

APOLLO PROGRAM

OFFICE OF MANNED
SPACE FLIGHT

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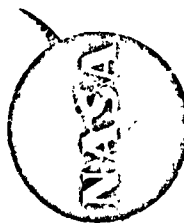
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FINAL FLIGHT EVALUATION REPORT APOLLO 5 MISSION

OCTOBER, 1968



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONTENTS

	<u>PAGE NO.</u>
ILLUSTRATIONS	iii
ABSTRACT	v
1.0 INTRODUCTION	1
1.1 PLANNED MISSION DESCRIPTION	1
1.2 SUMMARY OF MISSION AS FLOWN	2
1.3 APOLLO PROGRAM IMPACT	5
1.4 SUMMARY OF MISSION ACCOMPLISHMENTS	7
2.0 ANOMALY LISTING	17
2.01 CARRY-OVER ANOMALIES FOR SUBSEQUENT FLIGHT READINESS REVIEWS	21
2.1 MSC ANOMALIES	24
2.2 MSFC ANOMALIES	67
2.3 KSC ANOMALIES	79
3.0 REFERENCES	128

ILLUSTRATIONS

<u>FIGURE</u>		<u>PAGE</u>
1-1	Apollo 5 Planned Mission Profile - Major Events	3
1-2	Apollo 5 Mission Sequence	4
2.1-1	Accelerometer/Engine Chamber Pressure Phasing during First Descent Propulsion Burn	27
2.1-2	DPS-1 Start Transients	28
2.1-3	LM-1 Descent Propulsion Subsystem Schematic	30
2.1-4	LM-1 Vehicle	34
2.1-5	LM-1 Ascent Stage	35
2.1-6	RCS Propellant Data	37
2.1-7	RCS Installation Schematic	38
2.1-8	LM-1 Descent Propulsion Subsystem	41
2.1-9	Descent Engine Propellant Valves	42
2.1-10	Communication System Configuration	46
2.1-11	RCS Propellant System	59
2.1-12	RCS Installation	62
2.1-13	Descent Propellant Quantity Gauging System - Simplified Diagram	64
2.3-1	Freon Bottle Racks	81

ILLUSTRATIONS (CONT'D)

<u>FIGURE</u>		<u>PAGE</u>
2.3-2	Freon Bottle Standpipe Arrangement	82
2.3-3	Holddown Arms and Service Arms Control System Functional Diagram	96
2.3-4	View of Arm Links in Vehicle Restraining and Release Positions	97
<u>TABLE</u>		
I.	Apollo 5 Mission Planned vs. Actual Sequence of Events	15
II.	UHF Commands	45

ABSTRACT

THIS DOCUMENT IS A FINAL FLIGHT EVALUATION REPORT FOR THE APOLLO 5 MISSION. IT INCLUDES DATA FROM THE MSC, MSFC, AND KSC MISSION REPORTS. A DESCRIPTION OF THE MISSION IS PROVIDED, GIVING A SUMMARY OF PLANNED MISSION EVENTS AND DETAILS OF THE MISSION AS IT WAS FLOWN. THE IMPACT OF THIS MISSION, THE DEGREE OF OBJECTIVE ACCOMPLISHMENTS, AND THEIR EFFECT ON FUTURE APOLLO MISSIONS IS DISCUSSED. SIGNIFICANT MISSION ANOMALIES ARE PRESENTED FOR CARRY-OVER INTO SUBSEQUENT FLIGHT READINESS REVIEWS. FOLLOWING THE LIST OF SIGNIFICANT ANOMALIES, ALL ANOMALIES RESULTING FROM THIS MISSION ARE LISTED IN A SEPARATE SECTION AND NUMBERED ACCORDING TO SPACECRAFT, LAUNCH VEHICLE, AND GROUND SYSTEMS. WHERE FURTHER CLARITY WAS DEEMED NECESSARY, SUPPORTING MATERIAL HAS BEEN INCLUDED, GIVING THE ANOMALY BACKGROUND, A DETAILED DESCRIPTION, THE CAUSE, AND CORRECTIVE ACTIONS TAKEN.

THREE ANOMALIES REMAIN OPEN AT THIS TIME. AN ADDENDUM TO THIS REPORT WILL BE FURNISHED AT A LATER DATE WHEN INFORMATION BECOMES AVAILABLE ENABLING THE CLOSING OF THESE ANOMALIES.

THIS DOCUMENT HAS BEEN PREPARED BY THE BOEING COMPANY WDC/TIE UNDER NASA/APO MAT-1 TECHNICAL DIRECTION NASW-1650 FOR TASK NO. 10.0.

KEY WORDS

FLIGHT EVALUATION
MISSION REPORTS
ANOMALY
IMPACT
OBJECTIVES
SIGNIFICANT MISSION ANOMALIES
SUBSEQUENT MISSIONS

APOLLO 5

1.0 INTRODUCTION

APOLLO 5 WAS THE FOURTH FLIGHT OF THE SATURN IB LAUNCH VEHICLE AND THE FIRST FOR THE APOLLO LUNAR MODULE (LM-1) SPACECRAFT. THE PREVIOUS MISSIONS HAVE SUCCESSFULLY TESTED THE PERFORMANCE OF THE LAUNCH VEHICLE AND SPACECRAFT COMBINATION, INCLUDING THE PERFORMANCE OF THE COMMAND MODULE HEAT SHIELD AT LOW EARTH ORBITAL RE-ENTRY CONDITIONS. APOLLO 4 (AS-501) TESTED THE SATURN V LAUNCH VEHICLE AND THE PERFORMANCE OF THE COMMAND MODULE AT SIMULATED LUNAR RETURN VELOCITY.

APOLLO 5 (AS-204) WAS A LUNAR MODULE DEVELOPMENT MISSION DESIGNED TO QUALIFY THE LUNAR MODULE FOR MANNED FLIGHT. ITS PURPOSE WAS TO EXTENSIVELY TEST THE UNMANNED LUNAR MODULE PART OF THE SYSTEM IN NEAR-EARTH ORBIT.

1.1 PLANNED MISSION DESCRIPTION

THE MAIN OBJECTIVES OF THE APOLLO 5 MISSION WERE TO EVALUATE LM STAGING, VERIFY OPERATION OF THE LM STRUCTURE AND ASCENT AND DESCENT PROPULSION SYSTEMS, AND TO EVALUATE S-IVB/IU ORBITAL PERFORMANCE. THE MISSION WAS TO CONSIST OF INSERTION OF THE S-IVB/IU/LM INTO AN ELLIPTICAL EARTH ORBIT, SEPARATION OF THE LM FROM THE S-IVB/IU, AND ORBITAL OPERATIONS OF THE LM DESIGNED TO SIMULATE CONDITIONS ENCOUNTERED ON A LUNAR MISSION. THE FIRST DESCENT PROPULSION SYSTEM (DPS) BURN WAS DESIGNED TO SIMULATE THE POWERED LUNAR LANDING MANEUVER. THE FIRST ASCENT PROPULSION SYSTEM (APS) BURN WAS TO SIMULATE THE FIRE-IN-THE-HOLE (FITH) ABORT STAGING OF THE ASCENT STAGE FROM THE DESCENT STAGE AND THE SECOND APS BURN WAS DESIGNED TO SIMULATE A LUNAR LAUNCH PROFILE. AN OPERATIONAL TEST TO REMOVE RESIDUAL OXYGEN AND HYDROGEN PROPELLANTS AND HELIUM PRESSURANTS FROM THE S-IVB STAGE THROUGH THE J-2 ENGINE WAS SCHEDULED FOLLOWING LM SEPARATION. THIS "PROPELLANT DUMP" TEST WAS TO DETERMINE THE FEASIBILITY OF THIS METHOD OF LIGHTENING THE S-IVB STAGE FOR EASIER ORBITAL CONTROL AND PASSIVATION ON A LATER FLIGHT WHEN IT IS TO SERVE AS AN ORBITAL WORKSHOP. THERE WAS NO PLANNED SPACECRAFT RECOVERY. BOTH LM STAGES WERE EXPECTED TO REMAIN IN ORBIT FOR AN EXTENDED TIME AFTER COMPLETION OF THE MISSION.

A PROFILE OF THE PLANNED MISSION'S MAJOR EVENTS IS SHOWN IN FIGURE 1-1.

1.2 SUMMARY OF MISSION AS FLOWN

THE APOLLO 5 SPACE VEHICLE, SA-204/LM-1, WAS LAUNCHED FROM LAUNCH COMPLEX 37B AT CAPE KENNEDY ON JANUARY 22, 1968, WITH LIFT-OFF OCCURRING AT 17:48:08 EST. TWO HOLDS DURING THE COUNTDOWN OCCURRED, WITH ONE SCHEDULED AT T - 3 HOURS, 30 MINUTES, AND ONE UNSCHEDULED HOLD AT T - 2, 30 MINUTES. IGNITION, HOLD-DOWN, AND LIFT-OFF WERE ACCOMPLISHED WITHIN EXPECTED LIMITS. S-IB/S-IVB SEPARATION WAS NOMINAL, WITH ONLY SLIGHT VEHICLE RESPONSE BEING NOTED. THE S-IVB J-2 ENGINE MAIN STAGE OPERATING LEVELS WERE AS EXPECTED. S-IVB CUTOFF (INITIATED BY GUIDANCE) OCCURRED 5.1 SECONDS EARLIER THAN PREDICTED. CONTROL SYSTEM PERFORMANCE WAS AS EXPECTED, AS WAS THE PERFORMANCE OF THE IU MAJOR SYSTEMS. THE NOSECOE SEPARATED PROPERLY. IN ACCORDANCE WITH MISSION RULES, SLA DEPLOYMENT WAS COMMANDED FROM THE CANARY ISLAND STATION. LM/SLA SEPARATION FUNCTIONED PROPERLY.

THE LM WAS INSERTED INTO A 90 x 120 NAUTICAL MILE ORBIT. AFTER 2-1/2 REVOLUTIONS OVER COSTAL SENTRY QUEBEC AND CARNARVON STATIONS, THE FIRST DESCENT PROPULSION SYSTEM (DPS) BURN WAS COMMANDED. THERE WAS A PREMATURE ENGINE SHUTDOWN WHICH WAS INITIATED BY THE GUIDANCE SUBSYSTEM WHEN SUFFICIENT VELOCITY/TIME CRITERIA WERE NOT SATISFIED. BECAUSE OF THE PREMATURE CUTOFF OF THE FIRST DPS BURN, THE FLIGHT PLAN WAS MODIFIED AND ALTERNATE MISSION "C" WAS SELECTED. THE SECOND DPS BURN WAS INITIATED USING PROGRAM READER ASSEMBLY (PRA) CONTROL WITH RATE DAMPING. ASCENT PROPULSION SYSTEM (APS) FIRE-IN-THE-HOLE (FITH) SEPARATION WAS ACCOMPLISHED IMMEDIATELY FOLLOWING THE LAST DPS BURN. NEAR THE END OF THE FIFTH REVOLUTION, THE SECOND APS BURN WAS INITIATED, WHICH ALSO INCLUDED AN APS/RCS PROPELLANT INTERCONNECT TEST. THE SECOND APS BURN TO DEPLETION LASTED APPROXIMATELY SIX MINUTES. A TIME LINE OF THE ACTUAL MISSION SEQUENCE IS SHOWN IN FIGURE 1-2.

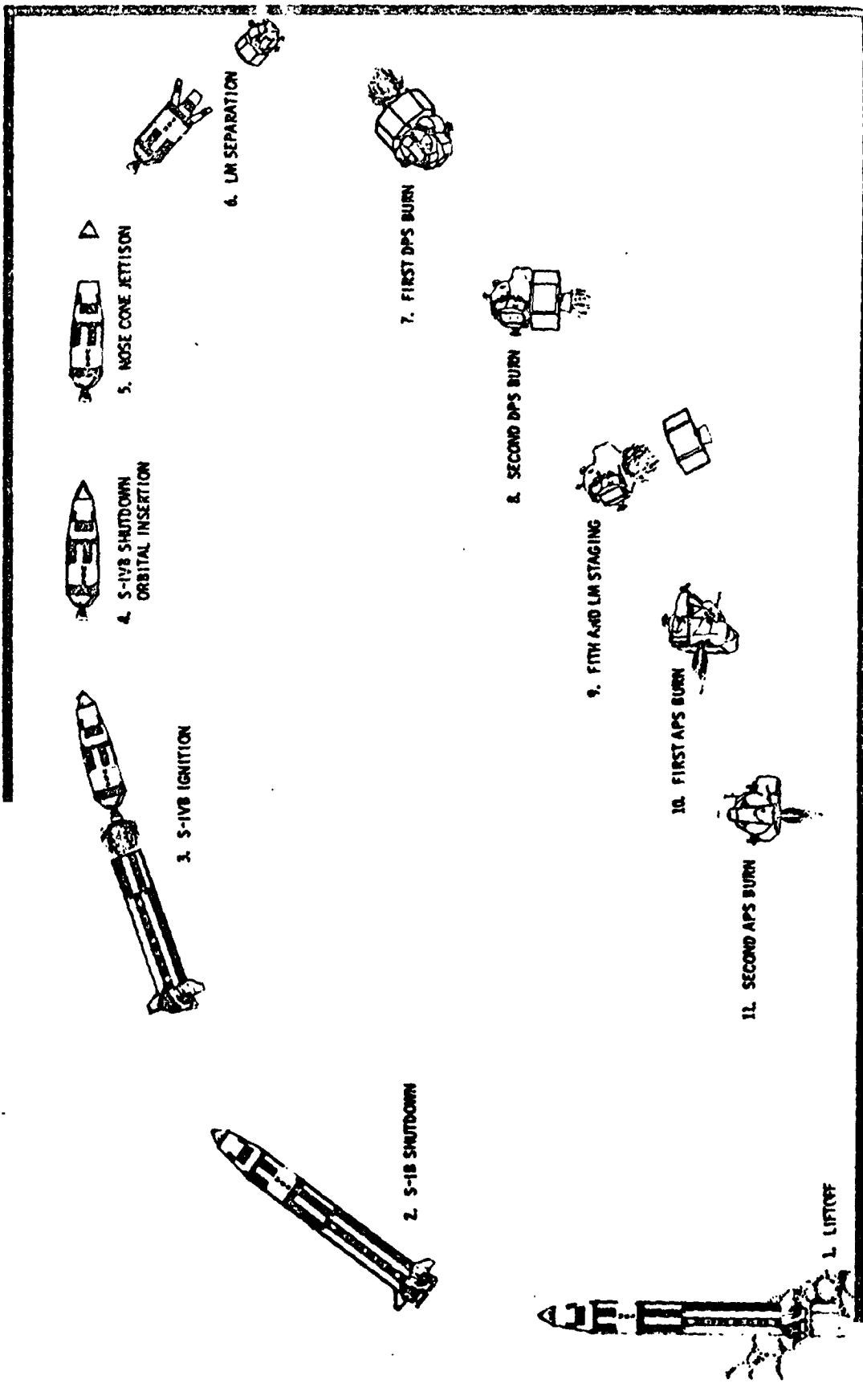


FIGURE 1-1

PLANNED MISSION PROFILE - MAJOR EVENTS

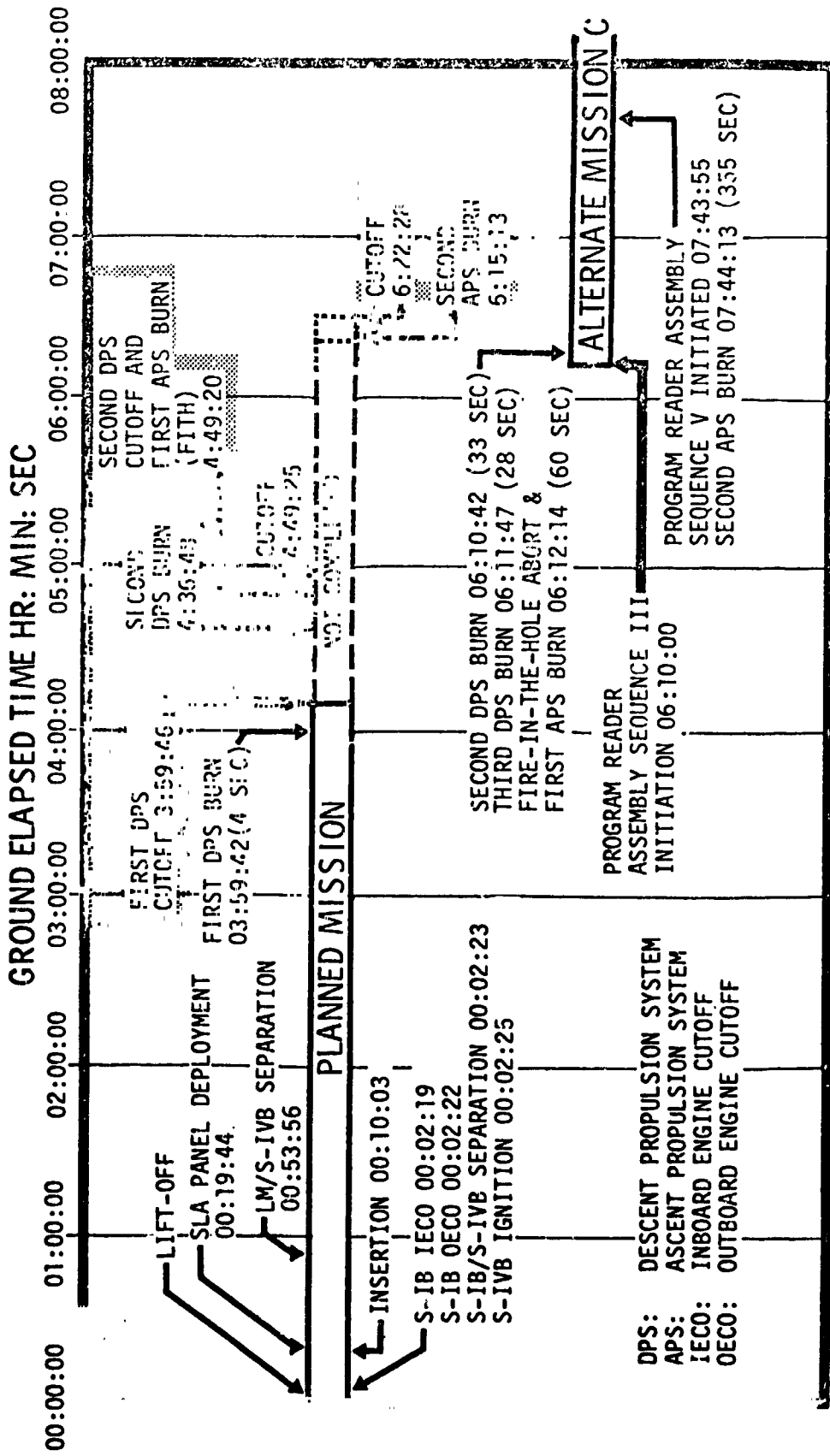


FIGURE 1-2
APOLLO 5 MISSION SEQUENCE

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1.3 APOLLO PROGRAM IMPACT

ALTHOUGH THE FIRST DPS BURN WAS TERMINATED EARLY AND RESULTED IN FLYING AN ALTERNATE MISSION, ALL LM-1 SYSTEMS PERFORMED AS COMMANDED. THE MISSION CAN THEREFORE BE CONSIDERED SUCCESSFUL. MISSION OBJECTIVES CLASSIFIED AS MARGINALLY ACCOMPLISHED OR NOT ATTEMPTED WERE DEPENDENT UPON LONGER PROPULSION SYSTEM BURN TIMES WHICH WERE PLANNED FOR THE PRIMARY MISSION MODE.

OVERALL LM-1 PERFORMANCE DURING EARTH-ORBITAL OPERATIONS VERIFIED THAT THE LUNAR MODULE POSSESSES SUFFICIENT DESIGN AND PERFORMANCE MATURITY TO SUPPORT A MANNED EARTH-ORBITAL MISSION. CONSEQUENTLY, IT WAS DETERMINED THAT AN ADDITIONAL UNMANNED FLIGHT TEST USING THE BACKUP LM-2 WAS NOT JUSTIFIED. THE NEXT MISSION USING THE LUNAR MODULE WILL BE FLOWN AS A PART OF THE SA-504/ M-104/LM-3 MANNED MISSION.

THE FOLLOWING SYSTEMS, MARGINALLY DEMONSTRATED ON THE APOLLO 5 MISSION, WILL HAVE TO BE PROVEN DURING THE SA-504/CSM 104/LM-3 OR SUBSEQUENT MISSIONS TO PROVIDE ADEQUATE BACKGROUND OR EXPERIENCE FOR THE MANNED LUNAR MISSION:

1. DPS GIMBAL ACTUATORS
2. PGNC'S PERFORMANCE
3. DPS THROTTLE RESPONSE
4. PRIMARY PROPULSION/VEHICLE INTERACTION
5. ASCENT ENGINE BURNING CHARACTERISTICS
6. DPS PROPELLANT FEED AND PRESSURIZATION SYSTEM
7. LONG DURATION APS AND DPS BURNS

1.3 APOLLO PROGRAM IMPACT (CONT'D.)

8. LM STRUCTURAL INTEGRITY
9. THERMAL EFFECTS OF THE DPS, APS AND RCS ENGINES
10. FIFTH ABORT STAGING DYNAMICS
11. FIFTH ABORT STABILITY CONTROL

THE OBJECTIVES FOR THE SA-504/CSM 104/LM-3 MISSION HAVE BEEN AMENDED TO INCLUDE REQUIREMENTS FOR DEMONSTRATING THE SYSTEMS MENTIONED ABOVE.

1.4 SUMMARY OF MISSION ACCOMPLISHMENTS

THE MISSION INCLUDED 25 OBJECTIVES FOR THE LM-1 AND FOUR FOR THE S-1B LAUNCH VEHICLE. ALL OBJECTIVES FOR THE LAUNCH VEHICLE WERE ACCOMPLISHED. FOURTEEN OF THE LM-1 OBJECTIVES ARE CONSIDERED FULLY ACCOMPLISHED AND 11 WERE MARGINALLY ACCOMPLISHED. SIGNIFICANT LM-1 MISSION OBJECTIVES NOT FULLY ACCOMPLISHED WERE THE EFFECT OF BURN DURATION ON ENGINE PERFORMANCE, THE PERFORMANCE OF DPS PROPELLANT FEED AND PRESSURIZATION SYSTEMS, AND THE DESCENT ENGINE GIMBALLING RESPONSE. THE DETAILED MISSION OBJECTIVES AND ACCOMPLISHMENTS ARE LISTED BELOW. THE MISSION SEQUENCE IS SHOWN IN FIGURE 1-2, AND A COMPARISON OF ACTUAL MISSION EVENT TIMES WITH THE PLANNED EVENT IS SHOWN IN TABLE I.

OBJECTIVE

I. LM SUBSYSTEMS VERIFICATION

P11.1 VERIFY DESCENT ENGINE GIMBALLING RESPONSE TO CONTROL SIGNALS.

P11.2 DEMONSTRATE PGNC'S THRUST VECTOR CONTROL AND ATTITUDE CONTROL CAPABILITY AND EVALUATE THE PERFORMANCE OF THE DAP AND IMU IN A FLIGHT ENVIRONMENT.

ACCOMPLISHMENT

DESCENT ENGINE GIMBAL TRIM ACTION SATISFACTORILY REDUCED THE THRUST OFFSET DURING THRUSTING. THE INTENT OF THIS OBJECTIVE WAS SATISFIED. ADDITIONAL DATA WILL BE OBTAINED ON MISSION D UNDER OBJECTIVE M11.6.

VERIFICATION OF THE PGNC'S PERFORMANCE DURING DPS AND APS ENGINE FIRING WAS NOT OBTAINED. IMU DATA INDICATED FLIGHT PERFORMANCE WAS COMPARABLE WITH PRE-FLIGHT PREDICTIONS EXCEPT FOR SOME DRIFT ERRORS. DAP DATA INDICATED SOME PERFORMANCE ANOMALIES. THIS OBJECTIVE

OBJECTIVE

ACCOMPLISHMENT

WAS ONLY PARTIALLY SATISFIED. ADDITIONAL DATA WILL BE OBTAINED ON MISSION D UNDER OBJECTIVES M11.6, P11.7 AND P11.10.

M13.1 DETERMINE DPS AND APS START, RESTART AND SHUTDOWN CHARACTERISTICS IN A SPACE ENVIRONMENT.

ALTHOUGH THE FIRST DPS BURN WAS CURTAILED AND THE LONG DPS BURN WAS NOT DEMONSTRATED, THE SYSTEMS DID PERFORM AS COMMANDED FOR THE ALTER-NATE MISSION AND THEREFORE, DEMONSTRATION OF THESE SYSTEMS WAS SUCCESSFULLY VERIFIED.

P13.2 VERIFY DPS THRUST RESPONSE TO THROTTLING CONTROL SIGNALS.

DPS THROTTLE CONTROL BY PGNC'S WAS NOT ACCOMPLISHED. THROTTLING CAPABILITY OTHER THAN FROM 10 PERCENT TO FTP WAS NOT DEMONSTRATED. THEREFORE, THIS OBJECTIVE WAS ONLY PARTIALLY ACCOMPLISHED. DPS THRUST RESPONSE TO MANUAL THROTTLE COMMAND WILL BE VERIFIED IN MISSION D UNDER OBJECTIVE M11.6

M13.3 DETERMINE THAT NO ADVERSE INTERACTIONS EXIST BETWEEN PROPELLANT SLOSH, VEHICLE STABILITY, ENGINE VIBRATION AND APS/DPS PERFORMANCE.

ALTHOUGH THERE WERE NOT ENOUGH DATA FOR EITHER THE APS OR DPS BURNS TO DETERMINE SYSTEM PERFORMANCE ACCURATELY TELEMETERED DATA INDICATE ENGINE PERFORMANCE WAS NOMINAL.

OBJECTIVE

ACCOMPLISHMENT

THIS OBJECTIVE THEN WAS ONLY PARTIALLY SATISFIED. FURTHER INTERACTION WILL BE DETERMINED ON THE D MISSION UNDER OBJECTIVES M13.11 AND M13.12.

M13.4 DETERMINE THAT NO VEHICLE DEGRADATION EXISTS WHICH WOULD AFFECT CREW SAFETY DURING APS BURN TO DEPLETION.

THE NORMAL DEPLETION SHUT-DOWN MODE WAS NOT ACCOMPLISHED BECAUSE OF PROPELLANT SLOSH CAUSED BY THE HIGH VEHICLE ATTITUDE RATES. A SAFE DEPLETION SHUTDOWN WAS DEMONSTRATED: THEREFORE, THIS OBJECTIVE WAS PARTIALLY ACCOMPLISHED. ADDITIONAL DATA WILL BE OBTAINED ON THE D MISSION UNDER OBJECTIVE S13.10

M13.5 VERIFY THE OPERATION OF THE DPS PROPELLANT FEED AND PRESSURIZATION SECTIONS.

SINCE THE TEST CRITERIA FOR THE SUPER-CRITICAL HELIUM PRESSURIZATION SYSTEM AND PROPELLANT FEED SYSTEM WERE NOT COMPLETELY SATISFIED, THESE TEST REQUIREMENTS ARE INCLUDED IN D MISSION OBJECTIVE M13.12.

M13.6 VERIFY THE OPERATION OF THE APS PROPELLANT FEED AND PRESSURIZATION SECTIONS.

SINCE THE ASCENT PROPELLANT FEED AND PRESSURIZATION SYSTEM OPERATED SATISFACTORILY AND HAD ONE LONG BURN PERIOD, THIS SYSTEM CAN BE CONSIDERED VERIFIED.

OBJECTIVE

M13.7 DETERMINE THE EFFECTS ON BURN DURATION ON DPS AND APS ENGINE PERFORMANCE.

ACCOMPLISHMENT

THERE WERE NOT ENOUGH STEADY-STATE DATA TO DETERMINE FLOW RATES, AND CHAMBER PRESSURE OSCILLATION OCCURRED INTERMITTENTLY DURING THE APS FIRINGS. HOWEVER, DATA INDICATE THAT THE APS ENGINE PERFORMANCE WAS NORMAL. LONG DURATION DESCENT ENGINE FIRING WAS NOT ACCOMPLISHED. THIS OBJECTIVE, THEREFORE, WAS ONLY PARTIALLY MET. FURTHER DATA ON BURN DURATION WILL BE OBTAINED ON D MISSION UNDER OBJECTIVES M13.11 and M13.12.

M13.8 VERIFY APS/RCS OPERATION USING THE APS PROPELLANT INTERCONNECT.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

P13.9 VERIFY PERFORMANCE AND OPERATIONAL CHARACTERISTICS OF THE RCS.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

S14.1 VERIFY SATISFACTORY OPERATION OF PORTIONS OF THE LM ECS EQUIPMENT.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

P15.1 VERIFY LM EPS PERFORMANCE.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

OBJECTIVE

ACCOMPLISHMENT

S15.2 EVALUATE THE PERFORMANCE OF THE SPACECRAFT JETTISON CONTROLLER (SJC) AND PYROTECHNICAL DEVICES IN THE EXECUTION OF NOSE CAP SEPARATIONS, SLA PANEL DEPLOYMENT AND LM/SLA SEPARATION FUNCTIONS.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

S16.1 VERIFY PERFORMANCE OF PORTIONS OF THE LM S-BAND COMMUNICATIONS SUBSYSTEM AND ITS COMPATIBILITY WITH MSFN.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

S16.2 EVALUATE THE PERFORMANCE OF THE INSTRUMENTATION SUBSYSTEM DURING BOOST AND LM PROPULSION SUBSYSTEM OPERATIONS.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

M.17.1 DEMONSTRATE THE STRUCTURAL INTEGRITY OF THE LM ASCENT AND DESCENT STAGES DURING SATURN IB LAUNCH, RCS, DPS AND APS FIRINGS IN AN EARTH-ORBITAL ENVIRONMENT.

LOADS, TEMPERATURES AND VIBRATION LEVELS OBTAINED DURING THE LM-1 MISSION WERE SATISFACTORY EXCEPT FOR THOSE WHICH REQUIRED A LONG DESCENT ENGINE BURN. SINCE THIS WAS NOT OBTAINED, THIS OBJECTIVE WAS ONLY PARTIALLY SATISFIED.

OBJECTIVE

ACCOMPLISHMENT

A LONG DESCENT ENGINE FIRING ON MISSION D WILL SATISFY THIS REQUIREMENT UNDER OBJECTIVE P17.18.

M17.2 DETERMINE THE INTERACTION LOADS BETWEEN THE LM AND THE SLA FOR A SATURN IB-LM LAUNCH ENVIRONMENT

THESE LOADS WERE SUCCESSFULLY OBTAINED.

M17.3 DETERMINE THE DYNAMIC RESPONSE OF THE ASCENT AND DESCENT STAGE OXIDIZER TANKS DURING FLIGHT-INDUCED ENVIRONMENTS.

THESE DATA WERE SUCCESSFULLY OBTAINED.

M17.4 DETERMINE VIBRATION LEVELS IN CRITICAL EQUIPMENT AREAS DUE TO LAUNCH AND TO ASCENT AND DESCENT ENGINE FIRINGS.

THESE DATA WERE SUCCESSFULLY OBTAINED.

M17.5 EVALUATE THE THERMAL AND PRESSURE RESPONSE ON HEAT SHIELDING, STRUCTURE, AND OUTRIGGERS WHEN EXPOSED TO DIRECT PLUME IMPINGEMENT AND RADIANT HEATING FROM OPERATIONS OF THE DPS, APS AND RCS ENGINES.

SUFFICIENT DATA WERE NOT OBTAINED TO EVALUATE THE THERMAL AND PRESSURE RESPONSE OF LM-1. THIS OBJECTIVE, THEREFORE, WAS ONLY PARTIALLY MET. MISSION D OBJECTIVE M17.17 IS BEING PROVIDED TO INCLUDE THIS REQUIREMENT FOR ADDITIONAL DATA.

OBJECTIVE

ACCOMPLISHMENT

II. LM STAGING EVALUATION

P18.1 DEMONSTRATE THE OPERATION OF THE EXPLOSIVE DEVICES.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

M20.1 VERIFY THAT THE DESCENT AND ASCENT STAGE STRUCTURE AND THERMAL SHIELD CAN SATISFACTORILY WITHSTAND LOADS DUE TO PRESURE AND TEMPERATURE BUILDUP DURING FIRE-IN-THE-HOLE ABORT.

THIS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

M20.2 DETERMINE STAGING SEPARATION DYNAMICS

ALTHOUGH FIRE-IN-THE-HOLE ABORT STAGING WAS SUCCESSFULLY ACCOMPLISHED, ASCENT STAGE ATTITUDE RATES WERE GREATER THAN THE RATES USED IN FC-1 SIMULATION. THIS OBJECTIVE THEREFORE, WAS ONLY PARTIALLY SUCCESSFUL.

M20.3 VERIFY ATTITUDE CONTROL DURING FIRE-IN-THE-HOLE ABORT.

SINCE THE DAP WAS NOT IN CONTROL DURING THE FIFTH SEQUENCE, NO DAP PERFORMANCE DATA WERE OBTAINED. ANALYSIS INDICATES THAT CONTROL WOULD HAVE BEEN ADEQUATE WITH PGNC/DAP ATTITUDE CONTROL TO ACCOMPLISH ABORT STAGING. THIS OBJECTIVE, THEREFORE, WAS ONLY PARTIALLY ACCOMPLISHED.

OBJECTIVE

III. S-IVB/IU ORBITAL PERFORMANCE

0 EVALUATE THE LAUNCH VEHICLE ATTITUDE CONTROL SYSTEM OPERATION AND MANEUVERING CAPABILITY.

0 VERIFY THE S-IVB LH₂ AND LOX TANK PRESSURE RISE RATES.

0 DEMONSTRATE NOSECONE SEPARATION FROM THE S-IVB/IU/SLA.

0 EVALUATE THE OPERATIONAL ADEQUACY OF THE LAUNCH VEHICLE SYSTEMS, INCLUDING GUIDANCE AND CONTROL, ELECTRICAL, MECHANICAL, AND INSTRUMENTATION.

ACCOMPLISHMENT

THE PERFORMANCE OF THE GUIDANCE AND CONTROL SYSTEM WAS SATISFACTORY AND AS EXPECTED. THIS OBJECTIVE, THEREFORE, WAS SUCCESSFULLY ACCOMPLISHED.

PRESSURIZATION CONTROL OF THESE SYSTEMS WAS NORMAL AND WITHIN PREDICTED LIMITS. THIS OBJECTIVE, THEREFORE, WAS SUCCESSFULLY ACCOMPLISHED.

THE NOSECONE SEPARATED WITHOUT INCIDENT: THEREFORE, THIS OBJECTIVE WAS SUCCESSFULLY ACCOMPLISHED.

SUFFICIENT DATA WERE OBTAINED TO EVALUATE THESE SYSTEMS; THEREFORE, THIS OBJECTIVE WAS SUCCESSFULLY ACCOMPLISHED.

TABLE 1. APOLLO 5 MISSION PLANNED VS. ACTUAL SEQUENCE OF EVENTS

<u>PRE-LAUNCH SEQUENCE OF EVENTS</u>			
<u>EVENT</u>	<u>PLANNED (EST)</u>	<u>ACTUAL (EST)</u>	<u>DIFFERENCES</u>
CALL TO STATION (1/21/68)	10:00:00	09:48:00	00:02:00
LAUNCH VEHICLE CLOSEOUT (1/22/68)	04:20:00	05:40:00	01:20:00
LAUNCH PAD CLEAR	10:30:00	10:22:00	00:08:00
S-IB AND S-IVB LOX LOADING COMPLETE	12:05:00	14:05:00	02:00:00
LH ₂ LOADING COMPLETE	13:10:00	16:50:00	03:40:00
LM ² TRANSFER TO INTERNAL POWER	13:30:00	17:06:00	03:36:00
AUTOMATIC SEQUENCE START	13:57:16	17:45:24	03:48:08
LAUNCH VEHICLE TRANSFER TO INTERNAL POWER	13:59:32	17:47:40	03:48:08
S-IB IGNITION SEQUENCE START	13:59:57	17:48:05	03:48:08
LIFE-OFF	14:00:00	17:48:08	03:48:08
<u>ASCENT-TO-ORBIT</u>			
<u>EVENT</u>	<u>PLANNED (EST)</u>	<u>ACTUAL (EST)</u>	<u>DIFFERENCES</u>
LIFT-OFF	00	00	0
PITCH AND ROLL START	10	10	0
ROLL COMPLETE	28	28	0
PITCH	133	133	0
IBECO	138.9	138.7	0.2
OBECO	141.8	141.9	0.1

TABLE 1 (CONTINUED)

<u>ASCENT-TO-ORBIT</u>			
<u>EVENT</u>	<u>PLANNED (EST)</u>	<u>ACTUAL (EST)</u>	<u>DIFFERENCES</u>
S-IB/S-IVB SEPARATION	143.3	143.3	0
S-IVB IGNITION	144.6	144.6	0
GUIDANCE INITIATE	158.9	158.9	0
S-IVB CUTOFF	597.95	593.0	4.95
NOSECONE JETTISON	643.15	638.2	4.95
SLA PANEL DEPLOY	1198.15	1193.2	4.95

<u>ORBITAL FLIGHT</u>			
<u>EVENT</u>	<u>PLANNED (EST)</u>	<u>ACTUAL (EST)</u>	<u>DIFFERENCES</u>
FIRST DPS BURN IGNITION	03:59:47	03:59:42	00:00:05
FIRST DPS BURN, GUIDANCE CUTOFF COMMAND	04:00:32	03:59:46	00:00:46

ALTERNATE MISSION "C" WAS INITIATED BY THE TRANSMISSION OF THE PRA III SEQUENCE COMMAND AT 06:10:00.

<u>EVENT</u>	<u>PLANNED FOR MISSION "C"</u>	<u>ACTUAL FOR MISSION "C"</u>	<u>DIFFERENCES</u>
SECOND DPS BURN	06:10:39	06:10:42	00:00:03
DPS SHUTDOWN	06:11:12	06:11:15	00:00:03
THIRD DPS BURN	06:11:44	16:11:47	00:00:03
DPS SHUTDOWN/APS/ FIRE-IN-THE-HOLE	06:12:12	06:12:14	00:00:02
APS SHUTDOWN	06:13:14	06:13:14	00:00:00
SECOND APS BURN	07:44:09	07:44:13	00:00:04
APS DEPLETION	--	07:50:30*	--

*LASTED 6 MINUTES, 11 SECONDS UNTIL DEPLETION. INCLUDED AN APS/RCS PROPELLANT INTERCONNECT TEST.

2.0 ANOMALY LISTING

THIS SECTION CONTAINS A DESCRIPTION OF SIGNIFICANT ANOMALIES WHICH SHOULD BE REVIEWED IN SUBSEQUENT FLIGHT READINESS REVIEWS. FOLLOWING THE LIST OF SIGNIFICANT ANOMALIES, ALL ANOMALIES RESULTING FROM THE MISSION ARE NUMBERED AND DESCRIBED ACCORDING TO SPACECRAFT, LAUNCH VEHICLE, AND GROUND SYSTEMS. WHERE CLARITY IS REQUIRED, SUPPORTING MATERIAL IS INCLUDED, GIVING THE ANOMALY BACKGROUND, A DETAILED DESCRIPTION, THE CAUSE, AND CORRECTIVE ACTION. THOSE ANOMALIES THAT WERE STILL OPEN WHEN THIS REPORT WAS ISSUED ARE IDENTIFIED WITH AN ASTERISK.

2.01 CARRY-OVER ANOMALIES TO BE INCLUDED IN SUBSEQUENT FRR'S

2.1 MANNED SPACECRAFT CENTER (MSC)

- 2.1.1 PREMATURE CUTOFF OF FIRST DPS BURN
- 2.1.1.2 EXCESSIVE RCS THRUSTER ACTIVITY/MASS UPDATE COMMANDS
- 2.1.1.3 RCS SYSTEM "B" OXIDIZER AND FUEL MANIFOLD PRESSURE - LOW
- *2.1.1.4 DPS ACTUATOR POSITION OUT-OF-PHASE CONDITION DURING SECOND AND THIRD BURN
- 2.1.1.5 DIFFICULTIES IN GETTING COMMANDS INTO THE LUNAR MODULE
- 2.1.1.6 LUNAR MODULE S-BAND TRANSCIEVER POWER OUTPUT FLUCTUATIONS
- 2.1.1.7 MEASUREMENT EXCEEDANCES AND FAILURES
- 2.1.1.8 OFF-NOMINAL PROPELLANT SYSTEM PRESSURES/MIXTURE RATIO
- 2.1.1.9 LM EXCESSIVE CABIN PRESSURE DECAY RATE
- 2.1.1.10 APS OXIDIZER TANK PRESSURE DACAY
- 2.1.1.11 INADVERTENT CLOSURE OF RCS OXIDIZER SHUTOFF VALVE

- 2.1.1.12 THRUST CHAMBER FAILURE
- 2.1.1.13 FAILURE OF PROPELLANT QUANTITY GAUGING SUBSYSTEM, NO. 2 TANKS
- 2.1.1.14 DESCENT STAGE THERMAL SHIELD FAILURE INDICATION
- 2.1.1.15 HIGH RCS CLUSTER TEMPERATURES
- 2.2 MARSHALL SPACE FLIGHT CENTER (MSFC)
 - 2.2.1 PCM/FM TRANSMITTER POWER OUTPUT BELOW SPECIFICATION
 - 2.2.2 EXCESSIVE ROLL ATTITUDE ERROR
 - 2.2.3 GN₂ LEAKAGE IN THERMAL CONDITIONING SYSTEM
 - 2.2.4 FM/FM TRANSMITTER POWER OUTPUT BELOW SPECIFICATION
 - 2.2.5 COLD HELIUM MASS LOSS INDICATION
 - 2.2.6 LOX VENT BLOCKAGE
 - 2.2.7 GAS BEARING DIFFERENTIAL PRESSURE EXCEEDANCE
- 2.3 KENNEDY SPACE CENTER (KSC)
 - 2.3.1 GSE-ECS FREON COOLING SYSTEM BOTTLE MALFUNCTION
 - 2.3.2 FAILURE OF AGCS IU DDAS POWER SUPPLY DURING HOLD
 - 2.3.3 S-IVB STAGE PNEUMATIC CONTROL REGULATOR PRESSURE EXCEEDED REDLINE
 - 2.3.4 S-IVB BATTERY NO.1 VOLTAGE BELOW REDLINE VALUE
 - 2.3.5 S-IVB UMBILICAL QUICK DISCONNECT LEAK
 - 2.3.6 IU FLIGHT CONTROL COMPUTER DETECTOR SWITCH'D FROM PRIMARY TO SECONDARY (SPARE) INVERTER DURING POWER TRANSFER
 - 2.3.7 LOX VALVE TIMING OUT OF ADJUSTMENT
 - 2.3.8 S-IVB STAGE GH₂ LEAK BETWEEN LH₂ FILL AND DRAIN DISCONNECT AND THE DEBRIS VALVE

2.3.9 EXTENDED S-IVB PNEUMATIC KICK-OFF CYLINDERS
 2.3.10 GASEOUS COOLING UNIT (GSCU) COOLANT
 TEMPERATURE OSCILLATIONS DURING COUNTDOWN
 2.3.11 FAILURE OF STABILIZATION AND ALIGNMENT
 REPEATER IN AGCS DURING HOLD
 2.3.12 INADVERTENT OPERATION OF EXPLOSIVE BOLTS
 2.3.13 CRACKED BASE ASSEMBLIES, HOLDDOWN ARMS
 1-2 AND 2-3
 2.3.14 LOSS OF FEEDBACK FROM LOX ISOLATION VALVE
 2.3.15 EXCESSIVE VALVE CLOSING TIME IN 96%
 MONITOR CHAIN
 2.3.16 LOX TRANSFER PUMP PROBLEMS
 2.3.17 RELIEF VALVE LEAK
 2.3.18 PUMP BEARING FAILURE
 2.3.19 LOX PUMP CASE FAILURE
 2.3.20 REPLENISH VALVE POSITION POTENTIOMETER
 2.3.21 LH₂ STORAGE FACILITY MAIN IGNITER FLUTTER
 2.3.22 EVAPORATOR DISCHARGE TEMPERATURE PROBE
 MALFUNCTION
 2.3.23 UNLOADER COMPRESSOR CONTROLLER FAILURE
 2.3.24 DEFECTIVE UNLOADER SUCTION VALVE ASSEMBLY
 2.3.25 CLOSED LOOP LINE CABLE DAMAGE
 2.3.26 SHORT RETRACT LANYARD
 2.3.27 CLOSED LOOP LINK INTERRUPTED
 2.3.28 S-IB FUEL TANK TEMPERATURE MEASUREMENT
 FAILURE
 2.3.29 DAMAGE TO HIGH PRESSURE GAS FACILITY
 *2.3.30 NITROGEN SUPPLY SYSTEM PRESSURE LOW
 *2.3.31 HELIUM COMPRESSOR DISCHARGE VALVES
 MALFUNCTION
 2.3.32 LIQUID NITROGEN RELIEF VALVE FAILURE
 2.3.33 POWER SUPPLY REGULATOR FAILURE
 2.3.34 FAN BELT FAILURE
 2.3.35 HYDRAULIC CYLINDER LEAKAGE
 2.3.36 JACK SCREW PIN FAILURE

2.3.37 200 KW DIESEL GENERATOR LOAD LOSS
2.3.38 ACE GENERATOR NO. 2 OUTAGE
2.3.39 ACE GENERATOR SHORT TO GROUND
2.3.40 TRIPPED SUBSTATION CIRCUIT BREAKER
2.3.41 COLOR CAMERA POWER SUPPLY FAILURE
2.3.42 DECREASE IN HELIUM SUPPLY PRESSURE

2.0 CARRY-OVER ANOMALIES TO BE INCLUDED IN SUBSEQUENT FRR'S

APOLLO 5 ANOMALY	FRR MISSION EFFECTIVITY	REMARKS
2.1.1 Premature Cutoff First DPS Burn	SA-504 (LM-3)	The planned 38-second DPS-1 burn was terminated after 4.17 seconds by the LM guidance computer (LGC) due to incorrect thrust/time criteria programmed in the LGC. The premature shutdown resulted in an alternate mission and a total DPS engine burn time of 65 seconds instead of the planned 782 seconds. The DPS and supercritical helium pressurization system performances were not accurately determined.
2.1.2. Excessive RCS Thruster Activity/Mass Update	SA-504 (LM-3)	After abort staging, excessive RCS thruster firings occurred because the LM Digital Auto-pilot was controlling the RCS firings based on the unstaged, fully-loaded LM mass. Proper vehicle mass update ground commands were not sent. This anomaly caused unplanned RCS propellant depletion, early RCS switch-over to the APS propellant tanks, ruptured RCS fuel tank bladder, temperature redline exceedances on Quads 1 and 3, and failure of the No. 4-up thruster.
2.1.5 Difficulties in Getting Commands into LM	SA-504 (CSM-104) (LM-3)	Uplink ground commands to the LM were rejected due to either the RF stage of the digital command assembly or the coaxial cabling connecting the diplexer and the digital command assembly.

2.0 (CONTINUED) CARRY-OVER ANOMALIES TO BE INCLUDED IN SUBSEQUENT FRR'S

APOLLO 5 ANOMALY	FRR MISSION EFFECTIVITY	REMARKS
2.1.10 APS Oxidizer Tank Pressure Decay	SA-504 (LM-3)	From approximately T - 110 hours to T + 4 hours, the ascent and descent propellant tanks experienced pressure drops believed to be due to helium diffusion into the propellants. The APS oxidizer tank experienced the greatest pressure drop (29 psi).
2.1.11 Inadvertent Closure of RCS Oxidizer Shutoff Valve	SA-504 (LM-3)	When the RCS crossfeed between systems A and B was opened, system A oxidizer manifold pressure decreased and system B pressure increased. The system A pressure decrease was due to closure of the main A oxidizer valve without command prior to RCS crossfeed valving. Power had been applied to the system A shutoff valves for approximately 50 minutes. The valves had an operational limitation of 2 seconds.
2.1.13 Failure of Propellant Quantity Gauging Subsystem, No. 2 Fuel and Oxidizer Tanks	SA-504 (LM-3)	The LM propellant quantity gauging indications for the No. 2 fuel and oxidizer tanks were erroneous prior to lift-off and during flight due to a faulty transistor within the gauging system.

2.0 (CONTINUED) CARRY-OVER ANOMALIES TO BE INCLUDED IN SUBSEQUENT FRR'S

APOLLO 5 ANOMALY	FRR MISSION EFFECTIVITY	REMARKS
<p>2.3.11 Failure of Stabilization and Alignment Repeater in Automatic Ground Control Station During Hold (MSFC-GSE)</p>	SA-504	<p>During pre-launch checkout of the azimuth laying and alignment equipment, a demodulator card was found to be defective as evidenced by the inability to command azimuth. The defective card was replaced and the replacement was also found to be defective. Gyro and accelerometer tests were accomplished using a manual mode.</p>
<p>2.3.42 Decrease in Helium Supply Pressure (MSFC-GSE)</p>	SA-504	<p>At T-2 minutes, the 6000 Psig helium supply pressure decreased 1400 Psig during a 45-second period of greatest helium demand. Apollo 6 also experienced helium pressurization difficulties.</p>

ANOMALY REPORT

NO. 2.1.1.1

TITLE: PREMATURE CUTOFF OF FIRST DPS BURN

SYSTEM: LM

MISSION: APOLLO 5

SUBSYSTEM: DESCENT PROPULSION SYSTEM

EVENT TIME: T-03:59:46

DESCRIPTION: AT 4.17 SECONDS INTO THE FIRST DPS BURN, A DISCRETE ENGINE OFF SIGNAL WAS OBSERVED, WITH PREMATURE ENGINE SHUTDOWN BEING INITIATED BY THE LUNAR MODULE GUIDANCE COMPUTER (LGC). THE PLANNED 38-SECOND DPS-1 BURN WAS TERMINATED BY THE LM GUIDANCE COMPUTER (LGC) DUE TO INCORRECT THRUST/TIME CRITERIA PROGRAMMED IN THE LGC. THE FIRST DPS BURN WAS INITIATED, AS PLANNED, AT LESS THAN FULL TANK PRESSURE AND THE RESULTING BUILDUP WAS SLOWER THAN THAT NECESSARY TO PASS THE DELTA V MONITOR CHECK.

IMPACT: APOLLO 5 SWITCHED TO ALTERNATE MISSION "C". SUBSEQUENT MISSIONS: NONE.

STATUS: ALL DATA INDICATE THAT THE GUIDANCE SYSTEM AND THE DESCENT ENGINE FUNCTIONED AS DESIGNED. THE SLOWER THAN NORMAL THRUST BUILDUP EXPERIENCED ON THE DESCENT ENGINE FIRST BURN, CAUSED BY THE START OF LESS THAN FULL TANK PRESSURE RESULTED IN FAILURE OF THE ENGINE TO MEET THE THRUST VERSUS-TIME CRITERIA PROGRAMMED IN THE GUIDANCE COMPUTER.*

ACTION: ON LM-3 AND SUBSEQUENT SPACECRAFT AN AMBIENT HELIUM TANK (SEE FIGURE 2.1-3) WILL BE PROVIDED. THE OPERATIONAL SEQUENCE WILL BE REVISED TO BRING THE PROPELLANT PRESSURES UP TO THE NORMAL REGULATED PRESSURE OF 240 PSIA BEFORE THE ENGINE VALVES ARE OPENED. ALL LOGIC AND CIRCUITS THAT COULD ISSUE ANY ENGINE CUTOFF OR INHIBIT ANY ENGINE START WILL BE EVALUATED TO DETERMINE WHICH SHOULD BE ELIMINATED, ALTERED OR RETAINED WITHIN THE SOFTWARE.* (SEE ATTACHED DETAIL SHEET). SOFTWARE AND HARDWARE COMPATIBILITY SHOULD BE CONTINUOUSLY REVIEWED ON EACH SUCCEEDING LM MISSION TO INSURE PROPER SYSTEMS INTEGRATION.*

ORGANIZATION: 5-2464

REFERENCES:

MSC 3-DAY REPORT, PAGES 1, 8 AND 10;
MSC 10-DAY REPORT, PAGES 1, 8 AND 10;
MSC 30-DAY REPORT, PAGES 4 AND 5
MSC 60-DAY REPORT, PAGE 12-2, ITEM 12.2;
* MSC ANOMALY REPORT NO. 2

RESOLUTION: CLOSED

DATE: 10/4/68

REV: C

DETAIL SHEET

ANOMALY 2.1.1.1

TITLE: PREMATURE CUTOFF OF FIRST DPS BURN

DISCUSSION

The first Lunar Module descent propulsion maneuver, which was controlled by the PGNCS, was scheduled to last approximately 38 seconds. The first 26 seconds were to be at 10-percent throttle, and the remaining 12 seconds at full throttle. The PGNCS commanded the "engine on" as planned at 03:59:41.39, but 4.17 seconds later, the PGNCS guidance computer issued an "engine off" discrete with an accompanying alarm indicating that the thrust/time criteria programmed in the guidance computer had not been met.

Prior to the premature shutdown, all events occurred in the proper sequence at the correct time. At the time of "engine on" (T_{ign}) minus 30 seconds, the PGNCS started recording sensed velocity changes from the inertial measurement unit pulse integrating pendulous accelerometers (IMU/PIPA). The PIPA produces one count for each cm/sec of accrued velocity in each of the three orthogonal axes and transmits the count to the Lunar Module Guidance Computer, where they are accumulated in appropriate accelerometer registers. The registers are sampled by the computer program every 2 seconds during navigation or guidance phases to update the state vector and compute guidance commands. For LM-1, the accumulated accelerometer counts were programmed to be utilized at 2-second intervals to monitor the thrust produced by the descent engine.

The descent engine thrust monitor was programmed to turn off the engine if any three consecutive 2-second accelerometer samples taken after the commanded "engine on" indicated an accumulated velocity of less than 45 cm/sec each, even after once reaching the required level of acceleration. The three samples taken for the descent engine first burn thrust monitor and the times over which the velocity was accrued are shown as follows:

DETAIL SHEET

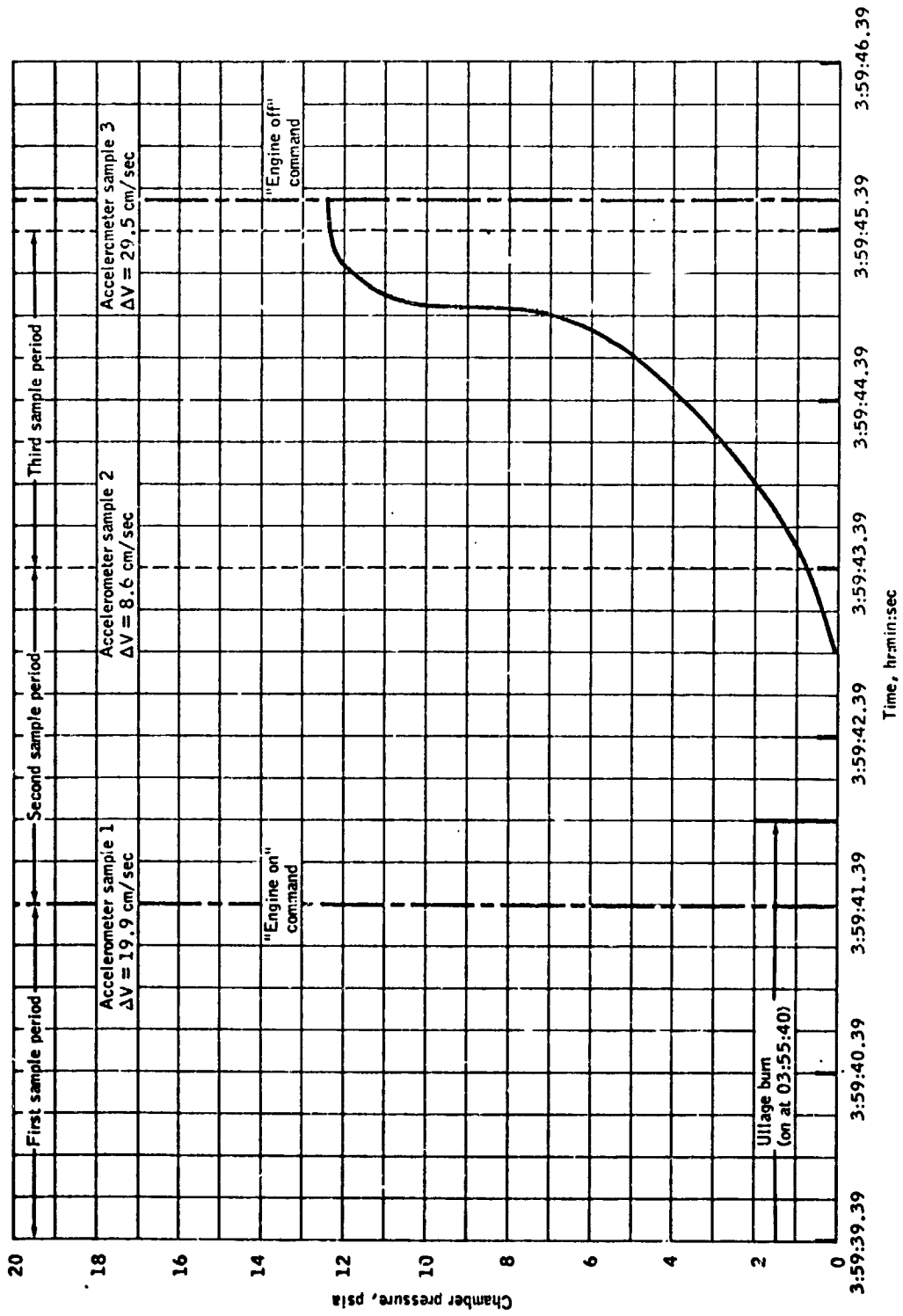
ANOMALY 2.1.1.1

TITLE: PREMATURE CUTOFF OF FIRST DPS BURN (CONTINUED)

Sample	Sample period from "engine on," sec	Sample time from "engine on," sec	Velocity accumulated cm/sec
1	-2 to 0	0	19.9
2	0 to +2	2	8.6
3	+2 to +4	4	29.5

Because of the phasing established at Tign minus 30 seconds, the first accelerometer sample utilized by the thrust monitor was taken within 0.01 seconds after commanded "engine on" and represented only the velocity accumulation due to the LM reaction control system (RCS) thruster ullage orientation burn. The RCS thruster burn ended 0.5 second after commanded "engine on" and therefore the second sample, taken at Tign plus 2 seconds, represented a combination of velocity accrued from the RCS thruster burn and the start of the descent engine burn. The third sample, taken at Tign plus 4 seconds, was the first that represented descent engine velocity accumulation only. Fig. 2.1-1 shows the time phasing of the accelerometer samples with the descent engine chamber pressure rise. Because none of the three samples met the 45 cm/sec minimum criteria programmed in the LM guidance computer, the engine was commanded off by the computer.

The effect of propellant tank pressures on the engine start characteristics is shown in Fig. 2.1-2, including the predicted characteristics for nominal tank pressures of 240 psia. The descent engine first burn start characteristics associated with fuel and oxidizer tank pressures of 132 and 126 psia, respectively, were within the 3-sigma band computed from pre-flight test data.



Accelerometer/engine chamber pressure phasing during first descent propulsion burn.

Figure 2.1-1

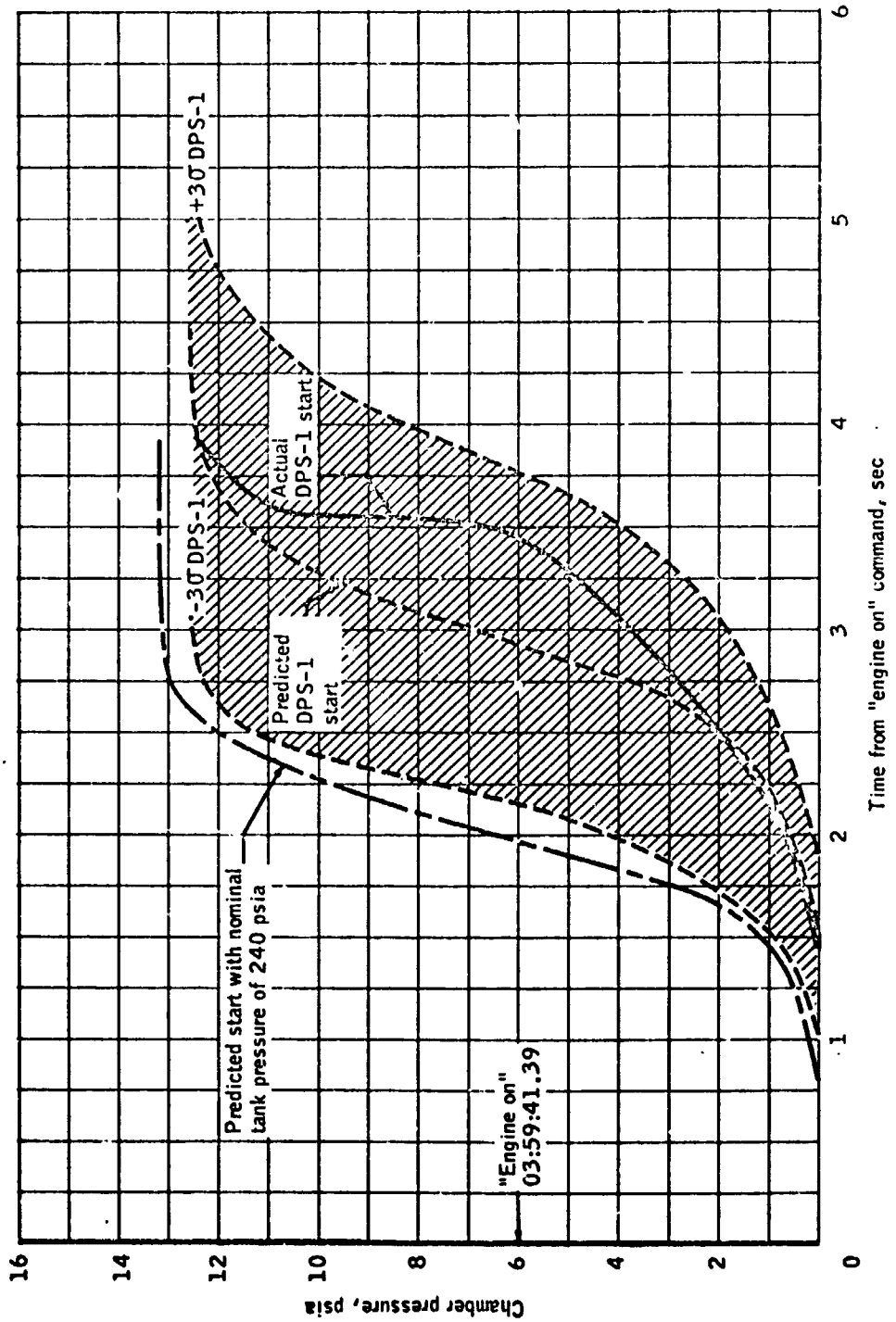


FIGURE 2.1-2 DPS-1 START TRANSIENTS

DETAIL SHEET

ANOMALY 2.1.1.1

TITLE: PREMATURE CUTOFF OF FIRST DPS BURN (CONTINUED)

The descent engine, as flown on LM-1, is shown schematically in Fig. 2.1-3. The cryogenic helium storage vessel was isolated by the three explosive valves identified in the figure, and were fired automatically by the pyrotechnic system 1.3 + 0.3 seconds after the "engine on" command was given. The valve activation delay was present so that helium flow through the fuel/helium heat exchanger would not be initiated before fuel flow had started, thus reducing the chance of fuel freezing in the heat exchanger.

CAUSE OF THE ANOMALY

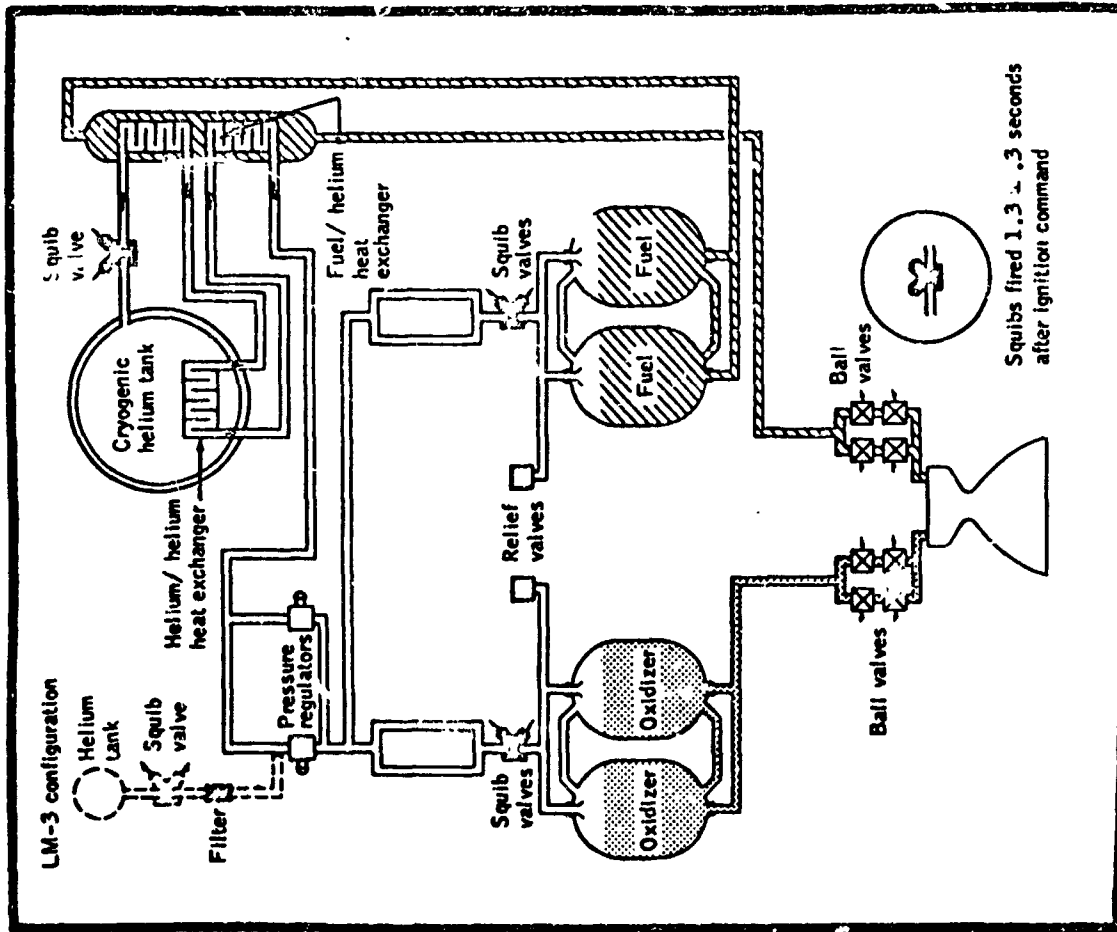
The LM-1 descent engine thrust monitor program utilized thrust buildup data based on nominal start characteristics for tank pressures of 240 psia instead of the actual fuel and oxidizer tank pressures of 132 and 126 respectively. The slower than normal thrust buildup resulted in failure of the engine to meet the thrust/time criteria programmed in the LGC.

Software design and verification personnel were not aware that the anticipated impulse would be less than that produced from full tank pressures.

Propulsion personnel were not aware of the thrust monitor programmed in the guidance computer or of the resultant engine shutdown possibility.

CORRECTIVE ACTION PLANNED ON LM-3 AND SUBSEQUENT MISSIONS

1. An ambient helium tank (indicated in dashed lines in Figure 2.1-3) was previously designed into the system to be included on LM-3 and subsequent spacecraft. The tank will contain one pound of helium stored at 1750 psia. The sequence of operation will be to fire the ambient helium isolation valve manually prior to opening the engine valves, which will bring the propellant pressures up to the normal regulated pressure of 240 psia before the engine valves are opened.
2. All LGC logic and electrical circuits that could issue any engine cutoff or inhibit any engine start will be evaluated to determine which should be eliminated or altered and which should be retained within the software. The LGC shutdown capability is not incorporated in the computer logic on manned missions.
3. Software and hardware compatibility will continuously be reviewed for each LM flight to insure proper systems integration.



LM-1 DESCENT PROPULSION SUBSYSTEM SCHEMATIC

FIGURE 2.1-3

DETAIL SHEET

ANOMALY 2.1.1

TITLE: PREMATURE CUTOFF OF FIRST DPS BURN (CONTINUED)

IMPACT ON APOLLO 5 MISSION

Premature shutdown of the first descent engine burn required re-programming the mission to use alternate mission "C." This was a minimum requirements mission, which utilized a Program Reader Assembly (PRA) for controlling the LM-1 functions instead of the PGNCs, as originally planned. The alternate mission "C" changed the descent engine burn, throttle and gimbal programs. The planned and actual burn times were approximately 782 and 65.17 seconds, respectively, and only 10-percent and fixed throttle position (FTP) settings were accomplished. The engine gimbal program using PGNCs was not accomplished.

IMPACT ON AS-503/LM-3/CSM-103 MISSION

Descent Engine

The planned descent engine burn times, throttling, and gimbal maneuvers were not completely accomplished on Apollo 5. Therefore, the LM-3 descent engine will be flown without full knowledge of comparable performance of long burn duration under orbital conditions.

Effect on Astronauts Aboard the Spacecraft

Astronauts aboard the spacecraft will monitor thrust buildup during engine starts instead of relying on LGC differential velocity shutdown logic that caused the premature cutoff of the LM-1 descent engine. The shutdown logic will not be included in the LGC on LM-3; therefore, a premature engine shutdown from that source cannot occur on the LM-3 descent engine.

ANOMALY REPORT

NO. 2.1.1.2

TITLE: EXCESSIVE RCS THRUSTER ACTIVITY/MASS UPDATE

SYSTEM: LM

MISSION: APOLLO 5

SUBSYSTEM: RCS THRUSTER

EVENT TIME: T+06:14:03 (APPROX.)

DESCRIPTION: AFTER COMPLETING THE FIRST APS BURN, CONTROL OF THE LM ASCENT STAGE WAS SWITCHED FROM THE PROGRAM READER ASSEMBLY (PRA) TO THE PRIMARY GUIDANCE, NAVIGATION AND CONTROL SUBSYSTEM (PGNCS) TO ACCOMPLISH THE SECOND APS BURN IN THIS MODE. EXCESSIVE RCS THRUSTER FIRINGS WERE IMMEDIATELY EXPERIENCED BECAUSE THE PGNCS LUNAR MODULE GUIDANCE COMPUTER (LGC) AND DIGITAL AUTOPILOT (DAP) WERE CONTROLLING THE RCS FIRINGS BASED ON THE UNSTAGED LUNAR MODULE MASS. CORRECTED MASS VALUES WERE INSERTED BY GROUND COMMAND; BUT THE DAP WAS NOT INITIAL-IZED TO USE THE NEW MASS VALUES. THE EXCESSIVE RCS THRUSTER FIRINGS CAUSED UNPLANNED RCS PROPELLANT DEPLETION AND EARLY SWITCHOVER TO THE APS PROPELLANT TANKS FOR RCS OPERATION REQUIRED FOR APS-2 START. TEMPERATURES ON RCS QUADS 1 AND 3 EXCEEDED REDLINE (190°F) DUE TO UNUSUALLY HIGH THRUSTER ACTIVITY.

IMPACT: EARLY LOSS OF RCS PROPELLANTS COULD SCRUB OR OMIT CERTAIN OBJECTIVES OF FUTURE MISSIONS.

STATUS: THE EXCESSIVE REACTION CONTROL ACTIVITY AND PROPELLANT CONSUMPTION WAS CAUSED BY INCORRECT USAGE OF THE PRIMARY GUIDANCE, NAVIGATION AND CONTROL SYSTEM DIGITAL AUTOPILOT. THE AUTO-PILOT WAS CONFIGURED FOR A STAGED VEHICLE AND THE FAILURE TO REINITIALIZE AFTER TRANSMITTING MASS UPDATE INFORMATION RESULTED IN GREATER CONTROL ENGINE ACTIVITY THAN THAT WHICH WOULD NORMALLY BE REQUIRED. *

ACTION: NO ACTION IS REQUIRED BECAUSE THE ANOMALY RESULTED FROM SEVERE OUT-OF-LIMIT OPERATING CONDI-TIONS OF THE SYSTEM, HOWEVER NEED FOR PROPER UPDATE COMMANDS FOR ABORT CONDITIONS SHOULD BE RECOGNIZED FOR FUTURE MISSIONS. *

ORGANIZATION: 5-2464

RESOLUTION: CLOSED

DATE: 10/4/68

REFERENCES: MSC 3-DAY REPORT, PAGES 2, 9 AND 11;

MSC 10-DAY REPORT, PAGES 2, 9 AND 11;

MSC 30-DAY REPORT, PAGES 6 AND 7;

MSC 60-DAY REPORT, PAGES 12-5, ITEM 12.6; PAGE 12-7, ITEM 12.6.4; PAGE 6.11-1;

* MSC ANOMALY REPORT NO. 4

REV: C

DETAIL SHEET

ANOMALY 2.1.1.2

TITLE: EXCESSIVE RCS THRUSTER ACTIVITY/MASS UPDATE

DISCUSSION

Because the vehicle mass in the DAP was configured for control of the unstaged LM (Fig.2.1-4), the RCS system was commanded to deliver propellant at a rate approximately 10,000 times greater than expected for control of the ascent stage (Fig.2.1-5). This caused the RCS to operate in severe off-limit conditions and resulted in failures in the system. Within 3.1 minutes, the A system propellant had been consumed to 27 percent and the system was isolated to conserve RCS propellant. The B system continued at a rapid duty cycle until propellant depletion 5 minutes later, at which time helium started leaking through the collapsed B system fuel bladder.

Satisfactory vehicle rates were restored due to the B system thrust reduction resulting from propellant depletion and by isolation of the A system propellant tanks, thereby compensating for the mass-constant error. While the B system was operating with two-phase oxidizer and helium-ingested fuel, engine 4-up failed (Anomaly 2.1.12). Just after the A system was reactivated, the main A oxidizer valve inadvertently closed because power had been applied to the valve's solenoid winding approximately 50 minutes versus an operational limit of 2 seconds maximum (Anomaly 2.1.11).

IMPACT ON SA-504/LM-3 MISSION

The LM-3 RCS system will be flown without significant operational experience in a nominal flight mission.

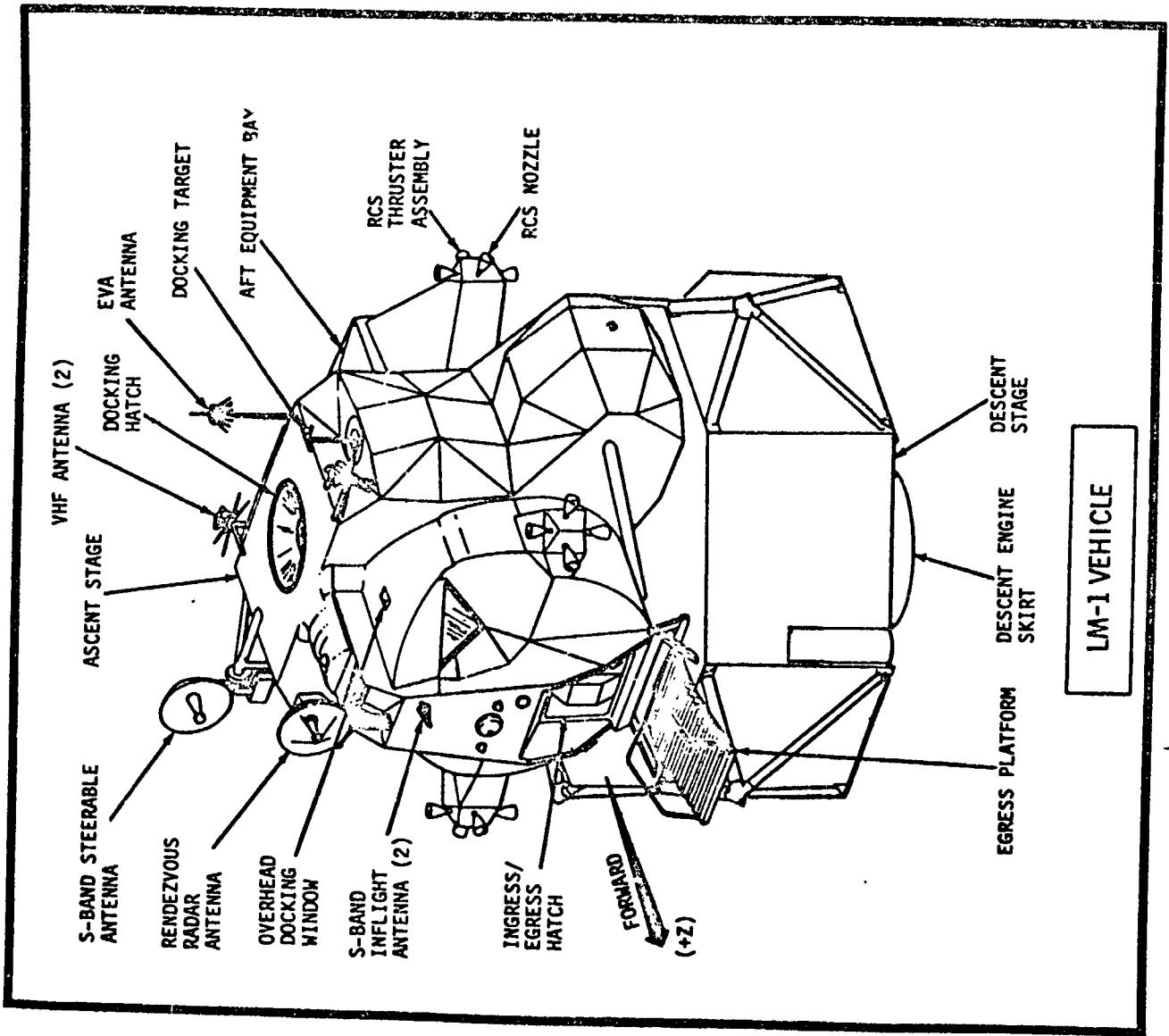


FIGURE 2.1-4

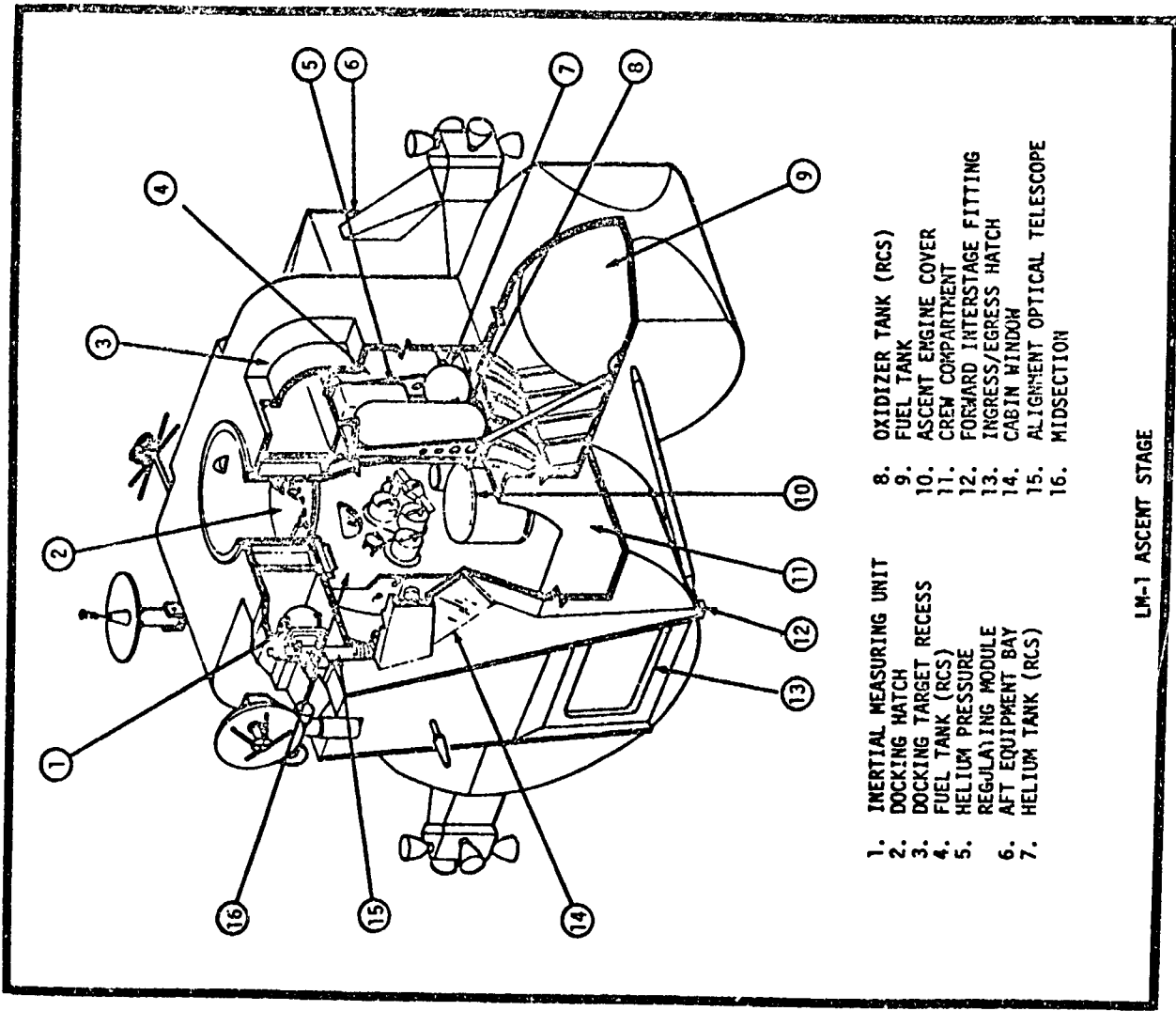


FIGURE 2.1-5

ANOMALY REPORT

NO. 2.1.1.3	TITLE: DISCREPANT RCS MANIFOLD PRESSURE INDICATIONS
SYSTEM: LM	MISSION: APOLLO 5
SUBSYSTEM: RCS	EVENT TIME: 06:19:29 TO 06:24:36
DESCRIPTION:	FOLLOWING THE PROPELLANT DEPLETION IN RCS SYSTEM B, THE OXIDIZER MANIFOLD PRESSURE DECREASED FROM 180 PSIA TO 50 PSIA (VAPOR PRESSURE) WITH FIRST INDICATIONS BEING THAT THE FUEL PRESSURE DID NOT DECAY FIRST AS EXPECTED. SUBSEQUENT DATA SHOW THAT THE FUEL PRESSURE DID DECAY FIRST, BUT VERY RAPIDLY INCREASED AGAIN DUE TO HELIUM LEAKAGE THROUGH THE FUEL BLADDER WHICH RUPTURED.
IMPACT:	NONE ON APOLLO 5.
STATUS:	DISCREPANT PRESSURE INDICATIONS HAVE BEEN RESOLVED. FUEL DEPLETION WAS OBSCURED BY HELIUM LEAKAGE THROUGH BLADDER. (SEE ATTACHED FIGURES 2.1-6 AND 2.1-7.)
ACTION:	NONE REQUIRED FOR ANOMALY. MORE CAREFUL ATTENTION.
ORGANIZATION:	5-2464
REFERENCES:	MSC 3-DAY REPORT, PAGES 2 AND 11; MSC 10-DAY REPORT, PAGES 2 AND 12; MSC 30-DAY REPORT, PAGES 6 AND 7; MSC 60-DAY REPORT, PAGE 12-5, ITEM 12.6.1 MSC ANOMALY REPORT NO. 4
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV: C

RCS PROPELLANT DATA

EVENT	GET	% QUANT		MANIFOLD PRESSURE						VALVES				
		A	B	A		B		XFEED	A MAIN	B MAIN				
				OX	FUEL	OX	FUEL							
END APS-1	6:13:14	-	-	-	-	-	-	-	-	-	-	-	-	
PGNS ON	6:14:XX	74	74	180	180	180	180	-	0	0	0	0	0	
'A' MAIN CL	6:17:11.2	27	26	180	180	180	180	180	180	180	180	180	0	0
	6:19:29	31	10	15	11	180	180	180	C	C	C	C	0	0
'B' DEPLETION	6:24:36	34	0	10	11	50	180	180	0	0	0	0	0	0
'A' MAIN OP	7:12:25	32	0	180	180	70	180	180	0	0	0	0	0	0
XFEED OP	7:12:50	31	0	90	180	90	180	180	0	0	0	0	0	0
INTERCONNECT OP	7:41:12	13	0	170	170	170	170	170	0	0	0	0	0	0
APS-2 ON	7:44:19	13	0	170	170	170	170	170	0	0	0	0	0	0
APS-2 OFF	7:50:30	-	-	-	-	-	-	-	-	-	-	-	-	-
'A' DEPLETION	7:52:12	0	0	3	8	3	6	6	0	0	0	0	0	0

984 1/31/68

FIGURE 2.1-6

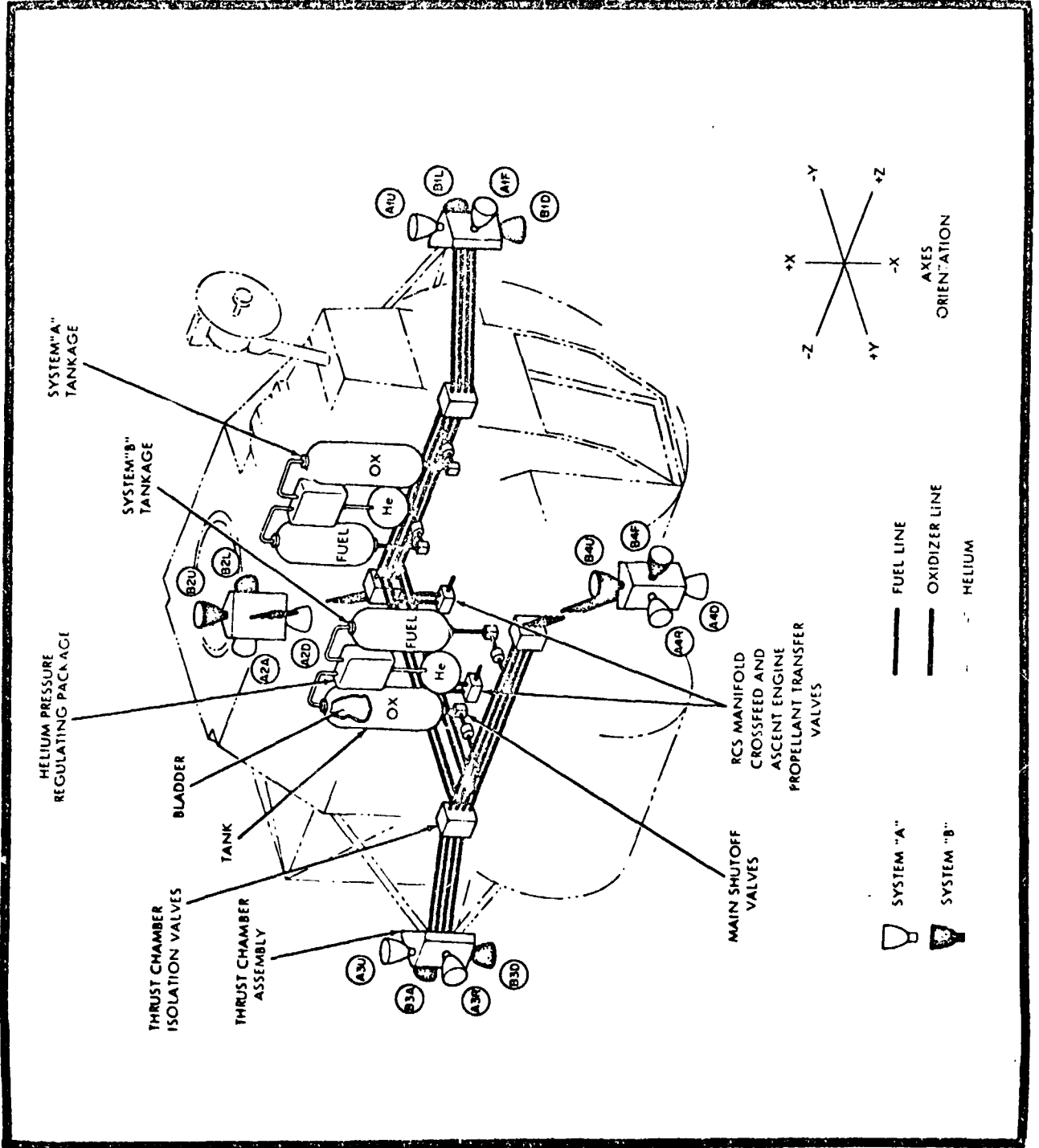


FIGURE 2.1-7 RCS INSTALLATION SCHEMATIC

ANOMALY REPORT

NO. 2.1.1.4	TITLE: DPS VALVE ACTUATOR POSITION OUT-OF-PHASE CONDITION	MISSION: APOLLO 5 T-06:10:00 (APPROX.)
SYSTEM: LM		EVENT TIME: (APPROX.)
SUBSYSTEM: DPS		
DESCRIPTION:	DURING THE SECOND AND THIRD DPS BURNS, A NON-UNIFORM RISE IN CHAMBER PRESSURE OCCURRED AT APPROXIMATELY 70 PERCENT THRUST LEVEL WHEN THE ENGINE WAS THROTTLED TO A FIXED THROTTLE POSITION (FTP), AND A VALVE ACTUATOR OUT-OF-PHASE INDICATION WAS RECEIVED AND MAINTAINED THROUGHOUT THE FTP BURN. THIS INDICATES ALL FOUR VALVES WERE NOT FULLY OPEN, BUT THRUST CHAMBER PRESSURE WAS NORMAL THROUGHOUT THIS TIME.	
IMPACT:	NONE ON APOLLO 5. AN ACTUAL OCCURRENCE ON MANNED FLIGHTS COULD RESULT IN CURTAILED DPS MANEUVERS OR MISSION ABORT.	
STATUS:	TEST DATA FROM TRW AND GAEC INDICATING THAT THE VALVE OUT-OF-PHASE CONDITION WAS DUE TO A MAGNETIC REED SWITCH MALFUNCTION IS QUESTIONABLE BECAUSE OF AN INSTRUMENTATION PROBLEM. THE WSTF* TEST PROGRAM SCHEDULED FOR SEPTEMBER HAS BEEN MODIFIED TO INCLUDE TESTS TO PROVIDE THESE DATA.	
ACTION:	THE UPCOMING TESTS SHOULD BE CLOSELY MONITORED TO ENSURE VALVE ACTUATOR QUALIFICATION FOR MANNED FLIGHT. * WHITE SANDS TEST FACILITY	
ORGANIZATION:	5-2464	RESOLUTION: OPEN
REFERENCES:	MSC 3-DAY REPORT, PAGES 2 AND 10; MSC 10-DAY REPORT, PAGES 2 AND 11; MSC 30-DAY REPORT, PAGE 5; MSC 60-DAY REPORT, PAGE 12-4, ITEM 12.4; MSC PT-ASR-1, APOLLO ANOMALY STATUS REPORT, AUGUST 6, 1968, PAGE 2;	

DETAIL SHEET

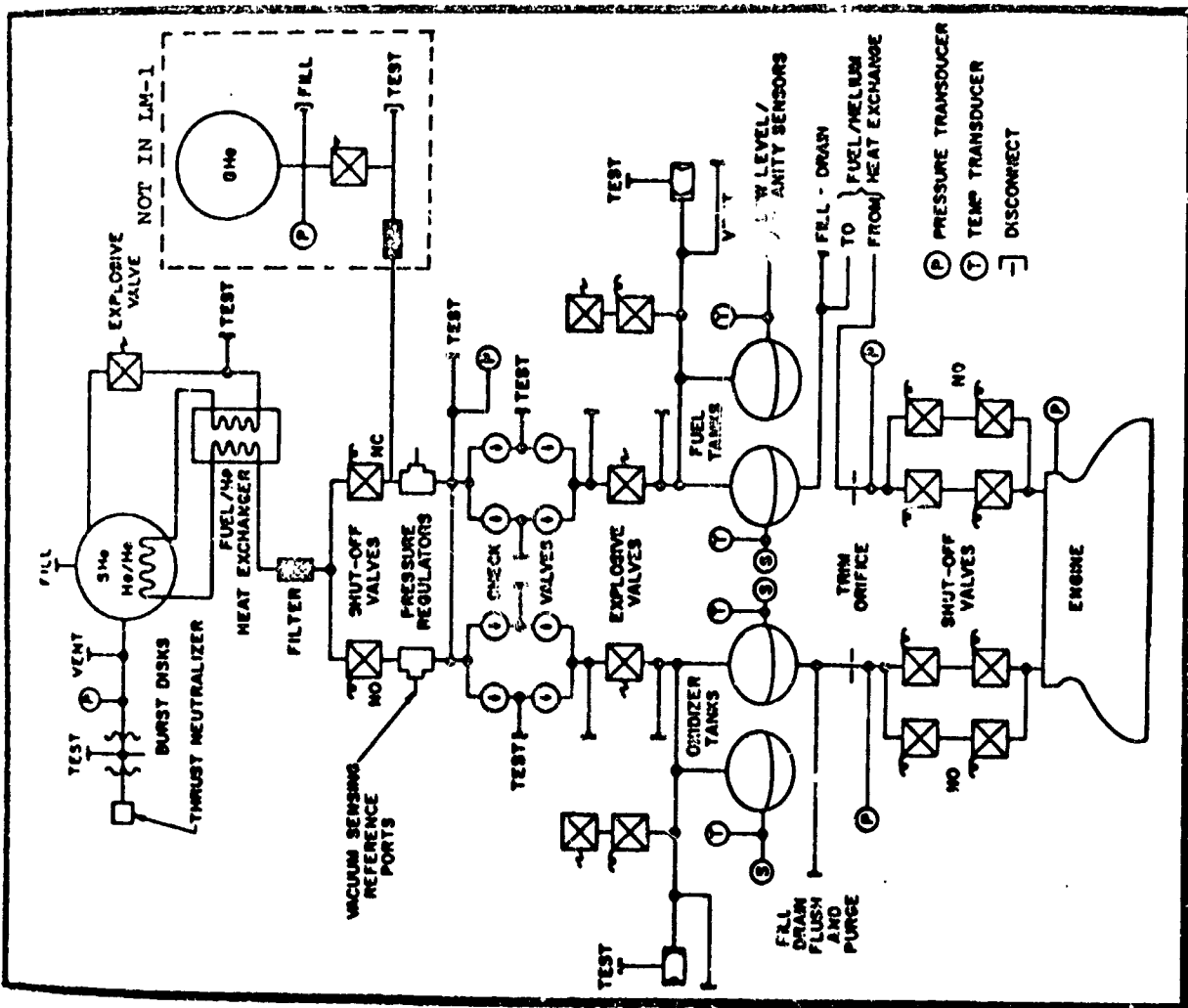
ANOMALY 2.1.4

TITLE: DPS VALVE ACTUATOR POSITION OUT-OF-PHASE CONDITION

DISCUSSION: There were four shutoff valve actuators (A, B, C, and D) each of which controlled a fuel and an oxidizer shutoff valve. The actuators were instrumented in two pairs, so that an indication was received if actuators A and B or C and D were not in the same position (open or closed). During the transition from 10 percent throttle to full throttle on the second and third descent engine firings, the signal received indicated that either A or B had closed. The indication slightly lagged in inflection point in the pressure/time curves for oxidizer and fuel injection pressures and chamber pressure. In addition, almost simultaneously, pressure rises were noted in the oxidizer and fuel engine-inlet pressures. The phenomenon was nearly identical on both firings. The Descent Propulsion System is shown in Figure 2.1-8 and the shutoff valves and actuator arrangements are shown in Figure 2.1-9.

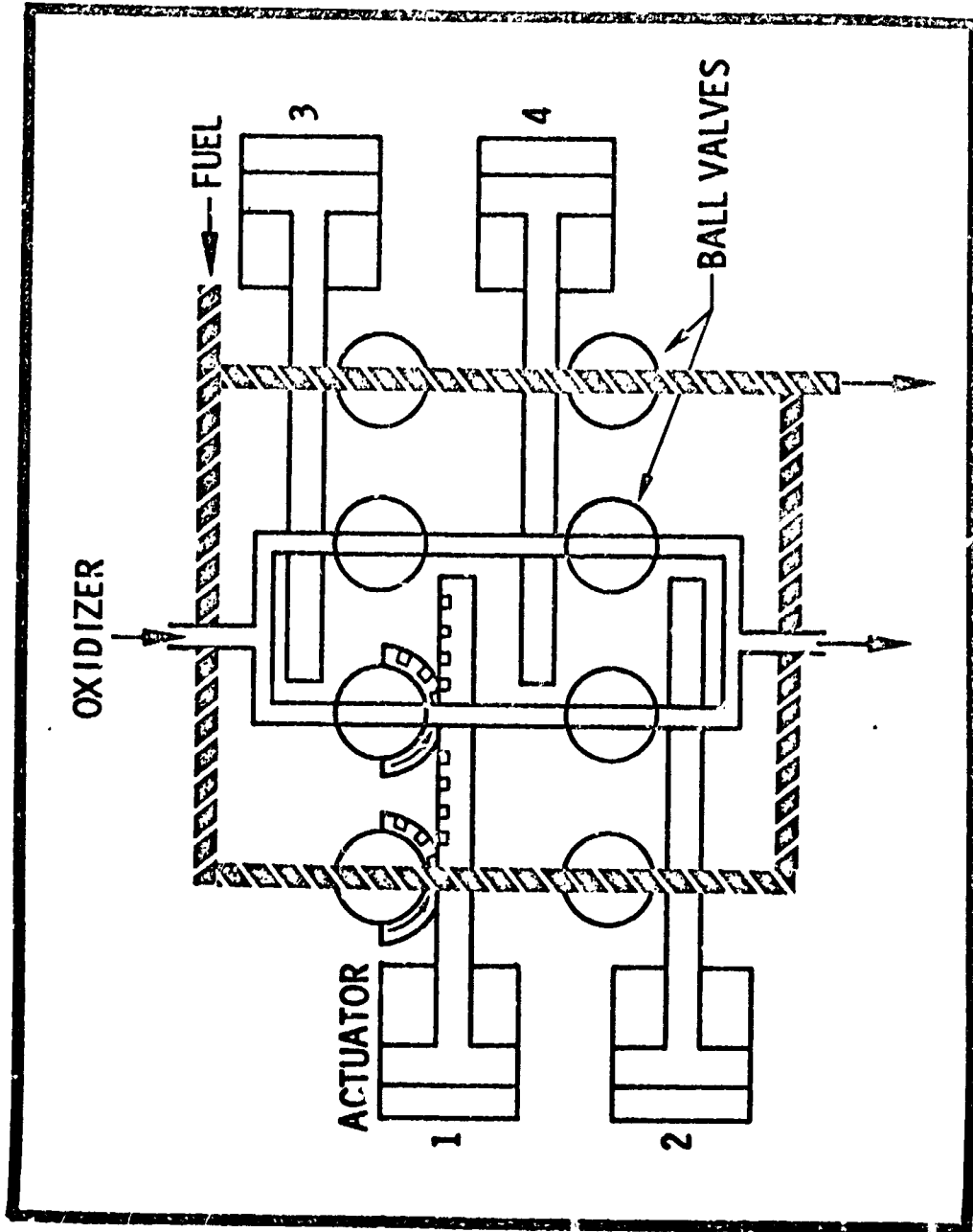
TESTS: Shroud test data from TRW and GAEC indicate the non-uniform rise in chamber pressure (Pc) was probably due to helium dissolved in the propellants. The shutoff valve out-of-phase indication was not supported by the recorded chamber pressure data. The expected effect could have been marked by instrumentation uncertainties. The valve out-of-phase indication was possibly due to a magnetic reed switch malfunction. Ground tests indicated no difference in the pressure transients between closing or not closing one leg of the shutoff valve. This test data is questionable, however, because of an instrumentation problem. A test has been scheduled in September at WSTF to provide additional test data.

CAUSE OF THE ANOMALY: No conclusion can yet be drawn; however, there is a strong indication that the valve did close, as evidenced by the rise in oxidizer and fuel engine inlet pressures. The test results will be included in MSC Anomaly Report No. 3.



LM-1 DESCENT PROPULSION SUBSYSTEM

FIGURE 2.1-8



DESCENT ENGINE PROPELLANT VALVES

FIGURE 2.1-9

ANOMALY REPORT

NO. 2.1.5 TITLE: DIFFICULTIES IN GETTING COMMANDS INTO THE LUNAR MODULE
SYSTEM: LM MISSION: APOLLO 5
SUBSYSTEM: DIGITAL COMMAND ASSEMBLY EVENT TIME: ORBIT (REV 1-3)

DESCRIPTION: PROBLEMS WERE EXPERIENCED IN GETTING DESIRED COMMANDS INTO THE LUNAR MODULE DUE TO FLUCTUATING SIGNAL STRENGTH AT THE LM DIGITAL COMMAND RECEIVER.

IMPACT: APOLLO 5 WAS AFFECTED AS STATED ABOVE, BUT ALTERNATE MISSION WAS ACCOMPLISHED.

STATUS: NO CORRECTIVE ACTION IS PLANNED AS DIRECT RESULT OF THIS ANOMALY. HOWEVER, MSC ANOMALY REPORT NO. 5 STATES THAT FLIGHT HARDWARE FOR SUBSEQUENT LM MISSIONS WILL BE SUBJECTED TO NEW VIBRATION ACCEPTANCE LEVELS WHICH WILL PREVENT RECURRENCE OF THE ANOMALY. (SEE ATTACHED DETAIL SHEET.)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSC 3-DAY REPORT, PAGE 13; REV: C
MSC 10-DAY REPORT, PAGE 14 AND 15;
MSC 30-DAY REPORT, PAGES 5 AND 6;
MSC 60-DAY REPORT, PAGE 12-4, ITEM 12.5;
MSC ANOMALY REPORT NO. 5

DETAIL SHEET

ANOMALY 2.1.1.5

TITLE: DIFFICULTIES IN GETTING COMMANDS INTO THE LUNAR MODULE

DISCUSSION

Because ground command capability was limited by the abrupt changes in received signal power, a correlation between non-validation of commands and low signal strength was made. Approximately 407 commands were transmitted during the mission. Table II lists 20 commands that were not validated in real time and the received signal strengths at the time of transmissions. Seven of the commands were obviously rejected because of low signal strength experienced during the mission. Commands that were rejected in real time but which corresponded to adequate signal strength were checked post-mission from playbacks. If the playback indicated rejection, then the elevation angle was checked. It was determined that eight other rejected commands were transmitted at low elevation angles; consequently, multi-path effects are the probable cause of rejection. Four commands were not validated in real time but were validated as having been received post-mission from the playback data. One command could not be validated in real time or post-mission; however, it must have been received because the spacecraft responded to the command.

The command rejections due to fluctuating UHF signal strength can be isolated either to the RF stage of the digital command assembly or to the coaxial cable assembly connecting the diplexer and the digital command assembly (Figure 2.1-10).

During Apollo 6 mission, several ground updates were rejected by the command module computer. A strong possible cause of rejection is a high "noise" level in the spacecraft interface between the command receiver and the guidance computer.

IMPACT ON
SA-504/
CSM-104/LM-3
MISSION

New flight hardware qualification standards for the diplexer, digital command assembly, and associated coaxial cabling have been defined and implemented.

TABLE II - UHF COMMANDS

Site	Revolution	Command	Time, hr:min:sec	Message acceptance		Received UHF signal power, dBm	Elevation, deg	Slant range, n. mi
				Real time	Playback			
Merritt Island	2 and 3 (overlap)	Digital command assembly self test	03:10:12	No		^a -108.9	6.4	493
Merritt Island	2 and 3 (overlap)	Digital command assembly self test	03:10:26	No		^a -106.2	8.3	439
Carnarvon	3	Prime relay reset	04:01:18	No		^a -101.8	21.2	289
Carnarvon	3	Prime relay reset	04:01:39	No		^a -103.9	28.9	226
Carnarvon	4	Guidance computer "enter"	05:33:49	No	No	^a -99.6	<5	722
Hawaii	4	Prime relay off	05:59:22	No		^a -97.0	3.8	604
Carnarvon	4	Prime relay off	05:59:31	No		^a -97.5	4.2	591
Carnarvon	5	Guidance computer "three"	07:12:02	No	Yes	-82		
Carnarvon	5	Guidance computer "enter"	07:13:42	No	Yes	-66.2		
Carnarvon	5	Guidance computer "one"	07:15:43	No	No	-68.6	^b 3.2	1639
Carnarvon	5	Guidance computer "three"	07:15:44	No	No	-69.7	^b 3.2	1639
Carnarvon	5	Guidance computer "three"	07:15:45	No	No	-70.7	^b 3.2	1639
Carnarvon	5	Guidance computer "three"	07:17:32	No	Yes	-96		
Carnarvon	5	Guidance computer "seven"	07:17:34	No	Yes	-90		1640
Carnarvon	5	Guidance computer "clear"	07:18:20	No	No	Out of station range (LOS)	<3	1640
Hawaii	5	Guidance computer "enter"	07:38:49	No	(accepted by computer)	-93	^b <3	900
Hawaii	5	Mission programmer start	07:43:19	No	No	-65.4	^b 6.6	602
Hawaii	5	Mission programmer start	07:43:19.6	No	No	-65.4	^b 6.6	602
Hawaii	5	Mission programmer start	07:43:20	No	No	-65.4	^b 6.6	603
Hawaii	5	Mission programmer start	07:43:21	No	No	-65.4	^b 6.6	603

^aRejected because of low signal strength.

^bProbable cause of rejection was low elevation angle.

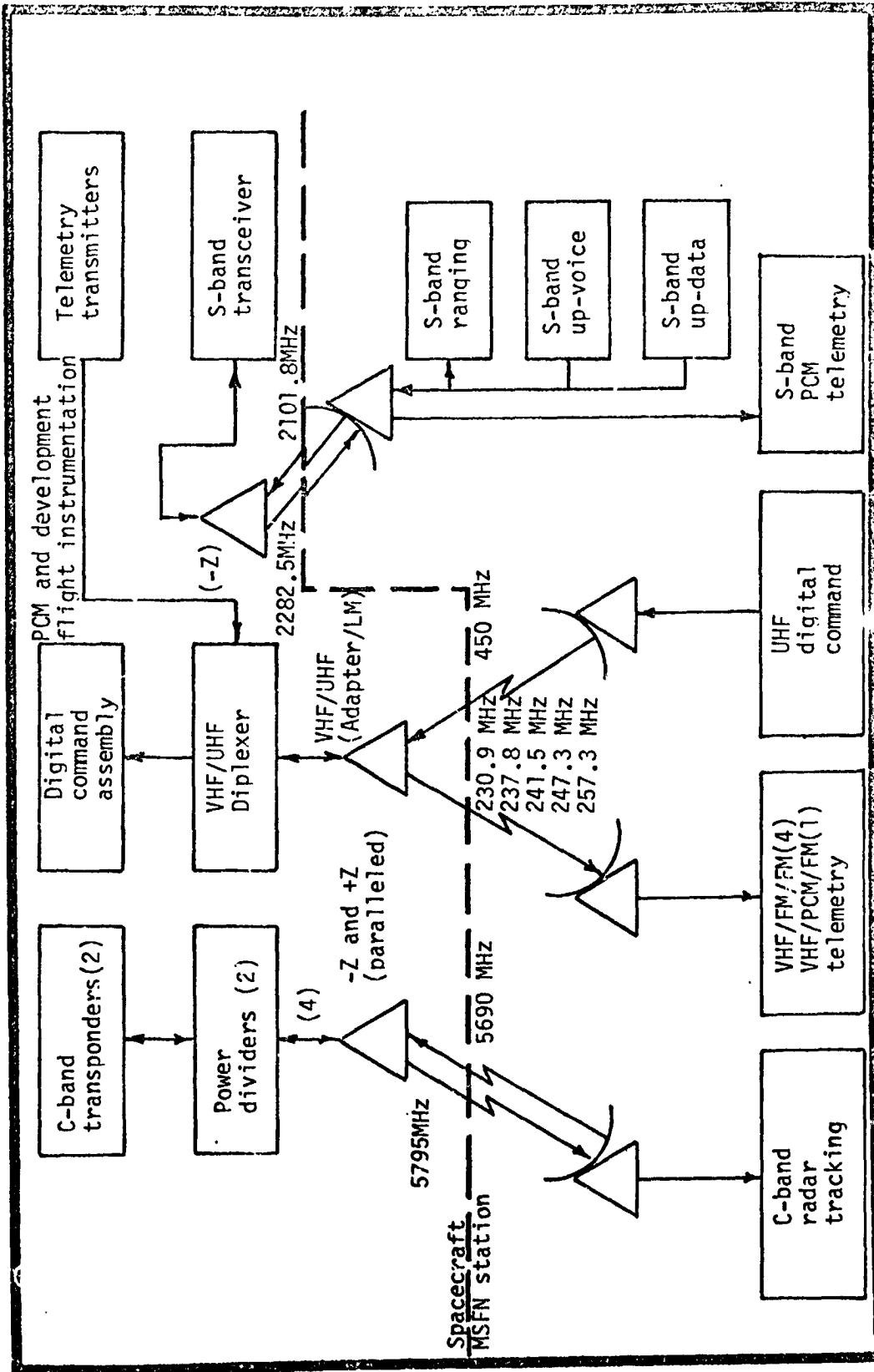


Figure 2.1-10 Communication system configurations.

ANOMALY REPORT

NO. 2.1.6	TITLE: LUNAR MODULE S-BAND TRANSCEIVER POWER OUTPUT FLUCTUATIONS
SYSTEM: LM	MISSION: APOLLO 5
SUBSYSTEM: S-BAND TRANSCEIVER	EVENT TIME: 1:34:00+
DESCRIPTION:	THE S-BAND TRANSCEIVER POWER OUTPUT MEASUREMENT FLUCTUATED FROM 5% TO 40% DURING THE MISSION. THIS WAS A HIGHER THAN EXPECTED FLUCTUATION.
IMPACT:	NONE ON APOLLO 5.
STATUS:	THE S-BAND TRANSCEIVER POWER OUTPUT MEASUREMENT FLUCTUATED DUE TO NOISE ON THE MEASUREMENT BECAUSE OF INADEQUATE FILTERING. FILTERING OF THIS MEASUREMENT DOES EXIST ON SUBSEQUENT VEHICLES.
ACTION:	NO FURTHER ACTION REQUIRED.
ORGANIZATION:	5-2464
REFERENCES:	MSC 3-DAY REPORT, PAGE 13; MSC 10-DAY REPORT, PAGE 14.
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV: C

ANOMALY REPORT

NO. 2.1.1.7	TITLE: MEASUREMENT EXCEEDANCES AND FAILURES	MISSION: APOLLO 5
SYSTEM: LM		EVENT TIME: 6:13:14
SUBSYSTEM: INSTRUMENTATION	DESCRIPTION: DATA ACQUIRED DURING FITH WAS NOISY AND SHOWED SPORADIC DROPOUTS OR FAILURE OF SEVERAL TEMPERATURE, PRESSURE AND EVENT SENSORS, ALL IN THE MANDATORY OR HIGHLY DESIRABLE CATEGORIES. THE ONLY RENDEZVOUS RADAR ANTENNA VIBRATION MEASUREMENT FLOWN OPERATED INTERMITTENTLY DURING ENGINE FIRINGS. FOUR SEPARATION DISTANCE MONITORS DID NOT FUNCTION DURING ABORT STAGING. NO ADAPTER PANEL DEPLOYMENT INDICATION WAS RECEIVED FROM THE EVENT MONITOR.	
IMPACT: NONE ON APOLLO 5.	STATUS: MSC CONSIDERS THIS ITEM CLOSED. POST-FLIGHT ANALYSIS SHOWS MEASUREMENT LOSSES/ DISCREPANCIES WOULD HAVE NO IMPACT ON FUTURE LM FLIGHTS. (SEE ATTACHED DETAIL SHEETS.)	
ACTION: NONE REQUIRED.	RESOLUTION: CLOSED	
ORGANIZATION: 5-2464	DATE: 10/4/68	REV: C
REFERENCES: MSC 3-DAY REPORT, PAGES 11 AND 13; MSC 10-DAY REPORT, PAGES 12 AND 16; MSC 30-DAY REPORT, PAGES 9 AND 10; MSC 60-DAY REPORT, PAGE 12-8, ITEM 12.8 MSC LETTER REPORT, PT5/L-018		

DETAIL SHEET

ANOMALY 2.1.1.7

TITLE: MEASUREMENT EXCEEDANCES AND FAILURES

BACKGROUND: Satisfactory measurement performance was obtained from 268 sensors except during abort staging when 11 measurements failed to provide data and four other measurements were questionable. Three measurements (GN7691D, GG6002D, and GB0522T) were defective prior to launch and four 0-35 PSID propulsion measurements (GQ3666P, GQ4116P, GP0616P, and GP1116P) were expected to provide questionable data due to the lack of suppression devices required to prevent transducer damage during engine startup and shutdown. Measurements GN7691D, GQ3666P and GA4116P operated partially during the flight. The data channel containing engine chamber pressure measurement GR5039P had an 8% clipping at the lower level. Data above 8% was satisfactory. The clipping was probably caused by a sensing diaphragm restriction in the transducer. Twelve descent stage measurements (GB0521T, GB0522T, GB0401T through GB0403T and GB0901P through GH0907P) were routed through an ascent stage follow-up cable to provide descent stage data during abort staging. Except for the measurements previously discussed, pressure measurements provided data up through interstage dynamics (06:12:15.6). At that time, these measurement channels indicated cable disconnect.

DISCUSSION: The four interstage separation distance measurements (GB3102H through GB3105H) failed to function: no cause for these failures has been determined. Five temperature measurements also failed during abort staging. The most likely cause of these failures was detachment of the thermocouple mounting tabs or breakage of the small thermocouple wires as a result of the flexure of the heat shield material.

Two of the 26 interstage pressure measurements (GB0817P and GB0818P) failed to provide data during abort staging. The response of these measurements was considerably delayed from other interstage pressure measurements and their apparent failure to sense the rapid pressure rise during staging is attributed to an obstruction in the pressure tubing or transducer orifice.

DETAIL SHEET

ANOMALY 2.1.1.7

TITLE: MEASUREMENT EXCEEDANCES AND FAILURES (CONTINUED)

Four other interstage pressure measurements (GB0621P, GB0623P, GB0805P, and GB0906P) were questionable because the data showed no measurable pressure rise. With the exception of GN0621P, which was not telemetered during launch, these measurements responded properly to the launch phase. No cause for the failure is apparent from analysis of the data and system configuration. Pressure measurement GB0814P had an intermittent output signal throughout the flight; however, the measurement was valid during staging.

ACTIONS: Suppression devices to prevent transducer damage during abort staging have been installed on LM-3.

Thermocouple installations on LM-3 will be improved to prevent failure of these instruments.

ANOMALY REPORT

NO. 2.1.1.8 TITLE: OFF-NOMINAL PROPELLANT SYSTEM PRESSURES/MIXTURE RATIO
SYSTEM: LM MISSION: APOLLO 5
SUBSYSTEM: DPS EVENT TIME: DPS BURNS 2 & 3

DESCRIPTION: LOW OUTLET PRESSURE AND UNBALANCED INTERFACE PRESSURES OCCURRED CAUSING POSSIBLE OFF-NOMINAL MIXTURE RATIO.

IMPACT: NONE ON APOLLO 5.

STATUS: DATA ANALYSES DO NOT REVEAL ANY ADVERSE EFFECTS ON ENGINE PERFORMANCE. (SEE ATTACHED DETAIL SHEET)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSC 10-DAY REPORT, PAGES 10 AND 11; REV: C
MSC 60-DAY REPORT, PAGE 6.12-2, ITEM 6.12.3

DETAIL SHEET

ANOMALY 2.1.8

TITLE: OFF-NOMINAL PROPELLANT SYSTEM PRESSURE/MIXTURE RATIO

The engine feed system parameters during the second and third firing are shown in the table below. No analysis of the flight data was made to determine the steady-state performance parameters because the short duration engine firings provided insufficient duration of acceleration data at full throttle and low propellant usage. The steady-state pressure parameters at 10-percent throttle and at full throttle were comparable to ground test results.

EVENT	HELIUM REGULATOR OUTLET PRESSURE, PSIA	ENGINE OXIDIZER INTER-FACE PRES-SURE, PSIA	ENGINE FUEL INTER-FACE PRESSURE, PSIA	THRUST CHAMBER PRES-SURE, PSIA
	CORRECTED FLIGHT DATA FOR SECOND FIRING			
BEFORE IGNITION	241.9	241.9	241.9	0
TEN-PERCENT THROTTLE	239.5	239.5	239.5	12.6
FULL THROTTLE	239.5	220.5	216.0	102.8
CORRECTED FLIGHT DATA FOR THIRD FIRING				
BEFORE IGNITION	241.	241.9	241.9	0
TEN-PERCENT THROTTLE	239.5	239.5	239.5	12.6
FULL THROTTLE	-	-	-	-

ANOMALY REPORT

NO. 2.1.1.9	TITLE: LM EXCESSIVE CABIN PPESSURE DECAY RATE	MISSION: APOLLO 5
SYSTEM: LM		EVENT TIME: 3:27:00
SUBSYSTEM: CABIN		
DESCRIPTION:	THE CABIN PRESSURE DECAY RATE INCREASED FROM ABOUT 0.3 PSIA/HR (EQUIVALENT TO ABOUT .45 LB/HR) TO 0.08 PSIA/HR (EQUIVALENT TO ABOUT 1.1 LB/HR AT NORMAL CABIN PPESSURE). AFTER 71 MINUTES, THE LEAKAGE RATE REDUCED TO APPROXIMATELY 0.44 LB/HR. THE MAXIMUM LEAK RATE ALLOWED FOR MANNED MISSION IS 0.2 LB/HR.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	MSC CONSIDERS EXISTING CABIN LEAK RATE SPECIFICATIONS ADEQUATE FOR LUNAR MISSIONS AND CONSIDERS ITEM CLOSED. CAUSE AND LOCATION OF LEAK CANNOT BE DETERMINED. (SEE ATTACHED DETAIL SHEET)	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION:	5-2454	RESOLUTION: CLOSED
REFEPNCES:	MSC 10-DAY REPORT, PAGE 2 AND 14; MSC 30-DAY REPORT, PAGE 4; MSC 60-DAY REPORT, PAGE 12-3, ITEM 12.3 MSC LETTER REPORT, PT5/L-C18, APRIL 19, 1968	DATE: 10/4/68 REV: C

DETAIL SHEET

ANOMALY 2.1.1.9

TITLE: LM EXCESSIVE CABIN PRESSURE DECAY RATE

BACKGROUND: At 03:27:00, the equivalent cabin pressure leak area abruptly increased from 0.0014 to 0.0044 square inch. After 71 minutes, the leak area decreased to approximately 0.0026 square inch.

DISCUSSION: The characteristics of the cabin pressure decay from cabin seal-off until 03:27:00 indicated that a constant leak area existed during this period. At 03:27:00, the leak area abruptly changed. Calculations show that the change in rate was equivalent to a change in area from 0.0014 to 0.0044 square inch. The leak area then decreased 71 minutes later to a value equivalent to about 0.0026 square inch and remained constant to the end of the mission.

CONCLUSION: At the time the leak area first changed, the vehicle was in a quiescent state, and the available data provide no indications as to the cause of the change. The minimum cabin pressure requirement was maintained to the end of the mission.

ANOMALY REPORT

NO. 2.1.10	TITLE: APS OXIDIZER TANK PRESSURE DECAY	MISSION: APOLLO 5
SYSTEM: LM		EVENT TIME: T-110 HOURS TO T+ HOURS (APPROX.)
SUBSYSTEM: APS		
DESCRIPTION: FROM APPROXIMATELY T-110 HOURS TO T+4 HOURS, APS OXIDIZER TANK PRESSURE DECAYED 29 PSI. OBSERVED OXIDIZER PRESSURE DECAY WAS WAIVED DUE TO SHORT DURATION OF THE FLIGHT.		
IMPACT: NONE ON APOLLO 5.		
STATUS: POST-FLIGHT ANALYSIS SHOWS PRESSURE DECAY COULD BE ATTRIBUTED TO HELIUM DIFFUSION INTO OXIDIZER INSTEAD OF TANK LEAKAGE. NOMINAL PROPELLANT PRESSURIZATION WAS PROVIDED DURING THE MISSION. (SEE ATTACHED DETAIL SHEET)		
ACTION: NONE REQUIRED.		
ORGANIZATION: 5-2464	RESOLUTION: CLOSED	DATE: 10/4/68
REFERENCES: MSC 10-DAY REPORT, PAGE 11; MSC 30-DAY REPORT, PAGE 2; MSC 60-DAY REPORT, PAGE 6.13-4, ITEM 6.13.4		REV: C

DETAIL SHEET

ANOMALY 2.1.1.10

TITLE:

APS OXIDIZER TANK PRESSURE DECAY

BACKGROUND:

The ascent and descent propellant tanks experienced pressure drops from the time of repressurization at the launch site (approximately 110 hours prior to launch) to the time of final pressurization in flight (4 hours after launch). The pressure decay of the ascent oxidizer tank, which had the largest decay, was believed to be the result of an oxidizer leak. However, subsequent analysis have shown that all of the experienced pressure decays could be attributed to helium diffusion into the liquid propellants.

DISCUSSION:

The flight data indicates nominal propellant pressurization during the mission. Calculated helium usage during the second firing agrees with analytical predictions.

Helium flow occurred during the coast between the first and second firing, amounting to approximately 2.5 percent of the total helium loaded. This helium flow is evidently the result of opening the propellant interconnect valves. During this time, the control engines used approximately 200 pounds of propellant from the ascent tanks. The amount of helium flow during the coast would be sufficient in normal system operation to expel approximately 180 pounds of propellant.

ANOMALY REPORT

NO. 2.1.1.11 TITLE: INADVERTENT CLOSURE OF RCS OXIDIZER SHUTOFF VALVE
SYSTEM: LM MISSION: APOLLO 5
SUBSYSTEM: RCS EVENT TIME: 07:19:13 (APPROX.)

DESCRIPTION: WHEN THE RCS CROSSFEED BETWEEN SYSTEMS A AND B WAS OPENED, SYSTEM A OXIDIZER MANIFOLD PRESSURE DECREASED AND SYSTEM B PRESSURE INCREASED. POST-FLIGHT ANALYSIS SHOWS THAT THE SYSTEM A PRESSURE DECREASE WAS DUE TO CLOSURE OF MAIN A OXIDIZER VALVE WITHOUT COMMAND PRIOR TO RCS CROSSFEED VALVING. POWER HAD BEEN APPLIED TO THE SYSTEM A SHUTOFF VALVES FOR APPROXIMATELY 50 MINUTES, CAUSING VAPORIZATION OF TRAPPED OXIDIZER WHICH FORCED THE VALVE TO CLOSE.

IMPACT: INADVERTENT CLOSING OF VALVES ON FUTURE MISSIONS COULD CAUSE PARTIAL LOSS OF RCS OXIDIZER REQUIRING MANUAL SWITCHOVER ON MANNED MISSION OR LOSS OF REDUNDANT SYSTEM.

STATUS: CAUSE OF ANOMALY IDENTIFIED AS MAINTAINING CURRENT TO SOLENOID WINDINGS WHICH RAISED VALVE TEMPERATURE. THE VALVE FUNCTIONED NORMALLY DURING SUBSEQUENT OPERATIONS. (SEE ATTACHED DETAIL SHEET).

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSC 30-DAY REPORT, PAGE ; REV: C
*LED-25-23, LM-3 DCR REPORT
MSC 60-DAY REPORT, PAGE 12-6, ITEM 12.6.2
MSC LETTER REPORT, PT5/L-018, APRIL 19, 1968
MSC ANOMALY REPORT NO. 4

DETAIL SHEET

ANOMALY 2.1.11

TITLE:

INADVERTENT CLOSURE OF RCS OXIDIZER SHUTOFF VALVE

DISCUSSION

The opening of the crossfeed valves (Fig.2.1-11) about 2 minutes after the main A valve was opened caused the B system fuel manifold pressure to increase to 180 psia. However, the A system oxidizer manifold pressure decreased to 80 psia, and the B system oxidizer pressure increased to the same value. This resulted from the main A oxidizer valve inadvertently becoming unlatched and essentially closing at that time. Current had been continuously applied to the valve for almost an hour, supplying sufficient heat to vaporize the oxidizer in the valve. When the valve was opened, oxidizer vapor was trapped above the upper magnet. The vapor pressure forced the valve to unlatch when the downstream pressure decreased after the crossfeed valves were opened. Oxidizer leakage through the valve is indicated by the gradual oxidizer manifold pressure rise to 115 psia from 80 psia. The oxidizer manifold pressure again decreased to about 50 psia as engine firings reduced the manifold pressure to the oxidizer vapor pressure.

The interconnect valves were opened several minutes prior to the second ascent engine firing, and both oxidizer and fuel pressures increased to the 184-psia ascent engine propellant feed pressure. During the second ascent engine firing, the pressures dropped to 170 and 177 psia in the oxidizer and fuel manifolds, respectively. About one minute after the second engine firing was initiated, the mission programmer automatically latched both main A valves in the closed position. About three minutes prior to ascent engine thrust decay, the mission programmer automatically closed the interconnect and crossfeed valves, and reopened the main A valves. The system A oxidizer was depleted about 1.5 minutes after the A system interconnect valves were closed because of the inadvertent closure of the main A oxidizer valve. During this 1.5-minute interval, 64 pounds of oxidizer were cold-flowed through the engines, which were commanded on almost continually.

IMPACT ON
SA-504/LM-3
MISSION

Inadvertent valve operations on LM-3 RCS will require real-time corrective action by the astronauts. Astronauts must request uplink commands, or operate the valves from the astronauts' control panel.

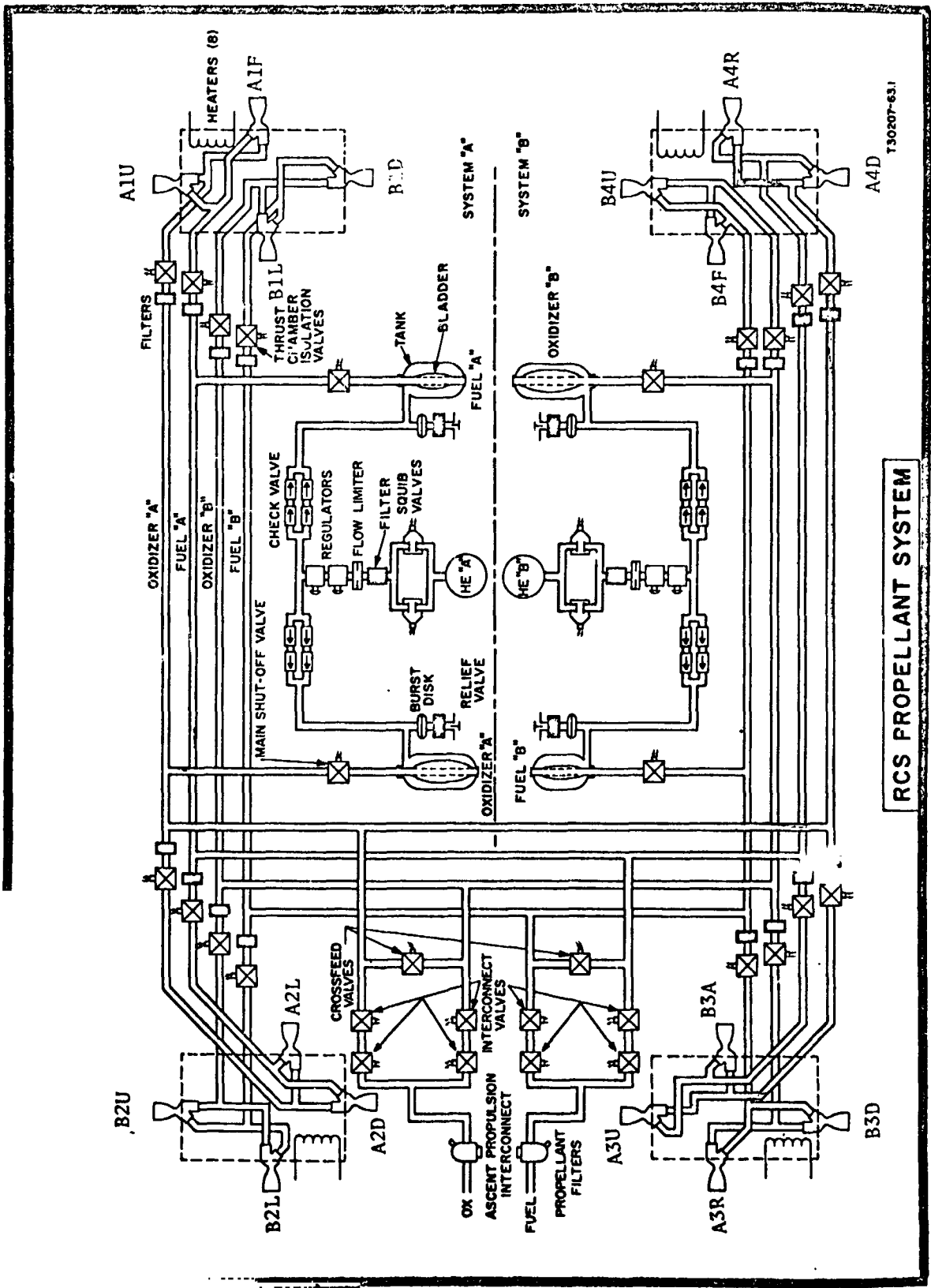


FIGURE 2.1-11

ANOMALY REPORT

NO. 2.1.12

TITLE: THRUST CHAMBER FAILURE

SYSTEM: LM

MISSION: APOLLO 5

SUBSYSTEM: RCS

EVENT TIME: FIFTH REVOLUTION

DESCRIPTION: THE UP-FIRING ENGINE IN CLUSTER 4, RCS SYSTEM B, WAS LAST OBSERVED TO BE OPERATING OVER ASCENSION DURING FIFTH REVOLUTION. THE ENGINE FAILURE WAS DISCOVERED BY OBSERVING VEHICLE PITCH AND ROLL RATES, AND LACK OF DETECTABLE ENGINE CHAMBER PRESSURE.

IMPACT: NONE ON APOLLO 5.

STATUS: THE ENGINE FAILURE WAS DUE TO THE EXTREMELY HIGH RCS DUTY CYCLE IN ATTEMPTING TO CONTROL THE LM ASCENT STAGE BASED ON UNSTAGED LM VEHICLE MASSES (SEE ANOMALY 2.1.2).

(SEE ATTACHED DETAIL SHEET.)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2164

RESOLUTION: CLOSED

DATE: 10/4/68

REFERENCES: MSC 30-DAY REPORT, PAGES 8 AND 9;

MSC 60-DAY REPORT, PAGE 12-6. ITEM 12.6.3.

MSC LETTER REPORT, PT5/L-018, APRIL 19, 1968

MSC ANOMALY REPORT NO. 4

REV: C

DETAIL SHEET

ANOMALY 2.1.1.12

TITLE: THRUST CHAMBER FAILURE

DISCUSSION

The chamber pressure for B system engines (Fig. 2.1-10) decreased to about 80 psia when the fuel manifold pressure dropped to 130 psia at fuel depletion. After helium began to leak through the bladder, the manifold pressure rose to the nominal 180 psia; engine chamber pressure also returned to normal. At oxidizer depletion, some 24 seconds after fuel depletion when the manifold pressures dropped to 50 psia, engine chamber pressures dropped to about 40 psia. Performance was quite varied from this time until the ascent propellant interconnect valves were opened. Shortly after the oxidizer was depleted and before the helium leakage in the fuel manifold was purged through the engines, the engine chamber pressures were about 40 psia. The combustion instability (+ 10 psi) of 300 Hz (characteristic of two-phase flow) also occurred at this time. Two-phase flow could be expected because the oxidizer manifold pressure was equivalent to the vapor pressure of the oxidizer. Later, as helium from the fuel manifold passed through the engine, chamber pressure showed a sharp drop to about 10 psia until the bubble was purged; the chamber pressure then returned to 40 psia. Several minutes later, the chamber pressure of those engines which were frequently fired was only about 10 psia, with occasional increase to 40 psia. The 10-psia value was indicative of oxidizer cold-flow; 40 psia indicated combustion.

Continued operation of the B system at these manifold pressures is believed to have precipitated the failure of up-firing engine 4 sometime during the 15-minute period between the Ascension and the Coastal Sentry Quebec stations during revolution 5. Engine 4-up produced no detectable chamber pressure during the Coastal Sentry Quebec pass nor during the remainder of the mission.

Ground tests have shown that similar operation enhances formation of explosive compounds which accumulate within the combustion chamber, even in the vacuum environment. Detonation of these residues has ruptured combustion chambers. Detonation characteristics with the 3-down engine were noted during this time, indicating compound formation.

IMPACT ON
SA-504/LM-3
MISSION

The LM-3 RCS thruster duty cycle requirements will be significantly less than those experienced on the LM-1 RCS thrusters during Apollo 5 mission. Therefore, RCS thrusters for the LM-3 are considered adequate for the planned AS-504 mission.

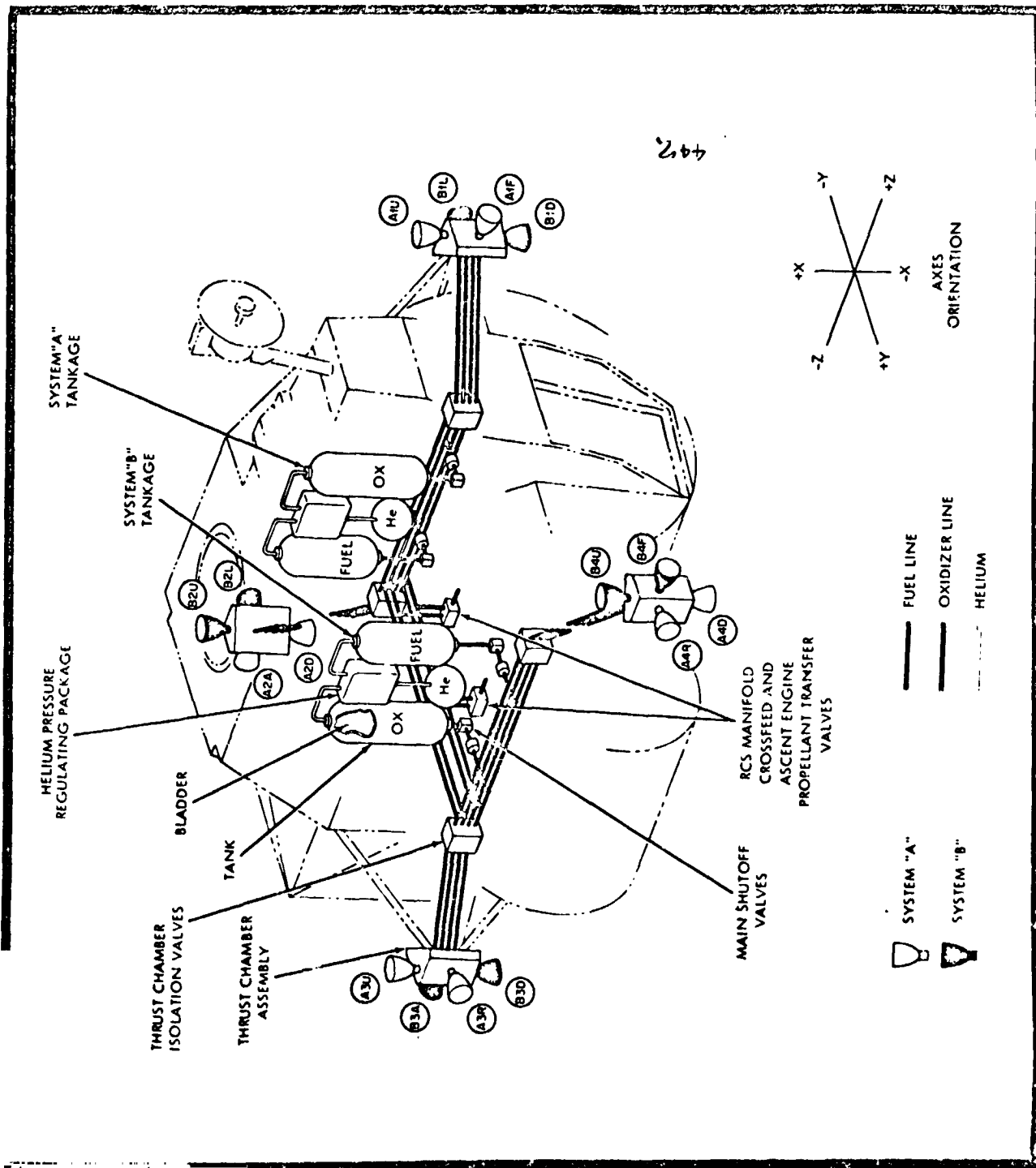
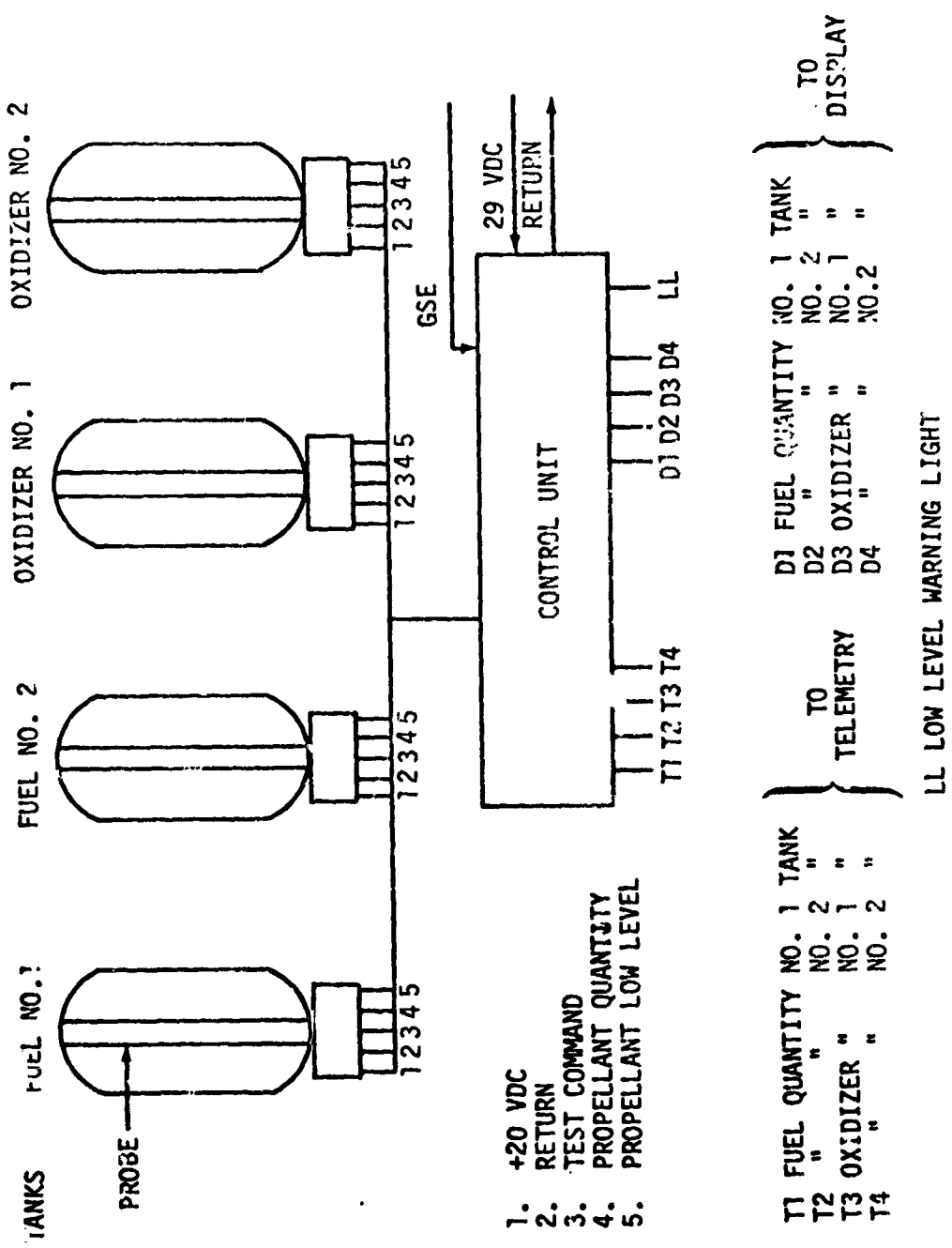


FIGURE 2.1-12 RCS INSTALLATION

ANOMALY REPORT

NO. 2.1.13	TITLE: FAILURE OF PROPELLANT QUANTITY GAUGING SUBSYSTEM, NO. 2 TANKS
SYSTEM: LM	MISSION: APOLLO 5
SUBSYSTEM: DPS	EVENT TIME: PRE-LAUNCH
DESCRIPTION:	ERRONEOUS PROPELLANT QUANTITY INDICATIONS FROM NO. 2 FUEL AND OXIDIZER TANKS PRIOR TO AND DURING FLIGHT.
IMPACT:	NONE ON APOLLO 5. NEW GAUGING SYSTEM CONTROL UNIT WILL BE USED ON SUBSEQUENT VEHICLES.
STATUS:	AN MSC FAILURE INVESTIGATION HAS ATTRIBUTED THE FAILURE TO A FAULTY TRANSISTOR WITHIN THE GAUGING SYSTFM. THE GAUGING SYSTEM CONTROL UNIT HAS BEEN RE-CONFIGURED FOR SUBSEQUENT VEHICLES TO UTILIZE HIGH-RELIABILITY PARTS. QUALIFICATION TESTING OF THE NEW CONFIGURATION IS COMPLETE. (SEE ATTACHED FIGURE 2.1-13.)
ACTION:	NO FURTHER ACTION REQUIRED.
ORGANIZATION:	5-2464
REFERENCES:	MSC 10-DAY REPORT, PAGE 11; MSC 60-DAY REPORT, PAGE 6.12-4, ITEM 6.12.6. LED 25-23, LM-3 DCR REPORT
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV: C



**DESCENT PROPELLANT QUANTITY
GAUGING SYSTEM-SIMPLIFIED DIAGRAM**

FIGURE 2.1-13

ANOMALY REPORT

NO.2.1.1.14 TITLE: DESCENT STAGE THERMAL SHIELD FAILURE INDICATION
SYSTEM: LM MISSION: APOLLO 5
SUBSYSTEM: DESCENT STAGE EVENT TIME: FITH

DESCRIPTION: TWO TEMPERATURE SENSORS (GB0401T AND GB0402T) ON THE UPPER SURFACE OF THE DESCENT STAGE FACING THE FIBERGLASS COVERING SHOWED ABRUPT TEMPERATURE RISES AT ABORT STAGING INDICATING A BREAK OR CRACK IN THE SHIELDING. GB0401T, LOCATED ON THE +3 DECK, INCREASED FROM 75° TO 200°F IN 0.1 SECONDS AT STAGING AND THEN DROPPED TO 140°F IN 0.1 SECONDS. GB0402T ROSE FROM 60° TO 110°F IN 0.1 SECONDS.

IMPACT: NONE; MAXIMUM OPERATING LIMIT WAS 300°F.

STATUS: POST-FLIGHT EVALUATION SHOWS THAT NO DETRIMENTAL EFFECTS WERE DETECTED DURING FITH.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSC 60-DAY REPORT, PAGE 2-7, ITEM 12.7; REV:C
MSC LETTER REPORT, PT5/L-018

ANOMALY REPORT

NO. 2.1.15 TITLE: HIGH RCS CLUSTER TEMPERATURES
SYSTEM: LM MISSION: APOLLO 5
SUBSYSTEM: RCS EVENT TIME: FIFTH TO EOM

DESCRIPTION: TEMPERATURES ON RCS CLUSTERS 1 AND 3 EXCEEDED THE 190°F UPPER REDLINE LIMIT DUE TO EXCESSIVE USE OF RCS ENGINES.

IMPACT: NONE; NO DEGRADATION IN ENGINE PERFORMANCE WAS OBSERVED.

STATUS: MSC DOES NOT CONSIDER THE TEMPERATURE EXCEEDANCES AN ANOMALY SINCE THEY WERE CAUSED BY EXCESSIVE ENGINE ACTIVITY.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSC 60-DAY REPORT, PAGE 12-7, ITEM 12.6.4 REV: C

ANOMALY REPORT

NO. 2.2.1 TITLE: PCM/FM TRANSMITTER POWER OUTPUT BELOW SPECIFICATION
SYSTEM: S-IVB MISSION: APOLLO 5
SUBSYSTEM: TELEMETRY EVENT TIME: T+0:18:20

DESCRIPTION: PCM/FM TRANSMITTER OUTPUT POWER (MEASUREMENT NO. N008-411) DROPPED ABRUPTLY FROM 26.8 TO 13.2 AT T+0:18:20, WITH PARTIAL RECOVERY TO 19 WATTS. APPROXIMATELY TWO MINUTES LATER, POWER GRADUALLY DROPPED TO 12.4 WATTS UNTIL T+2:28:45. GROUND STATION SIGNAL STRENGTH RECORDS CONFIRM THAT THIS WAS A POWER OUTPUT DEGRADATION, NOT A MEASUREMENT PROBLEM.

IMPACT: NONE ON APOLLO 5 OR SUBSEQUENT MISSIONS.

STATUS: A DIFFERENT MODEL WILL BE FLOWN ON SUBSEQUENT MISSIONS.

ACTION: NONE REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSFC 30-DAY REPORT, PAGE 3;
MSFC 60-DAY REPORT, PAGE 297, ITEM 1. REV: C

ANOMALY REPORT

NO. 2.2.2 TITLE: EXCESSIVE ROLL ATTITUDE ERROR
MISSION: APOLLO 5
SYSTEM: IU/S-IVB
SUBSYSTEM: GUIDANCE AND CONTROL/APS
EVENT TIME: T+2:25 TO 3:45

DESCRIPTION: DURING S-IVB POWERED FLIGHT, THE ROLL ATTITUDE ERROR EXCEEDED THE ALLOWABLE + 1 DEGREE OPERATING LIMIT. A 17-18 HZ OSCILLATION IN THE ROLL CONTROL RATE GYRO OUTPUT DURING THE FIRST 80 SECONDS AFTER S-IB/S-IVB SEPARATION RESULTED IN A MAXIMUM ROLL ATTITUDE ERROR OF 2.3 DEGREES.

IMPACT: NONE ON APOLLO 5. NONE ON SUBSEQUENT MISSIONS.

STATUS: FIXES HAVE BEEN IMPLEMENTED BY CCB ACTION TO PREVENT A RECURRENCE OF ADVERSE ATTITUDE CONTROL EFFECTS RESULTING FROM 17-18 HZ OSCILLATIONS IN THE CONTROL RATE GYRO OUTPUT SIGNALS. A SOFTWARE MODIFICATION WAS SUCCESSFUL ON APOLLO 6 (AS-502), AND A SOFTWARE MODIFICATION WILL BE MADE ON APOLLO 7 (AS-205). ON AS-206, AS-504, AND SUBSEQUENT MISSIONS, HARDWARE MODIFICATIONS WILL BE ACCOMPLISHED. (SEE ATTACHED DETAIL SHEET.)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464
RESOLUTION: CLOSED
DATE: 10/4/68
REFERENCES: MSFC 30-DAY REPORT
MSFC 60-DAY REPORT, PP. 173-175, PARA 12.3.4.2
AND P. 297, ITEM 7;
MSFC LETTER NO. I-I/IB-TF-25-68, MAY 21, 1968.
REV: C

DETAIL SHEET

ANOMALY 2.2.2

TITLE: EXCESSIVE ROLL ATTITUDE ERROR

BACKGROUND:

A 3-axis rate gyro package located in the IU provides pitch, yaw and roll angular rate information for vehicle control throughout flight. Both the attitude error signals from the Launch Vehicle Digital Computer (LVDC) and the control rate gyro output signals are fed to the Flight Control Computer (FCC). In the FCC, the signals for each control channel (pitch, yaw and roll) are summed and fed to a spatial amplifier that produces the vehicle steering commands for that control channel. During S-IVB powered flight, the pitch and yaw commands go to the appropriate S-IVB engine steering actuators. The roll commands go to the S-IVB Auxiliary Propulsion System (APS), which is used for roll control during S-IVB powered flight.

DISCUSSION:

Examination of detailed S-IB oscillograms showed some 17-18 HZ signals in the roll rate channel during and immediately after lift-off, but during the remainder of the S-IB stage flight, only 23-26 HZ content was noted. During the first 80 seconds of S-IVB flight, the output from the pitch and roll rate gyros had a significant 17-18 HZ content. The thrust vector (pitch and yaw) control channels were unaffected by the 17-18 HZ disturbance in the rate gyro outputs because of filters in the spatial amplifiers used for these channels in the FCC. The spatial amplifier used for the roll control channel does not have a filter; therefore, the roll control channel was adversely affected by the 17-18 HZ components present in the roll rate gyro signal. From 145 seconds to 225 seconds, the roll rate gyros exhibited a 17-18 HZ oscillation that peaked around 185 seconds at an amplitude of approximately 3.5 deg/sec peak-to-peak. During this period of time, APS firings did not occur as frequently as required to maintain the roll attitude error within the nominal + 1 degree operating limit.

The cause of the 17-18 HZ oscillation is unknown, but it was observed on other instrumentation such as some S-IVB forward skirt vibration measurements and the ST-124M-3 platform accelerometers. This frequency is in the range of IU shell modes determined from dynamic tests. Oscillations of 17-22 HZ have been observed on the rate gyro outputs of all S-IB and S-V flight tests; however, the amplitude and duration of oscillations were greater during the AS 204 S-IVB burn than previously observed.

DETAIL SHEET

ANOMALY 2.2.2

TITLE: EXCESSIVE ROLL ATTITUDE ERROR (CONTINUED)

SOLUTION:

Fixes have been implemented by CCB action to prevent a recurrence of this condition. A software change, an increase in the LVDC roll error limit from ± 3.5 degrees to ± 15.3 degrees, was made on AS 502. A similar software modification will be made on AS 205 in all three control channels. On AS 206, AS 504, and all subsequent missions, filters will be installed in the FCC roll control channel spatial amplifier to block the 17-18 HZ components in the roll rate gyro signals.

ANOMALY REPORT

NO. 2.2.3 TITLE: GN₂ LEAKAGE IN THERMAL CONDITIONING SYSTEM
SYSTEM: INSTRUMENT UNIT MISSION: APOLLO 5
SUBSYSTEM: ECS THERMAL CONDITIONING (TCS) EVENT TIME: T+0 TO T+20 MIN.
(APPROX.)

DESCRIPTION: LEAKAGE OCCURRED IN THE TCS HIGH PRESSURE GN₂ LINE AS EVIDENCED BY LOW WATER FLOW RATES DURING SUBLIMATOR WATER START-UP, LOW SUBLIMATOR WATER INLET PRESSURE, AND EXCESSIVE GN₂ CONSUMPTION (32% ABOVE PREDICTIONS).

IMPACT: NONE ON APOLLO 5; TCS MAINTAINED IU SYSTEM TEMPERATURES WITHIN SPECIFIED LIMITS.

STATUS: TCS SPECIFICATIONS HAVE BEEN UPDATED TO ISOLATE AND CORRECT LEAKS DURING PRE-LAUNCH CHECKOUT.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: MSFC 60-DAY REPORT, P. 265, ITEM 18.4.1 REV: C
AND P. 297, ITEM 2.
MAT-1/C. F. PILGER, APOLLO 5 FILE, JULY 10, 1968

ANOMALY REPORT

NO. 2.2.4	TITLE: FM/FM TRANSMITTER POWER OUTPUT BELOW SPECIFICATION
SYSTEM: S-IVB	MISSION: APOLLO 5
SUBSYSTEM: TELEMETRY	EVENT TIME: PRE-LAUNCH TO T+5 HOURS
DESCRIPTION:	FM/FM TRANSMITTER POWER OUTPUT (MEASUREMENT NO. N0017-411) WAS SLIGHTLY BELOW MINIMUM SPECIFICATION (24.9 VS. 25 WATTS) PRIOR TO LIFT-OFF BUT WAS WAIVED FOR FLIGHT. OUTPUT DROPPED TO 24.8 WATTS DURING FLIGHT.
IMPACT:	NONE ON APOLLO 5; TELEMETRY TRANSMITTAL WAS SATISFACTORY.
STATUS:	CAUSE OF LOW POWER OUTPUT CANNOT BE DETERMINED. A NEW MODEL TRANSMITTER WILL BE FLOWN ON SUBSEQUENT S-IB LAUNCH VEHICLES.
ACTION:	NO FURTHER ACTION REQUIRED.
ORGANIZATION:	5-2464
REFERENCES:	MSEC 60-DAY REPORT, P. 28,, ITEM 20.3.2 AND P. 297, ITEM 3. MAT-1/C. F. PILGER, APOLLO 5 FILE, JULY 10, 1968
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV:C

ANOMALY REPORT

NO. 2.2.5 TITLE: COLD HELIUM MASS LOSS INDICATION

SYSTEM: S-IVB MISSION: APOLLO 5

SUBSYSTEM: COLD HELIUM SUPPLY EVENT TIME: T+9 MIN, 54 SEC
TO T+58 MIN, 20 SEC

DESCRIPTION: FLIGHT DATA INDICATED A HELIUM MASS LOSS OF APPROXIMATELY 30 LBM BELIEVED TO BE DUE TO INSTRUMENTATION ERRORS, OR HELIUM LOSS. THIS PROBLEM ALSO OCCURRED ON APOLLO 4 AND 6.

IMPACT: NONE ON APOLLO 5.

STATUS: NON TEFLON COATED SEALS IN S-IVB STAGE He PIPING HAVE A HISTORY OF EXCESSIVE LEAKAGE. TESTS ON S-IVB 505 AT SACTO HAVE INDICATED THAT TEFLON COATED CONOSEALS HAVE MUCH BETTER SEALING CHARACTERISTICS AND WILL BE USED ON 206, 504 AND SUBSEQUENT VEHICLES. S-IVB 205 JOINTS WILL BE TORQUE CHECKED BEFORE AND AFTER CDDT TO ASSURE MINIMUM LEAKAGE. (SEE ATTACHED DETAIL SHEET.)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68

REFERENCES: MSFC 60-DAY REPORT, P. 112, ITEM 9.6.4 REV: C
AND P. 297, ITEM 4;
MAT-1/C. F. PILGER, APOLLO 5 FILE, JULY 26, 1968

DETAIL SHEET

ANOMALY 2.2.5

TITLE: COLD HELIUM MASS LOSS INDICATION

BACKGROUND:

At ECC, the cold helium temperatures ranged from 27 to 31°K (-411 to -404°F), indicating that all the bottles were no longer covered with liquid hydrogen. By 58min:20sec (3500 sec), the bottle temperatures had decreased to a range of 23 to 25°K (-419 to -415°F). During this time, the pressure had also decreased from 868 n/cm² (1259 psi) at ECC to 517 n/cm² (750 psi) at 58min:20sec (3500 sec). Using the bias applied during boost and burn, these conditions indicate a mass loss of 13.6 kg (30 lbm). Similar indicated mass losses occurred in AS-501 during orbital coast. It is not believed that mass losses actually occurred, and sphere instrumentation is thought to be responsible for the indicated mass losses.

DISCUSSION:

By the beginning of cold helium dump, the sphere temperature had increased to a range of 35 to 37°K (-397 to -393°F) and the pressure had increased to 818 n/cm² (1187 psi). The biased data indicated a mass of 73.5 kg (162 lbm). Bottle conditions indicated that the mass dumped was approximately 58 kg (150 lbm). The indicated bottle pressure and temperature at the end of the dump were 28 n/cm² (40 psi) and 16°K (143°F), respectively. All data indicates that safing of the cold helium bottle was successfully accomplished.

ANOMALY REPORT

NO. 2.2.6	TITLE: LOX VENT BLOCKAGE	MISSION: APOLLO 5
SYSTEM: S-IVB		EVENT TIME:
SUBSYSTEM: LOX REPRESSURIZATION	DESCRIPTION: DURING THE COLD HELIUM DUMP, THE LOX TANK ULLAGE PRESSURE INDICATED THAT THE LOX VENT WAS PARTIALLY BLOCKED. AFTER COLD HELIUM DUMP, THE LOX VENT VALVE "CLOSE" INDICATION DID NOT APPEAR UNTIL 18.9 MINUTES AFTER THE VALVE WAS COMMANDED TO CLOSE. THE LOX VENT AND THE VENT VALVE OPERATED PROPERLY DURING A SUBSEQUENT VENTING OPERATION.	
	IMPACT: NONE ON APOLLO 5 OR ON SUBSEQUENT MISSIONS.	
	STATUS: ON AS-206, AS-504 AND SUBSEQUENT MISSIONS, A NEW MICROSWITCH WILL BE INSTALLED ON THE VALVE TO IMPROVE VALVE POSITION READOUT. THE NEW SWITCH WILL NOT BE INCLUDED ON AS-205 BECAUSE IT IS NOT A MANDATORY CHANGE. (SEE ATTACHED DETAIL SHEET.)	
	ACTION: NO FURTHER ACTION REQUIRED.	
ORGANIZATION: 5-2464	RESOLUTION: CLOSED	DATE: 10/4/68
REFERENCES: MSFC 60-DAY REPORT, P. 9, PARA 9.6.2 AND P. 297, ITEM 5. MAT-1/C. F. Pilger, APOLLO 5 FILE, JULY 10, 1968		REV: C

DETAIL SHEET

ANOMALY 2.2.6

TITLE: LOX VENT BLOCKAGE

DESCRIPTION: Three programmed LOX vents occurred during orbit: the first vent occurred immediately after J-2 engine cutoff. The second vent began shortly after propellant dump at 2hr:31min:34.51sec, and terminated after the cold helium dump at 3hr:14min:11.31sec. The third vent began at 3hr:56min:56.71sec and ended at 4hr:43min:00.71sec. During the cold helium dump, the LOX tank ullage pressure indicated that the vent path was partially blocked; further analysis revealed that the vent effective flow area was at maximum when the ullage pressure began to decay, and then decreased during the remainder of the dump. Since the vent valve appeared to be fully open during this period (the open indication did not drop out and no abnormal gas usage occurred), the restriction may have been due to the formation of snowy or solid oxygen in the vent system. When the LOX vent valve was commanded closed at the end of the cold helium dump at 3hr:14min:11.11sec, the open indication dropped out, but the closed indication was not received until 3hr:33min:5sec. When the valve was commanded closed, the valve may not have closed completely. As the oxygen formation changed states, the valve finally closed at 3hr:33min:5sec. This theory is supported by the ullage pressure data, which begins increasing very slightly at 3hr:14min:11.11sec, indicating that partial sealing had occurred. At 3hr:33min:5sec, the rate of rise increased, indicating complete seal had probably occurred.

The restriction was absent when the vent valve was commanded open for the third vent at 3hr:56min:56.71sec. The vent effective flow area was normal, and the ullage pressure decreased rapidly from 1.7 n/cm² (2.5 psi) towards 0 psi.

ANOMALY REPORT

NO. 2.2.7 **TITLE:** GAS BEARING DIFFERENTIAL PRESSURE EXCEEDANCE
SYSTEM: INSTRUMENT UNIT **MISSION:** APOLLO 5
SUBSYSTEM: ECS GAS BEARING SUBSYSTEM (GBS) **EVENT TIME:** T+15 MIN TO EOM

DESCRIPTION: THE GBS ALLOWED THE DIFFERENTIAL GN₂ PRESSURE ACROSS THE ST-124M-3 INERTIAL PLATFORM TO EXCEED THE MAXIMUM SPECIFIED (15±0.5 PSID) BY 0.4 PSID. FROM T+15 MINUTES TO T+3 HOURS AND 15 MINUTES, THE DIFFERENTIAL PRESSURE ROSE TO 15.9 PSID AND REMAINED AT THAT LEVEL, POSSIBLY DUE TO INADEQUATE PRESSURE REGULATOR CALIBRATION TO MATCH GAS BEARING REQUIREMENTS.

IMPACT: NONE ON APOLLO 5.

STATUS: MSFC 60-DAY REPORT STATES THAT PROCEDURES AND TEST FIXTURES ARE BEING REVIEWED TO ENSURE THEIR ADEQUACY AND COMPATIBILITY BETWEEN THE GN₂ REGULATOR AND PLATFORM.
(SEE ATTACHED DETAIL SHEET.)

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 **RESOLUTION:** CLOSED **DATE:** 10/4/68
REFERENCES: MSFC 60-DAY REPORT, P. 273, ITEM 18.4.2 AND **REV:** C
P. 297, ITEM 6.

DETAIL SHEET

ANOMALY 2.2.7

TITLE: GAS BEARING DIFFERENTIAL PRESSURE EXCEEDANCE

BACKGROUND: The Gas Bearing Subsystem (GBS) supplies gaseous nitrogen (GN_2) at a regulated pressure and temperature to the ST-124M-3 inertial platform for pre-flight and Flight Operation.

During system operation (pre-flight and flight), GN_2 flows from the storage sphere, through a filter, to a pressure regulator which maintains a $10.35 \pm 0.345 \text{ N/CM}^2$ ($15 \pm 0.5 \text{ PSID}$) differential pressure across the gas bearings. The GN_2 then flows through the gas bearing heat exchanger and a second filter to the gas bearing inlet. The heat exchanger thermally conditions the GN_2 for use by the inertial platform.

DISCUSSION: The GBS maintained temperature within specifications. The differential pressure across the gas bearings was not maintained within the specified tolerances. The differential pressure rose 0.276 N/CM^2 (0.4 PSID) above the maximum specified value at 0.25 hours and achieved steady state at 10.97 N/CM^2 (15.9 PSID) at approximately 3.25 hours. The internal platform ambient is shown to drop from 12.4 N/CM^2 (18 PSI) at lift-off to 8.28 N/CM^2 (12 PSI) in flight; however, this is within the regulator design range and should not cause the set point drift.

The undesirable temperature drift characteristics of the regulator GN_2 inlet temperature experienced on previous flights did not occur on AS-204 due to modifications resulting in better sealing of the regulator; hence, the temperature should not have affected the set point. Inlet pressures for the regulator were within design limits.

The GN_2 heat exchanger performed satisfactorily. The existing GN_2 was at the M/W temperature. The platform GN_2 temperature remained within the required 274.6°K to 310°O F (35 to 100°F).

ANOMALY REPORT

NO. 2.3.1	TITLE: ERRATIC FREON COOLING DURING COUNTDOWN	MISSION: APOLLO 5
SYSTEM: MSC-GSE		EVENT TIME: T-2.5 HRS & T-45 MIN.
SUBSYSTEM: ENVIRONMENTAL CONTROL SYSTEM		
DESCRIPTION:	LACK OF PROPER STANDPIPE CONNECTIONS AND IMPROPER VALVE MANIPULATIONS ON GSE FREON COOLANT SUPPLY, RACK NO.1, CAUSED ERRATIC LM COOLANT TEMPERATURES. TWO FREON BOTTLES WERE ALLOWED TO EMPTY CAUSING A MIXTURE OF GASEOUS NITROGEN AND FREON TO FLOW INTO THE LM FREON BOILER. UPPER LIMIT OF LM COOLANT TEMPERATURE WAS INCREASED FROM 45° TO 55°F.	
IMPACT:	APOLLO 5 MISSION WAS DELAYED THREE HOURS, 45 MINUTES.	
STATUS:	FREON COOLANT SYSTEM NOT USED ON SUBSEQUENT FLIGHTS. (SEE ATTACHED DETAIL SHEET).	
ACTION:	NONE REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 3-DAY REPORT, SECTION 1, PAGE 1; SECTION 2, PAGE 3; MSC 30-DAY REPORT, PAGES 2 AND 3; KSC 60-DAY REPORT, PAGE 5-17, ITEM 5.29.4.1; MSC 60-DAY REPORT, PAGE 12-1, ITEM 12.1; MSC ANOMALY REPORT NO. 1	
		DATE: 10/4/68 REV: C

DETAIL SHEET

ANOMALY 2.3.1

TITLE:

ERRATIC FREON COOLING DURING COUNTDOWN

BACKGROUND:

This mission required that the Lunar Module (LM) be powered at liftoff, thus necessitating mission support by the GSE freon cooling system.

The water/glycol coolant of the Lunar Module (LM) heat transport system was cooled prior to launch by two freon boilers in the Environmental Control System. Freon was supplied to the boilers from two ground support equipment freon bottle racks (Fig. 2.3-1). The freon was expelled from the bottles by nitrogen pressure that forced freon through the standpipe and into the manifold (Fig. 2.3-2). Rack 1 was mounted on a weight scale to determine the amount of freon in the bottles. Freon flow was initially set at 50 LB/HR.

DISCUSSION:

From T minus 7.5 hours to T minus 3.5 hours the weight of rack 1 did not change. Since sufficient freon was available from rack 2, no attempt was made to correct the problem.

At T minus 3 hours freon delivery pressure to the LM dropped from 276 PSI to 146 PSI and the heat transport system coolant temperature began to increase from 50 to 64°, indicating loss of freon cooling. A hold was called at T minus 2.5 hours. The problem was isolated to rack 1 and rack 1 was shut off. The count has resumed using rack 2. At this time rack 1 was showing a weight loss of 60 LB/HR, which was half of the total freon flow, although the rack was turned off. No action was taken.

At approximately T minus 50 minutes with rack 1 showing a weight loss equivalent to two bottles, the problem recurred; flow rate increased, delivery pressure decreased and LM coolant temperature increased. By lowering freon flow rates to between 40 and 80 LB/HR, LM coolant temperatures were maintained at 50+ 5° F. This temperature was maintained within the prescribed limits until launch.

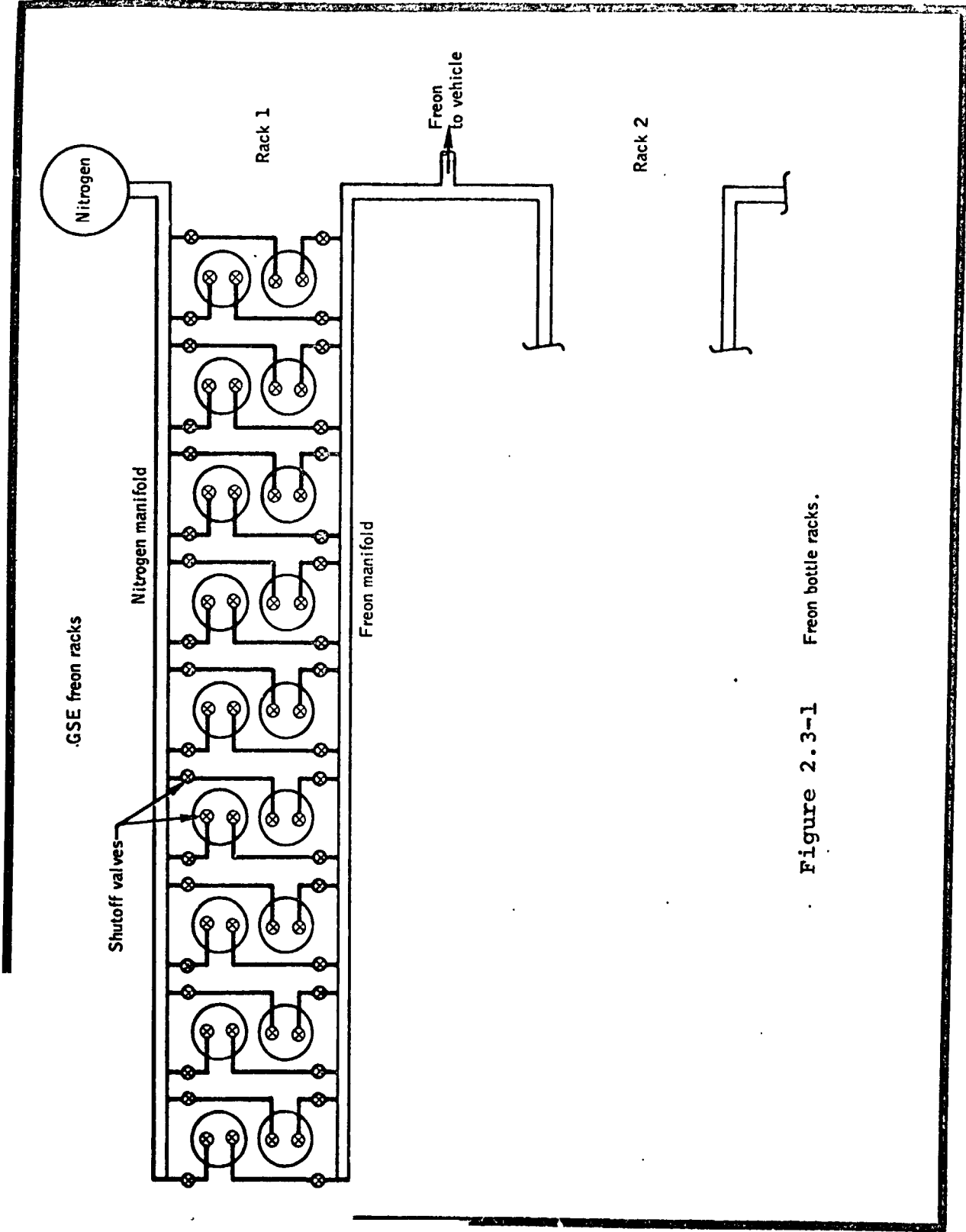
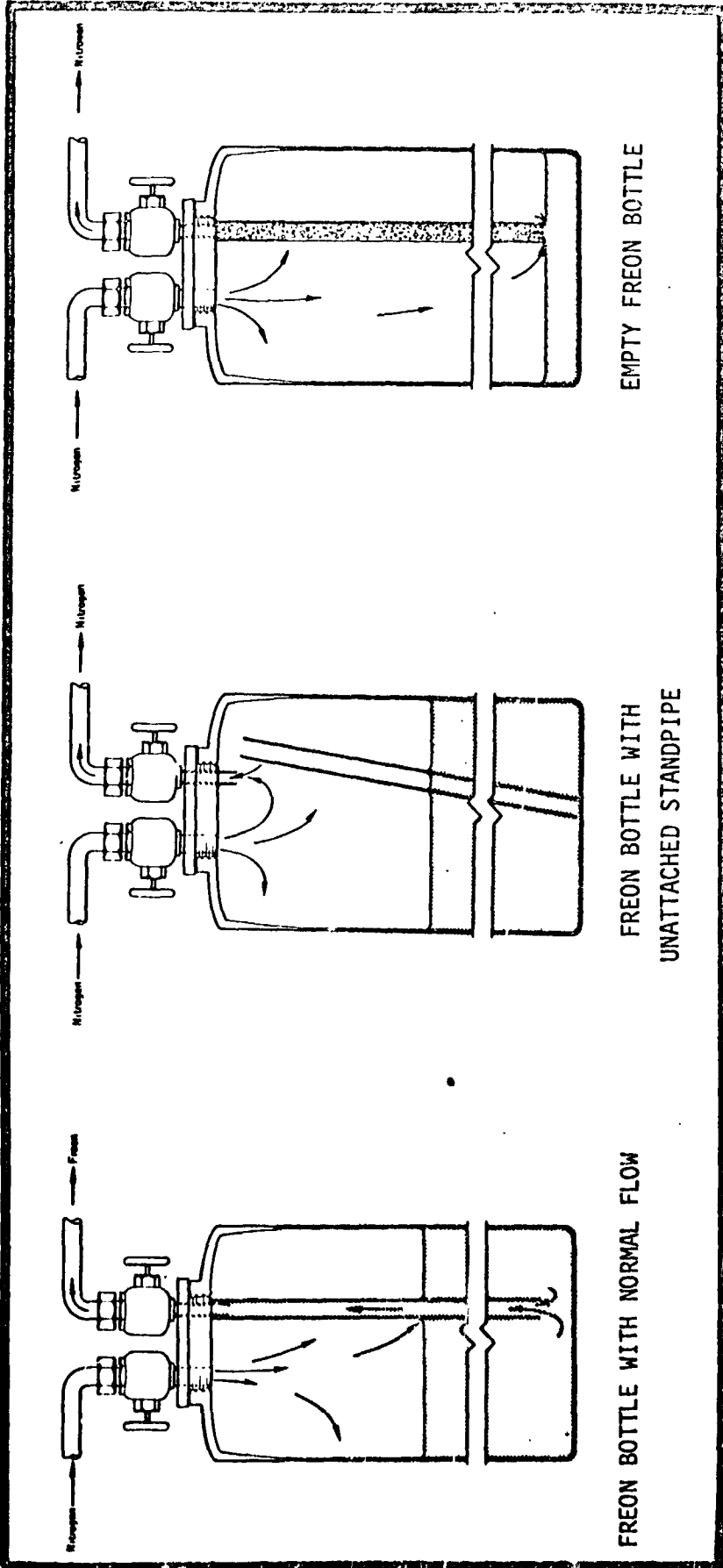


Figure 2.3-1 Freon bottle racks.



FREON BOTTLE STANDPIPE ARRANGEMENT
FIGURE 2.3-2

DETAIL SHEET

ANOMALY 2.3.1.1

TITLE: ERRATIC FREON COOLING DURING COUNTDOWN (CONT.)

OBJECTIVES: No objectives were compromised by this problem.

EXPLANATION: Examination of the freon racks on the morning following launch revealed two empty bottles and two bottles with standpipes which had dropped out of the cap block in rack 1. Apparently the loss in freon delivery pressure and increase in coolant temperature at T minus 3 hours was caused by the separation of the standpipes (inside of bottles 3 and 16 of rack 1) from their respective outlet flow valves. This allowed gaseous nitrogen to flow into the freon manifold and cause erratic flow rates.

The second malfunction at T minus 50 minutes appeared to be due to emptying of the two freon bottles inadvertently left open when the rack was isolated from the system. This again caused gaseous nitrogen flow into the freon manifold and erratic flow to the spacecraft heat exchanger.

RECOMMENDATION:

If a future requirement exists for support by a GSE freon cooling system, it is recommended that the freon system be redesigned. The redesign should eliminate individual bottles and utilize a single reservoir to prevent recurrence of freon flow problems.

ANOMALY REPORT

NO. 2.3.2 TITLE: FAILURE OF AGCS IU DDAS 12 VOLT POWER SUPPLY DURING HOLD
SYSTEM: MSFC-GSE MISSION: APOLLO 5
SUBSYSTEM: DIGITAL DATA ACQUISITION SYSTEM (DDAS) EVENT TIME: T-2:30

DESCRIPTION: THE POWER SUPPLY FAILED AT T-2 HOURS, 30 MINUTES. IT WAS REPLACED WITH A SPARE UNIT WHICH WAS ALSO DEFECTIVE. IT WAS FINALLY CLEARED BY REPLACING THE SUPPLY WITH A UNIT FROM ANOTHER OUTPUT REGISTER THAT WOULD NOT BE UTILIZED DURING THE REMAINDER OF THE COUNTDOWN.

IMPACT: NONE ON AS-204. COULD CAUSE DELAY OF LAUNCH OF FUTURE MISSIONS.

STATUS: AN ECP (GE 09-1044) HAS BEEN APPROVED BY THE CCB FOR DELETION OF THE INTERNAL FUSE FOR MODULATOR POWER SUPPLIES IN DDAS PANELS.

ACTION: NO FURTHER ACTION REQUIRED

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 3-DAY REPORT, SECTION 2, PAGE 2;
24-HOUR FLASH REPORT, PAGE 5;
KSC 60-DAY REPORT, PAGE 5-20, ITEM 5.30.5.3.1.
MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 10, 1968
REV: C

ANOMALY REPORT

NO. 2.3.3 TITLE: S-IVB STAGE PNEUMATIC CONTROL REGULATOR PRESSURE EXCEEDED REDLINE
SYSTEM: S-IVB MISSION: APOLLO 5
SUBSYSTEM: PNEUMATIC EVENT TIME: PRE-LAUNCH

DESCRIPTION: AFTER OPENING THE RECIRCULATION SHUTOFF VALVES DURING LH₂ LOADING, THE STAGE PNEUMATIC CONTROL REGULATOR OUTLET PRESSURE INCREASED TO APPROXIMATELY 600 PSIA (SLIGHTLY ABOVE REDLINE). THE BACKUP PRESSURE SWITCH PICKED UP. THE OPERATION WAS RETURNED TO NORMAL BY CYCLING THE RECIRCULATION VALVES.

IMPACT: NONE ON APOLLO 5.

STATUS: PROPER OPERATION OF BACKUP PRESSURE (RELIEF) SWITCH AND CYCLING OF RECIRCULATION SHUTOFF VALVES RETURNED THE SYSTEM TO NORMAL.

ACTION: NONE REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: XSC 3-DAY REPORT, SECTION 1, PAGE 3. REV: C

ANOMALY REPORT

NO. 2.3.4 TITLE: S-IVB BATTERY NO.1 VOLTAGE BELOW REDLINE VALUE
SYSTEM: S-IVB MISSION: APOLLO 5
SUBSYSTEM: ELECTRIC POWER EVENT TIME: PRE-LAUNCH

DESCRIPTION: BATTERY NO.1 OPEN CIRCUIT VOLTAGE WAS BELOW ITS REDLINE VALUE. THE REDLINE LIMIT WAS REVISED FROM 34.8 + 1 VOLT TO 32 +3, -1 VOLT.

IMPACT: NONE ON APOLLO 5.

STATUS: POST-FLIGHT ANALYSIS SHOWS THAT BATTERIES FUNCTIONED NORMALLY DURING FLIGHT.

ACTION: NONE REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 3-DAY REPORT, SECTION 1, PAGE 3 REV: C

ANOMALY REPORT

NO. 2.3.5	TITLE: S-IVB UMBILICAL QUICK DISCONNECT LEAK	MISSION: APOLLO 5
SYSTEM: S-IVB		EVENT TIME: PRE-LAUNCH
SUBSYSTEM: UMBILICAL		
DESCRIPTION:	A COMMON BULKHEAD INTERNAL PRESSURE RISE FROM 0.7 TO 1.4 PSIA WAS OBSERVED DURING BULKHEAD CONDITIONING WHILE THE BULKHEAD WAS OPEN TO THE VACUUM PUMP. PRESSURE RISE CHECKS, A BULKHEAD GAS SAMPLE, AND PRESSURE VARIATIONS DURING S-IB LOX LOADING INDICATED A PROBABLE LEAK AT THE UMBILICAL QUICK DISCONNECT.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	THE SMALL LEAKAGE WAS OF NO SIGNIFICANT CONSEQUENCE.	
ACTION:	NONE REQUIRED	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 3-DAY REPORT, SECTION 1, PAGE 4.	DATE: 10/4/68 REV: C

ANOMALY REPORT

NO.	2.3.6	TITLE:	IU FLIGHT CONTROL COMPUTER DETECTOR SWITCHED FROM PRIMARY TO SECONDARY (SPARE) INVERTER DURING POWER TRANSFER
SYSTEM:	IU	MISSION:	APOLLO 5
SUBSYSTEM:	CONTROL COMPUTER	EVENT TIME:	T-25 MINUTES
DESCRIPTION:	AT T-25 MINUTES DURING POWER TRANSFER, THE FLIGHT CONTROL COMPUTER INVERTER DETECTOR SWITCHED FROM THE PRIMARY TO THE SECONDARY (SPARE) INVERTER. IT WAS DETERMINED THAT THIS WAS CAUSED BY A VOLTAGE TRANSIENT DURING THE TRANSFER.		
IMPACT:	NONE ON APOLLO 5.		
STATUS:	SYSTEM PERFORMED NORMALLY.		
ACTION:	NONE REQUIRED		
ORGANIZATION:	5-2464	RESOLUTION:	CLJSED
REFERENCES:	KSC 3-DAY REPORT, SECTION 1, PAGE 4.	DATE:	10/4/68
		REV:	C

ANOMALY REPORT

NO. 2.3.7 TITLE: LOX VALVE TIMING OUT OF ADJUSTMENT
MISSION: APOLLO 5
SYSTEM: GSE
SUBSYSTEM: LOX
EVENT TIME: T-6:30

DESCRIPTION: DURING LOX COMPONENTS TEST AT T-6 HOURS, 30 MINUTES, THERE WAS NO FEEDBACK FROM LOX VALVE A325 (MAIN TANK AUXILIARY PRESSURIZATION VALVE) WHEN THE VALVE WAS COMMANDED OPEN, BECAUSE VALVE TIMING WAS OUT OF ADJUSTMENT.

IMPACT: NONE ON APOLLO 5.

STATUS: VALVE TIMING WAS PROPERLY ADJUSTED AND THE OPEN FEEDBACK INDICATION WAS RECEIVED DURING SUBSEQUENT VALVE CYCLING.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 3-DAY REPORT, SECT. 1, PAGE 5;
MAT-1/C. F. PILGER, APOLLO 5 FILE, JULY 26, 1968. REV: C

ANOMALY REPORT

NO. 2.3.8	TITLE: S-IVB STAGE GH ₂ LEAK BETWEEN LH ₂ FILL AND DRAIN DISCONNECT AND THE DEBRIS VALVE	MISSION: APOLLO 5
SYSTEM: MSFC-GSE		EVENT TIME: PRE-LAUNCH
SUBSYSTEM: LH ₂ FILL AND DRAIN	DESCRIPTION: DURING THE FAST FILL PHASE OF LH ₂ LOADING, A GH ₂ LEAK DEVELOPED BETWEEN THE LH ₂ TANK FILL AND DRAIN DISCONNECT AND THE DEBRIS VALVE. THE LEAK WAS DETECTED BY THE OPERATIONAL TELEVISION SYSTEM AND A HYDROGEN SENSOR SHOWING A GH ₂ CONCENTRATION IN EXCESS OF 8%. AT TERMINATION OF FILL, CONCENTRATION DECREASED TO 3-4%.	
IMPACT: NONE.	STATUS: MSFC DOES NOT CONSIDER THE SEAL LEAKAGE PROBLEM TO BE SERIOUS.	
ACTION: NO FURTHER ACTION REQUIRED.	RESOLUTION: CLOSED	
ORGANIZATION: 5-2464	REFERENCES: KSC 3-DAY REPORT, SECTI. 1, PAGE 6; SECTION 2, PAGE 1; KSC 60-DAY REPORT, PAGE 5-18, ITEM 5.30.2.4.1. MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 26, AND AUGUST 2, 1968.	DATE: 10/4/68 REV: C

ANOMALY REPORT

NO. 2.3.9	TITLE: EXTENDED S-IVB PNEUMATIC KICK-OFF CYLINDERS	MISSION: APOLLO 5
SYSTEM: MSFC-GSE		EVENT TIME: PRE-LAUNCH
SUBSYSTEM: PNEUMATIC KICK-OFF		
DESCRIPTION:	PNEUMATIC KICK-OFF CYLINDERS ON BOTH CARRIERS WERE EXTENDED, INDICATING PRIMARY RELEASE AND EJECTION WAS VIA THE PNEUMATIC SYSTEM.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	IT HAS BEEN DETERMINED THAT THIS WAS NOT AN ANOMALY.	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 3-DAY REPORT, SECTION 1, PAGE 6, MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 26, 1968.	DATE: 10/4/68 REV: C

ANOMALY REPORT

NO.	2.3.10	TITLE:	GASEOUS COOLING UNIT (GSCU) COOLANT TEMPERATURE OSCILLATIONS DURING COUNTDOWN	MISSION:	APOLLO 5
SYSTEM:	MSFC-GSE			EVENT TIME:	PRE-LAUNCH
SUBSYSTEM:	GSCU				
DESCRIPTION:	GSCU COOLANT TEMPERATURE OSCILLATIONS OCCURRED THROUGHOUT THE COUNTDOWN AND NUMEROUS SET POINT ADJUSTMENTS OF THE UNIT HAD TO BE MADE.				
IMPACT:	NONE ON APOLLO 5.				
STATUS:	AS A RESULT OF TESTS RUN BY MSFC, KSC OPERATIONAL PROCEDURES WILL BE UPDATED TO CORRECT THE PROBLEM.				
ACTION:	NO FURTHER ACTION REQUIRED.				
ORGANIZATION:	5-2464	RESOLUTION:	CLOSED	DATE:	10/4/68
REFERENCES:	KSC 3-DAY REPORT, SECTION 1, PAGE 1. MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 10, 1968 AND JULY 26, 1968. REV: C				

ANOMALY REPORT

NO. 2.3.11 TITLE: FAILURE OF STABILIZATION AND ALIGNMENT
SYSTEM: MSFC-GCE REPEATER IN AGCS DURING HOLD MISSION: APOLLO 5
SUBSYSTEM: STABILIZATION AND ALIGNMENT/AZIMUTH LAYING AND ALIGNMENT EVENT TIME: PRE-LAUNCH

DESCRIPTION: PROBLEM IDENTIFIED AS A DEFECTIVE DEMODULATOR PRINTED-CIRCUIT CARD WHICH WAS REPLACED. REPLACEMENT CARD ALSO FAILED. PLATFORM POSITIONING, INCLUDING GYRO AND ACCELEROMETER TESTS, WERE ACCOMPLISHED MANUALLY.

IMPACT: NONE ON AS-204. COULD CAUSE DELAY OF LAUNCH OF FUTURE MISSIONS.

STATUS: FOR AS-206, AS-504 AND SUBSEQUENT, ECP 305-8-0342 HAS BEEN APPROVED BY THE CCB TO REDUCE THE DRIVE RATE OF THE AZIMUTH LAYING PROGRAM (GT16) TO 7°/MINUTE, SO THAT THE AZIMUTH SYNCHRO DOES NOT SWITCH INTO THE COARSE MODE. THIS WILL ALLOW THE PLATFORM TO DRIVE AT ITS FASTEST RATE AND REACH ITS AZIMUTH SOONER. AN ADDITIONAL ECR IS IN PROCESS TO INCLUDE AUTOMATIC SHUTDOWN LOGIC IN THE LAUNCH COMPUTER SEQUENCING. THIS WILL PREVENT LAUNCH IN CASE OF AZIMUTH MISALIGNMENT OR LAYING AND ALIGNMENT EQUIPMENT MALFUNCTION. THE CHANGES WILL NOT BE INCLUDED ON AS-205 BECAUSE THEY ARE NOT CONSIDERED MANDATORY. SHUTDOWN CAN BE ACHIEVED MANUALLY.

ACTION: CLOSED FOR APOLLO 7, TRACK FOR AS-504.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED (FOR APOLLO 7 ONLY) DATE: 10/4/68
REFERENCES: KSC 3-DAY REPORT, SECTION 2, PAGE 2; REV: C
KSC 60-DAY REPORT, PAGE 5-21, ITEM 5.30.9.3.1;
MAT-1/C. F. PILGER, APOLLO 5 FILE, JULY 10 AND AUGUST 2, 1968.

ANOMALY REPORT

NO.	2.3.12	TITLE:	INADVERTENT OPERATION OF EXPLOSIVE BOLTS
SYSTEM:	GSE	MISSION:	APOLLO 5.
SUBSYSTEM:	HOLDDOWN ARMS	EVENT TIME:	LIFT-OFF
DESCRIPTION:	EXPLOSIVE BOLTS IN HOLDDOWN ARMS II AND III BLEW DURING LAUNCH. ALTHOUGH THE ARMS WERE RELEASED PNEUMATICALLY.		
IMPACT:	NONE ON APOLLO 5, BUT EARLY AND UNPLANNED OPERATION ON FUTURE MISSIONS WOULD CAUSE PREMATURE RELEASE OF HOLDDOWN ARMS, RESULTING IN ENGINE SHUTDOWN.		
STATUS:	TO PREVENT PREMATURE EXPLOSIVE BOLT DETONATION, THE HOLDDOWN RELEASE TIMING CIRCUIT HAS BEEN ADJUSTED TO INCREASE TIME BETWEEN RELEASE SIGNAL GENERATION AND BOLT DETONATION BY 20 MILLISECONDS.		
ACTION:	NO FURTHER ACTION REQUIRED.		
ORGANIZATION:	5-2464	RESOLUTION:	CLOSED
REFERENCES:	KSC 30-DAY REPORT, PAGE 2-7; KSC 60-DAY REPORT, PAGE 5-6, ITEM 5.8.3.1. KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968.		DATE: 10/4/68 REV: C

DETAIL SHEET

ANOMALY 2.3.12

TITLE: INADVERTENT OPERATION OF EXPLOSIVE BOLTS

DISCUSSION: Primary release of the holddown arms is accomplished through release of a pneumatic ball-lock separator in each arm upon signal from the terminal countdown sequencer at programmed thrust buildup. A 1500-psi gaseous helium control system is used to provide the necessary stored energy to release the pneumatic ball-lock separators. In series with each pneumatic ball-lock mechanism is an explosive-nut-separation-device-secondary release system. The mechanical and electrical control signals are timed to permit all arms to release within a 50-millisecond time span and prior to 250 milliseconds from launch commit. After approximately 30 inches vehicle rise and prior to 80 inches rise, a protective hood, actuated by a lanyard attached to the vehicle first stage, closes over the front of the holddown arm support assembly to protect it from the effects of the engine exhaust.

The holddown arms and service arms control system functional diagram is shown in Figure 2.3-3. A view of the arm links in vehicle restraining and release positions is shown in Figure 2.3-4.

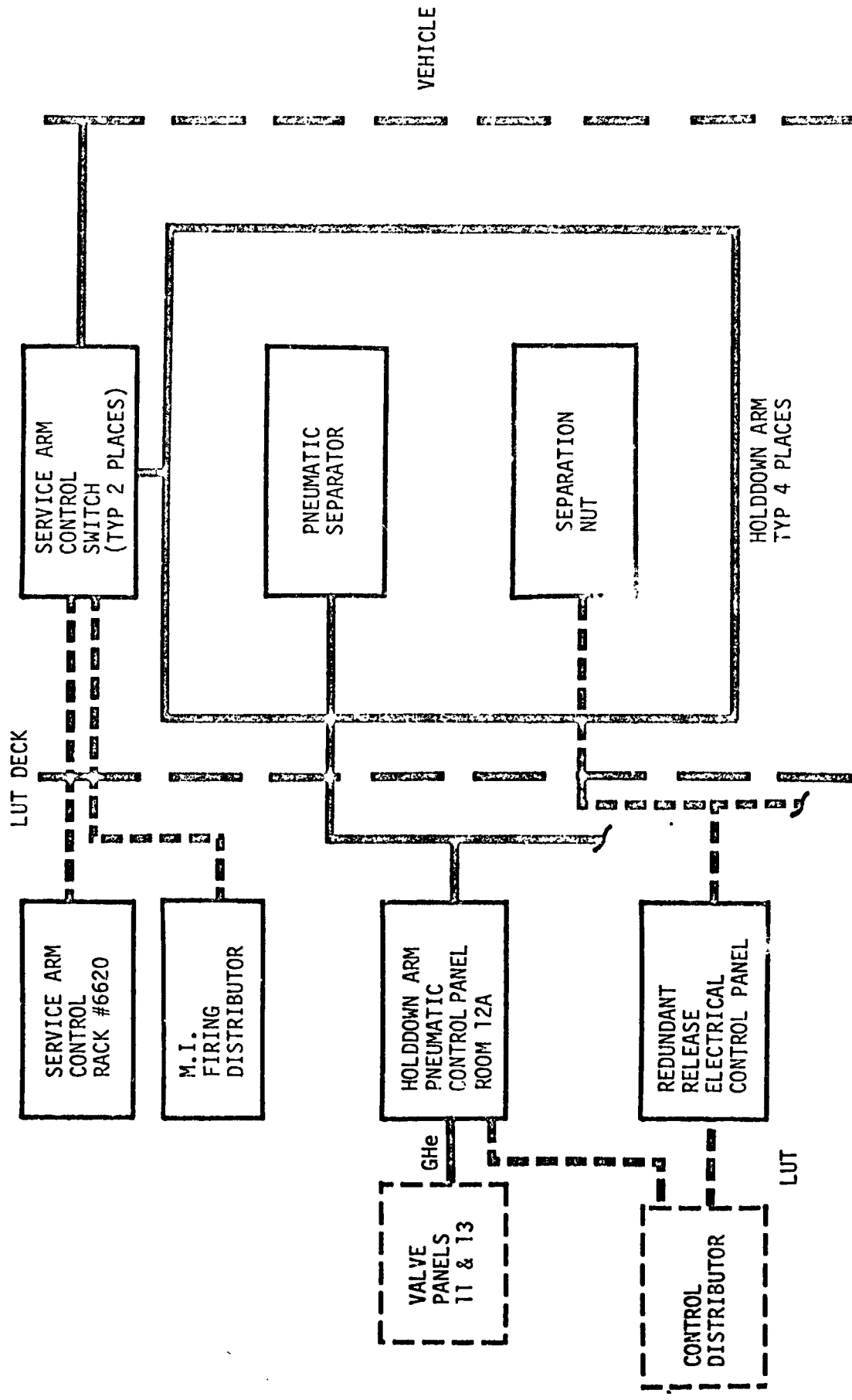
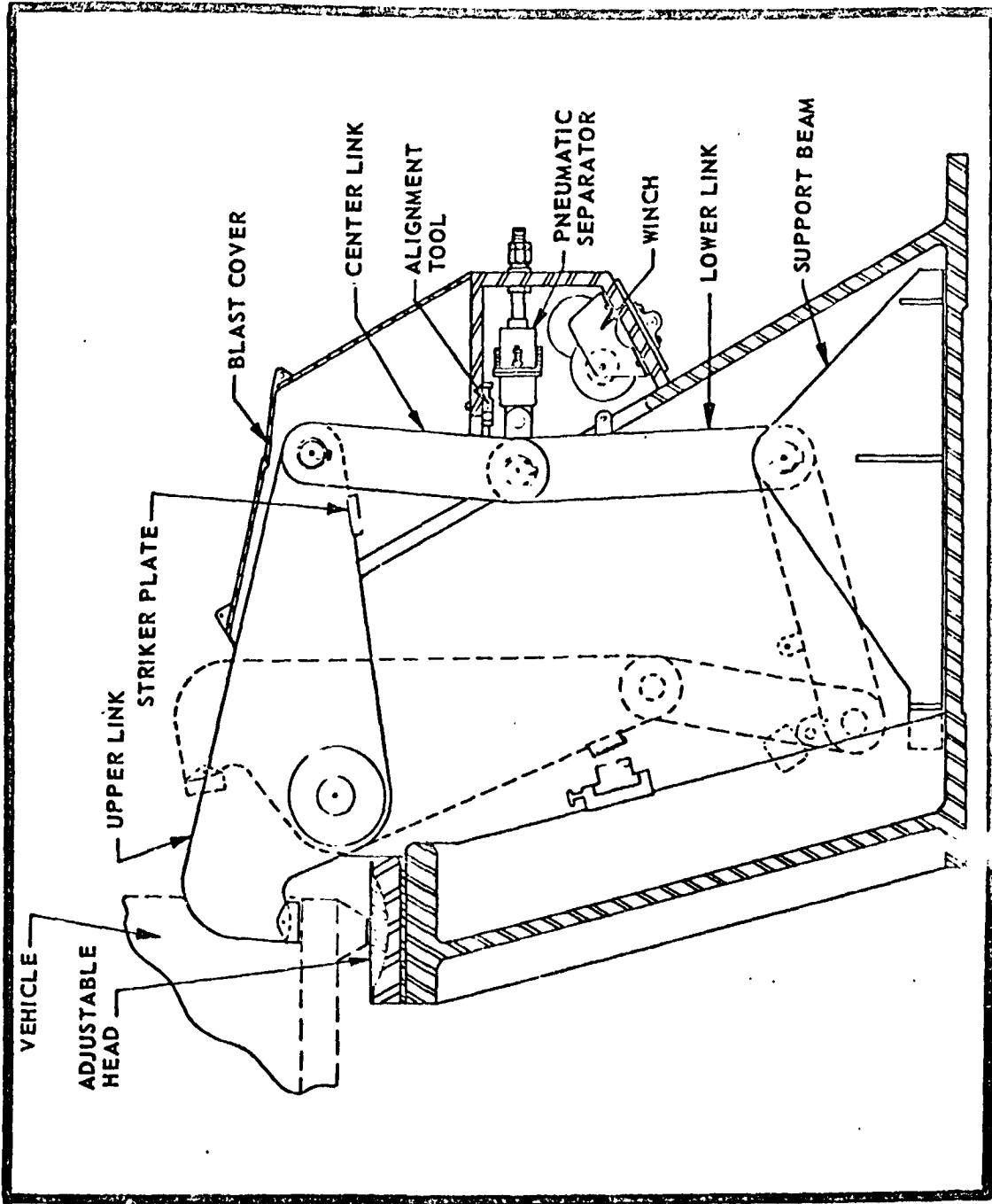


FIGURE 2.3-3 HOLDDOWN ARMS AND SERVICE ARMS CONTROL SYSTEM
FUNCTIONAL DIAGRAM



**VIEW OF ARM LINKS IN VEHICLE
RESTRAINING AND RELEASE POSITIONS**

FIGURE 2.3-4

ANOMALY REPORT

NO. 2.3.13 TITLE: CRACKED BASE ASSEMBLIES, HOLDDOWN ARMS 1-2 AND 2-3
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: HOLDDOWN ARMS EVENT TIME: LAUNCH

DESCRIPTION: BASE ASSEMBLIES ON HOLDDOWN ARMS 1-2 AND 2-3 WERE CRACKED NEXT TO THE UPPER PIVOT PINS.

IMPACT: NONE ON APOLLO 5, BUT RUPTURE OF HOLDDOWN ARM BASE ASSEMBLIES COULD CAUSE PREMATURE LIFT-OFF AND MISSION ABORT.

STATUS: A PROCEDURE HAS BEEN DEVELOPED TO GRIND OUT AND RE-WELD THE CRACKS.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, PAGES 5-5 and 5-6, ITEM 5.8.2.; REV: C
 KSC APOLLO F&A STATUS REPORT, JUNE 10, 1968.

ANOMALY REPORT

NO. 2.3.14	TITLE: LOSS OF FEEDBACK FROM LOX ISOLATION VALVE	MISSION: APOLLO 5
SYSTEM: KSC-GSE		EVENT TIME: CDDT
SUBSYSTEM: LOX		
DESCRIPTION:	DURING S-IB CHILLDOWN SEQUENCE, LOX SYSTEM REVERTED BECAUSE THE OPEN FEEDBACK FROM LOX ISOLATION VALVE WAS LOST DUE TO VIBRATION OF VALVE ACTUATOR SWITCHES.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	KSC 60-DAY REPORT STATES THAT THE ISOLATION VALVE WILL BE REPLACED WITH A SPOOL PIECE PER NASA WORK ORDER 260.	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-1, ITEM 5.2.4.1.	DATE: 10/4/68
		REV: C

ANOMALY REPORT

NO. 2.3.15 TITLE: EXCESSIVE VALVE CLOSING TIME IN 96% MONITOR CHAIN
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: LOX EVENT TIME: CDDT

DESCRIPTION: LOX SYSTEM REVERTED DURING CDDT WHEN LOX REACHED 96% LEVEL IN THE S-IB STAGE DUE TO SLOW CLOSURE OF VALVES (A31, A34, B152) IN MONITOR CHAIN.

IMPACT: NONE ON APOLLO 5.

STATUS: THE REVERT LOGIC HAS BEEN CHANGED TO DELETE THE REQUIREMENT FOR ALL THREE VALVES TO OPERATE WITHIN 30 SECONDS. THE NEW LOGIC REQUIRES THAT CLOSURE OF GROUND VALVE A-31 MUST OCCUR WITHIN 30 SECONDS.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-2, ITEM 5.2.4.2; REV: C
KSC APOLLO 5 F&A STATUS REPORT, JUNE 26, 1968.

ANOMALY REPORT

NO. 2.3.16 TITLE: LOX TRANSFER PUMP PROBLEMS MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: CDDT
SUBSYSTEM: LOX

DESCRIPTION: DURING LOX TRANSFER FROM MAIN TANK TO THE REPLENISH TANK, PRIME COULD NOT BE ESTABLISHED ON PUMPS A106 AND A107. ALSO, A107 PUMP COULD NOT BE CHILLED DOWN IN THE REQUIRED 15 MINUTES BECAUSE A106 PUMP COULD NOT BE ISOLATED FROM THE BLOCKHOUSE.

IMPACT: NONE ON APOLLO 5.

STATUS: PROCEDURES WILL BE CHANGED TO ALLOW LONGER PUMP CHILLDOWN TIME.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-4, ITEM 5.2.4.3 REV: C

ANOMALY REPORT

NO. 2.3.17 TITLE: RELIEF VALVE LEAK MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: CDDT & COUNTDOWN
SUBSYSTEM: LOX

DESCRIPTION: DURING CDDT AND COUNTDOWN, LEAKAGE OCCURRED IN LOX RELIEF VALVE A-354.

IMPACT: NONE ON APOLLO 5.

STATUS: VALVE HAS BEEN RE-WORKED IN THE LABORATORY AND RETURNED TO SERVICE.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-2, ITEM 5.2.4.4;
KSC APOLLO 5 F&A STATUS REPORT, JUNE 10, 1968. REV: C

ANOMALY REPORT

NO. 2.3.18	TITLE: PUMP BEARING FAILURE	MISSION: APOLLO 5
SYSTEM: KSC-GSE		EVENT TIME: CDDT
SUBSYSTEM: LOX		
DESCRIPTION:	DURING S-1B STAGE LOX FAST FILL, PUMP A105 BEARING FAILED AS EVIDENCED BY TEMPERATURE SPIKE, THEN DECREASED TO 50°F AND CONTINUED DOWNWARD. PUMP WAS REPLACED WITH A SPARE TO COMPLETE CDDT AND LAUNCH.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	TO PREVENT BEARING FAILURE, ECP's 32073E (ADDITION OF HEATER BLANKETS) HAVE BEEN APPROVED FOR BOTH CX 34 AND 37.	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION: 5-2464	RESOLUTION: CLOSED	DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-2, ITEM 5.2.4.5; KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968.		REV: C

ANOMALY REPORT

NO. 2.3.19	TITLE: LOX PUMP CASE FAILURE	MISSION: APOLLO 5
SYSTEM: KSC-GSE		EVENT TIME: CDDT
SUBSYSTEM: LOX		
DESCRIPTION:	DURING S-IVB LOX PUMP CIRCULATION TEST, A CRACK WAS DISCOVERED IN THE A106 PUMP CASE. PUMP WAS REPLACED TO COMPLETE CDDT AND LAUNCH.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	PUMP HOUSING HAS BEEN RETURNED TO THE VENDOR FOR EXAMINATION AND POSSIBLE REPAIR. UCR NO. ESC 093205 WHICH DOCUMENTS THE PROBLEM HAS BEEN CLOSED.	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-2, ITEM 5.2.4.6	DATE: 10/4/68
	KSC APOLLO 5 F&A STATUS REPORT, JULY 19, 1968.	REV: C

ANOMALY REPORT

NO. 2.3.20 TITLE: REPLENISH VALVE POSITION POTENTIOMETER
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: LH₂ EVENT TIME: CDDT

DESCRIPTION: LH₂ REPLENISH VALVE POSITION POTENTIOMETER FITTING BROKE LOOSE FROM HOUSING DUE TO FAILURE OF A SPOT WELD.

IMPACT: NONE ON APOLLO 5.

STATUS: THE POTENTIOMETER WILL BE REPLACED.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-3, ITEM 5.3.4.1 REV: C

ANOMALY REPORT

NO. 2.3.2.1	TITLE: LH ₂ STORAGE FACILITY MAIN IGNITER FLUTTER	MISSION: APOLLO 5
SYSTEM: KSC-GSE		EVENT TIME: CDDT
SUBSYSTEM: LH2		
DESCRIPTION:	AFTER LOADING, THE LH ₂ STORAGE FACILITY BURN POND MAIN IGNITER INDICATIONS FLUTTERED.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	IGNITER RELAY CURRENT WAS SET FOR RELAY PICKUP AT 13 AMPERES AND DROPOUT AT 12.5 AMPERES; NO FURTHER PROBLEMS WERE EXPERIENCED DURING CDDT AND COUNTDOWN.	
ACTION:	NONE REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-4, ITEM 5.3.4.2	DATE: 10/4/68
		REV: C

ANOMALY REPORT

NO. 2.3.22 TITLE: EVAPORATOR DISCHARGE TEMPERATURE PROBE MALFUNCTION
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: ECS EVENT TIME: T - 16 DAYS (APPROX)

DESCRIPTION: ON JANUARY 6, THE UNIT A-1 (B SIDE) EVAPORATOR DISCHARGE TEMPERATURE PROBE MALFUNCTIONED SHORTLY AFTER THE EVAPORATOR COILS ICED UP.

IMPACT: NONE ON APOLLO 5 BECAUSE OF ADEQUATE TEMPERATURE MEASUREMENTS LOCATED DOWNSTREAM OF FAILED PROBE.

STATUS: ECP 32032 WHICH CHANGES PROBE HAS BEEN APPROVED FOR LC 34 AND 37.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-4, ITEM 5.5.3.1;
KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968. REV: C

ANOMALY REPORT

NO. 2.3.23	TITLE: UNLOADER COMPRESSOR CONTROLLER FAILURE
SYSTEM: KSC-GSE	MISSION: APOLLO 5
SUBSYSTEM: ECS	EVENT TIME: CDDT T-2 DAYS, 8 5 MINUTES
DESCRIPTION:	UNIT A-3 COMPRESSOR INLET PRESSURE COULD NOT BE ADEQUATELY SET AND CONTROLLED BECAUSE THE COMPRESSOR UNLOADER CONTROLLER WAS STUCK.
IMPACT:	NONE ON APOLLO 5.
STATUS:	FAILURE ANALYSIS REVEALED FAILED UNLOADER VALVE WAS MANUFACTURED/ASSEMBLED WITHOUT A STRAINER. VALVE WAS CLEANED, REASSEMBLED WITH REPLACEMENT STRAINER, AND RETURNED TO SERVICE.
ACTION:	NO FURTHER ACTION REQUIRED.
ORGANIZATION:	5-2464
REFERENCES:	KSC 60-DAY REPORT, P. 5-5, ITEM 5.5.3.2; KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968.
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV: C

ANOMALY REPORT

NO. 2.3.24	TITLE: DEFECTIVE UNLOADER SUCTION VALVE ASSEMBLY
SYSTEM: KSC-GSE	MISSION: APOLLO 5
SUBSYSTEM: ECS	EVENT TIME: CDDT T-1 DAY, 15 HRS, 5 MINS.
DESCRIPTION:	SEVERAL UNIT A-3 COMPRESSOR CYLINDERS WOULD NOT UNLOAD BECAUSE OF DEFECTIVE UNLOADING SUCTION VALVE ASSEMBLIES.
IMPACT:	NONE ON APOLLO 5.
STATUS:	THE VALVES WILL BE REPAIRED WITH VENDOR UPGRADED UNLOADER VALVE PLATES AND RETURNED TO SERVICE.
ACTION:	NO FURTHER ACTION REQUIRED.
ORGANIZATION:	5-2464
REFERENCES:	KSC 60-DAY REPORT, P. 5-5, ITEM 5.5.3.3 KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968.
	RESOLUTION: CLOSED
	DATE: 10/4/68
	REV: C

ANOMALY REPORT

NO. 2.3.25	TITLE: CLOSED LOOP LINE CABLE DAMAGE	MISSION: APOLLO 5
SYSTEM: KSC-GSE		EVENT TIME: T-6 HOURS (CDDT)
SUBSYSTEM: TELEMETRY		
DESCRIPTION:	WHILE TELEMETRY CABLES WERE BEING DISCONNECTED FOR SERVICE. STRUCTURE REMOVAL, CABLES 872, 873 AND 874 WERE FOUND TO BE BROKEN AT DISTRIBUTOR BOX 177. THE CABLES WERE TOO SHORT AND HAD BROKEN DUE TO MOVEMENT OF THE SERVICE STRUCTURE.	
IMPACT:	NONE ON APOLLO 5.	
STATUS:	THE CABLES WERE REPAIRED AND EQUIPPED WITH 2-FOOT EXTENSIONS TO ALLOW FOR MOVEMENT OF THE SERVICE STRUCTURE.	
ACTION:	NO FURTHER ACTION REQUIRED.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-7, ITEM 5.11.3.1	DATE: 10/4/68
		REV: C

ANOMALY REPORT

NO. 2.3.26 TITLE: SHORT RETRACT LANYARD MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: CDDT
SUBSYSTEM: SWING ARM NO. 2

DESCRIPTION: DURING UMBILICAL SWING ARM PREPARATIONS FOR CDDT AND LAUNCH, THE REQUIRED SLACK (10 INCHES) IN THE SWING ARM NO. 2 STATIC RETRACT LANYARD COULD NOT BE ATTAINED.

IMPACT: NONE ON APOLLO 5.

STATUS: A NEW LANYARD WAS INSTALLED DURING CDDT AND PERFORMED SATISFACTORILY.

ACTION: NONE REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-7, ITEM 5.12.3.1 REV: C

ANOMALY REPORT

NO. 2.3.27 TITLE: CLOSED LOOP LINK INTERRUPTED
MISSION: APOLLO 7
SYSTEM: KSC-GSE
EVENT TIME: T-11 HOURS, 22 MINS
SUBSYSTEM: INSTRUMENT UNIT COMMAND SYSTEM

DESCRIPTION: THE INSTRUMENT UNIT COMMAND SYSTEM COULD NOT BE CONNECTED IN A CLOSED LOOP CONFIGURATION BECAUSE ONE END OF A JUMPER CABLE HAD BEEN DISCONNECTED FROM A RECEPTACLE (NO. 1303, PAD B DISTRIBUTOR 177) DUE TO INCORRECT ENGINEERING DRAWING.

IMPACT: NONE ON APOLLO 5.

STATUS: CABLES 1247, 1248, AND 1249, INSTALLED PER ECP 37 RFCE-001, ARE NOW IN USE FOR IU COMMAND SYSTEM CLOSED LOOP CHECKOUT. USE OF THESE CABLES DELETES THE REQUIREMENT FOR JUMPER.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464
RESOLUTION: CLOSED
DATE: 10/4/68
REFERENCES: KSC 50-DAY REPORT, P. 5-8, ITEM 5.14.3.1;
KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968.
REV: C

ANOMALY REPORT

NO. 2.3.28 TITLE: S-1B FUEL TANK TEMPERATURE MEASUREMENT FAILURE
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: VEHICLE MEASURING GROUND SUPPORT EQUIPMENT EVENT TIME: CDDT & T-1 HR.,
~~39 MINS.~~

DESCRIPTION: FUEL TANK NO. 3 TEMPERATURE MEASUREMENT (XC-179-F3) FLUCTUATED BETWEEN 2% and 10%, APPARENTLY DUE TO A FAULTY MEASURING AMPLIFIER WHICH WAS REPLACED. THE REPLACEMENT ALSO PRODUCED AN ERROR IN THE MEASUREMENT UNTIL 1 FT-OFF, BUT THE ERROR CORRECTED ITSELF AND VALID DATA WAS RECEIVED DURING FLIGHT.

IMPACT: NONE ON APOLLO 5, BUT ERRONEOUS FUEL TEMPERATURE READINGS COULD RESULT IN LOADING UNKNOWN FUEL QUANTITIES.

STATUS: PRIOR TO CDDT PROPELLANT MONITOR PROGRAM FUNCTIONS WILL BE SIMULATED TO ISOLATE AND CORRECT ANY FAULTS IN AFFECTED TEMPERATURE SENSOR CIRCUITRY.

ACTION. NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION. CLOSED DATE: 10/4/58
REFERENCES: KSC 60-DAY REPORT, P. 5-6, ITEM 5.9.2.1 REV: C

ANOMALY REPORT

NO. 2.3.29 TITLE: DAMAGE TO HIGH PRESSURE GAS FACILITY MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: LAUNCH
SUBSYSTEM: HIGH PRESSURE GAS FACILITY

DESCRIPTION: ROOF OVER THE HIGH PRESSURE GAS STORAGE FACILITY WAS PEELED BACK APPROXIMATELY FIVE FEET DUE TO LAUNCH BLAST EFFECTS. THE DAMAGED ROOF RESULTED IN INTEGRITY SEALS ON FUEL PIT LINES BEING BURNED OFF, ONE PANEL IN THE OXIDIZER PIT WAS BENT, AND INSULATION WAS BURNED ON CHILLED HELIUM LINE NO. 9.

IMPACT: NONE ON APOLLO 5.

STATUS: ROOF HAS BEEN REPAIRED AS A NORMAL POST-LAUNCH REFURBISHMENT ITEM.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-1, ITEM 5.16.3 REV: C
MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 26, 1968

ANOMALY REPORT

NO. 2.3.30 TITLE: NITROGEN SUPPLY SYSTEM PRESSURE LOW

SYSTEM: KSC-GSE MISSION: APOLLO 5

SUBSYSTEM: 3,500 PSIG NITROGEN SUPPLY EVENT TIME: CDDT T-19:28:08

DESCRIPTION: THE 3,500 PSIG NITROGEN SUPPLY SYSTEM FAILED TO SUPPLY THE REQUIRED 3,000 PSIG MINIMUM PRESSURE FOR THE WATER CONSOLE DUE TO HIGH DEMAND ON THE N₂ SYSTEM BY THE SERVICE TOWER PURGE SYSTEM. NITROGEN SUPPLY SYSTEM REGULATOR OUTLET PRESSURE WAS INCREASED TO COMPLETE THE LAUNCH.

IMPACT: NONE ON APOLLO 5.

STATUS: RESPONSIBLE GROUP AT KSC IS RE-ASSESSING NITROGEN SUPPLY SYSTEM USER REQUIREMENTS TO DETERMINE IF SUPPLY LINE RE-DESIGN IS REQUIRED.

ACTION: ESTABLISH NITROGEN SUPPLY SPECIFICATIONS WHICH WILL MEET THE REQUIREMENTS, INCLUDING THE SERVICE TOWER PURGE SYSTEM, AND INSURE THE ADEQUACY OF THE SOURCE PRIOR TO APOLLO 7.

ORGANIZATION: 5-2464 RESOLUTION: OPEN DATE: 10/4/68

REFERENCES: KSC 60-DAY REPORT, P. 5-10, ITEM 5.16.4.1; REV: C
KSC APOLLO 5 F&A REPORT, JULY 19, 1968.

ANOMALY REPORT

NO. 2.3.31 TITLE: HELIUM COMPRESSOR DISCHARGE VALVES MALFUNCTION
SYSTEM: KSC -GSE MISSION: APOLLO 5
SUBSYSTEM: HIGH PRESSURE HELIUM EVENT TIME: CDDT AND LAUNCH

DESCRIPTION: COMPRESSOR DISCHARGE VALVE DISCS IN THIRD AND FOURTH STAGES OF FOUR HELIUM COMPRESSORS FAILED AND REQUIRED REPLACEMENT 14 TIMES DURING CDDT AND LAUNCH.

IMPACT: NONE ON APOLLO 5, BUT LACK OF HELIUM COMPRESSOR CAPABILITY COULD HAVE CAUSED LAUNCH DELAY.

STATUS: KSC HAS ENGAGED A VENDOR TO STUDY THE PROBLEM. TESTS WILL BE PERFORMED TO SHOW THE THE COMPARATIVE MERITS AND RELIABILITY OF TWO DISCHARGE VALVES AVAILABLE FOR USE IN THIS TYPE OF COMPRESSOR.

ACTION: ENSURE THAT MORE RELIABLE COMPRESSOR DISCHARGE VALVE DISCS ARE PROVIDED FOR FUTURE MISSIONS.

ORGANIZATION: 5-2464 RESOLUTION: OPEN DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-10, ITEM 5.16.4.2; REV: C
KSC APOLLO 5 F&A STATUS REPORT, JULY 19, 1968

ANOMALY REPORT

NO. 2.3.32	TITLE: LIQUID NITROGEN RELIEF VALVE FAILURE	MISSION: APOLLO 5
SYSTEM: KSC-GSE		
SUBSYSTEM: LIQUID NITROGEN		EVENT TIME: PRIOR TO CDDT
DESCRIPTION:	FAILURES OCCURRED WHEN TWO RELIEF VALVES IN THE LIQUID NITROGEN SYSTEM OPENED AND FAILED TO RESEAT; BELIEVED TO BE DUE TO RELIEF VALVE COLD SOAKING.	
IMPACT:	NONE ON APOLLO 5	
STATUS:	ECP 52022-1E, WHICH PROVIDES FOR LONGER STANDOFF LINES TO PREVENT COLD SOAKING OF THE RELIEF VALVES, HAS BEEN APPROVED BY THE CCB.	
ACTION:	NONE REQUIRED WITH IMPLEMENTATION OF ECP.	
ORGANIZATION:	5-2464	RESOLUTION: CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-10, ITEM 5.16.4.3; KSC APOLLO 5 F&A STATUS REPORT, JULY 19, 1968 AND AUGUST 5, 1968.	
		DATE: 10/4/68 REV: C

ANOMALY REPORT

NO. 2.3.33

TITLE: POWER SUPPLY REGULATOR FAILURE

SYSTEM: MSFC-GSE

MISSION: APOLLO 5

SUBSYSTEM: S-IB GROUND COMPUTER EQUIPMENT

EVENT TIME: T-50 MINS. (CDDT)

DESCRIPTION: THE -26V REGULATOR IN POWER SUPPLY (P/N 2133930) FAILED AND WAS REPLACED WITH A SPARE WHICH ALSO FAILED. A REGULATOR WAS REMOVED FROM THE LC-34 AGCS COMPUTER AND INSTALLED FOR USE DURING THE REMAINING CDDT AND LAUNCH.

IMPACT: NONE ON APOLLO 5. COULD CAUSE LAUNCH DELAY OF FUTURE MISSIONS.

STATUS: AN ECP (REA-292) HAS BEEN APPROVED BY THE CCB TO REDESIGN THE SILICON CONTROLLED RECTIFIER DRIVE CIRCUIT WITHIN THE POWER SUPPLY. THE MODIFIED CIRCUITRY IS TO BE INSTALLED BY THE END OF JULY, 1968.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464

RESOLUTION: CLOSED

DATE: 10/4/68

REFERENCES: KSC 60-DAY REPORT, P. 5-21, ITEM 5.30.8.3.1

REV: C

MAT-1/C. F. PILGER APOLLO 5 FILE, JULY 10, 1968

ANOMALY REPORT

NO. 2.3.34 TITLE: FAN BELT FAILURE MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: T-5 HRS., 19MINS.
SUBSYSTEM: NITROGEN VAPORIZER

DESCRIPTION: A FAN BELT FAILED ON NITROGEN VAPORIZER UNIT B75M25540-1, CAUSING THE UNIT TO BE SHUT DOWN 54 MINUTES FOR REPLACEMENT OF THE BELT. AN ALTERNATE UNIT USED DURING THE SHUTDOWN ALLOWED THE OUTLET GAS TEMPERATURE TO DROP TO -89°F.

IMPACT: NONE ON APOLLO 5.

STATUS: THE FAN BELT WAS FAULTY AND APPARENTLY NOT DETECTED DURING PRE-LAUNCH INSPECTION. THE BELT HAS BEEN REPLACED.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-10, ITEM 5.16.4.4 REV: C
KSC APOLLO 5 F&A STATUS REPORT, JULY 19, 1968

ANOMALY REPORT

NO. 2.3.35 TITLE: HYDRAULIC CYLINDER LEAKAGE
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: SERVICE STRUCTURE EVENT TIME: T-6 HOURS

DESCRIPTION: TWO ANCHOR PINS OPERATING HYDRAULIC CYLINDERS (P/N H84SB432) DEVELOPED LEAKS AT THE LOWER CYLINDER HEAD DURING SERVICE STRUCTURE REMOVAL. LEAKAGE DID NOT PREVENT PROPER RETRACTION OF ANCHOR PINS.

IMPACT: NONE ON APOLLO 5.

STATUS: NO. 1 CYLINDER HAS BEEN REPLACED WITH A SPARE UNIT AND THE NO. 2 UNIT IS SCHEDULED FOR REPLACEMENT ON THE MAINTENANCE PROGRAM.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-11, ITEM 5.17.3.1 REV: C

ANOMALY REPORT

NO. 2.3.36

TITLE:

SILO GATE - JACK SCREW PIN FAILURE

SYSTEM:

KSC-GSE

MISSION: APOLLO 5

SUBSYSTEM:

SILO GATE C-1

EVENT TIME: END OF CDDT

DESCRIPTION:

WHEN THE SILO GATE LOCKS OF THE FLAME DEFLECTOR SERVICE STRUCTURE WERE RUN OPEN DURING THE GATE-CLOSING OPERATIONS FOLLOWING CDDT, THE PIN CONNECTING THE JACK SCREW WITH THE JACK SCREW ADAPTER SHEARED ON BOTH THE TOP AND BOTTOM LOCK ASSEMBLIES WHEN THEY STRUCK THE END STOPS. THIS PREVENTED THE LOCKS FROM ENGAGING THE STRIKE PINS. THE SILO GATE WAS LOCKED IN THE OPEN POSITION USING THE REDUNDANT TURNBUCKLE SYSTEM.

IMPACT:

NONE ON APOLLO 5.

STATUS:

NEW PINS WITH HIGHER SHEAR RESISTANCE WERE INSTALLED ON THE MAINTENANCE PROGRAM.

ACTION:

NO FURTHER ACTION REQUIRED.

ORGANIZATION:

5-2464

RESOLUTION: CLOSED

REFERENCES:

KSC 60-DAY REPORT. P. 5-11, ITEM 5.17.3.2

DATE: 10/4/68

REV: C

ANOMALY REPORT

NO. 2.3.37 TITLE: 200 KW DIESEL GENERATOR LOAD LOSS MISSION: APOLLO 5
SYSTEM: KSC-GSE EVENT TIME: UNKNOWN
SUBSYSTEM: ELECTRICAL DISTRIBUTION, CIF BLDG.

DESCRIPTION: THE CIF BUILDING 200 KW DIESEL GENERATOR DROPPED LOAD WHEN ATTEMPTS WERE MADE TO PARALLEL GENERATORS ONE AND TWO AFTER COMPLETING PREVENTIVE MAINTENANCE ON GENERATOR ONE.

IMPACT: NONE ON APOLLO 5.

STATUS: A THIRD GENERATOR HAS BEEN INSTALLED TO ALLOW MAINTENANCE AND SWITCHING DURING OPERATION.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-12, ITEM 5.18.3.1 REV: C

ANOMALY REPORT

NO. 2.3.38 TITLE: ACE GENERATOR NO. 2 OUTAGE MISSION: APOLLO 5
SYSTEM: KSC-GSE
SUBSYSTEM: ELECTRICAL DISTRIBUTION, AUTOMATIC CHECKOUT EQUIPMENT (ACE) EVENT TIME: CDDT
DESCRIPTION: AN OUTAGE OCCURRED ON ACE GENERATOR NO. 2 WHILE GENERATOR NO. 3 WAS OUT FOR PREVENTIVE MAINTENANCE.

IMPACT: NONE ON APOLLO 5.

STATUS: AN ADDITIONAL GENERATOR HAS BEEN INSTALLED AND CERTIFIED TO ALLOW REMOVAL OF ANY ONE UNIT FOR MAINTENANCE WITHOUT AFFECTING SUPPORT.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/58
REFERENCES: KSC 60-DAY REPORT, PAGE 5-12, ITEM 5.18.3.2 REV: C

ANOMALY REPORT

NO. 2.3.39 TITLE: ACE GENERATOR SHORT TO GROUND
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: ELECTRICAL DISTRIBUTION SYSTEM, AUTOMATIC CHECKOUT SYSTEM (ACE) EVENT TIME: CDDT

DESCRIPTION: GENERATOR NO. 3 DEVELOPED A SHORT TO GROUND DUE TO WELDER INSULATION FAILURE WITHIN THE GENERATOR TERMINAL BOX.

IMPACT: NONE ON APOLLO 5.

STATUS: ALL TERMINAL CONNECTIONS ON GENERATOR NO. 3 WERE RE-MADE AND ALL CONNECTIONS WERE INSPECTED ON GENERATORS NO. 1 AND NO. 2. THE J-BOX COVERS WERE ALSO INSPECTED.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-21, ITEM 5.18.3.3 REV: C

ANOMALY REPORT

NO. 2.3.40

TITLE: TRIPPED SUBSTATION CIRCUIT BREAKER

SYSTEM: KSC-GSE

MISSION: APOLLO 5

SUBSYSTEM: ELECTRICAL DISTRIBUTION

EVENT TIME: T-0

DESCRIPTION: A CIRCUIT BREAKER IN SUBSTATION 1-6 TRIPPED, CAUSING LOSS OF AUTOMATIC GROUND CONTROL STATION (AGCS) AIR-CONDITIONING.

IMPACT: NONE ON APOLLO 5.

STATUS: A NEW TRIP UNIT HAS BEEN INSTALLED

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464

RESOLUTION: CLOSED

DATE: 10/4/68

REFERENCES: KSC 60-DAY REPORT, P. 5-12, ITEM 5.19.3.1

REV: C

KSC APOLLO 5 F&A REPORT, MAY 10, 1968

ANOMALY REPORT

NO. 2.3.41 TITLE: COLOR CAMERA POWER SUPPLY FAILURE
SYSTEM: KSC-GSE MISSION: APOLLO 5
SUBSYSTEM: OPERATIONAL TV EVENT TIME: PRE-TEST CHECKOU

DESCRIPTION: DURING PRE-TEST CHECKOUT OF THE COLOR CAMERA, THE COLOR ENCODER POWER SUPPLY FAILED DUE TO A BENT CONTACT SPRING ON A MOMENTARY SWITCH. TEMPORARY REPAIRS WERE MADE WITH NON-STANDARD COMPONENTS.

IMPACT: NONE ON APOLLO 5

STATUS: THE POWER SUPPLY HAS BEEN REPAIRED AND RETURNED TO SERVICE.

ACTION: NO FURTHER ACTION REQUIRED.

ORGANIZATION: 5-2464 RESOLUTION: CLOSED DATE: 10/4/68
REFERENCES: KSC 60-DAY REPORT, P. 5-15, ITEM 5.25.3.1 REV: C
 KSC APOLLO 5 F&A STATUS REPORT, MAY 10, 1968

ANOMALY REPORT

NO.	2.3.42	TITLE:	DECREASE IN HELIUM SUPPLY PRESSURE
SYSTEM:	MSFC-GSE	MISSION:	APOLLO 5
SUBSYSTEM:	HELIUM SUPPLY	EVENT TIME:	T-2 MINUTES
DESCRIPTION:	THE 6,000 PSIG HELIUM SUPPLY PRESSURE DECREASED 1,400 PSIG DURING A 45-SECOND PERIOD OF GREATEST HELIUM DEMAND.		
IMPACT:	NONE ON APOLLO 5. REGULATED SUPPLY PRESSURE DID NOT DROP BELOW THE REQUIRED 3,100 ± 100 PSIG.		
STATUS:	THE PROBLEM IS STILL BEING STUDIED BY MSFC FOR AS-206, AS-504 AND SUBSEQUENT VEHICLES. NOT MANDATORY FOR AS-205.		
ACTION:	CLOSED FOR AS-205, TRACK FOR AS-206, AS-504 AND SUBSEQUENT VEHICLES.		
ORGANIZATION:	5-2464	RESOLUTION:	CLOSED
REFERENCES:	KSC 60-DAY REPORT, P. 5-19, ITEM 5.30.2.4.2 MAT-1/C. F. PILGER APOLLO 5 FILE, AUGUST 2, 1968.		
		DATE:	10/4/68
		REV:	C

3.0 REFERENCES

1. Apollo 5 "Quick Look" Operational Report.
2. MSC 3-Day Report for Apollo 5 Mission, January 25, 1968.
3. KSC Apollo 5 (AS-204/LM-1) Quick Look Assessment Report, January 26, 1968.
4. MSFC 3-Day Report for Apollo 5 Mission, January 26, 1968.
5. MSFC AS-204 Flight Results/10-Day Report, February 1, 1968.
6. MSC-PA-R-68-4A, Apollo 5 Mission 10-Day Report, February 1, 1968.
7. MSFC Failure and Anomalies Listing Reports, Apollo Saturn 204/LM-1 Mission, February 21 and March 7, 1968.
8. MSC-PT-R-68-12, Apollo 5 Mission Anomaly and Failure Listing Report, February 21, 1968.
9. KSC Significant Failure and Anomalies Listing (30 Day) Report, SA-204/LM-1, February 26, 1968.
10. MSC-PA-R-68-7, Apollo 5 Mission Report, March 27, 1968 (60 Day).
11. MSFC-SAT-FE-68-2, Results of the Fourth Sat IB Launch Vehicle Test Flight, AS-204, April 5, 1968.
12. KSC Apollo/Saturn IB Ground Systems Evaluation Report March 22, 1968.
13. Apollo 5 Mission MSC Anomaly Report No. 1, "Erratic Freon Cooling During Countdown."

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14. Apollo 5 Mission MSC Anomaly Report No. 2, "Premature Shutdown of First Descent Engine Burn."
15. Apollo 5 Mission MSC Anomaly Report No. 4, "Excessive Control Engine Propellant Usage."
16. Apollo 5 Mission MSC Anomaly Report No. 5, "Abrupt Changes in Received UHF Signal Strength."
17. MSC Letter Report PT5/L-018, Status of Apollo 5 Flight Anomalies Discussed in 30-Day Anomaly Summary and Final Mission Report.
18. Apollo 5 - Failures and Anomalies (F&A) Status Reports, May 10, June 10, June 26, and July 19, and August 5, 1968.
19. Apollo 5 File, MAT-1/Carl F. Pilger, July 10 and July 26, August 2, and August 13, 1968.
20. SPD-7-002, Apollo 5 Mission Requirements 204/LM-1 "B" Type Mission LM Development, Rev. 5, December 4, 1967.
21. SPD-8-R-014, Apollo 5 Detailed Test Objectives Assessment Report, May 24, 1968.
22. PT-ASR-1, Apollo Anomaly Status, August 6, 1968 (MSC).

REVISIONS

REV. SYM	DESCRIPTION	DATE	APPROVED
	Original Issue	2/1/68	<i>[Signature]</i>
	Revision A - Data Updated	2/15/68	<i>[Signature]</i>
	Revision B - Data Updated	3/12/68	<i>[Signature]</i>
	Revision C - Data Updated (Final)	10/4/68	<i>[Signature]</i>

CHANGE RECORD								
REV SYM.	SECT	PAGES			REV. SYM.	SECT.	PAGES	
		REVISED	ADDED	DELETED			REVISED	ADDED
	<u>REVISION A, FEBRUARY 15, 1968</u>							
	Data Updated							
	3		13a (13.1)					
	through		13b (13.2)					
	13		25a (25.1)					
	26							
	28							
	30							
	<u>REVISION B, MARCH 12, 1968</u>							
	Data Updated							
	2		2.1					
	6		13.3					
	through		through					
	30		13.6					
			25.2					
	<u>REVISION C, OCTOBER, 1968</u>							
	Complete document revision to reflect data obtained from MSFC, MSC and KSC final Flight evaluation and anomaly reports. Backup material has been added where required.							