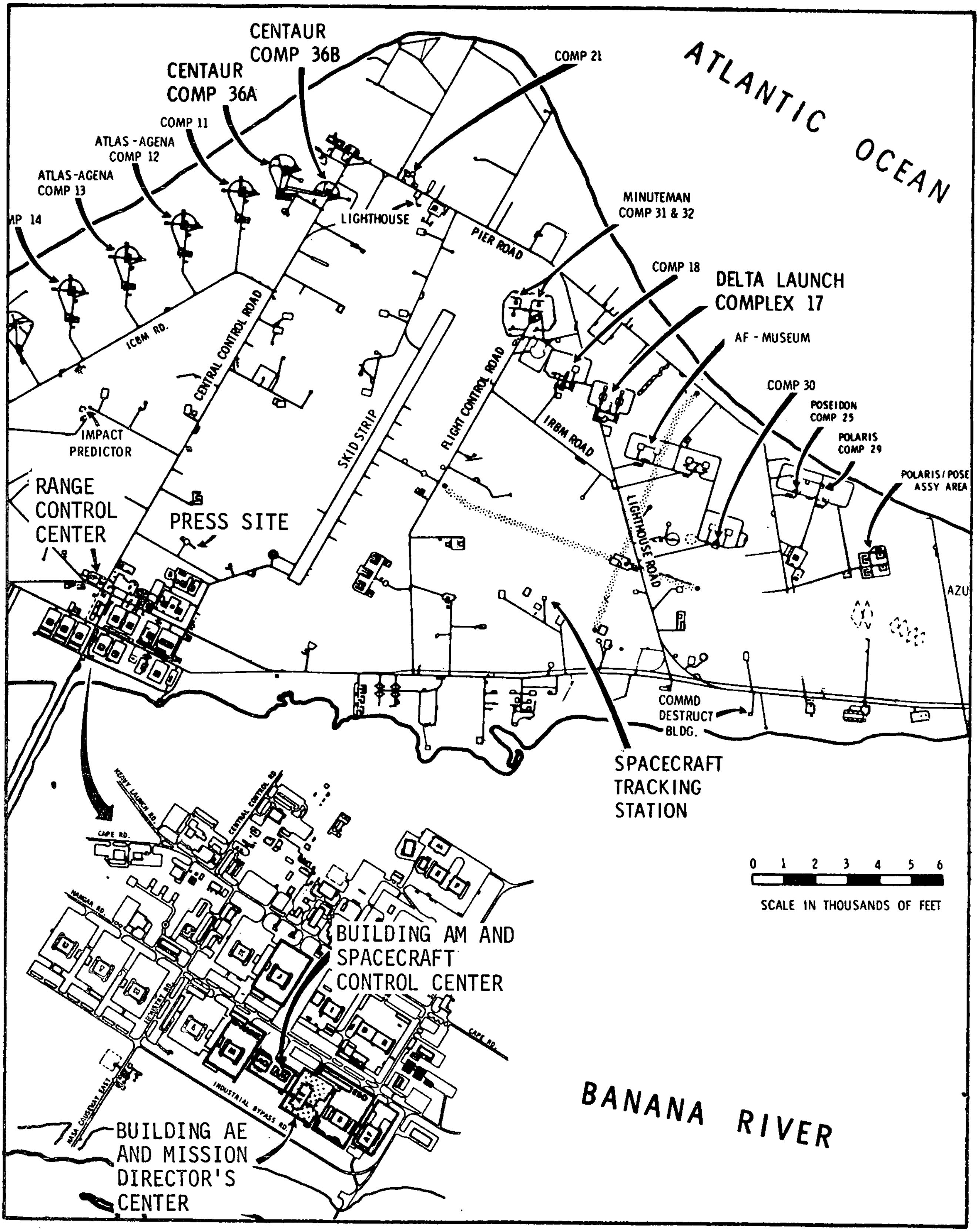


Figure 4. Launch and Operational Areas

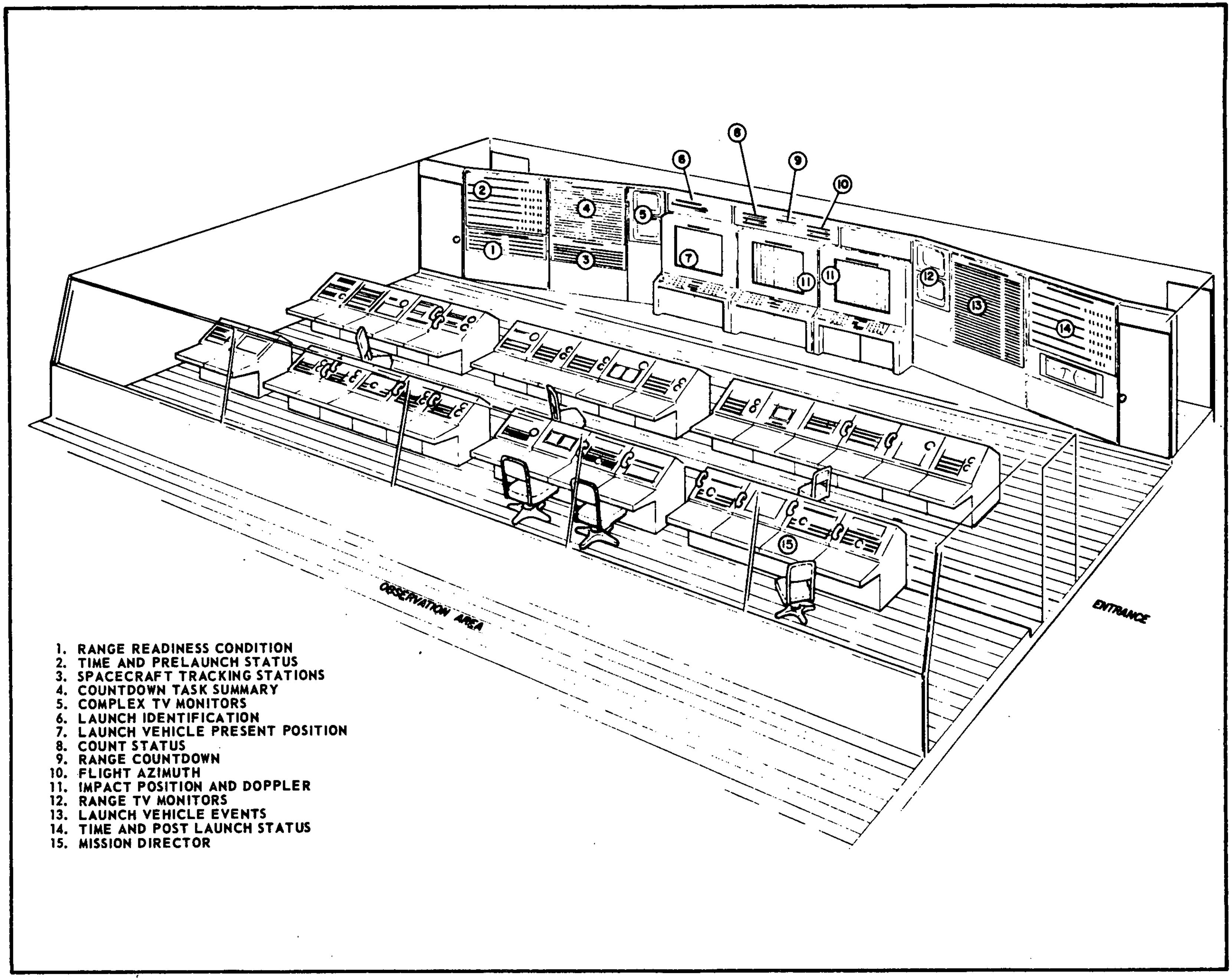


Figure 5. Mission Director's Center

4. Spacecraft Tracking Station. The STS will doppler-track the INTELSAT IV (F5) launch vehicle from liftoff through Loss of Signal (LOS). The doppler data will be transmitted to Building AE for display and to GSFC in realtime for display in the Operations Control Center (OPSCON). Launch vehicle and spacecraft telemetry signals will be received and recorded, and certain links relayed to AE for processing.

5. Range Control Center (RCC). Overall management of ETR support is provided by the Superintendent of Range Operations (SRO). Coordination with the SRO is provided by the ULO Test Controller with assistance from the GD/C Range communicator. A NTS representative is stationed at the RCC throughout the launch operations. He aids in maintaining liaison between the SRO and Test Controller and coordinates with the AF weather forecaster, the ETR scheduling office, and the Range Safety Officer (RSO). In addition, a ULO representative will be present to monitor and comment on trajectory and Range Safety matters during flight.

B. DATA ACQUISITION

Telemetry, optical, and radar data acquisition will be provided by equipment located at Cape Kennedy and by downrange instrumentation sites (figure 3) during the prelaunch, launch, and injection phases of the ATLAS/CENTAUR-29 mission. The active stations for the mission are as follows:

ETR Stations	
Radar:	1, 7, 91, and 12
Telemetry:	91, supported by Apollo Range Instrumentation Aircraft (ARIA), and 12
Range Safety Support:	1, 3, 7, and 91
Space Flight Tracking Data Network Stations	Bermuda (BDA), Ascension Island (ACN), Tananarive (TAN), and Carnarvon (CRO)
KSC Stations	Central Instrumentation Facility (CIF), AE, and STS

1. Telemetry. During ATLAS/CENTAUR-29 launch operations, airborne telemetry data will be acquired by five Cape area ground stations in realtime and on magnetic tape. Each of these stations will have specific assignments for realtime displays and playbacks so that the data may be reduced and distributed on a timely basis to fulfill analysis requirements. The formats for realtime displays are described in the Recorder Assignments table of the ATLAS/CENTAUR-29 Data Supplement (TR-1074). During flight, telemetry will be recorded by Antigua, Ascension, one Apollo Range Instrumentation Aircraft, and the Goddard Space Flight Center STDN stations.

a. Uprange Telemetry

(1) AE Telemetry Ground Station. The Building AE ground station will concentrate on the ATLAS/CENTAUR performance in realtime and provide playback of all other data for evaluation on a timely basis. The Building AE station will record on 0.5-inch magnetic tape at 30 or 15 inches per second

for all times the systems are radiating. The data will be displayed on 8-channel Sanborn recorders from turnon to LOS with Range timing displayed on the records. Playbacks of the telemetry tapes following launch will use identical formats, although special records for detailed analysis will also be processed through this station.

(2) KSC, Central Instrumentation Facility. The primary function of the KSC-CIF ground station is to process the digital data through the two GE 635 computers to obtain performance information from the guidance system. In addition, selected data will be processed to obtain graphical printouts in engineering units. The CIF station will record all telemetry links on 1-inch magnetic tape at 30 inches per second from T-70 minutes to LOS. The guidance data will be processed in realtime. Post launch data will consist of guidance data and digital data of analog measurements. The CIF Antenna Site will remote the launch vehicle telemetry video signals to Building AE for processing and display and will also remote spacecraft telemetry to Buildings AE and AM.

(3) Hangar J and Blockhouse 36. The GD/C telemetry stations in Hangar J and Blockhouse 36 will provide support as required. The primary function of the Hangar J station is to record ATLAS telemetry data. The primary function of the Blockhouse 36 station is to check out and determine flight readiness of airborne telemetry systems, and the secondary function is to record selected data items.

b. ETR and STDN Telemetry Support. Class I telemetry requirements placed on the ETR are from acquisition of signal to loss of signal from ETR stations 91 and 12 and ARIA positioned between stations 91 and 12. Class II telemetry requirements will be supported by STDN stations BDA, ACN, and CRO.

2. <u>Optics.</u> Twenty-five engineering sequential cameras will provide coverage from T-4 minutes to T+10 minutes. Two of these cameras are of the long focal length type (ROTI-IGOR) that will be tracking from acquisition through Loss of Vision (LOV). Also included is a long range tracker (Patrick IGOR) that will provide live TV for display and recording in Building AE and display and recording on blockhouse monitors. An additional twenty-six documentary cameras will record various launch operations.

3. <u>Radar Tracking, C-Band.</u> Stations with acceptable viewing, including ETR C-band radars 0.18, 1.16, 19.18, 7.18, 91.18, and 12.16 along with Goddard radar stations at Bermuda, Tananarive, and Carnarvon will utilize beacon and/or skin track to provide vehicle position and velocity data; realtime position and velocity information for Range Safety; inputs to the Realtime Computer System (RTCS) for determination of powered flight impact prediction; free flight orbital computation; STDN acquisition information; and post-retro orbit of the CENTAUR stage.

4. Spacecraft Tracking Station. The ULO STS will track the spacecraft during launch operations and provide launch doppler information for display in the Mission Director's Center and spacecraft telemetry data to the SCC.

5. GSFC Support. Goddard stations at Bermuda, Ascension Island, and Carnarvon will support the launch of AC-29. Telemetry data will be recorded at all stations. Mark events will be provided through the Goddard communications net.

6. Other Data. A Preliminary Test Report (PTR) will be prepared by the Range within 3 hours after test termination. In addition to the normal PTR items, launch azimuth and predicted orbital elements will be included.

7. Range Safety.

a. Forward Observer. An observer will be on station at the Cape lighthouse from T-60 minutes until launch. There are no Range Safety weather restrictions on this launch.

b. Skyscreens. One Vertical Wire Skyscreen (VWS) will be operated from launch to LOV to provide information on azimuth and program deviations. Two video (TV) screens will be operated from launch to LOV. This information will be presented to flight line and pitch program monitors in the RCC.

c. Instantaneous Impact Predictions. The RTCS (3600) will be operated to compute and display an IIP on an X-Y plotter in the RCC. Primary inputs will be provided by C-band radars.

8. Mark Events. Table 2 contains measurements which will indicate mark events. These events will be called out on OIS channel 1 from AE as soon as observed.

Table 2. Mark Events for AC-29

Mark No.	Event	T+Time in Seconds	Link/VCO Frequency/ Segment or Continuous	Description
	Liftoff (2-inch motion)	0		2-inch motion from Range readout
1	ATLAS BECO	151.4	2215.5/0.96/ continuous	B1 pump speed measurement goes out of band on low frequency side
2	ATLAS booster jettison	154.5	2215.5/2.3/ continuous	Axial accelerometer fine goes to low band edge

Table 2. Mark Events for AC-29 (Cont'd)

Mark No.	Event	T+Time in Seconds	Link/VCO Frequency/ Segment or Continuous	Description
3	CENTAUR insulation panel jettison	196.4	2215.5/70/3 & 18, 12 & 27	35 degree rotation indicators actuate
4	ATLAS SECO and VECO	241.2	2215.5/0.73/ continuous	Sustainer pump speed measurement goes out of band on low frequency side
5	ATLAS/CENTAUR separation	243.1	2202.5/30.0/ 1 and 16	Separation extension actuates
6	CENTAUR MES (MES 1)	252.7	2202.5/0.96/ continuous	C-2 chamber pressure rises to 75% of band
7	Jettison nose fairing	264.7	2202.5/.73/ continuous(blip)	Shroud relay actuates
8	CENTAUR MECO (MECO 1)	626.2	2202.5/0.96/ continuous	C-2 chamber pressure goes to 0
9A	CENTAUR MES (MES 2) C-1 engine	1519	2202.5/0.73/ continuous	C-1 chamber pressures rise to 75% of band
9B	CENTAUR MES (MES 2) C-2 engine	1519	2202.5/0.96 continuous	C-2 chamber pressures rise to 75% of band
10	CENTAUR MECO (MECO 2)	1593.6	2202.5/0.96/ continuous	C-2 chamber pressure goes to 0
11	Separate spacecraft	1728.6	2202.5/3.0/ 19	Separation switches activate
12	Start CENTAUR turnaround	1733.6	2202.5/1.3 & 1.7	P and Y rate gyros respond to turning command
13	Start propellant blowdown	1898.6	2202.5/70.0/ 18,12,22,13	Turbopump inlet pressures rise to approximately 20%
14	End propellant blowdown	2148.6	2202.5/70.0/ 18,12,22,13	Turbopump inlet pressures to 0
15	Power changeover	2198.6	2202.5/0.4/ continuous	400-Hz frequency goes open - noise

9. Data Evaluation Plan. This plan describes the manner in which telemetry data will be recorded and evaluated during the launch countdown. A data supplement to the plan has been issued under separate cover (TR-1074) containing detailed instrumentation assignments.

a. Airborne Telemetry. Two telemetry transmitters will be flown on the AC-29 vehicle, one on the ATLAS stage and one on the CENTAUR stage. Transmitter characteristics are shown below.

System	Stage	Radio Frequency	Nominal Power Output
RF-1	ATLAS	2215.5 MHz	7.0 watts
SS-1	CENTAUR	2202.5 MHz	7.0 watts

b. Instrumentation Assignments. The pertinent information defining telemetry location, gage range, and channel assignment for each measurement is contained in a series of supplemental tables (TR-1074) to provide a rapid reference for the following:

(1) A summary of the composite instrumentation for AC-29 (Data Supplement, table 1).

(2) Listings by systems of the telemetry channel assignment and gage range of each airborne ATLAS and CENTAUR measurement (Data Supplement, table 2).

(3) Same as above except measurements are listed by channel (Data Supplement, table 3).

(4) A listing by system of all landline measurements (Data Supplement, table 4).

c. Prelaunch Evaluation. All ATLAS/CENTAUR and spacecraft telemetry will radiate as listed below. Early checks will be monitored for presence of all subcarrier oscillators, commutation on all commutated channels, and RF quality. This will be an aid in determining mission readiness. Following each check, records will be examined and the status of every measurement determined. All discrepancies will be reported to and reviewed by the Test Conductor, Launch Director, and Mission Director. The complete analysis will be accomplished in approximately 45 minutes.

Links	Start	Complete
Two	T-375 min	T-280 min
Two	T-110 min	T-102 min
One	45 minutes into the hold at T-90 (ATLAS)	LOS
One	T-85 (CENTAUR)	LOS

All stations (Hangar J, Blockhouse 36, Building AE, and KSC-CIF) will monitor telemetry during each of the periods of radiation. Guidance will be monitored by KSC-CIF beginning at T-10 hours.

Data overlays will be constructed and used as a quick check to determine if the data response is within specified tolerance. These overlays allow an entire commutated channel to be examined at one time. The data evaluations employing these overlays will be made by ULO and Lewis Research Center (LeRC) personnel in Building AE. Reduction of data requires approximately 45 minutes following acquisition. After reduction, all results will be summarized by the ULO instrumentation representative in Building AE and transmitted to the Mission Director in Building AE and the Launch Director in Blockhouse 36, over Operational Intercommunication System (OIS) channel 14 (NASA data). Results of these evaluations will aid in determining mission readiness.

d. KSC Data Support. The KSC telemetry station and computer data reduction facility is available to support CENTAUR data requirements during prelaunch and post-launch operations. Support is received from these facilities to provide the following data:

(1) Guidance system measurement (position, velocity, steering commands, and gyro drift) printouts of the airborne computer flight program in digital form.

(2) Orbital elements for spacecraft injection and vehicle post blowdown based on guidance data, provided to MDC by the KSC computer.

(3) Realtime display of guidance and Event Monitor Systems (EMS) and landline analog data at Blockhouse 36 and Building AE.

(4) Post reduction of item (3) data.

10. Data Distribution. Following launch, flight data will be available to applicable personnel for preparation of a verbal report at T+3 hours and a written report at T+8 hours. These data will be available for general inspection following these reports.

The KSC photo group will collect and distribute all photographic data. All other data will be picked up by the KSC data group for distribution to cognizant project personnel. Data distribution lists are compiled by the CENTAUR missions office in the KSC Requirements Document (RD) 3400.

a. Engineering Sequential Data. All engineering sequential data will be available within 5 working days after launch. Quick look (16 millimeter) expedited prints of the selected items will be available within T+8 hours upon request.

b. Telemetry Data. Uprange telemetry magnetic tapes are normally available in T+4 hours. Downrange telemetry magnetic tapes (station 91, Antigua) are available in 3 working days. Telemetry realtime data are presented in graph form at T+1 hours. Link 2202.5 will be transmitted from stations 91 and 12 in realtime and provided in realtime to KSC for guidance data reduction, and to Building AE for processing and analysis.

c. Metric Data. Final reduced data for position and velocity will be available in 4 working days after receipt of tapes from ETR stations.

d. Best Estimate of Trajectory (BET). This document, including estimates of accuracy, will be available in 26 working days.

C. METEOROLOGICAL PLAN

The NASA Test Support Office (NTSO) is the only authorized contact with the Cape Kennedy weather station. Therefore, project and operations personnel will be furnished meteorological data only by the NTSO. From T-5 hours through T-0, all questions concerning weather forecast and observations will be referred to the NTS representative in the RCC. Prior to this period, NTS personnel may be contacted as listed below:

	Home	Office
R. J. Mazurkiewicz	262-2719	867-3962

From T-5 hours through T-0, the LeRC representative will monitor OIS channel 20 and stand by for green telephone calls from the NTS representative in the RCC.

1. Prelaunch Forecasts.

a. Upper Air. Upper air data will be read from a Winsonde printout at the Cape weather station (RCC) and will include wind velocity, wind direction, and wind shear in 1,000-foot increments.

b. F-3 Day. A launch area forecast will be called to the NTSO for dissemination. The forecast will include general weather conditions expected for T-0 and a general weather outlook for the period F-3 Day through F-0 Day. This information will be telephoned by the NTSO to the CENTAUR operations office, the LeRC represenative and GD/C.

c. F-2 Day. A launch area forecast will be called to the NTSO for dissemination. The forecast will include surface conditions (cloud cover, visibility, precipitation, wind, temperature, and sea level pressure), upper level winds (surface to 50,000 feet at 5,000-foot intervals), and maximum wind shear expected at T-0.

2. F-0 Day Transmission of Bending Moment Data. In addition to being tabulated for verbal relay to project and operations personnel at ETR, the upper air data (100-foot intervals) are printed out on IBM cards and transmitted on an IBM 066068 card transceiver and by the ETR on an IBM 1050 data set directly to San Diego by GD/C. Approximately 45 minutes after receipt, the IBM 7094 computer output and recording equipment will have printed out tabulations and graphs of bending moment data at critical vehicle stations versus time of flight. The flight pitch and yaw steering programs will be determined by these data.

As soon as it becomes available, applicable go/no-go information from the tabulations will be telephoned from San Diego to the LeRC weather representative at Building AE to aid in making prelaunch decisions. The graphs will then be hand-carried from the computer room to the LeRC-San Diego office and datafaxed to ETR. The KSC datafax facilities in the Building AE/MDC (Fax No. 7-411) will be used to receive the incoming bending moment graphs from San Diego. The datafax will be delivered by the LeRC weather representative or his alternate.

When sufficient time is available for receipt and evaluation of graphs, the final launch decision will be made only after evaluation of the bending moment data from these graphs. The verbal report from the tabulations will be considered preliminary in all cases except where time is the predominant consideration.

Upper air data will be obtained from the ETR Jimshere, Rawinsonde and Windsonde systems. Data will be transmitted from Hangar J to GD/C San Diego by IBM 066068 card transceiver and from the Meteorlogical Data Reduction System (MDRS) to GD/C San Diego by IBM 1050 data set.

Bending moment upper air data will be obtained from balloons released at 0-28, 0-10, and 0-8 hours and from balloons released at 0-390, 0-310, 0-230, 0-150, 0-40 minutes and T-0. Data from balloons released prior to and including the 0-8 hours balloons will run through approximately 80,000 feet. Data from balloons released at 0-390 minutes and after will run through 61,000 feet.

SECTION III
COMMUNICATIONS

A. GENERAL

The INTELSAT IV (F5) communications facilities which will be available for support of this mission are described in this section. These facilities will be used for prelaunch operations and early postflight intercommunications. The communications center will be located in the Mission Director's Center (MDC), Building AE.

B. MISSION DIRECTOR'S CENTER

Consoles in the MDC provide the assigned MDC personnel with the communications systems required to monitor and participate in vehicle and mission progress. The center's communications facilities provide the means for communicating with Cape stations (Blockhouse 36, STS, Range Control Center), downrange stations, NASA headquarters, LeRC, GSFC, and worldwide tracking stations. Communications systems available at the consoles in the MDC are described below.

1. Black Telephones. The black telephones used in this system are special dial phones installed in the consoles that enable MDC personnel to place or receive local and long distance calls. Individuals assigned to consoles may establish, listen to, or participate in conference calls on the black telephone system.

2. Green Telephones. The ETR green telephone system utilizes manually operated key panels at each console, limiting the number of users. This provides rapid direct communications between all sites participating in this launch operation. The key cabinets provided for this system have both visual and audible signaling.

3. Station Conferencing and Monitoring Arrangement (SCAMA) Telephone System. The SCAMA telephones provide direct contact with the GSFC SCAMA switchboard at Greenbelt, Maryland, for instantaneous long distance communications with the NASA global satellite tracking networks. SCAMA, originally designed to support the manned spacecraft network, has been extended to include the STADAN network (formerly called Minitrack). SCAMA can now link any combination of 51 communications points in NASA's global satellite tracking networks.

4. Operational Intercommunications 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. (This system was formerly called the MOPS network and most consoles still display that designation. The designation MOPS and OIS are synonymous.) All related operating positions, such as those for telemetry, are connected in parallel and the end instruments may communicate only with the channels to which connected. 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 that same channel.

D-2

During the INTELSAT IV (F5) launch, various operations are assigned specific OIS channels. 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. Table 3 shows the OIS system channel assignment.

5. Leased Voice Circuits. Two NASCOM voice circuits are used for voice communications in support of launch operations. The leased voice circuits are as follows:

a. LL-12 - LN/ST - Launch status (SCAMA)

b. LL-15 - MF/CN - MSFN coordination

6. Post-Liftoff Channels (OIS)

a. Channel 2. This channel will be used for flight events.

b. Channel 10. This channel will be used for Range Safety and trajectory commentary.

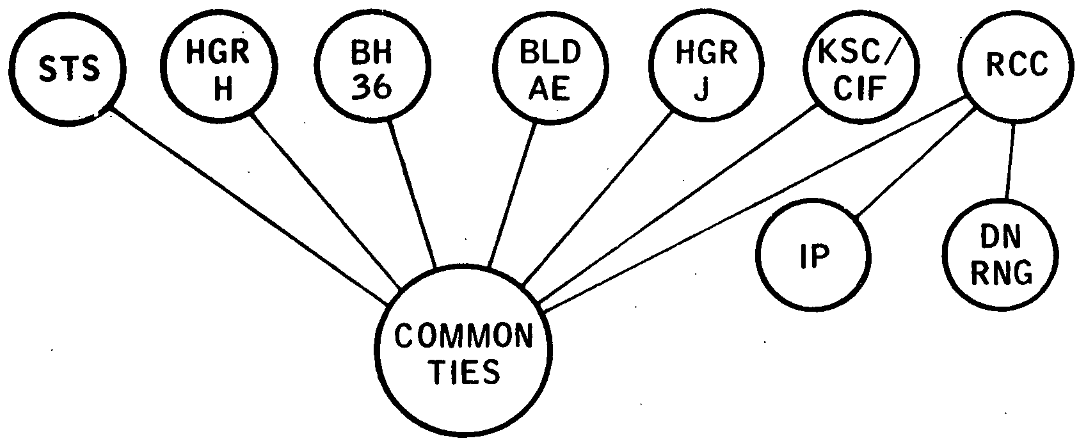
c. Channel 16. Liftoff time and mark event times for the MSFN will be called out on this channel.

d. Channel 20. This channel will carry the MDC commentary with regard to vehicle performance.

The OIS and green telephone network for the INTELSAT IV (F5) launch are shown in figures 6 and 7 respectively.

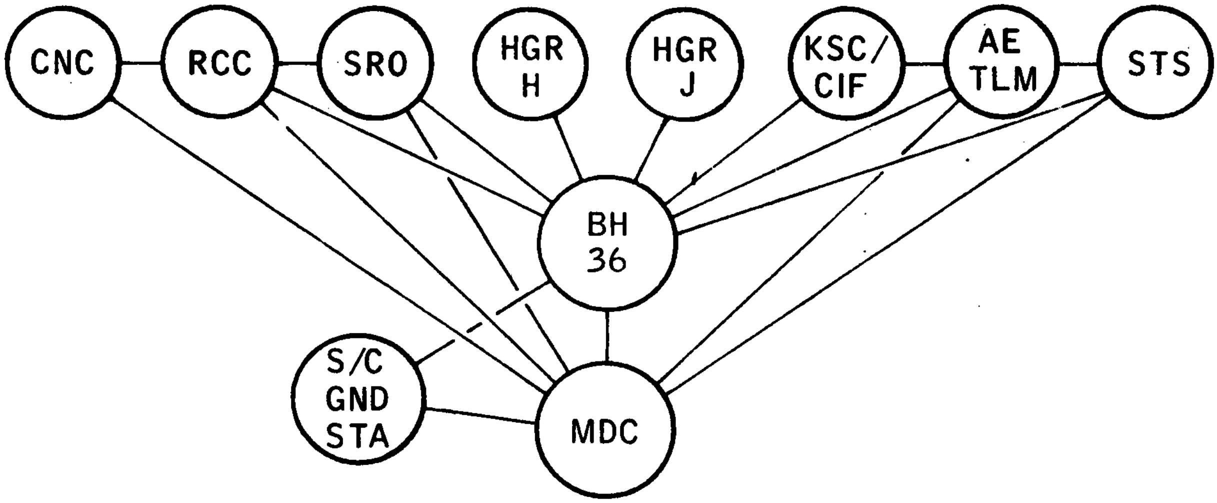
Table 3. OIS Channel Assignments

Channel Title	Channel Assignment
Test conductor	1
Blockhouse monitor stand	2
ATLAS propulsion	3
CENTAUR propulsion	4
Vehicle electrical	5
Complex electrical	6
ATLAS autopilot	7
CENTAUR autopilot	8
Landline instrumentation	9



BH	- BLOCKHOUSE COMPLEX 36
BLD	- BUILDING
CIF	- CENTRAL INSTRUMENTATION FACILITY
DN RNG	- DOWN RANGE
HGR	- HANGAR DESIGNATION
IP	- IMPACT PREDICTOR
KSC	- KENNEDY SPACE CENTER
RCC	- RANGE CONTROL CENTER, PROJ. REP.
RTCF	- REAL TIME COMPUTER FACILITY
STS	- SPACECRAFT TRACKING STATION

Figure 6. Operations Intercommunication System Network



BH	-	BLOCKHOUSE COMPLEX 36
CIF	-	CENTRAL INSTRUMENTATION FACILITY
CNC	-	CAPE NETWORK CONTROLLER
HGR	-	HANGAR DESIGNATION
KSC	-	KENNEDY SPACE CENTER
MDC	-	MISSION DIRECTOR'S CENTER
RCC	-	RANGE CONTROL CENTER, PROJ. REP.
S/C GND STA	-	SPACECRAFT GROUND STATION
SRO	-	SUPERVISOR RANGE OPERATIONS
STS	-	SPACECRAFT TRACKING STATION
TLM	-	TELEMETRY

Figure 7. Green Phone Network

Table 3. OIS Channel Assignments (Cont'd)

Channel Title	Channel Assignment
Telemetry and radio frequency	10
CENTAUR pneumatics and facilities	11
ATLAS pneumatics and launcher	12
Environmental control and water	13
NASA data	14
Propellant utilization	15
NASA engineering	16
Propellant/facilities	17
Guidance	18
Spacecraft test conductor	19
NASA project net	20
SRO	21
Pad safety	22
Spacecraft test operations	23
Mission director	24

7. Communications Circuits. Table 4 lists the communications circuits that will be used to transmit launch vehicle, spacecraft, and informational type data during prelaunch and post launch operations.

Table 4. INTELSAT IV Communications Circuits

Circuit	From	To	Subject	Type of Information
1	GSFC (Analog)	AE	L/V and S/C	Raw
2	Ascension	AE	L/V	Raw
3	Ascension	AE	L/V	Raw

Table 4. INTELSAT IV Communications Circuits (Cont'd)

Circuit	From	To	Subject	Type of Information
4	GSFC (L/V)	AE	L/V	Raw
5	CIF-1	AE	L/V	Video
6	CIF-2	AE	L/V	Video
7	CIF-3	AE	L/V	Video
8	CIF-4	AE	L/V	Video
9	CIF-5	AE	L/V	Video
10	CIF-6	AE	L/V	Video
11	CIF-7	AE	L/V	Video
12	CIF-8	AE	L/V	Video
13	Realtime Computer System	AE	L/V	Video
14	Complex-36	AE	L/V	Raw
15	STS	AE	L/V	Raw
16	STS	AE	L/V	Raw
17	Antigua	AE	L/V	Raw
18	Antigua	AE	L/V	Raw
19	AE	CIF	L/V	Raw
20	CIF-B	AE	L/V	Raw
21	CIF-C	AE	L/V	Raw
22	STS (Doppler)	AE	L/V	Raw
23	Range Safety TV	AE	Info	Video
24	Range Safety TV	AE	Info	Video
25	Complex-36	AE	Info	Video

Table 4. INTELSAT IV Communications Circuits (Cont'd)

Circuit	From	To	Subject	Type of Information
26	Complex-36	AE	Info	Video
27	AE	CX-36	Info	Video
28	Intercept Ground Optical Recorder	AE	Info	Video
29	Weather (RCC)	AE	Info	Video
30	AE	STS	Info	Video

SECTION IV
TEST OPERATIONS

A. LAUNCH VEHICLE AND SPACECRAFT PRELAUNCH MILESTONES

The significant launch vehicle and spacecraft prelaunch milestones are presented in tables 5 and 6, respectively.

Table 5. Launch Vehicle Prelaunch Milestones

Event	Location	Date
ATLAS arrived at ETR	Hangar J	2-10-72
CENTAUR arrived at ETR	Hangar J	2-4-72
ATLAS erected	Complex 36B	3-7-72
CENTAUR erected	Complex 36B	3-8-72
Terminal Countdown Demonstration	Complex 36B	5-9-72
Flight Acceptance Composite Test No. 1	Complex 36B	5-18-72
Flight Acceptance Composite Test No. 2	Complex 36B	6-2-72
Mate INTELSAT IV (F5) to CENTAUR	Complex 36B	6-8-72*
Composite Readiness Test	Complex 36B	6-8-72*
F-3, 2, and 1 day activities	Complex 36B	6-10 through 6-12-72*
Launch readiness	Complex 36B	6-13-72*
*Planned dates		

Table 6. Spacecraft Prelaunch Milestones

Event	Location	Date
Spacecraft arrived at ETR	Building AM	5-16-72
Spacecraft performance checks complete	Building AM	5-22-72
Transport spacecraft to ESA 60A	ESA 60A	5-29-72

Table 6. Spacecraft Prelaunch Milestones (Cont'd)

Event	Location	Date
Mating of apogee motor to spacecraft	ESA 60A	5-30-72
Hydrazine loading into position and orientation subsystem	ESA 60A	5-31-72
Spacecraft processing completed	ESA 60A	6-5-72
Spacecraft functional test	ESA 60A	6-5-72
Mate to ground transport vehicle	ESA 60A	6-6-72
Spacecraft encapsulated	ESA 60A	6-7-72*
Transport spacecraft to Complex 36B and mate to CENTAUR	Complex 36B	6-8-72*
Spacecraft functional test	Complex 36B	6-9-72*
Launch readiness	Complex 36B	6-13-72*
*Planned dates		

B. F-1 DAY OPERATIONS

The major operations occurring on F-1 day, with T-time matched to the Eastern daylight time the event is scheduled to occur, are listed in table 7.

Table 7. Major F-1 Day Operations

Time (EDT)	Count (Min)	Event
0600	T-630	Start countdown operations Start ATLAS propulsion launch preparations Start CENTAUR propulsion thrust section preparation
0700	T-570	Start telemetry and radio frequency systems early tests
0730	T-540	Start spacecraft functional test
1130	T-300	Spacecraft functional test complete
1200	T-270	ATLAS propulsion launch preparations complete

Table 7. Major F-1 Days Operations (Cont'd)

Time (EDT)	Count (Min)	Event
1200	T-270	CENTAUR propulsion thrust section preparation complete
1215	T-255	Start Range Safety Command Test
1235	T-235	Range Safety Command Test Complete
1240	T-230	Radio frequency silence established Start mechanical installation and electrical connection of ATLAS/CENTAUR destruct boxes and pyrotechnics
1325	T-185	Red box mechanical and electrical connections complete Start mechanical installation and electrical connection of ATLAS pyrotechnics and spacecraft electrical connection of pyrotechnics
1459	T-91	Mechanical installation and electrical connection of ATLAS pyrotechnic devices complete and spacecraft ordnance circuit checks completed Radio frequency silence may be lifted
1500	T-90	Start vehicle fairing closeout
1630	T-0	Vehicle fairing closeout complete Secure F-1 day operations

C. F-0 DAY OPERATIONS

The major events of the countdown, with T-time matched to the Eastern daylight time the event is scheduled to occur, are listed in table 8. All times listed are predicated on a launch that occurs within the first minute of the planned launch window.

Table 8. Major F-0 Day Operations

Time (EDT)	Count (Min)	Event
0808	T-515	Start countdown
0833	T-490	Start guidance system warmup
1103	T-340	Man stations for launch countdown operations

Table 8. Major F-0 Day Operations (Cont'd)

Time (EDT)	Count (Min)	Event
1108	T-335	Range countdown starts
1113	T-330	Start guidance/autopilot test
1143	T-300	Install spacecraft umbilical connectors
1148	T-295	Guidance autopilot test completed, preliminary results are go
1153	T-290	Start guidance system calibration
1333	T-190	Guidance/autopilot test results are go
1443	T-120	Start tower removal
1453	T-110	Guidance system calibration complete
1512	T-91	Start spacecraft initialization
1513	T-90	Start 60-minute builit-in hold
1613	T-90	End of built-in hold
1615	T-88	Tower securing complete
1633	T-70	Start CENTAUR lox tanking Arm spacecraft apogee motor
1643	T-60	Start ATLAS lox tanking
1703	T-40	Start CENTAUR LH_2 tanking
1721	T-22	Start Range Safety Command final test
1723	T-20	Start CENTAUR propellant utilization exercies Spacecraft to internal power
1725	T-18	Range Safety Command final test complete
1733	T-10	Start 10-minute built-in hold
1743	T-10	Built-in hold ends
1745	T-8	Spacecraft heaters on
1749	T-4	Spacecraft sequencer on CENTAUR to internal power

Table 8. Major F-0 Day Operations (Cont'd)

Time (EDT)	Count (Min)	Event
1751	T-2	ATLAS to internal power
1751.30	T-1.5	Range launch clearance
1753	T-0	Launch (2-inch motion)