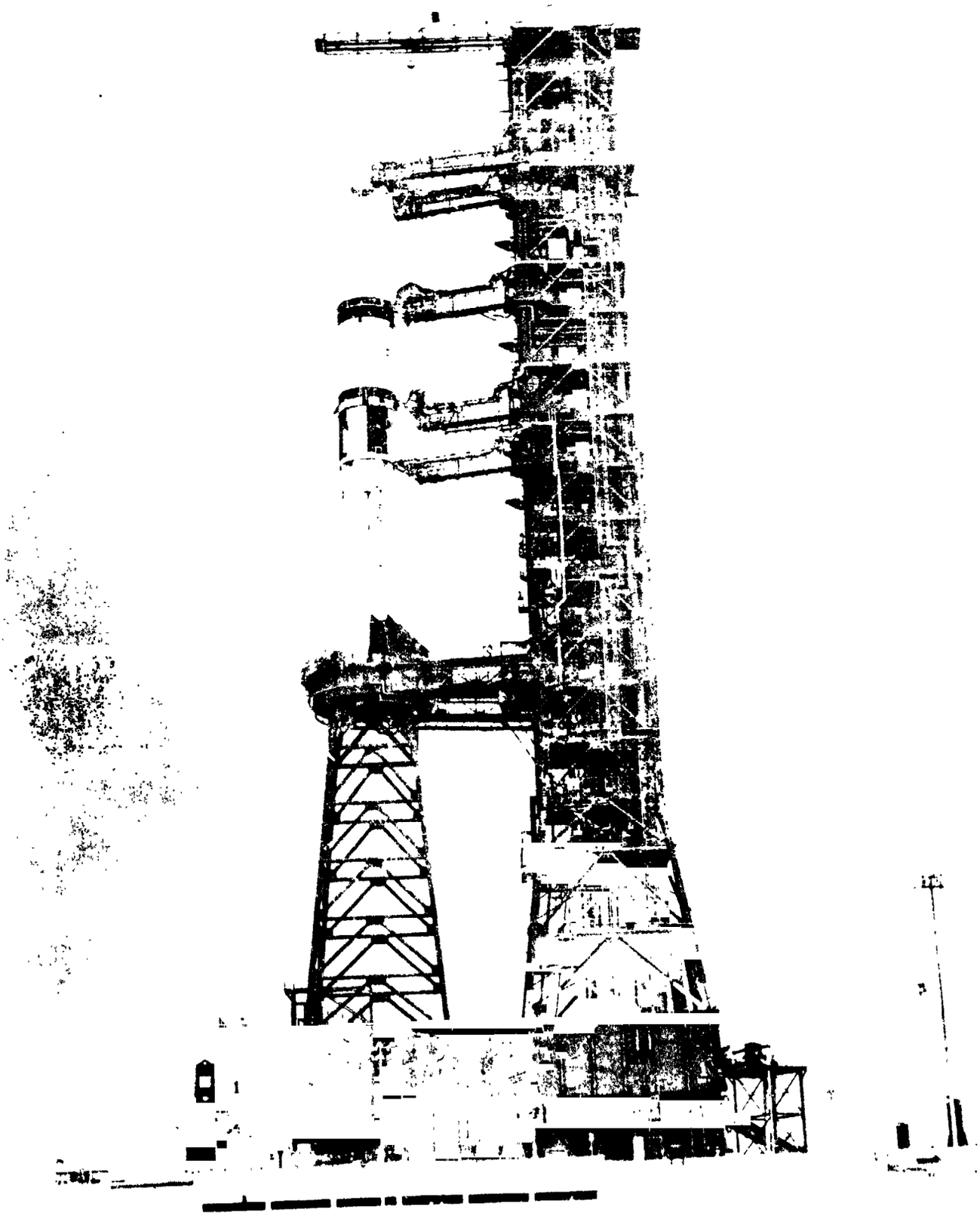
June 21, 1973

JOHN F. KENNEDY SPACE CENTER

SKYLAB 2

POST-LAUNCH REPORT

(RCS 76-0000-00048)



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POST-LAUNCH REPORT

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ABSTRACT

The Skylab 2 launch vehicle stages and the CSM were received and processed through the KSC flow without a major incident. Integration of the spacecraft with the launch vehicle went smoothly at the VAB and nominal checkout of the space vehicle followed. A malfunction of the Skylab 1 meteroid shield and solar panels on the OWS caused a ten day slip of the Skylab 2 launch to May 25. The final countdown for the May 25 launch began at 0530 EDT on May 23 after scrub/turnaround procedures were initiated on May 14. Launch occurred at 0900 EDT on May 25 which was the rescheduled launch time.

No major anomalies were reported on the space vehicle during launch and the launch effects on the KSC facilities and systems were nominal. After normal refurbishment, KSC facilities will be prepared to support Skylab 3 launch operations.

TABLE OF CONTENTS

1.0 INTRODUCTION

This KSC Post Launch Report for Skylab 2 (SL-2) is written in compliance with SLPD No. 35, "Skylab Mission Evaluation Reporting Requirements." The contents of this report, and the other Skylab Post Launch reports, will be condensed and submitted to NASA Headquarters for inclusion in a master volume entitled "Skylab Mission Evaluation Report."

Modifications to High Bay 1, ML-1, FR-3, MSS, Launch Pad B, and associated support systems were incorporated to accommodate the first Saturn IB vehicle to be processed at LC-39. Principal modifications associated with the S-IB Stage support systems were the firing accessories, the GN_2 and He pneumatic systems and the engine service platform. In each case these modifications adapted equipment formerly used at LC-34/37 for use at LC-39. Much of this work was completed prior to the arrival of the S-IB-206 Stage at KSC on August 22, 1972.

This report covers the launch vehicle stages, spacecraft (CSM), experiments, and their associated support equipment from their receipt at KSC through "tower clear" of the space vehicle launch. The performance of KSC systems in support of processing and launch of the SL-2 Space Vehicle (S/V) are described in this report. Major processing events for each Launch Vehicle (L/V) stage, Spacecraft (S/C), and the general experiments of the SL-2 S/V are described from their time of arrival at KSC through launch. The final countdown and hold times are noted and a summary of the launch is included. Finally, the weather at launch time and range support activities are described.

2.0 SKYLAB 2 MILESTONES AND OUTLINE OF SIGNIFICANT SKYLAB 2 PROCESSING EVENTS

2.1 Skylab 2 First Stage (S-IB-206)

2.1.1 S-IB Milestones

DATE	EVENT
8/22/72	Arrived on-dock KSC
8/31/72	Erected on ML-1
9/11/72	Initial power on

2.1.2 Narration of S-IB Processing Events

The S-IB arrived by barge at the Kennedy Space Center VAB dock on August 22, 1972. It was transported to the transfer aisle of the VAB where three of the eight fins were installed. It was then erected on the holddown arms in the transfer aisle where the remaining five fins were installed. Receiving and inspection was accomplished during this period. On August 31 the stage was erected on the eight holddown arms on the pedestal of Mobile Launcher (ML) 1 in High Bay 1. The pedestal is a 127 ft. addition to ML-1 which made it possible to accommodate the Saturn IB without modifying the ML from the S-IVB position and up. Additional S-IB stage activity is covered in the launch vehicle narrative.

2.2 Skylab 2 Second Stage (S-IVB-206)

2.2.1 S-IVB Milestones

DATE	EVENT
6/24/71	Arrived on-dock KSC
4/17/72	Removed from storage
9/5/72	Mated to S-IB
10/3/72	Initial power on

2.2.2 Narration of S-IVB Processing Events

The S-IVB stage arrived via Guppy aircraft at KSC on June 24, 1971 and was put in storage in the VAB low bay. It was removed from storage on April 17, 1972 and proceeded through modification for about three months and then through normal checkout in the low bay cells. The stage was mated to the S-IB in High Bay 1 on September 5. Additional S-IVB stage activity is covered in the launch vehicle narrative.

2.3 Instrument Unit (IU-206)

2.3.1 IU Milestones

DATE	EVENT
8/22/72	Arrived KSC
9/7/72	Mated to the S-IVB
10/3/72	Initial Power on

2.3.2 Narration of Skylab 2 IU Processing Events

The Skylab 2 IU arrived at KSC on August 22, 1972 via Guppy aircraft and was transported to Room 1L1 in the low bay of the VAB where it underwent receiving and inspection. On September 7 the IU was moved into the transfer aisle of the VAB and hoisted into High Bay 1 and mated to the S-IVB stage. There was no major IU activity until IU "power on" which occurred October 3. Additional IU activity is covered in the launch vehicle narrative.

2.4 Launch Vehicle (LV)

2.4.1 LV Milestones

DATE	EVENT
9/8/72	BP-30 and stub tower mated to IU
9/28/72	S-IB Vehicle/Pedestal Structural Test

DATE	EVENT
12/18/72	Sequence Malfunction Test completed
12/20/72	Service Arm Overall Test (SA OAT) completed
1/9/73	Launch Vehicle/BP-30 transferred to pad
1/30/73	Propellant Loading All Systems Test (PLAST) completed
2/2/73	Launch vehicle returned to VAB
2/14/73	Second Service Arm OAT
2/20/73	BP-30 destacked
2/21/73	Spacecraft (CSM 116) erected on IU
2/24/73	LV ordnance installed
2/24/73	Launch Escape System (LES) installed
2/26/73	Space Vehicle (SV) transferred to pad
2/27/73	S-IVB/IU power on
3/1/73	S-IB power on
3/14/73	LV Malfunction Overall Test completed
4/2/73	SV Plugs In Test/Software Integration Test (SIT) completed
4/5/73	SV Flight Readiness Test (FRT) completed
4/23/73	S-IB RP-1 load
5/3/73	Wet CDDT completed
5/4/73	Dry CDDT completed

2.4.2 Narration of Skylab 2 Launch Vehicle (LV) Processing Events

Testing began with qualification tests on the S-IB Service Arm 1A which was a modified arm installed on Mobile Launcher 1 (ML-1) to accommodate the S-IB stage. On September 7, 1972, during this testing, the kickoff pistons on the umbilical carrier hit against electrical connections on the S-IB stage umbilical plate causing minor scratches. The kickoff pistons on the umbilical housing were modified with spacers to prevent them from extending far enough to contact the stage during service arm retraction. No repairs or modifications were required on the stage.

On September 8 the BP-30 (Boilerplate spacecraft) and stub tower (Boilerplate Launch Escape System tower) were mated to the IU. S-IB mechanical systems tests were begun during this period. These tests included leak and pressure checks on the LOX and fuel systems. Also, components such as valves, pressure switches, and transducers were functionally checked.

On September 26 the Saturn IB Vehicle/Pedestal Structural Test (Pull Test) was started. This test included a maximum pull of 7500 pounds on the stub tower in the yaw and pitch planes, and a manual dynamic test which required exciting the first bending mode to an amplitude of five inches in the vicinity of where the spacecraft Service Module (SM) joins the SLA. This test was performed to verify technical analysis made of the Saturn IB/Pedestal/Mobile Launcher combination. This test was completed on September 28 and measured results agreed closely with predicted values.

During holddown arm validation tests on October 4, "mill scale" contamination was discovered in a redundant He pneumatic line when the line was disconnected in order to test the remaining line. The contaminant which was high in iron, chromium, and manganese, was also found in several He and GN_2 high pressure GSE systems which resulted in approximately 5400 feet of mobile launcher and pedestal tubing being replaced. Because of this, it was determined that inspections should be made in the S-IB stage, and contamination of the same type was found in the fuel pressurization and LOX bubbling system. This resulted in replacement of a quick disconnect filter

assembly and tube assembly in the fuel pressurization system. Also, a swivel joint and orifice in the LOX bubbling system were replaced. The S-IVB stage and IU were free of contaminants.

After IU "power on" on October 3, testing was accomplished on the IU ST-124M platform, which measured vehicle acceleration and attitude. Control system checks, which included calibrating generators, recorders, flight and ESE measurements, were made. The IU Launch Vehicle Digital Computer/ Launch Vehicle Data Adapter (LVDC/LVDA) semi-auto test was accomplished to verify the interface between the LVDC and LVDA, ST-124M platform, and Flight Control Computer (FCC). These tests continued through October. Guidance and control tests in which the ST-124M platform was operated with the flight computer were completed on November 9. S-IB mechanical systems tests continued through November and into December. On November 9, during these tests, the S-IB hydraulic system #2 pitch actuator experienced an unexpected pressure drop in the high pressure line during testing. The anomaly was most probably caused by piston cap seal leakage. All actuators were replaced with actuators having a redesigned seal.

Hydraulic fluid samples were also analyzed when the actuator problem occurred and contamination of metal particles was found high. Contamination was discovered to be chrome wear on ABEX pump piston shoes; therefore, all ABEX hydraulic systems were replaced (two of the four pumps on the SL-2 first stage were ABEX) with Vickers pumps. As a precaution, contamination analysis was conducted on the remaining two hydraulic systems, both of which used Vickers pumps. One of these pumps was contaminated with fine metal particles. Burnish marks were found on the hydraulic accumulator, making this a suspect area. This package was replaced with another Vickers unit, and this unit stalled due to a tolerance buildup and increased voltage required for operation. This package was replaced again with a Vickers unit, and the motor source voltage was increased from 108V to 214V.

On December 18 the Sequence Malfunction Test, which tested propellant dispersion (destruct) systems and simulator vehicle

malfunctions, was completed. The Service Arm Overall Test was accomplished on December 20. In this test liftoff was simulated with umbilical carriers being ejected and service arms retracted. During this test, the SA-8 (Service Arm No. 8) carrier, which houses the mechanisms connected to the spacecraft Service Module, did not push off from the vehicle properly because of a hangup on the BP-30 return water glycol quick disconnect (QD). The service arm carrier plate and BP-30 QD were damaged. Subsequently, in order to prevent damage to the spacecraft, latches on the SA-8 carrier water glycol QD's were removed, and the ball lock mechanism on the Service Module was modified on March 30 with a breakaway collar.

The next major operation was on January 9, 1973 when the launch vehicle was transferred to Pad B for the Propellant Loading All Systems Test (PLAST). This was a complete test and checkout operation performed at the pad on the 206 launch vehicle with BP-30 installed. The purpose was to check out the new Mobile Launcher Pedestal/Saturn IB launch configuration, including use of modified platforms on the Mobile Service Structure (MSS) for the S-IB stage. The test was virtually a Countdown Demonstration Test (CDDT), including propellant load.

a. While accomplishing RP-1 replenish on the S-IB stage, the computer indicated RP-1 at 2% ullage, but the overfill sensor indicated overfill. This was corrected by revising loading tables and procedures.

b. S-IB stage LOX prevalve #4 did not indicate open or close; #6 did not indicate closed. These switches were found defective and replaced.

c. The S-IVB chilldown system performed erratically, indicating excessive heat input into the system. This was because insulation around the pump was not installed in the flight configuration; however, all "red

lines" were met.

d. The Launch Vehicle Data Adapter (LVDA) P-19 failed because of a glass delay line bond failure in one channel. This LVDA was replaced with LVDA P-29. Since there are three channels with a two out of three voting logic, this would not have been a launch failure. Later, LVDA P-29 failed because of a fractured gage connector pin and was replaced.

PLAST was completed on January 30 and on February 2 the launch vehicle was returned to the VAB. During PLAST data review, a problem was discovered with the roll/yaw comparators on the Flight Control Computer (FCC) which sends pulses for firing the Auxiliary Propulsion System (APS) nozzles on the S-IVB. The FCC was sent to the vendor's plant where the problem was isolated to a buffer amplifier. The computer was repaired and reinstalled on February 6.

In order to give added assurance of swing arm operation, a second Swing Arm OAT was accomplished on February 14. SA-8 indicated a perfect ejection (the modification noted previously had not yet been installed). The IU LVDC final program was delivered February 14, loaded February 19, and verified February 20.

The BP-30 was destacked on February 20 and the spacecraft (CSM-116) erected on February 21. The LES was installed on February 24. Also on February 24, the LV ordnance was installed, which included retro rocket motors, propellant dispersion linear shaped charges, and ullage rocket motors.

On February 26 the SL-2 space vehicle was transferred to LC-39 Pad B. S-IVB and IU power on occurred February 27 and S-IB power on occurred March 1. In order to avoid the Terminal Countdown Sequencer (TCS) problem which occurred on Apollo 17, and provide a two out of three voting logic, two additional TCS's were installed on March 12. As a result of a problem on SL-1 (S-IC-513) a modification was installed on April 2 to assure all three TCS's would start at initiation of terminal sequence.

Launch Vehicle Malfunction OAT occurred from March 12

to March 14, including OAT preps on March 12. During the remainder of March, tests such as leak tests on the service arms and electrical mating of the space vehicle were accomplished. On April 2 Space Vehicle Plugs In Test and Software Integration Test were completed. In these tests the spacecraft and launch vehicle were electrically and mechanically mated on the ML. Guidance and Control systems were operated and engines gimballed. The terminal count sequence was run through simulated liftoff to start of plus time.

The S-IVB auxiliary pump received 18 four-amp spikes on March 23. During subsequent tests there were additional four-amp spikes. This problem was considered an unexplained anomaly and had no impact. From April 4 to April 5, the Space Vehicle Flight Readiness Test (FRT) was run. In this test propellant loading and service arm retractions were simulated. The launch vehicle flight computer programs simulated the launch vehicle through a flight using the final flight programs. During the remainder of April and prior to CDDT, the S-IB CONAX valves, which are pyrotechnically actuated and the key components in the engine cutoff sequence, were installed. Also hypergolic propellants required for the S-IVB APS and spacecraft were loaded on the space vehicle.

S-IB RP-1 load was accomplished April 23 and Wet CDDT began on April 26, 1973.

2.5 Command Service Module (CSM)

2.5.1 CSM Milestones

DATE	EVENT
7/19/72	CSM 116 arrived and moved to O&C Building
7/21/72	SM installed in Altitude Chamber L
7/25/72	Completed mate of SM and CM
8/10/72	Abbreviated Combined Systems Test began (power off portion)

DATE	EVENT
8/14/72	Spacecraft (S/C) powered up for Abbreviated Combined Systems Test
8/29/72	Completed Abbreviated Combined Systems Test
9/12/72	S/C moved from Altitude Chamber to H14-124 Stand
11/20/72	Started preps for CSM-AM/MDA Electrical Interface Test and Docked Simulated Mission
12/5/72	S/C moved to WITS for Docking Tests
12/18/72	Completion of Electrical Interface Test; S/C powered down (CSM portion of Docking Tests completed)
12/20/72	AM/MDA undocked from CSM
12/21/72	S/C moved from WITS to Altitude Chamber
1/3/73	C^2F^2 by Prime Crew and Backup Crew
1/8/73	Prime Crew participated in Simulated Altitude Test
1/9/73	Backup Crew participated in Simulated Altitude Test
1/12/73	Unmanned Altitude Chamber runs completed
1/17/73	Prime Crew participated in Altitude Chamber runs
1/19/73	Backup Crew participated in Altitude Chamber runs
1/23/73	Completed Software Integration Test (SIT) with Mission Control Center (MCC), Houston

DATE	EVENT
1/29/73	S/C moved from Altitude Chamber to H14-134 Stand; SPS nozzle extension installation and leak checks
2/8/73	S/C moved to East Integrated Test Stand (EITS)
2/9/73	Completed CSM/SLA mate
2/20/73	CSM/SLA moved from O&C Building to VAB
2/21/73	S/C mated to LV
2/25/73	Completed LES installation
2/26/73	SV moved from VAB to Pad B
2/27/73	MSS moved around SV
3/5/73	Combined Systems Test begun
3/28/73	Completed SV electrical mate
4/2/73	Completed SV OAT and Software Integration Test (SIT)
4/3/73	S/C powered up for Flight Readiness Test (FRT)
4/5/73	Completed FRT
4/13/73	Completed CSM Propellant Systems Verification Test
4/16/73	Started SV Hypergolic Loading
4/19/73	Completed SV Hypergolic Loading
4/22/73	Completed S/C ordnance installation

DATE	EVENT
4/23/73	Completed C^2F^2
4/25/73	Started CDDT
5/3/73	Wet CDDT, T-0 at 1300
5/4/73	Dry CDDT, T-0 at 1300
5/9/73	Started launch countdown for May 15 launch; S/C powered up at 2000 EDT
5/14/73	Launch scrubbed
5/22/73	Started Launch Countdown for May 25 launch at 2030 EDT
5/25/73	SL-2 launched at 0900 EDT

2.5.2 Narration of CSM Processing Events

Command Module 116 and Service Module 116 arrived at KSC on July 19, 1972 via the Super Guppy aircraft and were off-loaded and moved to the Operations and Checkout Building (O&C). The SM was installed in the Altitude Chamber on July 21 and the CM was mated to the SM on July 25. Receiving inspection and buildup operations commenced in preparation for the Abbreviated Combined Systems Test. This test was started August 29. During the fuel cell cryo leak checks, a leak was detected at the top of the O_2 Tank #1 electrical connector interface. The entire cryo shelf was removed and shipped to Rockwell International (RI)/Downey on September 18. The refurbished cryo shelf was returned to KSC and reinstalled on October 26. Also during the Abbreviated Combined Systems Test, excessive leakage was detected in the Propellant Storage Module (PSM) helium regulator. The complete PSM shelf was subsequently removed and returned to RI/Downey on October 20. Contamination was found in the helium tanks and associated components and was identified as metallic and non-metallic particulate and rust. The refurbished PSM was returned to KSC and reinstalled on December 20.

Preparations for the CSM-AM/MDA Electrical Interface Test and Docked Simulated Mission docking tests were started on November 20 and the CSM was moved to the West Integrated Test Stand (WITS) on December 5. The S/C was powered up December 10 and the test completed December 18. No significant CSM problems were encountered during these tests. The coupling data unit (CDU) malfunctioned and was replaced after completion of the docking tests. The crew participated in this test on December 12. The AM/MDA was undocked from the CSM on December 20, and the CSM was moved on the following day into the Altitude Chamber in preparation for manned Altitude Chamber runs.

Preparations for the Simulated Altitude Chamber Tests were started December 22. The Prime Crew participated in these tests on January 8, 1973, and the Backup Crew on January 9. Altitude Chamber Tests were started January 12 with manned runs with the prime crew and backup crew, January 17 and 19, respectively. The 2.22 ECS Temperature Controller was replaced upon completion of manned altitude chamber runs. The temperature controller had previously been removed in October 1972 and sent to RI/Downey for special screening tests. The normal number of minor discrepancies were encountered during altitude chamber runs.

The spacecraft was moved to the East Integrated Test Stand (EITS) on February 8 for CSM/SLA mate operations. During spacecraft ordnance installation, three (3) dings were made in the CM forward heat shield during the lowering of a handling sling as a result of a communications failure. The dings were repaired by normal repair procedures.

The spacecraft was transferred to the VAB on February 20 and was mated to the LV on February 21. SA-8 umbilical eject tests were conducted on February 22, the Launch Escape System (LES) tower was installed on February 25, and the space vehicle moved to Pad B on February 26.

The spacecraft was powered up on March 5 for Spacecraft Combined Systems Tests. A defective body mounted attitude gyro (BMAG) in the Stabilization and Control System (SCS) exceeded drift rate specifications and was replaced. Also, during abort runs the LES canard pyro circuit malfunctioned. The problem was traced to a defective Mission Events Sequence

Controller (MESC) and it was replaced. During this test the 2.22 Environmental Control System Temperature Controller was again removed and shipped to RI/Downey for screening tests. (This was the third removal of the 2.22 ECS Temperature Controller).

During the SM RCS leak and functional test, a leaking isolation valve in Quad B was encountered. Quad B was replaced by Quad B from CSM 118. The CM RCS "A" system oxidizer tank bladder exhibited leakage rates over specification. The bladder leakage was determined to be acceptable for flight; however, the burst disc was replaced due to excessive leakage.

The Software Integration Test (SIT) was completed April 2. The spacecraft was powered up for the Flight Readiness Test (FRT) on April 3. The test was completed on April 6 without any significant spacecraft problems. The CSM Propellant Systems Verification Test commenced April 9 and was completed April 13.

On April 13 the water glycol pump of Fuel Cell #3 experienced a delay of approximately six minutes in starting. The fuel cell was changed out and retested satisfactorily.

Space Vehicle Hypergolic Loading commenced on April 16 and was completed on April 19. The CM RCS oxidizer was loaded prior to fueling in order to verify as early as possible that the oxidizer bladder permeability was satisfactory in view of the earlier out of specification detected. No leakage occurred from the oxidizer tank bladder and hypergolic loading was completed without any significant problems. The two (2) rotational hand controllers were replaced on April 5 as the installed hand controllers were suspect due to a structural problem previously discovered in the gear retainer of other units.

The decision by NASA to deorbit the S-IVB stage resulted in the reassignment of SLA-6 (Block I type) to SL-2. The deorbit requires the SLA panels to be deployed and retained instead of being jettisoned as on the Block II SLA's. The SLA reassignment required the incorporation of the D-12 penetration to the SLA in order to provide a freon deluge capability on the

launch pad. (Only two of three freon sleds were used for SL-2). During the mod incorporation, the SLA honeycomb face sheet buckled and separated from the core in two places adjacent to the added freon deluge access door. The buckling occurred after the external doubler was hot bonded. The debonding was repaired and subsequent Eddysonic and "porta-pull" tests were conducted. Analysis indicated residual bonding stresses, plus flight stresses, would not exceed design margins. Spacecraft ordnance was installed on April 22 and Crew Compartment Fit and Functional (C^2F^2) was conducted on April 23. The Countdown Demonstration Test (CDDT) was commenced on April 25 and completed on May 4.

2.6 Experiments

There were two experiments launched aboard Skylab 2: Radiation in Spacecraft (D-008), launched in the Command Module and Thermal Control Coatings (M-415) launched aboard the Instrument Unit. The Zero-G Human Cell (S-015) was to have been launched aboard the Command Module but was removed late in the SL-2 checkout sequence to allow more stowage space for items needed to correct the problems aboard SL-1 and to replace some items which had possibly been damaged by the higher-than-anticipated SWS internal temperatures. Further discussion of the changes in the Skylab 2 storage is included in Section 4.4 of this report.

2.6.1 D008, Radiation in Spacecraft

2.6.1.1 D008, Radiation in Spacecraft Milestones

DATE	EVENT
7/19/72	Active Dosimeter arrived at KSC aboard CSM 116
5/11/73	Passive Dosimeter arrived at KSC
5/12/73	Passive Dosimeter installed in CSM 116

2.6.1.2 Narration of D008, Radiation in Spacecraft, Processing Events

The active dosimeter was delivered to KSC on July 19, 1972 aboard CSM 116. It was removed from the spacecraft and returned to the vendor for a check of the readout sensitivity range which did not appear to meet Skylab requirements. The range was found to be acceptable and the experiment was returned to KSC and reinstalled in CSM 116 on January 8, 1973 for altitude chamber tests. The passive dosimeters were delivered to KSC on May 11 and were installed aboard the CSM the next day.

2.6.2 M415, Thermal Control Coating

2.6.2.1 M415, Thermal Control Coating, Milestones

DATE	EVENT
2/13/73	Flight hardware received at KSC
2/16/73	Flight hardware installed on Instrument Unit (IU-206)

2.6.2.2 Narration of M415, Thermal Control Coating, Processing Events

Flight hardware was received at KSC on February 13, 1973 and installed on the launch vehicle instrument unit (IU-206) on February 16.

3.0 WEATHER

3.1 General Weather on Launch Day

A surface low pressure trough lay across northern Florida, and southern Georgia and Alabama, the axis of which was oriented from east northeast to west southwest. An extensive area of scattered showers, broken layers of middle and high cloudiness, with widely scattered embedded thunderstorms. extended southward from the trough axis to Central Florida. Broken layers of clouds over the launch area were observed at 500 feet, 7000 feet, and 18,000 feet. Showers were observed ten to fifteen miles south of the launch pad.

At launch time west southwest flow prevailed in the lower troposphere, from the surface to an altitude of 18,000 feet over the launch area. Above this level, wind directions were from west and west northwest. The maximum wind was observed to be 34 meters per second, from 290° azimuth, at an altitude of 14 km.

3.2 Weather Observations at T-0

	CKAFS Weather Station (XMR)	150 Meter Tower #313	O&C Bldg.
Sky and ceiling	600 scattered est 2500 broken 8000 broken 30,000 broken	800 scattered est 8000 broken 30,000 broken	500 thin broken est 7000 broken 18,000 broken
Visibility (miles)	9	6 ground fog	7
Pressure (mbs)	1011.9	1010.5	1012.5
Temperature (°F)	76	79	75
Dew Point (°F)	73	74	73
Wind (dir/speed, kts)	210/06	260/06	260/08

	CKAFS Weather Station (XMR)	150 Meter Tower #313	O&C Bldg.
Clouds	3/10 Fracto-cumulus*	5/10 Fracto-cumulus*	6/10 Stratus
	6/10 Cumulus	5/10 Altocu-mulus	4/10 Altocu-mulus
	3/10 Altocumulus	1/10 Cirrus	2/10 Altocu-mulus
	3/10 Cirrus		
Total sky cover (10ths)	9	9	8
Opaque sky cover (10ths)	8	8	8
Lightning observed	Negative	Negative	Negative

*Vehicle passed through cloud layers

4.0 CDDT, Countdown, and Launch Summary

4.1 CDDT

CDDT started at 2100 EDT on April 25; Wet CDDT T-0 was at 1300 EDT on May 3 and Dry CDDT T-0 was at 1300 EDT on May 4.

4.1.1 Overall Performance

All aspects of CDDT were conducted satisfactorily. During CDDT, Fuel Cell #3, which was previously replaced, was successfully activated and deactivated. Also, during performance tests excessive drift was noted in the Inertial Measurements Unit (IMU) Y gyro. Upon completion of CDDT, the IMU was replaced and subsequently retested. Near the end of CDDT a broken hydraulic line on the facility damper strut resulted in hydraulic fluid being sprayed on the side of the SM.

4.2 Countdown (May 15 Launch)

The Skylab 2 official countdown began at 0800 EDT on May 9 at T-140 hours. This countdown was oriented toward a May 15 launch.

4.2.1 Lightning Strike on SL-2 Slidewire and MSS

Showers and thunderstorms began to develop over Western and Central Florida by midmorning of May 9. Several periods of adverse weather occurred over the Pad areas during the interval from 1230 to 2315 EDT.

At 1311:37 EDT, the two magnetic links attached to the slidewire were magnetized and analysis indicated that the corona current amplitude exceeded the calibrated range of the instrument. Links mounted at the ML-1 anchor end of the wire recorded 33.6K amps with negative polarity while the set at the ground end of the wire recorded 42.6K amps with positive polarity. The magnetic links mounted on the ML-1 lightning mast and crane boom were not magnetized.

Also at 1311:37 EDT. the MSS lightning mast corona indicated a strike with amplitude exceeding the calibrated range of the instrument. With this strike, several of the pedestal current measurements recorded data. Pedestal A recorded a current of -.6K amps, pedestal D recorded +1.8K amps, and pedestal C recorded the event but the data level is not available at this time. The stroke counter did not record any event and the magnetic links on the mast were not magnetized. Induced voltages were reported at the base of the MSS. The reported data values were: Channel 1, +8/-5; Channel 2, +0/-25; Channel 3, +12.5/-12.5.

No special retests were run on the L/V because all items in the lightning retest plan were covered in the countdown. Retest plan #1 (reviewing data) was implemented on the S/C and no anomalies were noted.

4.2.2 Scheduled Holds For A May 15 Launch Occurred As Follows:

T-TIME (HR:MIN)	START-EDT	SCHEDULED HOLD (HR:MIN)	ACTUAL HOLD (HR:MIN)
T-77:00	2300 (5-11-73)	7:00	7:00
T-30:00	0500 (5-14-73)	0:30	0:30
T-22:15	1315 (5-14-73)	0:15	0:15

4.3 Scrub Turnaround

Scrub Turnaround was implemented at 2110 hours EDT, May 14 at T-14 hours, 35 minutes. Launch of Skylab 2 was rescheduled to May 20, 1973 at 1101 hours EDT. This action was taken as a result of Skylab 1 cluster hardware problems.

4.4 Countdown Reschedule

The Skylab 2 Launch was subsequently rescheduled for May 25 at 0900 EDT. This countdown was started at T-59 hours at 0530 EDT on May 23.

4.4.1 Scheduled Holds for the May 25 Launch Occurred As Follows:

T-TIME (HR:MIN)	START-EDT	SCHEDULED HOLD (HR:MIN)	ACTUAL HOLD (HR:MIN)
-9:00	2230 (5-24-73)	0:15	0:15
-3:30	0415 (5-25-73)	1:13	1:13
-0:15	0843 (5-25-73)	0:02	0:02

4.4.2 Unscheduled Holds

No unscheduled holds occurred. Launch vehicle cryo loading was revised to start three hours early to allow additional time after cyro loading for stowage of late arriving materials and equipment items aboard the Command Module.

4.4.3 Lightning Strike on ML-1 Lightning Mast

Adverse weather occurred over the Pad areas in the afternoon of May 24. At 1724:28 EDT, the magnetic links mounted on the lightning mast of the ML-1 recorded a maximum peak current of 3.3K amps with positive polarity. The magnetic links mounted on the lightning mast of the MSS indicated a maximum peak current of 4.1K amps with negative polarity. Magnetic links mounted on the slidewire and crane boom did not record data. The corona current amplitude exceeded the calibrated range of the instrument.

The L/V performed part IA (short retest during the countdown) of the lightning retest plan. The tests consisted of G & C confidence checks, J-2 engine sequence test, and selected stage electronics systems tests. No anomalies were noted other than a spurious "line 2" interrupt to the RCA 110A (which is expected). The S/C completed an instrumentation scan per Part I. There were no anomalies noted on the S/C.

4.4.4 Stowage of Repair Equipment For the Saturn Workshop

On May 24 from 1900 to 2100 EDT the following items were stowed:

(1) Sail Pole Base Plate and Foot Restraints Adapter (MSFC Sail)

(2) MSFC Sail

(3) Solar Array System (SAS) Tools

On May 25 from 0223 to 419 EDT, the following items were stowed:

(1) Poles and Tripod (MSFC Sail and JSC Parasol)

(2) Modified T027 Assembly (JSC Parasol)

(3) SEVA Sail - JSC

4.5 Launch Summary

All structure and active systems of the SL-2 S/V performed nominally through the launch. Two significant problems occurred during the final countdown.

The RCS PSM manifold was still pressurized at T-2 hours. The PSM manifold was vented by performing an RCS Direct Ullage maneuver at approximately T-1 hour 30 minutes.

The second problem was a momentary thrust failure indication and a cutoff start indication at 84 ms after launch commit. The S-IB launch bus, 1D161, went off as expected approximately 76 ms after commit; however, 8 ms later it cycled on/off for 6 ms. This signal was too short in duration to energize the cutoff start relay K72. A modification has been made so that once commit has been achieved during future launches, thrust failure cutoff cannot be initiated. Also, a modification has been installed to prevent re-energizing the power transfer circuitry in order to prevent a transfer back to ground power after commit until an actual command to cutoff the S-IB stage engines has been given. Also see Section 6.41.1.1.2.2.

4.6 Official Liftoff Time

Liftoff of SL-2 occurred at 0900:0.432 hours EDT on May 25, 1973.

5.0 RANGE SUPPORT ACTIVITIES

5.1 General

Range data acquisition and support systems functioned satisfactorily with all committed systems up and operational at launch.

5.2 Tracking and Data Acquisition

The coverage per system and station was as follows:

5.2.1 Radar

5.2.1.1 Mainland

1.16/0-420 seconds on auto beacon (momentary phase front shift at plus 100)

19.18/0-550 seconds on auto beacon (momentary skin tracks at 295 and 450)

0.18/20-428 seconds on auto skin/428-450 AB/450-545 AS

1.5/used for surveillance
1.35V/used for surveillance

5.2.1.2 Grand Bahama Island

3.13/84-233 seconds on auto beacon
233-245 seconds on auto skin
245-247 seconds on auto beacon
247-253 seconds on auto skin
253-256 seconds on auto beacon

NOTE: Radar experienced numerous phase front shifts and intermittent beacon dropouts after plus 256 seconds.

5.2.1.3 Wallops Island

WLP/188-687 seconds on auto beacon

5.2.1.4 Bermuda

67.18/240-744 seconds on auto beacon

5.2.2 Telemetry

5.2.2.1 Mainland - Tel IV

IU Link 255.1/-120 sec to +555 sec.
S-IB Link 256.2/-120 sec to +380 sec.
S-IVB Link 258.5/-120 sec to +555 sec.

5.2.3 Optics-Tracking

There were eight engineering and five documentary cameras scheduled to support from CKAFS. All cameras operated normally.

5.2.4 Command

5.2.4.1 Station 1

Carrier on 1220:20Z; off 1306:43Z

5.2.4.2 Bermuda

Carrier on 1306:40.9Z; off 1311:30Z
Functions: Safe 1309:56.8Z

5.2.5 Data Retrieval Status

Data retrieval was very good. All quick-look data items were provided as committed.

5.2.6 Range Support Problems

There were no significant Range problems.

5.3 Range Safety

There were no range safety problems encountered during the countdown and launch of SL-2. The vehicle performed slightly below nominal, but in general performed satisfactorily.

The command/destruct system on the S-IVB stage was safed immediately after insertion by the command transmitter at Bermuda.

6.0 KSC LAUNCH ACTIVE SYSTEMS

6.1 RP-1 Fuel System

6.1.1 Overall Performance

The RP-1 System successfully supported countdown and launch. Tail Service Mast fill and replenish was accomplished at T-8 hours and level adjust/line inert at about T-60 minutes. Both operations were completed satisfactorily and as planned. An erroneous transfer pump overheat indication was noted during system power application on May 23. (See Section 6.1.4)

6.1.2 Damage

There was no launch damage to the RP-1 system.

6.1.3 Material Consumption

Launch countdown support consumed 41,550 gallons of RP-1.

6.1.4 Problems

6.1.4.1 Transfer Pump Overheat Indicator

The Transfer Pump Overheat indication illuminated when power was applied to the RP-1 storage area on May 23. The pump was not operating at the time. Troubleshooting revealed a defective thermal switch. The switch was replaced and correct system indications were restored. (Ref. TPR B6-398)

6.2 Liquid Hydrogen System (LH_2)

6.2.1 Overall Performance

The LH_2 system successfully supported countdown and launch. The fill sequence began at 2347 EDT, May 24, and was completed 53 minutes later when normal S-IVB replenish was established manually at 0040 EDT, May 25. Replenish was nominal and was terminated at the start of TCS. A malfunctioning transfer line liquid sensor was discovered on May 9 and several

burn pond ignitors failed shortly before and after launch. (See section 6.2.4)

6.2.2 Damage

There was no launch damage to the LH_2 System.

6.2.3 Material Consumption

Launch countdown support consumed about 150,000 gallons of LH_2.

6.2.4 Problems

6.2.4.1 LH_2 Liquid Sensor

When LH_2 system power was applied on May 9, the S-IVB liquid sensor indicated WET with no liquid in the line. The problem was isolated to the liquid sensor probe inside the LH_2 transfer line. To correct this condition would have required removing and replacing the sensor and rerunning Pad/ML LOX and Fuel Leak checks. Since the sensor is used only in the automatic logic to restore the system to the fill sequence after a revert, and a WET indication is needed in that case, the sensor was used as is for launch and continuted to indicate WET. The unit will be replaced for AS-207 operations. (Ref. TPR B6-383)

6.2.4.2 LH_2 Burn Pond Ignitors #1, #2, #5, and #6 Failures

LH_2 Burn Pond Ignitor #1 failed shortly after start of LH_2 automatic loading; #2, #5 and #6 failed after lift off during automatic securing operations. Post launch investigation revealed that #1 was broken and that the circuit breaker in the inverter that powers #2, #5 and #6 was open. An investigation to determine the cause of the open CB is under way at this time.

6.3 Liquid Oxygen System (LOX)

6.3.1 Overall Performance

The LOX System supported countdown and launch satisfactorily.

The fill sequence began with S-IB chilldown at 2145 EDT, May 24 and was completed 2 hours 3 minutes later with all stage replenish at 2348 EDT. Replenish was automatic through TCS without incident. A leak was found in the vaporizer pit drain line during preps. See Section 6.3.4.

6.3.2 Damage

Damage was limited to the S-IB LOX service mast purge and sense line. This was expected and the installation will be refurbished.

6.3.3 Material Consumption

LOX consumption during launch countdown was 160,000 gallons.

6.3.4 Problems

6.3.4.1 Leak in the Vaporizer Water Pit Drain Line

On May 24 during LOX System final preps a leak was found in the vaporizer water pit drain line upstream from the shutoff valve. By placing sandbags around and over the line the leak was reduced sufficiently to permit the vaporizer to function normally. Satisfactory operation continued through launch.

6.4 Propellant Tanking Computer System (PTCS)

6.4.1 Overall Performance

The PTCS supported countdown and launch. There was no damage and only one minor discrepancy was noted.

6.4.2 Problems

6.4.2.1 Missing Digits in the S-IB AUTO LOX Readout

On May 24 during final preparations for propellant loading it was noted that the 4, 5, 6, and 7 digits in the "tenth" decade were missing in the S-IB AUTO LOX readout. A NOR1 card in the S-IB mass decoder (603-106A8A2 panel) was replaced

and satisfactory operation restored. (Ref. TPR B6-399).

6.5 Data Transmission System (DTS)

6.5.1 Overall Performance

The DTS supported all countdown operations satisfactorily. Two defective printed circuit boards (PCB) were replaced in the system during preps for launch. See Section 6.5.3.

6.5.2 Damage

There was no launch damage to the DTS.

6.5.3 Problems

6.5.3.1 Discrepant "Analog Switch" PCB

On May 14 LOX replenish line flow measurements 33G01 and 33G08 were indicating about 2 percent with system power off. Turning on system power appeared to have no effect. Trouble shooting revealed a discrepant "Analog Switch" PCB in DTS chassis 5298A7 at Pad B. The PCB was replaced and satisfactory system operation continued through launch. (Ref. TPR B6-388).

6.5.3.2 False Indication On Control Console

During the LOX preps for load, on May 22, the "S-IB Slow Fill Valve Closed" indication remained illuminated on the control console when the valve was opened. Trouble-shooting revealed that the false indication was caused by a defective "Relay Driver" printed circuit board in FR #3 DTS chassis 5999A12. The board was replaced and retest was satisfactory. (Ref. TPR B6-394).

6.6 Propellant DC Power

6.6.1 Overall Performance

The Propellant DC Power System successfully supported countdown and launch. There were no equipment failures

and no launch damage.

6.7 High Pressure Gaseous Nitrogen System ($HPGN_2$)

6.7.1 Overall Performance

The performance of the $HPGN_2$ System during support of SL-2 was satisfactory.

6.7.2 Damage

No damage was sustained to the $HPGN_2$ System by the launch of SL-2.

6.7.3 Material Consumed

The Big Three Industrial Gas Company supplied approximately 24,000,000 SCF for launch countdown. The Paul Rechargers were not operated in support of SL-2 launch countdown. The total includes both the high pressure GN_2 and the low pressure GN_2.

6.7.4 Non Conformances, Waivers, Deviations, and Problems

There were no significant problems with the $HPGN_2$ system.

6.8 High Pressure Gaseous Helium System (HPGHe)

6.8.1 Overall Performance

The overall performance of the HPGHe System was satisfactory.

6.8.2 Damage

No damage was sustained to the HPGHe System by the launch of SL-2.

6.8.3 Material Consumed

Approximately 500,000 SCF GHe was consumed for countdown of SL-2.

6.8.4 Non Conformances, Waivers, Deviations, and Problems

There were no signficant problems with the HPGHe system.

6.9 High Pressure Gaseous Hydrogen System ($HPGH_2$)

6.9.1 Overall Performance

The overall performance of the $HPGH_2$ System was satisfactory.

6.9.2 Damage

No damage was sustained to the $HPGH_2$ System by the launch of SL-2.

6.9.3 Material Consumed

Launch Countdown	Initial Pressure	3840 PSI
	Final Pressure	3680 PSI
	Mass Consumed	79 LB. MASS

6.9.4 Non Conformances, Waivers, Deviations, and Problems

6.9.4.1 Erratic Readings on GH_2 Recorder 5072

GH_2 Recorder 5072 was giving erratic readings by virtue of a faulty amplifier (M/N 13246E). The defective amplifier was replaced and proper indications were obtained.

6.9.4.2 GH_2 Line Valve A3621

GH_2 Line Valve A3621 (Annin) was found to be inoperative due to galling of the operator threads. The upper operator was replaced and normal operation obtained.

6.10 Gaseous Oxygen/Gaseous Nitrogen System (GO_2/GN_2)

6.10.1 Overall Performance

The system provided a GO_2/GN_2 gas mixture to the spacecraft interface as required by 65ICD7566, IRN26.

6.10.2 Damage

There was no significant damage to the GO_2/GN_2 system.

6.10.3 Material Consumption - (Window Purge & Cabin Conditioning)

Initial Pressure (psig) - 2190 psig

Re-pressurization Pressure (psig) - 1540 psig

Second Pressure (psig) - 2140 psig

Final Pressure (psig) - 1710 psig

Total Pressure Used (psig) - 1080 psig

Weight of Gas Used (pounds) - 322.56 lbs.

Cubic Footage Used (scf.) - 3790 scf.

6.10.4 Nonconformances, Waivers, Deviations, and Problems

6.10.4.1 Increased Usage of GO_2/GN_2 For Window Purge

The only problem experienced during launch countdown of Skylab 2 was the increased usage of GO_2/GN_2 for window purge. The increased usage forced development of a re-pressurization procedure during support to maintain 651CD7566, IRN26.

6.11 Environmental Control System (ECS)

6.11.1 Overall Performance

The ECS performed satisfactorily throughout countdown and launch. Changeover from air to GN_2 occurred at 2041 EDT on May 24. GN_2 purge was terminated at 0913 EDT on May 25. No waiver conditions were encountered during the countdown operation.

6.11.2 Damage

Launch damage was extremely minor and was confined to one

small hole in the Pad B ECS cooling tower.

6.11.3 Material Consumption

Approximately 11,175,000 SCF of GN_2 were used to purge the vehicle compartments.

6.11.4 Service Module Deluge Purge Panel (SMDPP)

6.11.4.1 Overall Performance

The SMDPP successfully supported countdown and launch with no failures or anomalies. There was no material consumption since gas flow was not initiated.

6.11.4.2 Damage

There was only slight launch damage. The SMDPP door latches were broken; this has occurred on all previous launches. Also the door gasket seal pulled away from the frame assembly in several places and will require recementing.

6.12 Service Arm Control Switches (SACS)

The Service Arm Control Switches (SACS) satisfactorily supported SL-2 launch countdown and launch. The SAC #3 primary switch closed at 289 milliseconds and SACS #7 primary switch closed at 268 milliseconds after COMMIT. There were no problems and there was only a minimal amount of heat and blast damage to the SACS.

6.13 Hydraulic Charging Unit (HCU)

The Hydraulic Charging Unit satisfactorily supported SL-2 launch countdown and launch. There were no problems and there was no launch damage.

6.14 Lightning Detection System

6.14.1 Overall Performance

The countdown and launch were supported with no significant

system anomalies. Lightning instrumentation on ML-1 and the MSS provided data during adverse weather conditions and three separate lightning strike events are noted below.

6.14.2 ML-1 Slidewire - May 9

Lightning struck the ML-1 Slidewire at 1311:37 EDT on May 9, 1973.

6.14.2.1 Lightning Detection Systems Measurements

6.14.2.1.1 Magnetic Links

The two magnetic links attached to the slidewire were magnetized and analysis indicates maximum peak currents as listed below. Links mounted at the ML-1 anchor end of the wire recorded 33.6K amps with negative polarity while the set at the ground end of the wire recorded 42.6K amps with positive polarity. The magnetic links mounted on the ML-1 lightning mast and crane boom were not magnetized.

6.14.2.1.2 Corona Current

The ML-1 lightning mast corona current measurement indicated an event occurring at 1311:37 EDT with an amplitude exceeding the calibrated range of the instrument.

6.14.2.1.3 All Sky Cameras

Three cameras located at pad perimeter camera locations recorded an event where the flash recorded did not reach the horizon. The termination point of the flash was triangulated from the positions of the cameras and this analysis indicated the termination of the flash at a point approximately 1150 feet from ML-1 at an azimuth of 280°. Elevation was calculated to be approximately 100 feet above grade. This termination point definitely indicates a stroke to the slidewire.

6.14.2.1.4 Other Measurements

The current waveform measurement recorded an event occurring at 1311:37 EDT but no other information is

available from this measurement. There was no data recorded by the lightning mast stroke current or the pedestal current measurements of ML-1.

6.14.3 MSS - May 9

Lightning struck the MSS at 1311:37 EDT on May 9, 1973.

6.14.3.1 Lightning Detection Systems Measurements

6.14.3.1.1 Corona Current

The MSS lightning mast corona current measurement indicated an event occurring at 1311:37 EDT with amplitude exceeding calibrated range of the instrument.

6.14.3.1.2 Current Measurements

Several of the pedestal current measurements recorded data. Pedestal A recorded a current of -.6K amps, Pedestal D recorded +1.8K amps, and pedestal C recorded the event but interpretation of the data level is not available at this time. All three events occurred at 1311:37 EDT. Pedestal B did not record data. The stroke current and induced current measurements on the lightning mast indicated an event occurring at 1311:37 EDT but the amplitudes were low and interpretation of these amplitudes has not been resolved at this time. The current waveform measurement also indicated activity at the event time but meaningful data from this measurement was not obtained.

6.14.3.1.3 Other Measurements

The stroke counter did not record any event and the magnetic links on the mast were not magnetized. Induced voltages were reported at the base of the MSS. The reported data values were: Channel 1, +8/-5; Channel 2, +0/-25; Channel 3, +12.5/-12.5.

6.14.4 ML-1 - May 24

Lightning struck ML-1 at 1724:28 EDT on May 24.

6.14.4.1 Lightning Detection Systems Measurements

6.14.4.1.1 Magnetic Links

The magnetic links mounted on the lightning mast of ML-1 recorded a maximum peak current of 3.3 K amps with positive polarity. The magnetic links mounted on the lightning mast of the MSS indicated a maximum peak current of 4.1K amps with negative polarity. Magnetic links mounted on the slidewire and crane boom did not record data.

6.14.4.1.2 Corona Current

The corona current measurement mounted on top of ML-1 recorded an event occurring at 1724:28 EDT with an amplitude exceeding the calibrated range of the instrument.

6.14.4.1.3 Stroke Counters

The lightning stroke counters mounted on the ML-1 lightning mast indicated a count of one event.

6.14.4.1.4 Current Waveform

The current waveform measurement mounted on the ML-1 lightning mast recorded an event occurring at 1724:28 EDT. Amplitude and duration information are not available.

6.15 Service Arms (S/A)

6.15.1 Overall Performance

The Service Arms (S/A's 1A, 6, 7, and 8) supported countdown in a satisfactory manner except for two minor items (see Section 6.15.3), neither of which caused a countdown hold. Performance was nominal during terminal count and liftoff.

6.15.2 Damage

Preliminary inspection revealed no launch damage to S/A 1A, 6, and 8; on S/A 7 a rubber piece came off a carrier bracket.

6.15.3 Problems

6.15.3.1 Change in GN_2 System Charging Frequency

On May 13 the S/A 7 Hydraulic Withdrawal GN_2 System charging frequency dropped to a 50 minute interval (minimum allowable frequency is 90 minutes). A pneumatic leak was found at the pilot inlet to Hydraulic Withdrawal Firing Valve (A5663-7). The O-ring was replaced and the system functioned satisfactorily.

6.15.3.2 GN_2 Vent Line Flex Hose Leakage

On May 23 the S/A GN_2 vent line flex hose (75M09304-31) CO_2 jacket was found to be leaking. The hose was replaced, recharged, and thereafter performed satisfactorily.

6.16 Primary and Auxiliary Damping Systems

6.16.1 Overall Performance

It was decided that the Primary Damper would not be connected during launch countdown unless high winds endangered the launch vehicle because of a Primary Damping System hose rupture during CDDT (see Section 6.16.3). Primary Damper operation was not required.

The Auxiliary Damper performed normally.

6.16.2 Damage

Launch damage to the Primary and Auxiliary Damping Systems was negligible.

6.16.3 Problems

6.16.3.1 Hydraulic Hose Rupture

During primary damper disconnect from the spacecraft in support of MSS emplacement on May 4, a hydraulic hose ruptured (RH Retract Damping Cylinder hose,

PN 11M00718-13). The failed hose was removed and replaced, the primary damper hydraulic hoses were proof tested in-place to 1000 PSIG, and the system was functionally tested (Ref. TPR B6-377, UCR KSC 431265). When additional time became available due to the slide in launch date a new set of hydraulic hoses was cleaned, hydrostated, installed in the system. and the system retested.

6.17 LUT (General)

6.17.1 Overall Performance

The LUT (General) System performed as designed throughout the SL-2 Launch Countdown.

6.17.2 Damage

There was no significant damage to the LUT (General) System.

6.17.3 Material Consumption

There was no significant material consumption by the LUT (General) System.

6.17.4 Nonconformance, Waivers, Deviations, and Problems

There were no deviations or waivers initiated during launch countdown.

6.18 Launch Umbilical Tower (LUT) Power Distribution (Industrial and Instrumentation)

6.18.1 Overall Performance

The LUT Power Distribution System performed as designed throughout the SL-2 Launch Countdown.

6.18.2 Damage

There was no significant damage to this system.

6.18.3 Material Consumption

There was no material consumption by the LUT Power Distribution System.

6.18.4 Nonconformances, Waivers, Deviations, and Problems

There were no significant technical problems experienced.

6.19 Low Pressure Gaseous Nitrogen ($LPGN_2$)

6.19.1 Overall Performance

The overall performance of the $LPGN_2$ Distribution System was satisfactory.

6.19.2 Damage

There was no damage to the $LPGN_2$ system.

6.19.3 Material Consumption

The Big Three Industrial Gas Company supplied approximately 24,000,000 SCF for LCD support. Nitrogen consumption is total for both $HPGN_2$ and $LPGN_2$ combined.

6.19.4 Nonconformances, Waivers, Deviations, and Problems

No significant problems were encountered as a result of system operation during support of SL-2 launch countdown.

6.20 Mobile Service Structure (MSS) General and Elevators

6.20.1 Overall Performance

The MSS systems and elevators functioned satisfactorily to support the countdown for launch of SL-2.

6.20.2 Damage

There was no damage sustained on any of the holddown columns nor was there any damage to utility stub-ups.

6.20.3 Material Consumption

There was no significant material consumption.

6.20.4 Nonconformance, Waivers, Deviations, and Problems

6.20.4.1 MSS Elevator No. 1

MSS Elevator No. 1 was used for limited service during the mission due to excessive number of wire breaks in hoist ropes. Deviation/waiver request #SO-423 was approved to allow the elevator to be used only when necessary to support mission requirements. The hoist ropes will be replaced after this launch.

6.21 Crawler/Transporters

6.21.1 Overall Performance

The Crawler/Transporter systems functioned satisfactorily to support the countdown for launch of SL-2.

6.21.2 Damage

There was no damage to the Crawler/Transporters nor to the Pad surface connection.

6.21.3 Material Consumption

There was no significant material consumption.

6.21.4 Nonconformances, Waivers, Deviations, and Problems

There were no nonconformances, waivers, deviations, significant technical problems nor out-of-tolerance conditions on the Crawler/Transporters.

6.22 Water Systems

6.22.1 Industrial and Firex Water Pump Station

6.22.1.1 Overall Performance

The pump station firex system was ready to support at

all times. The Industrial Water Pump Station System performed properly when called upon for support.

6.22.1.2 Damage

This system was not damaged.

6.22.1.3 Material Consumption

Approximately 2,200 gallons of diesel fuel was consumed and 325,000 gallons of water supplied to Pad Industrial Water System.

6.22.1.4 Nonconformances, Waivers, Deviations, and Problems

There were no problems with the Industrial and Firex Water Pump Station.

6.22.2 Pad Firex Water System

6.22.2.1 Overall Performance

The Pad Firex Water System consisting of all pad fire hydrants, fire nozzles, fire hoses and associated pumps and pressurized tank supported the launch adequately.

6.22.2.2 Damage

There was no damage to the Pad Firex Water System.

6.22.2.3 Material Consumption

None.

6.22.2.4 Nonconformances, Waivers Deviations and Problems

There were no problems with the Pad Firex Water System.

6.22.3 Industrial Water System (IWS)

6.22.3.1 Overall Performance

The Industrial Water System performed normally. Valve V-3 was commanded open at T-60 seconds by the TCS and flowed 9,400 GPM on the flame deflector. The 30 second timer commanded V-5 open at T-30 seconds and the combined V-3 and V-5 flow was 36,200 GPM. At T+0, the TCS commanded the Swing Arm Quench Valves and the Pedestal Deck Quench Valve open. Total mainline flow stabilized at 40,600 GPM. The system was secured at T+4 minutes after inspection of the Mobile Launcher by OTV.

6.22.3.2 Damage

The Industrial Water System was not damaged during launch.

6.22.3.3 Material Consumption

Approximately 293,000 gallons of water flowed.

6.22.3.4 Problems

No problems were experienced by the IWS.

6.22.4 Pad Water - Potable

6.22.4.1 Overall Performance

The potable water ground support system, supported the Skylab 2 mission from start of launch countdown through liftoff without delay or impact on the mission. All support requirements were met.

6.22.4.2 Damage

There was no damage to this system.

6.22.4.3 Material Consumption

The potable pad water used was negligible.

6.22.4.4 Nonconformance, Waivers, Deviations, and Problems

There were no nonconformances, waivers or deviations associated with the potable water ground support system. There was, however, the following incident:

At 0045 on May 24, water was detected running into the parking lot of M7-505 directly behind and south of the Cape critical cable vault (south of the O&C Building, M7-355).

Excavation revealed a hole in a transite coupling on a 6" waterline serving fire hydrant MD34 located on the south side of the O&C Building. A pipe clamp provided a temporary fix. Permanent repairs including repairs to a leaking acid line adjacent to the waterline (discovered during excavation) are under way.

6.23 Emergency Ingress/Egress System

6.23.1 Access Arm

The Access Arm (Service Arm 9) was retracted to the park position at T-45 minutes and was fully retracted at T-5 minutes. System operation was satisfactory. No problems occurred during countdown and launch damage was negligible.

6.23.2 Slidewire

6.23.2.1 Overall Performance

The system was available for use by the astronauts or closeout crew if needed for emergency egress. The system was not used.

6.23.2.2 Damage

There was no damage to the slidewire.

6.23.2.3 Material Consumption

None.

6.23.2.4 Nonconformances, Waivers, Deviations, and Problems

The slidewire was lowered on May 11 to check for possible damage from a lightning strike. No evidence of damage was found. The slidewire and cab were reinstalled and load tested.

6.23.3 Egress Elevator (Pad)

6.23.3.1 Overall Performance

The pad west side elevator was not required for emergency egress. The elevator supported the mission for normal ingress and egress from the ML.

6.23.3.2 Damage

There was no damage to the Pad Egress Elevator.

6.23.3.3 Material Consumption

None.

6.23.3.4 Nonconformances, Waivers, Deviations, and Problems

6.23.3.4.1 Down Leveling Switch

The down leveling switch at the Pad level of Elevator No. 2 failed at 0155 on May 24. The switch was replaced with a spare like item and the elevator restored to service at 0512 EDT.

6.23.4 Life Support Systems

6.23.4.1 Overall Performance

All Life Support equipment and systems performed as designed and on schedule.

6.23.4.2 Damage

No damage occurred to Life Support equipment or systems.

6.23.4.3 Material Consumption

Not applicable.

6.23.4.4 Nonconformances, Waiver , Deviations, and Problems

There were no problems with the Life Support Systems.

6.24 Power Distribution System

6.24.1 Overall Performance

The industrial and instrumentation power distribution system satisfied all operational requirements in support of the Skylab 2 launch. The Cape critical feeder providing power to the ACE facility experienced two transients after liftoff of Skylab 1 and the facility was transferred to an alternate feed while repairs to the cable feed were accomplished. This failure did not delay SL-2 launch activities. All emergency generators provided backup power required during launch countdown.

6.24.2 Damage

There were no visible damage to the electrical system at Pad B.

6.24.3 Material Consumption

Power consumption during launch activities will be reported in the monthly EUS Power Management Report.

6.24.4 Nonconformance, Waivers, Deviations, and Problems

There were no nonconformances, waivers or deviations associated with operation of the electrical power system. There were no significant technical problems; however, one problem did occur early in the initial (May 15) launch countdown and shortly after liftoff of Skylab 1.

6.24.4.1 Power Transient

Shortly after the liftoff of Skylab 1 on May 14, a power

transient was experienced at 1452 EDT on the critical power feed from CKAFS power plant to the ACE computer facility. The cause for the transient could not be determined. Subsequently, a second transient occurred on May 15, at 0258 EDT. While the cause for the transient was being determined, the ACE facility was fed from an alternate feed on FP&L power. It was established that a ground fault on "A" phase was the cause of the power transient; however, in order to ensure the reliability of the feeder, tests performed on the other two phases revealed a second potential problem on "B" phase. A faulty splice detected in each of the two phases was remade to effect the necessary repairs. Subsequent tests revealed still another faulty splice on "A" phase which also had to be repaired. The feeder was restored to normal service on May 17 at 0247 EDT.

In the interim while awaiting restoration of the normal ACE feeder, arrangements were made to provide the capability of supplying power to this facility from the generator installation at the CIF site. A fourth generator was sited here to increase the generating capacity and provide the necessary redundancy.

6.25 Facility and Environmental Measuring and Hazards Monitoring

There were no significant anomalies.

The Digital Acquisition, Vibration Data Acquisition, Acoustic Data Acquisition, and Signal Conditioning systems associated with the F&E Measuring and Hazards Monitoring systems, all functioned in accordance with design criteria.

The Meteorological System also operated in accordance with design criteria and remained operational except for the loss of wind anemometers and cabling on the ML-1 445 foot level which were destroyed at launch.

6.26 Photo System

6.26.1 Overall Performance

A total of 156 cameras were committed to the test.

69 Engineering
51 Documentary
3 Pre-Launch Engineering
5 Post-Launch Engineering
27 Pre-Launch Documentary
1 Post-Launch Documentary

Two cameras (E1-203 and E1-207) incurred a loss of engineering data due to cloud coverage.

6.26.2 Damage

No damage was incurred to photographic cameras.

6.26.3 Material Consumption

6.26.3.1 Motion Picture Film: 53,400 feet

6.26.3.2 Still film was expended as follows:

4 x 5 negatives	32
Rolls of 120 (12 exp. each)	10
Rolls of 120 (50 exp. each)	1
Rolls of 35mm (36 exp. each)	8
Rolls of 35 mm (250 exp. each)	10
Polaroid (4x5 sheet)	12

6.26.4 Nonconformances, Waivers, Deviations, and Problems

There were no problems with the Photo Systems.

6.27 Operational Television System (OTV) and OTV Lighting

6.27.1 Overall Performance

The OTV system successfully supported countdown and launch without any significant problems.

6.27.2 Damage

Minimum launch damage was experienced.

6.28 Operational Intercommunucation (OIS) and Special Communications Systems

6.28.1 Overall Performance

These systems performed satisfactorily throughout the mission.

6.28.2 Damage

Damage was minor.

6.29 Air-Conditioning Systems (LCC and PTCR)

6.29.1 Overall Performance

The heating, ventilating and air-conditioning ground support systems supported the Skylab 2 mission from start of launch countdown through liftoff without delay or impact on the mission. All support requirements were met.

6.29.2 Damage

There was no damage to the LCC and PTCR Air-Conditioning Systems.

6.29.3 Material Consumption

Not applicable.

6.29.4 Nonconformances, Waivers, Deviations, and Problems

There were no problems with the air conditioning systems.

6.30 LCC Measuring System and Mobile Launcher Measuring Equipment (MLME)

6.30.1 Overall Performance

The LCC Measuring System (LCCMS) and MLME supported test activities continuously from the start of countdown through launch. Overall system performance was satisfactory.

6.30.2 Damage

There was no damage to the LCCMS or MLME.

6.31 CIF Telemetry and Data Interface

6.31.1 Performance

These systems consist of the CIF Telemetry Station, CIF Antenna Site, EMC Monitoring, LIEF, and Met Radar. All elements of these systems supported the launch satisfactorily and sustained no launch damage.

6.31.1.1 CIF Telemetry Ground Station

Telemetry data were received from the following local acquisition sources:

	Countdown	Launch	CSM/OWS Orbits
DDAS	X		
CIF Antenna Site	X	X	X
MILA - USB	X	X	X
O&C	X		

Real-time CIF telemetry operations included preparation of magnetic tapes, strip charts and oscillograph records; data digitizing for CIF computer processing and transmission of data to other NASA Centers; data retransmission to MSOB, LCC-39, and MILA-USB Site. Post-launch operations included data processing for magnetic tapes, strip charts, and event records required by PSRD and RD. Liftoff occurred at approximately 0900 EDT on May 25. Signals from the S-IB were lost at T+6 minutes 22 seconds. Signals for the S-IVB, IU, and CSM were lost at 9 minutes 9 seconds. When

available, STDN data were processed until T+10 hours. Signals from the AM, ATM, and CSM were relayed during local orbital passes (revolution 158, 161, 162, 163).

6.31.1.2 CIF Antenna Site

Open loop telemetry signals were acquired and supplied to the CIF Telemetry Station. VHF and S-band data were received, demodulated, and relayed to the CIF Telemetry Ground Station during the countdown.

6.31.1.3 EMC Monitoring

The EMC Van monitored launch vehicle RF spectrum during countdown and launch. The 450 MH_Z command channel was monitored from the VAB roof.

6.31.1.4 LIEF

The LIEF system was on-line transmitting launch vehicle telemetry data to the HOSC continuously from T-20 1/2 hours to T-18, and T-9 hours to T+30 minutes. No discrepancies were reported by HOSC.

6.31.1.5 Met Radar

The Met Radar system successfully recorded data from a total of seven meteorological balloon releases during the launch countdown.

6.32 Telemetry Checkout Equipment (TCE)

6.32.1 Overall Performance

The Telemetry Checkout Equipment satisfactorily supported countdown operations; no significant TCE failures occurred. The TCE provided support to all launch vehicle telemetry and range safety personnel in the form of magnetic tape recording, oscillograph and strip chart recordings, and visual displays. The TCE met all planned requirements and provided additional support of magnetic tape recording for CCS system tests, and twenty tape playbacks and real

time stripouts to aid in troubleshooting of system anomalies. There was no damage to the Telemetry Checkout Equipment as this system is located in the LCC.

6.32.2 Material Consumption

The following material was used for launch countdown:

14 reels of 9200', 1-inch magnetic tape
1 roll of oscillograph paper
2 rolls of pen recorder paper

6.32.3 Problems

There were no significant failures or anomalies during countdown and launch. However, there were some minor recorder discrepancies which were corrected without significant loss of data or delay to the count.

6.33 RF Checkout Equipment (DRSCS)

The LCCMS and MLME operated within design limits and recorder failure rate was compatible with previous experience.

6.34 Wideband Transmission System

6.34.1 Overall Performance

The Wideband Transmission System supported countdown and launch with no problems.

6.34.2 Damage

There was no launch damage to this system.

6.35 Abort Advisory System

6.35.1 Overall Performance

The system supported throughout countdown and launch with no problems.

6.35.2 Damage

There was no launch damage.

6.36 Timing and Countdown Systems

6.36.1 Overall Performance

The system performed normally throughout the mission. One anomaly was investigated when problems were reported at 1800 EDT on May 24 on Timing to the RCA-110 on ML-1 and to the two DEE's in the PTCR. At 1900 a pulse conditioner module was replaced restoring timing to both areas. At 2100 the DEE-3F reported timing difficulties again and at 0200, May 25 timing maintenance personnel were sent to the PTCR at Pad B to investigate. No fault was found in the IN-OIS signal distribution at that time or in post launch testing. The timing to the DEE-3F was disabled at 0400 to allow internal operation for the remainder of the mission.

Further post-launch investigation with the DEE-3F personnel revealed that their equipment will not accept a timing signal with a duty cycle other than 50%. The pulse conditioner which was installed May 24 was not set to exactly a 50% duty cycle because no specific tolerance had been requested for this parameter. The validation procedure is being updated to incorporate a test for duty cycle to prevent recurrence of this type anomaly.

The 1 KPPS timing signal conditioning to the DEE-3F has now been adjusted to provide the correct signal characteristics.

6.36.2 Damage

There was no launch damage.

6.37 Digital Events Evaluator (DEE-3F)

6.37.1 Overall Performance

The DEE-3 System satisfactorily supported all countdown operations. There was no damage and only the following

minor anomalies. An Industrial Water System discrete became intermittent in the Backup Computer (DEE-3D), a timing anomaly caused the Primary Computer (DEE-3F) to gain time and a vacuum motor in the DEE-F Magnetic Tape section had to be replaced before launch. See Section 6.37.2.

6.37.2 Problems

6.37.2.1 Intermittent Dropouts from DEE-3D Computer

On May 24 during Industrial Water System preps for launch the DEE-3 operator noted intermittent dropouts of the V-65 CLOSED function (discrete #203) from the DEE-3D computer. Subsequent investigation isolated the problem to the DEE-3D. Since pad securing was in progress and the information was available in the primary system (DEE-3F) it was determined not to take corrective action. (Ref TPR B6-400).

6.37.2.2 Computer Time Printout Overgain

During Propellant Systems preps for loading on May 24 it was noted that computer time printout was gaining 4.3 seconds each minute with respect to range time. It was also discovered that the 110A and DEE-6 computers were similarly affected. Adjustment of range timing signals corrected the 110A and DEE-6 discrepancies but the DEE-3 continued to print erroneous time. The range timing signal input cable was then disconnected and system timing was allowed to revert to the DEE-3 internal clock. Support was satisfactory throughout the remainder of the countdown. (Ref. TPR B6-401R).

6.38 Data Display

6.38.1 Overall Performance

Continuous support was provided for the Television Data Display System (TDDS) from T-56 hours to T+10 hours in Firing Rooms 2 and 3. The STDN data were not available from JSC between T+3 hours 30 minutes and T+6 hours.

The overhead displays (Eidophors and Events) supported in Firing Room 2 from T-53 1/2 hours to T-50 hours and from T-10 hours to T+1 hours, and T+7 to T+8.

6.38.2 Damage

There was no launch damage to this system.

6.39 CIF Central Computer Complex

6.39.1 Overall Performance

The CIF Central Computer Complex (GE-635) provided launch support from T-48 hours through liftoff +1 hours with both computer systems, one primary and one backup. The IU and SL-1 OWS were supported with one system until T+10 hours while the second system began post-test data reduction.

Real-time computer functions for SL-1 included IU Guidance reduction, bending moments determination, automated telemetry checks, Hydrogen System Monitoring, Fire Detection Computation, propulsion (S-IVB Cryogenics) data, and display computations including those for the Television Data Display System (TDDS) and history retrieval. Engineering parameters data from the Vehicle Launch Phase were available for history retrieval purposes until T+10 hours.

In addition, the computers reduced radar data for critical wind monitoring purposes. Vehicle altitude and velocity data were computed and made available to the Display System (LCC Firing Room) based on real-time trajectory data received from the AFETR Real-Time Computer Facility (RTCF). During the earth orbital phase, SL-1 OWS engineering parameters were available in the STDN formats. To facilitate identification of the data source, a STDN status page was displayed.

6.39.2 Damage

There was no launch damage to this system.

6.40 JSC Furnished Ground Support Equipment (GSE)

6.40.1 CSM/SLA GSE

All GSE in support of the CSM/SLA performed satisfactorily from the start of KSC processing through launch.

6.40.2 Experiment GSE

There was no significant GSE used for the JSC experiments.

6.41 MSFC Furnished Ground Support Equipment (GSE)

6.41.1 S-IB Stage Oriented

6.41.1.1 Electrical GSE

6.41.1.1.1 Overall Performance

The overall performance of the S-IB stage electrical GSE was satisfactory.

6.41.1.1.2 Non-Conformances, Waivers, Deviations, and Problems

6.41.1.1.2.1 Cycling of Prevalve Open Indicators

The cause of the cycling of all Prevalve Open indications which occurred on April 25 is not yet determined. It is a summation circuit problem only, and was jumped out of the prep complete chain for launch.

6.41.1.1.2.2 Cycling of 1D161 Bus (See Section 4.5)

At 13:00:00.096 GMT the 1D161 Bus went off as expected approximately 76 ms after Commit. 8ms later the 1D161 Bus cycled on/off for 6ms. This cycle caused the S-IB Thrust Failure Cutoff and Cutoff Start signals to cycle. The following sequence of events occurred to cause this anomally although events a thru d are normal.

a. All Engines Running on at T-1.54"
b. Time for Thrust checks at T-0.19
c. Commit at T+0.020 (13:00:00.020" GMT)

d. 1D161 and S-IB All Engines Running signal off at 1300:00.096 GMT (All Engines Running is locked in from 1D161 through contacts of time for commit relay. The original energizing bus for All Engines Running is 6D119 in the IU ESE, which also de-energizes at commit).

e. 1D161 cycled On/Off for 6ms at 1300:00.102 GMT. This re-armed the Time for Thrust checks relay contacts and initiated thrust failure. "Cutoff" and "Cutoff Start" signal was given due to "All Engines Running" being "off". The signal was too short in duration to energize the cutoff start relay K72.

6.41.2 S-IVB Stage Oriented

6.41.2.1 Overall Performance

Overall performance of the S-IVB Stage Oriented, MSFC furnished GSE was satisfactory in support of all pre-launch and countdown operations. All operations and performance were normal except as noted below.

6.41.2.2 Damage

Post-launch inspection revealed that equipment damage was minor and less than on any previous launch.

6.41.2.3 Material Consumption

Consumables expended in servicing the stage through its GSE were 1300 lbm helium and 75 lbm gaseous hydrogen.

6.41.2.4 Nonconformances, Waivers, Deviations, and Problems

On May 14 at approximately 0440 EDT, the Mainstage OK Pressure Switch Supply Pressure Switch Talkback (Find Number A12056, located on the Model DSV-4B-432A Pneumatic Console) cycled with no system pressure applied (Reference TPR M206-110R, DR 1-1901). Because the system was not required for subsequent operations, the

condition was dispositioned acceptable for launch. The condition will be corrected prior to the next test operation.

6.41.3 IU Stage Oriented GSE

6.41.3.1 Mechanical GSE

6.41.3.1.1 Overall Performance

Overall mechanical system performance for launch countdown was satisfactory and no anomalies occurred.

6.41.3.1.2 Damage

At the IU Pneumatic Console, S/N 3, 280' level, the launch caused two broken Adel clamps which normally secure the manifold pressure line within the console cabinet. At the GSCU (Primary) S/N 15, 260' level, the filter separator differential pressure gauge sustained a broken glass face cover.

6.41.3.2 Electrical GSE

6.41.3.2.1 Overall Performance

The MSFC Electrical GSE performance for Launch Countdown was satisfactory and no anomalies occurred that affected testing.

6.41.3.2.2 Significant Malfunctions and Anomalies

The following problems were not an impact to testing or dangerous to personnel or equipment and will not be an impact to future launches.

6.41.3.2.2.1 S-IB Engine No. 4 Thrust OK No. 3

On May 13, during performance of EDS Test, the "S-IB Engine No. 4 Thrust OK No. 3" light indication failed to illuminate on EDS Flight Monitor Panel 603-610A3. A PC card in the DDAS Data Register

was found defective, replaced, and the signal (VK-174-4) was verified. Problem is closed. (See Section 6.41.6.2.1).

6.41.3.2.2.2 Switch Selector Malfunction Indication

On May 23 the switch selector malfunction indication came on at 1419:50.718 GMT. The last switch selector was issued approx. 2 seconds earlier. The problem was traced to the integration electrical support equipment backup battery checks that were in progress at that time. When the 20D100 power supply was switched to backup batteries, the 20D161 bus fluctuated causing the IU Switch Selector Malfunction indication and No Switch Selector Output indication to come on. The problem is closed.

6.41.3.3 Damage

There was no significant damage.

6.41.4 Experiment Oriented GSE

There was no MSFC experiment GSE for support of the SL-2 launch.

6.41.5 Digital Events Evaluator (DEE-6)

6.41.5.1 Overall Performance

Total system performance for all computers within the system was considered satisfactory. Several anomalies occurred during Launch Countdown but none occurred during critical periods of the count and none resulted in loss of support of normal data acquisition.

6.41.5.2 Significant Malfunctions and Anomalies

The following problems were not an impact to testing or dangerous to personnel or equipment and will not be an impact to future launches.

6.41.5.2.1 IU Franklin Printer

On May 11 the IU Franklin Printer stopped output of all data. The problem was isolated to a shorted solenoid in the ribbon reverse circuit. The Franklin Printer was replaced with a spare. The defective printer was repaired and the problem is closed.

6.41.5.2.2 S-IVB Discrete Input

On May 14 the S-IVB discrete 2688 cycled ON then OFF in four milliseconds scan interval. Troubleshooting of DEE-6 input gates did not disclose any defects.

6.41.5.2.3 601/930 System

On May 17 the 601 System did not accept or process a request for manual intervention by the operator and the computer to computer interrupts were locked out causing data transfer errors. Investigation found a priority interrupt flip-flop that did not reset properly. The P.C. card flip-flop was replaced and retest was successful.

6.41.5.3 Damage

The DEE-6 System incurred no damage during the launch of SL-2.

6.41.6 Digital Data Acquisition System (DDAS)

6.41.6.1 Overall Performance

The DDAS System performed satisfactorily through Countdown and Launch of SL-2.

6.41.6.2 Significant Malfunctions and Anomalies

The following problem was not an impact to testing or dangerous to personnel or equipment and will not impact future launches.

6.41.6.2.1 S-IB Engine No. 4 Thrust OK No. 3 Indicator

On May 13, S-IB Engine No. 4 Thrust OK No. 3 indication did not come on. Investigation found a defective capacity driver PC board. The PC board was replaced and retest was successful. (See Section 6.41.3.2.2.1).

6.41.6.3 Damage

The DDAS System sustained no damage during the launch of SL-2.

6.41.7 Countdown Clock

6.41.7.1 Overall Performance

The Countdown Clock performed satisfactorily during the Countdown and Launch of SL-2 with no anomalies.

6.41.7 2 Damage

The Countdown Clock System inccurred no damage from launch of SL-2.

6.41.8 Integration Electrical Support Equipment

6.41.8.1 Overall Performance

Overall system performance was satisfactory. The 23T500 60 cycle flywheel generator failed at 1258.7 GMT which is T-6 seconds, causing the ML RCA 110A Ground Computer to go out of support.

6.41.8.2 Significant Malfunctions and Anomalies

All integration electrical support equipment operated properly throughout the Countdown and Launch of SL-2 with no anomalies.

6.41.8.3 Damage

There was no significant damage to this equipment.

6.41.9 Saturn V Ground Computer Systems

6.41.9.1 Ground Computer (110A)

6.41.9.1.1 Overall Performance

Overall system performance was satisfactory. Several anomalies occurred but none during critical test periods and no vehicle support was lost during countdown.

6.41.9.1.2 Significant Malfunctions and Anomalies

The following problems were not an impact to testing or dangerous to personnel or equipment. Other problems that occurred resulted in replacements of module boards, switches, relays, or other components which corrected the problem and were retested successfully.

6.41.9.1.2.1 Spurious Line 7 Interrupt Message Displayed on Console 7

On May 13 at T-2 days, 3 hours, 0 minutes (1200 GMT) the post processing of Log Tape indicated the only activity in the immediate time frame was MDO 1950 turning OFF. MDO 1950 de-energizes relay K8 in the IU Stage Aux wer Distributor 601A33. The spurious interrupt had no impact on launch vehicle support. Reference, Phantom Rationale Package, PR I-206-0168P.

6.41.9.1.2.2 DDP-224 Halted During Support

On May 14 at T-17 hours, 39 minutes (2206 GMT) analysis of dump taken after the problem (no auto programs running) occurred indicated Bit 16 was dropping in either Z register or the XB, TTM &ADU routing busses, involving a possible total of 6 module boards. During troubleshooting, a CPU power supply and a cooling fan failed which were replaced with spares. To eliminate the possibility of future halts during vehicle support periods, the six suspect module boards were removed from the system and replaced with 6 proven good modules re-allocated from the firing room 2 system. Retest was successful.

6.41.9.1.2.3 DDP-224 CPU Parity Error

On May 19 at 2230 GMT a DDP-224 CPU parity error was received while running the Diagnostic Program (ADDS). Problem isolated to a failure of the "Repeat" instruction. "Repeat" is not used in the OPS System, therefore is not a constraint to testing. This is a known problem. Dispositioned to use-as-is for SL-2. Ref., PR's I-507-2174, I-509-0011, I-509-2954 and I-513-0010.

6.41.9.1.3 Damage

No damage was incurred by Ground Computer Systems during the launch of SL-2.

6.41.9.2 Ground Computer Programs

6.41.9.2.1 Overall Performance

The Ground Computer software performed satisfactorily during the Launch Countdown of SL-2.

6.41.9.2.2 Significant Malfunctions and Anomalies

There were no problems with the ground computer program.

6.41.10 Azimuth Laying and Alignment Equipment

6.41.10.1 Overall Performance

The Azimuth laying and alignment equipment supported the Launch Countdown of SL-2 satisfactorily.

6.41.10.2 Significant Malfunctions and Anomalies

There were no problems with this equipment.

6.41.10.3 Damage

There was no damage visible in either Mobile Launcher Room 7A or the Theodolite Building.

6.41.11 Ground Power Equipment

6.41.11.1 Overall Performance

All Ground Power and Battery equipment supported satisfactorily from the start of precount through launch. All systems performed within acceptable limits. One anomaly occurred as noted below.

6.41.11.2 Damage

No significant damage occured to Ground Power equipment during SL-2 launch.

6.41.11.3 Problems

No significant problems were experienced with Ground Power equipment during SL-2 countdown. However, the ML-1, 60 HZ, 60 KW motor generator dropped off line at approximately T-0. This has occurred on ML motor generators during other launches and is most likely due to launch vibration of control relays or switches. This anomaly has been previously coordinated with LV-GDC-28 and GE (design agency); no action will be taken.

6.41.12 Hazardous Gas Detection System

6.41.12.1 Overall Performance

The Hazardous Gas Detection System successfully supported SL-2 countdown on May 25. Support started at 2041 EDT, May 24 and concluded at 0900 EDT, May 25 with SL-2 launch. System operation was normal throughout the support period.

6.41.12.2 Damage

There was no damage to the Hazardous Gas Detection system.

6.41.12.3 Problems

One problem occurred during system preparations on May 14 prior to the countdown scrub.

6.41.12.3.1 Drifting of the Mass Signal Peaks

The mass signal peaks were observed to be drifting excessively from the center position of the mass pedestal to the trailing edge of the pedestal. Investigation isolated the problem to the Ion Accelerator Control (IAC) panel. The IAC panel was replaced with a spare and retested successfully. Subsequent failure analysis has indicated that the problem was due to misalignment of a motor and potentiometer shaft coupling on the IAC panel causing drift due to loss of synchronism. No design action is required and UCR KSC 435549 was closed. (Ref. TPR B6-389C).

During the final system preparations which started on May 23 no problems were encountered.

7.0 Summary

The Skylab 2 space vehicle (S/V) was a Saturn-IB launch vehicle - consisting of an S-IB (first stage), S-IVB (second stage) propulsion stages, and Instrument Unit (IU) stage, a Command Service Module (CSM), and a Spacecraft LM Adapter (SLA). The crew of SL-2 was Charles Conrad, Jr., Commander; Joseph P. Kerwin, Science Pilot; and Paul J. Weitz, Pilot.

The S-IVB stage arrived at KSC on June 24, 1971 and went into storage until April 17, 1972. The CSM arrived at KSC on July 19, 1972 and was moved into the O&C Building for systems testing. The S-IB stage arrived at KSC on August 22, 1972 and was erected on ML-1 on August 31. Also on August 22, 1972, the IU stage arrived at KSC. The S-IVB was mated to the S-IB on September 5 and the IU stage was mated to the S-IVB on September 8.

SL-2 was the first Saturn IB space vehicle to utilize the launch concept from LC-39. In order to verify the modified KSC facilities and systems, the SL-2 S/V (with boilerplate spacecraft) was temporarily moved to LC-39B on January 9, 1973. The mobile service structure (MSS) was set into position on January 12, and fit, function, and facility systems tests that would be required in support of the SL-2 launch were performed. The Propellant Loading All Systems Test (PLAST) started on January 29 and was completed the following day. The SL-2 S/V was returned to the VAB on February 2.

The Spacecraft LM Adapter (SLA) was mated to the CSM on February 9. On February 20, the S/C (CSM/SLA) was moved to the VAB and was mated to the L/V the following day. The SL-2 S/V transfer to LC-39B for launch was completed on February 27.

The S/V Flight Readiness Test (FRT) was completed on April 5. Countdown Demonstration Test (CDDT) for SL-2 was started on April 25. Cryogenic loading and fuel cell #3 activation and deactivation was completed on April 29. T-0 for the Wet CDDT occurred at 1300 EDT on May 3 and Dry CDDT was completed on May 4. SL-2 Launch Countdown

was begun at 0800 EDT on May 9. Lightning struck the SL-2 Slidewire and the MSS at 1311 EDT on May 9 but no anomalies were noted to the S/V.

SL-2 launch was scrubbed on May 14 due to undeployed OWS solar wings and the meteoroid shield anomaly that occurred on the now earth-orbiting Saturn Workshop. The SL-2 Countdown clock was stopped at T-14 hours 35 minutes (2110 EDT May 14) and scrub turnaround procedures started. The SL-2 countdown clock was held at T-59 hours and countdown resumed at 2030 EDT on Tuesday, May 22, for an expected T-0 at 0900 EDT on Friday, May 25. Lightning struck the ML-1 lightning mast at 1724 EDT on May 24 but retest proved no anomalies occurred to the S/V.

Reservice of the CSM cryogenics was completed on May 23 and GSE and mechanical closeout operations completed on May 24. Skylab 2 was flawlessly launched, as rescheduled, at 0900 EDT on May 25. Launch affects on KSC facilities and systems were nominal and KSC will be prepared to launch Skylab 3 after normal refurbishment.