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November 6, 1972

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DELTA-92

TELESAT-A

OPERATIONS SUMMARY

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

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OPERATIONS SUMMARY

Approved: for D. C. Sheppard
Chief, Spacecraft and Vehicle Support Operations Branch

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

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SECTION I
MISSION

A. MISSION OBJECTIVE

The Canadian domestic satellite communications system will use satellites located in synchronous, circular, equatorial orbits, as relay stations for a network of earth stations. The system will provide telephone message traffic, and television and radio program distribution.

The mission objective is to place a communications satellite in a geostationary orbit at a longitude of approximately 114 degrees west giving a desired coverage region which will include most of Canada. By agreement, launching services are provided by NASA for Telesat of Canada.

Telesat-A, the first of the Telesat satellites, will be launched by a Delta vehicle, model 1914, designated Delta-92.

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. Launch Vehicle. Delta-92 (figure 1) is the first of the new upgraded Delta Straight-Eight vehicles. It consists of a DSV-3P-11 extended long tank first stage with an MB-3 engine, augmented by nine low-drag Castor II solid motors; a DSV-3P-4 second stage within an eight foot mini-skirt adapter; and a TE-364-4 third stage. The prime contractor for the launch vehicle is the McDonnell Douglas Astronautics Company (MDAC). Pertinent vehicle data are presented in table 1.

2. Spacecraft. The Telesat-A satellite (figure 2) was produced by the Hughes Aircraft Company of California, in conjunction with two Canadian subcontractors, Northern Electric (electronics) and Spar Aerospace (structure). The spin-stabilized satellite electronics system will be powered normally by some 23,000 solar cells, with sufficient on-board battery capability to provide power to maintain service at full capacity during sun eclipse of the solar cells, which occurs when the moon or earth are positioned between the satellite and the sun for predictable short periods.

A 60-inch wide circular directional antenna extends 73.5 inches above the top, at an angle to the spacecraft centerline. The antenna is de-spun with respect to the spinning satellite body, remaining constantly aimed at Canada. An apogee motor is provided to circularize the spacecraft orbit. Periodic firing of two independent hydrazine propulsion systems will compensate for drift when on station. Further pertinent spacecraft data are presented in table 2.

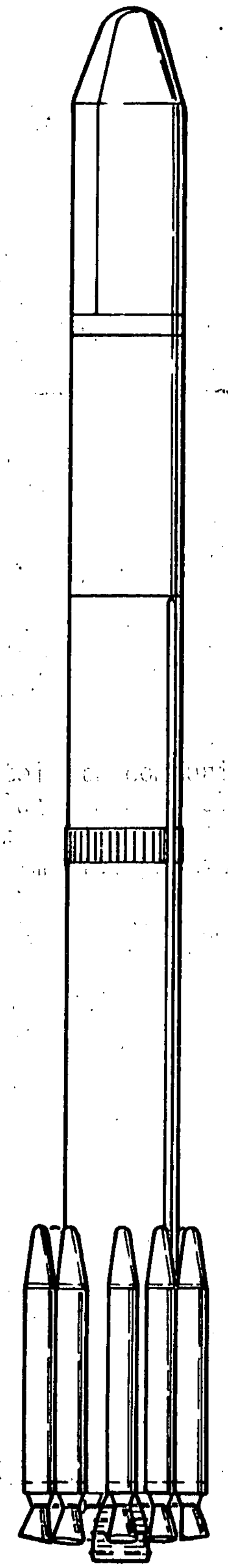


Figure 1. Delta-92 Launch Vehicle

Table 1. Delta-92 Vehicle Data

Item	Boosters	Stage I	Stage II	Stage III
Length (feet)	19.7	73.8	17.6	5.9
Diameter (inches)	31	96	54 W/96 adapter	37
Engine type	Solid	Liquid	Liquid	Solid
Engine manufacturer	Thiokol	Rocket-dyne	Aerojet	Thiokol
Designation	TX354-5	MB3-III	AJ10-118F	TE-M-364-18
Number of engines	9	1 (+2VEs)	1	1
Specific impulse	237.6	252.4	306.3	285.3
Thrust (pounds/engine)	52,150	175,000 & (2 VE@ 1,000 ea)	9,606	14,100
Burn time (seconds)	39	265	342	43.0
Propellant	TP-H7036	-	-	TP-H-3062
Fuel	-	RJ-1	A50	-
Oxidizer	-	Lox	N_2O_4	-
Nitrogen gas (psig)	-	3,100	4,000	-
Helium gas (psig)	-	1,150	4,350	-
Serial number	346, 347, 348, 349, 350, 351, 352, 353, 354	20,001	20,001	40,019

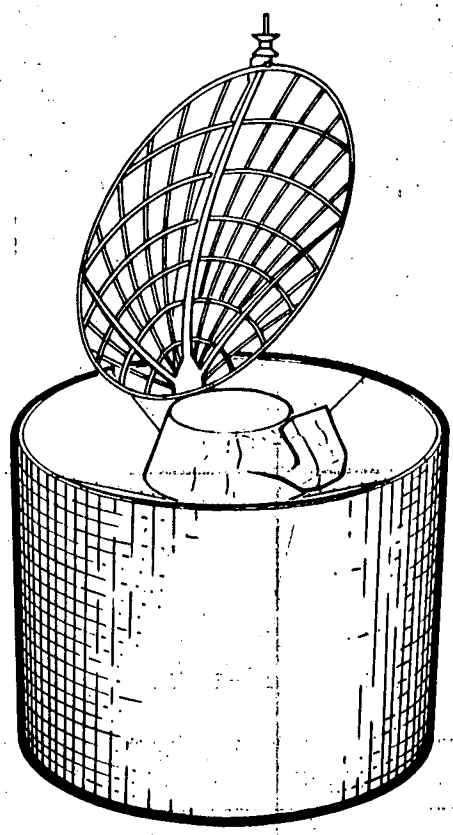


Figure 2. Telesat-A Spacecraft

Table 2. Telesat-A Spacecraft Data

Weight (pounds)	1,240
Height, body (inches)	61.5
Height, overall (inches)	135.0
Diameter (inches)	75.1
Electrical power	240 watts (maximum)
Life expectancy (years)	7

C. MISSION PLAN

1. Launch Constraints.

a. Launch Window. The actual time of the launch windows from November 9 thru November 15, 1972 are listed in table 3.

Table 3. Launch Windows

Date	Opens (Z)	Closes (Z) (following day)
Nov. 9	23:20:00	00:28:30
Nov. 10	23:19:00	00:29:00
Nov. 11	23:19:00	00:30:00
Nov. 12	23:18:30	00:30:30
Nov. 13	23:18:30	00:31:30
Nov. 14	23:18:00	00:32:00
Nov. 15	23:17:30	00:32:30

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 vehicle mandatory requirements on telemetry; however, if a telemetry channel carrying critical information becomes inoperative during countdown, it is sufficient cause for a hold to review the effects on vehicle readiness and performance.

c. Spacecraft. The Ottawa Satellite Control Center, and the Guam and Allan Park Satellite Tracking Stations must be operational.

d. 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 gantry around it is 64 knots. The maximum wind velocity which the vehicle can safely withstand when it is erected and with gantry removed is 43 knots.

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

2. Flight Plan. The Telesat-A spacecraft will be launched from Complex 17, Pad B, Cape Kennedy Air Force Station (CKAFS), Florida, no earlier than November 9, 1972. The pad azimuth will be 115 degrees and the vehicle will roll to 95 degrees shortly after liftoff placing the spacecraft into an elliptical transfer orbit as illustrated in figures 3 and 4. A kick motor will be fired at apogee to place the spacecraft in a circular synchronous earth orbit. Intermediate orbit parameters are listed in table 4.

Table 4. Telesat-A Orbit Parameters

Apogee	19,565 nm
Perigee	105 nm
Inclination	27.0
Period	24 hours*
*Circularized on 7th apogee	

The nominal sequence of events from liftoff through yo weight release are presented in table 5. 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 and S1+seconds.

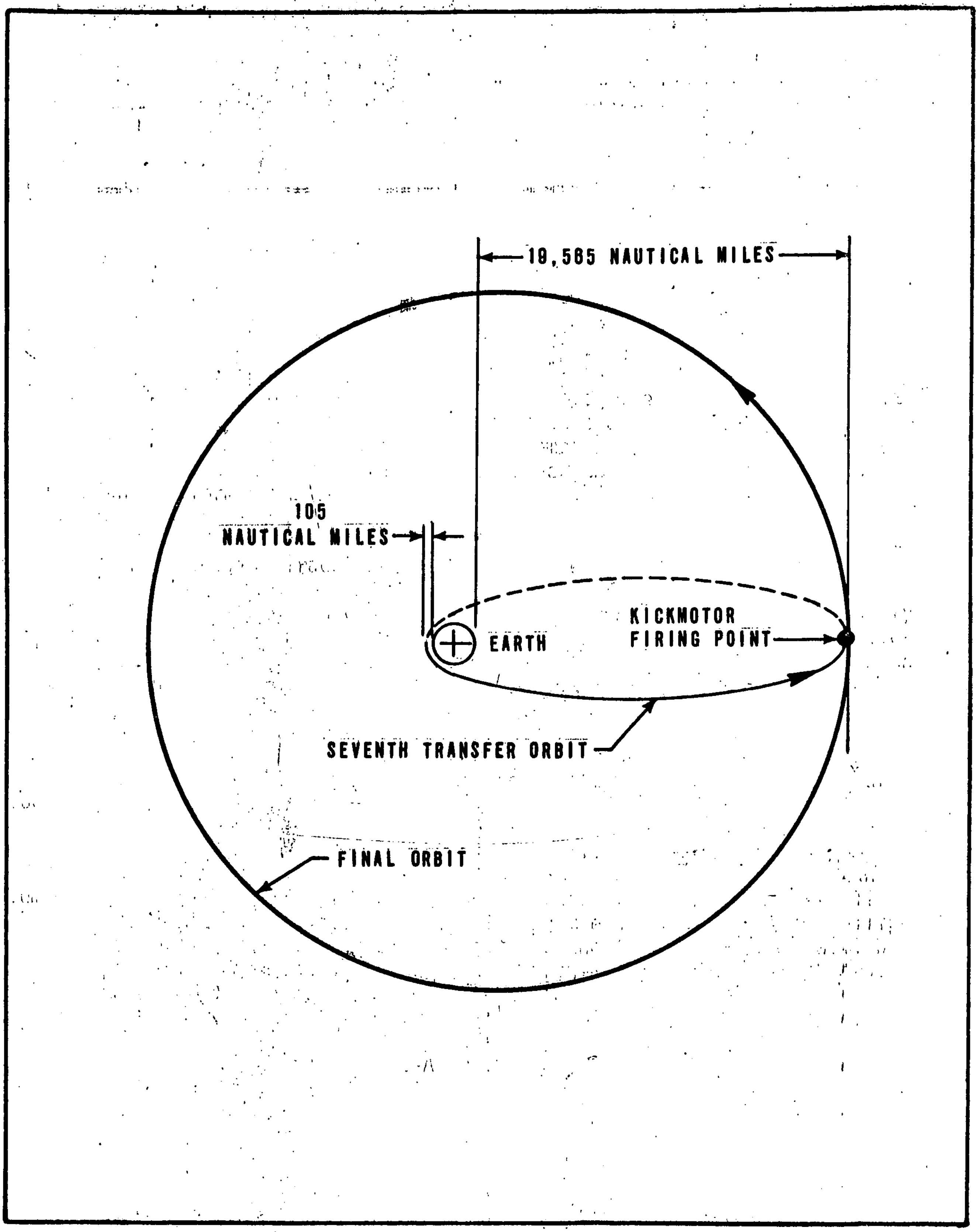


Figure 3. Telesat-A Orbital Paths

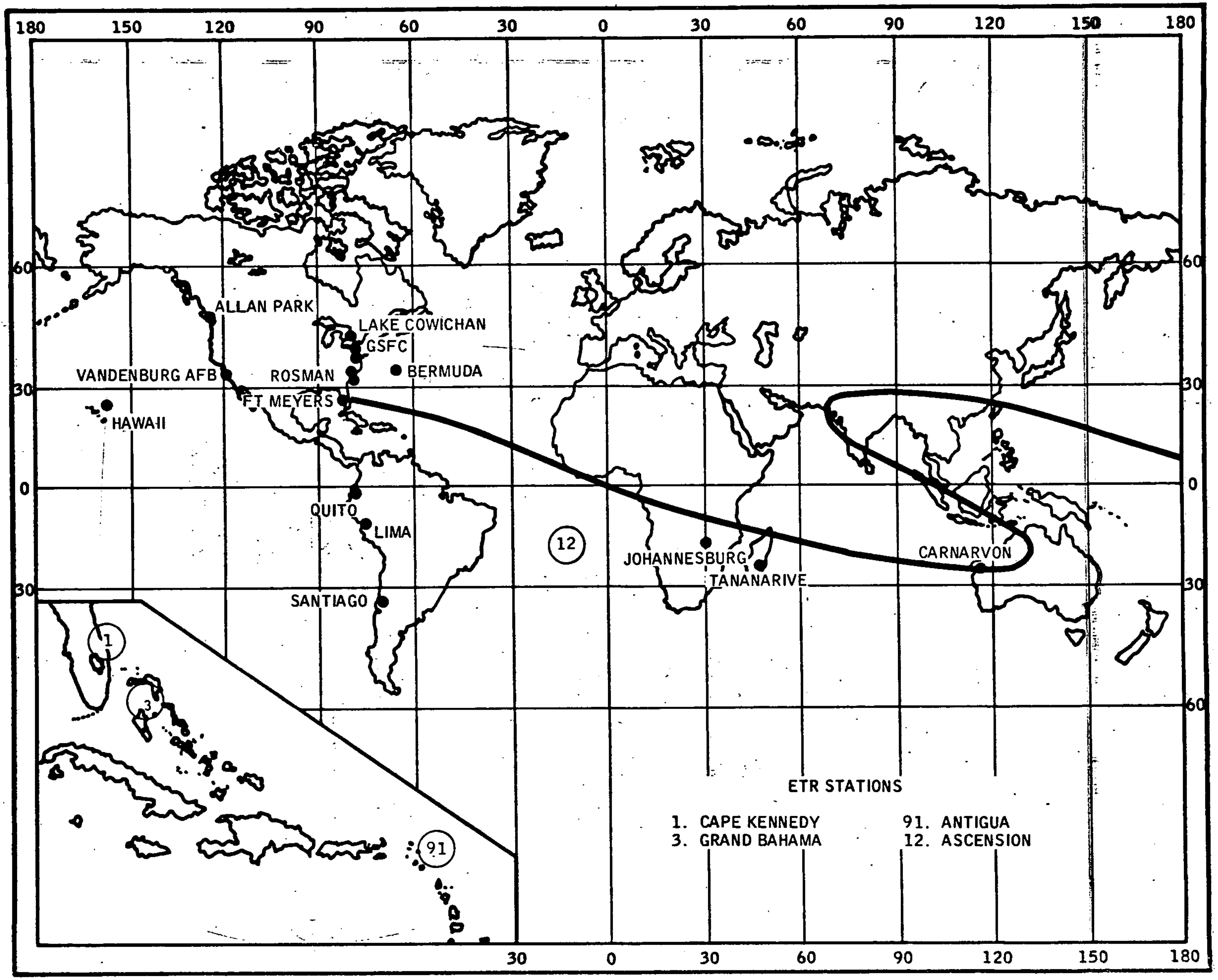


Figure 4. Spacecraft Tracking and Trajectory

Table 5. Sequence of Flight Events

T+Sec	Min;Sec	Event	Initiated By
T-0.2	-00;00.2	Pitch & yaw vernier engine lockout	DIGS discrete 29 off
		Solid motors (4, 5, 6, 7, 8, 9) ignition	FIP switches
		Start solid motor separation timer	Solid motor ignition relays
T+0	00:00.0	Liftoff	
		Initiate open loop guidance	DIGS
T+2.0	00:02	Begin stage I roll program	DIGS
T+7.0	00:07.0	End stage I roll program	DIGS
		Begin first pitch program	DIGS
T+11.0	00:11.0	End first pitch rate	DIGS
		Begin second pitch rate DIGS	
T+12.0	00:12.0	End second pitch rate	DIGS
		Begin third pitch rate	DIGS
T+25.0	00:25.0	End third pitch rate	DIGS
		Begin fourth pitch rate	DIGS
T+37.0	00:37.0	Gain change - pitch, yaw, roll	DIGS
T+38.2	00:38.2	Solid motor burnout (4, 5, 6, 7, 8, 9)	DIGS
T+39.0	00:39.0	Solid motors (1, 2, 3) ignition	Solid motor timers
T+40.0	00:40.0	End fourth pitch rate	DIGS

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min;Sec	Event	Initiated By
		Begin fifth pitch rate	DIGS
T+50.0	00:50.0	End fifth pitch rate	DIGS
		Begin sixth pitch rate	DIGS
T+65.0	01:05.0	End sixth pitch rate	DIGS
		Begin seventh pitch rate	DIGS
T+77.4	01:17.4	Solid motor (1, 2, 3) burnout	Depletion
T+85.0	01:25.0	Solid motors (1 thru 9) separation command	Solid motor timers
		Lox accumulator purge on	Solid motor timers
		Gain change - roll	DIGS
T+87.0	01:27.0	End seventh pitch rate	DIGS
		Begin eighth pitch rate	DIGS
T+100.0	01:40.0	Filter and gain change - pitch, yaw	DIGS
T+120.0	02:00.0	Start guidance	DIGS
T+140	02:20.0	Feedback S/N gain change	DIGS discrete 30 on
		Gain change - pitch, yaw	
T+200	03:20.0	Filter gain change - pitch, yaw	DIGS
T+238.1	03:58.1	Switch to velocity only steering	DIGS
T+240.0	04:00.0	Enable MECO	DIGS discrete 31 on

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event	Initiated By
T+253.0	04:13.0	End eighth pitch rate	DIGS
T+253.1	04:13.1	Stop computing guidance steering corrections	DIGS
T+254.1	04:14.1	Stop stage I closed loop guidance	DIGS
T+258.1	04:18.1	MECO	FIP switches
		VE enable/main engine lockout	DIGS discrete 29 on
		Stage II hydraulic pump on (back-up)	DIGS discrete 7 on
		Arm stage II ignition and pyrotechnic power	DIGS discrete 12, 13 on
		Pressurize tanks	DIGS discrete 22 on
		Filter and gain change - pitch and yaw	DIGS
T+261.1 (M+3.0)	04:21.1	Remove tank pressurization discrete	DIGS discrete 22 off
		Close tank pressurization valve (SECO discrete on)	DIGS discrete 5 on
T+264.1 (M+6.0)	04:24.1	VECO	DIGS discrete 32 on
T+266.1 (M+8.0)	04:26.1	Blow stage I/II separation bolts	DIGS discrete 2, 18 on
		Remove SECO discrete	DIGS discrete 5 off
T+267.1 (M+9.0)	04:27.1	Remove stage I discretes	DIGS

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event	Initiated By
T+267.1 (M+9.0)	04:27.1	Filter and gain change - pitch, yaw, roll	DIGS
T+270.1 (M+12.0)	04:30.1	Remove separation discretes	DIGS discrete 2, 18 off
		Pressurize tanks	DIGS discrete 22 on
T+271.1 (M+13.0)	04:31.1	Start stage II engine	DIGS discrete 3 on
		Filter and gain change - pitch, yaw	DIGS
		Filter and gains to gas jet control - roll	DIGS
T+271.4 (M+13.3)	04:31.4	Start steady burn	DIGS discrete 3, 22 off
T+272.1 (M+14.0)	04:32.1	Remove tank pressurization and engine start discretes	Pc=110 psia
T+274.5 (M+16.4)	04:34.5	Begin stage II first pitch rate	DIGS
T+298.0 (M+21.9)	04:58.0	Start guidance	DIGS
T+284.5 (M+26.4)	04:44.4	End stage II first pitch rate	DIGS
		Begin stage II second pitch rate	DIGS
T+294.0 (M+35.9)	04:54.0	Fairing unlatch	DIGS discrete 4 on
T+295.0 (M+36.9)	04:55.0	Fairing separation	DIGS discrete 4 off, 19 on

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min;Sec	Event	Initiated By
T+297.0 (M+38.9)	04:57.0	Remove fairing separation discrete	DIGS discrete 19 off
T+440.0 (M+181.9)	07:20.0	Gain change - pitch, yaw	DIGS
T+544.1 (M+286.0)	09:04.1	Switch to velocity only steering	DIGS
T+591.1 (M+333.0)	09:51.1	Stop computing guidance steering corrections	DIGS
T+592.1 (M+334.0)	09:52.1	Initiate check on thrust pressure switch	DIGS
T+593.1 (M+335.0)	09:53.1	Stop guidance	DIGS
T+594.1 (M+336.0)	09:54.1	SECO	DIGS discrete 5 on
(S1+0 time reference)		End stage II second pitch rate	DIGS
		Turn off hydraulic pump	DIGS discrete 7 off, 6 on
		Change pitch/yaw filters and gains to gas jet control	DIGS
		Start pitch/yaw gas jet control in course limit cycle	DIGS
T+650.0 (S1+55.9)	10:50.0	Begin stage II third pitch rate	DIGS
T+654.1 (S1+60.1)	10:54.1	Enable CDR turn off	DIGS discrete 27, 28 on
T+655.1 (S1+61.0)	10:55.1	Turn off CDRs	DIGS discrete 27 off

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min:Sec	Event	Initiated By
T+750.0 (S1+155.9)	12:30.0	End stage II third pitch rate	DIGS
T+765.0 (S1+170.9)	12:45.0	Begin stage II first yaw rate	DIGS
T+785.0 (S1+190.9)	13:05.0	End stage II first yaw rate	DIGS
T+1204.1 (S1+610.0)	20:04.1	Begin pitch/yaw gas jet control in fine mode	DIGS
T+1340.0 (S1+745.9)	22:20.0	Initiate first coast guidance	DIGS
T+1390.0 (S1+795.9)	23:10.0	End first coast guidance	DIGS
T+1400.6 (S1+806.5)	23:20.6	Fire spin rockets	Digs
		Start stage III ignition time delay	DIGS discrete 10 on
		Start stage III sequence timer	
T+1401.6 (S1+807.5)	23:21.6	Fire stage III wire cutters	DIGS discrete 11 on
		Remove spin rocket discrete	DIGS discrete 10 off
T+1402.6 (S1+808.5)	23:22.6	Blow stage II/III separation bolts	DIGS discrete 14 on
		Fire retros	
T+1415.6 (S1+821.5)	23:35.6	Stage III ignition	Pyrotechnic time delay
T+1458.4 (S1+864.3)	24:18.4	Turn on hydraulic pump	DIGS discrete 7 on, 6 off
		Remove SECO discrete	DIGS discrete 5 off

Table 5. Sequence of Flight Events (Cont'd)

T+Sec	Min;Sec	Events	Initiated By
T+1459.4 (S1+865.3)	24:19.4	Stage III burnout	Depletion
T+1479.4 (S1+885.3)	24:39.4	*Stage II engine restart	DIGS discrete 3 on
		Change pitch/yaw filters and gains to engine control	DIGS
T+1484.4 (S1+890.3)	24:44.4	Reactivate mode change logic via guidance	DIGS
T+1494.4 (S1+900.3)	24:54.4	Second SECO	Depletion
		**Events which occur at at sensed SECO 2	
		Change pitch/yaw filters and gains to gas jet control	DIGS
		Start pitch/yaw jet control in coarse mode	DIGS
T+1560.6 (S1+966.5)	26:00.6	Payload separation	Stage III sequence timer
T+1562.6 (S1+968.5)	26:02.6	Release yo weight	Stage III sequence timer

*DIGS discrete 23 on
**DIGS discrete 23 off

D. POST LAUNCH OPERATIONS

Following insertion into the transfer orbit, the spacecraft will be controlled from the Spacecraft Control Center at Ottawa. Tracking will be from a portable tracking station at Guam and the telemetry and command station at Allan Park, Canada. The apogee motor will be fired on the seventh apogee of the transfer orbit by command from the Allan Park station. Back-up command capability will be provided from the Lake Cowichan station. The spacecraft final position will be at 114 degrees west.

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 operation is the responsibility of the Unmanned Launch Operations (ULO) Directorate. The ULO Test Controller functions as the official contact between test personnel and the ETR. The ULO Spacecraft Operations Engineer in the blockhouse coordinates spacecraft activities and reports spacecraft status to the test conductor.

2. Hangar AO. The spacecraft checkout area is located in Hangar AO, and is connected by data circuits and voice communications to the Telesat Control Center in Ottawa, Canada.

3. Building AE. Two Telesat mission operational areas are located in Building AE. These are the Mission Director's Center (MDC) and the Launch Vehicle Telemetry Ground Station. In addition, an observation area is provided behind the MDC for observing overall mission progress. Figure 5 shows the location of the launch and operational areas.

The launch operations and overall mission activities are monitored by the Mission Director in the MDC (figure 6) 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 display and are used to show present position, Instantaneous Impact Prediction (IIP) plot and doppler information. These displays, when plotted with the theoretical plots, give an overall representation of the launch performance.

The following information will be displayed in the MDC during Telesat launch operations:

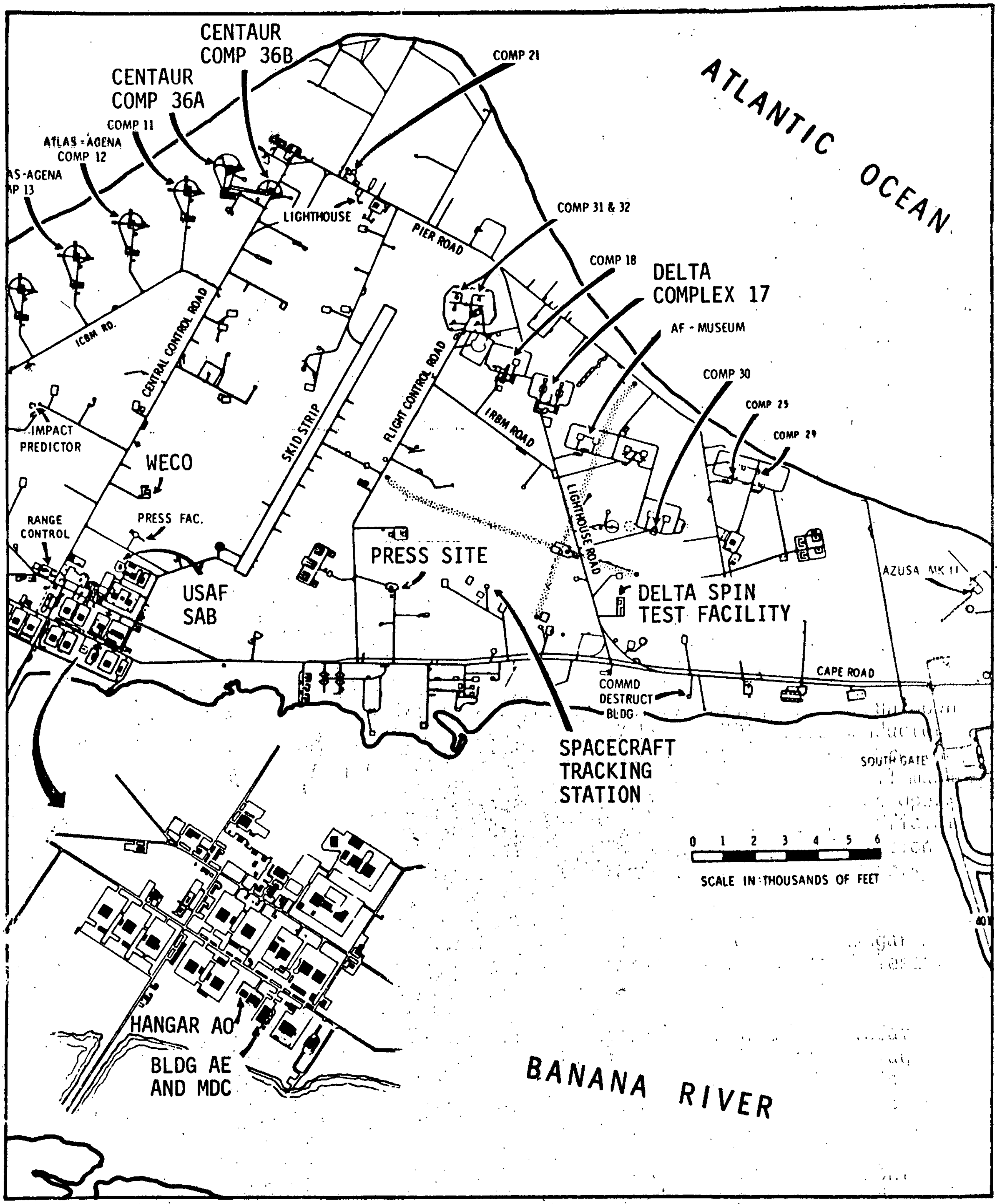
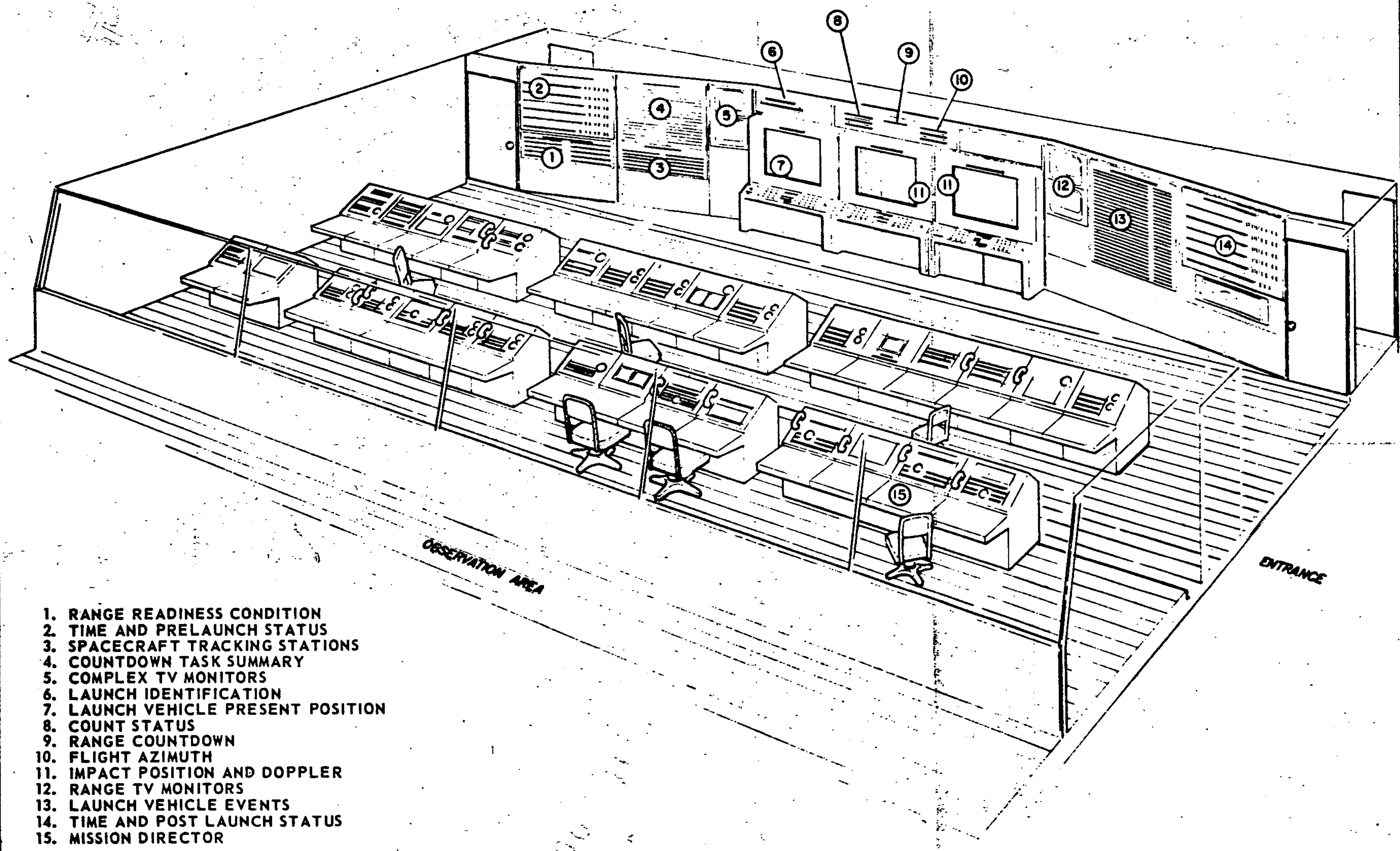


Figure 5. Launch and Operational Areas



1. RANGE READINESS CONDITION
2. TIME AND PRELAUNCH STATUS
3. SPACECRAFT TRACKING STATIONS
4. COUNTDOWN TASK SUMMARY
5. COMPLEX TV MONITORS
6. LAUNCH IDENTIFICATION
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 6. MISSION DIRECTOR'S CENTER

a. TV

b. ETR test number

c. Greenwich Mean Time (GMT) and Eastern standard Time (EST) 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 (Building AE) 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.

4. Spacecraft Tracking Station (STS). The STS will provide prelaunch spacecraft checkout support, consisting of frequency and power measurements, as requested by the spacecraft checkout team. In addition, launch vehicle telemetry signals will be remoted from the STS to Building AE, and spacecraft telemetry signals will be remoted from STS to Hangar AO in realtime.

B. DATA ACQUISITION

Telemetry, optical, and radar data will be supplied by a composite of ETR, GSFC, and KSC stations. The support requirements of various stations are described in the following paragraphs; the geographical location of the various stations are presented in figure 4.

1. Vehicle Telemetry.

a. Uprange Telemetry. During the prelaunch operations, the check-out 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/ULO. The AE station will display all channels telemetered and the Complex 17 station will display as many measurements as recorders permit. Systems 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.

Data will be received at both sites through their respective local antennas until just prior to liftoff, with switches after liftoff to other stations made as required to optimize the coverage. STS and CIF will provide early launch phase data to Building AE. Building AE will send the best of AE, CIF, or STS data to Complex 17. Complex 17 will therefore have the best data available. One hundred percent coverage is anticipated through the switch to Antigua data at about T+450 seconds.

b. Downrange Telemetry.

(1) Both MILA/USB and Bermuda stations will remote selected data to GSFC for GSFC displays. This data will be routed to Building AE on the Ascension circuits prior to Ascension AOS as an operational convenience to GSFC. It will be displayed at Building AE. See table 6.

Table 6. Bermuda/MILA USB Retransmissions

VCO	Vehicle Channel	Data
1	2-9	Engine Chamber Pressure
2	2-E-27	Nitrogen Regulator Pressure
3	2-E-20	Control Battery Voltage
4	2-E-23	Hydraulic Pressure
5	2-7	Pitch Jets
6	2-8	Roll Jets
7	2-E-9	Pitch Engine Position
8	---	Time

(2) Antigua (ETR station 9.1) is the prime downrange station for early launch. A composite of stage II and III data (see table 7) will be remoted to the Cape via the two subcable circuits. The PCM will be on the higher frequency subcable circuit remodulated on an IBM data modem. This data will be demodulated at Tel-4 and sent to Building AE for display and relay to Complex 17. The other channels will be directly placed on the lower frequency circuit. This 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 station viewing SECO.

Table 7. Antigua Retransmission

Transmit System	Vehicle VCO	Data
	High Freq Subcable	
IBM Modem	2-G	PCM
	Low Freq Subcable	
VCO-C	2-E	PDM
14	3-13	Pitch Acceleration
13	3-14	Yaw Acceleration
12	3-11	28-Volt Monitor
11	3-12	Engine Chamber Pressure
10	3-16	High Level Thrust Accel
9	2-9	Engine Chamber Pressure
8	2-8	Roll Jets
7	2-7	Pitch Jets
6	2-6	Yaw Jets
5	2-10	Yaw Control Signal
4	2-11	Pitch Control Signal

Note: 2 indicates link 2241.5 MHz
3 indicates link 2250.5 MHz

(3) Ascension Island has marginal coverage of the spinup through second SECO interval since the maximum elevation during this interval, for a nominal vehicle, is only 3.8°. However, the STDN site will attempt to receive, record, and retransmit selected data to Building AE. (See table 8 for the data to be sent.) It is anticipated that spinup, separation, ignition of stage III, burnout of stage III, spacecraft separation, and second burn of stage II will be received.

Table 8. Ascension Island, STDN, Realtime Data

LINK	IRIG SCO	VCO	FUNCTION
2241.5	E-42	1	Fuel Tank Pressure
2241.5	E-40	2	Fuel Injector Pressure
2241.5	E-41	3	Oxidizer Injector Pressure
2241.5	6	4	Yaw Jet Actuation (Spin Rate)
2241.5	E-38	5	Helium Regulated Pressure
2241.5	E-27	6	Nitrogen Regulated Pressure
2241.5	9	7	Stage II Chamber Pressure
		8	Time
LINK	**DOWN LINK IRIG SCO**	**VCO**	**FUNCTION**
2250.5	9	1	Radiometer
2250.5	10	2	Calorimeter
2250.5	12	3	Motor Chamber Pressure
2250.5	13	4	Pitch Acceleration
2250.5	14	5	Yaw Acceleration
2250.5	16	6	Thrust Acceleration
2241.5	6	7	Spin Rate
		8	Time

(4) An ARIA aircraft will provide backup to the Ascension station for the events associated with spinup, separation, ignition and burnout of stage III, spacecraft separation, and second burn of stage II. No ARIA with realtime retransmission capabilities is available because of the Apollo launch in early December; therefore, no 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+4-5 hours.

2. Spacecraft Telemetry.

Although the spacecraft will be radiating during the launch phase, the radiated frequency of 4198 MHz is such that only the STS will be providing receive, record, or retransmission services until acquisition by the Telesat ground stations.

3. Tracking. ETR radars will track through parking orbit insertion and will provide Range safety and orbital parameters based on this data. Radars 0.18, 1.16, 19.18, 3.18, 7.18, 91.18, and 12.17 may be used for this purpose. In addition, STDN radars will be used to provide final stage II orbital parameters.

The only tracking of the final orbit after stage III burn will be through use of the Telesat ground system using the spacecraft 4198 MHz signal. Accurate final orbits from Telesat should be available within 24 hours of launch.

STS will Doppler track the spacecraft signal through T+500 seconds and the resulting data will be remoted to the MDC and GSFC for display in realtime.

4. Miscellaneous Other Support.

a. STS will send the countdown to GSFC on the Digital Doppler System.

b. Stage III channel assignments are presented in table 9.

c. Building AE will remote mark events to GSFC using 8 VCO's (1 set of IRIG 1-8). (See table 10.)

d. The MILA USB site will track the vehicle and will supply data tapes if requested.

e. A block diagram of the overall data flow is presented in figure 7. Table 11 presents the wide band multiplexer assignments associated with this figure.

Table 9. Stage III Channel Assignments

VCO	INFORMATION
9	Radiometer
10	Calorimeter
11	28-Volt Monitor
12	Engine Chamber Pressure
13	Pitch Radial Acceleration
14	Yaw Radial Acceleration
15	Fairing Pressure
16	High Level Thrust Acceleration
17	Pitch Vibration
18	Thrust Vibration
19	Acoustic Microphone

Table 10. Building AE to GSFC Realtime Relay

LINK	IRIG SCO	VCO	FUNCTION
2241.5	G-2	1	Roll Attitude Error
2241.5	G-4	2	Pitch Attitude Error
2241.5	G-6	3	Yaw Attitude Error
2241.5	G-54	4	Orbit Time
2230.5	11	5	Main Engine Chamber Pressure
2241.5	9	6	Stage II Chamber Pressure
2241.5	A	7	Acceleration Thrust Axis
		8	Time

Table 11. Wide Band Multiplexer Assignments

MUX No. 1 - Complex 17 to Building AE	
1	2230.5 MHz Video
2	Spare
3	2241.5 MHz Video
4	PCM Direct
5	Vets
MUX No. 2 - Building AE to Complex 17	
1	CIF 2230.5 MHz/Ascension STDN No. 1
2	CIF 2241.5 MHz/Ascension STDN No. 2
3	Antigua Lo
4	Antigua Hi (PCM)
5	Ascension STDN No. 1
MUX No. 3 - STS to Building AE	
1	2230.5 MHz Video
2	2266.5 MHz Video
3	2241.5 MHz Video
4	2244.5 MHz Video
5	2250.5 MHz Video
MUX No. 4 - CIF to Building AE	
1	2230.5 MHz Video
2	2266.5 MHz Video
3	2241.5 MHz Video
4	2240.5 MHz Video
5	2250.5 MHz Video

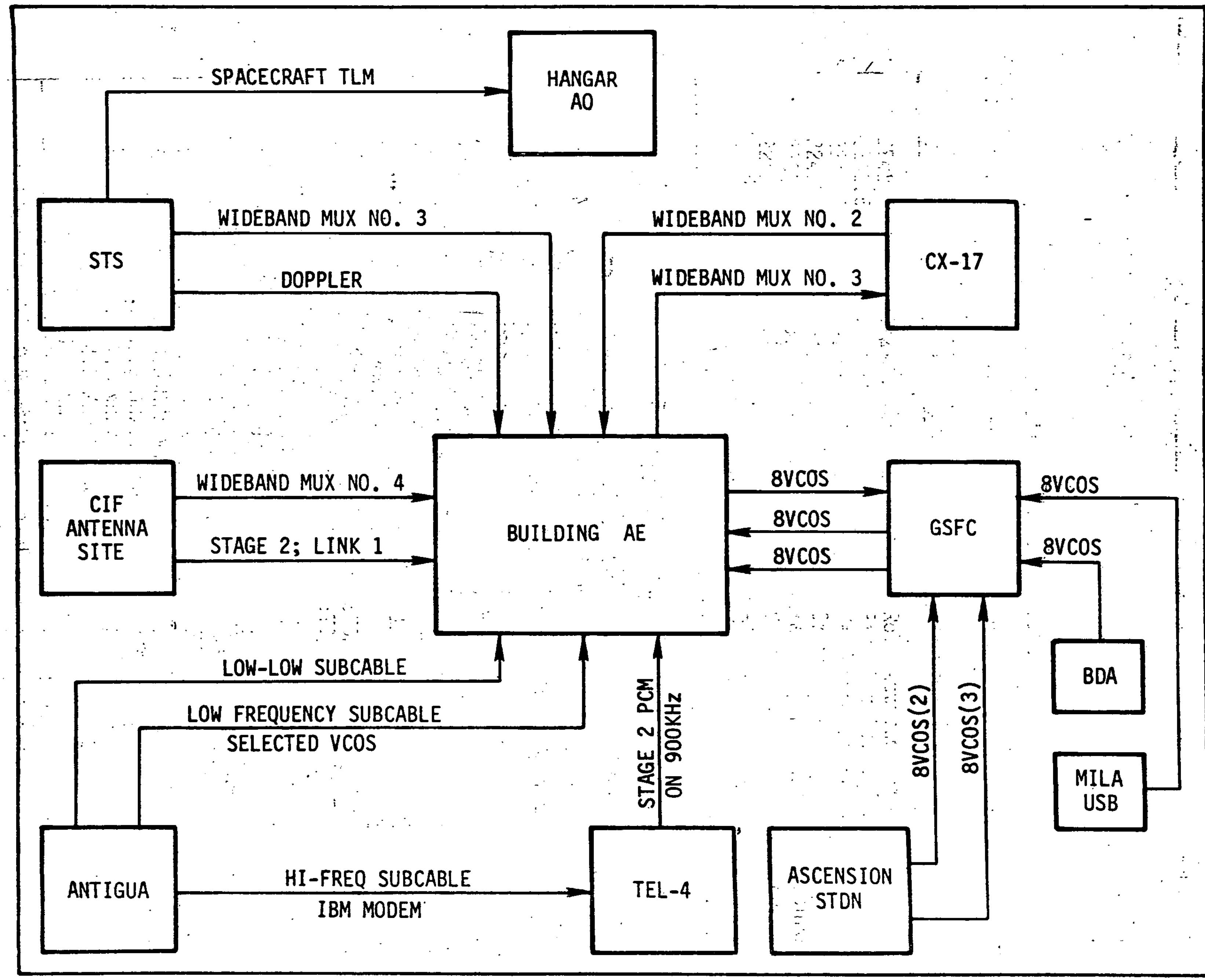


Figure 7. Telesat-A Data Flow

5. <u>Optics</u>. Thirty engineering sequential cameras will provide coverage from T-4 minutes to T+30 seconds. The Melbourne Beach long range tracking camera will track from acquisition to Loss of Vision (LOV). Seven tracking engineering sequential cameras will provide photographic coverage from liftoff to LOV. Twenty-four documentary cameras are assigned to the mission.

C. METEOROLOGICAL PLAN

Cape Kennedy Forecast Facility (CKFF) will provide Weather Warning (WW) services from the time the booster is erected on the pad until launch. WW notifications will be issued whenever surface winds are forecast to exceed 34 knots and/or electrical storm activity is expected within 5 nautical miles of Complex 17. F-5 Day forecasts of general surface and upper air conditions will be made available to the Test Requirements and Scheduling Office (TS-NTS-1) upon request. An upper winds forecast to 60,000 feet in 1,000-foot increments will be provided on F-2 Day. This forecast will include predictions of cloud cover, ceiling, visibility, surface winds, precipitation, and temperature. On F-1 Day, a forecast containing the same elements as on F-2 Day will be made. At T-10 hours, the F-1 Day forecast will be confirmed or modified and this will again be done at T-4 hours. In addition, the Assistant Staff Meteorologist will be available at the CKFF from T-4 hours until the test termination.

Minimum ceiling and visibility requirements will be as described by Range Safety. Upper air limitations, wind shears, and wind speeds will be determined by computer evaluation at MDAC Santa Monica from the latest forecasts.

SECTION III
COMMUNICATIONS

A. GENERAL

The operational communications facilities which will be available for support of the Telesat 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 6) 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, STS, 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 Telesat launch are listed in table 12.

Table 12. 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	AE TLM	AE TLM post liftoff oral 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-2	
19	Spacecraft-3	
20	Spare-3	

5. Special Circuits.

a. Two special voice circuits from the MDC to Ottawa, Canada are installed and will be used for mission coordination. These circuits show only at the Mission Director's position.

b. A teletype circuit from the Range communications center to Ottawa, Canada is installed and will be used to send orbital information to the Telesat Control Center in Canada. This information will be used in computing the spacecraft apogee firing time.

c. One special TV circuit from the ETR to Ottawa will be used for this launch. Plans call for the KSC color TV van to be located at Press Site No. 1 by the old Mercury Control Center. Video tapes of the visiting dignitaries will be made and access to the Complex 17 TV will be available thru Building AE. The launch will be fed live back to Canada.

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 13 and 14.

Table 13. Spacecraft Prelaunch Milestones

Event	Location	Date
Spacecraft ETR arrival	Hangar AO	10/12/72
Spacecraft performance checks	Hangar AO	10/13/72 10/24/72
Spacecraft moved to ESF-60A	ESF-60A	10/25/72
Spacecraft mated to third stage	Complex 17B	10/31/72
Mated to launch vehicle	Complex 17B	10/31/72

Table 14. Vehicle Prelaunch Milestones

Event	Location	Date
Stage I ETR arrival	Hangar M	9/15/72
Stage II ETR arrival	Hangar M	9/20/72
Stage III arrival	ETR	9/18/72
Stage I erection	Complex 17B	9/27/72
Stage II erection	Complex 17B	10/5/72
Simulated Flight Test	Complex 17B	10/30/72

B. F-3 DAY

The milestone activities accomplished during F-3 day are listed in table 15.

Table 15. F-3 Day Milestone Countdown

Time (EST)	Event
0600	TM station and DIG system turn-on
0700	Flight program verification
1200	Power on stray voltage checks
1530	Power off stray voltage checks Class B ordnance hookup Stage II S&A installation Solid motor separation cartridge installation Stage II primacord safety wiring Stage III destruct primacord connection

C. F-2 DAY

The milestone activities accomplished during F-2 day are listed in table 16.

Table 16. F-2 Day Milestone Countdown

Time (EST)	Event
0530	Spacecraft final preps
0730	Fairing installation Stage II propellant service preps
1500	Stage III telemetry and S&A demonstration S/C S&A demonstration
1600	Field joint final installation Strong back removal

Table 16. F-2 Day Milestone Countdown (Cont'd)

Time (EST)	Event
1930	Stage I solid motor ordnance installation Fairing ordnance installation and hookup
2130	Stage I solid motor ordnance hookup

D. F-1 DAY

The milestone activities accomplished during F-1 day are listed in table 17.

Table 17. F-1 Day Milestone Countdown

Time (EST)	Event
0530	Stage I final propellant servicing preps
0730	Stage II propellant servicing
1415	Stage I fueling
1500	Guidance and R/S systems checks S/C systems checks
1800	First stage engine preps

E. F-0 DAY

The milestone activities accomplished during F-0 day are listed in table 18.

F. TERMINAL COUNTDOWN

The terminal countdown starts at T-140 minutes and includes two built-in holds totaling 60 minutes. The first hold (50 minutes) occurs at T-60 minutes, the second hold (10 minutes) occurs at T-7 minutes. After completion of the second hold the countdown picks up at T-7 minutes and continues thru liftoff.

The milestone activities accomplished during the terminal countdown are listed in table 19.

Table 18. F-0 Day Milestone Countdown

Count (Min)	Time (EST)	Event
T-620	0700	Spacecraft class A ordnance hookup
T-620	0700	Class A ordnance hookup
T-500	0900	Final preps Hold fire checks Gantry removal preps Spacecraft final checks
T-350	1130	Solid motor single point arming
T-305	1215	Lanyard connect
T-260	1300	LCE warmup Gantry removal
T-230	1330	Stray voltage checks
T-140	1500	Stray terminal countdown

Table 19. Terminal Countdown

Count (Min)	Time (EST)	Event
T-140	1500	Start terminal count Pad securing Guidance system turn-on Beacon checks
T-60	1620	Built-in hold (50 minutes)
T-60	1700	Roll call
T-60	1710	Built-in hold ends Initiate terminal count
T-50	1720	Status check

Table 19. Terminal Countdown (Cont'd)

Count (Min)	Time (EST)	Event
T-45	1725	Helium loading Nitrogen loading
T-40	1730	First stage lox loading
T-35	1735	Final beacon checks
T-25	1745	Auto slews
T-15	1755	CDR's on (both stages)
T-9	1801	Range arm check on internal
T-7	1803	Built-in hold (10 minutes)
T-7	1813	Built-in hold ends Stage III telemetry external
T-5	1815	Stage I fuel tank pressurized Stage III ignition S&A arming
T-4	1816	Stage I telemetry internal Stage I E-package internal Stage I solid motor power internal Pressurize stage I Lox tank Stage II hydraulics on external
T-3	1817	All stage II systems on internal
T-2	1818	SRO clear to launch
T-90 sec		Spacecraft final report
T-60 sec	1819	Eng. recorders to high speed
T-15 sec		Final topping report
T-10 sec		Arm igniters Enable engine control

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Table 19. Terminal Countdown (Cont'd)

Count (Min)	Time (EST)	Event
T-5 sec		Open solo vent valve
T-2.6 sec		Engine start
T-0	1820	Liftoff