[redacted]

UNCLASSIFIED

VWZE 4-2-04

1701

LAUNCH REPORT

LV-2A/395 SS-01A/1604

PMR OPERATION NO. 2921 - "NICE BIRD"

Lucius A. Perry Jr.

LUCIUS A. PERRY, JR., COL., USAF

DEPUTY COMMANDER FOR SPACE SYSTEMS

6595TH AEROSPACE TEST WING

Vandenberg Air Force Base, California

15 May 1964

DOWNGRADED AT 3-YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

This material contains information affecting the National Defense of the U.S. within the meaning of the Espionage Laws (Title 18, U.S.C., sections 793&794), the transmission or revelation of which in any manner to an unauthorized person is prohib[illegible]

UNCLASSIFIED

Control No. 6595-64-2155

[redacted]

CONTENTS

[redacted]

SECTION II

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS.

1. A vehicle consisting of LV-2A booster stage (S.N. 39~~6~~5) and SS-01A orbital stage (S.N. 1604) was launched on the first attempt from Vandenberg AFB, Complex 75-3, Pad 4, at 1623:43.55 PDT on 27 Apr 1964. The primary launch objective, to place the SS-01A satellite with payload into a specified orbit was achieved.

2. The SS-01A electrical pyro system incurred a short circuit at separation. The malfunction was isolated to the lifeboat control junction box assembly, its input or output circuitry, or the C1S1 research payload (RP) lockout switch.

3. The telemetry system instrumentation schedule, LMSC DWG No. 1359017, dated 3 Feb 1964 and the final vehicle 1604 calibration book, dated 20 Mar 1964, were in error as to pyro current instrumentation. The confusion caused by this error resulted in delays and application of unnecessary man-hours to isolate and determine the nature of the electrical system malfunction.

4. Vehicle telemetry was left in the calibrate position during countdown due to an operator error.

5. The hydraulic power package temperature transducers and the gyro inertial reference package (IRP) block temperature transducer exceeded the calibrated band limits, although the temperatures were most likely well within the desired operating limits.

[redacted]

[redacted]

B. RECOMMENDATIONS.

1. Recommend the function and design of the lifeboat control junction box assembly and the C1S1 lockout switch be investigated.

2. Recommend that instrumentation be added to the SS-01A electrical system to further isolate these continuing electrical short circuits that occur at separation. Suggested points of instrumentation would be as current monitors at the input to the lifeboat control junction box assembly and key points within the lifeboat junction box.

3. Recommend that the telemetry system instrumentation schedule and final vehicle calibration book be amended before launch, to reflect as close as possible the true vehicle status.

4. Recommend that the range of the 28 VDC current monitor be increased from 50 to 100 amperes to give a better measurement for analysis of electrical malfunctions.

5. Recommend that the maximum transducer range of the hydraulic power package temperature and the gyro IRP block temperature be modified to preclude these transducer readings from exceeding band limits on nominal measurements.

[redacted]

[redacted]

[redacted]

SECTION II

EVALUATION

A. VEHICLE PREPARATION.

During the first dry count of the first stage, a slow slew condition was revealed. Special checks were then performed to determine the reason for the slow slew. During this special check the left vernier engine hung up in the yaw position. The trouble for both problems was traced to the control electronics assembly. The assembly was removed, lab-checked and the problems were resolved by the removal and replacement of the HIG Yaw Gyro and a D.C. amplifier located in the left vernier engine circuit. A successful dry countdown was then completed. During pre-launch testing of the second stage, it was necessary to replace the guidance cannister, DC-DC type X converter, and "H" timer.

B. COUNTDOWN HISTORY AND PAD DAMAGE.

1. The countdown was initiated at 0625 PDT on 27 Apr 1964 and proceeded to liftoff with two holds. Hold number 1 was imposed at T-60 minutes from 1453 to 1515 PDT to complete the replacement of the oxidizer fill line that had been leaking. Hold number 2 was imposed at T-15 minutes from 1601 to 1609 PDT to allow the pad crew to return to the pad to adjust the pneumatic regulators that were drifting.

2. Pad damage was normal for an LV-2A launch and the pad turnaround time can be maintained.

C. LAUNCH SUMMARY.

1. <u>Launch Objectives vs Results Attained.</u>

The objectives listed below are for the checkout and ascent phase of the test. The orbit phase lies beyond the scope of this report. A complete listing of the objectives can be found in the Systems Test Objectives (STO) for Program 162, document number LMSC-B001081-A.

Objective	Results	Comment
Primary Test Objectives		
1. Place payload in desired orbit.	Achieved	
2. Secure telemetered data for evaluation.	Achieved	

[redacted]

[redacted]

Objective	Results	Comment
3. In order to achieve the primary objectives it is mandatory that the 162 system shall provide or demonstrate the following capabilities:		
a. 162 Booster		
(1) Attain correct position at MECO.	Achieved	
(2) Attain correct velocity direction at MECO.	Achieved	
(3) Attain correct velocity magnitude at MECO.	Achieved	
(4) The BTL guidance system must maintain correct guidance and functional commands to the vehicle.	Achieved	
b. SS-01A Airframe and Adapter		
(1) Withstand guidance maneuvers and flight environment.	Achieved	
(2) Provide compatibility between booster and satellite stages.	Achieved	
c. SS-01A Propulsion System		
(1) Proper retro-rocket operation.	Achieved	
(2) Obtain impulse for orbital velocity.	Achieved	

[redacted]

[redacted]

OBJECTIVE	Results	Comment
(3) Demonstrate the capability for extended burn time.	Achieved	
d. SS-01A Electrical Power System must demonstrate acceptable performance.	Not achieved	Short circuit in SS-01A Pyro System.
e. SS-01A Guidance and Flight Control System.		
(1) Determine the time for orbital boost.	Achieved	
(2) Initiate and terminate orbital boost.	Achieved	
(3) Provide and maintain proper vehicle orientation.	Achieved	
(4) Provide and control the sequence of operations.	Achieved	
f. SS-01A Communications System.		
(1) Transmit continuous tracking signal.	Achieved	
(2) Receive and transmit radar tracing impulses.	Achieved	
(3) Control vehicle telemetry and S-band beacon operation.	Achieved	
(4) Accept and act upon ground commands.	Achieved	

[redacted]

[redacted]

Objective	Results	Comment
g. Aerospace Ground Equipment		
(1) Checkout booster and satellite stages.	Achieved	
(2) Control, monitor and power the 162 satellite and booster during countdown.	Achieved	
h. 162 System Facilities		
(1) Monitor vehicle functions to insure satisfactory flight.	Achieved	
(2) Produce adequate telemetry records of inflight data.	Achieved	
(3) Properly transmit and verify reception of all commands.	Partial	Pyro Power Problem
(4) Determine an orbit ephemeris.	Achieved	
(5) Provide interstation and intrastation communications.	Achieved	
4. Not applicable to ascent phase of operation.	N/A	

Secondary Test Objectives

Objective	Results	Comment
5. The 162 personnel must demonstrate the capability to:		
a. Calibrate and operate system checkout equipment.	Achieved	

[redacted]

[redacted]

[redacted]

[redacted]

Objective	Results	Comment
b. Operate SS-01A and payload consoles and related equipment.	Achieved	
c. Transport, checkout, mate, fuel, and launch the 162 vehicle.	Achieved	
d. Communicate within and between operating locations.	Achieved	
e. Accomplish checkout, launch, orbital and recovery, normal and emergency procedures.	Achieved	
6. Determine temperature of satellite structure and components.	Achieved	
7. Execute specialized tests.	Achieved	

2. First Stage.

a. Airframe - Performance of the airframe was satisfactory; however, the inherent oscillations of 16.5 to 19 cps occurred from T+114 until T+139 seconds respectively. The maximum peak-to-peak amplitude was 4.6 g's at T+132 seconds. Maximum loading of 7 g's occurred at T+132 seconds due to the combination of the steady state acceleration and the oscillations present.

b. Instrumentation - Turbine Inlet Temperature (Channel E, Segment 1, Link 28) - This transducer read high and out of band, starting at liftoff. The problem appears to be a circuit malfunction in the magnetic amplifier.

[redacted]

[redacted]

[redacted]

c. Aerospace Ground Equipment - The aerospace ground equipment for the first stage performed satisfactorily to support checkout and launch of the vehicle with one exception. A spurious liftoff signal was received by all stations outside the launch area, at approximately T-16 minutes. The liftoff monitor was reset properly at T-15 minutes.

3. <u>Second Stage.</u>

a. Electrical - Certain anomalies in the SS-01A electrical system telemetry data were observed prior to launch and at stage I/II separation command. The 28 VDC current monitor, channel 3, read approximately 48 amperes until T-0.4 seconds when it instantaneously returned to a normal level of 25 amperes. This apparent excessive current drain has been attributed to the SS-01A instrumentation in-flight calibration unit having been placed in the CAL HOLD mode from the blockhouse control console, as other telemetry channels connected to this unit were similarly affected. Umbilical separation at liftoff caused the external 28 VDC unregulated power to be removed and the calibration unit to be returned to a CAL OFF mode. Therefore, the high current flow shown on the monitor before liftoff is a false indication. From liftoff, and until about T+160 seconds, all electrical systems appeared to be normal. About 28 milliseconds after separation command, T+159.9 seconds, indications of large current surges were noted on the Agena 28 volt dc current monitor and the current indications remained at an off-band reading for about 800 milliseconds. For about 0.1 second after the separation command, exact electrical conditions are uncertain because of a telemetry drop-out which is normal. At recovery of the telemetry system, the shorted conditions still existed as shown by the current monitor indications. This large current surge, which exceeded the 50 amperes upper limit of the measurement range, was the result of a short circuit in the electrical system. A second 60 millisecond large current surge occurred at about T+161.7 seconds. The current continued erratic between 20 and 30 amperes until T+164 seconds after which the current returned to a normal value.

There is some speculation from simulation data taken at LMSC at Sunnyvale that the electrical system damage occurred as a result of detonation shock from the separation primacord. This is pure speculation as there is no evidence in the launch data that the primacord performed abnormally. It may be advisable for instrumentation of the SS-01A engine cone area to determine the shock from detonation of the separation primacord. Every possible malfunction cause, however slight, should be thoroughly investigated where practical. Simultaneously with the first current surge, the pyro bus voltage dropped from a 28.6 volt indication to about 17.9 volts. After 0.6 seconds at 17.9 volts, the pyro bus indication dropped to a zero bandwidth reading on telemetry indicating a value of less than 17.2 volts. During this same period the indication of pyro current

[redacted]

[redacted]

as listed in the telemetry system instrumentation schedule, LMSC DWG No. 1359017 dated 3 Feb 1964 and in the Final Vehicle 1604 calibration book, dated 20 Mar 1964, was about 9 amperes, the value it remained at throughout the entire flight. These two instrumentation documents were in error as the vehicle pyro current monitor point had been modified as directed by a LMSC engineering order. The modified instrumentation was such that pyro current was not indicated on telemetry and this monitor point indicated only a voltage to simulate a fixed meaningless reading. Thus this launch was without a telemetry reading of pyro current, so with the large current drain and with the drop of, and probably loss of, pyro bus voltage indication it is most likely that the short circuit occurred in the pyro circuit. The events that occurred in the pyro system isolate the failure to the lifeboat control junction box assembly, its input feeder line from the pyro bus, or its output circuitry. The single pyro voltage monitor point was installed in the lifeboat junction box. The occurance of pyro events subsequent to the anomalies at separation, such as ullage rocket ignition, rocket motor ignition, etc., indicate that the integrity of the main pyro power distribution system remained intact. Therefore, it can be deduced that the pyro buss feeder line to the lifeboat junction box may have opened due to the short circuit in the lifeboat junction box or its output circuitry. Electrical simulation studies by LMSC at Sunnyvale were reported to have duplicated the current and voltage flight indications by shorting out DRP lockout switch C1S1. This does not explain the reported lack of switched pyrotechnic voltages which would better be explained by a malfunction in wiring such as at plug C1P500A. Circuitry indicates other short circuits in this area of the pyro system could also cause the same indications. The DRP payload, which receives its pyro power from this junction box, was eliminated as being a contributory factor to the malfunction because its power is routed through the C1S1 adapter switch which should not normally be closed until separation complete. A short in the C1S1 switch or its lead-in wires would require other shorting such as in the C1P500A plug to explain the lack of switching in the pyrotechnic voltages. From the initial short the current drain was high and fluctuating,as if it was an arcing short, until ullage rocket burn at T+164.1 seconds where the current made a recovery. Ullage acceleration may have opened the short circuit, but it is more likely that the circuit burned an open at this time. Without more extensive instrumentation, it is impossible to pinpoint the area of malfunction more accurately in the lifeboat junction box, C1S1 switch, or the associated circuitry and thus pin down an accurate possibility of cause.

b. Instrumentation -

(1) During Phase IV of the terminal count, vehicle calibrations from the blockhouse were manually introduced into the telemetry system in order to calibrate certain continuous channels on Link 1. At T-0.35 sec this calibrate voltage was removed and the affected channels returned to nominal values.

[redacted]

(2) No. 3 Battery Temperature (17-01-23): This transducer was reading high and out of band at approximately 5.9 v throughout the flight. The problem appears to be a circuit malfunction.

(3) Hydraulic Power Package Temperature (12-01-27): The range of this transducer is calibrated from -26 deg F to +197 deg F. Since the pump has the capability of operating as high as +225 deg F and usually not below 50 deg F, the range of this transducer should be displaced upwards approximately 50 deg F. Presently, the T/M readout for this measurement approaches 0.5 v and calibrations beyond 0.4 v are invalid.

(4) Gyro Block Temperature (17-01-14): This transducer was reading high and out of band at approximately 5.1 v. The range is calibrated from -54 deg F to +137 deg F. Data from previous vehicles show this measurement to read approximately 145 deg F. The T/M voltage monitor for this transducer is calibrated between 3.7 v and 5.0 v (corresponding to -54 deg F and +137 deg F respectively). Data appears valid, however the transducer range should be corrected.

c. Aerospace Ground Equipment - The aerospace ground equipment for the second stage (LMSC) performed satisfactorily to support checkout and launch of the vehicle with the following exceptions:

(1) The oxidizer fill line developed a leak under its metal shroud. Replacement of the line was necessary, thus causing a hold in the countdown.

(2) The pneumatic regulators were drifting out of specifications during the terminal count which requires the dispatching of a pad crew to make adjustments.

(3) The dehumidifier on a Type 4 air conditioner on the pad malfunctioned and the air conditioner was replaced by a substitute unit.

(4) A hand load valve on the pad helium supply equipment malfunctioned and was replaced.

(5) A helium regulator, also on the pad helium supply equipment, malfunctioned and was replaced.

(6) A leak occurred at a fitting on the guidance gas pressurization supply trailer, but it was determined to be insufficient to delay the countdown for repairs.

(7) When the air conditioning was turned on, the oxidizer sniffer indicated full scale. Evaluation indicated that oxidizer fumes remained in the lines after the oxidizer circulation pump was replaced before countdown initiation.

(8) Spurious side band signals were observed from -10 to +20 KC on SS-01A Link 2 due to excessive signal strength received by the tracking station. This is a normal close-proximity reception and the condition is relieved after liftoff.

4. Launch Support - Photography -

a. A review of quick-look prints and a critique of original films by the Film Services Unit of engineering sequential photography and documentary photography revealed that IRIG-B timing was used on pad and tracking cameras. However, on all pad cameras reviewed by this office, (item 11.1, 11.2, 11.5, 11.9, 11.15 and 11.16) timing was garbled. Marker pulses were absent, and all liftoff times, though the same, were meaningless. The following additional discrepancies were noted:

(1) Lost in processing; not delivered

(a) Item 11.6 (high speed surveillance)

(b) Item 11.8 (umbilical ejection)

(c) Item 12.A (ignition and liftoff)

(d) Item 11.25 (tracking)

(2) Timing absent

(a) Item 11.4 (surveillance)

(b) Item 11.7 (umbilical ejection)

(c) Item 11.11 (ignition and liftoff)

(d) Item 11.13 (ignition and liftoff)

(3) Timing weak

(a) Item 11.15 (lower missile and launcher-liftoff)

(b) Item 11.23 (tracking)

(4) Scratched

(a) Item 11.4 (surveillance)

(b) Item 11.23 (tracking)

(c) Item 11.24 (tracking)

(d) Item 12.1 (tracking)

(e) Item 12.2 (tracking)

(5) Dirty Aperture

(a) Item 11.1 (surveillance)

(b) Item 11.5 (high speed surveillance)

(c) Item 11.23 (tracking)

(d) Item 11.24 (tracking)

(e) Item 12.2 (tracking)

(6) Broken perforation; not delivered

(a) Item 11.12 (ignition and liftoff)

(7) Obstruction in upper corners of frame

(a) Item 11.4 (surveillance)

(8) Spurious circular image

(a) Item 12.3 (tracking)

(9) Over-exposed print

(a) Item 11.9 (umbilical ejection)

(10) Image not centered

(a) Item 11.16 (blast effects against base mast)

(11) Erratic tracking

(a) Item 11.21 (tracking)

(b) Item 11.22 (tracking)

(c) Item 11.23 (tracking)

In view of the timing problems, loss of film in processing, and an abundance of poor picture quality, photographic support for this mission was unusually poor. No items of documentary photography were delivered.

APPENDICES

PREPARATION AND HISTORY

A. FIRST STAGE.

20 Jun 63	Booster 395 arrived.
24 Jun 63	Receiving inspections were completed.
2 Jul 63	Booster subsystems modifications were started.
8 Jul 63	Primacord installation was completed.
18 Jul 63	Booster subsystems modifications were completed.
29 Jul 63	Booster continuity checks were completed and hydraulic checks were started.
30 Jul 63	Telemetry modifications and hydraulic checks were completed.
1 Aug 63	Command destruct tests were completed.
6 Aug 63	Electrical checks and telemetry checks were completed.
8 Aug 63	An all-systems test was completed.
15 Aug 63	Booster 395 was weighed, secured, and transported to MAB 5 for post-checkout storage.
9 Oct 63	Booster 395 was transported to LE-2.
11 Oct 63	Booster indexing was completed and launcher checks with the booster were started.
16 Oct 63	Because of a change in launch schedule, booster 395 was demated and was placed in temporary storage in the pad shelter.
21 Oct 63	Booster 395 was returned to MAB 5 for storage.
28 Dec 63	The vernier engine actuators were removed for rework of the Cadillac valves.
2 Jan 64	Telemetry and electrical subsystem modifications were completed.

14 Jan 64	New vernier engine actuators were installed.
16 Jan 64	A rerun of hydraulic checks to verify vernier engine actuator replacement was completed.
22 Jan 64	Booster electrical checks and an all-systems test were completed. The booster was placed in post-checkout storage.
5 Feb 64	The main engine actuators were removed for rework.
12 Feb 64	A new main engine flame guard was installed.
26 Feb 64	The vernier engine actuators were removed for rework.
11 Mar 64	The feedback potentiometers on the vernier engine actuators were replaced.
16 Mar 64	Installation of main engine actuators was completed.
17 Mar 64	Hydraulic checks were rerun.
19 Mar 64	Booster electrical checks were rerun.
20 Mar 64	An all-systems test was completed.
23 Mar 64	Booster 395 was secured and transported to LE-4.
24 Mar 64	Booster indexing was completed and launcher checks were started.
25 Mar 64	Launcher checks were completed and booster leak checks were started.
3 Apr 64	Booster leak checks and hydraulic checks were completed.
10 Apr 64	Booster electrical checks were started.
14 Apr 64	Electrical checks were completed.
15 Apr 64	An all-systems test was completed.
17 Apr 64	A dry countdown was completed.
19 Apr 64	A single and dual propellant loading exercise was completed.
20 Apr 64	R-5 day preflight procedures were completed.

21 Apr 64	A dry countdown and phasing and polarity checks were completed.
22 Apr 64	R-3 day preflight procedures were completed.
23 Apr 64	Special checks revealed a bad HIG yaw gyro and the flight controller was removed and sent to the lab.
24 Apr 64	The flight controller was reinstalled and a dry countdown was completed.
25 Apr 64	R-2 day preflight procedure was completed. The phasing and polarity test were also completed.
26 Apr 64	R-1 day preflight procedures were completed and the solid motors were mated.
27 Apr 64	Booster 395 was successfully launched.

B. SECOND STAGE.

11 Mar 64	Vehicle arrived at VAFB and the receiving inspection was performed.
12 Mar 64	SS/B checks, guidance module cleanup and installation, and SS/D validations were performed.
19 Mar 64	Telemetry functional checks were begun, the pitch actuator was replaced, and the Brayco and hydraulics checks were re-run.
20 Mar 64	Telemetry functional checks were completed.
23 Mar 64	Voltage standing wave ratio checks were performed.
24 Mar 64	Magnetometer was sent to magnetometer range; pneumatic cleanliness verification was performed; Discoverer Research Payload (DRP) fit checks (aft panel only), booster adapter fit check, destruct checks, and D-timer sequence settings were performed.
25 Mar 64	Alignments were performed.
26 Mar 64	Payload monitor capability checks were performed.
27 Mar 64	Sequence timer functions leak checks were performed.
30 Mar 64	Magnetometer range checks were performed and the vehicle returned to the MAB.

31 Mar 64	Sequence timer leak checks and battery fit checks were performed.
1 Apr 64	DRP fit checks, booster adapter fit checks and destruct checks were performed.
3 Apr 64	Cleanup and modifications were performed.
8 Apr 64	Helium control valve functional tests were performed.
9 Apr 64	D-timer pressure checks and MAB finals were performed.
10 Apr 64	Pneumatic leak checks were performed.
11 Apr 64	Engine functional checks were performed.
13 Apr 64	Compatibilities were performed.
14 Apr 64	DRP fit checks (2 panels), advanced payload and adapter ring fit checks were performed and the DC/DC converter was changed.
15 Apr 64	Douglas all-systems run was performed.
17 Apr 64	Systems run phase 1 and 2, and Douglas flow checks were performed.
20 Apr 64	Evaluation, engine servicing, premate pyrotechnics, and research payload installation were performed. Launch slipped one day due to advanced projects payload problems.
21 Apr 64	The booster adapter was installed and the vehicles were mated.
22 Apr 64	Douglas dry countdown and flush and purge, BTL phasing and polarity checks, and Douglas all systems run were performed.
23 Apr 64	Battery modifications, post-mate pyrotechnics, and destruct checks were performed.
24 Apr 64	Advanced payload was mated and the Douglas all-systems run was performed.
26 Apr 64	The solid motors were mated.
27 Apr 64	The vehicle was successfully launched.

DISTRIBUTION

QUANTITY	RECIPIENT
18	LMSC/VAFB, Calif
10	Douglas Aircraft Co., VAFB, Calif.
1	6595th ATW, (TWOCE) Sunnyvale, Calif.
1	NASA, (Test Support Office) P.O. Box 435, Lompoc, Calif.
1	SSD (SSVXE) AF Unit Post Office, Los Angeles 45, Calif.
1	SSD (SSVAE-1)
1	SSD (SSVAE-2)
1	SSD (SSZD)
1	6595th ATW (VWZD), VAFB, Calif.
1	Air Force Western Test Range Attn: WTSO, VAFB, Calif.
1	Naval Missile Facility Point Arguello, Lompoc, Calif.

[redacted]

DECLASSIFIED IAW E.O. 12958
REVIEWED
BY Sh
DATE 9 June 98

[redacted]

File R+D 12-4 HB

UNCLASSIFIED

VWZE 4-2-02

170P

LAUNCH REPORT

LV-2A/396 SS-01A/1175

LUCIUS A. PERRY, JR., COL., USAF
DEPUTY COMMANDER FOR SPACE SYSTEMS
6595TH AEROSPACE TEST WING
Vandenberg Air Force Base, California

13 Apr 1964

DOWNGRADED AT 3-YEAR INTERVALS:
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

This material contains information affecting the National Defense of the U.S. within the meaning of the Espionage Laws (Title 18, U.S.C., sections 793&794), the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

UNCLASSIFIED [redacted]

CONTROL NO. 6595-64-1494

CONTENTS

[redacted]

[redacted]

[redacted]

[redacted]

SECTION I

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS.

1. A vehicle consisting of LV-2A booster stage (S.N. 396) and SS-01A orbital stage (S.N. 1175) was launched from Point Arguello launch complex 1, Pad 1, on 24 Mar 1964. This was the first launch of a vehicle of this combination from this complex. The primary launch objective, to place the SS-01A satellite with payload into a specified orbit was not achieved. This was caused by a failure of the SS-01A. All first stage booster systems performed satisfactorily.

2. The leak indicators (sniffers) have erroneously indicated leaks on several occasions, thereby holding up the countdown at critical times.

3. Data indicates that a short circuit occurred in the subsystem "C" electrical system. This first short circuit has been traced to the Type IX dc/dc converter. The original malfunction probably caused further deterioration of the electrical system until complete loss of regulated 28 volt dc power to the guidance module occurred.

4. After VECO, but prior to T+231 seconds, performance of the second stage flight control system had deteriorated due to a degraded output of the Type IX dc/dc converter but adequate attitude control of the vehicle was maintained. Subsequent to T+231 seconds, when complete loss of the Type IX dc/dc converter regulated output voltage occurred, portions of the flight control system ceased to function and a catastrophic loss of vehicle attitude control resulted.

B. RECOMMENDATIONS.

1. The reliability of the leak indicators (sniffers) should be improved so that only actual leaks are reported.

2. Recommend Lockheed Missile and Space Company (LMSC) engineering staff study the physical integrity of Type IX dc/dc converter components for possible weak or failure prone parts. Consideration should be given to near vacuum environment, event shocks, acceleration forces, 20 cps vibrations, rain water and effect of condensation moisture.

[redacted]

[redacted]

3. Recommend the LMSC Engineering staff perform an investigation of the horizon sensor fairing pin pusher assembly for possible reasons of plug or case failure. Also LMSC should conduct tests to simulate the damage that would give indications as observed, in the electrical system of vehicle 1175, during flight.

4. Recommend steps be taken to improve the Type IX dc/dc converter regulated power supply to prevent permanent loss of regulated voltage to the guidance module.

[redacted]

[redacted]

[redacted]

SECTION II

EVALUATION

A. VEHICLE PREPARATION.

On 21 Mar 1964, problems in the SS-01A flight controller caused the launch to be postponed 24 hours.

B. COUNTDOWN HISTORY AND PAD DAMAGE.

1. The countdown was initiated on schedule at 0335 PST, 24 Mar 1964 and proceeded to liftoff with three technical holds. At T-14 minutes the LV-2A gyro heaters were not cycling properly; therefore, hold number one (DAC) was imposed from 1347 to 1400 to increase electrical power to the heaters. This provided proper cycling. The second hold (BTL) was imposed in Phase III of the terminal count from 1404 to 1406 to recycle the guidance loop checks. In Phase V of the terminal count a third hold (LMSC) was imposed from 1417 to 1421 when the SS-01A fuel sniffer indicated a leak.

2. Pad damage was greater than previously encountered for launches from Complex 75. This was the first LV-2A launch from PALC-1, Pad 1 and the increased blast created by the solid motors burned through several pipes around the base of the launch stand. The pad turnaround time will not be affected by the repairs to the pad. Approval is being sought for the removal of GDA Aerospace Ground Equipment so that Douglas Aircraft Co. (DAC) can proceed with modifications to reduce pad damage in future launches.

C. LAUNCH SUMMARY.

1. <u>Launch Objectives vs Results Attained.</u>

The objectives listed below are for the checkout and ascent phase of the test. The orbit phase lies beyond the scope of this report. A complete listing of the objectives can be found in the Systems Test Objectives (STO) for Program 162, document number LMSC-B001081-A.

[redacted]

[redacted]

[redacted]

[redacted]

Objective	Results	Comment
Primary Test Objectives		
1. Place payload in desired orbit	No	
2. Secure telemetered data for evaluation	Yes	
3. In order to achieve the primary objectives it is mandatory that the 162 system shall provide or demonstrate the following capabilities:		
a. 162 Booster		
(1) Attain correct position at MECO	Yes	
(2) Attain correct velocity direction at MECO	Yes	
(3) Attain correct velocity magnitude at MECO	Yes	
(4) The BTL guidance system must maintain correct guidance and functional commands to the vehicle	Yes	
b. SS-01A Airframe and Adapter		
(1) Withstand guidance maneuvers and flight environment	No	Payload separation due to severe tumbling.
(2) Provide compatibility between booster and satellite stages	Yes	

[redacted]

[redacted]

[redacted]

[redacted]

Objective	Results	Comment
c. SS-01A Propulsion System		
(1) Proper retro-rocket operation	Yes	
(2) Obtain impulse for orbital velocity	No	Vehicle shutdown 205.5 seconds after ignition.
(3) Demonstrate the capability for extended burn time	No	Same as above.
d. SS-01A Electrical Power System must demonstrate acceptable performance	No	A type IX dc/dc converter failed 28 milli seconds after VECO
e. SS-01A Guidance and Flight Control System		
(1) Determine the time for orbital boost	Yes	This time was invalid.
(2) Initiate and terminate orbital boost	No	Boost terminated prematurely by fuel starvation.
(3) Provide and maintain proper vehicle orientation	No	Steering orders were not effective.
(4) Provide and control the Sequence of operations	No	Steering sequential commands were not accepted by the vehicle.
f. SS-01A Communications System		
(1) Transmit continuous tracking signal	Yes	
(2) Receive and transmit radar tracing impulses	Yes	
(3) Control vehicle telemetry and S-band beacon operation	Yes	

[redacted]

[redacted]

Objective	Results	Comment
(4) Accept and act upon ground commands	No	
g. Aerospace Ground Equipment		
(1) Checkout booster and satellite stages	Yes	
(2) Control, monitor and power the 162 satellite and booster during countdown	Yes	
h. 162 System Facilities		
(1) Monitor vehicle functions to insure satisfactory flight	Yes	
(2) Produce adequate telemetry records of inflight data	Yes	
(3) Properly transmit and verify reception of all commands	Yes	
(4) Determine an orbit ephemeris	N/A	
(5) Provide interstation and intrastation communications	Yes	
4. N/A		

Secondary Test Objectives

Objective	Results	Comment
5. The 162 personnel must demonstrate the capability to:		
a. Calibrate and operate system checkout equipment	Yes	

Objective	Results	Comment
b. Operate SS-01A and payload consoles and related equipment	Yes	
c. Transport, check-out, mate, fuel, and launch the 162 vehicle	Yes	
d. Communicate within and between operating locations	Yes	
e. Accomplish checkout launch, orbital and recovery, normal and emergency procedures	Partial	
6. Determine temperature of satellite structure and components	Partial	
7. Execute specialized tests	Yes	

2. First Stage.

a. Airframe - Performance of the airframe was satisfactory; however, the inherent oscillations of 17 to 20 cps occurred from T+120 until T+144 seconds respectively. The maximum peak-to-peak amplitude was 3.8 g's at T+138 seconds. Maximum loading of 7.1 g's occurred at T+138 seconds due to the combination of the steady state acceleration and the oscillations present.

b. Instrumentation - Strain gage #2 Rail #1 on FM Chan #13 failed to return any data.

c. Aerospace Ground Equipment - At liftoff the umbilical mast did not retract. This was caused by rust or sludge on a collar associated with the uprange hydraulic cylinder, preventing the activation of the mast uprange "B" cylinder lock-unlock switch.

3. Second Stage.

a. Spaceframe - Accelerations - After the loss of control at T+227 seconds, unusual accelerations were noted. A moderate transient on each of the acceleration traces, x, y, and z, and oscillations on the "R" axis magnetometer indicated tumble between T+230 and T+250 seconds. Indications of spinning at a varying rate with a very slow tumble rate occurred between T+250 and T+360 seconds. At T+360 seconds the spin rate decayed and the acceleration traces indicated the vehicle started to tumble violently. At T+372.2 seconds the payload monitor suddenly dropped from a 1 volt to a 0 volt level indicating a structural failure and the separation of the forward payload from the vehicle. At the time of structural failure the tumble rate was one cps.

(2) Pyrotechnics - There is no direct evidence of abnormal performance; however, there is a possibility that the plug in the horizon sensor fairing pin pusher was blown out causing damage to the type IX regulated power supply.

b. Propulsion - The propulsion system performed satisfactorily from ignition to T+376.43 seconds, when it experienced premature shutdown. Engine shutdown was caused by fuel starvation due to tumbling of the vehicle. Fuel tank pressure showed an abnormal increase immediately before shutdown and fuel pump inlet pressure decreased during this same period. This is an indication of fuel sloshing in the tanks. All other propulsion parameters remained near nominal until this time.

c. Electrical - An SS-01A electrical power problem developed, near VECO, at T+157.76 seconds, with a drop in the plus and minus 28 volt regulated dc indications and a noteable current drain. From this point on further deterioration of the electrical system occurred until loss of plus and minus 28 volt dc rendered the guidance system ineffective. This resulted in loss of control and the vehicle went into unusual attitude and was lost.

Until umbilical disconnect at T-0.4 sec, the 28 volt dc current monitor showed periodic fluctuations of about 7 amperes at a rate of the commutated wave train. This was apparently due to the AGE problems and it does not appear to be related to any inflight problems.

At T+157.76 seconds, 28 milliseconds after the VECO signal, the missile unregulated 28 volt dc current monitor indicated a moderate abnormal increase of bus current from 19 amperes to a value of 29 amperes. At this same time the plus 28 volt dc regulated voltage showed a drop of about 4 volts while the minus 28 volt dc regulated voltage dropped to a value less than 21 volts. This indicates that a failure and short circuit occurred in the type IX dc/dc converter or one of its output circuits. Events that should have occurred at VECO were uncaging of the signal IRP gyros, arming of the separation circuit, sending signals for horizon sensor shroud ejection, and disarming of the Agena destruct backup circuit. Considering the switching at these events, only unregulated 28 volt dc is actually switched and this should not have directly changed the output load on the type IX converter. With the regulated voltage drop this increase of about 250 watts of power appeared to be as an overload on the type IX converter. The type IX converter is designed for a peak output of 60 watts in the plus 28 volt dc circuit and 20 watts in the minus 28 volt dc circuit. This first power drain would likely overload the type IX converter and could cause a failure of the converter input circuity.

At T+159.2 seconds the current drain increased to a value in excess of 50 amperes and was estimated to be about 160 amperes for a peak value. At this point the 28 volt dc unregulated bus voltage dropped to about 12.5 volts indicating a severe short most likely in the unregulated bus, wiring to the type IX dc/dc converter, or in the input components of the type IX dc/dc converter. Such a short in one of the converters astable multivibrator circuits might cause these indications. When such a short burned an open circuit in one multivibrator channel the other multivibrator channel could continue to supply the converter transformer and partial recovery of the system would be explained. This could possibly be a transistor failure.

At T+168 seconds, during ullage rocket burn, electrical power distributions returned to normal for 1.4 seconds. After this brief recovery the type IX dc/dc converter output short was again indicated. Again it is possible that this output short loaded the circuit to cause at T+227.7 seconds a second short on the unregulated bus, lead-in wiring to the type IX converter or the input circuits of the converter. Such a short in the other astable multivibrator circuit might cause such indications as were received. With burnout of the second multivibrator at 232.9 seconds all output from the type IX dc/dc converter would go to zero. This was indicated by the plus and minus 28 volt regulated dc telemetry indications going to zero band width.

Further evidence of type IX dc/dc converter partial failure is the inability of the type IX converter to recover at T+163.5 seconds when unregulated bus read 26.0v. The converter should operate when supplied with an input voltage between 22.0 volts to 29.5 volts. The disturbance of the other electrical equipment was moderate and brief with full recovery to normal values.

Special diagnostic pyrotechnic bus measurements indicate that the main short was not the pyro bus but was between the main unregulated bus and structure ground. Additionally, the bus current voltage relationship indicates a very low resistance short and thus isolates the short to the forward portion of the vehicle. This also indicates the main short could not have been in the output of type IX dc/dc converter.

After the type IX converter failed completely the current monitor averaged between 11 and 22 amperes except for brief high current transients at T+297.7 seconds, from T+319.0 to T+323.3 seconds and from T+372.0 to T+372.5 seconds.

Because the initial short circuit in the type IX converter apparently caused the subsequent degeneration of the input circuitry, this malfunction should be investigated thoroughly. Possible causes of the short circuit are:

(1) Physical failure of the type IX dc/dc output transitors or circuitry.

(2) Water causing a partial short circuit in the converter components or the output circuitry.

(3) The failure of the horizon sensor fairing pin pusher with pieces of the pusher striking the type IX dc/dc converter case or output cable and causing damage that resulted as a short circuit.

With VECO all acceleration ceases and all components are in a weightless condition. Loose wiring or components could move at this point to cause a short circuit and initiate the malfunction.

VECO shock, another shock or the 20 cps vibrations may have induced aggravation of a pre-existing electrical or mechanical defect in the type IX converter and made the conditions for failure present. This seems the most likely failure occurrence.

A forward horizon sensor fairing squib may have ruptured causing damage to the type IX dc/dc converter or its cable. This is possible as approximately 28 millisecond delay followed the VECO signal to the first electrical failure indication. The type IX converter is in line with the back of the forward horizon sensor pin pusher squib. Also it is unlikely that incipient structural failure in the horizon sensor pin pusher case would be detected before launch.

Although wind and rain were prevalent during the thirty-six hours before launch, there seems to be only a small possibility that this was directly the cause of the malfunction because of the position of the type IX dc/dc converter, the protection given the missile on the stand, and the nature of the short circuit. Internal condensation seems more likely the cause of any water damage if present. The relative humidity reached as high as 93% during countdown. The nature of the failure does not make this as likely as the other two failures listed. The initial failure, electrical or pyrotechnic pin pusher, seems to be a random type failure.

d. Guidance/Flight Control -

(1) General - Available data indicates that performance of the second stage flight control system was nominal while in a standby status prior to VECO, T+157.70 seconds. After VECO but prior to T+227.6 seconds, performance had deteriorated due to a degradation of the +28 vdc regulated output of the type IX dc/dc converter but did provide satisfactory attitude control of the vehicle. At T+227.6 seconds, complete

[redacted]

failure of the type IX dc/dc converter rendered the flight control system, with the exception of the D-timer, ineffective, resulting in the loss of attitude control of the vehicle.

(2) Inertial Reference Package - The inertial reference package (IRP) gyros, operating in the caged mode, sensed changes in attitude throughout first stage powered flight. The gyros were uncaged at VECO and the data indicated that the IRP was responding normally to steering commands and was providing the proper signals to the pitch and yaw hydraulic actuators to make the required changes to the vehicle attitude until loss of the type IX dc/dc converter at T+227.6 seconds.

(3) Horizon Sensor - The horizon sensor fairings were programmed to be ejected by pyrotechnic actuators at VECO. The data subsequent to this time did not indicate normal pitch or roll horizon sensor outputs. Since the pitch output was erratic and the roll output remained near zero except for an indication of a minus roll error commencing at about T+208 seconds, which could be correlated with roll gyro and magnetometer data, it is not possible to determine definitely whether the impaired performance of the horizon sensor was the result of only one fairing being ejected or the degradation of the type IX dc/dc converter.

(4) Standard D-timer - The standard D-timer began its event sequencing control at MECO, T+148.80 seconds, when the brake was released, and provided the required event initiating signals at the proper times.

(5) Velocity Meter - The velocity meter was not enabled by a command from the ground guidance since the vehicle did not achieve the required spatial position and velocity. Engine shutdown occurred prematurely as a result of fuel starvation and a backup signal was provided by the D-timer.

(6) Attitude Control - Since the performance of the attitude control system and its telemetry monitors depend upon the balanced and regulated ±28 vdc, the quality of control was significantly affected. Adequate control was provided until the type IX dc/dc converter failed completely at 227.6 seconds, however two discrepancies were noted:

(a) Pneumatic control did not activate as expected at completion of separation. The gas valve current monitor indicated control was initiated 3.2 seconds after the separation switches involved in activating the pneumatics were tripped.

(b) The gas valve current monitor indicated that valves 1 or 3 and 2 or 5 operated continuously between 180.5 and 218.2 seconds. Any combination of two of these gas valves operating during this period of time would have imparted a spin [redacted] vehicle. Although the data

[redacted]

[redacted]

indicated that roll control was not being exercised due to saturation of the gas valves, neither the roll gyro nor magnetometer output data indicated the vehicle had acquired a spin rate. The operation of valves 4 and 6 in cluster 2 and valve 2 in cluster 1 would have given a similar indication on the gas valve current monitor and not have generated a roll torque. The gas valve cluster temperature data revealed that the cluster 2 temperature was decreasing at a faster rate than the cluster 1 temperature indicating that more gas was being expended from cluster 2. Gas consumption based on gas valve on-time (not considering the possibility of three valves operating at any one time) from separation to engine cutoff was 15 lb. The consumption based on temperature-pressure data was about 21 lb. This would further indicate that a third valve had been operating part of the time. However, this discrepancy could also be the result of errors inherent in calculating gas consumption in both methods and therefore is inconclusive. This foregoing condition is most likely the result of the unbalance between the + and - regulated 28 vdc power. Subsequent to the complete failure of the type IX converter, the vehicle began spinning and entered into a short period of tumbling which lasted until approximately T+250 seconds as indicated by the axial accelerometer and magnetometer data. The velocity also decreased (See Fig 1, Section II C, 4b) during this period of time, indicating a loss of net forward thrust along the flight path of the vehicle. Recovery from the tumble was effected as the spin rate increased and evidently positioned the engine near center. The spin rate appeared to vary, as indicated by the received signal strength, magnetometer data, and lateral and normal accelerometer data. The terminal phase of the flight occurred at T+360 seconds when the spin rate began decaying, causing the engine to move from center and the vehicle again entered into a tumbling motion that was of greater intensity than before, as reflected in the axial accelerometer and magnetometer data, since the moment of inertia had decreased as a result of fuel consumption. Fuel starvation finally caused engine shutdown at T+376 seconds.

Hydraulic pressure was maintained at a level of approximately 2850 psig during the thrust interval and permitted thrust vector control by the hydraulic actuators up to T+227.6 seconds.

e. Instrumentation - All measurements appeared to be producing realistic indications until the first severe short occurred at approximately T+160 sec. The commutators slowed down momentarily to 62 percent of their normal speed and then operated 4 percent slow for 47 seconds. After the second short at T+227 seconds and for the following 6 seconds the commutators reduced speed to about 80 percent of nominal. Except for two smaller transients at T+320 seconds and T+372 seconds, the commutators returned to an otherwise normal rate. The quantitative value of most guidance and control measurements were questionable after the initial short, in that these measurements and the associated signal conditioning depended upon the regulated plus and minus 28 volts which was far below normal.

[redacted]

f. Space Ground Communications - The Prelort radar satisfactorily tracked the S-band beacon from liftoff to 240 seconds. After 240 seconds, tracking was interrupted by periodic losses of the beacon signal due to gyrations of the vehicle and associated beacon. The Prelort radar was able to maintain automatic track until 353 seconds since the dropouts did not exceed the 3 second memory period of the tracking circuitry. The signal strength levels of the TLM-18 antenna system indicated vehicle instability after T+225 seconds of track. The amplitude modulated signal levels revealed 20 to 25 decible attenuation nulls at periodic intervals from 1 to 3 seconds; however, the detected signal at the null points still exceeded the noise level of the antenna system.

g. Aerospace Ground Equipment - The SS-01A fuel leak indicator (sniffer) erroneously reported a fuel leak during the terminal countdown. This indication apparently was due to the sensitive nature of the sniffer.

4. Command Guidance and Trajectory Analysis.

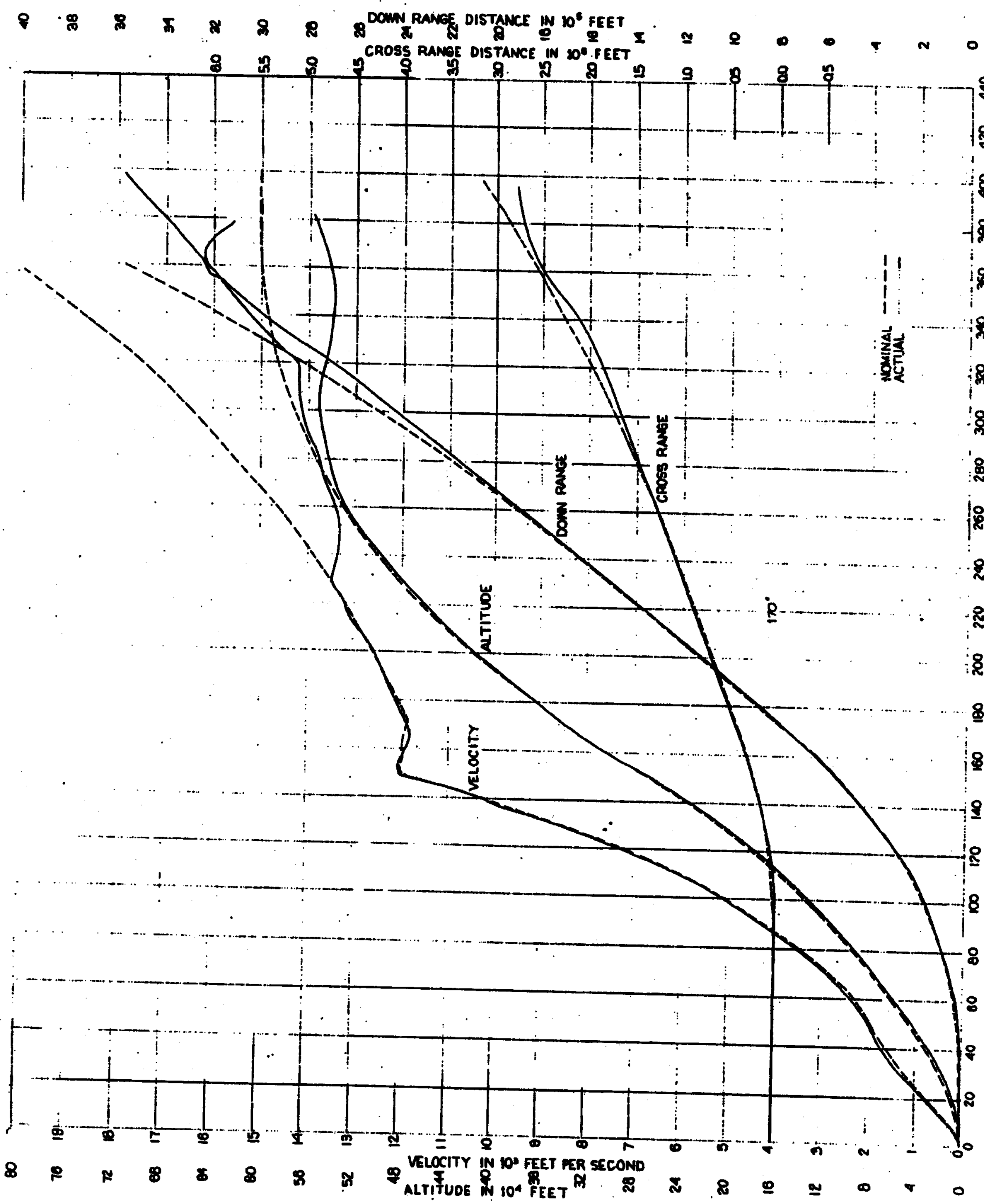
a. Command Guidance - The performance of the command guidance system was satisfactory during first stage guidance. Separation of the SS-01A vehicle from the booster was initiated by command at T+162.71 sec. Very light steering commenced at T+181.46 and continued until T+231 sec when space-ground communications experienced periodic interruptions. Despite poor guidance communications caused by the changing attitude of the vehicle, steering orders remained light until T+248 sec. Steering then increased to maximum amplitude but vehicle did not respond to these orders. Final loss of guidance track occurred at approximately T+400 seconds.

b. Trajectory evaluation based on a composite of BTL data, FPS-16 metric radar tabular data and PRELORT radar tabular data indicate near nominal trajectory until T+230 seconds (See Figure 1). Subsequently the velocity showed a decrease even with the SS-01A engine burning. By T+260 seconds a deviation of altitude and downrange plots was evident. The flight trajectory then rapidly diverged downward from the nominal altitude and corresponding changes occurred in the downrange and crossrange tracks. The computed SS-01A impact area was reported to be at 21° north latitude and 111.7° west longitude. The apparent loss of velocity from T+230 seconds to T+260 seconds correlates well with axial accelerometer and magnetometer outputs of the second stage during this time period which indicated a tumbling motion of the vehicle. The terminal flight phase began about T+360 seconds resulting in separation of the payload due to structural loading at T+372.2 seconds and engine shutdown at T+376 seconds.

5. Launch Support.

a. PMR Telemetry - Real-time and playback telemetric data was not fully satisfactory for evaluation of the Thor although the tracking and the tape recording were satisfactory. The last pre-calibrations on real-time

FIGURE 1
VEHICLE TRAJECTORIES



data were made one hour before liftoff. Pen recordings contained many pre and post-calibrations which were up to 2% in error. The instrumentation ground and 5-volt absolute were not adjusted during the flight.

b. Photography - Timing, when present, was garbled on all items of engineering sequential photography with the exception of item 11.20 (first stage engine section), which employed range timing. All garbled timing appeared to be IRIG-B. Other problems encountered were:

(1) Timing absent (items 11.7, 11.8A, 11.26).

(2) Time to frame references absent (items 11.5 and 11.20).

(3) Time to frame reference poor or unusable (item 11.8A, 11.23, and 11.25).

(4) Ignition not photographed (item 11.18).

(5) Dirty aperture (item 11.3, 11.24, 12.1).

(6) Poor focus (items 11.10 and 11.17).

APPENDICES

PREPARATION AND HISTORY

A. FIRST STAGE.

7-15-63	Booster 396 arrived, and was placed in position No. 1 at the RIM.
7-18-63	Receiving inspections were completed.
8-6-63	Modifications to booster subsystem were started.
8-16-63	Booster hydraulic checks were completed.
8-20-63	Booster electrical and instrumentation checks were completed.
8-21-63	An all-systems test was completed.
8-30-63	The booster was weighed and secured.
9-9-63	Booster 396 was transported to PALC 1 pad 1; booster mating was completed.
9-14-63	Solid motor mating tests were completed.
9-18-63	Booster simulator checks were started.
9-30-63	Booster simulator checks were completed.
10-3-63	Booster leak checks were completed.
10-4-63	Hydraulic checks were completed.
10-9-63	Electrical checks and an all-systems test were completed. The main engine yaw actuator was replaced, and portions of hydraulic checks were re-run.
10-10-63	During an all-systems test, the booster inverter burned out and had to be replaced.
10-11-63	An all-systems test and a dry countdown were completed.
10-14-63	A dry countdown was completed.
10-17-63	A single and dual propellant loading exercise was completed.
11-1-63	Because of a change in schedule, booster 396 was demated and returned to MAB V for storage.

11-13-63	Inspection of the booster revealed rust and corrosion of the main engine thrust chamber, engine ducting and support structure and vernier engine No. 2.
11-26-63	Removal of the above mentioned rust and corrosion was started.
12-30-63	Vernier engine No. 2 actuators were removed for rework of the servo-valves.
1-13-64	The No. 2 vernier engine was replaced.
1-28-64	Installation of new solid motor ejection rails was started.
2-3-64	The feedback potentiometers on the main and vernier engines were removed for rework.
2-20-64	A new main engine flame shield was installed.
2-24-64	Actuator feedback potentiometers were replaced.
2-26-64	Booster hydraulic checks were completed. Installation of the telemetry modifications to monitor the new solid motor ejection rails was completed.
2-28-64	The yaw actuator on vernier engine No. 1 was leaking and had to be replaced.
3-3-64	Booster electrical checks and an all-systems test was completed.
3-5-64	Booster 396 was secured and transported to PALC 1 pad 1.
3-6-64	Booster mating was completed.
3-7-64	Booster leak checks were started.
3-10-64	Leak checks and hydraulic checks were completed.
3-13-64	Booster electrical checks were completed.
3-16-64	An all-systems test and a dry countdown were completed.
3-17-64	A single and dual propellant loading exercise was completed.
3-18-64	R-5 day pre-flight procedures were completed.
3-19-64	R-4 day pre-flight procedures were completed.

3-20-64	R-3 day pre-flight procedures were completed. A dry countdown and BTL Phasing and Polarity checks were completed.
3-21-64	Problems in the SS-01A flight controller caused the launch to be postponed 24 hours.
3-22-64	R-2 day pre-flight procedures were completed. An all-systems test was completed.
3-23-64	R-1 day pre-flight procedures were completed. The solid motors were mated.
3-24-64	Booster 396 was successfully launched.

B. SECOND STAGE.

2-7-64	Vehicle 1175 arrived at VAFB
2-8-64	Receiving inspection was performed. Sub-system B checks were started.
2-10-64	Sub-system B checks were completed.
2-11-64	Alignments were performed. VOS slipped one day.
2-13-64	Vehicle hydraulic system checkout and electrical modification were performed on the forward end. Preparations were made for guidance and flight control checks.
2-15-64	Preparations were continuing for guidance and flight control checks.
2-17-64	Guidance and flight control checks were performed. TM functional checks were begun.
2-19-64	TM functional checks were completed.
2-21-64	Completed DRP (Discoverer research payload) fit checks. VOS slipped to 5 Mar 1964.
2-24-64	Adapter fit and destruct checks were performed.
2-24-64	VSWR's (voltage standing wave ratio's) were completed.
2-26-64 thru 3-4-64	Open paper work was cleaned up.
3-4-64	MAB final.
3-5-64	Vehicle was transported to magnetometer range and checks were completed.

3-6-64	Pneumatic leak checks were performed.
3-7-64	Engine functional and battery modification were begun.
3-8-64	Battery modification being worked.
3-9-64	Battery modification still being worked. Engine functional was completed and compatibilities checks were begun.
3-11-64	Compatibilities were completed.
3-12-64	Battery modification still in work.
3-13-64	Phase I of the system run was performed.
3-14-64	Phase II of the system run was performed.
3-15-64	High pressure checks were started.
3-18-64	High pressure checks were completed. In addition, engine servicing was performed.
3-19-64	DRP mate was started.
3-20-64	A/P (advance payload) and vehicle mating.
3-21-64	A/P mate was completed and RF checks were performed.
3-21-64	The launch was slipped one day due to changes in the electronic portion of the H-timer.
3-24-64	A successful countdown was initiated at 0335 PST.

DISTRIBUTION

QUANTITY	RECIPIENT
18	LMSC/VAFB
1	TWOCE Office, STC, 6594th ATW, Sunnyvale, Calif.
1	NASA (Test Support Office) P.O. Box 435, Lompoc, Calif.
10	Douglas Aircraft Corp, VAFB, Calif.
10	DDC, Arlington Hall Station, 4000 Arlington Blvd, Arlington 12, Va.
1	SSD (SSZAE-1) AF Unit Post Office, Los Angeles 45, Calif.
1	SSD (SSZAE-2/LTC
1	TWOCE Office, STC, 6594th ATW, Sunnyvale, Calif.
1	6595th ATW, VWZD, VAFB
4	6595th ATW, VWZE, VAFB

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION
news release

1691

THE DISCOVERER STORY

Rel. No. 61-15

"SOVIET PLACES FIRST EARTH SATELLITE IN ORBIT"

In English, Arabic, Hebrew, Hindustani, and a hundred other languages and dialects, newspapers the globe around bannered the report that the USSR had launched the world's first successful earth satellite.

The date was October 4, 1957. To all appearances the Soviets were well on their way to winning the space race. Russian scientists had stolen the march on their only competitor -- the United States -- or so it looked to the man on the street.

The space story, however, isn't written in one chapter. True, it is a matter of record that some time elapsed after the Soviet triumph before the United States placed its first Explorer satellite into orbit. It was even longer before this nation's first earth satellite program -- Vanguard -- bore results in the form of a grapefruit-sized satellite. Explorer and Vanguard, and even the Soviet's first Sputnik, were scientific efforts and relatively primitive in terms of sophistication.

Being purely scientific efforts these projects were paced by the normal, step-at-a time, walk before-you-can run research philosophy. In fundamental research, time -- plenty of time -- is a basic ingredient.

(more)

Back in 1946, pre-dating the launch of Sputnik by some 10 years, another earth satellite program had been conceived. This program couldn't afford the luxury of time. It was paced by an urgency dictated by the needs of our national security.

In addition to the element of time there was still another pacing factor -- operational requirements. This satellite would have to possess certain clearly defined capabilities if it was to serve as the space platform for military purposes -- communications, early warning, observation, etc.

Just placing a satellite into orbit would not satisfy the pre-requisites of national security. When this satellite took its place in space it would have a job to do.

It has taken better than a decade to develop such a satellite. Today, however, in the Air Force Discoverer program the United States has in being a versatile space vehicle which will serve as the basis for a whole family of military space systems. In the Air Force Discoverer this nation has the world's most successful space system -- perhaps the world's only complete space system, a space system which will, for instance, provide the basis for development of Midas (missile defense alarm system) -- a series of satellite borne infra-red sensors capable of detecting aggressor missiles seconds after launch.

Discoverer had its beginning with a series of studies performed by the Rand Corporation in 1946-1947 under contract to the Air Force. These studies established the feasibility of using earth satellites to perform

(more)

military missions in defense of our freedom.

A year later Gen. Hoyt Vandenberg, then chief of staff of the Air Force, issued a policy letter in which he said:

"... R & D of a satellite should be pursued as rapidly as the state of the art permits..."

In 1951 a series of study contracts were let to major U. S. industrial firms having the technical knowhow to make specific proposals.

Rand Corporation again entered the scene in 1954 with additional developmental recommendations based on evaluation of the industry studies.

Three U. S. companies were then asked for definitive proposals -- RCA, Martin and Lockheed.

Early in 1956 while these companies put the finishing touches to their proposals, the responsibility for development of such a satellite system was transferred from the Wright Air Development Center to ARDC's Air Force Ballistic Missile Division. Maj. Gen. Bernard A. Schriever, then AFBMD commander, immediately created a program directorate and set about staffing it with the most qualified Air Force personnel available.

Meanwhile an ARDC contractor evaluation board met and awarded the development and production contract to Lockheed.

Now the capabilities which had been verified by slide rule and computer would have to be proved with hardware.

Time and operational requirements still were the pacing factors. Time we didn't have. Certain operational capabilities we had to have.

Discoverer had to achieve a polar orbit -- infinitely more difficult to attain than the equatorial orbits planned for Sputnik, Explorer or Vanguard.

(more)

From the very first launch Discoverer would weigh at least a half a ton on orbit and it would grow progressively heavier as development proceeded.

The precise orbit required for Discoverer called for injection into orbit at a specific point in space and with the vehicle oriented horizontally with respect to the surface of the earth. This dictated that the satellite have not only its own rocket engine which could be ignited on ground command but also required a control system to reorient the satellite into a horizontal attitude after separation from its booster.

On orbit Discoverer had to be stable in all three axes -- pitch, yaw and roll. It had to maintain this stability for long periods and a provision to maneuver the vehicle into various stable attitudes was required.

It was necessary to separate a capsule from Discoverer on orbit and accomplish safe re-entry of the capsule into the atmosphere.

To accommodate the final operational capability -- recovery of the capsule -- it was necessary to control separation and re-entry with great accuracy and to develop a recovery force with maximum mobility.

In 1956 when the Air Force-Lockheed team pitched into the hardware phase of Discoverer development, these operational requirements were major scientific and technical challenges which would tax to the limit the knowledge, courage and determination of our scientific community.

Today, five years later, these same operational requirements are realities. In the achievement of each one of them the Discoverer program established a world first.

With the launch of Discoverer I on February 28, 1959 the precise polar orbit was achieved. Through the launch of Discoverer XIX in December

(more)

1960, polar orbit has been accomplished 13 times. Batting average -- well in excess of 600.

On the second flight test, stabilization, reorientation on timer command, separation and successful re-entry of the capsule all were accomplished. Due to a malfunction of ground equipment it was not possible to readjust the airborne timer to trigger separation at the proper point in space to permit recovery.

The amazing accomplishments of the first two flight tests, however, were a little like beginners luck in a game of cards. With the third launch, Discoverer began to follow the normal pattern of research and development -- trial, error and disappointment punctuated by success, achievement and elation.

The ability to launch, orbit, stabilize and reorient the vehicle was demonstrated with a high degree of consistency. Successful launch and orbit were achieved 13 out of 19 attempts. Stabilization and reorientation were accomplished 10 times -- no attempt was planned for Discoverer I. Capsule separation also was accomplished 10 times. It was not programmed for Discoverer I or XIX.

During the latter part of 1959 and early 1960 Discoverer project personnel encountered a major problem area. Repeatedly capsule separation occurred on schedule during the vehicle's 17th pass but either the waiting recovery force heard nothing from the capsule's radio beacon or the signals received indicated the capsule had not re-entered at the proper angle and was hurtling overhead out of their reach.

(more)

For several months Air Force officer-scientists and Lockheed technicians assisted by other contractors and USAF research facilities buckled down to pinpointing the problem. Finally their sleuthing paid dividends. The trouble was located, not in any one of the major systems or sub-systems, but in the small solid propellant rockets used to spin and de-spin the re-entry vehicle during the firing of the retro rocket. The small rockets were used to spin-stabilize the re-entry vehicle at the right angle while the retro rocket established the proper re-entry trajectory.

External jets through which gas under high pressure is metered were substituted for the solid propellant spin and de-spin rockets.

Also, the close scrutiny to which the entire Discoverer had been subjected, disclosed other areas where refinements would preclude the development of future trouble spots.

The stage now was set for complete success. Discoverer project people were determined to go all the way and with Discoverer XIII they did. A U. S. Navy helicopter plucked the gold-plated capsule from the surface of the Pacific Ocean near Hawaii marking the first recovery of a man-made vehicle from orbit around the earth. The fact that the waiting Air Force recovery crews had to have an assist from their sister service didn't dim their elation, nor that of the free world, one bit.

USAF crews flying the C-119 recovery planes out of Hawaii did make up their minds, however, that next time their Navy buddies wouldn't have a thing to do.

On the heels of "Lucky Thirteen", the next Discoverer roared into space from Vandenberg Air Force Base, California. This time the "pill" was delivered right into the hands of the C-119 recovery fleet. Capt.

(more)

Harold Mitchell executed the world's first aerial recovery of a satellite capsule.

Twice again in 1960 aerial recoveries of Discoverer capsules were accomplished. In both instances Capt. Gene Jones fielded the globe-girdling space hits.

In the two years since the first orbit of a Discoverer satellite, the Agena -- the orbiting vehicle -- has grown in size, weight and complexity. The first Agena A measured 19' feet in length, weighed 1,300 pounds on orbit and carried no equipment for stabilization, reorientation or capsule recovery. Once its 15,000-pound-thrust Bell liquid rocket engine was fired to inject it into orbit it had no further motive power.

Beginning with Discoverer XVI, the Agena B was substituted for the earlier model. This vehicle measures 26½ feet in length and weighs approximately 2,100 pounds on orbit. Its Bell rocket engine has a re-start capability. This capability, however, will not be exercised until sometime early this year. It is designed to enable the Agena to change orbit.

Although in Discoverer the Air Force has in being an operational space system complete with its own launch, tracking, data acquisition, control, command and recovery facilities, it does not intend to stop here.

Discoverer is a research and development system. It is designed to develop and prove the hardware, procedures and techniques necessary for a series of military satellite systems and to train the Air Force officers and airman necessary to operate them.

As such, Discoverer is going to be around for some time, increasing our technical knowhow, extending our beachhead in space and bolstering our ability to deter aggression through maintenance of sufficient military power to prevail in the event we are attacked.

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

REPLY TO ATTN OF: WDEC/Maj Harris/2705

SUBJECT: Presentation of Discoverer XIV Capsule

29 Nov 1960

TO: WDG

1. The following information concerning the presentation of the Discoverer XIV capsule at the Wright Day dinner ceremonies were received by telecon from Major Sloan, Air Force Museum. The AMC Information Office at Wright-Patterson Air Force Base is in charge of the program and is making detailed arrangements.

2. The program, at this time, indicates that Lt Gen Elwood (Pete) Quesada will be the principal speaker at the dinner. Your presentation of the plaque accompanying the capsule will be made to Lt Gen W. E. Todd or his Deputy, Maj Gen Troup Miller, Jr. The dinner will be held at 12 Noon, 16 December at the Biltmore Hotel, Dayton, Ohio.

3. A confirmed program is being forwarded by AMC Office of Information shortly.

W. J. McGinty

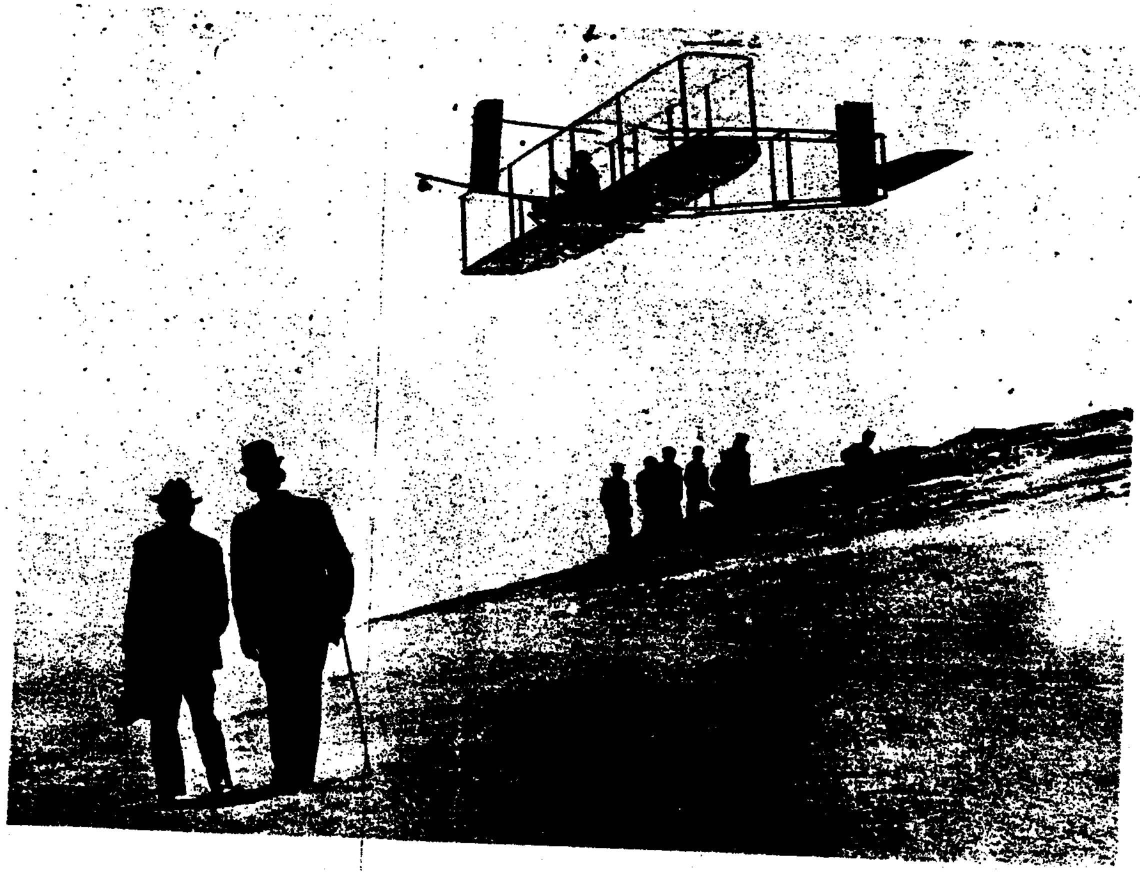
W. J. McGINTY
Lt Colonel, USAF
Director of Information

13-14th Seattle
15th AAS - AFBMD
16th WADD 12:00 Noon.

57TH Anniversary of Flight Subcommittee

George D. Andrews
Hans Belitz
James W. Jacobs
Earl V. Johnson
William G. Kiefaber
G. E. Leland
John Lombard
R. J. McIlrath
Lewis E. Michael
Dr. J. E. Miller
John H. Murphy
L. E. O'Neil
Dr. Richard J. Sievers
Robert J. Simons
E. V. Swenson

G. E. Weller, Chairman, Aviation Committee
Norvell Clarkson, Staff Director



57TH ANNIVERSARY OF POWERED FLIGHT

NOON ... DECEMBER 16, 1960 ... BILTMORE HOTEL ... DAYTON, OHIO

Dayton Area Chamber of Commerce   Anniversary of Flight Subcommittee   Aviation Committee

The speaker

Elwood R. Quesada
Administrator
Federal Aviation Agency

ELWOOD R. QUESADA entered the Army Air Service Primary Flying School in 1924 to start a brilliant Air Force career. When he retired in 1951 he was commander of Joint Task Force Three. Since then he has been associated with private industries in various executive capacities. He became Special Assistant to the President on aviation matters in 1957, and on November 1, 1958 was appointed Administrator of the new Federal Aviation Agency. This organization is the successor to both the Civil Aeronautics Administration and the Airways Modernization Board. It is responsible for allocating the nation's air space by developing and operating a national air navigation and traffic control system.

The program

Presiding .... B.D.Claffey, President, Dayton Area Chamber of Commerce

Star Spangled Banner .... Solo: William Rapp; accompanist: Ray Deerwester

Invocation .... Rabbi Joseph S. Weizenbaum

Presentation of Discoverer 14 Space Capsule .... Major General O. L. Ritland, USAF
Commander, Ballistic Missile Division

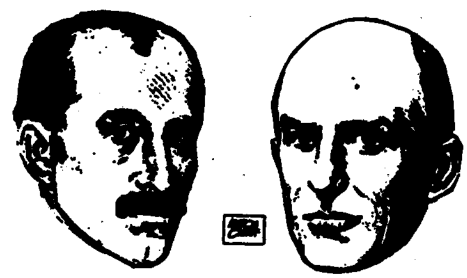
Acceptance of Discoverer 14 Space Capsule .... Major General Troup Miller, Jr., USAF
Vice Commander, Air University

Presentation of Plaque .... Colonel R. M. Cram, USAF
Commander, Orientation Group

Acceptance of Plaque .... G. E. Weiler, Chairman, Aviation Committee
Dayton Area Chamber of Commerce

Introduction of Speaker .... B. D. Claffey

Address .... Elwood R. Quesada



DISCOVERER XIV CAPSULE

THE FIRST AERIAL RECOVERY OF AN

EARTH ORBITING BODY

LAUNCHED 18 AUGUST 1960 - RECOVERED 19 AUGUST 1960

PRESENTED TO THE AIR FORCE MUSEUM

BY

MAJOR GENERAL O.J. RITLAND

COMMANDER, AFBMD

AIR RESEARCH AND DEVELOPMENT COMMAND

REMARKS AT PRESENTATION OF DISCOVERER CAPSULE
TO THE AIR FORCE MUSEUM - 16 DECEMBER 1960

GENERAL MC KEE, GENERAL MILLER, DISTINGUISHED GUESTS, LADIES AND GENTLEMEN ---- MY PURPOSE IN COMING HERE IS TO TURN OVER TO THE UNITED STATES AIR FORCE MUSEUM THE [redacted] RECOVERED FROM THE DISCOVERER [redacted] SATELLITE.

THIS IS INDEED AN HISTORIC OCCASION, AND I TAKE PART [redacted]AL OF PERSONAL PLEASURE AND PROFESSIONAL SATISFACTION. FIFTY-SEVEN YEARS AGO TOMORROW, THE WRIGHT BROTHERS --- FOR WHOM THIS MUSEUM AND THIS BASE ARE NAMED --- MADE THE FIRST SUCCESSFUL CONTROLLED POWERED AIRPLANE FLIGHT FROM THE SANDS OF KITTY HAWK.

PRECISELY FIFTY-THREE YEARS AGO TODAY THE AERONAUTICAL DIVISION OF THE ARMY SIGNAL CORPS ISSUED BIDS FOR A LIGHTER-THAN-AIR AIRSHIP, AND ONE WEEK LATER CALLED FOR BIDS FOR A TRUE "FLYING MACHINE."

I REMIND YOU OF THESE FACTS OF MODERN HISTORY ONLY TO ILLUSTRATE WHAT I BELIEVE TO BE A SALIENT POINT. IT IS JUST THIS: IN THE LIFETIME OF A SINGLE MAN, THE AIRPLANE HAS EVOLVED FROM THE CRUDEST WINGED CONTRAPTION POSSIBLE, TO A SUPERSONIC, HIGH-FLYING, OCEAN-SPANNING ELECTRONIC BIRD. IN THE SPACE OF FIFTY YEARS, WE HAVE PROGRESSED FROM THE JENNY TO THE JET, AND FROM KITTY HAWK TO CANAVERAL ---- AND NOW WE ARE POISED AT THE EDGE OF SPACE.

No Hermiont for future

THE FACT THAT WE ARE PREPARED TO COPE WITH THE CHALLENGES OF SPACE IS, I FEEL, WELL DEMONSTRATED BY THE OCCASION WHICH BRINGS US TOGETHER HERE TODAY. THIS PIECE OF MAN-MADE HARDWARE HAS BEEN SENT WHIRLING AROUND THE GLOBE BEYOND THE ATMOSPHERE, AND THEN SNATCHED OUT OF THIN AIR TO BECOME THE FIRST ORBITING VEHICLE EVER AERIALLY RETRIEVED FROM ORBIT.

FURTHERMORE, I THINK IT IS INDICATIVE OF THE RAPID PACE AT WHICH OUR CAPABILITIES ARE GROWING THAT IN THE SHORT TIME SINCE THIS CAPSULE WAS RECOVERED, LAST AUGUST 19, THAT WE HAVE TWICE-MORE DEMONSTRATED OUR ABILITY TO ORBIT AND RECOVER VEHICLES IN THIS MANNER.

NOTHING COULD BE NEWER, OR MORE EXCITING TO OUR IMAGINATIONS, THAN SPACE. TRUE, SPACE HAS ALWAYS BEEN THERE, BUT IT HAS NEVER BEEN SO CLOSE TO OUR GRASP.

NOW WE SEE IT AS THE FRONTIER WITH THE BUILT-IN FUTURE. IT REPRESENTS THE BROADEST KIND OF CHALLENGE. IT AFFORDS INFINITE OPPORTUNITIES FOR EXPLORATION, ADVENTURE, AND ANALYSIS. IT IS THE NEW DIMENSION OF TREMENDOUS POTENTIAL.

OUR JOB IN THE U.S. AIR FORCE IS TO MAKE CERTAIN THAT THOSE REGIONS BEYOND OUR EARTH'S ATMOSPHERE ARE MADE SECURE FOR PEACEFUL PURPOSES IF THE FAR-REACHING POTENTIALS OF SPACE ARE TO BE FULLY REALIZED.

THIS IS THE JOB WE HAVE UNDERTAKEN WITH OUR SERIES OF DISCOVERER SATELLITES. WITH REGARD TO SPACE, I SUGGEST THAT WE ARE JUST ABOUT IN THE SAME POSITION TODAY THAT WE WERE WITH RESPECT TO THE AIRPLANE FIFTY YEARS AGO.

5

THE SIGNIFICANCE OF THAT COMPARISON, I SUSPECT, IS APPARENT HERE TODAY. WE ARE GREATLY ENCOURAGED BY THE PROGRESS WE HAVE MADE. WE ARE CONFIDENT OF MUCH GREATER PROGRESS ALONG THE VAST BROAD SPECTRUM OF SPACE IN THE DAYS AND YEARS AHEAD.

NOW IT GIVES ME A GREAT DEAL OF PLEASURE TO PRESENT TO THE AIR FORCE MUSEUM, ON BEHALF OF THE AIR RESEARCH AND DEVELOPMENT COMMAND, THIS CAPSULE FROM THE AIR FORCE DISCOVERER XIV SATELLITE.

I present you whist of First Aero Space Event in History

I PURPOSE

II WHAT THEY DID

III WHAT WE DID

Maj Connelly

DOUGLAS AIRCRAFT COMPANY, Inc.

GENERAL OFFICE
SANTA MONICA, CALIFORNIA

January 29, 1962

C-Legal-77

SUBJECT: LIABILITY FOR LOSS OF THOR BOOSTER NO. DAC [illegible]

REFERENCES: (a) Contracting Officer's letter to Donald W. Douglas, Jr., RAKA 2350, dated 27 December 1951

(b) Letter dated January 10, 1962, from Donald W. Douglas, Jr., to Air Force Plant Representative

TO: Air Force Plant Representative
United States Air Force
Douglas Aircraft Company, Inc.
3000 Ocean Park Boulevard
Santa Monica, California

ATTENTION: Albert A. Fitzpatrick
Capt. USAF
Contracting Officer

1. At the request of your office, Contractor has reinvestigated the loss of the subject booster. Following is a report of such reinvestigation.

2. Attached as Exhibit "A" is a detailed history of Thor Booster No. DAC 322 which indicates that production, modification, testing and inspection of the missile were accomplished in accordance with normal Contractor procedures.

3. The precise cause of the booster failure may never be conclusively determined. A thorough [illegible] of our records with respect to the production and [illegible] modification of the missile under Contracts AF [illegible] and [illegible]-04(647)-532, respectively, discloses no evidence of deficiencies or defects which could have contributed to failure [illegible] question. The work performed by Contractor under both of these contracts was inspected and accepted by the Air Force without exception.

4. As set forth in greater detail subsequently in this report and also in previous reports made to the Air Force, there are at least two and possibly more, independent possible causes of the failure. In prior reports submitted to the Air Force, Contractor has [illegible] as to the most likely cause of the failure; it should be recognized, however, that such speculation is not conclusive proof of the cause of the failure.

5. There has been some indication that the Air Force believes that faulty Contractor procedures contributed to the cause of the failure but Contractor's investigation clearly negates that possibility. Even if it be assumed that the failure was due to the wiring change on the connector and subsequent flight programmer replacement under Contract AF 04 (647)-739, and as noted above there is no clear cut evidence that this was the case, it cannot be concluded that the failure resulted from inadequate or faulty Contractor procedures. The wiring change was documented by the issuance of an appropriate Engineering Order in accordance with existing Contractor procedures. The engineer who authorized the subsequent flight programmer replacement did so in accordance with standard Contractor procedures which required, among other things, documentation of the replacement and a review of all previous engineering paper on the Control Electronics Assembly, including the Engineering Order under which the previous wiring change was made. It is important to emphasize here that the engineer, pursuant to standard Contractor procedures, actually reviewed the engineering order in question. As a result of an error in engineering judgment, however, he concluded that the replacement of the flight programmer effectively removed the previous wiring change and that interchangeability was therefore not affected. Thereafter, and again in accordance with Contractor procedures, the Control Electronics Assembly was subjected to the necessary laboratory functional checkout, including rate gyro polarity checks. The records of the Manufacturing Technician who actually performed these latter checks, as well as the inspection paper, indicate that the pitch rate, main engine actuator circuit was operable. It is, of course, possible, as has been suggested in previous reports, that the circuit in question was in fact discontinuous [illegible] that the Technician erred in his reading of the three [illegible]ers involved in the rate gyro polarity checks. Careful [illegible]erence to the existing Contractor procedures, however, [illegible]uld have eliminated this possible error. Thus, even with

respect to this one suspected cause of failure, the available evidence would indicate that an error in engineering judgment coupled with a possible additional human error on the part of a manufacturing technician rather than inadequate Contractor procedures may have been the cause of failure.

6. Subsequent to the booster failure Contractor procedures have been refined in an effort to minimize further the possibility of human error and occurrence of such a failure. It does not follow from that fact, however, that Contractor procedures which were [illegible] prior to the booster failure were inadequate. [illegible] to the contrary, the evidence indicates that by carefully following the pre-accident procedures the possibility of a failure from the suspected cause discussed in some detail in the preceding paragraph would be eliminated. Procedures of the type in question are never stable. They are inherently evolutionary. This is particularly true in the developmental context of the present problem. As a result of analysis of the possible causes of the booster failure, it has been determined that certain procedural refinements would further minimize the chances of an occurrence of such a booster failure. This is but another logical step in the evolution of Contractor procedures.

7. An additional and highly relevant factor for consideration is the Thor booster's over-all record of success (presently 91%) in the Discoverer program. This factor cannot be ignored in evaluating the adequacy of procedures; indeed, it can be argued with considerable force that it is the ultimate test of the adequacy of procedures.

8. Attached as Exhibit "B" are Contractor's responses to the specific questions which your office requested Contractor to answer.

9. To date Contractor has not been provided with a statement of a specific reason for the Government's belief that Contractor is liable in this matter. Based upon Contractor's reinvestigation of this matter, it is sincerely believed and respectfully submitted that there exists no sound legal basis upon which Contractor could be held liable

~~FOR OFFICIAL USE ONLY~~

for the subject loss. If, however, additional information is desired, we will be happy to cooperate with your office in efforts to obtain it.

DOUGLAS AIRCRAFT COMPANY, INC.

Newman L. Dotson
Newman L. Dotson
Assistant Counsel

NLD:jt
Encls.

~~FOR OFFICIAL USE ONLY~~

~~FOR OFFICIAL USE ONLY~~

Veh 1110

INTERIM REPORT OF DISCOVERER XXVII FAILURE

I. INTRODUCTION

A. The requirement for this report was first made known to the Office of the Staff Judge Advocate, Space Systems Division on 6 December 1961 by a visit of LtColonel Turner AFSPM-CP-1, Chairman of the Task Force on Contractor Deficiencies and Mathew S. Perlman, Office of the General Counsel, Secretary of the Air Force, specifying the type of investigation and legal review desired. This was followed by a letter from DCMK on 7 December 1961. (Ex 1)

B. No Missile Accident/Incident Investigation such as that specified in AF Regulation 58-10 has been accomplished by the Air Force. An informal report (Ex 2, 30 Oct 1961, previously furnished) prepared by the Discoverer Program Office had been made based primarily upon DAC technical reports (Attachments to Ex 2, previously furnished.)

C. A complete investigation has now been accomplished by all interested agencies of the Air Force in accordance with specific directions of the Commander, Space Systems Division (Ex 3). DAC has been apprised of this investigation in accordance with procedures recommended by the Staff Judge Advocate, Western Contract Management Region (Ex 4). In addition, Douglas was requested to furnish it's version of questions of fact, the answers to which lie peculiarly in their possession. (Ex 5) Douglas has requested an extension of time in which to reply and their response along with an analysis of the technical aspects by the Discoverer Program Office will be furnished upon receipt. In view of recommendation number 1 this interim report is being submitted now.

II. TECHNICAL EVALUATION OF FAILURE

DAC Report SM-38822 - Flight Report Discoverer XXVII Booster S/N 322 September 1961 (Attachment to Ex 2) is the only known complete technical analysis and report. It provides in part as follows:

> Discoverer XXVII consisted of a Douglas Model DM-21 Booster (S/N 322) and a Lockheed Model 6205 Agena B second stage and orbital vehicle (S/N 1110).
>
> The vehicle combination was launched from Complex 75-3-4 at Vandenberg Air Force Base, California on 21 July 1961. The primary objective (classified).
>
> Flight objectives associated with the booster were not achieved. The Discoverer Satellite was not placed in orbit because of a first stage malfunction.
>
> The failure of this flight was due to control system instability caused by the inadvertent isolation of the main engine loop rate from the rest of the control system. A detailed analysis concerning the cause of this malfunction, and the corrective action to be taken, is discussed in paragraph 3.2.1.

~~FOR OFFICIAL USE ONLY~~

3.2.1

****

The conclusion is that the circuit was open between points "e" and "g" since this is the only condition that could satisfy all the conditions encountered in flight.

A review of the engineering documentation affecting changes to the CEA has revealed that the main engine rate shaping network was probably open prior to launch. The final RIM building checkout records are contradictory and indicate that continuity was obtained during test.

The network involved is shown schematically in figure 8. The auxiliary rate shaping network was connected in series with the main engine rate network through the programmer. This was necessary in order to use a shorting relay in the programmer for system checkout. In May 1961, during VAFB laboratory checks, a pin on the connector between the main engine shaping network and the programmer was broken. The wire to this broken pin was moved to a spare pin on the same connector and the programmer side of the plug was also rewired to agree.

In July 1961, it was necessary to replace the programmer. However, the programmer side of the plug was no longer compatible with the modified plug from the main engine shaping network. Records indicate that the programmer connector was never modified to match the standard programmer.

A subsequent laboratory check which would indicate this error was performed but, since the technician had to read three meters at once, it was possible that this error was not noticed.

The polarity check performed at the launch emplacement was not designed to check this particular network.

The best engineering estimate is that the pitch rate loop was open prior to liftoff because of a wiring error.

III. CONTRACTUAL PROVISIONS

A. DAC Space Systems Vehicle S/N 322 was originally procured under Contract AF 04(647)-407. (Ex 6) The Missile Booster and Allocation Schedule reveals that it was originally to be configured for Courier and was subsequently changed to Discoverer configuration under Letter Contract AF 04(647)-582 (Ex 7). This latter reference appears to be in error because the contract file shows that DAC 322 had not been accepted by the Air Force at the time of Letter Contract 582 and S/A 13 to Contract -407 definitizing CCN 13 provided for modification of boosters 320, 322 and 323 to Discoverer configuration (Ex 8). Apparently the only modification accomplished under Letter Contract 582 was the installation of BTL Guidance to be accomplished at Vandenberg Air Force Base site. DAC 322 was accepted by the Air Force on February 14, 1961 on the DAC Package Tally (Ex 9) at Santa Monica. On the same document it was marked as GFE and was shipped to Vandenberg AFB on 13 April 1961. There the Package Tally was receipted for by a DAC employee on 13 April 1961. (Ex 10) It is noted that this document is marked as "Partial 8." According to the statement of Mr. McFadden (Ex 11) the procedure of inspection and acceptance which has been approved for this contract provides for final acceptance by the Government on DD Form 250 after the completion of all of the work on the contract. Inspection is performed by random checks by AF Quality Control Inspectors. This procedure appears to waive the final inspection and acceptance provisions of the contract. Since there has been no final acceptance the final turn-over document DD Form 1149 (Ex 12) and the Accountability Termination Document AF Form 1005 (Ex 13) also refer to Letter Contract 582.

B. A chronological history of DAC 322 prepared by one of the Discoverer Launch Officers confirms that DAC 322 arrived at Vandenberg Air Force Base on 13 April 1961 (Ex 14) and that the CEA was removed to DAC Lab for checkout which was in progress on 1 May 1961. This checkout was completed on 30 May 1961 and apparently during this time the BTL Guidance was installed and checked out although no specific reference is made thereto. The file on Contract 407 reveals that written authorization was given on certain boosters e.g. 298 and 300 to accept the CEA without checkout (Exs 15 and 15A). No such record exists with regard to DAC 322 however.

C. The test procedure which first indicated the discrepancy in electrical continuity between the Flight Controller and the connecting plug to the Flight Programmer was TP 7797779 - "Functional Test Procedure - Flight Controller (BTL)" which appears to be a requirement by DAC as part of flight test preparation and checkout under Contract AF 04(647)-759 Item 1A(2) of the Statement of Work (Ex 16). A possibility exists that this could have been part of the requirement of Item 9 Letter Contract 582 which provides that DAC will install and checkout at the launch site Government Furnished BTL 400 Radar Guidance. A request was made of the Resident AF Auditor to check the DAC engineering time charges and work orders on both TP 7797779 and EO 2796676 (Exs 17 and 18) which check revealed that DAC had originally charged this work to Contract 759 but had recently determined this charge to have been in error and properly charged to Letter Contract 582. (Ex 19).

D. Modification work is however authorized by Item IB of the launch support contract - 759. The responsibility for spares (which were not available at the critical time) is the Government's under Item IIIF. The flight test preparation and conduct is provided for by Item IIIC which incorporates by reference "Systems Supplement No. 1 - Responsibilities, Procedures and Authorization for AFBMD Activities at Vandenberg AFB" dated 13 August 1959. (Ex 19½)

E. Letter Contract 582 incorporates a Government Furnished Property Clause contained in Paragraph 24 of Basic Agreement - 7273 (Ex 20) and Contract 759 incorporates a Government Property Clause contained in Paragraph 19 as amended of Basic Agreement 7361 (Exh 21). The provisions of these clauses in their applicable parts are substantially the same although not identical. The latter edition of the clause provides as follows:

"The Contractor shall not be liable for any loss of or damage to the Government Property or for expenses incidental to such loss or damage except that the Contractor shall be responsible for any such loss or damage (including expenses incidental thereto)

(A) Which results from willful misconduct or lack of good faith on the part of any of the Contractor's Directors or Officers or on the part of any of it's Superintendants or other equivalent representatives who has supervision or direction of:

(I) All or substantially all of the Contractor's business, or

(II) All or substantially all of the Contractor's operations at any one plant or seperate location in which this contract is being performed, or

(III) A seperate and complete major industrial operation in connection with the performance of this contract; or

(B) Which results from a failure on the part of the Contractor due to the willfull misconduct or lack of good faith on the part of any of it's directors, officers or other representatives mentioned in subparagraph (A) above,

(I) To maintain and administer in accordance with sound industrial practice the program for maintenance, repair, protection and preservation of Government Property as required by Paragraph (e) hereof..."

F. Contract 759 incorporates by Paragraph D7 of Basic Agreement 7361 the following provision:

"Standards of Work:

The Contractor agrees that the performance of work and services pursuant to the requirements of this contract shall conform to high professional standards."

IV. THEORIES OF LEGAL LIABILITY AND ANALYSIS OF EVIDENCE

A. In view of the exceedingly restrictive language in the Government Property Clause incorporated in Letter Contract 582 by Basic Agreement 7273 and in Contract 759 by Basic Agreement 7361, it would appear profitable to search for a legal basis for liability elsewhere.

B. In this regard, it is noted that although Contract 759 appears to be a contract to cover services required to support test launches at Vandenberg Air Force Base (Part IIA, Statement of Ground Rules) the actual launch requirement appears to be set forth in Item 9, Amendment 2 to Letter Contract 582. (The only language which could be interpreted as a launch requirement in Contract 759 is Part I, Item 1A which provides: "The Contractor shall provide the services and supplies necessary to maintain a capability to launch Discoverer type vehicles at a rate of (CLASSIFIED) each per month and shall launch Discoverer type vehicles as directed by the Government...") Letter Contract 582 contemplates a fixed price incentive type contract and has not yet been definitized. It can hardly be said that a launch which failed so completely to meet the requirements (CLASSIFIED) set forth in the Flight Test Directive prepared by Lockheed Launch Systems Department under Contract AF04(647)-558; and agreed to by DAC under Contract 759 Part IIID, is a successful launch and the DAC Report SM-38822 admits as much. Although this is admittedly a research and development area and failures are to be expected, the statement of work does not provide for "best efforts" on the part of DAC.

C. Unfortunately, this is a very complex contractual situation and upon checking it out with the Air Force buyer it was revealed that the Air Force has been in the process of attempting to definitize Letter Contract 582 under Contract Number AF04(695)-24 for the past three (3) months. He states that DAC negotiators informally raised the point as to whether Letter Contract 582 was a launch contract (Exhibit 22, Para 1) and were assured verbally by Air Force negotiators that it was not. The success of the launches has not been included in the incentive aspects of the negotiations. The buyer also states it was never the intent of the Air Force to make such provision. The negotiations on the definitization of this contract are being held up for other reasons and it appears that it might go into Disputes procedure.

D. Although under these circumstances it might well be held that a mutual mistake of fact existed as to Item 9, Amendment 2, Letter Contract 582, it appears possible that negotiations for the definitization of this contract could still take into consideration the failure of DAC 322. Of course the fact that the work contemplated by this contract appears to have been substantially completed makes any bargaining on this point difficult.

E. However, even if relying on Contract 759 as a launch requirement, it is noted that neither is this a "best efforts" type and it contains the clause whereby DAC agrees to the Lockheed prepared Flight Test Directives which set forth the requirements for performance of the Douglas Thor Booster. Nevertheless, since this is a CPFF type contract, in an admittedly research and development area and there is no specific warranty on flight success, it would appear that DAC could negate any attempt to imply a warranty on the ground that in this type of effort it has been well established that failures are to be expected and that percentage-wise it's success with Thor type vehicles is outstandingly high.

F. Assuming that after analysis of all available evidence the best engineering estimate remains that expressed by the DAC Report SM 38822, we may consider the proximate cause of the failure to be the wiring error accomplished during TP 7797779. This requires a consideration of the Government Property Clause.

1. Even though DAC 322 is at no place designated on a contractual schedule as Government Property, it appears inescapable that it was accepted by the Government from DAC on 14 February 1961 and then turned back to DAC as GFE and so receipted by them on 13 April 1961. There appears however, to have been some understandable confusion on the part of the property administrators and auditors as to which of the three contracts involved covered what work. Both DD 1149 authorizing turn-over to DAC for expenditure and AF 1005 - Missile Accountability Termination Document refer to Letter Contract 582. This designation was made because the established procedure was to charge all work, except the launch support work, to the basic procurement and modification contract. In the normal case, Letter Contract 582 would have covered all such work, but, as we have seen, DAC 322 was an unusual case and the greater part of the work was accomplished under Contract 407 and S/A 13 thereto. Apparently the installation of BTL Guidance was accomplished under Letter Contract 582 but the procedure authorizing expenditure of the booster without finally accepting it under a DD-250 (until completion of the total work under the contract) effectively waives the inspection requirements and consideration of latent defects which may have arisen in the installation and checkout work under Letter Contract 582. It is also noted that the BTL guidance installed under Letter Contract 582 was described in the schedule as GFP in Item 9.

G. A finding of liability under the Government Property Clause requires (a) a determination of willful misconduct or lack of good faith and (b) that this be on the part of management or supervisory personnel of the contractor.

1. Neither the pertinent contracts nor the basic agreements incorporated by the contracts define specifically either by name or title which of the DAC personnel are management or supervisory personnel such as to hold the corporation liable. Nor have any cases on this subject been found. It may well be that this will have to be determined as a question of fact by the BCA. In view of the DAC lines of engineering responsibility at the operating sites it would appear that a reasonable case could be made out to hold the project engineers who approved the applicable procedures and engineering orders as such management personnel.

2. By reverse engineering of DAC changes in procedures subsequent to the Discoverer XXVII Failure, we discover four (4) areas, of some degree of malfeasance, which are attributable to DAC management personnel, to wit:

(a) The failure on the part of the project engineer, as approval authority for EO 2796676, (Ex 18) to properly designate the change accomplished as a noninterchangeable change and the failure on the part of DAC supervisory engineers to establish such procedure. See letter RWRXQ dated 12 December 1961 (Ex 23) and Douglas Memo of the Chief Engineers Office M&S/DEO-M-1 (Ex 24) and DAC Vandenberg Field Station Memo A31-260-M-469 (Ex 25).

(b) Failure on the part of DAC management engineering personnel to provide a procedure for recording of values shown on meter readings in order to demand detailed attention of the technicians in TP 7797779 (Ex 26).

(c) Failure on the part of DAC management to provide for the painting or marking of noninterchangeable parts at VAFB Test Site in spite of the fact that such was required at the Santa Monica Plant. DAC Memo from the Chief Draftsman's Office CDOM-692(Ex 27).

(d) Failure on the part of Douglas operating engineer to review the engineering paper or to further consider the noninterchangeability aspect when the programmer was replaced even though the matter was called to his attention by the technician during 7797179. See Memo dated 18 August 1961 from VQE (Ex 28), and Douglas Memo A288-GW-61014 (Ex 29). (This information was relayed by word of mouth to AF personnel and it is presently being verified.)

H. The concept of lack of good faith is a slippery one, much as that of gross negligence, although it cannot be equated to it. Although the background for the ASPR GP Clause is not available for research, it would appear that the concept of gross negligence, which is well known to the law of bailments, was deliberately omitted to avoid the argument that any negligence, with an epithet added, would hold the contractor liable. Nevertheless, there is a line of cases, more usually applicable to purchase and insurance situations, which provide:

> "A want of that caution and dilligence which an honest man of ordinary prudence is accustomed to exercising in making purchases is, in judgment of law, a want of good faith." Pringle v. Phillips, 7 NY Super (5Sandf.) 157,165; Murray v. Wiley, 127 P. (2d) 112, 121, 169 Or. 381; Siano v. Helvering, (D.C., N.J.) 13 F. Supp. 776, 780.

It also appears that good faith may be equated to honest intent and as such may be left to the finders of fact to determine from the facts and circumstances.

"Good faith of parties entering into settlement is like honest intent or a state of mind made known by acts and circumstances and can be proved by such as well as by direct and positive testimony." Sowder v. Lawrence, 281 P. 921, 923, 129 Kan. 135.

There is a dearth of cases in which the BCA has made findings of lack of good faith.

V. CONCLUSIONS:

A. A launch requirement for the Discoverer XXVII shot was contained in both Contract 759 - Launch Support (CPFF) and Letter Contract 582 Thor Modification (FPI). Although it was originally the intent of the Air Force to consider Contract 759 the applicable contract, it is possible under these circumstances to negotiate it into Letter Contract 582 prior to definitization. The latter procedure affords the best opportunity for obtaining some consideration from DAC for the loss suffered by the Air Force as a result of the failure of DAC booster 322. Possibly it would be advantageous to use this possible course of action as leverage to obtain favorable settlement of the other points of dispute in the present negotiations.

B. The basic liability of DAC is for the loss of the Thor booster. However, it must be remembered that if liability can be established for the loss of the booster [redacted] flow a liability for [redacted] and payload, and launch [redacted] Since this latter aspect might involve a seperate cause of action, it will not be considered at this time.

C. The liability on the part of DAC which might arise from the latent defects provision of Letter Contract 582 for the faulty rewiring of the Flight Controller has been effectively waived by the procedure of inspection and acceptance in use at Vandenberg AFB which authorizes the expenditure of boosters prior to final acceptance. At any rate, the remedy provided is no longer available.

D. DAC 322 is Government Property under Letter Contract 582 and Contract 759. In order to hold DAC liable for loss or damage to GP there must be established (1) willful misconduct or lack of good faith (2) on the part of management or supervisory personnel of Contractor, only. The best case which could be made out under (1) above is that cited in IV G 2 (d) where direct knowledge and failure to act in accordance with high professional standards may possibly be proved (pending evaluation of evidence to be submitted by DAC), but, in that case, quaere, Would an operating engineer be held to meet the requirements of (2) above.

VI. RECOMMENDATIONS

It is recommended that:

A. DAC be required to take into consideration the loss ocassioned by the Air Force as to DAC Booster 322 in negotiations for definitization of Letter Contract 582.

B. DAC be relieved of liability for loss or damage to Government Property under any other contract unless policy considerations of emphasizing contractor's standards of reliability intervene.

C. In the latter case, it is recommended that a case be prepared based primarily on IV G. 2 (d) recognizing that, although a possible case for liability on the part of DAC exists, it is not a strong one.

JOHN R. DONNELLY
Major, USAF
Staff Judge Advocate
Space Systems Division (AFSC)

Exhibits Listed on Separate Sheet

INDEX

26 - Meter Readings - TP 7797779

27 - DAC Memo CDOM-692

28 - Memo fr VQE dtd 18 Aug 1961

29 - Douglas Memo A288-GW-61014

30 - Douglas Ltr A31-260-AN-499

31 - Removal Card

32 - Douglas Standard Practice Memo - SPM-A45-1001
(Douglas procedure at Missile Test Site A45 Sacramento - similar to procedures authorized at A-31 Vandenberg AFB not presently available.)

FINAL REPORT OF DISCOVERER XXVII FAILURE

5 February 1962

1. The DAC Report on Liability for Loss of [illegible] No. DAC 322 dated January 29, 1962 was received on 2 February 1962 and reviewed by this office. It is, as might be expected [illegible] the circumstances, remarkably uninformative. In particular, no [illegible] from individuals involved were furnished despite general agreement to the contrary at a preliminary conference with representatives of [illegible] Legal and Contract Administration Department.

2. The answer to Question 7 of DAC Exhibit B is particularly evasive. However, in view of the fact that the individual concerned, Mr. Frayne is classified as a Design Engineer and does not appear on the DAC Management Structure Chart, this matter is not now being pursued.

3. DAC Exhibit A appears to be irrelevant to this investigation except for pp.51 ff.

4. The information furnished does not add substantially to that previously acquired and therefore the conclusions and recommendations contained in our Interim Report remain unchanged.

5. No further effort to obtain engineering and technical evaluation of the failure will be made failing advice to the contrary.

JOHN R. DONNELLY
Major, USAF
Staff Judge Advocate
Space Systems Division (AFSC)

EXHIBIT "B"

1. What was the cause of failure of DAC 322?

The cause of the failure of Discoverer Booster 322 cannot be precisely ascertained. The failure was due to an instability which developed in the main engine pitch rate loop, and a technical analysis of the telemetry records indicates that this loop probably developed an open circuit at lift-off. The open circuit may have been present prior to launch since the automatic launch equipment did not verify this portion of the circuitry. Earlier check-out records indicate that the rate loop was functioning properly. However, an examination of the engineering paper indicates that the pitch rate, main engine actuator circuit may have been open due to a salvage rework having been performed on this particular missile booster. This rework created a non-interchangeable situation, and the subsequent replacement of the flight programmer without recognition of this fact could have created the open circuit. It should be noted, as set forth in greater detail in prior reports to the Air Force, that the failure to recognize this non-interchangeability was not due to inadequate procedures, but, rather, was due to an error in engineering judgment on the part of a certain design engineer. The engineering evaluation of this failure has indicated that other malfunctions in the pitch rate, main engine actuator circuit could have created the identical flight failure. The circuit in question contains components which are subject to malfunction modes which could have produced the flight failure. For example, it is possible that the flight failure could have been caused by the failure of a capacitor in the pitch rate, main engine actuator circuit. Because of this possibility a redesign was made which removed such capacitor from the yaw and pitch rate circuits and deleted the requirement for routing these circuits through the connector in question.

2. Who was the highest approval authority for E.O. 2796676 authorizing rewiring of the pin on the connector of the CEA and what was his title?

The highest approval authority for E.O. 2796676 was Mr. W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

3. Was this designated as a non-interchangeable modification? If not, why not?

EO 2796676 contained no statement as to the interchangeability of the items after the rewiring change. Since the change was a salvage modification and the basic Santa Monica production configuration was not affected, the Field Station policy in effect at that time did not require the identification of non-interchangeability. If production interchangeability had been affected, then the standard Douglas procedure (Standard Practice Memorandum A6-304-1860) would insure review at Santa Monica in order that the production drawings be changed as necessary to eliminate the problem on subsequent units. The cited Standard Practice Memorandum is attached as Exhibit "B1".

4. Was the lack of such designation in accordance with established DAC procedure? If so, who was the highest approval authority for this procedure and what was his title?

There was no Douglas policy or procedure requiring a field station change to be designated as interchangeable or non-interchangeable, if Santa Monica production was not affected.

5. What was the DAC management and supervisory structure of the DAC Field Station at Vandenberg AFB during the month of July, 1961?

Attached as Exhibit "B2", is an organization chart which sets forth the management and supervisory structure of the VAFB Field Station during the month of July, 1961.

6. Who was the highest approval authority for the installation of the new flight programmer for DAC 322 and what was his title?

The highest approval authority for the installation of the new flight programmer for DAC 322 was D. K. Frayne, Design Engineer, Vehicle Electronics Section, VAFB Field Station. In addition it was necessary that a test procedure change be made in order to assure that the replacement part functioned properly in the system. This test procedure change was established by E.O. No. 7797779-Variation, dated July 14, 1961. The highest approval authority for this E.O. was W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

7. Was k or anyone notified at the time of the installation of the new flight programmer that this change would not correct the previous change accomplished by E.O. 2796676? If so, who notified him and what action was taken?

The effect the earlier rewiring change accomplished under E.O. 2796676, might have on the flight programmer replacement was considered by Mr. D. K. Frayne, Design Engineer, at the time of the replacement. Pursuant to standard Contractor procedures, Mr. Frayne reviewed the engineering orders written against both flight programmers and erroneously concluded that interchangeability was not affected. Mr. W. H. Whatley, Group Engineer, reviewed and approved the procedure modification, E.O. 7797779-Variation, dated July 14, 1961, the morning following the programmer replacement. Since this variation E.O. dealt only with a test procedure modification, Mr. Whatley neither recognized nor had reason to recognize that interchangeability was affected.

8. Who was the highest approval authority for TP 7797179 used in the RIM Building?

The rate gyro polarity checks were accomplished under Test Procedure 7797779, as revised by E.O. 7797779-Variation, dated July 14, 1961 and not under Test Procedure 7797179. The highest approval authority for Test Procedure 7797779 was W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

9. Who were the individuals who ran the rate gyro polarity checks under the above TP?

The rate gyro polarity checks were accomplished under Test Procedure 7797779, as revised by E.O. 7797779-Variation, dated July 14, 1961. The rate gyro polarity checks were accomplished by R. L. Burns, Manufacturing Technician, and were signed-off by Junichi Shiromizu, Inspector, on July 11, 1961.

10. Did each individual see the meter readings? If not, who did?

The meter readings were witnessed by R. L. Burns, Manufacturing Technician. The Inspector, Junichi Shiromizu, has stated that he does not recall witnessing these particular meter indications, but that he normally does witness meter readings during this type of test.

EXHIBIT "B"

1. What was the cause of failure of DAC 322?

The cause of the failure of Discoverer Booster 322 cannot be precisely ascertained. The failure was due to an instability which developed in the main engine pitch rate loop, and a technical analysis of the telemetry records indicates that this loop probably developed an open circuit at lift-off. The open circuit may have been present prior to launch since the automatic launch equipment did not verify this portion of the circuitry. Earlier check-out records indicate that the rate loop was functioning properly. However, an examination of the engineering paper indicates that the pitch rate, main engine actuator circuit may have been open due to a salvage rework having been performed on this particular missile booster. This rework created a non-interchangeable situation, and the subsequent replacement of the flight programmer without recognition of this fact could have created the open circuit. It should be noted, as set forth in greater detail in prior reports to the Air Force, that the failure to recognize this non-interchangeability was not due to inadequate procedures, but, rather, was due to an error in engineering judgment on the part of a certain design engineer. The engineering evaluation of this failure has indicated that other malfunctions in the pitch rate, main engine actuator circuit could have created the identical flight failure. The circuit in question contains components which are subject to malfunction modes which could have produced the flight failure. For example, it is possible that the flight failure could have been caused by the failure of a capacitor in the pitch rate, main engine actuator circuit. Because of this possibility a redesign was made which removed such capacitor from the yaw and pitch rate circuits and deleted the requirement for routing these circuits through the connector in question.

2. Who was the highest approval authority for E.O. 2796670 authorizing rewiring of the pin on the connector of the CEA and what was his title?

The highest approval authority for E.O. 2796676 was Mr. W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

3. Was this designated as a non-interchangeable modification? If not, why not?

EO 2796676 contained no statement as to the interchangeability of the items after the rewiring change. Since the change was a salvage modification and the basic Santa Monica production configuration was not affected, the Field Station policy in effect at that time did not require the identification of non-interchangeability. If production interchangeability had been affected, then the standard Douglas procedure (Standard Practice Memorandum A6-304-1880) would insure review at Santa Monica in order that the production drawings be changed as necessary to eliminate the problem on subsequent units. The cited Standard Practice Memorandum is attached as Exhibit "B1".

4. Was the lack of such designation in accordance with established DAC procedure? If so, who was the highest approval authority for this procedure and what was his title?

There was no Douglas policy or procedure requiring a field station change to be designated as interchangeable or non-interchangeable, if Santa Monica production was not affected.

5. What was the DAC management and supervisory structure of the DAC Field Station at Vandenberg AFB during the month of July, 1961?

Attached as Exhibit "B2", is an organization chart which sets forth the management and supervisory structure of the VAFB Field Station during the month of July, 1961.

6. Who was the highest approval authority for the installation of the new flight programmer for DAC 322 and what was his title?

The highest approval authority for the installation of the new flight programmer for DAC 322 was D. K. Frayne, Design Engineer, Vehicle Electronics Section, VAFB Field Station. In addition it was necessary that a test procedure change be made in order to assure that the replacement part functioned properly in the system. This test procedure change was established by E.O. No. 7797779-Variation, dated July 14, 1961. The highest approval authority for this E.O. was W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

7. Was [illegible] or anyone notified at the time of the installation of the new flight programmer that this change would not correct the previous change accomplished by E.O. 2796676? If so, who notified him and what action was taken?

The effect the earlier rewiring change accomplished under E.O. 2796676, might have on the flight programmer replacement was considered by Mr. D. K. Frayne, Design Engineer, at the time of the replacement. Pursuant to standard Contractor procedures, Mr. Frayne reviewed the engineering orders written against both flight programmers and erroneously concluded that interchangeability was not affected. Mr. W. H. Whatley, Group Engineer, reviewed and approved the procedure modification, E.O. 7797779-Variation, dated July 14, 1961, the morning following the programmer replacement. Since this variation E.O. dealt only with a test procedure modification, Mr. Whatley neither recognized nor had reason to recognize that interchangeability was affected.

8. Who was the highest approval authority for TP 7797179 used in the RIM Building?

The rate gyro polarity checks were accomplished under Test Procedure 7797779, as revised by E.O. 7797779-Variation, dated July 14, 1961 and not under Test Procedure 7797179. The highest approval authority for Test Procedure 7797779 was W. H. Whatley, Group Engineer, Vehicle Electronics Section, VAFB Field Station.

9. Who were the individuals who ran the rate gyro polarity checks under the above TP?

The rate gyro polarity checks were accomplished under Test Procedure 7797779, as revised by E.O. 7797779-Variation, dated July 14, 1961. The rate gyro polarity checks were accomplished by R. L. Burns, Manufacturing Technician, and were signed-off by Junichi Shiromizu, Inspector, on July 11, 1961.

10. Did each individual see the meter readings? If not, who did?

The meter readings were witnessed by R. L. Burns, Manufacturing Technician. The Inspector, Junichi Shiromizu, has stated that he does not recall witnessing these particular meter indications, but that he normally does witness meter readings during this type of test.

[illegible]

21\. [illegible]

[illegible]

22\. [illegible]

[illegible]

[illegible]

23\. [illegible]

[illegible]

[illegible]

[illegible]