SA

APR 1 1969

THROUGH: NASA Headquarters
Attention: Dr. George E. Mueller, M

TO : NASA Headquarters
Attention: Mr. B. P. Helgeson, DY

FROM : Director

SUBJECT : Final Accident Investigation Board Report (dated March 12, 1969) of the Lunar Landing Training Vehicle (LLTV) No. 1 Crash on December 8, 1968

Seven copies of the subject report are transmitted with my concurrence.

The following attachments are included:

a. Memorandum dated March 19, 1969, from Legal to Flight Safety Office, covering approval by the Center's Legal Office of the subject report.

b. Draft News Release by the Center's Public Affairs Office, dated March 24, 1969, of the subject report.

It has been estimated by the Flight Crew Operations Directorate that 8 to 10 weeks will be required after resumption of the LLTV program to complete flight test for verification of the wind tunnel test data and recommended revisions. Factors such as weather and other unforeseen problems may extend this planned time period. Astronaut training flights can then be initiated following completion of these flight tests.

Implementing actions on the Board's recommendations have been initiated. Status reports will be submitted.

Original Signed By
R. R. Gilruth
Robert R. Gilruth

Enclosures 3
(Enclosure 1 - 7 copies under separate cover)

bcc: SA/M. L. Raines (w/one cy)
CA/D. K. Slayton (w/three cys)
SC/J. E. Powell (w/one cy)

SA:JCFrench:at 3/26/69
Rewritten AA:ILScott:lc 3/28/69

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : AA/Director
Through: AB/Deputy Director

DATE: MAR 25 1969

FROM : SA/Acting Manager, Flight Safety Office

SUBJECT: Final Accident Investigation Board Report (dated March 12, 1969) of the Lunar Landing Training Vehicle No. 1 Crash on December 8, 1968

1. PURPOSE

The attached letter of transmittal indicates the Director's concurrence and forwards the subject report to the NASA Director of Safety through the Institutional Director as required in Section IX of NHB 1700.1, NASA Safety Manual.

2. DISCUSSION

The Flight Safety Office's review of the report identified several minor deficiencies which have been corrected with the Board's agreement. However, there exists one substantive point which warrants your attention:

Under Findings of the Board on page 2-B-2, Factor 4 states: "Recommendations of the previous accident board for LLRV #1 were not totally implemented."

Flight Safety Office Comment: This factor was reviewed with Mr. George Trimble and we are both in agreement that the Board should be requested to clarify this Factor 4. It is the Flight Safety Office's opinion that it should be deleted or a more detailed explanation under paragraph 4, page 2-B-5 should be provided.

A review of the previous board recommendations did not disclose any open items which, in our opinion, contributed to the subject accident. The LLRV FRR Board attended by the chairman and members of Headquarters Flight Readiness Evaluation Board which discussed the previous LLRV recommendations did not indicate any deficiencies in the recommendations that would hold up the flight tests on the LLTV.

3. CLEARANCES

The memorandum to Headquarters has the concurrence of SA/Flight Safety Office, CA/Flight Crew Operations Directorate, AL/Legal Office, and AP/Public Affairs Office.

4. RECOMMENDATIONS

It is recommended that under Findings of the Board, page 2-B-2, Factor 4 and related data be deleted or expanded by the subject Board prior to signing the memorandum to NASA Headquarters.

Original signed by:
M. L. RAINES

M. L. Raines

Enclosure

SA:JCFrench:at 3-25-69

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : SA/Flight Safety Office
Attn: John C. French

DATE: March 19, 1969

FROM : AL4/Chief, General Legal Branch

SUBJECT: Lunar Landing Training Vehicle No. 1 Accident (December 8, 1968) Investigation Board Report

In response to your oral request of March 14, 1969, the subject document has been reviewed and we see no legal objection to the formal Board report. You may consider this review as constituting our coordination as required for the Director (AA) by paragraph 4.403-2d of MSCM 1700.

Richard J. Wieland

Attachment

AL4:RULea:md 3-19-69

5010-108

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3-24-69

D R A F T -- News Release for LLTV #1 Accident Investigation Board Report

Aerodynamics forces overcame the vehicle's attitude control system and caused the December 8 crash of the Lunar Landing Training Vehicle (LLTV) No. 1 from which pilot Joseph Algranti safely ejected. The crash took place at Ellington AFB near the NASA Manned Spacecraft Center during a lunar landing simulation flight of the wingless vehicle. A Board was appointed immediately after the crash by Manned Spacecraft Center Director Robert R. Gilruth, and was chaired by Captain Walter M. Schirra, Jr.

Through a reconstruction of the four-minute flight from telemetry tapes, motion pictures and videotapes, the board determined that there had been no mechanical malfunction to cause the accident. The Board concluded:

1. That the primary cause of the accident was that the vehicle entered a region of flight where aerodynamic moments overpowered the control system in use such that attitude control was lost. The source of the control problem was not identified by either the pilot or the TM Van in time to add a second control system which could have restored control capability.

2. That the adverse region of flight was entered because:

(a) The aerodynamic limitations of the LLTV were not completely known by anyone.

(b) The existing wind conditions were insufficiently accounted for in preflight and real time flight planning.

(c) The configuration of displays in both the LLTV and the supporting TM Van inadequately defined the existing flight conditions.

-more-

Since the crash of LLTV No. 1, LLTV No. 3 has been tested in a Langley Research Center wind tunnel to measure the vehicle's responses to various wind conditions.

The crash occurred following a normal climb to 680 feet and positioning of the LLTV to begin the simulated lunar landing.

As the pilot began the simulated lunar landing run, the turbojet engine which subtracts five-sixths of the vehicle's weight was released from its fixed normal vertical thrust position (vertical relative to vehicle). Shortly after the lunar simulation run had begun, the LLTV attitude began to oscillate about all three axes. The pilot attempted to regain control of the vehicle by relocking the turbojet engine in its normal position.

The vehicle continued to oscillate (maximum 102 degrees bank) until it exceeded the point where the turbojet engine and the lift rockets could counteract gravity. The LLTV began a rapid descent, and at about 100 feet altitude the pilot ejected from the vehicle as it oscillated through the horizontal plan. Descent velocity has been estimated at 95 feet per second (64.8 mph) at the time of ejection.

The ejection seat propelled the pilot back to an altitude of 200 feet where the parachute opened. The parachute drifted well away from the LLTV impact and fireball, and the pilot was uninjured except for minor thigh bruises caused by the force of ejection.

An earlier version of the LLTV, the Lunar Landing Research Vehicle, crashed May 6, 1968, when loss of helium rocket fuel pressurant caused loss of attitude control. Pilot Neil A Armstrong ejected safely away from the vehicle.

In the report to the Manned Spacecraft Center Director, the LLTV Accident Investigation Board made 11 recommendations aimed toward improved flight safety in future LLTV flight tests and astronaut lunar landing training:

* Conduct wind tunnel tests to measure LLTV aerodynamic characteristics so that operating limits can be set.

* Redesign attitude control system to automatically select both sets of LLTV attitude thrusters when the pilot's hand controller hits the hard stops.

* Provide an improved cockpit display of airflow velocity and direction as well as displays of attitude control ability in all directions.

* Revamp telemetry and ground control vans to include improved attitude control displays and a real-time plotboard of vehicle airspeed and direction.

* Relocate into the pilot's field of view an improved yaw reference indicator.

* Increase thrust output of the attitude thrusters.

* Revise LLTV Operations Manual to spell out all details of various flight profiles to be flown, including wind condition tolerances.

* Measure the existing winds up to an altitude of 700 feet.

* Provide adequate crash rescue protection.

* Investigate ways to lessen pilot leg injuries in ejection.

* Review all flight data systematically to uncover any abnormal situations with flight hazard potential.

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