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MPAD VERIFICATION OF APOLLO 5 (AS-204/LM-1) FLIGHT MISSION RULES

By Mission Planning And Analysis Division

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

(NASA-TM-X-69632) MPAD VERIFICATION OF APOLLO 5 (AS-204/LM-1) FLIGHT MISSION RULES (NASA) 28 p

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PROJECT APOLLO

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HOUSTON, TEXAS

Approved: Carl R. Huss
Carl R. Huss, Assistant Chief for Mission Design

Approved: Carl R. Huss
for John P. Mayer, Chief
Mission Planning and Analysis Division

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FOREWORD

The Mission Planning and Analysis Division (MPAD) has conducted an internal verification review of the Apollo 5 (AS-204/LM-1) Flight Mission Rules. Each rule was reviewed with regard to the MPAD's contribution to the creation, verification, or justification of the rule and, also, to the MPAD's agreement or disagreement with the rule.

This document presents the results of the MPAD's internal verification review and contains the following information about each rule which falls within the MPAD's area of responsibility: background or clarifying statements that may be pertinent to why the rule was necessary, the data the rule was based on, limitations that exist, if any, etc.; statements concerning disagreements; and a list of references which substantiate the rule. Where disagreement with a rule was discovered, the disagreement was discussed with the responsible flight controller and in most cases was resolved and is so stated.

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
1-13	Launch aborts will normally be based on violation of FIDO limit lines or SLV failures. If a S/C system failure, which would preclude the accomplishment of minimum objectives at CRO, occurs during launch, a fixed time abort will be executed between T + 7:20 and T + 9:00 to optimize the chances of obtaining the minimum objectives. The LM malfunction requiring an abort must have been noted and verified no later than 30 seconds prior to the time of the abort. If the LGC is Go, Mode III abort will be used; if No-Go, PRA Sequence IV, SOS.		

PHILOSOPHY:

A launch abort will be initiated upon trajectory violation of the Mode III limit lines as shown on the V_i-γ_i plotboard (ref. 1, fig. 1) or the cross-range limits prior to Mode IV capability as shown on the ϕ-λ plotboard (ref. 1, fig. 4). A successful abort can be performed any time during flight in the Mode III region, but an optimum time of abort would be at T + 7:20 based on the elevation angle at Bermuda being maximum (ref. 2, fig. 17 and 21); in addition the insertion ship will provide tracking overlap with BDA. The Mode III region beginning where the dynamic pressure is 1 psf and ending where the IP crosses into Africa is shown on the V_i-γ_i plotboard. PRA sequence 4, Mode II, and Mode III IP histories are shown in reference 3, figure 1. An update to this reference has been provided to the Flight Control personnel.

COMMENTS: None

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Plan. MSC IN 67-FM-55, May 15, 1967.

3. Henderson, Edward M.: African Impact History for the 204/LM-1 Launch Phase. MSC Memorandum 67-FM36-229, June 30, 1967.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
1-33	Launch phases: There are three phases of powered flight: A. Liftoff until the q $\leq$1 PSF where the nose cap can be jettisoned. During this period there is no abort capability. (Defined as a limit of an H, V plot.) B. Mode III: From q $\leq$1 PSF until V_{GO} = 3800 fps (V, γ line). During this period there is both SLV abort and SOS (LGC and PRA) capability. An abort in the Mode III launch phase will be executed by the LGC unless the PRA SOS is specifically designated in the specific rules. C. Mode IV: From V_{GO} = 3800 fps (V, γ line) to insertion. During this period there is SLV abort and COI capability.		

PHILOSOPHY:

The three phases of powered flight are:

A. A Mode I abort necessitates a ballistic entry of the whole launch vehicle because of the inability to release the nose cap and extract the LM due to high dynamic pressure (ref. 2, p. 5). The first time the nose cap can be jettisoned is when the dynamic pressure becomes 1 psf as shown on the V_i-γ_i and h-d plotboards (ref. 1, fig. 1 and 3).

B. A Mode III abort is possible when the nose cap can be jettisoned (at a dynamic pressure $\leq$1 psf) and the LM extracted (ref. 2, p. 7). The Mode III aborts are prime until Mode IV capability exists (ref. 1, fig. 1).

C. Mode IV is prime when the $V_g \leq 3620$ fps along the nominal trajectory (ref. 2, p. 10). This mode extends until the Go/No-Go line and is capable of inserting the LM into an acceptable orbit. While in this region, the LM descent propulsion system is used for the contingency insertion maneuver.

COMMENTS:

The Mode IV capability line does not consist of a constant V_g as might be interpreted from this rule. The V_g is a function of the flight-path angle and varies along the Mode IV capability line. See comments on rule 4-4.

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Play. MSC IN 67-FM-55, May 15, 1967.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
1-34	Reentry configurations: For convenience in maintaining terminology consistent with manned missions the following have been used to define reentry configurations. A. Mode I: Total vehicle with nose cone attached. (Could be 1 or 2 booster stages). B. Mode II: S-IVB with SLA deployed and LM attached.		

PHILOSOPHY:

The two ballistic entry configurations are:

A. A Mode I abort necessitates a ballistic entry of the whole launch vehicle because of the inability to release the nose cap and extract the LM due to high dynamic pressure (ref. 2, p. 5). The first time the nose cap can be jettisoned is when the dynamic pressure becomes 1 psf as shown on the V_i-γ_i and h-d plotboards (ref. 1, fig. 1 and 3).

B. Mode II aborts can occur anywhere from a dynamic pressure of 1 psf until insertion, and is a result of failure to separate the LM from the S-IVB. This failure can occur in either Mode III or Mode IV abort attempts. A Mode II IP history is shown in reference 4, figure 1.

COMMENTS: None

REFERENCES:

1. Lunde, Alfred M.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Plan. MSC IN 67-FM-55 May 15, 1967.

3. Henderson, Edward M.: African Impact History for the 204/LM-1 Launch Phase. MSC Memorandum 67-FM36-229, Juen 30, 1967.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-1	$V_I \geq 20\ 000$ fps and $T_{FF} = 1{:}54$ and decreasing, or Mode III limit line exceeded, or cross-range limit line violated prior to Mode IV capability. A. LGC Go B. LGC No-Go	A. 1. Send immediately: SLV abort command 2. Upon verification of SLV abort sequence initiate (nose cap jettison or SLA deploy) send: LGC SOS command B. 1. Send immediately: SLV abort command 2. Execute PRA Seq IV, SOS (ref GUIDO rule 4-51).	1. Cues: FIDO launch digitals; γ_I vs V_I and ϕ vs λ plots. 2. SLV abort sequence must be verified prior to commanding SOS, as there is no interlock between S-IVB and LGC sequencing.

PHILOSOPHY:

If any limit line is violated in the Mode III region, a Mode III abort will be initiated. The limit lines are the cross-range limits consisting of the extreme acceptable launch azimuth limits of 61° and 86° (ref. 4, p. 1), the Mode III limit line consisting of:

A. The 1000 000-ft altitude constraint (ref. 5, action item 9.3).

B. VHF communications blackout constraint (ref. 8).

C. The 0° elevation angle constraint (ref. 1, fig. 1, and ref. 3).

Also if the velocity is greater than 20 000 fps, the T_{ff} = 1:54 limit approximates the communications blackout constraint which makes up part of the Mode III limit line. Thus, abort decisions could be based on a violation of the T_{ff} value of 1:54 (ref. 2, fig. 13).

COMMENTS: None

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Plan. MSC IN 67-FM-55, May 15, 1967.

3. Henderson, Edward M.: Mode III Abort Limit for AS-206, MSC Memorandum No. 67-FM34-110, April 5, 1967.

4. Crafts, James L.: SA-204/LM-1 Range Safety Analysis. MSFC Memorandum, June 6, 1967.

5. Allen, Charlie C.: Results of the Ninth Apollo Abort Working Group Meeting Held on March 16, 1967. MSC Memorandum 67-FM34-90, March 27, 1967.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-3	No S-IVB C/O by 300 n.mi. apogee line.	FIDO send immediately: SLV abort command	1. Cues: γ_i vs V_i plot γ vs V_s plot 2. Required to maintain communications and normal timelines.

PHILOSOPHY:

If the S-IVB fails to cutoff at nominal insertion, a ground commanded cutoff will be sent when the S-IVB has reached an overspeed condition resulting in an apogee of 150 n. mi. Any such overspeed condition is detrimental to the nominally planned orbit and the booster should be shutdown as soon as possible after the overspeed is detected. Due to data and reaction delay, the S-IVB cutoff apogee will be greater than 150 n. mi. The 150 n. mi. overspeed line is shown on the V_i-γ_i plotboard (ref. 1, fig. 1).

COMMENTS:

Mr. H. D. Reed (FCD) has stated that the h_a line has been changed from 300 n. mi. to 150 n. mi. in the latest revision to the mission rules.

REFERENCE:

1. Lunde, Alfred N.: Update to Flight Dyanmics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-4	$V_G \leq 3800$ fps	1. FIDO report to flight "Mode IV mark" 2. SLV abort command responsibility for premature S-IVB cutoffs transfers from BSE to FIDO.	1. Cues: FIDO launch digitals γ_i vs V_i plot 2. $V_G \leq 3800$ fps is lower unit for COI capability.

PHILOSOPHY:

The Mode IV capability region is made up of three segments:

A. A 500-sec descent propulsion system (DPS) burn which is the maximum burn allowed in order to get a DPS reignition (ref. 3, p. 4).

B. The 350 000-ft altitude constraint that would restrict burns below it (ref. 4).

C. A line which defines a region where a guidance shutdown occurs before perigee altitude reaches 75 n. mi.

The latter results when TGO is less than 10 sec and the LGC stops steering on the radius and the spacecraft acceleration is not sufficient to overcome and raise the rapidly decreasing altitude by the time the target velocity is achieved (ref. 2, p. 11). These various segments of the Mode IV capability region are shown on the V_i-γ_i and V_s-γ_i plotboards (ref. 1, fig. 1 and 2).

COMMENTS:

Mr. H. D. Reed (FCD) stated that the revised mission rules do not contain the V_g number of 3800 fps, but rather the phrase "Mode IV capability." A constant V_g number is only valid for the nominal trajectory and will change with non-nominal flight-path angles and altitudes. Console plots are being provided to Flight Control personnel to determine the V_g corresponding to the Mode IV capability achievement for different flight-path angles and altitudes. There are two sources of V_g's during real time. The first is based on an RTCC empirical relationship using real-time data and displayed during S-IVB powered flight. The second simulates the actual LGC computation and is displayed during the Mode IV burn (DPS). Curves of both these V_g values will be provided.

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Plan. MSC IN 67-FM-55, May 15, 1967.

3. MSC and MSFC: AS-206 Joint Operational Constraints. MSC and MSFC Trajectory Document No. 66-FMP-23, December 15, 1966.

4. Allen, Charlie C.: Results of the Twenty-fifth Apollo Abort Working Group (AAWG) Meeting on the AS-204/LM-1 and AS-502/020 Missions held on December 14, 1967. MSC Memorandum No. 67-FM36-512, January 4, 1968.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-16	$H_p \geq 75$ n.mi.	1. FIDO request "SAFE" from RSO. 2. FIDO report "GO" to FD.	Cues: FIDO launch digitals

PHILOSOPHY:

If the S-IVB cutoff after the $H_p \geq 75$ n. mi. no action will be initiated since the spacecraft is in an acceptable orbit (ref. 2). The $H_p \geq 75$ n. mi. line is indicated on the V_i-γ_i plotboard (ref. 1, fig. 1).

COMMENTS:

The H_p = 75 n. mi. line is a Keplerian predicted perigee.

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Analytical Research Operations and Engineering Operations TRW Systems: Evaluation of a Minimum Orbital Altitude for Apollo Spacecraft - Amendment 1. TRW Note No. 66-FTM-206, March 4, 1966.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-17	H_P <75 n.mi. A. V_G $\leq$4190 fps (inside COI capability)	A. 1. Report to flight and RSO "(trajectory) Go Mode IV" 2. Send: SLV abort command 3. PGNS Go (A) Upon verification of SLV sequence initiate, send: COI command (B) See alternate mission matrix (Note: If COI burn time is $\geq$80 sec, perform alternate L. If burn time is <80 continue mission.) PGNS No-Go RFO Recommend abort mode.	Cues: FIDO launch digitals

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-17 (Cont'd)	B. V_G >4190 fps (outside COI capability)	B. 1. Report "No-Go" to FD 2. Send: <u>SLV abort command</u> (Ref BSE rule 5-15) 3. <u>PGNS Go</u> Upon verification of SLV seq initiate send: <u>LGC SOS</u> <u>PGNS No-Go</u> RFO recommend abort mode (Mode II or PRA Seq 4)	

PHILOSOPHY:

If the S-IVB C/O when h_p <75 n. mi. and there is Mode IV capability, a Mode IV abort would be performed to insert the spacecraft into an acceptable orbit. The Mode IV region is shown on the V_i-γ_i plotboard (ref. 1, fig. 1). If the h_p <75 n. mi. and there is no COI (Mode IV) capability then a Mode III abort will be performed. If the LGC is No-Go PRA sequence 4 will be initiated. The Mode III IP African crossing is shown on the V_i-γ_i plotboard, and the PRA sequence 4 IP on Africa will be shown on a console plot.

COMMENTS:

Mr. H. D. Reed (FCD) stated that the revised mission rules do not contain the V_g number of 4190 fps, but rather the phrase "inside COI capability". Console plots as described in verification of rule 4-4 will be provided.

REFERENCE:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verification by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-30	Instantaneous H_p decreases to <75 n.mi. during any LGC controlled maneuver.	1. FIDO send immediately: Eng Stop O/R 10B 2. See alternate mission matrix.	1. If APS 2 cannot be retargeted prior to nominal initiation, alternate mission K must be executed. 2. If Eng Stop O/R sent during APS 2 FIDO will request GUIDO to select AGS and execute PRA interconnect close routine.

PHILOSOPHY:

If the instantaneous perigee decreases to <80 n. mi. during any LGC controlled maneuver, the thrusting maneuver will be terminated. Seventy n. mi. altitude is indicated to be the minimum altitude to perform any thrusting maneuver. A PRA sequence completes the LM propulsion test if the instantaneous perigee falls below 80 n. mi. The violation of this line can be monitored on the h_a-h_p plotboard (ref. 1, fig. 5).

COMMENTS:

The inaccuracy of the Keplerian perigee prediction has resulted in increasing the limit from 75 to 80 n. mi.

REFERENCE:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-31	Instantaneous H_p decreases to <65 n.mi. during any PRA controlled maneuver.	FIDO send immediately: Eng Stop O/R 10B	No further maneuvers will be executed if H_p is confirmed <65 n.mi.

PHILOSOPHY:

If the instantaneous perigee decreases to h_p <70 n. mi. during any PRA controlled maneuver, the thrusting maneuver will be terminated since the LM is so low that damage to the antenna, windows, and skin will result (ref. 2, p. 4-1 to 4-22). The violation of the 70 n. mi. perigee limit can be monitored on the h_a-h_p plotboard (ref. 1, fig. 5).

COMMENTS:

The inaccuracy of the Keplerian perigee prediction has resulted in increasing the limit from 65 to 70 n. mi.

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Analytical Research Operations and Engineering Operations TRW Systems: Evaluation of a Minimum Orbital Altitude for Apollo Spacecraft - Amendment 1. TRW Note No. 66-FTM-206, March 4, 1966.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-50	Premature S-IVB C/O with Mode III IP on Africa, and Mode II IP on water.	1. Upon cue from flight send: Guidance select AGS 40B 2. Execute PRA Sequence IV, SOS.	1. Reference retro rule 4-80B. 2. PRA sequences will be executed only upon cue from flight.

PHILOSOPHY:

If the trajectory is No-Go, Mode III IP is on Africa, and Mode II IP is on water, a PRA sequence 4 abort will be initiated. The Mode III IP crossing of the west coast of Africa is shown on the V_i-γ_i plotboard (ref. 1, fig. 1). The west coast of Africa IP for the Mode II will be shown on a console plot to be furnished to Mr. H. D. Reed (FCD).

COMMENTS:

African landings can occur for the PRA sequence 4 aborts even with water landing indications of the Mode II IP. However, support data is being provided to flight control of the Mode II IP longitude line biased to insure PRA sequence 4 water landings.

REFERENCE:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-74	Minimum T_{FF} = 1:54 and decreasing $V_I \geq$ 20 000 fps.	1. Retro report to FIDO: "Mark, minimum T_{FF}." 2. Mode III abort or PRA sequence IV, SOS will be commanded. (Reference FIDO rule 4-1).	1. Cues: γ vs V; h vs d; Retro launch digitals 2. T_{FF} = 1:54 to 300K assures primary portion (2:05) of Mode III sequence prior to blackout.

PHILOSOPHY:

If $V_i \leq$20 000 fps, the Mode III limit line, which in that region consists of the communications blackout constraint, is almost coincident with the T_{ff} limit of 1:54 (ref. 2, fig. 13). This T_{ff} limit is shown on the R_{IP}-T_{ff} plotboard (ref. 1, fig. 7) and as digital display.

COMMENTS: None

REFERENCES:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

2. Spaceflight Operations Department TRW Systems: Spacecraft Operational Abort and Alternate Mission Plan for 204/LM-1 (Formerly AS-206), Vol. 1 - Abort Plan. MSC IN 67-FM-55, May 15, 1967.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-80	Trajectory is No Go and Mode III IP is on Africa.		1. Cues: ϕ, λ plot T_{FF}, R_{IP} plot retro launch digtals.
	A. Mode II IP also on Africa.	A. Retro report to flight and FIDO: "Go Mode III"	A. FIDO will initiate Mode III abort.
	B. Mode II IP clear of Africa.	B. Retro report to flight and GUIDO. "Go PRA Sequence IV."	B. GUIDO will initiate PRA Sequence IV, SOS. Reference GUIDO rule 4-50.

PHILOSOPHY:

At S-IVB cutoff:

A. If the trajectory is No-Go and both Mode III and Mode II IP is on Africa, a Mode III abort will be done since there is not any possibility of having a water landing. A Mode III abort will result in a more substantial propulsion test of the LM than if a PRA sequence 4 were used.

B. If the trajectory is No-Go and Mode III IP is on Africa and Mode II IP is on water, a PRA sequence 4 will be initiated. The Mode III IP crossing of the west coast of Africa is shown on the V_i-γ_i plotboard (ref. 1, fig. 1), and the Mode II and Mode III IP crossing of the west coast of Africa will be shown on a console plot.

COMMENTS:

Comments under mission rule 4-50 apply to part B of this mission rule.

REFERENCE:

1. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
4-83	Trajectory No Go after q $\leq$1 PSF with PGNS No Go.	Retro report to flight and GUIDO: "Go PRA Sequence IV."	Cues: FDO report trajectory No Go. GNC report PGNS No Go or GUIDO report LGC No Go.

PHILOSOPHY:

Having determined that the booster has passed the dynamic pressure = 1 psf region, the nose cap can be jettisoned (ref. 1, p. 6). If the trajectory is then No-Go, the PRA sequence 4 can be used to carry out the LM propulsion test. The V_i-γ_i and h-d plotboards (ref. 2) can be monitored to determine when dynamic pressure = 1 psf.

COMMENTS: None

REFERENCES:

1. MSC and MSFC: AS-206 Joint Operational Constraints. MSC and MSFC Trajectory Document No. 66-FMP-23, December 15, 1966.

2. Lunde, Alfred N.: Update to Flight Dynamics Display Plotboards for the 204/LM-1 Missions. MSC Memorandum 68-FM36-11, to be published.

Verified by: A. N. Lunde/E. M. Henderson

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
14-39	Loss of CES power supply	1. Stay in PGNS control 2. Go to appropriate area of flight plan in this rule.	1. Cues GL4027X CES dc pwr fail GH1311V man thrust cmd GH1331V auto thrust cmd GH1247V yaw err cmd GQ6806H var inj act pos GH1214X auto on cmd
	A. Prior to DPS 1 burn	A. Execute alternate mission H	2. Failure of the CES pwr supply will result in the following:
	B. During DPS 1 burn	B. 1. Continue mission 2. After DPS cutoff, execute alternate mission H	A. Loss of vehicle attitude stability control in AGS.
	C. After DPS 1 burn and prior to DPS 2 burn.	C. Execute alternate mission H	B. Lock of GDA position
	D. During DPS 2 burn	D. 1. Continue mission 2. After DPS cutoff execute alternate mission H.	C. Max DPS throttle D. Loss of APS auto engine on and off signals out of CES. LGC still sends on signal.
	E. After completion of APS 1 burn and before APS 2 burn.	E. 1. To perform APS 2 burn use LGC program 46 as planned: 2. When +X translation is detected send: (A) Eng start O/R 14B (B) Eng Reset 15B	E. Loss of +X translation in AGS control. F. Prohibits starting the descent engine. The DPS should not be started at a throttle setting over 60 percent. G. If ASC engine is on via auto engine on route, the engine will shut down.

Rule no.	Condition/Malfunction	Ruling	Notes/Comments/SOP's
14-39 (Cont'd)		3. The ascent engine will burn to depletion and the interconnect test will be performed.	
	F. During APS 2 burn	F. 1. APS 2 burn is occurring in LGC program 46 2. LGC goes to P00. 3. Attempt to retarget APS 2 burn. 4. Perform ruling 14-39E.	

PHILOSOPHY (14-39B):

If a powered-flight maneuver is in progress during failure of CES power supply, alternate mission H is executed after termination of that burn. If a burn is not in progress, alternate H is employed immediately.

COMMENTS: None

REFERENCE:

1. Dupnick, E. A.; and Glantz, Stanton A.: Spacecraft Operational Abort and Alternate Mission Plan for AS-204/LM-1 - Vol. II - Alternate Mission. MSC IN No. 67-FM-201, December 27, 1967.

Verified by: A. N. Lunde/E. M. Henderson