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VIKING 75 ORBITER
SYSTEM TEST AND LAUNCH OPERATIONS
FINAL REPORT
VOLUME 2: LAUNCH OPERATIONS

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The Viking Orbiter test and launch program was successful because of the contributions of too many people to list. The following key people stand out: A. E. Wolfe, Orbiter Spacecraft Manager; W. J. Castellana and W. K. Moore, test chiefs; T. J. Laney, mechanical engineer; H. Fitzhugh, test engineer; J. C. Beckert, support; C. Ashley, documentation. Most of the Volumes 1 and 2 were assembled and written by N. Eddy from sparse and scattered source material.

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SECTION I
INTRODUCTION

A. SCOPE

This document, the Viking 75 Orbiter System-Test and Launch Operations Final Report, describes the activities and results of the test and operations program performed on the three orbiter spacecraft (VO-1, VO-2, and VO-3). The document is in two volumes:

Volume 1: System Test covers the period from receipt of orbiter hardware at the Spacecraft Assembly Facility (SAF) at JPL through shipment of the orbiter systems and support equipment to the Air Force Eastern Test Range (AFETR).

Volume 2: Launch Operations covers the period from shipment of the orbiter systems and support equipment to the AFETR through launch of the flight spacecraft (VO-1 and VO-2).

The Viking launch operations described in this, Volume 2, were the responsibility of the Langley Research Center (LRC) and their integrating contractor, the Martin-Marietta Corporation (MMC). The activities were managed by JPL within the overall operations structure.

B. BACKGROUND

As discussed in Volume 1 of this document, the Orbiter Project scope was reduced in September 1974 to two functional systems: a Proof-Test Orbiter (PTO)/flight VO-1 and a flight VO-2. The third system, VO-3, was not completed or tested and its subsystems were used as spares for VO-1 and VO-2. The pathfinder test sequence was reduced significantly and incorporated only the major features of the previous plan. This shorter sequence was referred to as the precursor test phase and was initiated with the VO-1 upon arrival at the Air Force Eastern Test Range (AFETR).

At the end of the Pasadena test program (see Volume 1 of this document) the untested VO-3 bus was shipped to the AFETR to verify the shipping and handling equipment and procedures. Both VO-1 and VO-2 were shipped soon thereafter.

Despite many facility problems at the AFETR, the orbiter operation proceeded on schedule through the first attempted launch of VO-2, scrubbed because of a launch problem. While waiting for the next launch attempt, the VO-2 was inadvertently turned on, discharging the batteries. It was decided to pull VO-2 off the launch pad to replace the batteries and to launch VO-1 instead.

1. Lightning Effects

From the early planning phases it was recognized that Viking launches occurred at the peak thunderstorm period of the year. Particular attention was paid to the safety of the Orbiters and the Viking Spacecraft in the various test facilities. Significant increases in protection were incorporated during the launch operations program. An extensive review of Orbiter installations was conducted by NASA consultants and by Project working groups.

Despite the added effort and protection, the Orbiter systems suffered lightning damage on two occasions. The first was when the pressure transducers of a fueled and pressurized Propulsion module were damaged by induced voltage on instrumentation wiring leading from the Propulsion storage building to the instrumentation lab. The wiring was buried in an underground trench but this apparently did not provide sufficient protection. Because of the bad transducers the spare Propulsion was used.

The second lightning event had only indirect effects on flight hardware but these were of major significance because they caused the VO-2 recycle from the pad. The Orbiter launch complex equipment included an emergency circuit permitting remotely controlled shutdown of the Orbiter in the event of a complete loss of power. A secondary feature of the circuit was the ability to turn on the Orbiter by remote control. On August 12 a severe lightning storm hit the Cape. An antenna tower was struck with enough energy to knock down an antenna, and some circuitry in the range timing system malfunctioned.

These events were of no concern to the Orbiter launch team because they were two or three miles away from both the spacecraft and test complex at building AO. Unfortunately the wiring for our emergency circuit was in the same bundle with the timing circuits. About the time of the lightning stroke the Orbiter turned on, running its batteries to total discharge, and forcing a launch delay to replace the batteries and revalidate the Orbiter.

A common feature of the two events is the long lines with an end circuit which could produce an unplanned effect. In one case direct damage occurred, in the other a sensitive relay was turned on long enough to activate the main power switch. Neither of these potentially dangerous circuits was detected by the extensive hazard analysis and lightning effects analysis carried out by the project. Both circuits were unnecessary, and each was disconnected after the incident. The Propulsion monitor was connected to take readings, but left disconnected. The launch complex emergency battery on circuit was deleted.

One lesson to be learned is that lightning energy may reach unexpected places, and the fewer conductors leading into spacecraft facilities the better. Another lesson is to examine effects of turn on of all ground circuits and verify that no hazard is caused by this condition.

2. VO-1 and VO-2 Launch

The VO-1 launch was made while VO-2 was being reworked and tested. Once again on the launch pad, VO-2 had nearly completed the prelaunch test when a receiver anomaly occurred. VO-2 was taken from the launch pad again and spare parts installed. A third attempt to launch VO-2 was successful.

3. VO-3

VO-3 was used as a source of spares to support system activities at the AFETR. During the later stages of preparation for the VO-1 launch, no electrical test activity was scheduled on either flight system for nearly two weeks (see Section IIC). Since it was desired to have VO-3 ready for mission operations support, the test team began integration of the PTO and spare hardware into the system. Most of the available subsystems were installed and checked out. The checkout phase continued in slack time until August 13 when VO-2 recycle started. Since all resources were committed at that time, there was no further VO-3 activity until it was shipped back to JPL after the launches.

SECTION II
LAUNCH OPERATIONS PLAN

A. OBJECTIVE

The launch operations program for the Viking Orbiter was performed in accordance with JPL Document 612-22, the Test and Operations Plan. That portion of the program conducted at the AFETR provided an orderly sequence of tests and operations leading to the successful Viking spacecraft launches. Orbiter/lander, orbiter/lander/Mission Operations System, and orbiter/lander/Deep Space Network interfaces were thoroughly tested and exercised to ensure their compatibility and proper operation in real-time flight situations.

B. IMPLEMENTATION

1. Personnel

The launch operations at the AFETR were conducted by the same JPL organization which conducted the system test program at JPL (see Section IIB of Volume 1). However, the program management at the AFETR was much more complicated than the orbiter testing at JPL. Figure 1 shows how the JPL organization related to the management at the AFETR.

2. Facilities

Launch operations at the AFETR took place at the following locations:

(1) Spacecraft Assembly and Encapsulation Buildings (SAEB) No. 1 and No. 2.

(2) Spacecraft Checkout Facility (SCF), Building AO.

(3) Explosive Safe Area (ESA) 60.

(4) Launch Pad 41 (LP-41) at the Integrate-Transfer-Launch (ITL) Facility.

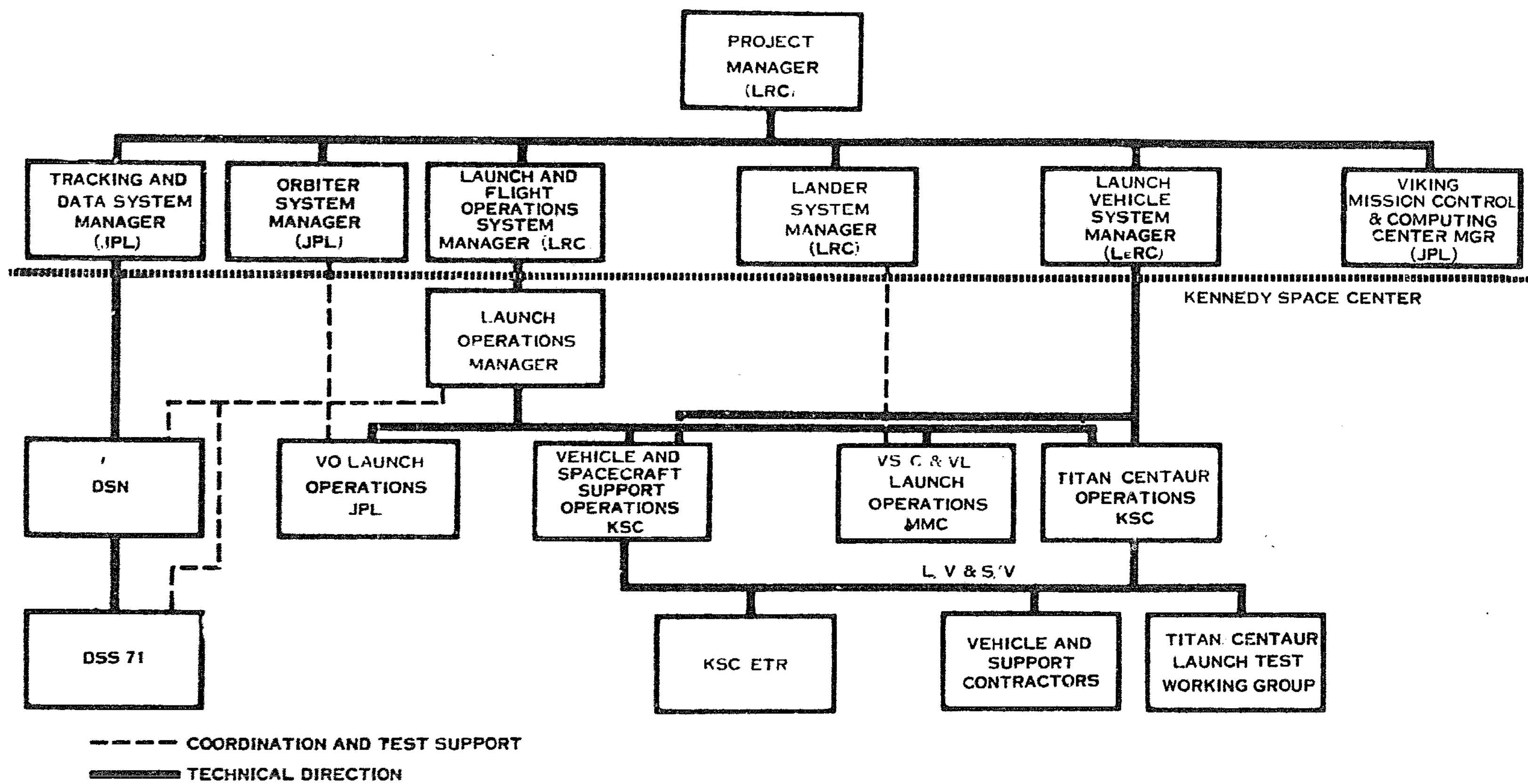

Figure 1. Viking Project Organization at the AFETR

All combined VO-VLC tests and spacecraft tests prior to S/C - L/V mate were accomplished in one of two SAEBs. Both buildings were designated as Class 100,000 clean rooms. Each building was equipped with a sterilization chamber, a lander AGE set trailer, and necessary electrical service for an orbiter LCE trailer.

Orbiter nonhazardous operations were performed in Building AO. The high bay of Building AO was a Class 100,000 clean room which could accommodate simultaneous testing of two orbiters. One STC was installed in Building AO. All orbiter system support operations and office space were also located there.

ESA-60 was a complex of buildings consisting of a Spacecraft Assembly Building, a Propellant Lab, an Instrumentation Lab, and storage buildings. One high bay of the Assembly Building, a Class 100,000 clean room, was used for orbiter final assembly and checkout. The Propellant Lab, a Class 100,000 clean room, was used for fueling the orbiter propulsion module. The Instrumentation Lab was used as a personnel staging area and to store equipment not required in the clean rooms. Two storage buildings were built to permit fueled orbiter propulsion modules to be stored, thereby preventing the long propulsion module service time from becoming a bottleneck in orbiter operations.

Launching of the spacecraft was from LP-41 at the Titan ITL Facility. Operations at the ITL Facility included participation in the S/C - L/V mate anc combined space vehicle tests, and spacecraft readiness tests.

C. SCHEDULE

The launch operations program at the AFETR commenced with the shipment of VO-3 on Jan. 2, 1975 and ended with the launch of VO-2 on Sept. 9, 1975. The major milestones occurring during this period are shown in Figure 2.

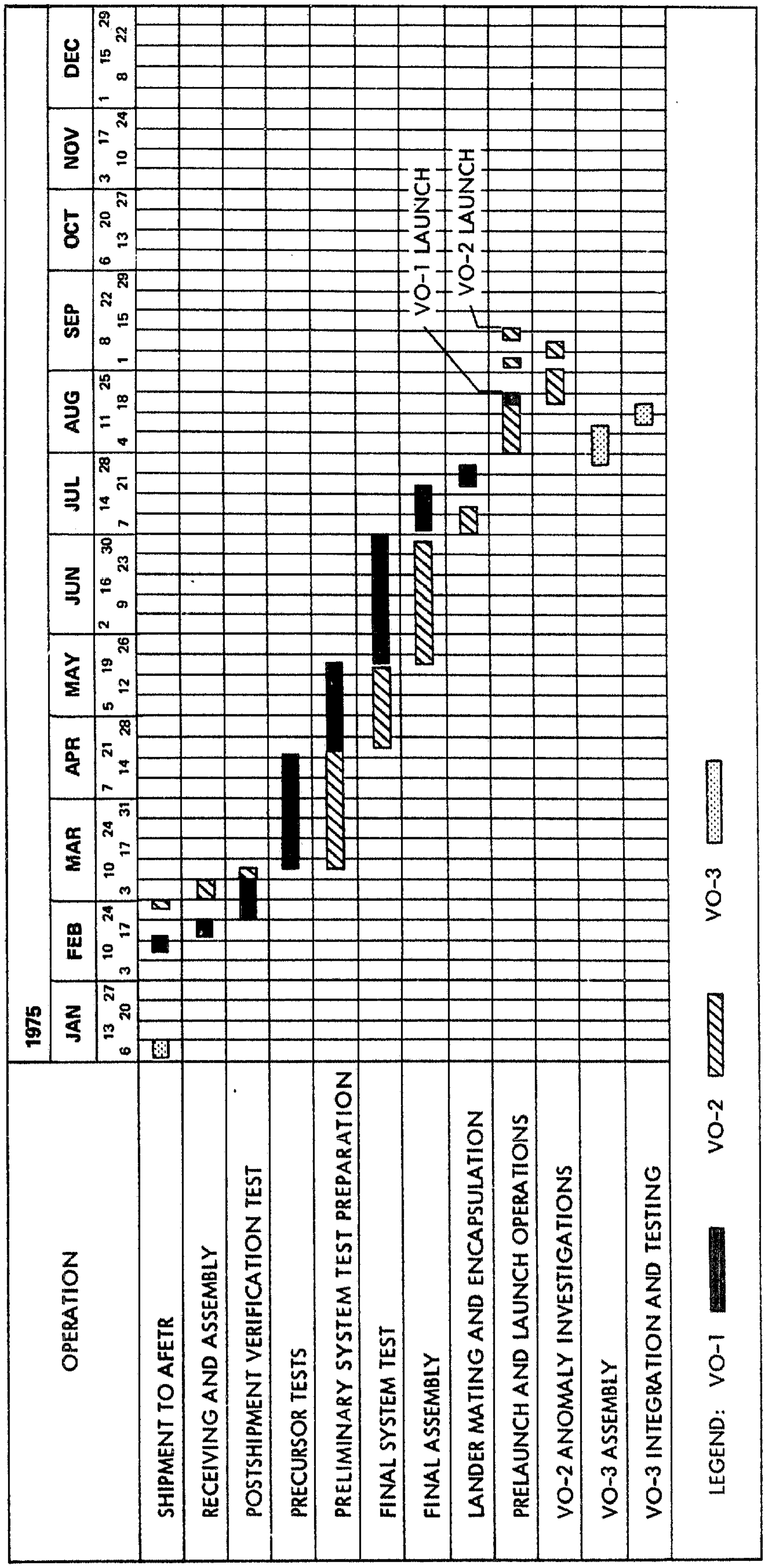

Figure 2. Viking 75 Orbiter Launch Operations History

D. CONTAMINATION CONTROL

Contamination control during tests and operations performed on the Viking Orbiters at the AFETR conformed to the requirements of JPL Document 612-22. The cleanliness of the orbiters was constantly observed by JPL quality assurance (QA) personnel, and spot cleaning was performed as required. Additional general overall cleaning of the orbiters was a normal aspect of mechanical buildup. To insure cleanliness, a visual observation was performed jointly by JPL QA and members of the Contamination Control Working Group (CCWG) prior to the major milestones in the orbiter operations. These milestones included the end of Building AO operations, the end of ESA-60 operations, mating with the VLC, and encapsulation. Additional inspections were performed upon arrival at ESA-60 and the SAEF to insure cleanliness during transportation between facilities as well as when mating to the transporter.

E. CHANGE AND CONFIGURATION CONTROL

In discussions of Problem/Failure Reports (P/FRs) and corrective action (see Sections III, IV, and V), the impression may be given that fixes were incorporated on the spot. The actual procedure involved a formal problem resolution, processed and documented by the QA organization assigned to the AFETR. Design changes by means of the Engineering Change Request (ECR) and Software Change Request (SCR) required concurrence by subsystem cognizant design engineers and system design engineers, with final approval by the Orbiter Spacecraft Manager. At the earliest opportunity, sometimes overnight, the defective hardware was removed from the system, transferred to subsystem cognizance, reworked and reverified under full QA cognizance, and returned, reinspected, and reinstalled for system verification.

SECTION III
VIKING ORBITER 1 LAUNCH OPERATIONS RESULTS

A. SHIPMENT TO AFETR

VO-1 was the first flight orbiter shipped to the AFETR. It left JPL on Feb. 7, 1975, in one of a caravan of 40-foot air-ride electronics vans supplied by United Van Lines and a JPL-manned control vehicle. The orbiter had been assembled to the flight configuration per JPL Procedure VO75 100, with the exception of the following items which were shipped separately in their own containers:

(1) Solar panels and associated dampers, acquisition sensors, attitude control gas system, low pressure module, and outriggers.
(2) Batteries.
(3) Low-gain antenna, relay antenna, high-gain antenna, and associated dampers.
(4) Thermal shields and blankets.
(5) Pyrotechnics.
(6) Spacecraft and lander truss structure.
(7) Propulsion subsystem (PROP).
(8) Solar energy controller devices.
(9) Louver assemblies.
(10) Attitude control inertial reference units and Canopus tracker were released immediately after preshipment system test for hand-carried air shipment to the AFETR. Early shipment allowed AFETR validation of operation and calibrations before the first AFETR system test.
(11) Flight Data Subsystem (FDS) required a rework cycle and was air-shipped separately.

The van carrying VO-1 was air-conditioned to maintain a temperature of less than 80°F and a humidity of less than 50 percent. Failure of the heating system caused a brief layover in Arizona.

A 0- to 5-g accelerometer was attached to the orbiter shipping container in order to measure and record shocks in three axes. An audible alarm signal device on the two-way channel used for convoy control acted whenever a shock greater than 1g was detected.

The propulsion subsystem was shipped separate from the orbiter in its own transporter per JPL Procedure VO75 123. Support equipment (SE) including the System Test Complex (STC) and Mission and Test Computer System (MTCS) were secured in the individual SE consoles, except for heavy components which were removed from their consoles and packaged separately. The van carrying these was not air-conditioned.

Shipment of VO-1 and SE was per JPL Procedure VO75 106. Duplicate equipment was assigned to different vans to reduce the chance of an accident damaging the duplicates. The caravan arrived at the AFETR on Feb. 11, 1975.

B. RECEIVING AND ASSEMBLY

VO-1, its separately shipped subsystems (except PROP), the STC, and the MTCS were unloaded for receiving inspection at Building AO on Feb. 11, 1975. The PROP and associated SE were unloaded at ESA-60. All elements of the shipment including the VO-1 bus and the PROP module were in good condition and no visible damage was apparent. The FDS arrived on Feb. 13 in good condition.

The STC, MTCS, and Launch Complex Equipment Trailers (LCET) at the SAEB and Launch Complex were checked out and made ready for test. All SE checkout was completed on Feb. 17.

VO-1, still in Building AO, was assembled into system test configuration and installed on the system test stand.

Members of the orbiter test team participated in a Radioisotope Thermoelectric Generator (RTG) safety class and a clean room practices training class. These classes were required prerequisites for unescorted access to the SAEBs and lander test area access.

C. POSTSHIPMENT VERIFICATION TEST

VO-1 initial power turn-on occurred Feb. 17. A cursory check of all subsystems followed, with no major problems. The abbreviated testing included a System Readiness Test (SRT), a precountdown test, a verification of the special software to run with the lander in preseparation checkout, and two days of compatibility testing with the Merritt Island Launch Area (MIL-71). All tests were done on the current flight version of Computer Control Subsystem (CCS) software. Verification testing was completed March 3, 1975.

The major problem in this phase was a power output anomaly in the Radio Frequency Subsystem (RFS) S/N 203 (P/FR 34535). During DSN compatibility testing, TWTA-1 parameters fluctuated. RFS S/N 203 was removed for testing at Motorola, and the spare RFS S/N 204 was installed so that precursor operations could continue. The anomalous operations of TWTA-1 was thought to be the result of an intermittent high resistance. RFS S/N 203 was reassembled with different TWTAs, retested at Motorola, and returned to the AFETR. The failed TWTA was not repaired, as it was not then needed as a flight spare.

While VO-1 was undergoing verification in Building AO, the orbiter PROP modules were being built up in ESA-60. Both VO-1 and VO-2 PROPs had been delivered with the VO-1 caravan, while the spare PROP which went on the precursor arrived with the VO-2 caravan on Feb. 24, 1975. The spare PROP was unloaded, inspected, and moved to Building AO for interfacing with the VO-1 bus. Then, a closed-loop test was conducted to demonstrate correct end-to-end phasing of the orbiter inertial reference units to the gimbal actuators.

D. CONTINUED PRECURSOR ACTIVITIES

Following completion of the preshipment verification test, the precursor underwent a number of operations listed in Table 1.

Table 1. Precursor Activities

Location	Operation	Date
SAEB-2	VO-1 moved to SAEB-2	March 7
	VO-1 and VL mated	8
	Limited precountdown	10
	VO/VLC bonding test	11
	Lander battery condition/power switchover	12-13
	Complete precountdown and system exercises	14-19
	VLC prelaunch A and B and GCSC updates	20-21
	DSN command discrimination test	22
	Orbiter high gain probe test	23-25
	VO/VLC battery charge	26
	Encapsulate	27
LP-41	VLC-1/VO-1 moved to LP-41, mate and initial pad power on	31
	Flight events demonstration and battery condition/power switchover	April 1
	Orbiter precountdown	2
	Prelaunch A	3
	Prelaunch B	4
	Terminal countdown demonstration	5-6
	Demate and move to SAEB-2	7
SAEB-2	FCT-3	10
	UHF relay verification	14
	FCT-4	15
	Move to Building AO	16

VO-1 performed well in all precursor tests. No significant internal system anomalies occurred in this period, and no lander interface anomalies were found which required hardware fixes. However, two major problems described below were present at the end of precursor tests.

High temperatures in SAEB-2 caused uncomfortable working conditions and potential hardware problems. The spacecraft batteries were to be allowed only 186 hours of temperatures above 80°F, and this time was being used up rapidly. Also, the pressurant tanks could not exceed 90°F at planned flight pressures, and any significant increase in SAEB temperature would have forced evacuation of the building. Attempts to lower the temperature resulted in the humidity exceeding 50 percent.

Severe surface contamination by many types of particulate matter caused much concern. A number of P/FRs were written:

(1) Many liquid runs were found on the high-gain antenna dish (P/FR 34542). An RTG coolant leak from MMC equipment had been removed with demineralized water but it was unclear if this was the cause of the contamination. The liquid runs were cleaned, and no hardware damage was observed.

(2) Visual inspection of the orbiter after return from LP-41 to the SAEB-2 revealed many types of contamination, including paint chips, metalized film, plastic foam, glass fiber, and tape (P/FR 34560). The source of most of the contaminants were identified. A working group was formed with representatives from involved organizations in order to control potential contamination sources. This activity was quite effective in reducing spacecraft contaminations.

(3) The Infrared Thermal Mapper Subsystem (IRTM) aperture was contaminated with particles of fiberglass, plastic, and crystals (P/FR 34573). The instrument was vacuum cleaned and recalibrated, with no damage evident. Further corrective action was the same as P/FR 34560.

(4) The Canopus tracker baffle contained various contaminants, including a fibrous material as large as one-quarter inch (P/FR 34577). The baffle was a spare used on the precursor to prevent possible damage or contamination of the flight baffle. It was cleaned and returned to bonded stores. Further corrective action was the same as P/FR 34560.

E. FINAL SYSTEM TEST

VO-1 was moved to Building AO on April 16, 1975. During the following month, electrical testing of VO-2 occupied the test team. Several VO-1 subsystems were removed for change-out of suspected contaminated integrated circuit parts. VO-1 was put into system test configuration as hardware was returned. Precursor units, including PROP, were removed. Cannon D connectors which had been demated underwent a pin retention test before final mate. The electronics bays and the bus were cleaned.

The final system test was similar to all other system tests performed at JPL. The data obtained was compared with the results of previous tests to verify the readiness of the orbiter to continue to final assembly operations.

Testing during this phase started on May 16, 1975 (see Table 2) and continued through June 30. VO-1 performed well, with the exception of a few significant problems discussed below. At the conclusion of the final system test phase, no known problems remained and VO-1 had 1960.9 hours total operating time. Subsequently, the orbiter was rigidly controlled to ensure that no activity was permitted that in any way would invalidate the results of the tests. Any connector demating required revalidation of all functions through the connector.

The FDS failed to modify VIS parameters per CCS commands (P/FR 34579) because of a missed memory address command. The problem could not be recreated in the system or in the FDS lab and was thought to have been the result of a noise transient during the FDS memory load. The orbiter was monitored for recurrence of the problem.

Table 2. VO-1 Final System Test Phase Activities

Operation	Date
System test configuration	April 17 - May 15
FDS integration	May 16-19
VIS calibration	20
System readiness test	21-22
Orbiter block validation	23
DSN compatibility	27-29
DSS/FDS EMC test	30
OPAG test	June 2
System test	3-12
Playback bicentinnel emblems, MAWD zero-G removal	13
Special MDS/CCS bit sync test, MAWD validation, scan drive dog installation	16
CCS launch load	17
E^2/M^2 maneuver, final CCS load	18
CCS installation verification	19
Orbiter moved to work stand	20
Science instrument alignment	21-22
Bay 2 button-up, bay 5 verification, battery charge	23
400 Hz anomaly investigation (VO-2 problem)	25-27
RFS investigation	30
Note: All operations performed in Building AO.	

FDS S/N 003 failed to respond to coded commands from the CCS while on power converter B with no FDS direct access (P/FR 34596). The problem was traced to a design change (ECR 18065) which had not been incorporated into this FDS, even though the paper work indicated it had been. This change could only be checked electrically at the system level with the FDS direct access pulled. A no-cables test was done in Pasadena, but a new FDS unit was installed at the AFETR and the next no-cables test did not occur until very late in the schedule. The change was incorporated into FDS S/N 003, reverified visually for FDS S/N 001 (spare), and system-level tested for FDS S/N 002 (on VO-2 in launch configuration).

DTR-A overshot the end point during a tape positioning sequence (P/FR 34582). The characteristic rundown distance for DTR-A was found to sometimes exceed the distance used in the tape positioning sequence, thus causing overshoot. DTR-A was the spare unit, and was installed on VO-1 temporarily while the flight DTR was being reworked. The flight DTR, which had a shorter characteristic rundown distance, was reinstalled and experienced no problems.

DTR-A TIC readout from the CCS was seven TICs off at the beginning-of-tape signal (P/FR 34584). The offset resulted from processes caused by cycling the DTR power off and on. A mission rule was submitted to OPAG that required off-on cycles to be minimized.

CCS telemetry showed two occurrences of Processor B going to primary command error after switching from RCVR-2/CDU-B to RCVR-1/CDU-A (P/FRs 34585 and 34585-A). The cruise/orbit software was revised to correct the problem (ECR 18181).

During solar panel deployment preparations, it was found that the epoxy bonding material securing the connector back nut to the relay antenna coax cable was fractured (P/FR 34595). Subsequent inspection of the two remaining VO-1 cables on the solar panels revealed that one connector was loose. The teflon outer jacket of the cable was not sodium etched during fabrication, preventing the epoxy from properly bonding to the teflon. This problem was generic to all VO'75 cables of this type. Two spare cable sets were reworked by sodium etching and insertion of a copper shim, and they were installed on the two flight orbiters.

F. FINAL ASSEMBLY

After completion of the system test phase in Building AO, VO-1 was moved to ESA-60 for final mechanical operations on the internal cavity of the orbiter in preparation for mating to the fueled PROP (see Table 3).

Table 3. VO-1 Final Assembly Activities

Operation	Date
VO-1 moved to ESA-60	July 2
Installed PROP	3
Installed solar panels	9
Propulsion click test, propulsion telemetry verification, check valve heater	10
FDS memory load investigation, ACS phasing, sun gate verification	11
Gas pressurization and leak tests	12-13
FDS S/N 001 installed and validated	14
High-gain antenna phasing, S-band power out tests, relay radio antenna and umbilical test	16
Precountdown test	17
VO-1 moved to SAEB-2	18

At ESA-60, the orbiter and U-ring were mounted on a workstand in the south bay of the Sterilization and Assembly (S&A) Labs. The scan latch pressurization, scan pyrotechnic loading, and partial installation of the upper thermal blanket were completed prior to PROP mating operations.

The PROP was readied for mating to the orbiter bus in parallel to the orbiter mechanical preparations. The mating operations took place on the leveled PROP transporter and were followed by a functional verification of the electrical connections between the orbiter and the PROP.

The mated orbiter and PROP were transferred from the PROP transporter to the thermal blanket installation stand, and lower mechanical buildup continued (installation of the PROP thermal blankets and shields, low-gain antenna, associated dampers and coaxial lines, and the solar energy collectors. When these operations were completed, the orbiter was mated to the spacecraft truss structure located on the orbiter transporter. Spacecraft mechanical release devices and associated pyrotechnic squibs were then installed at the four lift-off pad positions.

Solar panel deployment tests were conducted in the north bay of the S&A Labs in parallel with orbiter mechanical preparations. During these tests, the first leaf of the deployment spring that contacts the spring retainer pin of the solar panel deploy damper failed (P/FR 34599). The failure appeared to be progressive, becoming more pronounced with each cycle of the spring. Although the failure of this single leaf in the spring stack increased the friction of the system, deployment time was still within functional limits. The spring leaf was replaced, however, and the spring retainer pin burnished to remove wear marks. The assembly then performed well, and the remaining units exhibited no symptoms that would have indicated failure.

When the orbiter was ready for solar panel installation, each inner and outer subassembly of the solar panels was moved to the south bay and mated to the orbiter bus. Then, an ACS gas pressurization and leak test was performed.

A special troubleshooting sequence was performed to determine why the XTX power output was 4 dB lower than expected (P/FR 35302). The problem was traced to a defective coaxial cable connector. The final bus thermal blanket installation was delayed until the XTX cable was replaced just before encapsulation. The VO-2 XTX cable was found to have about 0.4 dB loss but was not replaced.

After completion of all mechanical and electrical preparations, the orbiter precountdown test was utilized to perform a final readiness test prior to movement to the SAEF for lander mating. The complete orbiter, with the exception of the high-gain antenna and associated assemblies, was mated to the spacecraft truss structure installed on the VO transporter and moved to SAEB-2.

G. LANDER MATING AND ENCAPSULATION

Table 4 lists the activities during this phase. The lander truss structure was assembled on the Viking Lander Capsule Adapter (VLCA) support ring/ tooling plate, and the lander mated to the truss structure. The lander/truss was then mated to the orbiter mounted on the orbiter transporter, and mechanical preparations were completed. Following pyrotechnic verification checks, the orbiter upper thermal blanket was attached and the high-gain antenna with its associated rotary hardware installed and mechanically checked. Pinpuller installation was then verified using the pyrotechnic field test kit.

Table 4. VO-1 Lander Mating and Encapsulation Activities

Operation	Date
Installed lander on VLCA	July 16
VO-1 moved from ESA-60 to SAEB-2	18
Installed lander on orbiter	19
Precountdown test	20
Prelaunch A test	22
Prelaunch B test, biosampling	23
Installed shroud on spacecraft	24

After final spacecraft mechanical verification, a pre-encapsulation verification test was performed under the direction of MMC. The spacecraft RF and data system tests were also conducted at this time.

Following electrical verification of the spacecraft, a detailed walk-around was conducted to verify cleanliness and removal of all covers and protective devices. Biosampling was made on the exterior surfaces of the spacecraft and interior surfaces of the assembled shroud. Upon completion of this survey, the spacecraft was removed from the orbiter transporter and mated to the spacecraft transporter. Following a final mechanical inspection, the encapsulation was performed by General Dynamics/Convair with MMC and JPL witnesses. At the conclusion of SAEF testing, VO-1 had 2028 hours of operating time, 67.5 hours in this phase.

H. PRELAUNCH AND LAUNCH OPERATIONS

The mated VLC-1/VO-1, designated Viking B, was scheduled for the second of two launches. No action was taken on Viking B during the three weeks following encapsulation. During this period, Viking A (VLC-2/VO-2) was being prepared for launch.

On August 14, 1975, the launch of Viking A was cancelled due to orbiter battery discharge (see Section IV). While the VO-2 problem was being resolved in SAEB-1, VLC-1/VO-1 was brought out and prepared for launch instead. The VO-1 system on-pad activity (see Table 5) was smooth and uneventful compared to VO-2, with only a few problems described below. A successful launch occurred on August 20.

Battery test load one came on unexpectedly during a DC 2K command (P/FR 35304). The anomaly occurred because a simultaneous battery charger automatic switchover function. The block dictionary battery charging mode was modified to eliminate this effect (SCR P1015).

During the precountdown test, processor B went to error and did not issue 14 events as expected (P/FR 35310). The orbiter test conductor was alerted to the procedure necessary to avoid recurrence of the problem.

During countdown, the CCS issued a processor word indicating a termination and reject of a command (P/FR 35314). The CCS action resulted from

Table 5. VO-1 Prelaunch and Launch Operations Activities

Operation	Date
VLC-1/VO-1 moved to LP-41, VO-1 batteries charged	August 15
Precountdown test	16
Battery conditioning, power switch-over, and prelaunch A test	17
Update to cruise procedure, pre-launch B test	18
Final memory conditioning, memory readout of launch load	19
Launch at 2222 GMT	20

changing the mode of commanding at the MDS-SE and thereby causing the CDU to interpret the sequence as an erroneous command. The procedure for changing modes was modified to ensure that the CDU dropped bit sync lock before transferring mode.

SECTION IV
VIKING ORBITER 2 LAUNCH OPERATIONS RESULTS

A. SHIPMENT TO AFETR

VO-2 was the second flight orbiter shipped to the AFETR. VO-3 and VO-1 had preceded it. VO-2 left JPL on Feb 20, 1975, in the same shipping configuration as VO-1 (see Section III). The VO-2 caravan arrived at the AFETR on Feb 24.

The shock warning system malfunctioned in the van carrying the PROP (P/FR 34797). The alarm detector was turned off in Alabama, after 58 alarms had been recorded. The recording system then lost power due to a lack of gasoline. Subsequent testing at JPL revealed that the alarm detector could be triggered by nearby produced signals caused by intermittent inductive line loads. In any case, the PROP was not exposed to excessive shock, and no corrective action was required. The alarm system in the van carrying the orbiter bus performed normally and produced nine alarms.

B. RECEIVING, ASSEMBLY, AND POSTSHIPMENT VERIFICATION TEST

VO-2 and the second STC were unloaded at Building AO on Feb 25, 1975, while the PROP and associated SE were unloaded at ESA-60. All elements passed inspection. The VO-2 was built up for postshipment verification testing, missing the MAWD and with a load box in place of an RFS and MDS. Testing was completed satisfactorily on March 7.

The only significant problem during this phase of testing was a high-resistance short in battery cell No. 3 (P/FR 34802). The battery was designated a nonflight unit and was used for testing only.

C. FINAL SYSTEM TEST

No electrical work was done on VO-2 during the next six weeks because of Precursor activities. The VO-2 PROP, which had been shipped in the VO-1 caravan, underwent helium sphere pressurization and was put into storage. The VO-2 bus was assembled into system test configuration.

VO-2 power was applied April 17, 1975, followed by many operations (see Table 6) including a complete system test. VO-2 performed well in this test phase, with the exceptions described below. VO-2 accumulated 156.5 hours in this test phase, for a total running time of 998 hours.

The most significant problem was a jittery DTR-A direct-access status strobe (P/FR 34815). The DTR was reacting to excessive system noise by generating erroneously timed direct-access status pulses and motor drive pulses, and extra tach clock monitor pulses. ECR 18503 reduced the noise by 6 dB through modifications to both DTR bay chassis harnesses, the FDS bay chassis harness, and the upper ring harness. Following the extensive rework, completion of system testing revalidated all functions in these harnesses.

The loaded PROP sustained lightning damage while in storage (P/FR 34835). One pressure transducer was damaged beyond repair, and two transducers required recalibration. The VO-2 PROP was reassigned as a spare, the VO-1 PROP was reassigned for use on VO-2, and the previous spare was reassigned to VO-1.

D. FINAL ASSEMBLY

Following completion of the system test phase, VO-2 was built up as much as possible before being moved to ESA-60 (see Table 7). At ESA-60, the PROP, solar panels, and thermal blankets were installed. Various special tests, a precountdown test, and a biosampling were performed before the completed orbiter was moved to SAEB-2 for lander mating and encapsulation. A number of problems occurred during the final assembly phase, some of them involving the facilities. These problems are discussed below.

Table 6. VO-2 Final System Test Phase Activities

Operation	Date
System test configuration	March 8- April 16
Power on	April 17
VIS integration	18
Relay test with VLC-2	21
System readiness test	22-23
System test	April 24- May 5
Optical navigation test, begin DSS/FDS noise investigation	April 29
Block validation	May 6
Special CCS Revision G tests	7-8
McGregor tests complete, MAWD final test	8
Bicentennial emblems recorded	9
DSS/FDS noise tests	10
VIS calibration, PYRO no-volt test	12
CCS launch load	13
CCS launch-related tape validation, scan final position, and DSS/FDS noise investigation	14
Note: All operations performed in Building AO.	

Table 7. VO-2 Final Assembly Activities

Operation	Date
ACS LP gas system moved to ESA-60, solar panel buildup at ESA-60	May 15
Science instruments alignment (Building AO)	16
HGA structure installation	19
VO-2 cleaning	20
Pin retention tests	21
Final torque verifications	22-23
Final buildup (SEC, louvers, blankets), cleaning, and inspection	27-30
VO-2 moved to ESA-60	31
Installed PROP	June 3
Propulsion click test, propulsion telemetry verification, check valve heater	5
Completed solar panel installation	13
Completed blanket stand work	15
Installed VO-2 or VSCA	16
Low-gain probe test, S-band power out tests	19
Precountdown test	20
S-band power out tests, UHF radiated emission test, HGA phasing	23
400 Hz anomaly investigation	25
Biosampling	26
VO-2 moved to SAEB-2	28

During an insertion loss test on the HGA articulation structure, the wow condition of the elevation-axis dual-frequency rotary joint (DFRJ) was out of specification (P/FRs 34838 and 34858). The undesired wow was caused by looseness between the S-band channel and X-band waveguide wall, and by looseness in the S-band coaxial connector. The DFRJ assembly was clamped securely and the coaxial connector secured by roll pins (ECR 18179). Retesting verified the solution. Because this problem was generic to the assembly, rework was also performed on VO-1 and spare assemblies.

The low-pressure module (LPM) went from 35 psig to 5 psig in a 90-hour period while in storage (P/FR 34842). Tests could not localize the leak. Although the pressure loss was within specification, this LPM was replaced with the spare for safety.

Cone offset of the IRTM exceeded the allowable limit (P/FR 34845). Analysis determined that the alignment was acceptable with in-flight recalibration. Therefore, the problem resolution was postponed until an inflight alignment check could take place.

The IRTM thermal blanket overlapped the IRTM aperture opening by approximately 1/16- to 1/8-inch (P/FR 34843). Because overlap in excess of 1/10-inch could affect the IRTM, all such orbiter thermal blankets were modified to eliminate overlap.

The ESA-60 cranes malfunctioned during orbiter assembly (P/FRs 34844, 34853, and 34855). During the PROP installation in the S&A Lab, the crane load float system failed to respond. During the move from the blanket stand to the VSCA in the north bay, the crane lifted in a fast motion, overran a stop command, and pulled the orbiter and blanket stand partially off the floor. A little more lift would have caused the solar panels to fall off their supports. Inspection revealed no damage to orbiter hardware. The lifting procedure was altered to avoid crane movement until the panels were secured for lifting. The north-bay crane was found to be defective, and the air-lock crane was modified for use in the north bay until the other crane could be repaired.

ESA-60 experienced serious air-conditioning problems (P/FRs 34848, 34849, 34851, and 34852). Orbiter hardware, including the loaded PROP, was exposed to a peak temperature of 93°F and a peak humidity of 73 percent. On June 7, the north-bay temperature exceeded 90°F for 40 minutes and the humidity was above 50 percent for 2 hours. On June 11, the north-bay temperature reached 82°F and humidity exceeded 70 percent for 30 minutes. The equipment failures which caused these environment control problems were corrected, and an alarm was installed in the guard shack to permit quick action if another out-of-tolerance incident occurred. The temperature extremes experienced, while in the danger zone, were not a major problem to the hardware because of the short duration. The humidity was of some concern because of potential condensation and IC lid corrosion. Analysis and inspection indicated no degradation of the orbiter systems, or their cleanliness at encapsulation.

E. LANDER MATING AND ENCAPSULATION

Table 8 lists the activities during this phase. The procedure followed was similar to that for VO-1 (see Section IIIG). Except for the contamination described below, no significant problems developed. At the conclusion of SAEF testing, VO-2 had 1076 hours of operating time, 78.9 hours in this phase.

Table 8. VO-2 Lander Mating and Encapsulation Activities

Operation	Date
Installed lander on VLCA	June 30
Installed lander on orbiter, initial power on at SAEB-1	July 1
Precountdown test	3
Prelaunch test A, biosampling	8
Prelaunch test B	9
Installed shroud on spacecraft	10

Minute particles were found on the orbiter bus blanket (P/FR 34861). The particles were removed by spot cleaning, and reinspection verified the cleanliness of VO-2. Additional precautions were taken to maintain a clean condition.

F. PRELAUNCH AND LAUNCH OPERATIONS

1. Initial Launch Attempt

The mated VLC-2/VO-2, designated Viking A, was scheduled for the first of two launches. No action was taken on Viking A during the 18 days following encapsulation. During this period, Viking B (VLC-1/VO-1) was undergoing final assembly, mating, and encapsulation.

Viking A was moved to LP-41 on July 28, 1975 (see Table 9). During the precountdown test, three problems were encountered:

(1) The CCS safing routine was activated which initiated an ACE power changeover (P/FR 34869). Consequently, some gas jets were enabled and 0.46 pound was lost before corrective action was taken. The culprit seemed to be a power glitch associated with an FDS oscillator switchover. The precountdown procedure was changed to eliminate this problem.

(2) While operating in command auto mode, the modulation to RFS-SE went off (P/FR 34871). The problem appeared to be at least partially caused by an unstable pull-up voltage in the CCS-SE drawer due to a cold solder joint. The joint was reworked, but because another cause of the problem could not be ruled out, a temporary modification to the CCS-SE disabled the function in the drawer.

(3) Apparent external EMI caused signal degradation (P/FR 34872). No corrective action was required to flight hardware. During science checkout sequences in flight, the RRS/RTS will be turned on in order to characterize the background UHF noise level.

Table 9. VO-2 Prelaunch and Launch Operations Activities

	Operation	Date
	VLC-2/VO-2 moved to LP-41	July 28
	Precountdown test	29
	Prelaunch A test	30
	Update to cruise procedure, prelaunch B test	31
	Configure for launch	August 9
	Countdown, no launch due to launch vehicle problem	11
	Kinetic switch found on, orbiter batteries discharged, orbiter health check	14
	VLC-2/VO-2 moved to SAEB-1	15
	VO-2 decapsulated	18
	VO-2 interface verification	21
	VO-2 moved to transporter, mated to lander	22
Recycle one	Precountdown, VO special tests	23
	Battery condition PWR switchover	24
	Encapsulation, prelaunch B test	25
	VLC-2/VO-2 moved to LP-41	27
	Precountdown	28
	Battery conditioning, power switch-over, and prelaunch A test	29
	VO-2 receiver threshold diagnostics	30-31
	VLC-2/VO-2 moved to SAEB-1	Sept 1
	VO-2 decapsulated	2

Table 9. VO-2 Prelaunch and Launch Operations Activities (contd)

	Operation	Date
Recycle two	Replaced S-band RF hardware and antenna	Sept 3
	Test ARTC, S-band, and X-band functions; encapsulate	4
	Precountdown test	5
	VLC-2/VO-2 moved to LP-41, battery conditioning, power switchover	6
	Prelaunch A test, update to cruise procedure	7
	CCS/FDS memory conditioning and readout	8
	Launch at 1939 GMT	9

Three more problems occurred during initial launch preparations:

(1) Both battery chargers erroneously switched over to low-rate charge after a DC-75A1 command (P/FR 34874). The software was altered (SCR P1015) to maintain proper charging modes.

(2) The CCS SE stopped processing several times while direct memory loading the CCS (P/FR 34875). A faulty drum power supply was replaced with the spare unit. No further problems occurred.

(3) LP-41 air conditioning failed to provide class 100 air to the shroud payload for approximately seven hours (P/FR 34876). During the recycle one period, a failed air-conditioning filter was replaced, and VO-2 was inspected. Routine cleaning corrected any minor contamination.

Subsequent spacecraft tests went smoothly, and a launch attempt was carried out August 11. This was scrubbed because of a launch vehicle problem.

2. First Recycle: Battery Turn-on Anomaly

While waiting for the launch vehicle problem to be resolved, a routine battery charge of the orbiter on August 14 uncovered the fact that the kinetic switch was closed, and the orbiter had operated unattended long enough to run the batteries down (P/FR 34877). A quick power-on check showed no surprises in the orbiter state and gave confidence that the effects of the power rundown were not catastrophic. A recycle for VO-2 was initiated.

VLC-2/VO-2 was moved to SAEB-2 on August 15. The VO-2 mechanical disassembly was performed on the blanket stand. Two solar panel assemblies were removed to get access to the battery bays, and the batteries were removed and replaced. Analysis of the effects of the power rundown profile on all subsystems involved was completed with the conclusion that no stress should have occurred. A major JPL effort involving lab testing of other units of affected subsystems produced data confirming the analysis. Reassembly of the VO-2 was completed on August 21, and reverification of solar panel and associated interfaces was completed along with battery and other broken interfaces. Only about 0.003 pound of gas was blown in reverification. In addition to battery replacement, the three flexible RRS cables on the solar panel were replaced because of a generic manufacturing error. The XTX output cable was replaced because of a different generic manufacturing error. These had not been replaced earlier because the risk was not high enough to justify decapsulation. These same RAS and XTX cables were also replaced on VO-1 before it was encapsuiated.

Analysis of the cause of the turn-on was not conclusive at the time. A sensitive relay connected to nine miles of telephone line could pull in with a current of 0.75 milliamp and would turn on the orbiter with the power from the emergency power-off battery. Sources of -40 volt glitches were found which originated in lightning protection circuits on the phone lines. These glitches did not activate the relay because the clamping diode shorted negative pulses. Other glitches were found to originate in the LP-41 paging microphone keying circuits. In fact, investigation revealed several sources of AC and DC noise which could have caused the turn on. Why these never occurred during Pasadena testing of this circuitry or during Precursor activity was not understood. Lightning effects on the sensitive relay could not be completely ruled out, but no lightning activity was found at the highest probability time of turn on. However, months later, continuing analysis extended the on time to make the predicted switch-on correspond to a severe lightning storm on August 13.

Protective and corrective action included deleting the emergency turn-on circuit and instituting a continuous monitor on the orbiter to detect any turn on. More secure lines (video pairs) were connected for the second launch. Procedures were changed to operate with the launch interlock relay enabled all the time the kinetic switch was on. This interlock, when energized, disconnected all sources of power to the kinetic switch so that no inadvertent off command could occur.

3. Second Recycle: Receiver Threshold Anomaly

After encapsulation on August 25, the system was moved to LP-41. The first test on pad was an orbiter precountdown. The test went smoothly until the end when a degradation in receiver sensitivity (threshold shift of 3 dB) was detected when radiating over the HGA (P/FR 34882). The original suspicion was that the effect was caused by reflected energy in the shroud, but a shroud door was opened and an absorber was held over the high-gain feed horn. The effect remained, so the conclusion was that energy conversion from transmitter to receiver frequency was taking place in the HGA feed system.

The spacecraft was brought down off the pad on Sept 1 and decapsulated again. Attempts to isolate the problem were inconclusive although it did recur before and after decapsulation. The complete spare RF coaxial feed system, antenna support structure, and antenna were installed, without demating the lander. Retest of the RF interfaces verified the problem was gone, and the spacecraft was encapsulated on Sept 4.

4. Launch

A full precountdown was performed after encapsulation with no anomalies except a 2 to 3 dB discrepancy between the signal-to-noise ratio estimator (SNORE) and received signal strength (AGC) calibrations (P/FR 34884). It was concluded that the discrepancy was acceptable and the spacecraft was taken to LP-41.

As the spacecraft was readied for lifting onto the launch vehicle, it was discovered that two pieces of air conditioning duct lining were missing (P/FR 34885). One piece was established to have been missing before, and the other piece was considered too large to be a significant risk.

All on-pad tests were trouble-free and a successful launch occurred just ahead of a threatening thunderstorm on Sept 9.

SECTION V
PROBLEM/FAILURE REPORT SUMMARY

Tables 10, 11, and 12 summarize the major problems reported during the launch operations program at the AFETR for the Viking orbiters. Of 220 P/FRs relating to the launch operations prgoram, 63 were considered major due to having an orbiter risk (OR) or failure criticality (FC) rating of more than one.

The orbiter risk assessment was a judgment of the likelihood of a given problem recurring during flight operations:

Risk 1	Cause known, minimal risk or recurrence
Risk 2	Cause unknown, minimal risk of recurrence
Risk 3	Cause known, some risk of recurrence
Risk 4	Cause unknown, some risk of recurrence

The failure criticality rating defined the effect of the problem recurring during flight or launch operations:

Criticality 1	Negligible or no effect on mission
Criticality 2	Significantly degrading to mission
Criticality 3	Catastrophic to mission

A more thorough description of these ratings is given in JPL Document 612-33. The subsystem (S/S) numbers given in Tables 10, 11, and 12 are listed in Volume 1, Figure 5 of this document.

Table 10. VO-1 Launch Operations P/FR Summary (1 of 4)

PFR NO.	PFR DATE	S/S	S/N	F C	O R	SUMMARY
34521	2-17-75	2103	1	1	2	MOD GLITCH CAUSED CDU TO DROP LOCK, MAN MODE. ECR 18117 MODIFICATION INSTALLED, REF 30774.
34522	2-17-75	2105	002	1	2	SECOND FDS BLOCK LOAD HAD NUMEROUS BIT ERRORS. RANDOM OCCURRANCE. NO ACTION AT THIS TIME.
34535	3- 1-75	2002	203	1	2	TWT 1 PARAMETERS FLUCTUATE. DSN COMPAT 10-B. PROBABLY DUE TO INTERMITTENT HI RESISTANCE. REPLACED TWTA IN RFS 203. SCRAP TWTA #23.
34537	3- 3-75	2152		1	2	SPECTRUM ANALYZER DOES NOT DETECT UHF SIGNAL. UNABLE TO FIND TROUBLE. UNIT RETESTED OK.
34538	2-21-75	2004	VO-1	1	2	CELL #25 FAILED SHORT TEST, 1.191 VOLTS. BATTERY RETESTED OK AFTER CONDITIONING. TO BE USED AS FLT SPARE. REF IOM 342-758-156.
34542	3-10-75	2001		1	2	CONTAMINATION ON HGA DISH. RTG COOLANT LEAKED. REMOVED WITH DISTILLED WATER. NO HDW DAMAGE.
34544	3-12-75	2115		1	2	PIECE OF COTTER KEY WASHED FROM CONNECTOR. NO HARDWARE DAMAGED. SUBSYSTEM RETESTED OK.
34548	3-17-75	2000	VO-1	1	4	POWER STATUS 2 TOGGLING AT RANDOM INTERVALS. NO ACTION. DATA CAN BE OBTAINED OTHER WAYS.
34549	3-20-75	2103	VO-1	1	2	ENG TELEM SHOWED UPDATE ERRORS. SEVERAL CHANS. ERRATIC OPERATION OF LO RATE BIT SYNCHRONIZER. CLEANED ALL INTERNAL CONTACTS. RETESTED OK.
34550	3-20-75	2003	VO-1	2	1	FIRST 2 OF 3 CMDS NOT SEEN BY CCS. MDS MANUAL. SE PROBLEM. FLT HDW OK. SEE PFR 34556 CLOSURE.

Table 10. VO-1 Launch Operations P/FR Summary (2 of 4)

PFR NO.	PFR DATE	S/S	S/N	FC	OR	SUMMARY
34551	3-21-75	2003	VO-1	2	1	NO RESPONSE WHEN CCS-SE SENT 6B22 TO CCS. SE PROBLEM. FLT HDW OK. SEE PFR 34556 CLOSURE.
34560	4-10-75	2000	VO-1	2	3	CONTAMINANTS ON VO SURFACE. SHROUD REMOVED. FROM VARIOUS SOURCES. CHECK OUT FACILITIES.
34563	4-10-75	2005	REV. F	2	1	MODE CORRECTION ROUTINE NOT OPERATE CORRECTLY. SHARE MODE ROUTINE SWITCHED PER ECR 18157.
34564	4- 7-75	2039	108	1	2	RED DISCOLORATION SPOTS ON SEVERAL IC'S. NO ACTION THIS PFR. REF IOM 153-GEN-75-217.
34572	4-24-75	2009	VO-1	1	2	CONN 6A8P2 PINS 36 & 29 FAILED RETENTION TEST. NAPKIN RING ON SOCKET 29 WAS DEFORMED. EXACT CAUSE UNKONWN. REPLACED CONNECTOR. IR-301185.
34573	4-21-75	2038	004	2	3	CONTAMINATION IN IRTM APERTURE AFTER DECAP. PARTICLES OF FIBERGLASS. PLASTIC. & CRYSTALS. VACUUM CLEAN & RECALIBRATE INSTRUMENT OK.
34576	3-17-75	2000	VO-1	1	4	VO UNREGULATED DC POWER TO VL HAD TRANSIENTS. HARDWARE NOT SENSITIVE TO TRANSIENTS. UAI.
34577	4-10-75	2007	VO-1	2	3	NUMEROUS FIBROUS PARTILES ON C/T BAFFLE. BAFFLE CLEANED. REF PFR 34560 CLOSURE ACTION.
34579	5-19-75	2006	VO-1	2	2	FUS NOT MODIFY VIS PARAMETERS AS PER CCS CMDS. DUE TO MISSED MEMORY ADDRESS COMMAND. EXACT CAUSE NOT DETERMINED. NO RECURRANCE. UAI.
34582	5-22-75	2016	VO-1	2	1	OVERSHOOTING END POINT ON TAPE POSITION SEQ. FLIGHT SPARE DTR. REPLACED WITH FLIGHT UNIT.
34584	5-22-75	2000	VO-1E	1	3	DTR A TIC READOUT FROM CCS WAS 7 TICS AT BOT. MINIMIZE ON/OFF CYCLES TO PRESERVE ACCURACY OF THE TIC ACCOUNTING PROCESS. SEE ALSO 34739.

Table 10. VO-1 Launch Operations P/FR Summary (3 of 4)

PFR NO.	PFR DATE	S/S	S/N	FC	OR	SUMMARY
34585	5-22-75	2000	VO-1	1	3	CCS TLM SHOW PROC B GOING TO ERROR AFTER SW. CRUISE/ORBIT S/W REVISED. REF ECR 18181.
34585A	7-23-75	2000	VO-1	1	3	APPARENT REPEAT OF PFR 34585 INCIDENT. SAME CLOSURE ACTION AS BASIC PFR.
34586	5-23-75	2000	VO-1	1	4	POWER STATUS 2 TOGGLING AT RANDOM INTERVALS. RECURRANCE OF PREVIOUS PROBLEM. REF PFRS 34023 34607 & 34548. INFORMATION AVAILABLE FROM OTHER ANALOG TELEMETRY. ACCEPT AS IS. NO ACTN.
34589	5-29-75	2000	VO-1	1	2	RMS PHASE JITTER OVER SPEC. EXC/TWTA #2. EXACT CAUSE UNKNOWN. NO PERFORMANCE EFFECT.
34595	6-25-75	2067	VO-1	2	3	CONNECTOR BACK NUT BONDING MATL FRACTURED. DUE TO TEFLON ON CABLE NOT SODIUM ETCHED. REWORKED 2 SPARE CABLE SETS. INSTALL ON S/C.
34596	6-25-75	2006	VO-1	3	1	FDS NOT RESPOND TO CODED CMDS WHEN ON CONV B. ECR 18069 INCORPORATED INTO THIS FDS S/N 003.
34599	7- 7-75	2012	VO-1	1	3	SOLAR PANEL DEPLOYMENT SPRING LEAF FAILED. REWORK UNIT. RETEST OK. TIME IN SPEC.

Table 10. VO-1 Launch Operations P/FR Summary (4 of 4)

PFR NO.	PFR DATE	S/S	S/N	FC	OR	SUMMARY
35301	7-10-75	2006	VO-1	2	2	UNABLE TO UPDATE LOCATION 734G. REPLACED DEFECTIVE MEMORY BOARD #A104.
35302	7-16-75	2042	04	2	1	XTX POWER OUT AT HGA RJ1 4DB LOWER THAN EXPTD. REPLACED DEFECTIVE COAX CABLE. RETESTED OK.
35303	7-17-75	2001		1	3	BUS ACCELEROMETER RESISTANCE 20 MEG. S/B OPEN. EXACT CAUSE UNKNOWN. CONDITION ACCEPTABLE.
35304	7-17-75	2004	VO-1	2	1	BATT TEST LOAD 1 CAME ON WITH TWT PWR ON CMD. SCR P1015 REVISES BLOCK DICT BATTERY CHG MODE.
35305	7-17-75	2000	VO-1	1	4	14 SEC OF DATA LOST AT RTS TLM. SUSPECT RFI. EXACT CAUSE UNKNOWN. REF IOM JK-33-ETR-37.
35310	8-16-75	2000	VO1(A)	2	1	PROCESSOR B WENT TO ERROR. REF VISA 2538. REVISE PROCEDURES TO CATCH POSSIBLE RECURR.
35311	8-16-75	2000	VO-1	1	2	RELAY LINK LOSS AT LC-41. REF 34872 ON VO-2. DUE TO RADIATED COUPLING IN LAUNCH CONFIG. RRS/RTS TO BE TURNED ON AFTER RAS DEPLOYMENT.
35314	8-20-75	2000	VO1(A)	2	1	CCS C-BASE PROCESSOR WORD. INCORRECT ID. PROCEDURE FOR CHANGING FROM MANUAL MODE TO AUTOMATIC HAS BEEN AMENDED TO INSURE THAT CDU DROPS BIT SYNC LOCK BEFORE TRANSFERRING.

Table 11. VO-2 Launch Operations P/FR Summary (1 of 3)

PFR NO.	PFR DATE	S/S	S/N	FC	OR	SUMMARY
34802	4- 3-75	2004	VO-2	3	1	BATTERY #011 CELL 3 VOLTAGE LOW. SHORTED. RECHARGED & RETEST OK. BATTERY FOR TEST ONLY.
34807	4-16-75	2039	107	1	2	RED DISCOLORATION ON IC'S & TRANSISTORS. NO ACTION THIS PFR. REF IOM 153-GEN-75-217.
34811	4-17-75	2009		1	2	VIS HARNESS CONNECTOR PIN FAILED RETENTION. REPLACE DAMAGED HARNESS. REWORK AT JPL.
34815	4-24-75	2000	VO-2	2	1	DTR A DIRECT ACCESS STATUS STROBE IS JITTERY. DUE TO SHIELD CONNECTIONS. MODIFY PER ECR 18503 ON VO-1 & VO-2. RFI RETESTED OK.
34816	4-24-75	2002	203	1	4	FOUR SPIKES, 10 PK ON S/C RCVR SPE AND DPE. NO DEGRADATION OF RFS PERFORMANCE. USE AS IS.
34820	4-28-75	2102	002	1	2	SPURIOUS NOISE SIGNALS ON RCVR 1 & 2 DPE. SIGNAL SOURCE UNKNOWN. NO PERFORMANCE DEGRADATION. NO OSCILLATIONS DURING AIR LINK. UAI.
34830	5- 9-75	2016	VO-2	1	3	PLAYBACK ANOMALIES ON TRK 2 & TRK 6 OF DTR B. NORMAL SYSTEM OPERATION. ONLY 4 LINES LOST.
34835	5-13-75	2010	005	1	2	TRANSDUCERS INDICATING ABNORMAL PRESSURES. DUE TO LIGHTNING INDUCED MONITERING EQUIP PROBLEMS. ASSIGN S/N 005 S/S TO SPARE STATUS. ALL OTHER TRANSDUCERS CHECKED OK.
34838	5-20-75	2017		2	3	DUAL FREQ ROTARY JOINT #012. WOW OUT OF SPEC. DUE TO CONNECTOR LOOSENESS. REWORK & RETEST.

Table 11. VO-2 Launch Operations P/FR Summary (2 of 3)

PFR NO.	PFR DATE	S/S	S/N	F C	O R	SUMMARY
34842	5-23-75	2077	VO-2	1	3	LO PRESS MOD PRESSURE WENT FROM 35 TO 5 PSI. LEAKAGE WITHIN SPEC. PRESSURE LOSS UNEXPLAINED REPLACE LPM #007 WITH SPARE LPM #003.
34843	5-30-75	2038	005	2	1	IRTM THERMAL BLANKET OVERLAPPED APERTURE. MODIFY ALL THERMAL BLANKETS. NO OVERLAP.
34845	5-30-75	2000	VO-2	1	4	CONE OFFSET OF IRTM #005 LOS EXCEEDS SPEC. EXACT CAUSE UNKNOWN. VERIFY ALIGN IN FLT.
34858	6-22-75	2017		2	3	HGA INSERTION LOSS VARIATION (WOW) OFF SPEC. REWORK CONNECTORS PFR ECR 18179. RETEST OK.
34861	7- 1-75	2000	VO-2	2	3	MINUTE PARTICLES ON BUS BLANKET, S/C AT SAEF. CLEAN & REINSPECT OK. CHK FACILITY CLEANING.
34869	7-29-75	2000	VO-2	2	3	CCS ISSUED SAFEING EVENTS & ENTERED ACE CHG. PRECOUNTDOWN PROCEDURES HAVE BEEN CHANGED.
34871	7-29-75	2103		2	2	MODULATION TO RFS-SE WENT OFF. AUTO CMD MODE. REWORKED COLD SOLDER JOINT IN CCS DRAWER. MODIFY CCS TO DISABLE RESET FUNCTION.
34872	7-29-75	2000	VO-2	2	2	EXTERNAL EMI INCIDENT SIMILAR TO PFR 34859. NO ACTION TO FLT HDW. RRS/RTS TO BE TURNED ON IN FLT TO DETERMINE BACKGROUND UHF NOISE.
34874	8- 1-75	2004	VO-2	2	1	BOTH BAT CHGRS SWITCHED TO LO RATE @ DC-75A1. SAME ANALYSIS & CLOSURE ACTION AS PFR 35304.
34875	8-17-75	2105	VO-2	2	1	SE STOPPED PROCESSING. DIRECT MEMORY LOADING. REPLACED DRUM POWER SUPPLY #01. RETESTED OK.

Table 11. VO-2 Launch Operations P/FR Summary (3 of 3)

PFR NO.	PFR DATE	S/S	S/N	FC	OR	SUMMARY
34876	8-10-75	2000	VO-2	2	1	NO CLASS 100 AIR TO SHROUD PAYLOAD FOR 7 HRS. DUE TO HEPA FILTER MALFUNCTION. REPLACE FILTER & RECERTIFY A/C SYSTEM. CLEAN VO-2.
34877	8-13-75	2000	VO-2	3	1	PWR S/S KINETIC SWITCH IN BATTERY ON POSITION. NONE OF FLT S/S DEGRADED EXCEPT FLT BATTERIES. REPLACED BATTERIES. CHANGE SE CONFIGURATION.
34879	8-23-75	2000	VO2(B)	1	3	CCS SAW 2 PWR FAILURES WHEN 6A1R ISSUED. PFR 34869 ACTION PRECLUDES HARMFUL EFFECT OF BLOWING A/C GAS. OPERATION WAS NORMAL.
34881	8-28-75	2000	VO-2	1	2	LARGE VARIATIONS NOTED IN PRS TLM DATA. PROBABLY DUE TO TEMP RELATED PHENOMENA OF CENTAUR RADIO. PERFORMANCE NORMAL. UAI.
34882	8-29-75	2017	VO-2	2	2	RCVR 1 & 2 2-3 DB LOW IN THRESHOLD. HI GAIN. REPLACED HGA. DFRJ'S & COAXIAL CABLES BETWEEN RFS & HGA. TEST SHOW NO H/W DEGRADATION.
34883	9- 1-75	2104		1	2	CONTROL ENA/RESET CMD NOT ACCEPTED AT LC-41. PROBLEM DID NOT RECUR. NO FURTHER ACTION RQD.
34885	9- 6-75	2000	VO-2	2	3	2 PIECES OF TEFLON LINER MISSING FROM FLEXHOSE UNABLE TO FIND MISSING PIECES. LAUNCH "AS IS".

Table 12. VO-3 Launch Operations P/FR Summary

PFR NO.	PFR DATE	S/S	S/N	F C	O R	SUMMARY
35016	8-15-75	2106	3	2	1	CANBERRA CASSETTE UNIT BLOWS FUSES. REPLACED DEFECTIVE CASSETTE WITH SPARE.

APPENDIX A

GLOSSARY

APPENDIX A
GLOSSARY

ACE	attitude control electronics
ACS	attitude control subsystem
AFETR	Air Force Eastern Test Range
AGC	automatic gain control
AGE	aerospace ground equipment
AHSE	assembly, handling, and shipping equipment
AO	Building AO (AFETR Spacecraft Checkout Facility)
A/PW	analog to pulse width
ARTC	articulation control subsystem
B/R	booster-regulator
BCE	bench checkout equipment
BOB	breakout box
CABL	cabling subsystem
CC	coded command
CCS	computer command subsystem
CCWG	Contamination Control Working Group
CDU	command detector unit
CRS	central recorder subsystem
CTA-21	Compatibility Test Area 21 (DSN)
CT	Canopus tracker
CTS	central timing subsystem
DAPU	data acquisition and processor unit
DC	discrete command
DCT	data compatibility test
DEV	mechanical devices subsystem
DN	data number
DFRJ	dual-frequency rotary joint
DSN	Deep Space Network
DSS	data storage subsystem
DTM	developmental test model
DTR	digital tape recorder

ECI	Engineering Change Instruction
ECR	Engineering Change Request
EMC	electromagnetic compatibility
ETL	Environmental Test Laboratory (JPL)
ESA	Explosive Safe Area (AFETR)
ETR	Eastern Test Range
EMI	electromagnetic interference
E^2M^2	emergency early midcourse maneuver
EXC	exciter
FA	flight acceptance
FC	failure criticality
FCT	flight compatibility test
FDS	flight data subsystem
FED	flight events demonstration
GMT	Greenwich Mean Time
HGA	high-gain antenna
IC	integrated circuit
IRTM	infrared thermal mapper subsystem
IRU	inertial reference unit
ITL	integrate-transfer-launch
JPL	Jet Propulsion Laboratory, Pasadena, CA
KSC	Kennedy Spaceflight Center
LCET	launch complex equipment trailer
LP	low pressure
LP-41	launch pad at AFETR
LPM	low pressure module
LRC	Langley Research Center
L/V	launch vehicle
MAWD	Mars atmospheric water detector subsystem
MDS	modulation demodulation subsystem
MIL-71	Merrit Island Launch Area (DSN/STDN station)

MOI	Mars orbit insertion
MMC	Martin-Marietta Corporation
MTC	Mission and Test Computer
MTCF	Mission and Test Computer Facility
MTCS	mission and test computer system (MTCF)
MTVS	mission and test video system (MTCF)
OPAG	Orbiter Performance Analysis Group (at JPL)
OR	orbiter risk
PAU	propulsion actuator unit
PCE	power conversion equipment
P/FR	Problem/Failure Report
PROP	propulsion subsystem
PSU	pyrotechnic switching unit
PTO	proof-test orbiter (VO-1)
PWR	power subsystem
PYRO	pyrotechnic subsystem
QA	quality assurance
RAS	relay antenna subsystem
R-C	resistance-capacitance
RCA	reaction control assembly
RCVR	receiver
RF	radio frequency
RFS	radio frequency subsystem
R&R	removal and reinstallation
R/RC	removal/recertification form
RRS	relay radio subsystem
RTG	radioisotope thermoelectric generator
RTS	relay telemetry subsystem
RX	receiver
SAEB	Spacecraft Assembly and Encapsulation Building (SAEF)
SAEF	Spacecraft Assembly and Encapsulation Facility (AFETR)
SAF	Spacecraft Assembly Facility (JPL)

SCF	Spacecraft Checkout Facility (AFETR)
SCR	Software Change Request
SE	support equipment
SEC	solar energy collector
SNORE	signal-to-noise ratio estimator
SRT	system readiness test
STC	system test complex
S&A	sterilization and assembly
S/C	spacecraft
S/N	serial number
S/S	subsystem
STRU	structure subsystem
STV	solar thermal vacuum
SVT	solar vacuum tests
TA	type approval
TIC	tape increment count (in DSS)
TMEM	transport-mounted electronic module
TMU	telemetry modulation unit
TOP	Test and Operations Plan
TWT	traveling wave tube
TWTA	traveling wave tube amplifier
UES	Universal Environmental Shelter
UHF	ultra-high frequency
VIS	visual imaging subsystem
VL	Viking lander
VLC	Viking lander capsule (including lander and bioshield)
VLCA	Viking lander capsule adapter
VMCCC	Viking mission computing and control center
VO	Viking orbiter
VO75	Viking 1975 orbiter
VSCA	Viking spacecraft adapter
XTX	X-band transmitter subsystem

APPENDIX B

REFERENCE DOCUMENTS

APPENDIX B
REFERENCE DOCUMENTS

The following JPL documents contain information useful to understanding the Viking orbiter 75 system test program:

1. Documents

612-22	Viking 75 Orbiter, Test and Operations Plan
612-23	Viking 75 Orbiter, Problem Failure Reporting and Analysis Program
M75-146-2B	Viking Launch Operations Design Book

2. Procedures

VO75 100	Assembly
VO75 106	Transportation Between Pasadena and Air Force Eastern Test Range
VO75 123	Propulsion Subsystem Handling and Transportation

NASA — JPL — Coml., L.A., Calif.