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JOHN F. KENNEDY SPACE CENTER

TR-1199
October 5, 1972

DELTA-90
INTERPLANETARY MONITORING PLATFORM-H
(IMP-H)

FLASH FLIGHT REPORT

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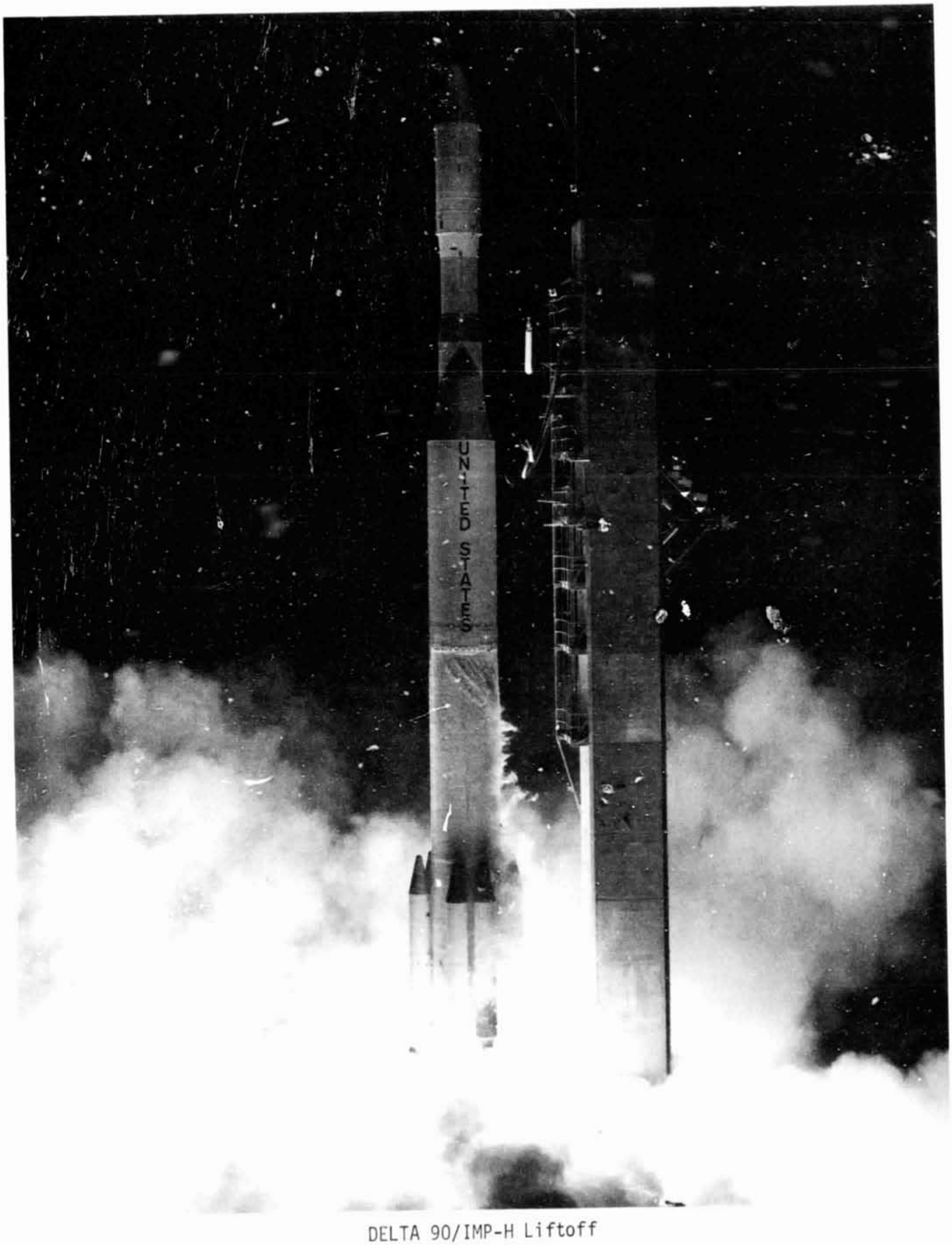
Prepared by
Spacecraft and Vehicle Support Operations Branch, KSC-ULO



DELTA 90/IMP-H Liftoff

TR-1199
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DELTA-90

INTERPLANETARY MONITORING PLATFORM-H

(IMP-H)

FLASH FLIGHT REPORT

Approved for H. A. Weston
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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SUMMARY

The Delta-90 launch vehicle and the IMP-H spacecraft were successfully launched from Pad B, Complex 17, Cape Kennedy Air Force Station, Florida, at 2120:00.559 EDT on September 22, 1972. The countdown proceeded smoothly to liftoff with no major difficulties or unscheduled holds.

The Delta-90/IMP-H were launched on a pad azimuth of 115 degrees, the vehicle then rolled to 95 degrees from the north placing the spacecraft in a highly elliptical transfer orbit. Firing the spacecraft kickmotor at 1136 EDT, September 25, 1972, injected the spacecraft into its final desirable near-circular orbit approximately half way between the planet earth and its moon.

Vehicle performance of all stages appeared nominal with all sequenced events occurring at the expected times. Data acquisition from all range stations was very good. Damage to the launch pad caused by liftoff was nominal.

SECTION I
MISSION

A. MISSION OBJECTIVES

The Interplanetary Monitoring Platform-H (IMP-H) project objectives are the study of solar and galactic cosmic radiation, solar plasma and wind, energetic particles, electromagnetic field variations, and the interplanetary magnetic field. The IMP-H spacecraft was successfully launched at 2120:00.559 EDT, September 22, 1972, from Complex 17, Pad B, Cape Kennedy Air Force Station (CKAFS) by a Delta launch vehicle designated Delta-90.

B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTION

1. Launch Vehicle. The Delta-90 (figure 1) was a three stage model 1604 configured vehicle for which the McDonnell Douglas Astronautics Company (MDAC) is prime contractor. The first stage (S/N 20006) was a DSV-3N extended long-tank liquid propellant booster powered by an MB3-III Rocketdyne engine system rated at 172,000 pounds of thrust at sea level. The first stage was augmented by six strapped-on solid propellant Thiokol TX354-5 Castor II motors, each motor produced approximately 52,150 pounds of thrust for a period of 39.0 seconds.

The second stage (S/N 20003) was powered by an Aerojet General AJ-10-118F liquid propellant engine rated at 9,606 pounds of thrust in a vacuum. Due to mission requirements the second stage was not equipped with a restart capability.

The third stage (S/N 40018) was powered by a Thiokol TE-364-18 solid propellant engine rated at 14,600 pounds of thrust with a burn time of 43.6 seconds.

2. Spacecraft. The IMP-H spacecraft (figure 2) manufactured by the Goddard Space Flight Center (GSFC) has structure improvements and modifications which are based on advances in the state-of-the-art and new spacecraft requirements. Geometrically, the structure is a 16-sided drum measuring 53.402 inches across flats and 62.125 inches in overall height. Three solar array rings are used to supply power to the experiments and electronics when in orbit. Two of the rings are mounted above and one below the experiment section. Appended to the exterior of the structure are two experiment booms approximately 11 feet long and two Attitude Control System (ACS) booms four feet long. These booms were folded alongside the spacecraft and will be deployed at a preselected time and sequence in orbit. The IMP-H spacecraft life expectancy is in excess of two years.

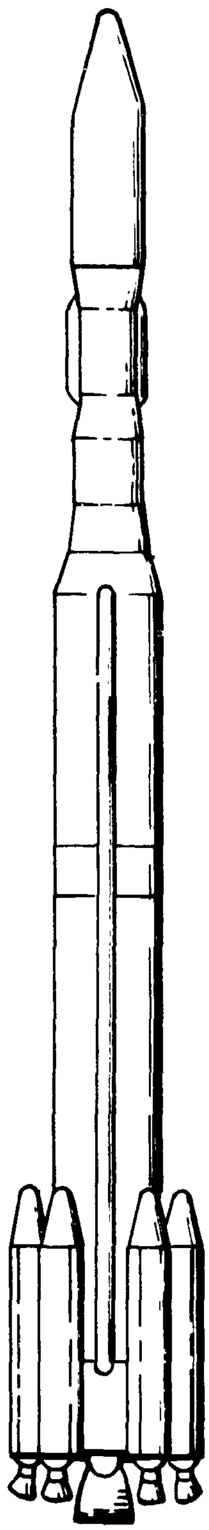

Figure 1. Delta-90 Launch Vehicle

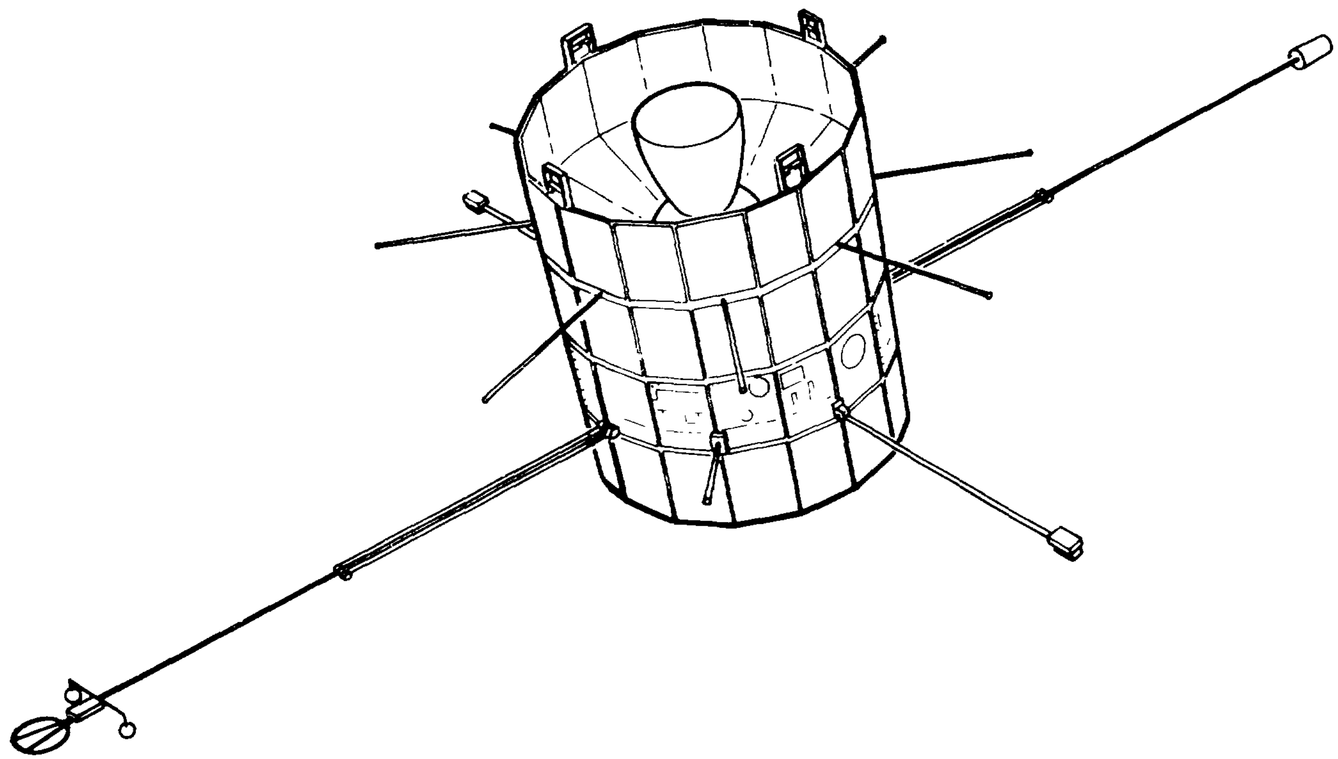

Figure 2. IMP-H Spacecraft

SECTION II
FLIGHT PERFORMANCE

A. SPACECRAFT

All IMP-H spacecraft subsystems were normal during countdown and launch. Shortly after liftoff the spacecraft was inserted into a desirable elliptical transfer orbit as illustrated in figure 3. On September 24, 1972 the spacecraft attitude was shifted in preparation of the kickmotor firing. At a point in apogee at 1136 EDT, September 25, 1972 the kickmotor was fired placing the spacecraft in its final near-circular orbit. Following kickmotor burn the spacecraft spin rate was reduced to 20 rpm by the attitude control system, the booms were then released and the spin rate was further reduced to 12 rpm. After achieving the desirable final orbital parameters listed in table 1, the spacecraft was rotated perpendicular to the ecliptic plane and experiment turn-on was initiated on the morning of September 26, 1972; this function is scheduled to continue for 14 consecutive days.

Table 1. IMP-H Oribital Parameters

Element	Transfer Orbit	Final Circular Orbit
Apogee (Km)	237,796	235,558
Perigee (Km)	247	207,836
Inclination (degrees)	28.6	17.72
Period	7365 (min)	12.25 (days)
Eccentricity	0.9471	0.08

B. RANGE SAFETY AND TRAJECTORY

The Delta-90 vehicle was launched from Complex 17, Pad B, on an azimuth of 115 degrees and rolled to a flight azimuth of 95 degrees true. All flight plots were smooth and nominal for the entire flight; vehicle trajectory was essentially nominal according to the latest expected performance values.

No Range Safety actions were required nor was any taken. A Range Safety Impact Prediction (IP) program was used by the Realtime Computer Facility to convert DIGS telemetry to IP. This program appeared to provide excellent data.

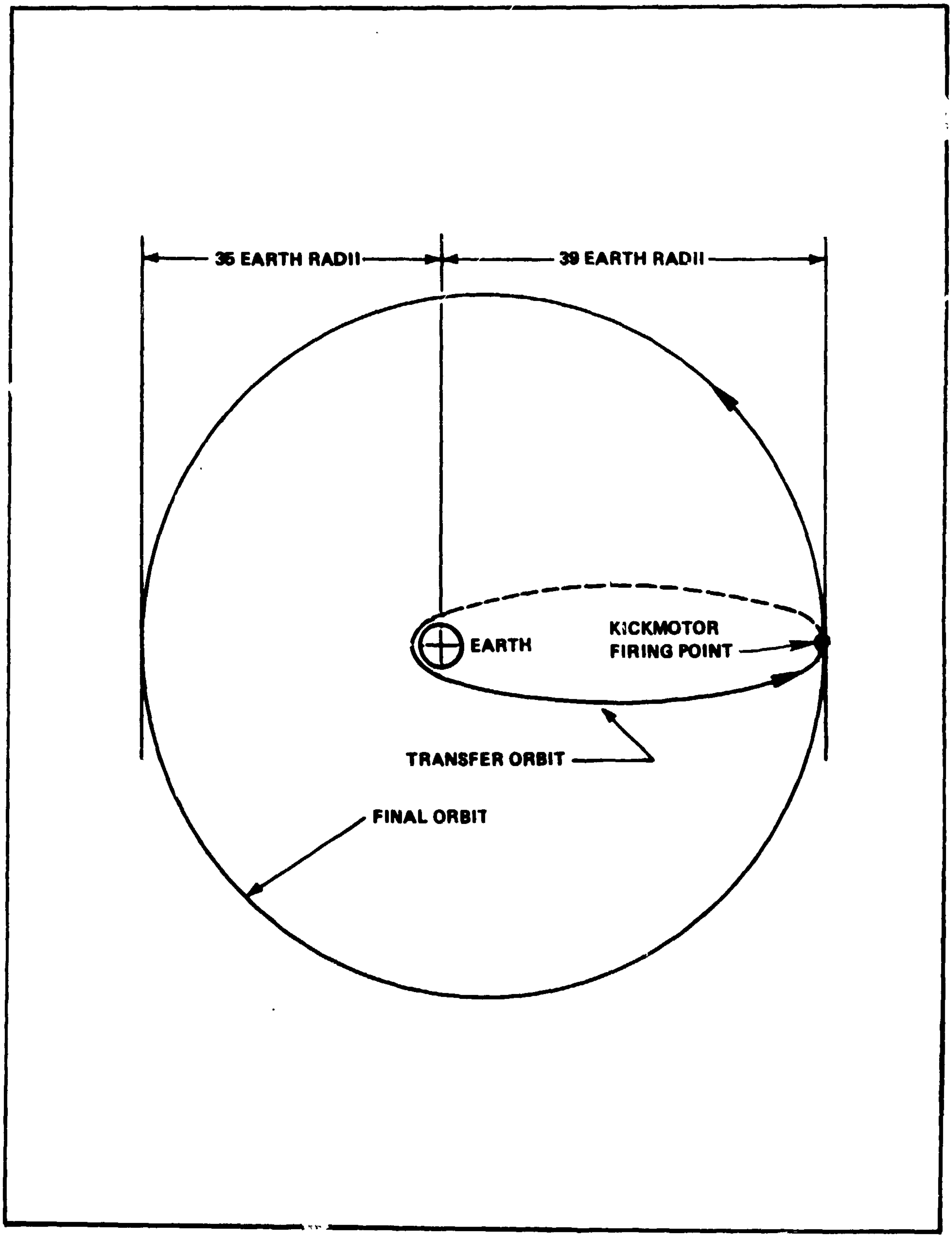

Figure 3. IMP-H Orbital Path

C. VEHICLE

1. Propulsion.

a. Stage I. The performance of the first stage propulsion system appeared to be satisfactory. MECO occurred at T+267.8 seconds as a result of fuel depletion with approximately 790 pounds of lox remaining; VECO was commanded at T+274.4 seconds. The main engine sea level thrust at T+30 seconds was 172,000 pounds.

A redesigned hydraulic system which incorporated the Saturn-IVB accumulator/reservoir and a pressure compensated pump was flight tested for the first time on this vehicle. Preliminary data analysis indicates satisfactory operation with no anomalies. Steady state pressure was 3,060 psia and system fluid remained essentially stable at 100 degrees F throughout the flight. Accumulator bleed-down time after MECO was 87.2 seconds

b. Stage II. A preliminary analysis of available second stage data indicates normal system operation during powered and coast flight. Thrust 30 seconds after ignition was 9,375 pounds as compared to a predicted 9,474 pounds. Burn time as measured from start to SECO discrete was 331.8 seconds. Hydraulic pressure was constant at 1,020 psig throughout powered flight. Helium and nitrogen regulation was satisfactory.

c. Stage III. Based on the obtained orbital parameters. . stage performance was nominal. Action time was 44.2 seconds with a sepa spin rate of 51.6 rpm.

2. Guidance and Controls.

a. State I. The stage I liftoff transients were small and quickly damped. All six solid motors ignited at liftoff and their thrust misalignment caused a 190 foot-pound CW moment to the vehicle. Maximum engine excursion during the region of maximum aerodynamic pressure was 0.98 degree pitch down and 0.59 degree yaw left. Main engine thrust misalignment at MECO was 0.19 degree pitch down and negligible in yaw.

The programmed sequences occurred as scheduled. Guidance steering commenced 120 seconds after liftoff with initial commands of 0.36 degree/second down and 0.22 degree/second left.

At liftoff, the control battery voltage dropped from 29.4 vdc to 26.0 vdc due to the solid motor ordnance loading and recovered to 28.8 vdc in approximately 11.5 seconds.

Three POGO periods were noted during first stage burn; the first two mini POGO periods occurred at T+188.2 and T+194.2 seconds with peak-to-peak amplitudes of 0.4 g, the third POGO phenomena occurred just prior to MECO and existed for 1.4 seconds with a peak-to-peak amplitude of 0.6 g as recorded by the second stage thrust axis accelerometer.

b. Stage II. The first/second stage separation was initiated by the DIGS discrete 2 signal and caused less than 0.1 degree perturbations in the pitch, yaw, and roll attitude gyros. Second stage engine start was initiated by the DIGS discrete 3 signal at T+280.3 seconds. Second stage thrust misalignment at engine start was less than 0.1 degree pitch down and approximately 0.2 degree yaw right. At SECO, engine thrust misalignment was 0.3 degree up and 0.4 degree right.

Actual fairing jettison imparted a CCW moment to the vehicle which the roll control system properly damped.

All voltages appeared normal during the period of time data were available.

First stage mini POGO effect at T+0.1:23:09 minutes was exhibited on all three rate gyros. The yaw gyro went band edge to band edge (5.6 degrees/second) for approximately five seconds and pitch rate approached its upper and lower band-width level for approximately two seconds. The guidance system filters adequately damped this disturbance from the first stage control system.

The coast control system adequately contained the gyros within their specified limits until seven seconds after acquisition of the first pass over Hangar AE at T+5827 seconds. At this time the N counter of the guidance computer overflowed, causing the computer time to become a large negative value; subsequent logic operations put the control system into the control DACS rather than in the coast control system. The guidance system entered the guidance mode again but with unspecified information beyond the normal guidance tables. This unspecified information resulted in large guidance commands to which the vehicle did not respond. Because of this situation the vehicle exhibited tumbling rates in all three axes.

c. Stage III. A telemetry system installed on the third stage motor to obtain performance data during burn consisted of: 24 temperature sensors, two voltage monitors, six accelerometers, a chamber pressure transducer, a calorimeter, a radiometer, and an acoustic microphone.

Data collected by ARIA aircraft stationed between Antigua and Ascension Islands indicated nominal third stage performance. Spin-up, payload separation, and yo weight deployment occurred on time. The pitch and yaw accelerometers indicated 51 rpm at spin-up and 53 rpm at the end of third stage burn. The thrust accelerometer indicated 4.4 g at third stage ignition which increased to 13.0 g at burnout. This is quite favorable with expected values as outlined in the IMP-H Detailed Test Objectives. The chamber pressure transducer disclosed an action time of 44.5 seconds for the third stage motor.

D. SEQUENCE OF FLIGHT EVENTS

The scheduled and actual times of occurrence of major flight events are presented in table 2.

Table 2. Sequence of Flight Events

Event	Scheduled (+ seconds)	Actual (+ seconds)
Liftoff	2120:00.0 EDT	2120:00.5 EDT
Solid motor burnout	T+34.5	T+34.5
MECO	T+265.2	T+267.3
Stage I/II separation	T+273.2	T+276.0
Stage II ignition	T+277.2	T+280.0
Fairing jettison	T+295.0	T+297.5
SECO	T+602.2	T+611.8
Stage II/III separation	T+927.2	T+931.5
Stage III ignition	T+940.2	T+945.3
Stage III burnout	T+983.8	T+987.5
Spacecraft separation	T+1085.2	T+1089.5
Spacecraft kickmotor ignition		1136.0 EDT

E. WEATHER

The surface weather during F-0 Day was excellent; specific weather conditions at time of launch are listed in table 3.

Table 3. Launch Time Weather Conditions

Item	Condition
Temperature	73.4 degrees F.
Visibility	10 miles
Surface winds	4 knots from 340 degrees
Relative humidity	76 percent

Table 3. Launch Time Weather Conditions (Cont'd)

Item	Condition
Sea level pressure	1019.3 millibars
Dew point	66.0 degrees F.
Clouds	0.1 cumulus at 3,000 feet, 0.2 cirrus at 28,000 feet

F. PAD DAMAGE

Pad damage from liftoff was minimal.

SECTION III
DATA ACQUISITION

A. DATA AND INSTRUMENTATION

Telemetry, optical, and radar data were supplied by a composite of ETR, GSFC, and KSC stations. The support requirements and results 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 prelaunch operations, checkout data were 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 Building AE station displayed all channels telemetered, and systems engineers observed the data at both sites to determine the flight readiness of the vehicle. Both stations displayed the realtime data post-test for flight evaluation prior to the post-flight critique. Other than PCM dropouts in the blockhouse during terminal count, no known problems existed.

Data were received at both sites through their respective local antennas until near liftoff, with switches to other stations made as required to optomize the coverage. STS and CIF provided early launch phase data to Building AE. Building AE sent the CIF data to Complex 17. Complex 17, therefore, had the best data available. One hundred percent coverage was obtained through the switch to Antigua data at about T+450 seconds.

The CIF data were excellent to the horizon. Relay of these data to Building AE was also excellent, but relay to Complex 17 was noisy, causing some data dropouts, even on the ground.

b. Downrange Telemetry. Antigua (ETR station 9.1) was the prime downrange station for early launch. A composite of stage II and III data (see table 4) was remoted to the Cape via two subcable circuits. The PCM was on the higher frequency subcable circuit remodulated on an IBM modem. These data were demodulated at Tel 4 and sent to Building AE and Complex 17 for processing and display. The other channels were placed directly on the lower frequency circuit. These data were also sent to Building AE and Complex 17 for realtime flight analysis and to Tel 4 for the range safety display. This was the only station viewing SECO. Antigua received excellent quality data throughout the pass but relay of the PDM data to Building AE and Complex 17 was very poor. The PCM relay was excellent, with no appreciable loss of data well past SECO.

An ARIA aircraft supported in the interval between Antigua LOS and Ascension AOS. It received and recorded only, but dumped the data to Antigua for relay up the subcable to Building AE on the way back to the staging base. The aircraft was the only source of stage III spinup, ignition, and burnout information; therefore, this information was not available in realtime.

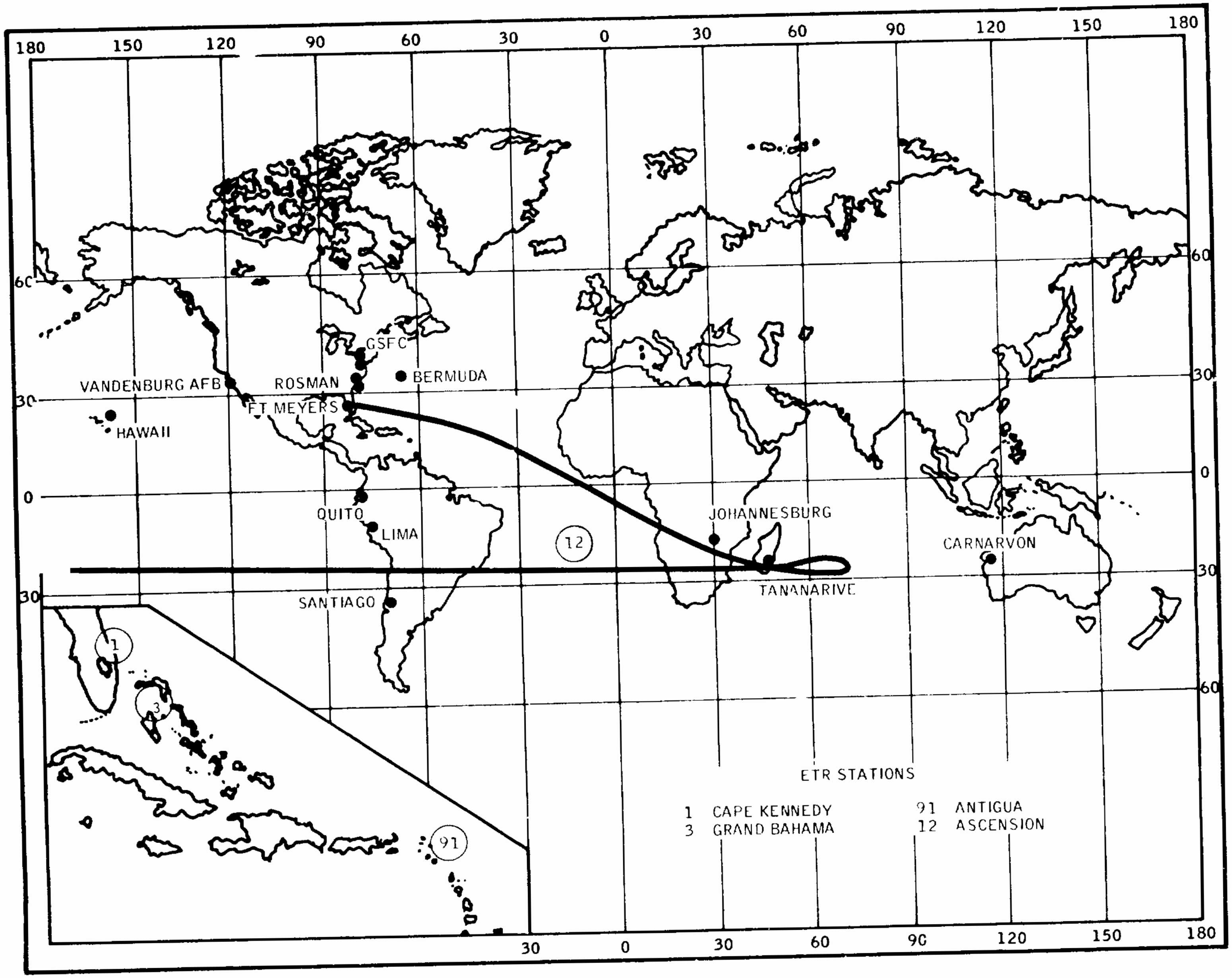

Figure 4. Tracking Stations

Table 4. Antigua Retransmission

Retransmit VCO	Vehicle VCO	Data
	High Freq Cable	
IBM Modem	2-G	PCM
	Low Freq Cable	
C	2-E	PDM
14	3-14	Pitch Accelerometer
13	3-13	Yaw Accelerometer
12	3-12	Low Level Thrust Accelerometer
11	3-11	Chamber Pressure
10	3-15	High Level Thrust Accelerometer
9	2-9	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

The ARIA recorded excellent stage III data and all events were easily discernible. The stage II data were quite poor until after stage III separation, at which time it, too, became of good quality. The data dump was good on stage III, but time limitations made the stage II dump marginal, and no PDM or PCM data were obtained at Building AE.

Ascension Island viewed a portion of the coast phase, and both the MSFN site (ACN) and the ETR site (station 12 or ASC) remoted information on vehicle coast performance to Building AE and Complex 17 for analysis. (See tables 5 and 6.) The rest of STDN, as applicable, received and recorded until battery depletion (Hawaii, second pass, was the last station recording).

On the first orbital pass, the data from CIF were relayed to Building AE and displayed. It showed an apparently malfunctioning vehicle. Further analysis indicated that it was a software problem in the airborne computer. All necessary data were available for this analysis.

2 Spacecraft Telemetry.

a. Uprange. The spacecraft 136 MHz signal (PCM/PM) was received in Hangar S and recorded at GSFC using data modem techniques, using the Hangar S antenna system (fixed) up until late terminal count. At that time, the data

Table 5. Ascension Island Realtime Data, Manned Space Flight Network

Vehicle VCO	Data
Line No. 1	
3-14	Pitch Accelerometer
2-6	Yaw Sets
2-7	Pitch Jet
2-E-20	Control Battery Voltage
2-E-27	N_2 Regulated Pressure
3-12	Low Level Thrust Accelerator
2-8	Roll Jets
	Timing
Line No. 2	
Not available due to circuit limitations	

Table 6. Ascension Island Realtime Data, Eastern Test Range

VCO	Vehicle VCO	Data
	Line No. 1	
1	2-G-4 (DS-3)	Pitch Attitude Error
2	2-7	Pitch Jets
3	2-G-2 (DS-2)	Roll Attitude Error
4	2-8	Roll Jets
5	2-E-27	Nitrogen Regulator Pressure
6	2-E-16	Nitrogen Bottle Pressure
7	2-E-7	G. C. Logic Voltage
8	-----	Time
	Line No. 2	
1	2-G-6 (DS-3)	Yaw Attitude Error
2	2-6	Yaw Jets
3	2-E-20	Control Battery Voltage
4	2-E-21	Instrumentation Battery Voltage
5	2-E-43	Engine Battery Voltage
6	2-E-22	Oxidizer Tank Pressure
7	2-E-35	I.M.U. Logic Voltage
8	-----	Time

source was switched to STS video and remained with STS video until LOS. One hundred percent coverage was obtained. Building AE backed up STS with a redundant high gain antenna system which was not used. The MILA USB site also received, recorded, and remoted spacecraft data to GSFC. The data were good.

b. Downrange. Antigua received and recorded the spacecraft signal. Realtime remoting was not possible due to the bit rate and cable limitations. The data were reported to be good.

All data beyond this point used STDN sites directly to GSFC, with processed data relay to Hangar S as available.

c. DTS Operations. The DTS systems in Hangar S, utilizing a 203 data modem, remoted all data as seen in the IMP station to GSFC. This included all minus count operations through STS LOS. In addition, command signals from GSFC were sent to the spacecraft, via another modem, for command checkout. After liftoff, the best processed data at GSFC (ASC, Johannesburg, Carnarvon, etc.) were remoted to Hangar S for two days for information of the checkout team. All decommutation was done at GSFC. Certain display information was also remoted to Hangar S for checkout use using additional modems.

3. Tracking. Tracking by ETR radars was per plan. Preliminary orbits were generated using the Antigua radars after the second stage burn with a nominal third stage burn assumed. Final orbits differed only slightly.

STS Doppler tracked the spacecraft signal through approximately T+520 seconds. Antigua also supported and verified SECO. The STS and Antigua data were remoted to the MDC and GSFC for display in realtime, and were excellent.

4. Miscellaneous Other Support.

a. STS sent the countdown to GSFC on the Digital Doppler System.

b. Building AE remoted mark events to GSFC using 8 VCO's (See table 7.)

c. The MILA USB site tracked the vehicle and spacecraft and supplied data tapes.

d. A block diagram of the overall data flow is presented in figure 5.

B. RADAR AND OPTICS

1. Radar. Mainland radars 0.13, 1.16, 0.18, and 19.18 supported the launch with coverage from T+10 to T+555 seconds. Downrange radars 3.13, 7.18, 91.18, 12.16, 67.18, and 67.16 supported the launch with coverage from T+11 to T+807, and from T+1290 to T+1638 seconds.

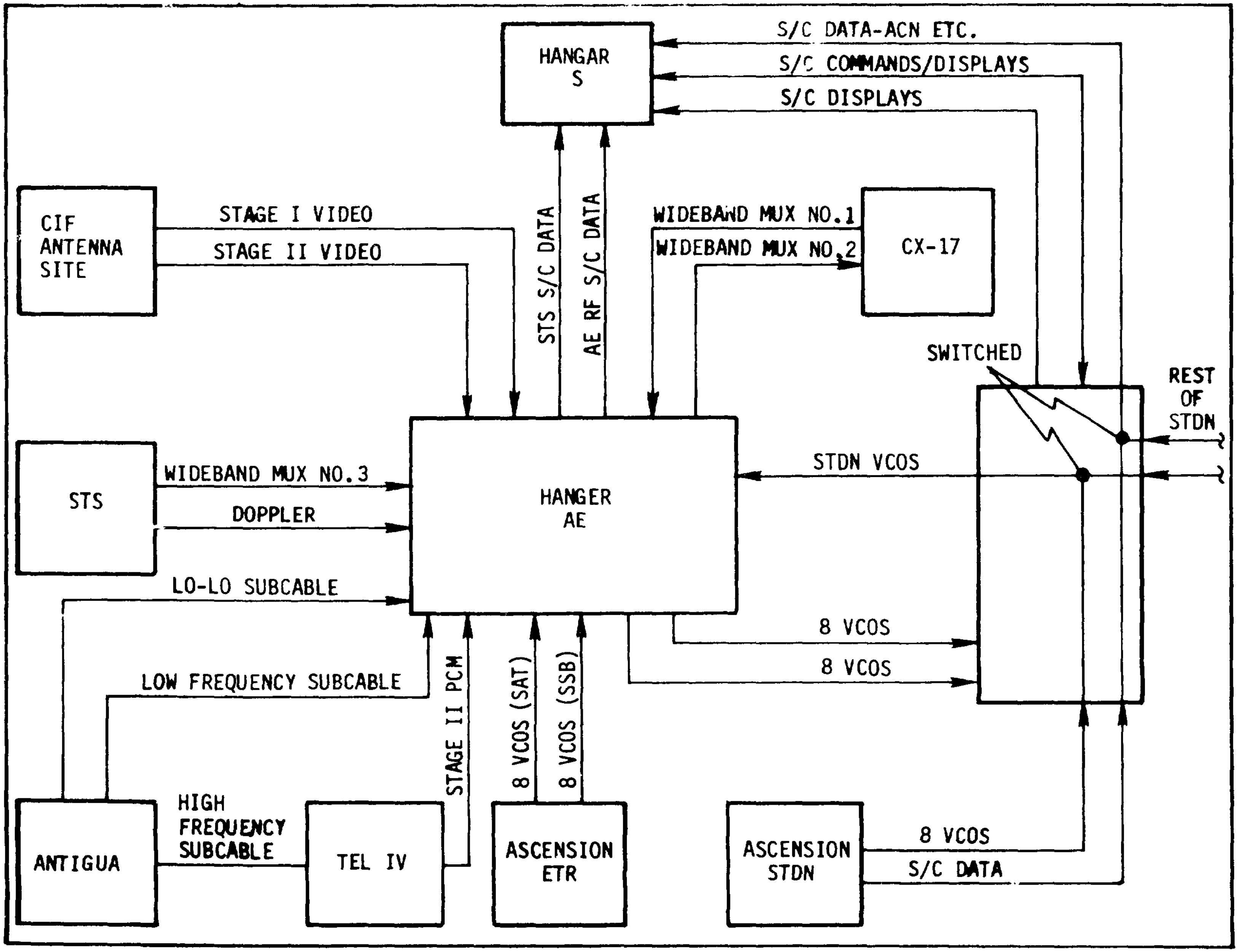

Figure 5. IMP-H Data Flow

Table 7. Building AE to GSFC Realtime Remote

Line	Vehicle VCO/Segment	Remoting 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-25	4	X-axis Acceleration
2241.5	G-1	5	Roll Rate
2241.5	G-3	6	Pitch Rate
2241.5	G-5	7	Yaw Rate

2. Optics. There were twenty-three fixed engineering sequential cameras, seven tracking engineering sequential cameras, twenty-three documentary cameras, and the Melbourne Beach long-range tracking camera assigned to the mission. All cameras performed satisfactorily except for one fixed engineering sequential camera, the cause of failure was not readily available and is currently under investigation.

The quality of the optics coverages ranged from good to very good.

SECTION IV
PRELAUNCH OPERATIONS

A. VEHICLE MILESTONES

The significant vehicle prelaunch milestones are presented in table 8.

Table 8. Significant Vehicle Prelaunch Milestones

Event	Date
Third Stage arrived ETR	7-1-72
First stage arrived ETR	7-21-72
Second stage arrived ETR	7-24-72
First stage erected Pad 17B	7-28-72
Second stage erected Pad 17B	8-8-72
Solid motors erected	8-17-72
Third stage erected Pad 17B	9-11-72
Simulated Flight Test	9-12-72
RFI Test	9-14-72
F-3 Day	9-19-72
F-2 Day	9-20-72
F-1 Day	9-21-72
F-0 Day countdown and launch	9-22-72

B. MAJOR TESTS SUMMARY

1. Simulated Flight Test. This test was satisfactorily conducted on September 12, 1972. The following problems were encountered:

a. A Range Safety MECO/VECO occurred during performance of this test. The range safety receivers for the first and second stages were on at this time and no arm function occurred on second stage receivers. (See comments under item b, for evaluation and subsequent troubleshooting activities.)

b. The first stage Command Destruct Receiver (CDR) AGC monitor circuit did not deflect the signal strength meter in the RF monitor panel in the blockhouse and no saturate light was seen. All three receiver arm and destruct functions occurred properly except for the above noted anomaly.

Prior to the simulated flight test and during qualification of a replacement CDR per DCI to LPD 041-070-91, the saturate lamp on the RF monitor panel failed to light. The signal strength voltmeter indicated approximately 2.5 vdc at that time. As stated, this operation occurred with a newly replaced CDR, P/N 1BO 7052-1C, S/N 548. and followed the symptoms observed with the originally installed first stage CDR, P/N 1BO 7052-1C, S/N 571.

Because the qualification test was delaying the start of the simulated flight test, it was decided to proceed with the remainder of the DCI and attempt to adjust the amplifier on the saturate lamp during the Simulated Flight Test using the Range command transmitter. An attempt to adjust the input to the saturate circuit amplifier was made during the Simulated Flight Test, but the lamp failed to illuminate. Further troubleshooting was delayed until after test conclusion.

After the panel was secured in the console, the saturate circuit test switch was depressed to verify that the amplifier and saturate lamp were operative. When the switch was depressed the lamps on the panel dimmed and the voltmeter indicated approximately half scale (normally full scale).

Apparently coincident with this action, a MECO signal was reported at the first stage control console and confirmed to be a CDR arm cutoff by the first stage telemetry monitor. The cutoff circuits were reset. The test switch was again depressed to see if MECO signal would repeat, but this did not occur. To verify operation of the CDR, arm and destruct signals were then sent and were received normally.

On September 13, extensive troubleshooting and testing with meters connected to the output of the CDR proved that the CDR AGC was normal, approximately 4.5 vdc. A study of the schematics revealed a possible failure mode such that if the amplifier adjust potentiometer was stuck at the high voltage end, then voltage could be applied from the test switch through a zener diode (4.3V) to the ground bus in the panel, through a suppression diode on the arm monitor relay, and thence to the vehicle arm relay.

Troubleshooting revealed that the potentiometer was stuck and the zener diode was open. The zener diode was replaced and a test was run to repeat the anomaly. The cutoff signals were again received when the saturate circuit test switch was depressed. The cutoff circuits were reset and the test switch again depressed with normal results. The zener diode was measured and found to be open. This test repeated the anomaly just like Simulated Flight except that a Babcock Signal Generator was used instead of the command transmitter.

The cause of the saturate lamp not illuminating was found to be a raising of the vehicle ground bus in the RF monitor. The AGE return line is connected to the vehicle ground bus in the aft umbilical J-box. This bus is connected to the first stage control console by a single wire. Loads in the first stage console cause enough current to flow in the ground wire to raise it approximately 2 volts.

The following modifications were made prior to IMP-H launch; the zener diode was removed, the potentiometer was replaced, the saturate test switch was disconnected, and the AGC return line was routed to the RF monitor.

c. The first T-0 engine start sequence was followed by a MECO at approximately T plus 2.7 seconds. This was caused by failure to depress the AGE vernier engine chamber pressure switch and is the normal abort engine shut-down mode under these circumstances. LPD D41-071-91 was updated to include the VEPC simulation in the engine start sequence.

d. First stage instrumentation channel C8 for the turbine inlet temperature read low and varied with slight wiggling of the P4119 reference junction heater connector in the booster boattail. In addition, channel C20 for the hydraulic accumulator body temperature and channel C21 for the VE actuator temperature read below zero volts. These channels also utilize the reference junction heater.

The reference junction heater, P/N 7608580-503, was removed and replaced and the pins of connector P4119 were cleaned. Ref: F09210 dated September 15, 1972.

e. The Fairing Off discrete D4 was not received during the test. This discrete should have occurred at T+295 seconds. The cause was due to guidance initiate at T+290 seconds jumping to approximately T+298 seconds. This jump is computed by the GC and is the expected time adjustment. The D4 discrete, which is from T+295 to T+297 seconds, was executed but occurred for less than 20 milliseconds and did not allow the vehicle circuit to respond.

The guidance initiate time was recently changed by issue of 1B91595-1, revision B (IMP-H Mission Constants Tape). This is the first run of the B change tape with the flight program. Although the B change tape had been used prior to this test in IMP-H, the previous use was with the checkout program which does not adjust time.

On September 13, the vehicle fairing separation circuits were loaded by the AGE circuit breakers while fairing discrete D4 was initiated. This accomplished the circuit load test missed in the Simulated Flight Test.

The remaining plus time testing included a hand set change for guidance initiate instead of T+290 seconds.

f. The third stage timers zero indicate contacts were momentarily subjected to a current passage due to the closing of circuit breaker CB97 in the ordnance test set panel located in the seventh level room of the MST. When the AGE 28 volt power supply for this test set was turned on, the zero indicate recorder channel was paralleled with the circuit breaker load. The CB97 circuit breaker is a nominal 0.8 amp load and the normal opening time is approximately 30 milliseconds. Loads of this amplitude and time range will not damage the zero indicate timer contacts.

On September 14, circuit breaker CB97 was tested per 1B20166D and test results showed that the passage of 0.95 amp for 28 milliseconds opened the circuit breaker. This is an acceptable condition for the IMP-H launch.

2. Flight Program Verification.

The flight program verification test was conducted on September 19 on Pad 17B and no significant anomalies were encountered.

3. Countdown and Launch.

The countdown was picked up and proceeded to launch with no significant anomalies encountered.

C. SIGNIFICANT ELECTRICAL PROBLEMS AND MODIFICATIONS

Significant electrical problems and modifications are listed in chronological order.

1. January 29. WRO authorized the FTC accomplishment of DIGS azimuth determination system testing and validation in conjunction with A3 Engineering coordination and/or instructions. Tasks involved in this effort included the following:

a. A3 definition of operational criteria for usage of the new azimuth alignment system and the test requirements for vehicle deflection angle and external prism azimuth deviation test effort.

b. Modification, installation and checkout of Model DSV-3L-719 Secondary Support Equipment (AGE), P/N 1B19821-1, S/N 0001, to provide hardware for determining the azimuth of the porro prism mounted on the IMU in the second stage guidance compartment.

c. Establishment of a theodolite position on the MST for use in determining the azimuth of the IMU while mounted on the Troyke table.

d. Accomplishment of an external prism azimuth deviation test on the IMP-H mission to provide additional data on azimuth shifts that occur after tower removal when the internal IMU mounted prism can no longer be observed.

e. A41 preparation of prism bracket EOs and bracket installation instructions.

f. A41 fabrication and installation of prism brackets and the external porro prism.

g. A41 accumulation of azimuth measurements during vehicle testing.

h. A41 determination of azimuth deviations during the various stages of launch preparation and checkout to determine the correlation between those readings taken with the DIGS azimuth determination system sighting on the IMU porro prism. This will include monitoring the vehicle deflection angle and determining correlation to apparent azimuth shifts as well as evaluation of the IMU and external prism azimuth shifts established during launch preparations.

i. A41 preparation of an integrated test plan to define operations and procedures to be followed as part of the initial validation test of the new DIGS azimuth determination system.

Revision 2 of the WRO, dated May 19, authorized the A41 fabrication of 4 DIGS azimuth prism adjusters (per Engineering sketch SK51772) as required for the DIGS alignment modification.

EO 1B89983 NEW was released June 16, defining details for the fabrication and installation of the 1B89983-3 prism assembly (including the C-33 porro prism) on the second stage vehicle. EO 1B89983-A, dated July 17, authorized decal installation per LPD D41-109-91 following prism installation.

2. During test of the booster hydraulic system, utilizing the Steering Amplifier Test Set and with the actuators at center, erractic motion of the main engine was noted. The erratic main engine motion occurred intermittently on three occasions during an approximate 5-minute interval. The motion observed was not isolated to either the pitch or yaw plane, and the absolute magnitude/rate of the motion could not be determined. Attempts to repeat the problem with additional system monitoring were unsuccessful.

Analysis of potential causes of the problem indicated the following: (a) either or both of the ME actuators (including servo valve and potentiometer), (b) engine section actuator connectors and wiring, and (c) the Steering Amplifier Test Set and associated cables.

The following troubleshooting/corrective action was initiated:

a. The ME pitch and yaw actuators (S/N 01 and S/N 03 were removed and replaced by S/N 012 and S/N 010.

b. Connectors P82, P85, P93, P96, J260, and P/J266 were x-rayed. P/J266 indicated one loose and one crossed strand of wire in the connector (P266 was replaced).

c. Engine section actuator wiring was continuity and megger tested.

d. Pin retention tests were accomplished on sockets and the diameter was checked on pins in connectors P/J82, P/J85, P/J93, P/J96, J260, and P/J266.

e. The steering amplifier test set was connected to dummy loads and operated using the same test configuration (including power supply) as in the booster hydraulic system test, with continuous recorder monitoring to detect any intermittent outputs.

Investigation of removed actuators S/N 01 and S/N 03 continued. Further testing did not confirm a failure mode. The vehicle hydraulic system was retested with no recurrence of the anomaly.

A41 continued to monitor all vehicle checkout activities for any recurrence of this condition. This is a CP 10.001-AC item.

3. The following open work items from Delta Mission Checkout were accomplished at ETR.

a. Incorporation of single point arming modifications to TAD solid motors.

b. Safety wiring of connector P72 at the bipropellant valve.

c. Replacement of the second stage telemetry transmitter because of case leakage.

d. Installation of the IMU and GC.

e. Installation and requalification of the I&S box containing reworked tempo timers.

f. Thermal protection wrapping of second stage engine section electrical connectors after final mating.

g. Third stage telemetry installation.

h. Installation of new spin table support beam and electrical cable assembly.

4. May 16. During Absolute Pressure Transducer Calibration and Maintenance of the TAD solid motor pressure transducer, P/N 1A22479-507R, S/N 82-953, in the A41 Lab, the following conditions were noted:

a. Transducer linearity at the 60 percent point of applied maximum pressure (800 psia) was 1.44 percent and should have been a maximum of +/-0.97 percent.

b. Transducer hysteresis at the 80 percent point of applied maximum pressure (800 psia) was 1.3 percent and should have been a maximum of +/-0.97 percent.

The pressure transducer was not acceptable for use and was returned to Santa Monica for repair. Unit replacement was P/N 1A22479-507R, S/N 169051, which was satisfactorily tested at A41 on May 23 for subsequent installation.

Note: EO 1B93629-A41-1 was issued May 17 to authorize the use of a J change transducer in lieu of a R or S change part. This substitution was not required, as noted above.

5. May 17. EO was issued to incorporate the use of MS21919DG4 cable clamps in lieu of MS21919DG6 cable clamps, six each per solid motor, for retaining the solid motor wire harness in the motor tunnel area. The solid motor equipment installation configuration utilized less wiring, and smaller clamps were required to provide better harness retention. Also authorized by this EO, was the use of 1A22479-507 J chamber pressure transducer in lieu of 1A22479-507 R or S unit as originally specified because of a part rejection.

6. May 17. During the accomplishment of the destruct harness installation portion of Composite Solid Motor Buildup and Checkout in the Mark IV area, it was found that the 1D14019-501 connector on solid motor destruct charge harness assembly, P/N 1B08726-1E, S/N 0000028, would not mate to and lock with the mating receptacle on the 1B23029-1 test plug connector. The destruct charge harness assembly was replaced with a similar unit, P/N 1B08726-1C, S/N 00194.

Two of the above 1B23029-1 AGE test connectors in the Mark VI area were found to have a white residue substance (thought to be cement adhesive) inside the connectors on the 0.234/0.242-inch surface of the 1B23029-3 block, and were rejected May 22 on FARR 502-035-358. The residue was removed, and the test connectors were successfully checked with three of the destruct charge harness assemblies in the Mark VI area, utilizing the newly defined 2 to 40 pound connector demate requirement as provided by A3 Engineering. The three remaining harness assemblies will be rechecked with the reworked connectors following solid motor installation. Recheck of the originally rejected harness assembly, S/N 0000028, is pending.

7. June 15. EO authorized rework of the spin table support panels, P/N 1D00129-3 and P/N 1D00129-9 by chamfering each panel 0.28 by 0.28 inch at the junction point of the panels at Quadrants I and IV to provide clearance for the third stage motor igniter.

8. June 26. WRO authorized the installation of A3 furnished instrumentation as required to measure the following booster parameters:

a. LOX pump inlet pressure.

b. POGO compliant device pressure.

c. Fuel pump inlet pressure.

d. Hydraulic pump temperature.

e. ME actuator temperature.

f. VE actuator temperature.

g. Hydraulic accumulator pressure.

h. ME gimbal block acceleration.

i. Compliance device temperature No. 4.

j. Fuel pump inlet temperature.

This activity included mounting two A3 furnished brackets in the engine section, installing amplifiers to the brackets, installing a busing connector bracket, installation of a TB assembly, and installing related wiring and hardware.

9. July 6. During x-ray inspection of the third stage solid motor S&A igniter assembly, P/N E23038-03-C, S/N 002F, per Task XIII of H&CO 1B89914 NEW, high-density materials were noted within the inner shield of the E18182-03 igniter output cable approximately 2.75 inches from the S&A end of the cable assembly.

Initial disposition was given to carefully part the outer shield braid in order to expose the material particles and examine the area to determine, if possible, the depth of penetration into the cable.

One piece of material, 1/16 inch by 3/8 inch, was removed from the shield, and there was no discernable evidence of damage to the conductor insulation. It was believed, however, that the remaining pieces of material could not be removed at A41 without damage to the shield, and final DR disposition was given to return the igniter assembly, P/N E23038-03-C, S/N 002F, to the supplier (Thiokol) for rework or replacement.

Additional x-rays were made at Thiokol of the suspect area and examined by Thiokol and MDAC propulsion personnel. The foreign material was determined to be in a non-critical area, and the unit was accepted and shipped to A41 on July 21. Copies of the x-rays involved were shipped to A41 with the igniter assembly.

The above igniter assembly had been removed from the Pioneer-G Third Stage motor S/N 40017 shipping container for use on the IMP-H Third Stage motor S/N 40018.

10. July 12. WRO authorized the installation of an A3 furnished magnetic shield for the second stage bipropellant valve in order to reduce the magnetic coupling experienced during checkout, thus minimizing second stage engine deflection during powered flight.

11. July 21. EO authorized the use of NAS1403-1 screws and AN960D10L washers, 12 each, for installing the 1B93778-15, -17, and -21 mounting blocks for the three Kistler Model 303B accelerometers (GFP) at Quads II, III, and IV. In addition, the EO deleted the following requirements since continuous shielding and telemetry shielding is not required for the IMP-H mission: (1) requirement to shield GFE wiring to the third stage telemetry, and (2) from the shield braid to connector J112 backshell and from the shield braid to J112-9. EO 1B93778-A41-1A was released August 1 changing the above screw and washer requirements from 12 to 8 each because the attaching hardware for the 1B93778-17 Kistler mounting block had already been provided.

12. July 24. EO provided for the assignment of, and changes to, various reference designations associated with booster special instrumentation, as well as the addition of wiring to connect RT708-C22 (temperature compliance device) to its associated amplifier.

13. July 25. EO authorized the addition of wire XXF835F20 from J3001-f to J3005-K in the 1B83976-501 instrumentation distribution box, using ST223-20PB and ST223-20SB contacts respectively. The EO specified the use of S034LA20U wire, string tied as required with MIL-T-713 Type P Class 2 type. This addition was required to provide blockhouse monitoring of CDR signal strength. EO 1B93629-A41-2A was issued August 25 to provide an AGC return path to the blockhouse via umbilical J714-D, and added a wire within the telemetry J-box and another wire in the engine section to accomplish this.

14. July 25. EO authorized the following modifications of booster special instrumentation to provide an alternate method of splicing to avoid damage to delicate thermocouple wiring:

a. Delete the requirement to Western Union splice and silver braze splices, except that connector P4119 splices may be of the Western Union type.

b. Solder all splices per modification note 1.4.2.5.

c. Splice TC-70 through TC-73 by exposing the PNF wire 1/2-inch minimum (except leave one strand protruding 2-inches minimum but bent at a right angle to the remaining strands), insert TC wires from the opposite direction into the remaining strands exiting adjacent and parallel to the right angle strand, wrap both wires about the exposed strands 5 turns minimum, solder, and heat shrink cover a minimum of 1/2 inch on either side.

15. July 26. While drilling mounting holes in the third stage telemetry system mounting block, P/N 1B93843-1, in the Spin Test Area, the drill broke, leaving approximately 1/2 inch of drill in the hole. A portion of the broken

drill, 5/16-inch long, was removed, but the remaining portion could not be extracted. It was determined that sufficient hole depth was available to permit adequate thread tapping to retain the required screw, and the condition was accepted without further rework.

16. July 29. During Spin Test Area preparations for installing the 1B93778-17 accelerometer mounting block on the payload attach fitting, which involved removing 4 rivets and countersinking the holes for No. 10 attach screws, the 100° countersinks were made too deep. Countersinks were 0.406 to 0.437 inch and should have been 0.391 ± 0.005 inch per DPS 13052. In addition, the countersinks were not in alignment with the mounting holes in the accelerometer mounting block, resulting in screw heads making contact only on one edge of the countersink. The condition was evaluated and accepted without rework since the accelerometer mounting block had been leveled per the drawing and the mounting screws as installed provided adequate anchoring and support for the block.

17. July 29. EO authorized relocation of the following angle brackets for third stage instrumentation cable clamps on the payload attach fitting in order to utilize existing attach holes and avoid drilling new holes.

a. Bracket TA143D7-8 from 0.72 inch in Quad III - Quad II to 3.12 inches in Guad III - Quad IV, deleting the 0.88 inch hole.

b. Bracket TA143D7-8 from 0.53 inch in Quad I - Quad IV to 3.12 inches in Quad I - Quad II, deleting the 0.50 inch hole.

18. July 31. WRO authorized increasing the IMP-H yo weight by one pound to assure an adequate spacecraft and third stage separation distance. EO 1D01095-A41-1 was released August 3 defining fabrication details for the 1D01095-A41-3 weight as well as installation instructions. EO 1D01095-A41-1A was issued August 19 to clarify installation details.

19. August 1. EO authorized the installation of new Fenwall Electronics temperature thermistors, P/N G647A, one each on the helium and nitrogen bottles, as replacements for the originally installed Rosemont units, TGBH and TGBN, because of an incompatibility with A41 ground monitoring AGE.

It was subsequently found that the replacement thermistors would not be available in time to allow ground monitoring of helium and nitrogen bottles. EO 1B93630F was released August 21 to utilize the originally installed Rosemont unit TGBN on the nitrogen bottle and install an available ALRC temperature transducer harness 096754-1 adjacent to the TGBH unit on the helium bottle. Modifications to vehicle and thermistor wiring were defined to establish the required AGE compatibility, with all details being noted in the F change EO.

20. August 1. Inspection of the payload attach fitting battery wires, 4 each, which are part of the 1D14089G electrical equipment installation, disclosed that the wires were incorrectly fabricated and contained ST231-16-006

terminals instead of YAE18G43 terminals. Disposition was given to replace the 4 terminals with YAE18G43 per 1D14089G drawing requirements. After rework, retesting was satisfactorily accomplished August 28 per tag instructions.

21. August 3. EO authorized the reorientation of booster special instrumentation components (one busing connector, P/N 1B14815-1, and four amplifiers, P/N 1B91498-1, plus attaching hardware) on the 1B94221-5 bracket in the aft section in order to make the drawing installation instructions agree with design intent. The EO also defined the method to be used in clamping the wiring to stringer No. 1 and to the existing clamp on the hydraulic line adjacent to stringer No. 1.

22. August 3. WRO authorized the reidentification of vernier engine actuator servo valves in accordance with A3 planning paper. The servo valve polarity was verified at DMCO prior to booster shipment to the FTC, but reidentification to the 1B00229-503 configuration was not accomplished. Reference: TWX A3-AE-579-002 dated June 28 and TWX A3-250-ACHO/X72-221 dated July 14. Servo valve reidentification was completed August 21.

23. August 3. Revision 2 of this WRO deleted the requirement for the FTC incorporation of FEB T3-7, Turbopump Gear Case Lube Inspection, since this requirement is no longer effective on the Delta main engines being furnished by R/NAR.

24. August 4. Subject drawing authorized A41 accomplishment of the following activities in order to incorporate R/NAR Field Engineering Bulletins and modification instructions.

a. Inspection of the R/NAR main engine thrust chamber exit blowoff cover, P/N 9025325, within 15 days prior to launch per FEB T3-12.

b. Replacement of the turbopump inlet elbows for turning vane welds per FEB T3-16. This was completed August 5, and authorization for return of the 9680-48147 elbow to R/NAR was contained in WRO DSV-A41-1166.

c. Replacement of the oxidizer bootstrap check valve per FEB T3-17. This was accomplished August 7, and authorization for return of the valve to R/NAR was contained in WRO DSV-A41-1166. Note: Valve, P/N NAS5-26337-1, S/N 288, was replaced with S/N 125.

d. Installation of thermal insulation on thrust chamber bands per modification instructions R-991-311 (reference: LPD D41-076).

e. Installation of thermal insulation on the vernier engine per modification instructions R-991-304 (reference: LPD D41-076).

f. Fabrication of a 1B89997-3 tube assembly of a shape and length to be determined (reference: vehicle lox duct purge tube assembly), and installation of the tube assembly in place of P/N 1D13541-522. Installation in the vehicle was accomplished August 11.

25. August 5. EO authorized the use of the third stage destruct system harness, P/N 1B13306-501, as manufactured to the B change (in lieu of the C or later change part), in order to utilize the earliest load date harness.

26. August 8. EO authorized changing the spin table petal-to-base bond resistance requirements from 0.0025 ohms to 0.0085 ohms maximum dc resistance between each spin table petal and spin table base (reference: 1B82513F). The original resistance requirements were too stringent, thus necessitating the noted change.

27. August 8. WRO authorized removal of the following items from the booster and replacement of same with the following reworked and reidentified units:

Multicoder, P/N 1B13899-1K, S/N 2567-012
Multicoder, P/N 1B13899-1K, S/N 2567-014
S-Band Transmitter, P/N 1B84532-501C, S/N 523.

EO 1B83629G was issued August 23 confirming Engineering acceptance of replacement multicoder, P/N 1B13899-503N, S/N 4062-10 (connected to P3101, P3114 and P3116 for FM F), and replacement multicoder, P/N 1B13899-503N, S/N 4297-7/4520-2 (connected to P3101A, P3114H and P3116A for FM C). These units had been selected to avoid any chill failure during countdown and launch. These replacement multicoders were installed in the booster on August 25.

Revision 1 of the above WRO authorized shipment of the removed multicoders to the vendor for rework.

EO 1B93629H, dated August 29, authorized the installation of telemetry transmitter, P/N 1B84532-511F, S/N 520 (reidentified from unit P/N 1B84532-501C, S/N 520, in compliance with 1B84532F AEO), as the replacement for the originally installed transmitter, P/N 1B84532-501C, S/N 523. The installation was completed August 31.

28. August 8. WRO authorized removal of the following items from the second stage and replacement of same with reworked and reidentified units:

Multicoder, P/N 1B13899-501K, S/N 4519-3
S-Band Transmitter, P/N 1B84532-1B, S/N 504.

EO 1B93630G was issued August 23 confirming Engineering acceptance of the replacement multicoder, P/N 1B13899-505N, S/N 4272-2, which had been temperature cycled for reliance during countdown and launch. The EO also deleted the requirement for the application of heat-transfer silicone grease. EO 1B93630J was issued to clarify the originally installed multicoder part number. The replacement multicoder was installed on August 25.

Revision 1 of the above WRO authorized shipment of the removed multicoder to the vendor for rework.

EO 1B93630K, dated August 29, authorized installation of telemetry transmitter, P/N 1B84532-509F, S/N 508 (reidentified from unit P/N 1B84532-1B, S/N 508, in compliance with 1B84532F AEO), as the replacement for the originally installed transmitter, P/N 1B84532-1B, S/N 504. The installation was completed August 31.

29. August 9. EO authorized the use of NAS1715D10K cable clamps in lieu of NAS1715C10K clamps in attaching new spin table cable assembly P/N 1B85881-1, because the stainless steel clamps originally specified were not available in time for cable installation operations.

30. August 9. EO authorized the use of NAS600-5P screws (two required) plus washers and nuts in lieu of MS20470AD4 rivets for attaching the microphone cable clamps to the payload attach fitting. This change was necessary to avoid riveting vibration of the attach fitting after installation of the payload separation timer.

31. August 10. This WRO was originally issued to authorize the bipropellant valve magnetic shield installation to minimize second stage engine deflection during powered flight. Revision 2 of the WRO authorized the A41 installation of temperature patches on the oxidizer tank aft bulkhead for the ground monitoring of oxidizer temperatures, in accordance with A3 Engineering and Planning instructions. Subsequent investigation disclosed that this installation was accomplished in DMCO prior to vehicle delivery to A41.

32. August 11. EO improved the seal joint design at the POGO accumulator by eliminating the bulkhead fitting for the special POGO suppression device transducer. This included removing the MS24393J6 union and 1B90718-519 tube assembly and installing and AN815-6J union and 1B90718-515 tube assembly.

33. August 14. During the accomplishment of Task 3 of LPD-D41-105-91 and while conducting the connector pull test portion per item 1-5 which requires a pull test of each connector three times, it was found that connector P1119 of cable assembly P/N 1B11510-407.4AA, S/N 4946-2, pulled from the mating connector at 2.5 pounds, 1.8 pounds, and 1.8 pounds. The required release force was 5 ± 3 pounds. The cable assembly was reworked August 19 by removing and replacing the P-1119 connector. Retest and requalification of the cable assembly was completed August 22 per a DCI of the LPD.

34. August 15. EO authorized potting the backshells of the engine section instrumentation electrical connectors P700 through P706 and P708, using DA-50905-1 potting boots and MIL-S-8516 Class 2 compound per 1P00033. This potting was required to provide environmental protection to instrumentation connectors in the engine section.

35. August 21. EO authorized insulation of the 1B12638-507 HR-21 control battery by uniformly covering the accessible battery surfaces with 5 layers of MIL-B-5924 batting, using MSFC-10M01597 tape, while providing battery connector access and not obstructing the vent valve. After final connector mating, the connector access hole was to be filled and taped as above. This modification was required to provide battery thermal protection during prelaunch operations. Reference: WRO DSV-A41-1174.

36. August 22. EO authorized the use of a MS21076-3 lock nut plate in lieu of a NAS1329H3K80L nut, four places, for attaching first stage electrical wire bundle clamps, because the originally specified rivnuts did not arrive in time to avoid the use of the large installation tool adjacent to the second stage engine bell.

37. August 22. During the accomplishment of LPD-D41-063-91 and while conducting solid motor ignition connector mating per section 3, it was found that the ignition connector P214H on solid motor 8 would not fully engage the vehicle receptacle J214H in that the white stripe on the vehicle receptacle was still visible.

Troubleshooting included the mating of a production plug to the J214H vehicle receptacle and a production receptacle to the solid motor No. 8 P214H connector. In both cases, proper mating of connectors was achieved. The noted discrepancy appeared to be an incompatibility of this particular plug and receptacle, and the J214H vehicle receptacle was removed and replaced per DCI No. 60 of the LPD.

38. August 22. During the performance of the second stage Umbilical Eject Test per section 4 of LPD-D41-063-91, the second stage receptacle JU1, P/N 1B08537-1, failed to deadface. This was evidenced by the fact that the shear catch assembly did not retract inside the receptacle at umbilical plug separation, which was initiated by an electrical signal from the blockhouse.

After test conclusion, the PU1 plug was removed from the plug carrier and a test was conducted to determine the amount of axial force applied to the shear catch assembly on the receptacle required to achieve deadface. The measured force was approximately 54 pounds, using a Chatillon DPP-50 gage. Reference: TWX CAP HTB-557 VAB-75 dated August 24.

On August 26, a representative from the supplier (Cannon) and a representative from A3 Components Standards disassembled the JU1 connector from the second stage umbilical for the purpose of replacing the springs as had been previously accomplished in the successful rework operations at A31 on the ITOS-C JU1 connector.

These springs effect deadfacing of the rear insert of the JU1 connector at time of umbilical ejection. The rework accomplished at A41 consisted of the following:

a, Removal of four outer springs, P/N 259-6103-000 and replacement with new springs, P/N 259-6104-000.

b. Removal and replacement of four inner springs, using springs of the same part number.

This rework provided a total compressed force (in the fully compressed condition) of 340 pounds. Prior to rework, the total compressed force was 300 pounds.

Subsequent to spring replacement and connector reassembly, several umbilical eject operations were performed using the lanyard pull on the Cannon engagement tool. The first two ejections resulted in normal deadface. In all subsequent tests, however, the JU1 connector failed to deadface.

Inspection of the front and back pin blocks in JU1 was made with the umbilical in the torqued condition. Uneven gaps were seen between the two blocks up to approximately 0.050 inch. When the torque was gradually reduced, the uneven gap became slightly more uneven, and binding was confirmed by free turning of the hand wheel of the Cannon engagement tool.

The uneven gaps were not consistent for repeated torques. Relocation of the springs to different corners of JU1 resulted in different gap patterns but was not a conclusive cause of the gaps being uneven. It was postulated that the pin to socket misalignment between the two blocks was causing the blocks to bind together. Note: A hard catch assembly was used during the above operation.

The JU1 connector was reinstalled to continue vehicle checkout.

On August 31, the JU1 connector was again reworked by the vendor representative and the A3 Components Standard representative, and the final configuration was established. This consisted of a new Cannon forward insert, a new 0.100-inch Cannon supplied spacer on the face of the forward insert, and the addition of 2 washers on each spring guide. Umbilical ejection tests on August 31 and September 2 resulted in proper deadface operations.

On September 5, inspection of the JU1 connector disclosed that the face plate screws had potting which was flush on one side and half full on the other. In addition, the potting compound protruded slightly above the face of the plug. Disposition was given to trim the potting flush with the JU1 face.

39. August 22. On August 18, the IMP-H guidance computer, P/N 1B82218-505D, S/N 007, was purged and pressurized at the FTC per LPD-D41-322. The lock-up pressure was 2.8 psig, subsequently stabilizing at 2.6 psig on August 21.

TRD Code E488B, as defined in the B change issue of 1B92998, specifies a pressurization of 2 ± 0.2 psig. Accordingly, the GC pressure was carefully bled to 2.2 psig by removing the pressure monitor while holding it in the depressed position. The subsequent pressure decay check readings of 2.2 psig on August 21 and 2.05 psig on August 22 were acceptable. Reference: TWX CAP HTB-555 VAB-73 dated August 24, and WRO DLC-A41-3.39.

The guidance computer, S/N 007, was installed in the second stage on August 23.

40. August 23. During the accomplishment of LPD-D41-064-91 and while preparing for the first stage Hydraulic Simulation Test per section 12, there was no pressure reading on the hydraulic accumulator GN_2 pressure when telemetry was turned on. A reading of approximately 50 percent (2000 psi) should have been present on channel PDM 1C-32.

Troubleshooting was initiated per DCI No. 10, and the accumulator was precharged to assure correct pressure. Blockhouse telemetry still indicated no pressure. Connector P4702 was disconnected from transducer MT702 in the engine section, and readings were approximately 3.5 K ohms and were acceptable.

Readings were then taken between Pins C and A of the P4702 connector, and zero volts were obtained although an intermittent 5 volt reading could be obtained while flexing the cable. A Simpson meter was then used to apply voltage between Pins A and B of P4702, and a steady level was recorded on telemetry which indicated that the circuit was good.

Pin C of connector P4702 was thus determined to have an intermittent connection, and on August 24 the P4702 connector, P/N PT06CE8-4S was removed and replaced. The new connector was subsequently requalified per the DCI and operated satisfactorily.

Note: The PT06CE8-4S was installed in DMCO when it was found that the potting boot and potting were broken loose from the connector pins of the original P4702 connector, P/N MS3116P84S. Reference: DMCO Report, page 29, tag D15254.

Connector PT06CE8-4S was subsequently rejected on Failure Report F08384 because the wire to Pin C was broken. Disposition was given to remove and replace the contacts.

41. August 23. At initial video link turn-on for the second stage on August 11 per LPD-D41-141-91, a noisy and unusable signal was noted at the data station.

Troubleshooting, initiated August 12, revealed that the output from the umbilical had a 1.1 volt peak-to-peak 120 Hz rectified sine wave with a 0.1 volt composite video signal. This signal was measured at the second stage umbilical J-box. The input and output lines of the J-box were ungrounded, but the 120 Hz signal remained.

The returns were regrounded, and on August 13, the signal was noted to be intermittently good and/or without the 120 Hz. A 0.18 volt peak-to-peak 120 Hz ripple with similar wave shape was riding on the 28 volt input power bus. Later, while the wideband amplifier, P/N 7833107-501N, S/N 657, was providing useable data (without the 120 Hz interference), the test point output was measured to be 0.077 volt RMS.

When a slight finger pressure was applied to the side opposite the amplifier label, the 120 Hz noise reappeared, providing the similar unuseable signal at the data station. The gain adjustment was increased, but the signal remained unuseable. A light tap removed the 120 Hz interference to provide a good signal, but the 120 Hz returned with a light squeeze.

The wideband amplifier, P/N 7833107-501N, S/N 657, was removed and rejected on the above failure report. The replacement amplifier, P/N 7833107-501F, S/N 31528, was installed and provided a very clean signal without the 120 Hz interference. The defective part was returned to A3 for further investigation and evaluation. The second stage vehicle uses two of these amplifiers, one to modulate the transmitter and the other (the one that failed) to provide a ground video link through the umbilical.

EO 1B93630H, dated August 23, authorized Engineering acceptance of the replacement wideband amplifier as manufactured to the F change configuration.

42. August 24. During modification/rework of the multicoder, P/N 1B13899-502N, S/N 4062-10, at the supplier's facility, the frame rate stability test was noted as 879 pulses per second at -5F instead of 860 ± 18 pulses per second. Although this condition was accepted at the supplier by MDAC Engineering (Reference: TWX A-151-PS-676), no formal documentation of the anomaly was made. The above Failure Report (F08382) was initiated at A41 after multicoder receipt to reflect the condition as found at the supplier, and the part was accepted without rework at the FTC.

43. August 25. WRO authorized the accomplishment of a RFI vehicle compatibility test with all radars and telemetry systems, including spacecraft systems, turned on during the following operations with the tower back:

a. Perform first and second stage engine slews.

b. Perform a guidance system alignment, followed by a flight system run utilizing the basic flight program tape and the mission constants tape.

Normal Simulated Flight Test demonstrated vehicle RF compatibility with RF environment.

44. August 25. EO authorized the installation of 0.15-inch thick 1P20091 insulation on the forward face of the second stage RF shield assembly, P/N

1B88506-1, to provide protection for the second stage guidance section during third stage motor ignition. The EO defined all details affecting the method and degree of insulation application, weight requirements, clearance requirements, and the reapplication of Quadrant markings per drawing requirements. Reference: WRO DS -A41-1178.

EO 1B83903F, dated August 29, and EO 1B83903G, dated August 30, provided revisions to the method of cleaning the surfaces of the shield which were to be coated, and included new instructions for conducting a bond line strength test of test patches installed per EO specifications.

EO 1B83903H was released September 5 to provide necessary details for the following: (1) identification of the method to be used during surface cleaning and priming; (2) clarification of the insulation location; and (3) providing clearance for the spin table base installation.

45. August 26. Various booster telemetry problems were observed during the performance of LPD-D41-034-71, LPD-D41-064-91 and LPD-D41-067-91 as follows:

a. The main engine yaw position telemetry channel was deflected approximately 4 percent peak-to-peak when the vernier engines were slewed to their maximum roll positions. The VETS data channels did not show this effect. This was a telemetry anomaly and not an actual engine deflection.

b. The telemetry positions for VE roll stops were asymmetrical between the VE No. 1 and VE No. 2 telemetry channels by approximately 4 percent. This condition was noted on ERTS-A. The vernier engines were moved by hand to the maximum roll deflection to assure that there was no mechanical limiting of VE travel.

c. The main engine chamber pressure telemetry channel FM11 showed approximately 25 percent amplitude spikes with the first stage E-package on internal power using the battery simulator. Troubleshooting was performed.

d. The turbine inlet temperature telemetry channel C8 varied. The magnetic amplifier, P/N 7846219-501, for this channel had a broken electrical receptacle. This magnetic amplifier was removed and replaced.

46. August 26. Various second stage telemetry problems were observed during the performance of LPD-D41-034-71, LPD-D41-064-91 and LPD-D41-067-91 as follows:

a. Hydraulic pressure telemetry channel E23 displayed 6 to 8 percent peak-to-peak noise with hydraulic pressure applied, and about half of the above noise amplitude with the hydraulic pump turned off. This condition disappeared with the use of flight type batteries.

b. Engine battery telemetry channel E43 exhibited approximately 10 percent peak-to-peak noise when the hydraulic pump was powered from external or internal power. This channel improved during simulated flight using flight type batteries.

c. Yaw axis accelerometer telemetry channel FM12 had an approximate 80 percent peak-to-peak noise band with the hydraulic pump motor operating, and less noise with the pump turned off.

47. August 28. EO authorized wrapping the entire length of the 1B13306-501 third stage destruct harness above the RF shield, including 4 each connectors after final installation, using MIL-T-23594 Type 1 tape to a 0.90-inch minimum thickness. The EO specified a 0.50-inch minimum overlap on the tape and teflon tubing of the 1A95108-1 harness, with final brushing of the tape with an anti-static brush as required. This rework, needed to provide primacord thermal protection, included changing specified mounting clamps to a larger size for harness installation and updated other portions of drawing requirements. Reference: WRO DSV-A41-1178.

48. August 29. During preparations for installing the IMU, P/N 1B82217-503 B, S/N 007, and while replacing the vendor supplied porro-prism cover, three small fingerprints were evident on the prism surface. Installation of the IMU was completed on August 29 with no attempt being made to clean the prism surface due to the possibility of causing porro-prism misalignment. The origin of the fingerprints could not be determined.

Subsequent investigation disclosed that the IMU had previously been rejected August 11 for this condition on discrepancy report D31889 at A3 and accepted.

49. August 29. During installation of the A3 furnished pilot valve magnetic shield, P/N 1B94471-3B, it was found that the clearance between the gimbal support plate and the oxidizer manifold was less than the diameter of the magnetic shield, and entrance for the shield could not be made parallel with the pilot valve body.

EO 1B94471-A41-1 was written to cover modification to the shield assembly made during the installation process. This modification consisted of trimming up to 1/4 inch of the 1B94471-11 shield end cap on the side that conflicted with the oxidizer manifold, plus chamfering of three rivet heads inside the shield assembly for installation past the cylinderical end of the pilot valve. The 1B944/1-5 shield housing was formed to match the trimmed 1B94471-11 shield end cap.

Installation of the modified unit could not be accomplished without slight dents occurring in the shield assembly, and Discrepancy Report D28679 was written to document the shield assembly condition. Subject DR also noted a condition of suspected possible damage to the pilot valve due to shield installation. The shield damage condition was evaluated and accepted. Disposition was given to cycle the TCVPV per LPD-D41-067-91, section 20, and leak test per LPD-D41-068-91, step 009-7-J.

50. August 29. WRO DSV-A41-1176 authorized the accomplishment of a socket separation test (in accordance with STP 0367-32) on all Viking connectors, P/N VP2/2BC6, located on TAD solid motor separation filters, P/N 1B08036-1. Twelve filters for the IMP-H solid motors were sent to the Spin Test Area for check, and the following 1B08036-1 RF filters were rejected: Units S/N 00417, 00432, 00434, 00442, 00444 and 00500. Each unit had one pin pull out at 2 ounces or less. Pull test requirement was a minimum of 2 ounces. Replacement RF filters were selected and tested.

51. August 30. EO authorized the addition of vehicle wiring to provide a load wire to the IMU fine temperature control circuit in order to prevent the SMRD monitor from reading out low frequencies. Details of wiring installation, shield termination and splice insulation were defined in the EO

52. September 1. EO authorized the installation of an AN814-6J plug and a MC252S6TA seal in the 1B89070-503 POGO LOX accumulator per 1D13542 SEO 002A in place of the 1B91017-1 temperature transducer. The temperature probe was not available for flight, and the above installation was leak checked per LPD D41-065-91. The EO also authorized acceptance of the 1B90875-1 fuel bellows installation as installed per 1D13542N. The installation was leak checked and was acceptable.

53. September 1. EO authorized the accomplishment of several changes to third stage telemetry equipment installation as follows:

a. Relocation of TC-21 from the top to the side of the GFP telemetry transmitter in order to avoid obscuring the transmitter I.D. which is on top.

b. Reorientation of 2221E accelerometer cables to avoid excessive looping before clamping.

c. Wrapping of ignition wiring with teflon tape to provide abrasion protection from the yo weight cable attach point and the ballast weight bracket edge.

d. Rework of ignition wire clamping because of a cable routing change.

54. September 5. During shutdown of the flight sequence run of LPD-D41-067-91, the FIP Switches S300 and S301 AGE closed talkback remained illuminated. Increasing the engine power supply voltage from approximately 28 1/2 volts to 34 volts caused the closed lights to extinguish and the open lights to illuminate.

55. September 5. During the CDR checks per section 8 of LPD-D41-064-91, the RF monitor CDR AGC meter in the blockhouse gave no indication of first stage CDR signal strength.

56. September 6. During the lox leak checks portion of LPD-D41-070-91, the first stage lox pump inlet pressure telemetry channel FM8 read approximately 25 percent high.

57. September 7. The second stage engine step response test, required per LPD-D41-067-91, was performed on August 30. Subsequent data evaluation shows yaw position overshoot and dampening characteristics approaching the 6 DB high gain plots contained in 1B84541. The pitch response was closer to the nominal than the 6 DB high plots. Charts of the realtime data were sent to A3 for evaluation. A3 determined this was acceptable for flight.

D. SPACECRAFT MILESTONES

Significant IMP-H spacecraft milestones are listed in table 9.

Table 9. Significant Spacecraft Prelaunch Events

Date	Event
8/16/72	First GSE and personnel arrived
8/18/72	Spacecraft arrived at ETR
8/21/72	Spacecraft/attach fitting compatibility fit check Spacecraft inspection Started MIT cable repair
8/22/72	Completed MIT cable repair ACS leak check X-rayed kick motor
8/23/ to 8/29/72	Long functional test
8/25/72	APL experiment removed and cold solder joint repaired
8/30/72	Countdown tasks practice
8/31/72	Spacecraft mechanical preps ACS system filled and pressurized
9/1/72	Spacecraft mechanical preps completed
9/5/72	Spacecraft transported to Delta Spin Test Facility Spacecraft mated to Precision Measurement Facility and aligned

Table 9. Significant Spacecraft Prelaunch Events (Cont'd)

Date	Event
9/6/72	Kick motor insulation spacer installed and aligned
9/7/72	Kick motor installed on spacecraft; alignment measured
9/8/72	Weighed spacecraft (860.26 pounds)
9/9/72	Spacecraft/third stage mated and installed in transportation can
9/11/72	Spacecraft/third stage assembly mated to launch vehicle Spacecraft aliveness check
9/12/72	Spacecraft preps for sim flight (S/C not turned on)
9/14/72	Spacecraft tracking and data acquisition network simulation Spacecraft supported RFI
9/15/72	Spacecraft secured from RFI
9/18/72 thru 9/22/72	Spacecraft countdown (spacecraft countdown included from F-3 Day through launch)