INDEPENDENT ORBITER ASSESSMENT

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ANALYSIS OF THE MANNED MANEUVERING UNIT

21 NOVEMBER 1986

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MCDONNELL DOUGLAS ASTRONAUTICS COMPANY HOUSTON DIVISION

SPACE TRANSPORTATION SYSTEM ENGINEERING AND OPERATIONS SUPPORT

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INDEPENDENT ORBITER ASSESSMENT ANALYSIS OF THE MANNED MANEUVERING UNIT

21 November 1986

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Independent Orbiter Assessment Analysis of the Manned Maneuvering Unit

1.0 EXECUTIVE SUMMARY

The McDonnell Douglas Astronautics Company (MDAC) was selected in June 1986 to perform an Independent Orbiter Assessment (IOA) of the Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL). Direction was given by the STS Orbiter and GFE Projects Office to perform the hardware analysis using the instructions and ground rules defined in NSTS 22206, Instructions for Preparation of FMEA and CIL, 10 October 1986. The IOA approach features a top-down analysis of the hardware to determine failure modes, criticality, and potential critical items. To preserve independence, this analysis was accomplished without reliance upon the results contained within the NASA FMEA/CIL documentation. This report documents (Appendix C) the independent analysis results corresponding to the Manned Maneuvering Unit (MMU) hardware.

The MMU is a propulsive backpack, operated through separate hand controllers that input the pilot's translational and rotational maneuvering commands to the control electronics and then to the thrusters. Twenty-four thrusters on the unit provide the astronaut with six-degree-of-freedom maneuvering control capability. Dual electrical/power and propulsion systems have been designed into the MMU to optimize astronaut return to the Orbiter. Throughout the duration of its mission, the MMU performs propulsion, control, system maintenance and stowage and crewmember restraint/fit functions. MMU hardware employed to perform these functions comprise the following:

- o Propulsion Subsystem
- o Electrical/Power Subsystem
- o Support Structures and Mechanisms
- o Flight Support Station

The IOA analysis process utilized available MMU hardware drawings and schematics for defining hardware subsystems, assemblies, components, and hardware items. Final levels of detail were evaluated and analyzed for possible failure modes and effects. Criticality was assigned based upon the worst case severity of the effect for each identified failure mode.

Figure 1 presents a summary of the failure criticalities for each of the four major subdivisions of the MMU. A summary of the number of failure modes, by criticality, is also presented below with Hardware (HW) criticality first and Functional (F) criticality second.

Summary of	IOA F	ailure	Modes	By Cri	lticali	ty (HW	N/F)
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
Number :	5	37	25	3	25	41	136

For each failure mode identified, the criticality and redundancy screens were examined to identify Potential Critical Items (PCIs). A summary of PCIs is presented as follows:

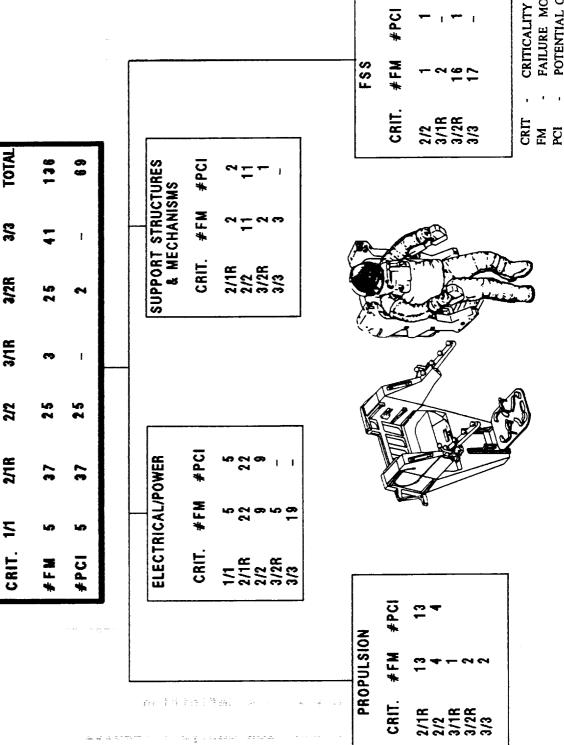
Summary	y of :	IOA Pot	ential	Crit	ical It	ems (HW/F)
Critical	ity:	1/1	2/1R	2/2	3/1R	3/2R	TOTAL
Number	:	5	37	25	-	2	69

In summary, the IOA analysis of the MMU has found that the majority of the PCIs identified are resultant from the loss of either the propulsion or control functions, or are resultant from inability to perform an immediate or future mission. The five most severe criticalities identified are all resultant from failures imposed on the MMU hand controllers which have no redundancy within the MMU.

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FAILURE MODE POTENTIAL CRITICAL ITEM



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ANALYSIS SUMMARY

Figure 1 - MMU OVERVIEW ANALYSIS SUMMARY

2.0 INTRODUCTION

2.1 Purpose

The 51-L Challenger accident prompted the NASA to readdress safety policies, concepts, and rationale being used in the National Space Transportation System (NSTS). The NSTS Office has undertaken the task of reevaluating the FMEA/CIL for the Space Shuttle design. The MDAC is providing an independent assessment of the Orbiter and Government Furnished Equipment (GFE) FMEA/CIL for completeness and technical accuracy.

2.2 Scope

The scope of the independent FMEA/CIL assessment activity encompasses those Shuttle Orbiter subsystems and GFE hardware identified in the Space Shuttle Independent FMEA/CIL Assessment Contractor Statement of Work. Each subsystem analysis addresses hardware, functions, internal and external interfaces, and operational requirements for all mission phases.

2.3 Analysis Approach

The independent analysis approach is a top-down analysis utilizing as-built drawings to breakdown the respective subsystem into components and low-level hardware items. Each hardware item is evaluated for failure mode, effects, and criticality. These data are documented in the respective subsystem analysis report, and are used to assess the NASA and Prime Contractor FMEA/CIL reevaluation results. The IOA analysis approach is summarized in the following Steps 1.0 through 3.0. Step 4.0 summarizes the assessment of the NASA and Prime Contractor FMEA/CILs that is performed and documented at a later date.

Step 1.0 Subsystem familiarization

- 1.1 Define subsystem functions
- 1.2 Define subsystem components
- 1.3 Define subsystem specific ground rules and assumptions

Step 2.0 Define subsystem analysis diagram

- 2.1 Define subsystem
- 2.2 Define major assemblies
- 2.3 Develop detailed subsystem representations

Step 3.0 Failure events definition

- 3.1 Construct matrix of failure modes
- 3.2 Document IOA analysis results

Step 4.0 Compare IOA analysis data to NASA FMEA/CIL

- 4.1 Resolve differences
- 4.2 Review in-house
- 4.3 Document assessment issues
- 4.4 Forward findings to Project Manager

2.4 MMU Ground Rules and Assumptions

Due to the unique functions performed by the MMU, the IOA project determined it necessary to establish groundrules and assumptions applicable solely to the MMU (reference Appendix B). These ground rules and assumptions, in addition to those established project wide (also provided in Appendix B), are intended to both complement and supplement those defined in <u>NSTS 22206</u>. Additional, they ensure that the IOA MMU analysis is capable of being understood by personnel who did not directly participate in the analysis.

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3.0 SYSTEM DESCRIPTION

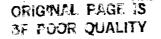
3.1 Design and Function

The MMU, reference Figure 2, is a modular, self-contained, propulsive backpack designed to attach to the Extravehicular Mobility Unit (EMU) and to be donned and doffed by one unassisted crewmember. When used, the MMU increases the Orbiter crew's Extravehicular Activcity (EVA) mobility by extending the range of their activities from the payload bay to other portions of the spacecraft, to appendages of payloads protruding from the cargo bay, or to other spacecraft entirely. When not in use, the MMU is stowed in the forward payload bay on the Flight Support Station (FSS), reference Figure 3. Two MMUs are typically flown on each Orbiter mission.

The IOA analysis has defined the MMU as being comprised of a propulsion subsystem, electrical/power subsystem, support structures and mechanisms, and the FSS. These subsystems and hardware can operate singly or in an integrated manner to perform four primary functions: propulsion, control, system maintenance and stowage, and crewmember restraint/fit.

- 1. Propulsion Subsystem Two independent, identical subsystems are each capable of providing the translational and rotational forces necessary for propulsion. Inert GN2 propellant is stored in two pressure vessels. Activation of a motor-driven isolation valve (open) allows GN2 to flow to a pressure regulator and then to the thruster manifolds which consist of four 3-thruster (triad) assemblies for each of the two subsystems. Based on hand-controller and gyro inputs, electrical power to the thruster solenoid valves result in expansion of the nitrogen gas through a nozzle to produce propulsion. The two systems are isolated but can be interconnected through hand-actuated toggle valves. Quick-disconnect valves provide GN2 recharge capability for the pressure vessels when the MMU is stowed in the FSS. Figure 4 is a schematic of the propulsion subsystem.
- 2. <u>Electrical/Power</u> Subsystem Encompasses the control electronics and the power storage and distribution within the MMU. Figure 5 presents an overview of this subsystem.

The maneuvering control comprises three main elements - two hand controllers and the Control Electronics Assembly (CEA). These operate together to provide signals to the propulsion system for rotational or translational motion. The Rotational Hand Controller (RHC) furnishes switching logic that converts rotary motions of the handle to rotational commands. The RHC also supplies control for the attitude hold function. The Translational Hand Controller (THC) provides switching logic that converts the motions of the handle in three axes to translational commands. The THC also controls the propellant isolation valve.



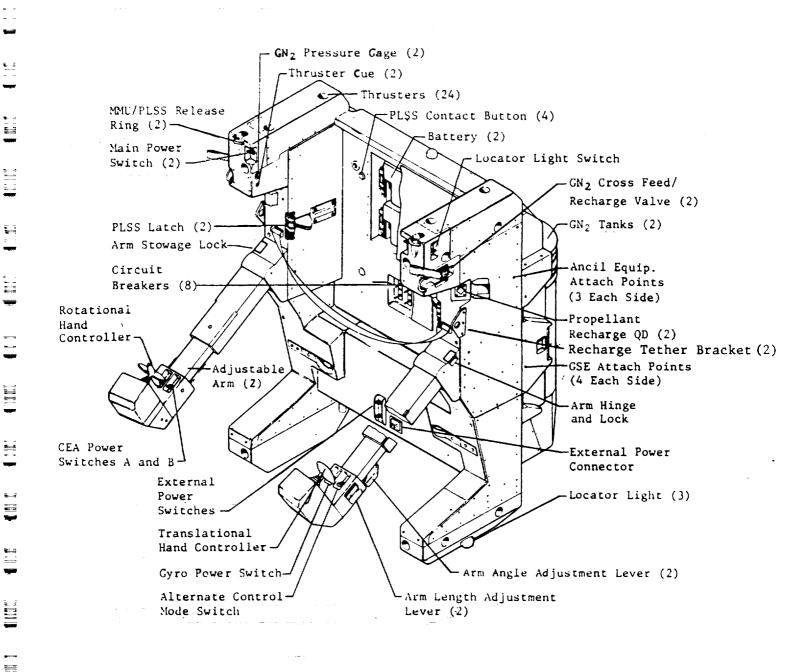


Figure 2 - MANNED MANEUVERING UNIT (MMU)

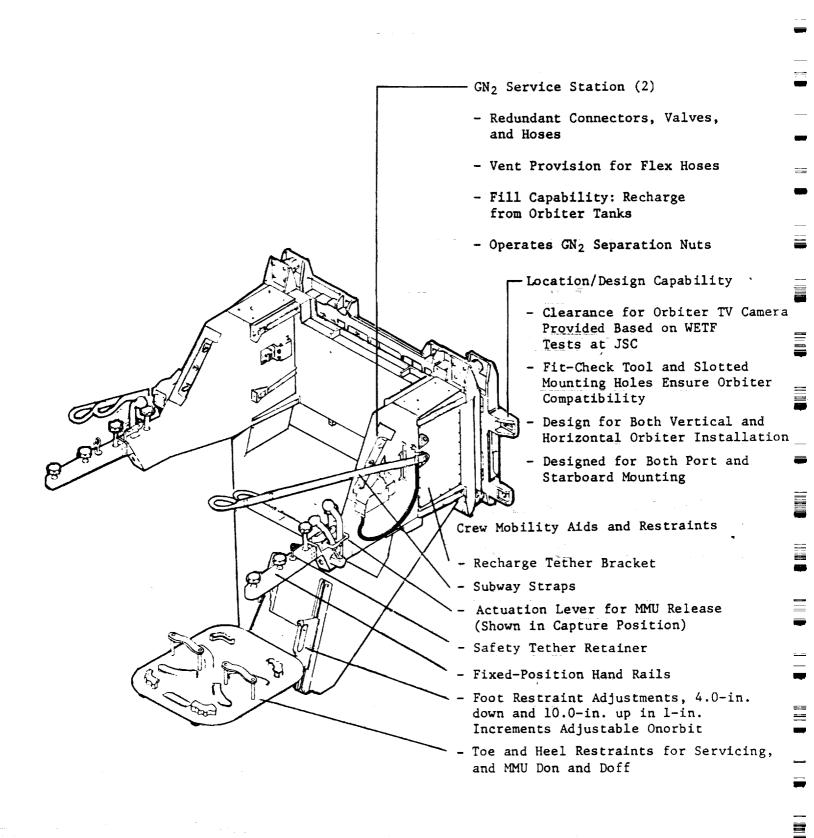
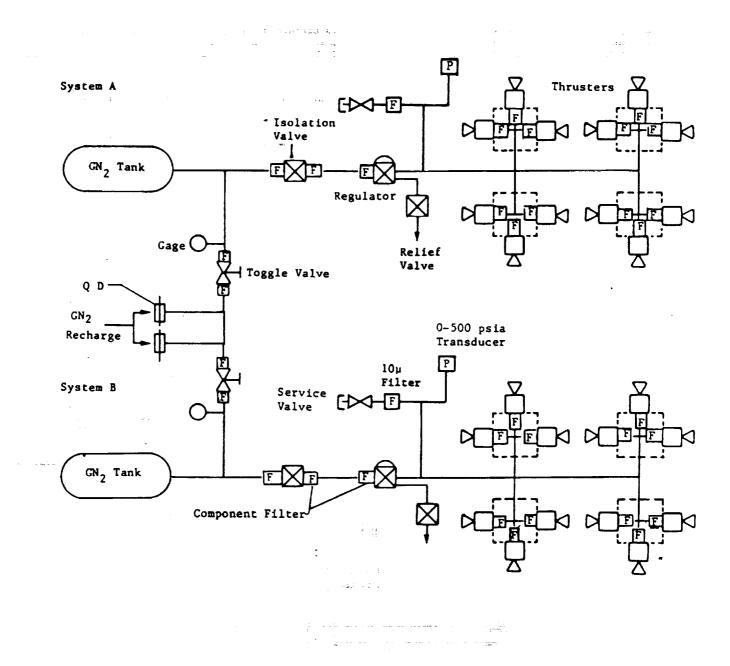


Figure 3 - FLIGHT SUPPORT STATION

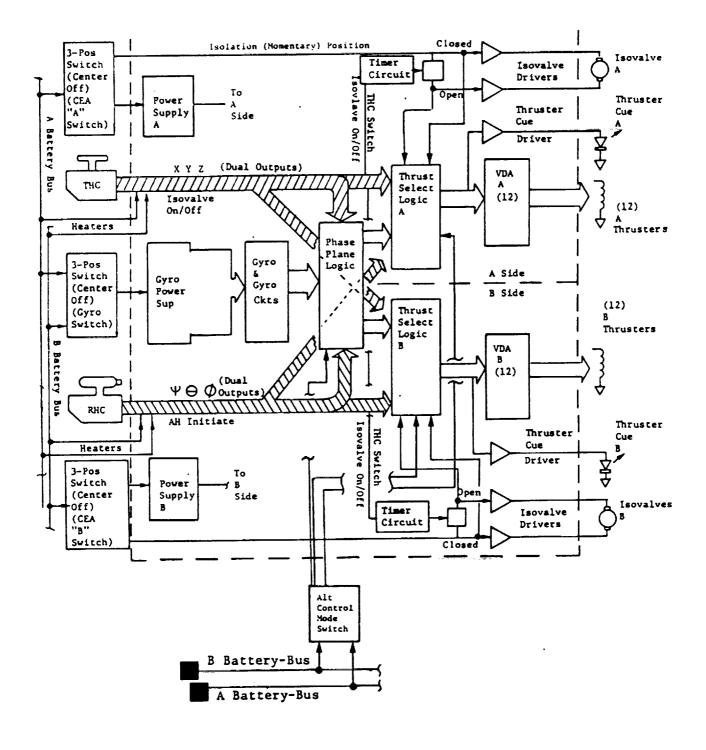


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 Figure 4 - PROPULSION SUBSYSTEM SCHEMATIC



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Figure 5 - ELECTRICAL/POWER SUBSYSTEM OVERVIEW

The CEA contains circuitry to operate the thruster valves of the propulsion system, and circuitry to respond to handcontroller commands for translational and rotational control. Gyro circuitry provides attitude and rate information. Phase-plane circuitry furnishes inputs for the thruster select logic for the automatic attitude hold mode of operation.

The thruster select logic uses either or both redundant thruster sets to convert manual and/or attitude hold commands to thrust commands. Valve drive amplifiers amplify the thruster valve signals to levels required for valve operation. Isolation valves, when open, allow GN2 to flow from the pressure vessels to the pressure regulators.

Thruster cue lights allow a visible indication of thruster commands and isolation valve operation.

The power comprises two silver-zinc batteries and two separate power distribution systems that include the circuit breakers, switches, and relays required for MMU operation. Power conditioners in the CEA, fed from the batteries, supply power to the CEA and hand controllers. Locator lights provide visible indication of the location of the EVA crewmember to an observing crewmember inside the Orbiter. The locator lights consist of a converter assembly and three light assemblies. The batteries also furnish heater power for the propulsion heaters and handcontroller case heaters. Heaters are required for both orbital storage and EVA operations. During EVA, skin temperatures can be as low as -120 degrees F, whereas most components must be above -60 degrees F for operation.

3. Support Structures and Mechanisms - The basic MMU structure consists of two side towers connected by the center structure and two arms. The towers support the thrusters and provide mounting for the MMU/FSS retention latches and the propulsion subsystem Quick Disconnects (QDs). The center structure supports the two batteries, eight circuit breakers, the CEA, two pressure vessels, and propulsion equipment. Also supported are the external power connector, and thermal cover, and the thermal covers for the batteries.

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In conjunction with the towers, the center structure supports the retention system for the EMU. This EMU/MMU retention system consists of two independent manually activated latches, guide ramps, and back-support points. The arms can be pivoted and extended for flight or located in the stowed position. 4. Flight Support Station (FSS) - The FSS, reference Figure 3, provides MMU stowage, GN2 pressure vessel recharge, and stowage heaters for the MMU on the port or starboard side of the Orbiter near the EVA airlock and hatch.

The FSS structure comprises the side arms, foot restraints, and the Orbiter mounting structure. A locking handle and butterfly latch are provided for flight docking, capture, and release of the MMU. The foot restraints are adjustable on orbit to accomodate the full range of astronaut anthropometry. Shock mounts (vibration isolators) are provided to attenuate the Orbiter launch environment. The MMU is secured in the FSS during launch with four capture bolts and Gas Actuated Nuts (GANs) installed in the MMU. On astronaut operation, the nuts will actuate and MMU bolts release, allowing FSS egress. For contingency operations, the nuts can be manually engaged or disengaged.

The pneumatic portion of the FSS consists of a dual Orbiter interface which routes GN2 to redundant charging systems, either one of which can recharge the MMU propulsion system. Each charging system contains a charging valve, vent valve, flex hose, and one-half of the QD. GN2 can also be supplied to the GANs used for MMU-to-FSS launch attachment. ___

FSS heaters are supplied 28-Vdc power from the Orbiter through two independent power buses. Breakers in the Orbiter cabin furnish circuit protection. Five temperature sensors are provided for crew temperature monitoring of the MMU during orbital storage.

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3.2 Interfaces and Locations

Interfaces occur between the MMU (including the FSS) and other Space Transportation System (STS) Orbiter elements in three specific areas. First, the MMU itself interfaces with the FSS. Second, structural, mechanical, electrical, and nitrogen recharge interfaces exist between the Orbiter and the FSS. Third, mechanical and man/machine interfaces exist between the crewmember in the EMU and the MMU.

When not in use the MMU is stowed in the front of the payload bay of the Orbiter on the FSS. Due to this location the MMU is continually exposed to the space environment when in orbit. The EMU to MMU interfaces are depicted in Figure 6. The MMU to FSS interfaces envelopes in the payload bay are depicted in Figures 7 and 8.

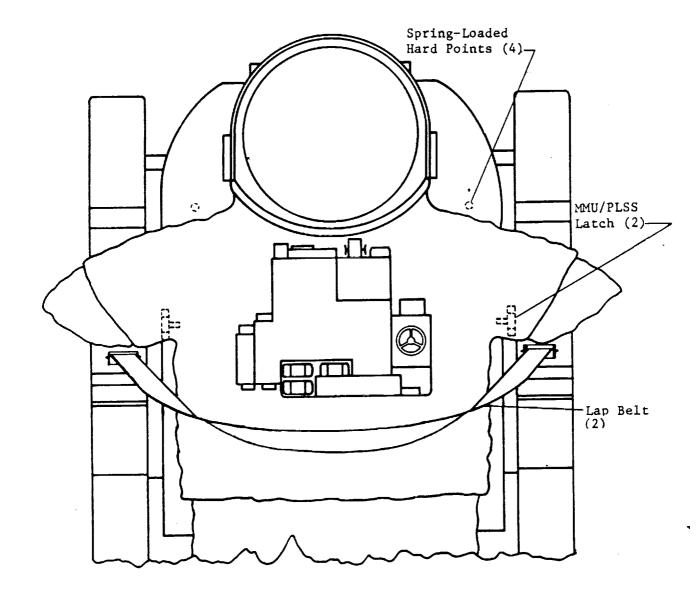
3.3 Hierarchy

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Figures 9 through 13 illustrate the hierarchal relationships between the MMU, subsystems, and components employed for the enclosed IOA analysis.



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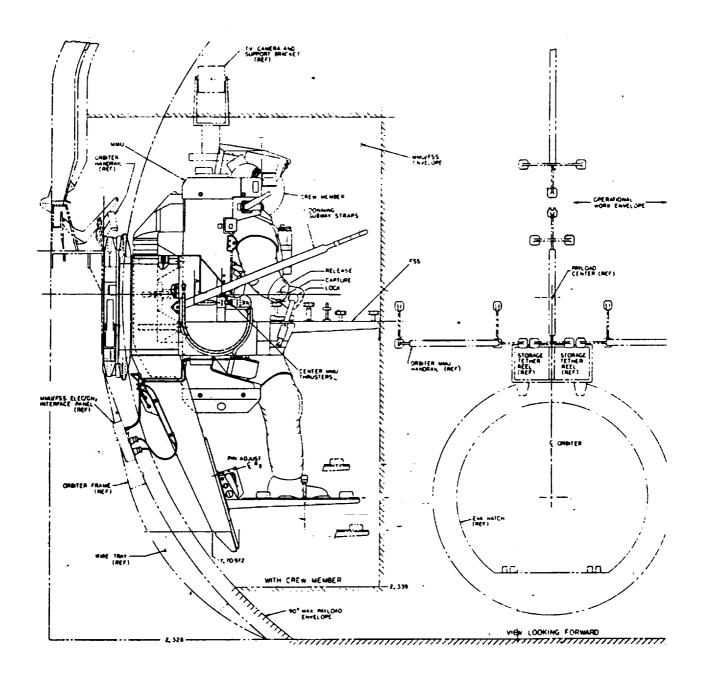
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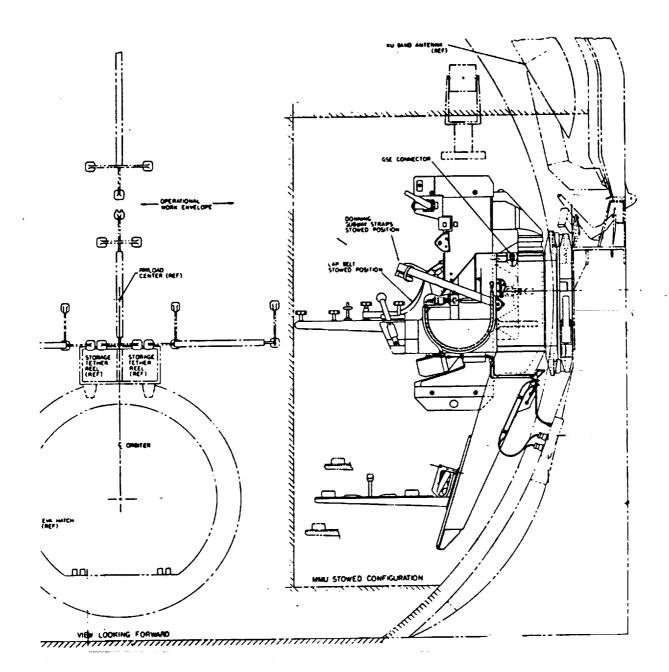
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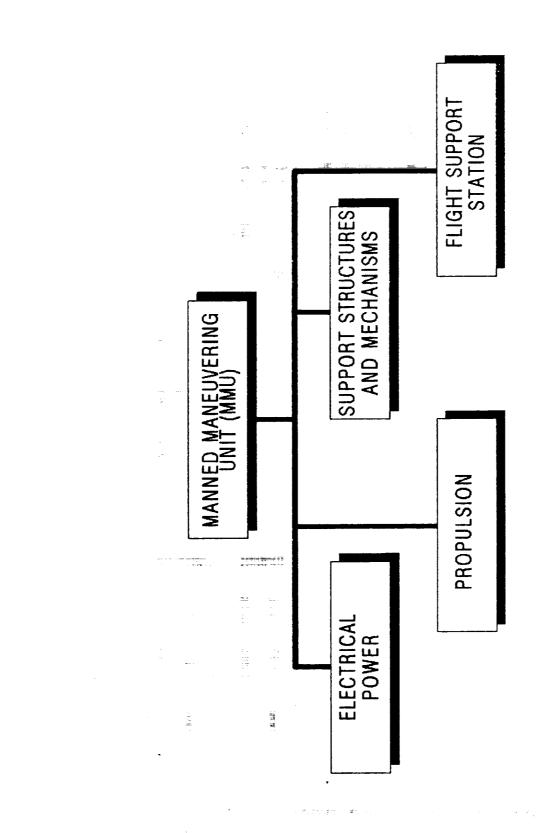
Figure 7 - MMU-FSS ENVELOPE - PORT SIDE



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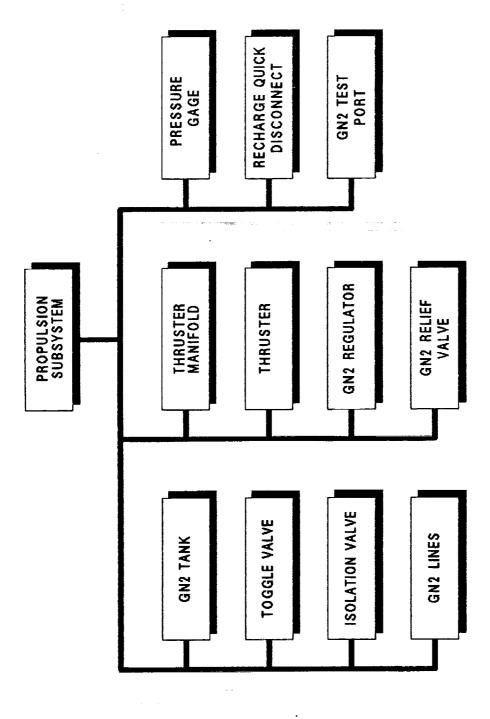
Figure 8 - MMU-FSS ENVELOPE - STARBOARD SIDE



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Figure 9 - MMU - TOP LEVEL HIERARCHY



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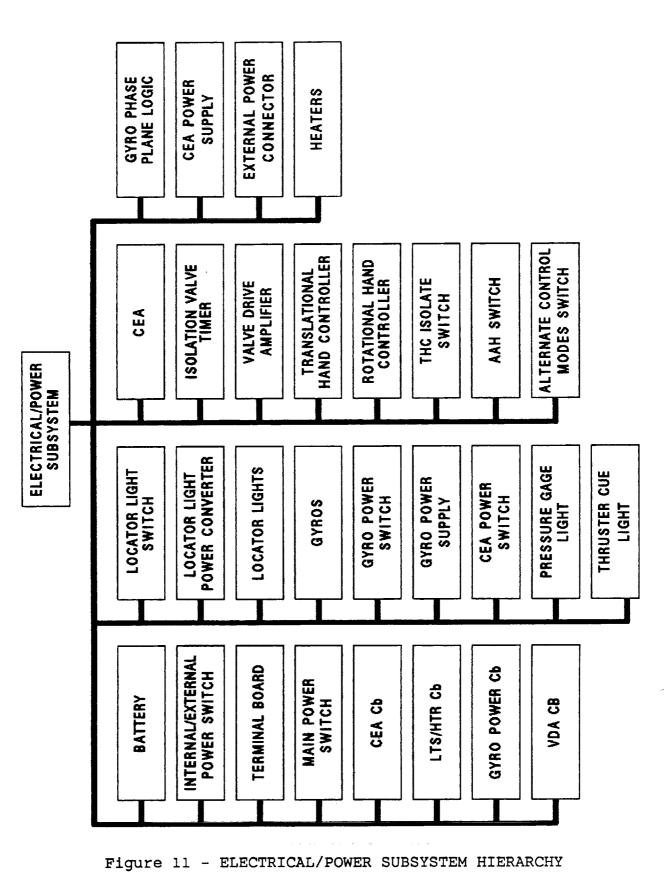
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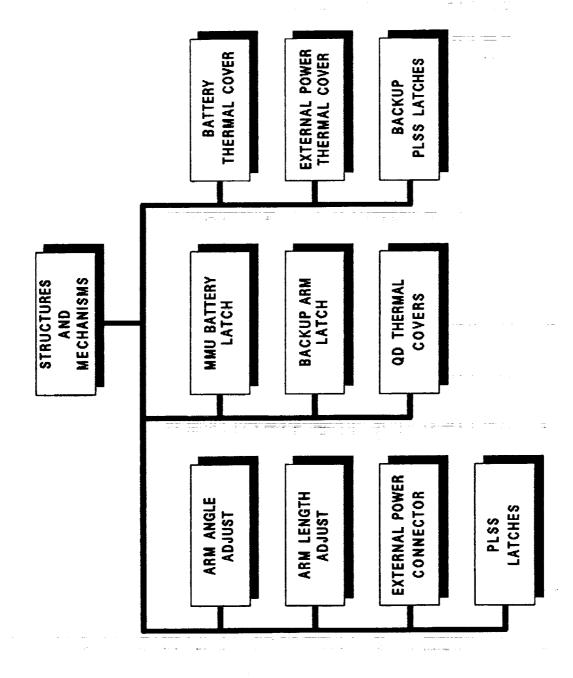
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Figure 10 - PROPULSION SUBSYSTEM HIERARCHY





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Figure 12 - HIERARCHY OF SUPPORT STRUCTURES AND MECHANISMS

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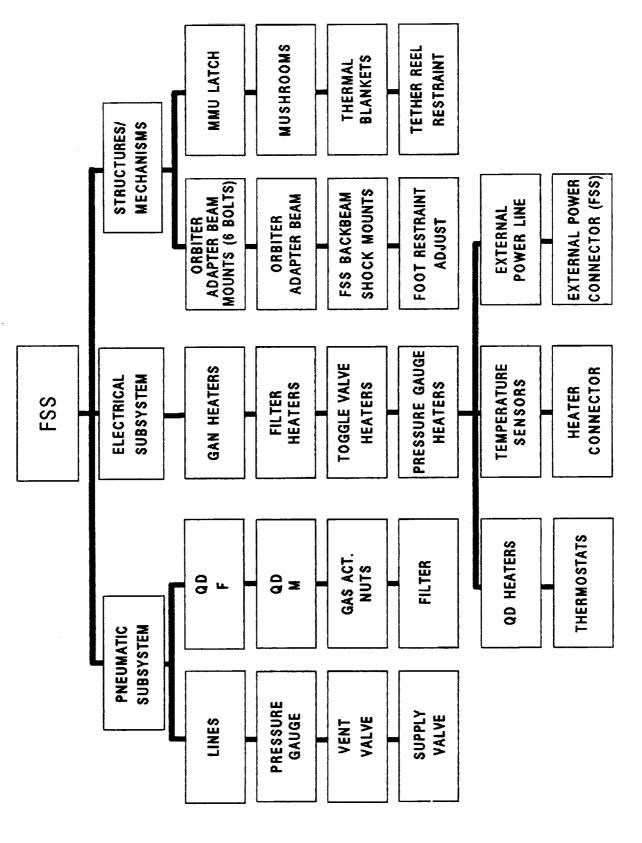


Figure 13 - FSS HIERARCHY

4.0 ANALYSIS RESULTS

The IOA analysis of the MMU resulted in the identification of 136 failure modes (reference Appendix C) from which 69 PCIs (reference Appendix D) were derived. The summary distributions of failure criticalities and their corresponding PCIs are provided in Tables I and II respectively.

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TABLE I Sur	nmary o	of IOA I	ailure	e Modes	and Cr	ltical	lties
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
Propulsion	-	13	4	1	2	2	22
Electrical/ Power	5	22	9	-	5	19	60
Support Structures & Mechanisms	-	2	11	-	2	3	18
FSS	-	-	1	2	16	17	36
TOTAL	5	37	25	3	25	41	136

TABLE II Sur	nmary 1	IOA of 1	Potent:	ial Crit	tical I	tems
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	TOTAL
Propulsion	-	13	4	-	-	17
Electrical/ Power	5	22	9	· · -	-	36
Support Structures & Mechanisms	-	2	11	-	1	14
FSS	-	-	1	-	1	2
TOTAL	 5	37	 25		2	69

More detailed discussions of the above findings are presented in the following paragraphs.

4.1 Analysis Results - Propulsion

The MMU propulsion subsystem analysis identified twenty-two (22) failure modes which could occur during a MMU mission. Of these twenty-two failure modes, seventeen (17) were considered PCIs and none were single point failures which could result in loss of life or vehicle. All seventeen single point failure PCIs resulted in mission impacts, and thirteen (13) of these could cause loss of life or vehicle if a redundant MMU propulsion or propulsion control function (typically by loss of a side) were lost.

4.2 Analysis Results - Electrical/Power

Five (5) electrical/power single point failures have been identified by the IOA; any one of which, if realized, can result in loss of crewperson by failure of MMU propulsion control capability.

An additional thirty-one (31) single point failure PCIs also exist as possible mission impacts. Within these PCIs are twentytwo (22) which, if analyzed in conjunction with redundant function failures (frequently loss of other side's propulsion or control functions), result in possible loss of the crewperson.

4.3 Analysis Results - Support Structures and Mechanisms

The hardware encompassed by support structures and mechanisms contains a total of eighteen (18) failure modes from which fourteen (14) PCIs have been identified. Thirteen (13) of these PCIs result in mission termination typically by failing the crewperson restraint/fit function or by failing either MMU mission preparation or consummables recharge. Additionally, two (2) of these PCIs can result in loss of crewperson when their redundant crewperson restraint function is failed. A remaining PCI (MDAC ID 197) also exists which will be both an EMU and MMU mission impact due to inability of the crewperson to release one of the four PLSS-to-MMU latches thereby requiring ingress into the Orbiter, via the airlock, with the MMU connected.

4.4 Analysis Results - FSS

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Due to extensive redundancy and support functions, the FSS contains only two PCIs. MDAC analysis ID 220 revealed a mission impact due to inability of the MMU to be removed from the FSS, whereas ID 222 identified potential mission impact due to contamination causing component malfunction when redundant filters are failed.

5.0 REFERENCES

Reference documentation available from NASA was used in the analysis. The documentation used included:

- 1. NSTS 22206, Instructions for Preparation of Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL), 10 October 1986
- 2. MMU-SE-17-73, Manned Maneuvering Unit, Space Shuttle Program, Operational Data Book, Volume I, Rev. B, July 1985
- 3. MMU-SE-17-73, Manned Maneuvering Unit, Space Shuttle Program, Operational Data Book, Volume II, October 1984
- 4. 852MM000019, Propulsion Flow Diagrams, Rev C, 15 April 1986

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5. 852CD0000825, Electrical Check Diagram FSS and MMU, 9 September 1986

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APPENDIX A ACRONYMS

	<u>н</u> –	Automatic Attitude Hold
	:B -	Circuit Breaker
CE	IA –	Control Electronics Assembly
	:L -	Critical Items List
EN	IU –	Extravehicular Mobility Unit
EV	'A –	Extravehicular Activity Functional
	F -	Functional
	:A –	Failure Modes and Effects Analysis
	гм –	Failure Mode
		Flight Support Station
GA	- M	
GI	ΥE –	
GN	12 -	Gaseous Nitrogen
F	w –	Hardware
		Hand Controller
H	JT –	Hard Upper Torso
тс	Δ –	Independent Orbiter Assessment
IN IN	/A -	Intravehicular Activity
JS	6C -	Johnson Space Center
	ED -	
	:s -	
	- DA	
	1U –	
NST	'S –	
	- I	
	В –	
		Portable Life-Support System
		fQuick Disconnect
	-	Rotational Hand Controller
Sat Sta	-	Satellite Stabilization
		Solar Maximum Mission
	_	Space Operations Simulator
		Space Transportation System
		Thermal Control System
	ĩC –	
TPA	ND -	
		Valve Drive Amplifier
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APPENDIX B

DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.1 DefinitionsB.2 Project Level Ground Rules and AssumptionsB.3 Subsystem-Specific Ground Rules and Assumptions

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APPENDIX B DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.1 Definitions

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Definitions contained in NSTS 22206, Instructions For Preparation of FMEA/CIL, 10 October 1986, were used with the following amplifications and additions.

INTACT ABORT DEFINITIONS:

<u>RTLS</u> - begins at transition to OPS 6 and ends at transition to OPS 9, post-flight

TAL - begins at declaration of the abort and ends at transition to OPS 9, post-flight

 \underline{AOA} - begins at declaration of the abort and ends at transition to OPS 9, post-flight

<u>ATO</u> - begins at declaration of the abort and ends at transition to OPS 9, post-flight

<u>CREDIBLE (CAUSE)</u> - an event that can be predicted or expected in anticipated operational environmental conditions. Excludes an event where multiple failures must first occur to result in environmental extremes

<u>CONTINGENCY</u> <u>CREW</u> <u>PROCEDURES</u> - procedures that are utilized beyond the standard malfunction procedures, pocket checklists, and cue cards

EARLY MISSION TERMINATION - termination of onorbit phase prior to planned end of mission

EFFECTS/RATIONALE - description of the case which generated the highest criticality

HIGHEST <u>CRITICALITY</u> - the highest functional criticality determined in the phase-by-phase analysis

<u>MAJOR</u> <u>MODE</u> (<u>MM</u>) - major sub-mode of software operational sequence (OPS)

<u>MC</u> - Memory Configuration of Primary Avionics Software System (PASS)

<u>MISSION</u> - assigned performance of a specific Orbiter flight with payload/objective accomplishments including orbit phasing and altitude (excludes secondary payloads such as GAS cans, middeck P/L, etc.) <u>MULTIPLE</u> ORDER FAILURE - describes the failure due to a single cause or event of all units which perform a necessary (critical) function

<u>OFF-NOMINAL CREW PROCEDURES</u> - procedures that are utilized beyond the standard malfunction procedures, pocket checklists, and cue cards

OPS - software operational sequence

PRIMARY MISSION OBJECTIVES - worst case primary mission objectives are equal to mission objectives

PHASE DEFINITIONS:

<u>PRELAUNCH</u> <u>PHASE</u> - begins at launch count-down Orbiter power-up and ends at moding to OPS Major Mode 102 (liftoff)

LIFTOFF MISSION PHASE - begins at SRB ignition (MM 102) and ends at transition out of OPS 1 (Synonymous with ASCENT)

ONORBIT PHASE - begins at transition to OPS 2 or OPS 8 and ends at transition out of OPS 2 or OPS 8

<u>DEORBIT</u> <u>PHASE</u> - begins at transition to OPS Major Mode 301 and ends at first main landing gear touchdown

LANDING/SAFING PHASE - begins at first main gear touchdown and ends with the completion of post-landing safing operations

APPENDIX B DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.2 IOA Project Level Ground Rules and Assumptions

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The philosophy embodied in <u>NSTS 22206</u>, <u>Instructions for</u> <u>Preparation of FMEA/CIL</u>, <u>10 October 1986</u>, was employed with the following amplifications and additions.

1. The operational flight software is an accurate implementation of the Flight System Software Requirements (FSSRs).

RATIONALE: Software verification is out-of-scope of this task.

2. After liftoff, any parameter which is monitored by system management (SM) or which drives any part of the Caution and Warning System (C&W) will support passage of Redundancy Screen B for its corresponding hardware item.

> RATIONALE: Analysis of on-board parameter availability and/or the actual monitoring by the crew is beyond the scope of this task.

3. Any data employed with flight software is assumed to be functional for the specific vehicle and specific mission being flown.

RATIONALE: Mission data verification is out-of-scope of this task.

4. All hardware (including firmware) is manufactured and assembled to the design specifications/drawings.

RATIONALE: Acceptance and verification testing is designed to detect and identify problems before the item is approved for use.

5. All Flight Data File crew procedures will be assumed performed as written, and will not include human error in their performance.

RATIONALE: Failures caused by human operational error are out-of-scope of this task.

- 6. All hardware analyses will, as a minimum, be performed at the level of analysis existent within NASA/Prime Contractor Orbiter FMEA/CILs, and will be permitted to go to greater hardware detail levels but not lesser.
 - RATIONALE: Comparison of IOA analysis results with other analyses requires that both analyses be performed to a comparable level of detail.
- 7. Verification that a telemetry parameter is actually monitored during AOS by ground-based personnel is not required.

RATIONALE: Analysis of mission-dependent telemetry availability and/or the actual monitoring of applicable data by ground-based personnel is beyond the scope of this task.

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8. The determination of criticalities per phase is based on the worst case effect of a failure for the phase being analyzed. The failure can occur in the phase being analyzed or in any previous phase, whichever produces the worst case effects for the phase of interest.

RATIONALE: Assigning phase criticalities ensures a thorough and complete analysis.

9. Analysis of wire harnesses, cables and electrical connectors to determine if FMEAs are warranted will not be performed nor FMEAs assessed.

RATIONALE: Analysis was substantially complete prior to NSTS 22206 ground rule redirection.

10. Analysis of welds or brazed joints that cannot be inspected will not be performed nor FMEAs assessed.

RATIONALE: Analysis was substantially complete prior to NSTS 22206 ground rule redirection.

11. Emergency system or hardware will include burst discs and will exclude the EMU Secondary Oxygen Pack (SOP), pressure relief valves and the landing gear pyrotechnics.

> RATIONALE: Clarify definition of emergency systems to ensure consistency throughout IOA project.

APPENDIX B DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.3 MMU Ground Rules and Assumptions

1. Loss of the MMU's automatic attitude hold capability will not be considered life or vehicle threatening, or a mission impact.

Rationale: To date no normal or contingency MMU operation has been identified or envisioned which would require the automatic attitude hold capability.

2. The availability of the Orbiter to perform a rescue of a stranded crewperson will not be considered in determining the criticality of the applicable failure mode.

Rationale: The IOA project believes such an exclusion is necessary to ensure worst case scenario analysis results in the most appropriate criticality.

- 3. For all analyses, it is assumed that the MMU may be required for planned or contingency operations anytime up to initiation of the Orbiter deorbit phase.
 - Rationale: The above assumption ensures that failures occuring subsequent to a MMU mission are analyzed for their effect on subsequent MMU missions.
- The following MMU flight phase definitions are applicable for the analyses provided in Appendix C:
 - Pre-Ops: The timeframe extending from installation in the Orbiter to removal of the MMU (onorbit) from the FSS
 - Ops: The on-orbit duration of time during which the MMU is manned and not stowed in the FSS
 - Post-Ops: Any timeframe subsequent to on-orbit stowage of the MMU and prior to Orbiter mission completion
- 5. Although two (2) MMUs are flown on each mission, criticality assignment is performed without consideration to the availability of the second MMU.

Rationale: The assignment of worst case criticality is ensured by this assumption.

APPENDIX C DETAILED ANALYSIS

This section contains the IOA analysis worksheets generated during the analysis of this subsystem. The information on these worksheets is intentionally similar to the NASA FMEAS. Each of these sheets identifies the hardware item being analyzed, and parent assembly, as well as the function. For each failure mode, the possible causes are outlined, and the assessed hardware and functional criticality for each mission phase is listed, as described in the NSTS 22206, Instructions for Preparation of FMEA and CIL, 10 October 1986. Finally, effects are entered at the bottom of each sheet, and the worst case criticality is entered at the top.

LEGEND FOR IOA ANALYSIS WORKSHEETS

Hardware Criticalities:

1 = Loss of life or vehicle

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- 2 = Loss of mission or next failure of any redundant item
 - (like or unlike) could cause loss of life/vehicle
- 3 = All others

Functional Criticalities:

1R = Redundant hardware items (like or unlike) all of which, if failed, could cause loss of life or vehicle.

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2R = Redundant hardware items (like or unlike) all of which, if failed, could cause loss of mission.

Redundancy Screen A:

- 1 = Is Checked Out PreFlight
- 2 = Is Capable of Check Out PreFlight

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- 3 = Not Capable of Check Out PreFlight
- NA = Not Applicable

Redundancy Screens B and C:

- P = Passed Screen
- F = Failed Screen
- NA = Not Applicable

DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY	HDW/FUNC
MDAC ID: 100	FLIGHT:	2/1R
ITEM: GN2 TANK FAILURE MODE: LEAK	a second seco	· 1949 - 1
LEAD ANALYST: P. BAILEY S	UBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)		
CRI	TICALITIES	
PRE-OPS OPS: POST-OP	IASE HDW/FUNC 5: 3/3 2/1R PS: 3/3	
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:		
CAUSES: IMPACT, OVERWRAP SEPAR		
EFFECTS/RATIONALE:	OSS OF SIDE DRODULSIVE	

LOSS OF PROPELLANT LEADING TO LOSS OF SIDE, PROPULSIVE CAPABILITY. LOSS OF SECOND SIDE STRANDS CREWMEMBER IN FREE SPACE. POSSIBLE PROPULSIVE VENT LEADING TO LOSS OF CONTROL.

REFERENCES:

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REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 102	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 3/2R
ITEM: TOGGLE VALVE FAILURE MODE: FAIL OPEN	
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CR	ITICALITIES
FLIGHT P PRE-OP OPS: POST-O	3/2R
REDUNDANCY SCREENS: A [2]	B[P] C[P]
LOCATION: SIDE A OR B	

PART NUMBER:

CAUSES: CONTAMINATION SEAT FAILURE/WEAR

EFFECTS/RATIONALE:

FAILED OPEN VALVE CAUSES LOSS OF TOTAL REDUNDANCY, BUT NOT OF NOMINAL OPERATIONAL OR MALFUNCTION REDUNDANCY. LOSS OF BOTH VALVES DOES CAUSE LOSS OF PROPULSION SYSTEM REDUNDANCY AND REQUIRES MISSION TERMINATION.

REFERENCES:

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REPORT DATE 11/22/86

DATE: 9/19/86	HIGHEST CRITICALITY HDW/FUNC		
SUBSYSTEM: MMU MDAC ID: 103	FLIGHT: 2/2		
ITEM: TOGGLE VALVE FAILURE MODE: FAIL CLOSED			
LEAD ANALYST: P. BAILEY SUBSY	'S LEAD: G. RAFFAELLI		
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITICA FLIGHT PHASE			
PRE-OPS: OPS:	3/3 3/3		
POST-OPS:	2/2		
REDUNDANCY SCREENS: A [2]	B[P] C[P]		
LOCATION: SIDE A OR B PART NUMBER:			
CAUSES: CONTAMINATION ON SEAT, INI	ET OR OUTLET FILTER BLOCKED		
EFFECTS/RATIONALE: FAILED CLOSED VALVE PREVENTS USE OF PROPELLANT OF FAILED SIDE IN GOOD SIDE, BUT NORMAL SYSTEM REDUNDANCY PRESENT. FAILURE PREVENTS RECHARGE SO POST EVA MISSION MAY BE JEOPORDIZED.			

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SUBSYSTEM: MMU MDAC ID: 104 FLIGHT: 2/2	2
ITEM: ISOLATION VALVE FAILURE MODE: FAIL OPEN	
LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICALITIES	
FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2	
OPS: 2/2 POST-OPS: 3/3	
REDUNDANCY SCREENS: A [2] B [F] C [P]	
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: MECHANICAL FAILURE, ELECTRICAL SHORT/OPEN	
EFFECTS/RATIONALE: IF DETECTED LOSS OF MISSION SINCE MMU MUST NOT BE FLOWN WITHOUT ISOLATE CAPABILITY.	
REFERENCES:	

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 105	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/1R		
ITEM: ISOLATION VALVE FAILURE MODE: FAIL CLOSE			
LEAD ANALYST: P. BAILEY SUBS	YS LEAD: G. RAFFAELLI		
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITIC FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	3/3		
REDUNDANCY SCREENS: A [2]	B[F] C[F]		
LOCATION: SIDE A OR B PART NUMBER:	- · ·		
CAUSES: MECHANICAL FAILURE, ELECT OUTLET FILTER BLOCKED.			
EFFECTS/RATIONALE: IF SUBSYSTEM A ISOLATION VALVE FAILS CLOSED, THE GAS TANK ON THAT SIDE IS SHUT OFF FROM THE THRUSTERS ON THAT SIDE. LOSS OF FUNCTION OF THAT SIDE RESULTS. LOSS OF PROPULSION SUBSYSTEM REDUNDANCY RESULTS, A MISSION RULE IS VIOLATED, LOSS OF MISSION RESULTS. LOSS OF OTHER SIDE CAN RESULT IN STRANDED CREWPERSON.			
REFERENCES:			

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 106	HIGHEST CRITICALITY FLIGHT:			
ITEM: GN2 LINES FAILURE MODE: LEAK				
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI			
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)				
CRITICA				
FLIGHT PHASE PRE-OPS:	HDW/FUNC 3/3			
PRE-OPS: OPS: POST-OPS:	2/1R 3/3			
REDUNDANCY SCREENS: A [2]	в[Р] С[Р]			
LOCATION: SIDE A OR B PART NUMBER:				
CAUSES: MATERIAL FAILURE AT SEALS AND/OR CONNECTORS				
EFFECTS/RATIONALE: IF LEAK IS LARGE, ISOLATION VALVE W ALL LEAKED OUT ALREADY. IN EITHER CORRESPONDING PROPULSION SUBSYSTEM PROPULSION SUBSYSTEM REDUNDANCY IS RULE	CASE, FUNCTION OF IS LOST AND THEREFORE LOST. THIS VIOLATES	A MISSION		

RESULTING IN MISSION TERMINATION. LOSS OF OTHER SIDE CAN RESULT IN POSSIBLE LOSS OF CREWPERSON BY STRANDING.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU			ALITY HDW/FUNC	
MDAC ID: 110		FLIG	HT: 2/1R	
ITEM: THRUST FAILURE MODE: LEAK	ER MANIFOLD			
LEAD ANALYST: P. BAIL	EY SUBSY	S LEAD: G. RAFF.	AELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSY	STEM	····.		
2) PROPULSION SUBSY 3) 4) 5) 6) 7) 8) 9)	STEM			
	CRITICA	דיתיניפ		
	FLIGHT PHASE			
	PRE-OPS:			
	OPS: POST-OPS:	3/3		
REDUNDANCY SCREENS:	A [2]	в[Р] С	[P]	
LOCATION: SIDE A PART NUMBER:	OR B	т.		
CAUSES: MATERIAL FAI	LURE, SEAL FAI	LURE, THERMAL C	YCLING	
EFFECTS/RATIONALE: IF LEAK IS LARGE, SIDE ISOLATED, CAUSING LOSS OF SIDE. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF OTHER SIDE.				

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU 2/1R FLIGHT: MDAC ID: 111 THRUSTER MANIFOLD ITEM: FAILURE MODE: CONSTRICTION LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 2/1R POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] SIDE A OR B LOCATION: PART NUMBER: CAUSES: CONTAMINATION, IMPACT, INLET FILTER BLOCKED EFFECTS/RATIONALE: IF CONSTRICTION OBSTRUCTIVE ENOUGH, MARKED LOSS OF THRUST RESULTS, LEADS TO EFFECTIVE LOSS OF SIDE. POSSIBLE STRANDING OF CREWMEMBER IF OTHER SIDE FAILS. **REFERENCES:**

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 112	HIGHEST CRITICALITY FLIGHT:	_
ITEM: THRUSTER FAILURE MODE: FAIL OPEN		
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)		
CRITICA		
FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	3/3 2/1R	
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:		
CAUSES: CONTAMINATION, GALLING		

EFFECTS/RATIONALE: CAUSES UNCOMMANDED ACCELERATION, LOSS OF SIDE. POSSIBLE STRANDING OF CREWMEMBER IF OTHER SIDE FAILS.

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REFERENCES:

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DATE: 9/19/86	HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 113	FLIGHT: 2/1R
ITEM: THRUSTER FAILURE MODE: FAIL CLOSED	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA	
FLIGHT PHASE PRE-OPS:	
OPS: POST-OPS:	2/1R
POST-OPS:	3/3
REDUNDANCY SCREENS: A [2]	B[P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: SHORT/OPEN CIRCUIT IN SOLE FILTER BLOCKED	NOID; CONTAMINATION, GALLING,
EFFECTS/RATIONALE: CAUSES UNCOMMANDED ACCELERATION, SL	UGGISH RESPONSE. SIDE CAN BE

CAUSES UNCOMMANDED ACCELERATION, SLUGGISH RESPONSE. SIDE CAN BE USED BUT IS PROBABLY BEST SHUT OFF. IF OTHER SIDE FAILS, CREWPERSON CANNOT CONTROL MMU AND MAY BE STRANDED OR DRIVE INTO OTHER OBJECT.

REFERENCES:

DATE:	9/19/86		HIGHEST C	RITICALITY	HDW/FUNC
SUBSYSTEM: MDAC ID:	MMU 114			FLIGHT:	2/1R
ITEM: FAILURE MODE	THRUSTER : LEAK				
LEAD ANALYST	: P. BAILEY	SUBSYS	LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) PROPULS 3) 4) 5) 6) 7) 8) 9)	ERARCHY: ION SUBSYSTEM	1			
		CRITICAI			
	I C	CGHT PHASE PRE-OPS: OPS: POST-OPS:			
REDUNDANCY S	CREENS: A [[2] H	3 [P]	C [P]	
LOCATION: PART NUMBER:	SIDE A OR H	3			
CAUSES: MAT	ERIAL FAILURE	/FRACTURE,	SEAL FAIL	URE	

EFFECTS/RATIONALE:

LARGE LEAK COULD CAUSE LOSS OF ALL GAS ON SIDE. IF BOTH SIDES ARE LOST, POSSIBLE STRANDING OF CREWPERSON.

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DATE: SUBSYSTEM:	9/19/86	HIGHEST	CRITICALITY	HDW/FUNC
MDAC ID:			FLIGHT:	2/1R
ITEM: FAILURE MODI	GN2 REGULATOR E: FAIL CLOSED			
LEAD ANALYS	F: P. BAILEY	SUBSYS LEAD:	G. RAFFAELLI	
BREAKDOWN H 1) MMU 2) PROPULS 3) 4) 5) 6) 7) 8) 9)	IERARCHY: SION SUBSYSTEM			
	C	RITICALITIES		
	FLIGHT	PHASE HDW	FUNC	

FLIGHT PHASEHDW/FUNCPRE-OPS:3/3OPS:2/1RPOST-OPS:3/3

REDUNDANCY SCREENS: A [2] B [P] C [P]

LOCATION: SIDE A OR B PART NUMBER:

CAUSES: MATERIAL FAILURE, CONTAMINATION, SPRING FRACTURE, FILTER BLOCKED

EFFECTS/RATIONALE:

REGULATOR FAILED CLOSED CAUSES LOSS OF SIDE. IF BOTH SIDES LOST, POSSIBLE STRANDING OF CREWPERSON.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC			
MDAC ID: 117	FLIGHT: 2/1R			
ITEM: GN2 REGULATOR FAILURE MODE: FAIL OPEN				
LEAD ANALYST: P. BAILEY SUBSY	'S LEAD: G. RAFFAELLI			
BREAKDOWN HIERARCHY: 1) MMU				
2) PROPULSION SUBSYSTEM 3)				
4) 5)				
6) 7)				
8) 9)				
CRITICA	TTTTES			
FLIGHT PHASE				
PRE-OPS:	2/1R			
OPS: POST-OPS:	2/1R 2/1R			
REDUNDANCY SCREENS: A [2]	B[P] C[P]			
LOCATION: SIDE A OR B PART NUMBER:				
CAUSES: SPRING FAILURE, MATERIAL FAILURE, CONTAMINATION				
EFFECTS/RATIONALE: REGULATOR FAILED OPEN CAUSES LOSS OF SIDE. IF RELIEF FAILS.				
POSSIBLE "EXPLOSIVE" FAILURE DUE TO OVERPRESSURIZATION OF				
MANIFOLD CAUSING HIGH VELOCITY SHRAPNEL, WHICH CAN CAUSE LOSS OF CREWPERSON.				

REFERENCES:

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LOSS OF OTHER SIDE CAN STRAND CREWPERSON.

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 119 GN2 REGULATOR ITEM: FAILURE MODE: FAIL LOW LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU PROPULSION SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 2/2OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [F] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: CONTAMINATION, SPRING FAILURE, INCORRECT CAL. EFFECTS/RATIONALE: SLUGGISH CONTROL RESPONSE. MISSION TERMINATION.

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REFERENCES:

DATE: 9/19/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 120	FLIGHT:	2/1R
ITEM: GN2 REI FAILURE MODE: FAIL OF		
LEAD ANALYST: P. BAIL	EY SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYS 3) 4) 5) 6) 7) 8) 9)	STEM	
	CRITICALITIES	
	FLIGHT PHASEHDW/FUNCPRE-OPS:3/3OPS:2/1RPOST-OPS:3/3	
REDUNDANCY SCREENS:	A[2] B[P] C[P]	
LOCATION: SIDE A (PART NUMBER:	DR B	
CAUSES: SPRING FAILUR	RE	
FFFFCTS / RATIONALE.		

EFFECTS/RATIONALE: FAILED OPEN CAUSES LOSS OF ALL GAS UNLESS ISO. VALVE IS CLOSED. MISSION TERMINATION POSSIBLE. LOSS OF OTHER SIDE CAN RESULT IN CREWPERSON BEING STRANDED.

REFERENCES:

REPORT DATE 11/22/86

DATE:	9/19/86	HIGHEST C	RITICALITY	HDW/FUNC
SUBSYSTEM: M MDAC ID: 1			FLIGHT:	3/1R
ITEM: FAILURE MODE:	GN2 RELIEF VALVE FAIL CLOSED			
LEAD ANALYST:	P. BAILEY SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN HIE 1) MMU 2) PROPULSI 3) 4) 5) 6) 7) 8) 9)	RARCHY: ON SUBSYSTEM			
	CRITICA			
	FLIGHT PHASE PRE-OPS:			
	OPS: POST-OPS:	3/1R		
REDUNDANCY SC	REENS: A [2]	B [P]	С[Р]	
LOCATION: PART NUMBER:	SIDE A OR B			
CAUSES: SPRI	NG FAILURE, CONTAMINAT	ION		
EFFECTS/RATIO	NALE:			

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IF REGULATOR FAILS OPEN AND RELIEF VALVE ALSO FAILS CLOSED, CAPABILITY TO REGULATE GAS PRESSURE AT THRUSTER MANIFOLD IS LOST, RESULTING IN POSSIBLE EXPLOSION OF MANIFOLD, DAMAGE TO ORBITER, OR LOSS OF CREWMEMBER.

REFERENCES:

DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY	HDW/FUNC		
MDAC ID: 122	FLIGHT:	2/1R		
ITEM: PRESSURE GAGE FAILURE MODE: LEAK				
LEAD ANALYST: P. BAILEY SUBS	YS LEAD: G. RAFFAELLI			
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)				
CRITIC	ALITIES			
FLIGHT PHASE PRE-OPS:	3/3			
OPS: POST-OPS:	2/1R 3/3			
REDUNDANCY SCREENS: A [2]	B [P] C [P]			
LOCATION: SIDE A OR B PART NUMBER:	. <u>.</u> .			
CAUSES: MATERIAL FAILURE				
EFFECTS/RATIONALE: LEAK CAUSES GAS LOSS, LOSS OF SIDE IF LEAK LARGE ENOUGH. POSSIBLE STRANDING OF CREWPERSON IF BOTH SIDES ARE LOST.				

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 123 PRESSURE GAGE ITEM: FAILURE MODE: FAIL HIGH (INDICATION) LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [F] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: MATERIAL FAILURE OF BOURDON TUBE - TUBE RELAXES, CONTAMINATION EFFECTS/RATIONALE: IF DETECTED, DIAGNOSE WITH MALF PROCEDURE. CONTINUE MISSION, NO IMPACT. **REFERENCES:**

REPORT DATE 11/22/86

DATE: SUBSYSTEM:	9/19/86		HIGHEST C	RITICALITY	HDW/FUNC
MDAC ID:				FLIGHT:	3/3
	PRESSURE FAIL LOW		ON)		
LEAD ANALYST	T: P. BAILEY	SUBSYS	5 LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) PROPULS 3) 4) 5) 6) 7) 8) 9)	IERARCHY: SION SUBSYSTE	ΞM			
		CRITICA			
	FI	LIGHT PHASE PRE-OPS:		INC	
		OPS:	3/3		
		POST-OPS:	3/3		
REDUNDANCY S	SCREENS: A	[2]	В[F]	С[Р]	
LOCATION: PART NUMBER:	SIDE A OR	В			
CAUSES: CON	NTAMINATION/H	BLOCKAGE OF	BOURDON TU	IBE	
EFFECTS/RAT IF DETECTED IMPACT.	IONALE: , DIAGNOSE WI	ITH MALF PRO	CEDURE. C	ONTINUE MIS	SION, NO

REFERENCES:

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 125 MDAC ID: RECHARGE QUICK DISCONNECT ITEM: FAILURE MODE: FAIL OPEN/LEAK LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: POST-OPS: 2/2 REDUNDANCY SCREENS: A [2] B [F] C [P] SIDE A OR B LOCATION: PART NUMBER: CAUSES: CONTAMINATION, MATERIAL DEFECT OF SEAL, SPRING FRACTURE EFFECTS/RATIONALE: FAIL OPEN WILL PREVENT RECHARGE AND SUBSEQUENT MISSIONS.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 126	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 3/2R
ITEM: RECHARGE QUICK DISC FAILURE MODE: FAIL CLOSED	ONNECT
LEAD ANALYST: P. BAILEY SUBS	YS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITIC	ALITIES
FLIGHT PHASE PRE-OPS:	HDW/FUNC 3/3
OPS: POST-OPS:	3/3 3/2R
REDUNDANCY SCREENS: A [2]	B[P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: MATERIAL DEFECT, SPRING F	RACTURE, CONTAMINATION
EFFECTS/RATIONALE: FAILURE CLOSED OF BOTH QD'S PREVEN MISSIONS.	TS RECHARGE AND SUBSEQUENT

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 127	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/1R
ITEM: GN2 TEST PORT FAILURE MODE: LEAK	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) PROPULSION SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA	
FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	3/3 2/1R
REDUNDANCY SCREENS: A [2]	B[P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: SEAL FAILURE	and the second
EFFECTS/RATIONALE: LOSS OF GAS RESULTING IN LOSS OF SI CREWPERSON WITH LOSS OF BOTH SIDES.	DE. POSSIBLE STRANDING OF
REFERENCES :	

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DATE: SUBSYSTEM: MDAC ID:	MMU		HIGHEST C	RITICALITY FLIGHT:	
ITEM: FAILURE MOD		T - LOW OUTPO	JT		
LEAD ANALYS	r: p. bailey	SUBSYS	G LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	EM			
	_			NO	
	E.	LIGHT PHASE PRE-OPS:	3/3		
		OPS: POST-OPS:	2/1R 3/3		
REDUNDANCY	SCREENS: A	[2] H	3 [P]	С[Р]	
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: CO	NTAMINATION,	CORROSION, (PEN	· .	an
		LOSS OF PROI	PULSION SU	BSYSTEM. PC	DSSIBLE

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/1R MDAC ID: 129 INTERNAL/EXTERNAL POWER SWITCH ITEM: FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 2/1R OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER:

CAUSES: CONTAMINATION, MATERIAL FAILURE

EFFECTS/RATIONALE:

LOSS OF POWER TO HEATERS RESULTS, POSSIBLE LOSS OF SIDE IF LOW TEMP. LIMITS EXCEEDED AND EQUIPMENT DAMAGED. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF BOTH SIDES. **REFERENCES:**

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 130	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/2
ITEM: INTERNAL/EXTERNA FAILURE MODE: FAIL TO INTERNAL	
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
	ITICALITIES
	HASE HDW/FUNC
PRE-OPS OPS:	
POST-OF	PS: 3/3
REDUNDANCY SCREENS: A [2]	B[P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: CONTAMINATION, MATERIA	AL FAILURE OF CONTACT-FRACTURE
EFFECTS/RATIONALE:	

POWER NOT AVAILABLE TO HEATERS DURING STORAGE, POSSIBLE LOSS OF SIDE DUE TO EQUIPMENT UNDER TEMPS. MISSION TERMINATION.

REFERENCES:

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REPORT DATE 11/22/86

DATE: SUBSYSTEM:	9/19/86 MMII		HIGHEST C	RITICALITY	HDW/FUNC
MDAC ID:				FLIGHT:	2/1R
	INTERNAL E: FAIL TO			I	
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	ЕМ			
		CRITICA	LITIES		
	F	LIGHT PHASE	HDW/FU	NC	
		PRE-OPS:	2/2		
		OPS:	2/1R	-	
		POST-OPS:	3/3		
REDUNDANCY	SCREENS: A	[2]	B [P]	С[Р]	
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: CO	NTAMINATION,	MATERIAL FA	ILURE OF C	ONTACTS-FRA	CTURE
EFFECTS/RAT POWER LOSS	TO HEATERS D	URING FLIGHT	. POSSIBL	E LOSS OF S	IDE.

POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF BOTH SIDES.

REFERENCES:

REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 132	5 HIGHEST CRITICALITY FLIGHT:	_
ITEM: TERMIN FAILURE MODE: SHORT	IAL BOARD	
LEAD ANALYST: P. BAIL	LEY SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSY 3) 4) 5) 6) 7) 8) 9)	STEM	
	CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 2/1R POST-OPS: 3/3	
REDUNDANCY SCREENS:	A[2] B[P] C[P]	
LOCATION: SIDE A PART NUMBER:	OR B	
CAUSES: DEBRIS, CONT	FAMINATION	
EFFECTS/RATIONALE:		

LOSS OF POWER TO AFFECTED CIRCUITS AND/OR RAPID BATTERY POWER USAGE CAUSES LOSS OF SIDE AND MISSION TERMINATION. POSSIBLE TO STRAND CREWPERSON WITH LOSS OF OTHER ELECTRICAL SUBSYSTEM.

REFERENCES:

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REPORT DATE 11/22/86

DATE: SUBSYSTEM: MDAC ID:	MMU	HIGHEST CRITICALITY FLIGHT:	_
	TERMINAL BOARD E: FAIL OPEN		
LEAD ANALYS	T: P. BAILEY SUBS	SYS LEAD: G. RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTEM		
		CALITIES	
	FLIGHT PHASE PRE-OPS:		
	OPS: POST-OPS:	2/1R 3/3	
REDUNDANCY S	SCREENS: A [2]	В[Р] С[Р]	
PART NUMBER			
CAUSES: IM	PACT, VIBRATION		
	IONALE: ER TO AFFECTED CIRCUITS ON WITH LOSS OF BOTH SI		SIBLE LOSS
REFERENCES:			

DATE: SUBSYSTEM: MDAC ID:	9/19/86 MMU 134	HIGHEST C	RITICALITY FLIGHT:	
ITEM:	MAIN POWER SWITCH E: FAIL OFF			
	E: FAIL OFF T: P. BAILEY SUBSY	'S LEAD: G.	RAFFAELLI	
BREAKDOWN H				
	CRITICA FLIGHT PHASE		NC	
	PRE-OPS: OPS: POST-OPS:	2/2 2/1R 3/3		
REDUNDANCY	SCREENS: A [2]	В[Р]	C[P]	
LOCATION: PART NUMBER	A OR B SIDE :			
CAUSES: CO	NTAMINATION, CORROSION,	UNDER TEMP	ERATURE	
EFFECTS/RAT LOSS OF POW OF BOTH SID	ER TO SIDE. POSSIBLE STR	ANDING OF	CREWPERSON	WITH LOSS
REFERENCES :			.i. j.	

REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 135	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/2		
ITEM: MAIN POWER SWITCH FAILURE MODE: FAIL ON			
LEAD ANALYST: P. BAILEY SUBSY	IS LEAD: G. RAFFAELLI		
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITICALITIES			
FLIGHT PHASE PRE-OPS:	2/2		
OPS: POST-OPS:	3/3 2/2		
REDUNDANCY SCREENS: A [2]	B[P] C[P]		
LOCATION: SIDE A OR B PART NUMBER:			
CAUSES: CONTAMINATION, UNDER TEMPERATURE			
EFFECTS/RATIONALE: CANNOT EMPLOY EXTERNAL PWR DURING STOWAGE, HENCE NO HEATERS & POSSIBLE DAMAGE TO UNIT. MISSION TERMINATION.			
REFERENCES:			

REPORT DATE 11/22/86

DATE: 9/19/86	HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 136	FLIGHT: 2/1R
ITEM: LTS/HTR.cb FAILURE MODE: FAIL OPEN	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA FLIGHT PHASE	
PRE-OPS: OPS:	3/3
OPS: POST-OPS:	2/1R 3/3
REDUNDANCY SCREENS: A [2]	В[Р] С[Р]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: CONTAMINATION, CORROSION	
EFFECTS/RATIONALE: LOSS OF POWER TO ALL HEATERS, POSSI	BLE LOSS OF SIDE. POSSIBLE

LOSS OF POWER TO ALL HEATERS, POSSIBLE LOSS OF SIDE. STRANDING OF CREWPERSON WITH LOSS OF BOTH SIDES.

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC		
MDAC ID: 137	FLIGHT: 3/2R		
ITEM: LTS/HTR.Cb FAILURE MODE: FAIL CLOSED			
LEAD ANALYST: P. BAILEY SUBSY	IS LEAD: G. RAFFAELLI		
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITICALITIES			
	HDW/FUNC		
PRE-OPS: OPS:	3/3 3/2R		
POST-OPS:	3/3		
REDUNDANCY SCREENS: A [2]	B[P] C[P]		
LOCATION: SIDE A OR B PART NUMBER:			
CAUSES: CONTAMINATION, CORROSION, MECHANICAL FAILURE			
EFFECTS/RATIONALE: LOSS OF cb PROTECTION IN CASE OF OVERCURRENT TO HEATERS OF LOCATOR LIGHTS. 2ND FAILURE (i.e. SHORT) REQUIRED FOR MISSION TERMINATION.			

REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM:	9/19/86 MMU	HIGHEST	CRITICALITY		
MDAC ID:	138		FLIGHT:	2/1R	
ITEM: CEA CIRCUIT BREAKER FAILURE MODE: FAIL OPEN					
LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI					
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)					
CRITICALITIES					
	FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	HDW/1 3/2 2/2 3/2	3 1R		
REDUNDANCY	SCREENS: A [2]	B [P]	С[Р]		

LOCATION: SIDE A OR B PART NUMBER:

CAUSES: CONTAMINATION MANUFACTURING DEFECT

EFFECTS/RATIONALE:

LOSS OF POWER TO ASSOCIATED SUBSYSTEM CEA. THIS RESULTS IN LOSS OF ASSOCIATED PROPULSION SUBSYSTEM, FORCES IMMEDIATE TERMINATION OF MISSION. IF BOTH CEA cb's FAIL OPEN, CREWMEMBER IS STRANDED DUE TO LOSS OF ALL CONTROL AUTHORTY.

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC			
MDAC ID: 139	FLIGHT: 3/2R			
ITEM: CEA CIRCUIT BREAKER FAILURE MODE: FAIL CLOSED				
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI			
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)				
c	RITICALITIES			
PRE-C	PHASE HDW/FUNC PS: 3/3 3/2R OPS: 3/3			
REDUNDANCY SCREENS: A [2]	в[Р] С[Р]			
LOCATION: SIDE A OR B PART NUMBER:				
CAUSES: CONTAMINATION, CORROSION, MECHANICAL FAILURE				
EFFECTS/RATIONALE: NO cb PROTECTION IN CASE OF OVERCURRENT TO CEA. 2ND FAILURE (i.e. SHORT) REQUIRED FOR MISSION TERMINATION.				

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 140	HIGHEST CRITICALITY FLIGHT:	
ITEM: GYRO PWR cb FAILURE MODE: FAIL OPEN		
LEAD ANALYST: P. BAILEY SU	BSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)		
••••= -	TCALITIES	
FLIGHT PHA PRE-OPS: OPS: POST-OPS	3/3 3/3	
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:		
CAUSES: CONTAMINATION, CORROSIC	N	

EFFECTS/RATIONALE: MAY CAUSE LOSS OF AUTOMATIC ATTITUDE HOLD. MISSION CONTINUES.

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 141	FLIGHT:	3/2R
ITEM: GYRO PWR Cb FAILURE MODE: FAIL CLOSED		
LEAD ANALYST: P. BAILEY SUBSY	YS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)		·
CRITICA		
FLIGHT PHASE PRE-OPS:		
OPS: POST-OPS:	3/2R 3/3	-
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:		
CAUSES: CONTAMINATION, CORROSION,	MECHANICAL FAILURE	
EFFECTS/RATIONALE: NO OVERCURRENT PROTECTION. IF A SE OCCURS DAMAGE TO GYROS MAY CAUSE DA MISSION TERMINATES IF DETECTED.	COND FAILURE (1.e. SH MAGE TO OTHER CEA COM	ORT) PONENTS.

REFERENCES:

REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU 2/1RFLIGHT: MDAC ID: 142 ITEM: VDA cb FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 2/1ROPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: CONTAMINATION, CORROSION EFFECTS/RATIONALE:

LOSS OF POWER TO VDA'S. RESULTS IN LOSS OF SIDE. POSSIBLE LOSS OF CREWPERSON WITH LOSS OF BOTH SIDES.

REFERENCES:

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REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST C	RITICALITY	HDW/FUNC
MDAC ID: 143		FLIGHT:	3/2R
ITEM: VDA Cb FAILURE MODE: FAIL CLOS	SE		
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G.	RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTE 3) 4) 5) 6) 7) 8) 9)	ЕМ		
101	CRITICALITIES	NC	
FI	JIGHT PHASEHDW/FUPRE-OPS:3/32/22		
	OPS: 3/2R POST-OPS: 3/3		
REDUNDANCY SCREENS: A	[2] B[P]	C[P]	
LOCATION: SIDE A OR PART NUMBER:	B		
CAUSES: CONTAMINATION,	MECHANICAL FAILURE, C	ORROSION	
EFFECTS/RATIONALE: NO OVERCURRENT PROTECTIO DAMAGE TO OTHER COMPONEN			POSSIBLE
REFERENCES:		1 N	

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REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 144	HIGHEST CRITICALITY HDW/FU FLIGHT: 3/3	JNC
MDAC ID: 144		
ITEM: LOCATOR FAILURE MODE: FAIL OFF		
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYST 3) 4) 5) 6) 7) 8) 9)	ГЕМ	
	CRITICALITIES	
F	FLIGHT PHASE HDW/FUNC	
	PRE-OPS: 3/3 OPS: 3/3	
	POST-OPS: 3/3	
REDUNDANCY SCREENS: A	A[2] B[P] C[F]	
LOCATION: PART NUMBER:		
CAUSES: CONTAMINATION,	, MECHANICAL FAILURE, ELECTRICAL OPEN	
EFFECTS/RATIONALE: LOSS OF LOCATOR LIGHTS.	MISSION CONTINUES.	

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC DATE: 9/19/86 SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 145 LOCATOR LIGHT SWITCH ITEM: FAILURE MODE: FAIL ON POSITION A LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: -3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: CONTAMINATION, MECHANICAL FAILURE, SHORT EFFECTS/RATIONALE: LIGHT POWER SOURCE NOT SELECTABLE. MISSION CONTINUES.

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REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM: M		HIGHEST CRITIC	ALITY HDW/FUNC
MDAC ID: 1		FLIG	HT: 3/3
	LOCATOR LIGHT SWITC FAIL ON POSITION B	н	
LEAD ANALYST:	P. BAILEY SUBS	YS LEAD: G. RAFF	AELLI
BREAKDOWN HIE 1) MMU 2) ELECTRIC 3) 4) 5) 6) 7) 8) 9)	RARCHY: AL SUBSYSTEM		
	CRITIC	ALITIES	
	FLIGHT PHASE		
	PRE-OPS: OPS: POST-OPS:	3/3	
	POST-OPS:	3/3	
REDUNDANCY SC	REENS: A [NA]	B [NA] C	[NA]
LOCATION: PART NUMBER:			
CAUSES: CONT.	AMINATION, MECHANICAL	FAILURE, SHORT	
EFFECTS/RATIO LIGHT POWER S	NALE: OURCE NOT SELECTABLE.	MISSION CONTIN	UES.
REFERENCES :			

REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/2R MDAC ID: 147 LOCATOR LIGHT POWER CONVERTER ITEM: FAILURE MODE: FAIL HIGH/FAIL LOW LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/2ROPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: CONTAMINATION, SHORT EFFECTS/RATIONALE: LOSS OF LOCATOR LIGHTS MAY RESULT. MISSION MAY BE IMPACTED DUE TO POWER UASGE ON THE BATTERY SIDE WITH SHORT AND IF OTHER SIDE'S POWER FAILS. **REFERENCES:**

DATE: 9/19/8 SUBSYSTEM: MMU	6 H	IIGHEST CRITICALITY	HDW/FUNC
MDAC ID: 148		FLIGHT:	3/3
ITEM: LIGHT FAILURE MODE: 1-3 I			
LEAD ANALYST: P. BAI	LEY SUBSYS	LEAD: G. RAFFAELL	I
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBS 3) 4) 5) 6) 7) 8) 9)	YSTEM		
	CRITICALI		
	FLIGHT PHASE PRE-OPS:	HDW/FUNC 3/3	
	OPS: POST-OPS:	3/3 3/3	
			۹
REDUNDANCY SCREENS:	A [2] B]
LOCATION: PART NUMBER:			
CAUSES: MATERIAL DE	FECT. LIFETIME I	JIMIT.	
EFFECTS/RATIONALE: EACH LAMP HAS 4 INDE OPERATE INDEPENDENTI		ON 2 SEPARATE BUS	SES. LAMPS
REFERENCES :			

REPORT DATE 11/22/86

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DATE: 9/19/8 SUBSYSTEM: MMU MDAC ID: 149	5	HIGHEST CRI	TICALITY	_
ITEM: GYRO FAILURE MODE: FAIL	POWER SWITCH OPEN (OFF)			
LEAD ANALYST: P. BAI	LEY SUBSY	S LEAD: G. R	AFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBS 3) 4) 5) 6) 7) 8) 9)	YSTEM			
	CRITICA	LTTTES		
	FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	HDW/FUNC 3/3 3/3		
REDUNDANCY SCREENS:	A [NA]	B [NA]	C [NA]	
LOCATION: PART NUMBER:				

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PART NUMBER:

CAUSES: CONTAMINATION, UNDERTEMP.

EFFECTS/RATIONALE:

LOSS OF AUTOMATIC ATTITUDE HOLD. MISSION CONTINUES.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/3 SUBSYSTEM: MMU MDAC ID: 150	36	HIGHEST C	RITICALITY FLIGHT:	
ITEM: GYRO FAILURE MODE: FAIL				
LEAD ANALYST: P. BA	LEY SUBSYS	S LEAD: G.	RAFFAELLI	
BREAKDOWN HIERARCHY 1) MMU 2) ELECTRICAL SUB 3) 4) 5) 6) 7) 8) 9)				
	CRITICAI FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	HDW/FU 3/3 3/3	INC	
REDUNDANCY SCREENS:	A [2] B	3 [P]	C [NA]	
LOCATION: PART NUMBER:				
CAUSES: CONTAMINAT	ON, UNDERTEMP.			

EFFECTS/RATIONALE: INABILITY TO SELECT ALTERNATE POWER SOURCE OR DESELECT CURRENT POWER SOURCE. MISSION CONTINUES.

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 151 GYRO POWER SUPPLY ITEM: FAILURE MODE: FAIL OFF/FAIL HIGH/FAIL LOW LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) GYRO POWER SUPPLY 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [NA] LOCATION: PART NUMBER: CAUSES: OVERTEMP, CONTAMINATION, MECHANICAL FAILURE, SHORT EFFECTS/RATIONALE: CAUSES DEGRADATION OR LOSS OF AUTOMATIC ATTITUDE HOLD. MISSION CONTINUES.

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REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM: MDAC ID:			HIGHEST	CRITICALITY FLIGHT:	
ITEM:	CEA POWE				
LEAD ANALYS	T: P. BAILEY	SUBSYS	S LEAD: G	. RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	ЕМ			
		CRITICAL	פתדתד		
	'च	LIGHT PHASE		UNC	
	-	PRE-OPS:	3/3		
		OPS: POST-OPS:	2/1	R	
		POST-OPS:	3/3		
REDUNDANCY	SCREENS: A	[2]	3 [P]	C[P]	
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: CO	NTAMINATION,	MECHANICAL I	FAILURE	en e	
	DE, CAUSES L	OSS OF SIDE. E FAILS ALSO		e loss (stra	NDING) OF

REFERENCES:

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REPORT DATE 11/22/86

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DATE: SUBSYSTEM:	MMU		HIGHEST C	RITICALITY	
MDAC ID:	153			FLIGHT:	3/3
ITEM: FAILURE MODI	CEA POWE E: FAIL ON	R SWITCH			
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) ELECTRI 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	ЕМ			
		CRITICA			
	FI	LIGHT PHASE PRE-OPS:		NC	
		OPS:	3/3		
		POST-OPS:	3/3		
REDUNDANCY S	SCREENS: A	[2]	В [Р]	C[F]	
LOCATION: PART NUMBER:	SIDE A OR	В			
CAUSES: CON	TAMINATION,	UNDER TEMP.			
EFFECTS/RATI INABILITY TO IMPACTS.	CONALE: D SELECTIVELY	ISOLATE WI	THOUT USE	OF MAIN PWR	SW. NO
REFERENCES :				,	

DATE: SUBSYSTEM:	9/19/86 MMU		HIGHEST C	CRITICALITY	HDW/FUNC
MDAC ID:	154			FLIGHT:	2/1R
ITEM: FAILURE MODE	CEA POWER S : FAIL OFF	WITCH			
LEAD ANALYST	: P. BAILEY	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) ELECTRI 3) 4) 5) 6) 7) 8) 9)	ERARCHY: CAL SUBSYSTEM				
	e ve i stational	CRITICA	LITIES		
	FLIC			JNC	
	PF	RE-OPS:	3/3		
	OF PC	PS: DST-OPS:	2/1F 3/3		
REDUNDANCY S	CREENS: A [2]	в[Р]	C[P]	
LOCATION: PART NUMBER:	SIDE A OR B				
CAUSES: CON	TAMINATION, UN	DER TEMP.			
	ONALE: AILURES WOULD				HER CEA

TERMINATION. POSSIBLE LOSS OF CREWPERSON WITH LOSS OF OTHER CH DURING FLIGHT.

REFERENCES:

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REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU		HIGHEST CRITICALITY	HDW/FUNC	
MDAC ID: 155		FLIGHT:	3/3	
ITEM: CEA POWE FAILURE MODE: FAIL OFE	ER SWITCH F IN ISO.			
LEAD ANALYST: P. BAILEY	SUBSY	S LEAD: G. RAFFAELLI		
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYST 3) 4) 5) 6) 7) 8) 9)	ſEM			
	CRITICA			
I	PRE-OPS:			
	OPS:	3/3		
	POST-OPS:	3/3		
REDUNDANCY SCREENS: A	[2]	B[P] C[P]		
LOCATION: SIDE A OF PART NUMBER:	ξВ	а р. 		
CAUSES: MECHANICAL FAILURE, CORROSION, CONTAMINATION				
EFFECTS/RATIONALE: NO EFFECT.				

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REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM: MDAC ID:	9/19/86 MMU 156	HIGHEST (CRITICALITY	_
ITEM:	PRESSURE GAGE E: FAIL OFF	LIGHT		<i>,</i> ,,,
LEAD ANALYS	F: P. BAILEY	SUBSYS LEAD: G	. RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTEM			
	C	RITICALITIES		
	FLIGHT	PHASE HDW/FU	JNC	
	PRE-O OPS: POST-	PS: 3/3 3/3 OPS: 3/3		
REDUNDANCY	SCREENS: A [2]		C[P]	
LOCATION: PART NUMBER	:			
CAUSES: OP	EN, THERMAL CYCLIN	G		
EFFECTS/RAT GAUGE MAY FI RESULTS IN 1	REEZE BUT OTHER GA	UGE MAY BE USED.	LOSS OF BO	ТН
REFERENCES:			a da antes estas	

REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 157 ITEM: THRUSTER CUE LT. FAILURE MODE: FAIL OFF LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: EFFECTS/RATIONALE: NON-CRITICAL FUNCTION. NO IMPACTS.

REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM:	MMU		HIGHEST	CRITICALITY	
MDAC ID:	158			FLIGHT:	2/1R
ITEM: FAILURE MOI		L ELECTRONICS N 1-12 CH.	S ASSEMBLY		
LEAD ANALYS	ST: P. BAIL	EY SUB:	SYS LEAD: G	. RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTH 3) 4) 5) 6) 7) 8) 9)	HIERARCHY: RICAL SUBSY	STEM			
		CRITIC FLIGHT PHAST PRE-OPS: OPS: POST-OPS:	CALITIES E HDW/F 3/3 2/1 3/3	UNC R	
REDUNDANCY	SCREENS:	A [2]	В[Р]	С[Р]	
LOCATION: PART NUMBER	R:				
CAUSES: MA	ATERIAL DEF	ECT, CONTAMII	NATION, SHO	RT	

EFFECTS/RATIONALE: LOSS OF SIDE, UNCOMMANDED ACCELERATION. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF BOTH SIDES.

REFERENCES:

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REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC DATE: 9/19/86 SUBSYSTEM: MMU FLIGHT: 2/1R MDAC ID: 159 CONTROL ELECTRONICS ASSEMBLY ITEM: FAILURE MODE: FAIL OFF 1-12 CH. LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) · 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/1R OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: MATERIAL DEFECT, CONTAMINATION EFFECTS/RATIONALE: LOSS OF SIDE, UNCOMMANDED ACCELERATION. SINGLE CHANNEL FAILURE MAY BE DIFFICULT TO DETECT. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF BOTH SIDES. **REFERENCES:**

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DATE: SUBSYSTEM: MDAC ID:			HIGHEST C	RITICALITY FLIGHT:	
	CONTROL I E: NOISY OUT		ASSEMBLY		
LEAD ANALYS	T: P. BAILEY	SUBSYS	S LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTI	ЕМ			
	=	CRITICAL	LITIES		
		LIGHT PHASE		NC	
		PRE-OPS: OPS:	3/3 2/1R		
		OPS: POST-OPS:	3/3		
REDUNDANCY	SCREENS: A	[2]	3 [P]	C[P]	
LOCATION: PART NUMBER	:			<u>-</u>	
CAUSES: MA	TERIAL DEFECT	F, CONTAMINAT	NOI		
	IONALE: ONSE TO COMM TURNED OFF. I				

REFERENCES:

OF BOTH SIDES.

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/1R MDAC ID: 161 CONTROL ELECTRONICS ASSEMBLY ITEM: FAILURE MODE: LOGIC FAILURE LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/1R OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: MATERIAL DEFECT, CONTAMINATION EFFECTS/RATIONALE: ERATIC RESPONSE TO COMMANDS. VEHICLE MAY BECOME UNCONTROLLABLE

UNTIL SIDE TURNED OFF. POSSIBLE LOSS OF CREWPERSON WITH LOSS OF BOTH SIDES. **REFERENCES:**

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 162	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/2
ITEM: ISOLATION VALVE TIME FAILURE MODE: FAIL OFF	ĨR
LEAD ANALYST: P. BAILEY SUBSY	'S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA	LITIES
FLIGHT PHASE PRE-OPS:	HDW/FUNC 2/2
OPS:	3/3
POST-OPS:	
REDUNDANCY SCREENS: A [2]	B[F] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: ELECTRONICS FAILURE, DUE 1	O THERMAL CYCLING, OPEN, SHORT
EFFECTS/RATIONALE: MISSION TREMINATION WITH LOSS OF AC OPS.	CESS TO MAINFOLD DURING PRE-
REFERENCES:	a Color (1996) - Color (1997) - La cal

REPORT DATE 11/22/86

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5-3 5-3

9/19/86 HIGHEST CRITICALITY HDW/FUNC DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 163 ISOLATION VALVE TIMER ITEM: FAILURE MODE: TOO SHORT LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/2 OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [F] C [P] SIDE A OR B LOCATION: PART NUMBER: CAUSES: MATERIAL FAILURE, SOLID-STATE TIMER DRIFTS, ELECTRICAL SHORT EFFECTS/RATIONALE: ····· VALVE WILL EITHER NOT FULLY CLOSE OR NOT FULLY OPEN DEPENDING ON TIME OF FAILURE. MISSION TERMINATION WITH LOSS OF EFFICIENCY IN SIDE WHERE VALVE FAILED.

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REFERENCES:

REPORT DATE 11/22/86

DATE:			HIGHEST	CRITICALI	TY HDW/FUNC
SUBSYSTEM: MDAC ID:				FLIGHT:	2/1R
	ISOLATION E: FAILS ON	N VALVE TIME	R		
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G	. RAFFAEL	LI
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	EM			
		CRITICAL			
	FI	LIGHT PHASE			
		PRE-OPS: OPS:	3/3 2/1		
		POST-OPS:	3/3		
REDUNDANCY	SCREENS: A	[2]	B [F]	С[Р]
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: MA	TERIAL FAILU	RE			
EFFECTS/RAT DRIVES MOTO	IONALE: R AFTER VALVI	e fully open	OR CLOSE	D. CAN B	URN OUT

MOTOR. USES EXCESSIVE BATTERY POWER. MISSION TERMINATION. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF OTHER SIDE.

REFERENCES:

REPORT DATE 11/22/86 C-60

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/1R MDAC ID: 166 VALVE DRIVER AMPLIFIER ITEM: FAILURE MODE: FAIL OFF LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/1R OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [F] C [P] SIDE A OR B LOCATION: PART NUMBER: CAUSES: MATERIAL FAILURE, ELECTRICAL OPEN EFFECTS/RATIONALE: THRUSTER FAILS OFF, ISO VLV. FAILS OPEN OR CLOSED. MISSION

TERMINATION. CREWMEMBER COULD BE STRANDED WITH LOSS OF OTHER SIDE.

REFERENCES:

REPORT DATE 11/22/86

C-61

DATE: SUBSYSTEM:	9/19/86 MMU	HIGHEST C	RITICALITY	
MDAC ID:	167		FLIGHT:	271R
ITEM: FAILURE MOD	VALVE DRIVER AMPLIE E: FAIL ON	FIER		
LEAD ANALYS	T: P. BAILEY SUBS	SYS LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTEM			
	CRITIC	ALITIES		
	FLIGHT PHASE	HDW/FU	NC	
	PRE-OPS:	3/3		
	OPS:	2/1R 3/3	i -	
	F051-0F5.	575		
REDUNDANCY	SCREENS: A [2]	В[Р]	С[Р]	
LOCATION: PART NUMBER	SIDE A OR B			
CAUSES: MA	TERIAL FAILURE			

EFFECTS/RATIONALE: THRUSTER FAIL ON OR ISO VLV. MOTOR CONTINUOUSLY DRIVEN. MISSION TERMINATION. POSSIBLE STRANDING OF CREWPERSON WITH LOSS OF OTHER SIDE.

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC					
MDAC ID: 168	FLIGHT: 2/1R					
ITEM: VALVE DRIVER AMPLIF FAILURE MODE: NOISY	IER					
LEAD ANALYST: P. BAILEY SUBS	YS LEAD: G. RAFFAELLI					
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)						
CRITIC	ALITIES					
	HDW/FUNC 3/3					
PRE-OPS: OPS:	2/1R					
POST-OPS:	3/3					
REDUNDANCY SCREENS: A [2]	B[P] C[P]					
LOCATION: SIDE A OR B PART NUMBER:						
CAUSES: MATERIAL FAILURE, CONTAMINATION						
EFFECTS/RATIONALE: INTERMITTANT UNCOMMANDED ACCELERATIONS, ERRATIC CONTROL RESPONSE. MISSION TERMINATION. POSSIBLE STRANDING OF CREWPERSON IF BOTH SIDES FAIL.						
REFERENCES:						

DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC
MDAC ID: 169	FLIGHT: 1/1
ITEM: TRANSLATIONA FAILURE MODE: FAIL ON 1-3	L HAND CONTROLLER AXES
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	н на
	CRITICALITIES
FLIGH PRE	T PHASE HDW/FUNC -OPS: 2/2
OPS	: 1/1
POS	T-OPS: 3/3
REDUNDANCY SCREENS: A [2	2] B[P] C[P]
LOCATION: PART NUMBER:	
CAUSES: LOOSE MAGNET, MECH	ANICAL JAMMING
EFFECTS/RATIONALE: FAILURE CANNOT BE ISOLATED. REQUIRED. RESCUE REQUIRED.	LOSS OF PROPULSION CONTROL. ABORT

REFERENCES:

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REPORT DATE 11/22/86 C-64

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DATE: 9/19/80 SUBSYSTEM: MMU	5 HIGHE	ST CRITICALITY	HDW/FUNC
MDAC ID: 170		FLIGHT:	1/1
ITEM: TRANSI FAILURE MODE: FAIL (LATIONAL HAND CONTROL DFF 1-3 AXES	LER	
LEAD ANALYST: P. BAII	LEY SUBSYS LEAD	: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSY 3) 4) 5) 6) 7) 8) 9)	STEM		
	CRITICALITIES		
	FLIGHT PHASE HD PRE-OPS: OPS:	W/FUNC 2/2 1/1 3/3	
REDUNDANCY SCREENS:	A [2] B [NA] C [NA]	
LOCATION: PART NUMBER:			

CAUSES: LOOSE MAGNET, MECHANICAL JAMMING

EFFECTS/RATIONALE:

IF FAIL OFF IN ALL 3 AXES, LOSS OF PROPULSION FUNCTION. RESCUE REQUIRED. CREWPERSON IS STRANDED.

REFERENCES:

DATE: 9/19/86 HIGHEST CRITICALITY HDW/FUNC SUBSYSTEM: MMU MDAC ID: 171 FLIGHT: 1/1 ITEM: ROTATIONAL HAND CONTROLLER FAILURE MODE: FAIL ON (1-3 AXES) LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2 OPS: 1/1 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [NA] C [NA] LOCATION: PART NUMBER:

CAUSES: LOOSE MAGNET, MECHANICAL JAMMING

EFFECTS/RATIONALE: FAILURE CANNOT BE ISOLATED. ABORT REQUIRED. RESCUE REQUIRED. CREWPERSON STRANDED.

REFERENCES:

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HIGHEST CRITICALITY HDW/FUNC DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 172 FLIGHT: 1/1 ITEM: ROTATIONAL HAND CONTROLLER FAILURE MODE: FAIL OFF (1-3 AXES) LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2 1/1 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [NA] C [NA] LOCATION: PART NUMBER:

CAUSES: LOOSE MAGNET, MECHANICAL JAMMING

EFFECTS/RATIONALE: CREWMEMBER MAYNOT BE ABLE TO RETURN TO ORBITER WITH THC ONLY. CREWPERSON CAN BE STRANDED.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 HIGHEST CRITICALITY HDW/FUNC SUBSYSTEM: MMU MDAC ID: 173 FLIGHT: 1/1 ITEM: THC ISOLATE SWITCH FAILURE MODE: FAIL ON LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2 OPS: 1/1 z.: . • .• POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [NA] C [NA] LOCATION: PART NUMBER: CAUSES: MECHANICAL JAM, SWITCH MAT'L FAIL

EFFECTS/RATIONALE: LOSS OF ALL PROPULSIVE CAPABILITY. RESCUE REQUIRED. CREWPERSON STRANDED

REFERENCES:

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REPORT DATE 11/22/86 C-68

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 174 THC ISOLATE SWITCH ITEM: FAILURE MODE: FAIL OFF LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/2 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [NA] C [NA] LOCATION: PART NUMBER: CAUSES: MECHANICAL JAM, SWITCH MAT'L FAILS

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EFFECTS/RATIONALE: INABILITY TO ABORT VIA THC. MISSION TERMINATION.

REFERENCES:

REPORT DATE 11/22/86

DATE:		100	9/19/86					Η	IGH	İESI	C.	RII	'IC	AL	II	Y	HD	W/FU	JNC
SUBSYS MDAC I												FI	JIC	HI	!:			2/2	
			AUTOMA FAIL O		C AT	TITU	DE H	IOL	D S	נוש	CH								
LEAD A	NALYS'	r:]	P. BAIL	EY		S	UBSY	S	LEA	D:	G.	RA	FF	'AE	LL	ι			
BREAKD 1) M 2) E 3) 4) 5) 6) 7) 8) 9)	1MU		ARCHY: L SUBSY	STE	EM														
				, . •		CRI	TICA	LI	TIE	S									
		901, I	an na setti ta na <u>se</u> retti	FI	LIGH PRE		ASE :		Н	/ DW ر 3	/3 /2	NC							
REDUNI	DANCY	SCR	EENS:	A	[2]		в	[F	']			С	[F]			
LOCATI PART N		:																	
CAUSES	5: ME(CHAI	NICAL F	AII	LURE														
	SIVE US	SE (ALE: OF PROP TION RE			FOR	ROT	'AT	ION	IAL	MA	NEU	JVE	RS	•	MIS	SSI	ON	

REFERENCES:

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 REPORT DATE 11/22/86

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DATE: SUBSYSTEM:	MMU	HIGHEST C	RITICALITY FLIGHT:	
MDAC ID:	176		FDIGHI.	575
	AUTOMATIC ATTITUDE H E: FAIL OFF	OLD SWITCH	Ĩ	
LEAD ANALYS	T: P. BAILEY SUBSY:	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) ELECTRI 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTEM			
	CRITICA	LITIES		
	FLIGHT PHASE	HDW/FU 3/3	JNC	
	PRE-OPS: OPS:	3/3		
	POST-OPS:	3/3		
REDUNDANCY S	SCREENS: A [2]	В[Р]	С[Р]	
LOCATION: PART NUMBER	:		· · · · · · · · · · · · · · · · · · ·	· .
CAUSES: ME	CHANICAL FAILURE			
EFFECTS/RAT				
REFERENCES:				

REPORT DATE 11/22/86

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DATE: 9/19/8 SUBSYSTEM: MMU MDAC ID: 177	6	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/2
ITEM: ALTEF FAILURE MODE: FAIL		
LEAD ANALYST: P. BAI	Ley Subsy	IS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBS 3) 4) 5) 6) 7) 8) 9)	YSTEM	
	CRITICA	
V.	FLIGHT PHASE	HDW/FUNC 3/3
	PRE-OPS: OPS:	2/2
REDUNDANCY SCREENS:	A [2]	B[F] C[F]
LOCATION: PART NUMBER:		
CAUSES: MATERIAL FA	ILURE OF CONTAC	CTS-FRACTURE, UNDER TEMP
	INABILITY TO SE	E SATELLITE OR MATCH RATES WITH ELECTIVELY DISABLE AAH WITHOUT TO SELECT SATELLITE

STABILIZATION THRUSTER SELECT LOGIC. POSSIBLE MISSION IMPACT.

REFERENCES:

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REPORT DATE 11/22/86

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DATE: SUBSYSTEM:	9/19/86		HIGHEST C	RITICALITY	HDW/FUNC
SUBSYSTEM: MDAC ID:	MMU 178			FLIGHT:	3/3
ITEM: FAILURE MOD	ALTERNA E: FAIL ON	TE CONTROL MOI SATELLITE STA	DES SWITCH ABILIZER		
LEAD ANALYS	r: p. BAILE	Y SUBSYS	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYS	TEM			
		CRITICAL			
]	FLIGHT PHASE PRE-OPS:		NC	
		OPS: POST-OPS:	3/3		
REDUNDANCY	SCREENS:	A[2]	3 [F]	C [F]	
LOCATION: PART NUMBER	:			1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	
CAUSES: MA BINDS SWITC		URE DUE TO TH	ERMAL CYCL	ING, CONTAM	INATION
EFFECTS/RAT DEGRADATION STABILIZATI	TN ABILITY	TO PERFORM R SELECT LOGIC	OTATIONAL IS USED F	MANEUVERS. OR ALL COMM	SATELLITE NANDS.

REFERENCES:

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REPORT DATE 11/22/86

DATE: SUBŠYSTEM: MDAC ID:	MMU		HIGHEST	CRITICALITY FLIGHT:	
		ATE CONTROL MONIN IN "AXIS IN		СН	
LEAD ANALY	ST: P. BAIL	EY SUBS	YS LEAD:	G. RAFFAELLI	
1) MMU	HIERARCHY:	STEM			
		CRITIC	ALITIES		
		FLIGHT PHASE			
		PRE-OPS:	a /	3	
		OPS: POST-OPS:	3/	-	
REDUNDANCY	SCREENS:	A [2]	B [F]	C [F]	
LOCATION: PART NUMBE	CR:				
CAUSES: N BINDS SWIT		LURE DUE TO T	HERMAL CY	ĈLING, CONTAM	INATION
EFFECTS/RA		NAL AXES INHI	BIT FROM	AUTOMATIC ATT	ITUDE

ONE (OR MORE) ROTATIONAL AXES INHIBIT FROM AUTOMATIC ATTI HOLD. NO IMPACTS.

REFERENCES:

REPORT DATE 11/22/86

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DATE:	9/19/86		HIGHEST C	CRITICALITY	HDW/FUNC
SUBSYSTEM: MDAC ID:				FLIGHT:	3/3
	GYRO PHA E: FAIL OFF	SE PLANE LOG '1-3 CH.	IC		
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G	RAFFAELLI	
BREAKDOWN H 1) MMU 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYST	ΈM			
		CRITICA	LITIES		
	F	LIGHT PHASE		JNC	
		PRE-OPS: OPS:	3/3 3/3		
		POST-OPS:			
REDUNDANCY	SCREENS: A	[2]	B [NA]	C [NA]	
LOCATION: PART NUMBER	:				
CAUSES: MA	TERIAL DEFEC	T, OVERTEMP,	CONTACTS	FRACTURE, O	PEN
EFFECTS/RAT LOSS OF AAH	IONALE: IN AFFECTED	AXIS.			
REFERENCES:					

REPORT DATE 11/22/86 C-75

DATE: SUBSYSTEM: MDAC ID:	9/19/86 MMU 181		HIGHEST C	RITICALITY FLIGHT:	
		HASE PLANE LOG FALSE OUTPUTS	IC		
LEAD ANALYS	T: P. BAILF	EY SUBSY:	S LEAD: G.	RAFFAELLI	<u>.</u> .
BREAKDOWN H 1) MMU 2) ELECTR 3) CEA 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYS	STEM			
		CRITICA			
		FLIGHT PHASE PRE-OPS:	HDW/FU 3/3	NC	
	• •	PRE-OPS: OPS: POST-OPS:	3/3 3/3		
REDUNDANCY	SCREENS:	A [2]	B [NA]	C [NA]	
LOCATION: PART NUMBER					
CAUSES: MA	TERIAL DEFE	ECT DUE TO CON	TACTS FRAC	TURED, OVER	TEMP
EFFECTS/RAT MAY FORCE S		AAH. NO IMPAG	CTS.		
REFERENCES:			un mara su		

REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 182	HIGHEST CI	RITICALITY FLIGHT:	
ITEM: CEA PWR SPLY FAILURE MODE: FAIL HIGH OR LOW, GR 4.9V	EATER THAN	5.1V, LESS	
LEAD ANALYST: P. BAILEY SUBSY	'S LEAD: G.	RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITICA FLIGHT PHASE	LITIES	NC	
PRE-OPS: OPS: POST-OPS:	3/3 2/1R		
POST-OPS:	3/3		
REDUNDANCY SCREENS: A [2]	В[Р]	С[Р]	
LOCATION: SIDE A OR B PART NUMBER:			
CAUSES: OVERTEMP, SHORT			
EFFECTS/RATIONALE: DIGITAL LOGIC IN CEA FAILS DUE TO I OF CONTROL AUTHORITY TO THAT PROPUL LOGIC SELECT RESULTS IN MISSION TER CREWPERSON IF OTHER POWER SUPPLY FA	NCORRECT VO SION SIDE H MINATION. H	RESULTS. LO	SS OF CEA
REFERENCES:			

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 183		HIGHEST CH	RITICALITY FLIGHT:	
MDAC 1D: 185			r prom.	0, 11
ITEM: WIRE HARNES FAILURE MODE: SHORT OR OF		r		
LEAD ANALYST: P. BAILEY	SUBSYS	S LEAD: G.	RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)				
والمراجع المراجع	CRITICAL	LITIES		
Static Hermanica FLI			NC	
	RE-OPS: PS:	3/3 2/1R		
P	PS: OST-OPS:	3/3		
REDUNDANCY SCREENS: A [2]	В[Р]	C[P]	
LOCATION: SIDE A OR B PART NUMBER:				
CAUSES: CONTAMINATION, CO	ORROSION			
EFFECTS/RATIONALE: LOSS OF AFFECTED SIDE DUE AUTHORITY. POSSIBLE STRAND SIDES.	TO LACK O DING OF CR	F, OR ERRA EWPERSON WI	IIC, CONTRO ITH LOSS OF	L BOTH

REFERENCES:

REPORT DATE 11/22/86 C-78

DATE: 9/19/86	HIGHEST CR	ITICALITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 184	I	FLIGHT: 2/2
ITEM: EXTERNAL PO FAILURE MODE: FAIL OPEN,		
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. H	RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)		
	CRITICALITIES GHT PHASE HDW/FUNG	-
PI	GHT PHASE HDW/FOR RE-OPS: 2/2 PS: 3/3 OST-OPS: 2/2	~
REDUNDANCY SCREENS: A [2] B[P]	C [F]
LOCATION: SIDE A OR B PART NUMBER:		
CAUSES: BENT PIN, CONTAM	INATION	
EFFECTS/RATIONALE: LOSS OF HEATER POWER DURIN COMPONENT AND LOSS OF MISS		IN LOSS OF HEATED
REFERENCES :		

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU 2/2 FLIGHT: MDAC ID: 185 ITEM: HEATERS FAILURE MODE: FAIL OFF LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 2/2 PRE-OPS: 2/2 OPS: POST-OPS: 2/2 REDUNDANCY SCREENS: A [2] B [P] C [F] SIDE A OR B LOCATION: PART NUMBER: CAUSES: ELECTRICAL OPEN/SHORT EFFECTS/RATIONALE: POSSIBLE LOSS OF HEATED COMPONENT DURING STORAGE OR FLIGHT. MISSION TERMINATION REQUIRED.

REFERENCES:

REPORT DATE 11/22/86

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DATE: 9/19/ SUBSYSTEM: MMU	36 I	HIGHEST CRITICALITY	HDW/FUNC
MDAC ID: 186		FLIGHT:	2/1R
ITEM: HEAT FAILURE MODE: FAIL	ERS ON (CEA)		
LEAD ANALYST: P. BA	ILEY SUBSYS	LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY 1) MMU 2) ELECTRICAL SUB 3) 4) 5) 6) 7) 8) 9)			
	CRITICALI		
	FLIGHT PHASE PRE-OPS:	3/3	
	OPS: POST-OPS:		
REDUNDANCY SCREENS:	A [2] B	[P] C[P]	
LOCATION: SIDE A PART NUMBER:	A OR B		
CAUSES: MATERITAL	DEFECT IN THERMOST	'AT	
EFFECTS/RATIONALE: POSSIBLE LOSS OF CEA CREWPERSON IF BOTH (TEMP. POSSIBLE STR	ANDING OF
REFERENCES:			

REPORT DATE 11/22/86

DATE: 9/19/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 187	FLIGHT:	3/3
ITEM: GYROS FAILURE MODE: DRIFT		
LEAD ANALYST: P. BAIL	EY SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBSY 3) 4) 5) 6) 7) 8) 9)	STEM	
	CRITICALITIES FLIGHT PHASE HDW/FUNC	
	PRE-OPS: 3/3 OPS: 3/3	
	POST-OPS: 3/3	
REDUNDANCY SCREENS:	A[2] B[F] C[F]	
LOCATION: PART NUMBER:		
CAUSES: OUT OF SPEC.	TEMPERATURE	
EFFECTS/RATIONALE: CONTINUOUS ROTATIONAL MUST BE DISABLED).	INPUT, NO ATT. HOLD IN THAT AXIS.	(AAH

REFERENCES:

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REPORT DATE 11/22/86

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DATE: 9/19/80	6 HIGHEST CRITICA	LITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 188	FLIG	IT: 3/3
ITEM: GYROS FAILURE MODE: FAIL (
LEAD ANALYST: P. BAI	LEY SUBSYS LEAD: G. RAFFA	ELLI
BREAKDOWN HIERARCHY: 1) MMU 2) ELECTRICAL SUBS 3) 4) 5) 6) 7) 8) 9)	YSTEM	
	CRITICALITIES	
	FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3	
	OPS: 3/3 POST-OPS: 3/3	
REDUNDANCY SCREENS:	A[2] B[F] C[F]
LOCATION: PART NUMBER:		
CAUSES: OUT OF SPEC	. TEMPERATURE, ELECTRICAL OPEN	
EFFECTS/RATIONALE: NO AAH IN AFFECTED AX	XIS. MISSION MAY CONTINUE.	
REFERENCES :		

REPORT DATE 11/22/86

MDAC ID: 189 FLIGHT: 3/3 ITEM: ARM ANGLE ADJUST FAILURE MODE: ARM DOES NOT LATCH TO FLIGHT POSITION (UNLATCHED, LATCHED STOWED, LATCHED WORKSITE, LATCHED FLIGHT). LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FU	JNC
<pre>FAILURE MODE: ARM DOES NOT LATCH TO FLIGHT POSITION (UNLATCHED, LATCHED STOWED, LATCHED WORKSITE, LATCHED FLIGHT). LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.</pre>		FLIGHT: 3/3	
BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	FAILURE MODE: ARM DOES NOT LATCHED STOWED, LATCHED WORK	LATCH TO FLIGHT POSITION (UNLATCHED SITE, LATCHED FLIGHT).),
<pre>1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.</pre>	LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI	
FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9)		
OPS: 3/3 POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	FLIGHT	PHASE HDW/FUNC	
POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	PRE- OPS	OPS: 3/3 3/3	
LOCATION: LEFT OR RIGHT ARM PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	POSI		
PART NUMBER: CAUSES: MECHANISM BINDS, CONTAMINATION EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	REDUNDANCY SCREENS: A [2] B[P] C[P]	
EFFECTS/RATIONALE: LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.		ARM	
LATCH IS DISENGAGED ENTIRELY AND PINNED IN FLIGHT POSITION. NO IMPACTS.	CAUSES: MECHANISM BINDS, CO	NTAMINATION	
	LATCH IS DISENGAGED ENTIRELY	AND PINNED IN FLIGHT POSITION. NO	
	REFERENCES:	a An Braidhean an A	

REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 190 ARM LENGTH ADJUST ITEM: FAILURE MODE: FAIL UNLATCHED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU v parazzi na na na na na na STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2 2/2 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT SIDE PART NUMBER: CAUSES: MECHANISM BINDS

EFFECTS/RATIONALE:

POOR CREWMAN FIT CAN RESULT IN DIFFICULTY/INABILITY TO COMPLETELY CONTROL TRANSLATIONS OR ROTATIONS. MISSION IMPACT/TERMINATION.

REFERENCES:

REPORT DATE 11/22/86

DATE: 9/19/86 SUBSYSTEM: MMU MDAC ID: 191	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 2/2
ITEM: ARM LENGTH ADJUST FAILURE MODE: FAIL LATCHED SHORT	
LEAD ANALYST: P. BAILEY SUBS	YS LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9)	
CRITIC FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	HDW/FUNC 2/2
REDUNDANCY SCREENS: A [2]	В[Р] С[Р]
LOCATION: LEFT OR RIGHT SIDE PART NUMBER:	· · · · · · · · · · · · · · · · · · ·
CAUSES: ADJUSTS MECHANISM BINDS	
EFFECTS/RATIONALE:	

POOR CREWMAN FIT CAN RESULT IN DIFFICULTY/INABILITY TO COMPLETELY CONTROL TRANSLATIONS OR ROTATIONS. MISSION IMPACT/TERMINATION.

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 REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 192 ARM LENGTH ADJUST ITEM: FAILURE MODE: FAIL LATCHED LONG LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 2/2 PRE-OPS: 2/2 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: LEFT OR RIGHT SIDE PART NUMBER: CAUSES: ADJUSTS MECHANISM BINDS EFFECTS/RATIONALE: POOR CREWMAN FIT CAN RESULT IN DIFFICULTY/INABILITY TO COMPLETELY CONTROL TRANSLATIONS OR ROTATIONS. MISSION IMPACT/TERMINATION. **REFERENCES:**

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DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY	
MDAC ID: 194	FLIGHT:	212
ITEM: EXTERNAL POWER FAILURE MODE: FAIL CONNECTED		
LEAD ANALYST: P. BAILEY	SUBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9)		
	RITICALITIES	
	PHASE HDW/FUNC PS: 2/2	
OPS:	2/2	
POST-0	OPS: 3/3	-
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: PART NUMBER:		
CAUSES: CONNECTOR BINDS DUE	TO THERMAL CYCLING	
EFFECTS/RATIONALE: MISSION LOST, INABILITY TO LEA	AVE FSS.	
REFERENCES:		

REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 195 EXTERNAL POWER CONNECTOR ITEM: FAILURE MODE: FAIL DISCONNECTED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 2/2 3/3 OPS: 2/2 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [F] LOCATION: PART NUMBER: CAUSES: MECHANISM BINDS DUE TO THERMAL CYCLING EFFECTS/RATIONALE: COMPONENTS AND SUBSEQUENT USE OF MMU MAY BE LOST DUE TO LACK OF POWER TO HEATERS WHEN IN FSS. **REFERENCES:**

C-89

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HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU 2/1RFLIGHT: MDAC ID: 196 ITEM: PLSS LATCHES FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/2RPRE-OPS: 2/1R OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [F] C [P] LEFT OR RIGHT SIDE LOCATION: PART NUMBER: CAUSES: MECHANICAL BINDING OR DAMAGE, CONTAMINATION EFFECTS/RATIONALE: LAP BELTS PROVIDE BACKUP. LOSS OF LATCHING CAPABILITY MAY RESULT IN LOSS OF CREW VIA SEPARATION FROM MMU IF LAP BELT FAILS.

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/2R MDAC ID: 197 PLSS LATCHES ITEM: FAILURE MODE: FAIL CLOSED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/3 OPS: POST-OPS: 3/2R REDUNDANCY SCREENS: A [2] B [F] C [P] LEFT OR RIGHT SIDE LOCATION: PART NUMBER: CAUSES: MECHANICAL BINDING OR DAMAGE, CONTAMINATION EFFECTS/RATIONALE: ONLY ONE LATCH NEEDS TO OPERATE FOR PLSS RELEASE. IF ALL LATCHES FAIL CLOSED, CREWMEMBER ENTERS AIRLOCK WITH MMU ATTACHED AND SUBSEQUENT MISSIONS ARE IMPACTED. **REFERENCES:**

C-91

DATE: SUBSYSTEM:	9/19/86 MMU		HIGHEST (CRITICALITY	
MDAC ID:				FLIGHT:	2/2
	MMU BATT E: FAIL UNL				
LEAD ANALYS	T: P. BAILEY	SUBSYS	LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) STRUCTO 3) 4) 5) 6) 7) 8) 9)	IERARCHY: URES & MECHA	ANISMS			-
		CRITICAL			
	ti da F	LIGHT PHASE		JNC	
		PRE-OPS: OPS:	/113	4	
		POST-OPS:	3/3	-	
REDUNDANCY S	SCREENS: A	A[2] E	5 [P]	C[P]	
LOCATION: PART NUMBER	:				
CAUSES: ME	CHANICAL FAI	LURE - BINDS,	SPRING P	RACTURES	
EFFECTS/RAT	IONALE:				

LOSS OF SIDE RESULTS SINCE SECURE POWER SOURCE IS NOT AVAILABLE. MISSION TERMINATION.

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 199 MMU BATTERY LATCHES ITEM: FAILURE MODE: FAIL LATCHED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: 2/2 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P]

LOCATION: SIDE A OR B PART NUMBER:

CAUSES: MECHANICAL FAILURE - BINDS, SPRING FRACTURES

EFFECTS/RATIONALE:

BATTERY CANNOT BE RECHARGED, SUBSEQUENT MISSION LOST.

REFERENCES:

REPORT DATE 11/22/86

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DATE: 9/19/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 200	FLIGHT:	2/2
ITEM: BACKUP ARM LATCH FAILURE MODE: FAIL LATCHED		
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9)		
CRITICA		
FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	3/3 2/2	
REDUNDANCY SCREENS: A [2]		
LOCATION: RIGHT OR LEFT ARM PART NUMBER:		
CAUSES: SNAP FAILS MECHANICALLY -	BINDS	
EFFECTS/RATIONALE:		YABLE. TE

UNLESS LATCH IS CUT, ARM CANNOT BE RELEASED, MMU NOT FLYABLE. IF LATCH CUT, PRIMARY LATCH MUST BEAR ENTRY & LANDING LOADS ALONE.

REFERENCES:

REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 201 BACKUP ARM LATCH ITEM: FAILURE MODE: FAIL UNLATCHED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 2/2 OPS: 3/3 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] RIGHT OR LEFT ARM LOCATION: PART NUMBER: CAUSES: SNAP FAILS MECHANICALLY, DEBRIS IN SNAP EFFECTS/RATIONALE: ARM DAMAGED IF PRIMARY LATCH FAILS. MISSION IMPACT OR DAMAGE.

REFERENCES:

REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU 3/2R FLIGHT: MDAC ID: 202 QD THERMAL COVERS ITEM: FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: MMU 1) STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/2R OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER:

CAUSES: VELCRO FAILURE DUE TO EMBRITTLEMENT

EFFECTS/RATIONALE:

QD MAY BECOME INOPERABLE IF EXPOSED TO EXTREMES OF HEAT OR COLD. USE OTHER QD FOR RECHARGE. NO RECHARGE IF BOTH QD'S ARE FAILED. MISSION TERMINATION FOR SUBSEQUENT MISSIONS.

REFERENCES:

REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 203 ITEM: BATTERY THERMAL COVER FAILURE MODE: FAIL OPEN DURING STOWAGE LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: 2/2 POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: VELCRO FAILURE DUE TO EMBRITTLEMENT EFFECTS/RATIONALE: BATTERIES MAY FAIL DUE TO EXPOSURE TO TEMPERATURE EXTREMES. CAUSES DIFFICULTY WITH RECHARGE, POSSIBLE DELAY/LOSS IN SECOND MISSION.

REFERENCES:

REPORT DATE 11/22/86

DATE:	9/19/86 MMU		HIGHEST C	RITICALITY	HDW/FUNC
SUBSYSTEM: MDAC ID:	MMU 204			FLIGHT:	3/3
ITEM: FAILURE MOD	BATTERY S E: FAIL OPEN	THERMAL COVE N DURING FLIC	r Ght		
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) MMU 2) STRUCT 3) 4) 5) 6) 7) 8) 9)	IERARCHY: URES & MECHAN	NISMS			
		CRITICA	LITIES		
	F I	LIGHT PHASE	HDW/FU	INC	
		PRE-OPS: OPS:	3/3 3/3		
		OPS: POST-OPS:	3/3		
REDUNDANCY	SCREENS: A	[2]	B [F]	C [F]	
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: CR	EWMEMBER IMP.	ACT. VELCRO	FAILURE D	OUE TO EMBRI	TTLEMENT
EFFECTS/RAT NO IMPACT.	IONALE:				

REFERENCES:

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 REPORT DATE 11/22/86

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DATE: SUBSYSTEM: MDAC ID:	9/19/86 MMU 205	HIGHEST CR	RITICALITY FLIGHT:	
ITEM:	EXT. PWR. THERMAL CO E: FAIL OPEN DURING FLI			
LEAD ANALYST	T: P. BAILEY SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) STRUCTU 3) 4) 5) 6) 7) 8) 9)	IERARCHY: JRES & MECHANISMS			
	CRITICA FLIGHT PHASE		IC	
	PRE-OPS: OPS: POST-OPS:	3/3 3/3		
REDUNDANCY S	SCREENS: A [2]	B [P]	C[F]	
LOCATION: PART NUMBER:	:			
CAUSES: CRE	WMEMBER IMPACT. VELCRO	FAILURE DU	E TO EMBRI	TTLEMENT
EFFECTS/RATI NO IMPACT.	ONALE:			
REFERENCES :				

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/1R MDAC ID: 206 BACKUP PLSS LATCHES (LAP BELTS) ITEM: FAILURE MODE: FAIL OPEN DURING FLIGHT LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU 2) STRUCTURES & MECHANISMS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/2R PRE-OPS: 2/1R OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: CREW ERROR, WORN EYELET, BROKEN CONE EFFECTS/RATIONALE: REDUNDANT BACKUP LATCHES PREVENT LOSS OF CREW IN CASE OF PRIMARY LATCH/FAILURE. FULL COMPLEMENT OF LATCHES REQUIRED TO

BEGIN/CONTINUE FLIGHT. LOSS OF ALL LATCHES CAN RESULT IN LOSS OF CREWPERSON BY SEPARATION FROM MMU.

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REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/19/86 DATE: SUBSYSTEM: MMU FLIGHT: 2/2 MDAC ID: 207 BACKUP PLSS LATCHES ITEM: FAILURE MODE: FAIL CLOSED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) MMU STRUCTURES & MECHANISMS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/3 OPS: POST-OPS: 2/2 REDUNDANCY SCREENS: A [2] B [P] C [P] RIGHT OR LEFT SIDE LOCATION: PART NUMBER: CAUSES: BROKEN CONE DUE TO IMPACT OR MATERIAL DEFECT EFFECTS/RATIONALE: MMU LOST FOR SUBSEQUENT MISSION DUE TO LOSS OF FULL REDUNDANCY IN

LATCHES WHICH ENSURE CREWMEMBER RESTRAINT. .

REFERENCES:

REPORT DATE 11/22/86

C-101

DATE: 9/26/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC
MDAC ID: 208	FLIGHT: 3/2R
ITEM: GN2 LINES FAILURE MODE: LEAK	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) FSS 3) PNEUMATIC SUBSYSTEM 4) 5) 6) 7) 8) 9)	
FLIGHT PHASE PRE-OPS:	3/3
OPS: POST-OPS:	3/3 3/2R
REDUNDANCY SCREENS: A [2]	В[Р] С[Р]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: MATERIAL FAILURE, CREWMEMB	ER IMPACT, SEAL FAILURE
EFFECTS/RATIONALE: LOSS OF ONE RECHARGE SYSTEM, POSSIB COULD BE USED FOR RECHARGE). MISSIO	LE ORBITER GAS LOSS (OTHER FSS N LOST IF OTHER FSS LOST.
REFERENCES:	

REPORT DATE 11/22/86

DATE: 9/26/86 H SUBSYSTEM: MMU MDAC ID: 210	IGHEST CRITICALITY HDW/FUNC FLIGHT: 3/2R
ITEM: GN2 LINES FAILURE MODE: BLOCKED	
LEAD ANALYST: P. BAILEY SUBSYS	LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) FSS 3) PNEUMATIC SUBSYSTEM 4) 5) 6) 7) 8) 9)	
CRITICALI FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	
REDUNDANCY SCREENS: A [2] B	[P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	and an
CAUSES: CONTAMINATION, PINCHED BY CR	EWMEMBER IMPACT
EFFECTS/RATIONALE: LOSS OF ONE RECHARGE SYSTEM. SUBSEQUE SUBSYSTEM LOST.	NT MISSIONS LOST IF OTHER
REFERENCES:	

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REPORT DATE 11/22/86

DATE: 9/26/86 SUBSYSTEM: MMU MDAC ID: 211	HIGHEST CRITICALITY HDW/FU FLIGHT: 3/2H	
ITEM: PRESSURE GUAGE FAILURE MODE: LEAK		
LEAD ANALYST: P. BAILEY SU	JBSYS LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) FSS 3) PNEUMATIC SUBSYSTEM 4) 5) 6) 7) 8) 9)		
	TICALITIES	
	ASE HDW/FUNC	
PRE-OPS : OPS :		
POST-OPS		
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:	ang sa	
CAUSES: SAEL FAILURE/GALLED		
EFFECTS/RATIONALE:	THE FOR OF STREE BOSSIDLE	

LOSS OF GN2, INACCURATE GAS READINGS, LOSS OF SIDE. POSSIBLE LOSS OF SUBSEQUENT MISSIONS WITH LOSS OF BOTH SIDES.

REFERENCES:

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 REPORT DATE 11/22/86

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	GHEST CRITICALITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 212	FLIGHT: 3/2R
ITEM: VENT VALVE FAILURE MODE: FAIL CLOSED	
LEAD ANALYST: P. BAILEY SUBSYS I	EAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) MMU 2) FSS 3) PNEUMATIC SUBSYSTEM 4) 5) 6) 7) 8) 9)	
CRITICALIT FLIGHT PHASE	
PRE-OPS:	3/3 2/2
PRE-OPS: OPS: POST-OPS:	3/2R
REDUNDANCY SCREENS: A [2] B [P] C[P]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: DEBRIS/CONTAMINATION, MECHANI TOGGLE OR FOLLOWER, UNDER TEMP	CAL FAILURE, GALLING OF
EFFECTS/RATIONALE: LOSS OF AFFECTED RECHARGE SYSTEM. LOSS WITH LOSS OF BOTH SIDES.	OF SUBSEQUENT MISSIONS
REFERENCES:	

REPORT DATE 11/22/86

[.] .	DATE:		9	/26/8	6			HIGHE	EST C	RITICALITY	HDW/FUNC
	SUBSYS MDAC I	ID:	MMU 213							FLIGHT:	3/2R
	ITEM: FAILUR							<u> </u>			
	LEAD A	NALYST	C: P	. BAI	LEY		SUBS	YS LEAI	D: G.	RAFFAELLI	
	2) F	íMU				4					
							CRITIC				
						PRE-	PHASE OPS:		3/3	NC	
				-		OPS: POST	-OPS:		3/3 3/2R		
	REDUND	DANCY S	SCRE	ENS:	A	[2]	вгр]	C[P]	
	LOCATI PART N			IDE A	OR	В					
	CAUSES FAILUR		BRIS	, GAI	LIN	G OF	TOGGLE	OR FOI	LOWE	R, BELLEVIL	E SPRING
		BLE LOS PREMAT	SS C FURE)F AFF	FECTI	ED SI		ESSIVE	GAS	LOSS. GANS T MISSIONS	MĪGHT BE
										4 ⁷⁷	
	REFERE	ENCES:									

REPORT DATE 11/22/86

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DATE: 9/26/86 SUBSYSTEM: MMU	HIGHEST CRITICALITY	HDW/FUNC
MDAC ID: 214	FLIGHT:	3/2R
ITEM: VENT VALVE FAILURE MODE: LEAK		
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) MMU 2) FSS 3) PNEUMATIC SUBSYSTEM 4) 5) 6) 7) 8) 9)	te per la constante de la constante de la constante de la constante de	
CRITICA		
FLIGHT PHASE PRE-OPS:		
OPS:	3/3	
POST-OPS:	3/2R	
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: SIDE A OR B PART NUMBER:	• • • • • • • • • • • • • • • • • • •	
CAUSES: O-RING FAILURE		
EFFECTS/RATIONALE: LOSS OF ONE RECHARGE SYSTEM, POSSIBI LOST IF OTHER FSS LOST.	LE ORBITER GAS LOSS. I	MISSION
REFERENCES :		

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REPORT DATE 11/22/86 C-107

DATE:	9/26/86 MMU		HIGHEST C	RITICALITY	HDW/FUNC
MDAC ID:	MMU 215			FLIGHT:	3/3
	QD-HOSE END : FAIL OPEN, 1				
LEAD ANALYST	: P. BAILEY	SUBSYS	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) MMU 2) FSS 3) PNEUMAT 4) 5) 6) 7) 8) 9)	ERARCHY: IC SUBSYSTEM				
		CRITICAL	LITIES		
	PR	E-OPS:	HDW/FU 3/3 3/3 3/3	INC	
REDUNDANCY S	CREENS: A [С[Р]	
LOCATION: PART NUMBER:	SIDE A OR B				
CAUSES: THR	EADS GALLED O-1	RING DAMA	Ge -		
EFFECTS/RATI NO EFFECT TO				···· :	
REFERENCES:					

REPORT DATE 11/22/86

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DATE: SUBSYSTEM: MDAC ID:	MMU	HIGHES	T CRITICALITY FLIGHT:	
ITEM: FAILURE MOD	QD-HOSE END E: FAIL CLOSED			
LEAD ANALYS	F: P. BAILEY	SUBSYS LEAD:	G. RAFFAELLI	
BREAKDOWN H 1) FSS 2) PNEUMA 3) 4) 5) 6) 7) 8) 9)	IERARCHY: TIC SUBSYSTEM			
		CRITICALITIES	/	
			/3	
			/3 /2R	
REDUNDANCY	SCREENS: A [2] B[P]	C[P]	
LOCATION: PART NUMBER	SIDE A OR B			
CAUSES: TH	READ GALL CONTA	MINATION		
EFFECTS/RAT LOSS OF AFF SIDES LOST.		LOSS OF SUBSEQUE	NT MISSIONS IF	вотн
REFERENCES:				

REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC DATE: 9/26/86 SUBSYSTEM: MMU FLIGHT: 3/2R MDAC ID: 217 QD-FIXED HALF ITEM: FAILURE MODE: LEAK, FAILED OPEN SUBSYS LEAD: G. RAFFAELLI LEAD ANALYST: P. BAILEY BREAKDOWN HIERARCHY: 1) FSS PNEUMATIC SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/3 OPS: POST-OPS: 3/2RREDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: POPPET NOT SEALED, O-RING DAMAGE, DEBRIS EFFECTS/RATIONALE: LOSS OF RECHARGE SIDE IF LEAK BAD ENOUGH. GANS WOULD REQUIRE MANUAL ACTUATION. POSSIBLE LOSS OF SUBSEQUENT MISSIONS IF OTHER

REFERENCES:

SIDE FAILS.

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REPORT DATE 11/22/86

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DATE: SUBSYSTEM: MDAC ID:	MMU	HIGHEST CR	ITICALITY	
ITEM:	QD-FIXED HALF E: FAILED CLOSED			
LEAD ANALYST	: P. BAILEY SUBS	YS LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) FSS 2) PNEUMAT 3) 4) 5) 6) 7) 8) 9)	TERARCHY:			
		ALITIES	20	
	FLIGHT PHASE PRE-OPS:	3/3	C	
	OPS: POST-OPS:	3/3 3/2R		
REDUNDANCY S	SCREENS: A [2]	B [P]	C[P]	
LOCATION: PART NUMBER:	SIDE A OR B			
CAUSES: DEE	BRIS, GALLING OF POPPET			
EFFECTS/RATI LOSS OF RECH MANUAL ACTUA FAILS.	IONALE: HARGE SIDE IF LEAK BAD ATION. LOSS OF SUBSEQUE	ENOUGH. GAN NT MISSIONS	S WOULD REG IF OTHER S	QUIRE IDE
REFERENCES:				

REPORT DATE 11/22/86 C-111

DATE: SUBSYSTEM: 1 MDAC ID: 2	MMU	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 3/1R
ITEM: FAILURE MODE	GAS ACTUATED NUTS (4 : FAIL OPEN	L)
LEAD ANALYST	P. BAILEY SUBSY	'S LEAD: G. RAFFAELLI
BREAKDOWN HI 1) FSS 2) PNEUMAT 3) 4) 5) 6) 7) 8) 9)	ERARCHY: IC SUBSYSTEM	
	CRITICA FLIGHT PHASE	
	PRE-OPS:	3/3
	OPS: POST-OPS:	3/3 3/1R
REDUNDANCY SO	CREENS: A [2]	B[P] C[P]
LOCATION: PART NUMBER:	SIDE A OR B	
	MENT BINDING, PISTON BI RE, STRIPPED THREADS, U	NDING/GALLING, O-RING FAILURE, INDERTEMP
MAY ALLOW DAN MISSION. "IR" BECAUSE OTHER HARD LA	KUP TO FSS/PLSS LATCHES MAGE TO MMU DURING ENTF IF THEY FAIL DURING EN ANDING, MMU MAY FREE IT	5. LOSS OF MORE THAN ONE GAN RY BUT HAS NO IMPACT ON MMU TTRY, ESPECIALLY AN ABORT OR CSELF FROM THE FSS AND IT ROLLS AROUND THE PLB.
REFERENCES:		

REPORT DATE 11/22/86

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DATE: 9/26/86 SUBSYSTEM: MMU MDAC ID: 220	HIGHEST (CRITICALITY FLIGHT:	
ITEM: GAS ACTUATED NUTS (4 FAILURE MODE: FAIL CLOSED	L)		
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G	. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) FSS 2) PNEUMATIC SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)			
CRITICA FLIGHT PHASE PRE-OPS: OPS: POST-OPS:		INC	
REDUNDANCY SCREENS: A [2]	В[Р]	с[]	
LOCATION: SIDE A OR B PART NUMBER:			
CAUSES: SEGMENT BINDING, PISTON BI UNDERTEMP	NDING, GAI	LLED THREADS	,
EFFECTS/RATIONALE: MISSION TERMINATION DUE TO EMU STUC AVAILABLE TO BACK BOLTS OUT/IN).	K IN STATI	-	
REFERENCES:	* *** **		

REPORT DATE 11/22/86

DATE: 9/26/86	HIGHEST	CRITICALITY HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 221		FLIGHT: 3/2R
ITEM: FILTER FAILURE MODE: LEAK		
LEAD ANALYST: P. BAILY	SUBSYS LEAD: G	. RAFFAELLI
BREAKDOWN HIERARCHY: 1) FSS 2) PNEUMATIC SUBSYST 3) 4) 5) 6) 7) 8) 9)	ГЕМ	
e e e	CRITICALITIES FLIGHT PHASE HDW/F PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/2	
REDUNDANCY SCREENS:	A [2] B [P]	С[Р]
LOCATION: SIDE A (PART NUMBER:	DR B	
CAUSES: SEAL FAILURE	، م الح المراجع ا الم	
SHUTDOWN OF BOTH SIDES MISSIONS.	SHUTDOWN OF SIDE AND D PREVENTS MMU RECHARGE	
	· · · · · · · · · · · · · · · · · · ·	
REFERENCES:		<u> </u>

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DATE: SUBSYSTEM:	9/26/86	- ·	HIGHEST C	RITICALITY	HDW/FUNC
MDAC ID:	222			FLIGHT:	3/2R
ITEM: FAILURE MODI	FILTER E: FRACTURE				
LEAD ANALYS	r: p. bailey	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN HI 1) FSS 2) PNEUMA 3) 4) 5) 6) 7) 8) 9)	IERARCHY: TIC SUBSYSTEN	4			
		CRITICA			
	FI	LIGHT PHASE PRE-OPS:	3/2F	2	
		OPS: POST-OPS:	3/3 3/2F	ι	
REDUNDANCY	SCREENS: A				
LOCATION: PART NUMBER	SIDE A OR	В			
CAUSES: EMI	BRITTELMENT I	DUE TO UNDER	TEMP		
DEBRIS PRODU OF SIDE IF I SCERNAIO WII RECHARGE/VEI OR OTHER FII	IONALE: UCED MAY CAUS REDUNDANT FII LL IMPACT SUN NT VALVES ON LTER VALVES O ION, FAILING	SE MALFUNCTI LTER ELEMENT BSEQUENT MIS FSS TO CLOG DR REGULATOR	S WERE TO SIONS. MA DUE TO DE IN MMU PN	ALSO FAIL. Y CAUSE BRIS,	SUCH A
REFERENCES:					

HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 223 GAN HEATERS ITEM: FAILURE MODE: OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM GAN 1-4 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/3 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: SHORT, OPEN CIRCUIT

EFFECTS/RATIONALE: GAN MAY MALFUNCTION WITH LOSS OF HEATER, BUT BOLT CAN BE MANUALLY OPERATED.

REFERENCES:

REPORT DATE 11/22/86

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SUBSYSTEM: MMU	HIGHEST CRITICALITY HDW/FUNC
MDAC ID: 224	FLIGHT: 3/3
ITEM: HEATER FOR FSS RECHA FAILURE MODE: FAIL OPEN, SHORT CIR	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA	LITIES
FLIGHT PHASE	HDW/FUNC
PRE-OPS: OPS: POST-OPS:	3/3 3/3
REDUNDANCY SCREENS: A [2]	в[Р] С[Р]
LOCATION: SIDE A OR B PART NUMBER:	
CAUSES: MATERIAL FAILURE OF CONTAC	TS-FRACTURE DEBRIS
EFFECTS/RATIONALE: IF HEATER FAILS, FILTER MAY BECOME PRESSURIZATION IMPULSE. REQUIRES DO IMPACTS.	
REFERENCES :	

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC SUBSYSTEM: MMU MDAC ID: 225 FLIGHT: 3/2R ITEM: TOGGLE VALVE HEATERS FAILURE MODE: OPEN CIRCUIT, SHORT CIRCUIT LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: - Partic Line - - - -1) FSS 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 OPS: 3/3 POST-OPS: 3/2R REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: MATERIAL FAILURE OF CONTACTS-FRACTURE DEBRIS EFFECTS/RATIONALE: TOGGLE VALVE MAY FAIL TO OPERATE. USE OTHER SIDE FOR RECHARGE. TERMINATION OF SUBSEQUENT MISSIONS IF BOTH SIDES FAILED. **REFERENCES:**

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SUBSYSTEM:			HIGHEST C	RITICALITY			
MDAC ID:	226			FLIGHT:	3/3		
	PRESSURE E: FAIL OPEN						
LEAD ANALYS	LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI						
BREAKDOWN H 1) FSS 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTF	EM					
- /							
	ान	CRITICA LIGHT PHASE		NC			
		PRE-OPS:	3/3				
		OPS: POST-OPS:	3/3 3/3				
REDUNDANCY	SCREENS: A	[2]	В[Р]	C[P]			
LOCATION: PART NUMBER	SIDE A OR	В		.71 23			
CAUSES: MA	TERIAL FAILUF	RE OF CONTAC	TS-FRACTUR	E DEBRIS			
EFFECTS/RAT	IONALE: AGE MAY MALFU	INCTION. NO	IMPACTS.				
REFERENCES :							

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HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU 3/2R FLIGHT: MDAC ID: 227 **QD HEATERS** ITEM: FAILURE MODE: FAIL OFF, OPEN CIRCUIT, SHORT CIRCUIT LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3OPS: POST-OPS: 3/2R **REDUNDANCY SCREENS:** A[2] B[P] C[P] LOCATION: SIDE A OR B PART NUMBER: CAUSES: MATERIAL FAILURE OF CONTACTS-FRACTURE DEBRIS

EFFECTS/RATIONALE: QD MAY FAIL CAUSING LOSS OF ONE RECHARGE SIDE. LOSS OF BOTH SIDES INHIBITS PERFORMACE OF SUBSEQUENT MISSIONS.

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU 3/2R FLIGHT: MDAC ID: 228 HEATER THERMOSTATS ITEM: FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: FSS 1) ELECTRICAL SUBSYSTEM 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3 3/3 OPS: POST-OPS: 3/2R REDUNDANCY SCREENS: A [2] B [P] C [P] SYSTEM A OR B LOCATION: PART NUMBER: CAUSES: MATERIAL FAILURE OF CONTACTS-FRACTURE, THERMAL CYCLING EFFECTS/RATIONALE: HEATED COMPONENTS (QDs) MAY FAIL DUE TO UNDERTEMP. POSSIBLE LOSS OF SUBSEQUENT MISSIONS IF BOTH QDs ARE FAILED.

REFERENCES:

REPORT DATE 11/22/86

C-121

DATE: SUBSYSTEM: M	ſMU	HIGHEST C	RITICALITY	
MDAC ID: 2	29		FLIGHT:	3/3
	HEATER THERMOST FAIL CLOSED	TATS		
LEAD ANALYST:	P. BAILEY	SUBSYS LEAD: G.	RAFFAELLI	
BREAKDOWN HIE 1) FSS 2) ELECTRIC 3) 4) 5) 6) 7) 8) 9)	ERARCHY: CAL SUBSYSTEM			
	· · · · · · · · · · · · · · · · · · ·	RITICALITIES		
	FLIGHT	PHASE HDW/FU	NC	
	PRE-O	PS: 3/3		
	OPS:	PS: 3/3 3/3 OPS: 3/3		
	POST-(OPS: 3/3		
REDUNDANCY SC	CREENS: A [2]	В[Р]	C[P]	
LOCATION: PART NUMBER:	SYSTEM A OR B			
CAUSES: CONT	TIMNATION, CONTAC	TS-FRACTURE		
EFFECTS/RATION HEATED COMPON	ONALE: Nents May Fàil Dùi	E TO OVERTEMP.	NO CRITICAL	IMPACTS.

REFERENCES:

REPORT DATE 11/22/86

C-122

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DATE: 9/26/86 SUBSYSTEM: MMU	HIGHEST CRIT	ICALITY HDW/FUNC			
SUBSYSTEM: MMU MDAC ID: 230	FL	IGHT: 3/3			
ITEM: TOGGLE FAILURE MODE: LOSS C	VALVE TEMP. SENSORS				
LEAD ANALYST: P. BAII	EY SUBSYS LEAD: G. RA	FFAELLI			
BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)					
	CRITICALITIES				
	FLIGHT PHASE HDW/FUNC PRE-OPS: 3/3				
	0.00 . 2/3				
	POST-OPS: 3/3				
REDUNDANCY SCREENS:	A [2] B [P]	С[Р]			
LOCATION: PART NUMBER:	-				
CAUSES: ELECTRICAL C)PEN	n na statu n Za daž na statu na st			
EFFECTS/RATIONALE: LOSS OF TEMP. INDICAT	ION; MISSION CONTINUES. NO	IMPACTS.			
REFERENCES:					

REPORT DATE 11/22/86 C-123

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DATE: SUBSYSTEM: M MDAC ID: 2	MU		HIGHEST (CRITICALITY FLIGHT:	_
ITEM: FAILURE MODE:			ENSORS		
LEAD ANALYST:	P. BAILEY	SUBSY	S LEAD: G	. RAFFAELLI	
BREAKDOWN HIE 1) FSS 2) ELECTRIC 3) 4) 5) 6) 7) 8) 9)		ЕМ			
		CRITICA			
	FI	LIGHT PHASE PRE-OPS:		JNC	
		OPS:	3/3		
		POST-OPS:	3/3		
REDUNDANCY SC	REENS: A	[2]	B [P]	С[Р]	
LOCATION: PART NUMBER:					
CAUSES: MATE	RIAL FAILU	RE (CHEMICAL	ABSORBTI	ON-OZONE)	
EFFECTS/RATIO FALSE HIGH RE		SION CONTINU	ES. NO IM	PACT.	

REFERENCES:

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REPORT DATE 11/22/86

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HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 MDAC ID: 232 TOGGLE VALVE TEMP. SENSORS ITEM: FAILURE MODE: FAIL LOW LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM A OR B TEMP SENSORS 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: MATERIAL FAILURE (CHEMICAL ABSORBTION-OZONE) EFFECTS/RATIONALE:

FALSE LOW READING; MISSION CONTINUES.

REFERENCES:

DATE: 9/26/86 SUBSYSTEM: MMU MDAC ID: 233	HIGHEST CRITICALITY HDW/FUNC FLIGHT: 3/3
ITEM: ORBITER POWER CONNEC FAILURE MODE: FAIL OPEN (1 OR MORE	
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI
BREAKDOWN HIERARCHY: 1) FSS 2) ELECTRICAL SUBSYSTEM 3) 4) 5) 6) 7) 8) 9)	
CRITICA	
FLIGHT PHASE PRE-OPS:	HDW/FUNC 3/3
OPS: POST-OPS:	3/3 3/3
REDUNDANCY SCREENS: A [2]	B[P] C[F]
LOCATION: PART NUMBER:	
CAUSES: DEBRIS, PIN FAILURE DUE TO	MISALIGNMENT OR FRACTURE
EFFECTS/RATIONALE: LOSS OF PARTIAL OR ALL HEATER POWER TEMPERATURE SENSOR OUTPUT. HEATED C CONTINUES; SOME THERMAL CONDITIONIN	OMPONENTS MAY FAIL. MISSION

REFERENCES:

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REPORT DATE 11/22/86

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DATE:		HIGHEST CRIT	ICALITY HDW/FUNC
SUBSYSTEM: MDAC ID:		FL	IGHT: 3/3
	EXTERNAL POWER LINE E: OPEN CIRCUIT	E/CONNECTOR	<u>.</u> .
LEAD ANALYS	T: P. BAILEY SUBS	SYS LEAD: G. RA	FFAELLI
BREAKDOWN HI 1) FSS 2) ELECTR 3) 4) 5) 6) 7) 8) 9)	IERARCHY: ICAL SUBSYSTEM		
		CALITIES	
	FLIGHT PHASE PRE-OPS: OPS: POST-OPS:	3/3	
REDUNDANCY	SCREENS: A [2]	B[P]	С[Р]
LOCATION: PART NUMBER	:		
CAUSES: DEI	BRIS IN CONNECTOR, DAMA	AGED PIN/INSULT	ATION

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EFFECTS/RATIONALE:

FULL OR PARTIAL LOSS OF HEATER POWER TO MMU AND/OR MMU TEMPERATURE "SENSOR OUTPUT" FROM MMU IS RESULT OF CONNECTOR FAILURE. MISSION CONTINUES; THERMAL PRECONDITIONING MAY BE REQUIRED.

REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM:	9/26/86		HIGHES	T CRITICALITY	HDW/FUNC
MDAC ID:	235			FLIGHT:	3/1R
ITEM: FAILURE MOD		R ADAPTOR BEAM RE	MOUNTS	(6)	
LEAD ANALYS	T: P. BAIL	EY SUBSY	S LEAD:	G. RAFFAELLI	
BREAKDOWN H 1) FSS 2) STRUCT 3) 4) 5) 6) 7) 8) 9)					
		CRITICA		•	
		FLIGHT PHASE	HDW	/FUNC /1R	
		OPS:	3	/1R	
		PRE-OPS: OPS: POST-OPS:	3	/1R	
REDUNDANCY	SCREENS:	A [2]	В[Р]	С[Р]	
LOCATION: PART NUMBER	:				
CAUSES: MA	TERIAL FAI	LURE DUE TO FA	TIGUE O	R THERMAL CYCI	LING
EFFECTS/RAT LOSS OF ONE SEPARATION ASCENT OR E	BOLT IS TO OF FSS FROM	OLERABLE. LOS M ORBITER; POS	S OF AL SIBLE D	L BOLTS CAUSES AMAGE TO ORBIT	S MER DURING

REFERENCES:

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REPORT DATE 11/22/86

HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/2R MDAC ID: 237 BACKBEAM SHOCK MOUNTS (4) ITEM: FAILURE MODE: SPLITTING, FRACTURING LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS STRUCTURES 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/2R PRE-OPS: 3/2R OPS: 3/2R POST-OPS: REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: MECHANICAL FAILURE, UNDERTEMP, CHEMICAL ATTACK EFFECTS/RATIONALE: LOSS OF SHOCK ISOLATION ALLOWS TRANSMISSION OF VIBRATION TO

LOSS OF SHOCK ISOLATION ALLOWS TRANSMISSION OF VIBRATION TO FSS/MMU RESULTING IN POSSIBLE DAMAGE TO AND LOSS OF FSS/MMU FOR MISSION OPERATIONS.

REFERENCES:

REPORT DATE 11/22/86

DATE: SUBSYSTEM: N MDAC ID: 2	MMU	HIGHEST	CRITICALITY FLIGHT:	
	FOOT RESTRAINT : JAM UNLOCKED	ADJUST		
LEAD ANALYST	: P. BAILEY	SUBSYS LEAD: G	. RAFFAELLI	
BREAKDOWN HIN 1) FSS 2) MECHANIS 3) 4) 5) 6) 7) 8) 9)				
		RITICALITIES		
	FLIGHT PRE-O	PHASE HDW/F PS: 3/3		
	OPS: POST-(PS: 3/3 3/3 OPS: 3/3]	
REDUNDANCY SO	CREENS: A [2]	B [P]	С[Р]	
LOCATION: PART NUMBER:				
CAUSES: GALI	LING, DEBRIS			
EFFECTS/RATION MISSION CONT	ONALE: INUES WITH OR WITH	HOUT FOOT/RESTF	AINT.	

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HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/3 239 MDAC ID: FOOT RESTRAINT ADJUST ITEM: FAILURE MODE: JAM LOCKED LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS 2) MECHANISM 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: POST-OPS: 3/3 REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: in the second CAUSES: GALLING, DEBRIS EFFECTS/RATIONALE: MISSION CONTINUES WITH OR WITHOUT FOOT/RESTRAINT.

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REFERENCES:

DATE:	9/26/86	HIGHEST C	RITICALITY	HDW/FUNC
SUBSYSTEM: M MDAC ID: 2			FLIGHT:	3/3
ITEM: FAILURE MODE:				
LEAD ANALYST:	P. BAILEY S	UBSYS LEAD: G.	RAFFAELLI	
BREAKDOWN HIE 1) FSS 2) MECHANIS 3) 4) 5) 6) 7) 8) 9)				
		TICALITIES		
	FLIGHT PH	ASE HDW/FU	NC	
	OPS:	: 3/3 3/3 S: 3/3		
	POST-OP	S: 3/3		
REDUNDANCY SC	REENS: A [2]	B [P]	C[P]	
LOCATION: PART NUMBER:	SIDE A OR B			
CAUSES: DEBR	IS, MATERIAL GALLI	NG		
EFFECTS/RATIC LAUNCH RESTRA REQUIRES MMU	NALE: NINT BOLTS (GANS) B STRAPDOWN IN MIDDE	ACKUP LATCHES. CK.	LOSS OF G	ANS ALSO
REFERENCES :				

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DATE: SUBSYSTEM: MDAC ID:			HIGHEST C	RITICALITY FLIGHT:	
ITEM:	MMU LATCH E: JAM CLOSE				
LEAD ANALYS	T: P. BAILEY	SUBSY	S LEAD: G.	RAFFAELLI	
BREAKDOWN H 1) FSS 2) MECHAN 3) 4) 5) 6) 7) 8) 9)			·		
		CRITICA			
	FI	JIGHT PHASE PRE-OPS: OPS: POST-OPS:	_	INC	
REDUNDANCY	SCREENS: A	[2]	В[Р]	С[Р]	
LOCATION: PART NUMBER	SIDE A OR	В		на стария. Спорти	
CAUSES: DE	BRIS, MATERIA	L GALLING	ta i a gradati		
EFFECTS/RATIONALE: RELEASED/DISENGAGED MANUALLY. BACKED UP BY GAS ACTUATED NUTS. LATCH JAMMED CLOSED PREVENTS MMU FROM BEING RELEASED FROM FSS. LATCH CAN BE OVERRIDDEN MANUALLY IF NECESARY, WHICH DISABLES LATCH. GAS ACTUATED NUTS WOULD THEN BE ENGAGED TO SECURE MMU IN FSS. REFERENCES:					

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DATE: 9/26/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM: MMU MDAC ID: 242	FLIGHT:	3/3
ITEM: MUSHROOM KNOBS (8) FAILURE MODE: FRACTURE		
LEAD ANALYST: P. BAILEY SUBSY	S LEAD: G. RAFFAELLI	
BREAKDOWN HIERARCHY: 1) FSS 2) STRUCTURE 3) 4) 5) 6) 7) 8) 9) CRITICA	ALITIES	
FLIGHT PHASE PRE-OPS:	HDW/FUNC	
OPS: POST-OPS:	3/3	
REDUNDANCY SCREENS: A [2]	B[P] C[P]	
LOCATION: LEFT AND RIGHT SIDE F PART NUMBER:	AILS	
CAUSES: MATERIAL FAILURE		
EFFECTS/RATIONALE: NO EFFECT; MISSION CONTINUES.	an i the states and so the second	en e
REFERENCES:		

REPORT DATE 11/22/86

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INDEPENDENT ORBITER ASSESSMENT ORBITER SUBSYSTEM ANALYSIS WORKSHEET HIGHEST CRITICALITY HDW/FUNC 9/26/86 DATE: SUBSYSTEM: MMU FLIGHT: 3/2R 243 MDAC ID: THERMAL BLANKETS ITEM: FAILURE MODE: FAIL OPEN LEAD ANALYST: P. BAILEY SUBSYS LEAD: G. RAFFAELLI BREAKDOWN HIERARCHY: 1) FSS 2) 3) 4) 5) 6) 7) 8) 9) CRITICALITIES FLIGHT PHASE HDW/FUNC 3/3 PRE-OPS: 3/3 OPS: POST-OPS: 3/2R REDUNDANCY SCREENS: A [2] B [P] C [P] LOCATION: PART NUMBER: CAUSES: VELCRO RELEASE i e e e i e e i e e i EFFECTS/RATIONALE: OD'S OR RECHARGE SYSTEM VALVES MAY MALFUNCTION FROM THERMAL EXPOSURE RESULTING IN LOSS OF RECHARGE AND SUBSEQUENT MISSION CAPABILITY. **REFERENCES:**

REPORT DATE 11/22/86

SUBSYSTEM:		HIGHEST CRITICALITY	_
MDAC ID:	244	FLIGHT:	3/3
ITEM: FAILURE MOD	TETHER REEL RESTRAIN E: FRACTURE	4. L	
LEAD ANALYS	T: P. BAILEY SUBSY	IS LEAD: G. RAFFAELLI	
BREAKDOWN H 1) FSS 2) STRUCT 3) 4) 5) 6) 7) 8) 9)			•
	CRITIC	ALITIES	
		HDW/FUNC	
	PRE-OPS:	3/3	
	OPS: POST-OPS:	- 3/3	
REDUNDANCY	SCREENS: A [2]	B [P] C [P]	
LOCATION: PART NUMBER	RIGHT OR LEFT SIDERAT	IL	
CAUSES: MA	TERIAL FAILURE DUE TO T	HERMAL CYCLING	
EFFECTS/RAT MISSION CON	IONALE: TINUES WITH OR WITHOUT 1	RESTRAINT.	

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DATE: 9/26/86	HIGHEST CRITICALITY	HDW/FUNC		
SUBSYSTEM: MMU MDAC ID: 245	FLIGHT:	3/3		
ITEM: TETHER REEL RESTRAIN FAILURE MODE: DEFORMATION	NT			
LEAD ANALYST: P. BAILEY SUBSY	YS LEAD: G. RAFFAELLI			
BREAKDOWN HIERARCHY: 1) FSS 2) STRUCTURES 3) 4) 5) 6) 7) 8) 9)				
CRITICATE DHASE	ALITIES HDW/FUNC			
PRE-OPS: OPS:				
POST-OPS:				
REDUNDANCY SCREENS: A [2]	B [P] C [P]			
LOCATION: RIGHT OR LEFT SIDERAIL PART NUMBER:				
CAUSES: THERMAL CYCLING				
EFFECTS/RATIONALE: MISSION CONTINUES WITH OR WITHOUT RESTRAINT.				
REFERENCES:				

REPORT DATE 11/22/86

APPENDIX D POTENTIAL CRITICAL ITEMS

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		POTENTIAL CRITICAL ITEMS	
	CRIT	ITEM	FAILURE MODE
169	1/1	THC THC RHC RHC THC ISOLATE SWITCH GN2 TANK ISOLATION VALVE GN2 LINES THRUSTER MANIFOLD THRUSTER MANIFOLD THRUSTER THRUSTER THRUSTER THRUSTER GN2 REGULATOR GN2 REGULATOR GN2 REGULATOR GN2 RELIEF VALVE PRESSURE GAGE GN2 TEST PORT BATTERY INTERNAL/EXTERNAL POWER SW	FAIL ON 1-3 AXES
170	1/1	THC	FAIL OFF 1-3 AXES
171	1/1	RHC	FAIL ON (1-3 AXES)
172	1/1	RHC	FAIL OFF (1-3 AXES)
173	1/1	THC ISOLATE SWITCH	FAIL ON
100	2/1R	GN2 TANK	LEAK
105	2/1R	ISOLATION VALVE	FAIL CLOSE
106	2/1R	GN2 LINES	LEAK
110	2/1R	THRUSTER MANIFOLD	LEAK
111	2/1R	THRUSTER MANIFOLD	CONSTRICTION
112	2/1R	THRUSTER	FAIL OPEN
113	2/1R	THRUSTER	FAIL CLOSED
114	2/1R	THRUSTER	LEAK
116	2/1R	GN2 REGULATOR	FAIL CLOSED
117	2/1R	GN2 REGULATOR	FAIL OPEN
120	2/1R	GN2 RELIEF VALVE	FAIL OPEN
122	2/1R	PRESSURE GAGE	LEAK
127	2/1R	GN2 TEST PORT	LEAK
128	2/1R	BATTERY	NO OUTPUT - LOW
			OUTPUT
		INTERNAL/EXTERNAL POWER SW	
	· _	TERMINAL BOARD TERMINAL BOARD MAIN POWER SWITCH LTS/HTR.cb	POSITION
132	2/1R	TERMINAL BOARD	SHORT
133	2/1R	TERMINAL BOARD	FAIL OPEN
134	2/1R	MAIN POWER SWITCH	FAIL OFF
136	2/1R	LTS/HTR.cb CEA CIRCUIT BREAKER VDA cb	FAIL OPEN
138	2/1R	CEA CIRCUIT BREAKER	FAIL OPEN
142	2/1R	VDA CD	FAIL OPEN
152	2/1R	VDA cb CEA POWER SWITCH CEA POWER SWITCH CONTROL ELECTRONICS ASSY CONTROL ELECTRONICS ASSY CONTROL ELECTRONICS ASSY	FAIL ON IN ISO.
154	2/1R	CEA POWER SWITCH	FAIL OFF
158	2/1R	CONTROL ELECTRONICS ASSY	FAIL ON 1-12 CH.
159	2/1R	CONTROL ELECTRONICS ASSY	FAIL OFF 1-12 CH.
161	2/1R	CONTROL ELECTRONICS ASSY	LOGIC FAILURE
164	2/1R	ISOLATION VALVE TIMER	FAILS ON
166	2/1R	VALVE DRIVER AMPLIFIER	FAIL OFF
167	2/1R	VALVE DRIVER AMPLIFIER	FAIL ON
168	2/1R	VALVE DRIVER AMPLIFIER	NOISY
182	2/1R	CEA PWR SPLY	FAIL HIGH OR LOW,
			GREATER THAN 5.1V,
			LESS THAN 4.9V

APPENDIX D POTENTIAL CRITICAL ITEMS

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		PUTENTIAL CATTICAL TIEMS	
	CRIT		FAILURE MODE
183	2/1R	WIRE HARNESS HEATERS PLSS LATCHES BACKUP PLSS LATCHES (LAP BELTS) TOGGLE VALVE ISOLATION VALVE GN2 REGULATOR RECHARGE QUICK DISCONNECT INTERNAL/EXTERNAL POWER SW MAIN POWER SWITCH	SHORT OR OPEN
186	2/1R	HEATERS	FAIL ON (CEA)
196	2/18	PLSS LATCHES	FATL OPEN
206	2/10	BACKUD DLSS LATCHES	FATL OPEN DURING
200	2/11	(LAP BELTS)	FLIGHT
103	2/2	TOGGLE VALVE	FAIL CLOSED
104	$\frac{2}{2}/2$	TSOLATION VALVE	FAIL OPEN
110	2/2	GN2 REGULATOR	FATL LOW
125	2/2	PECHARGE OUTCE DISCONNECT	FATL OPEN/LEAK
130	2/2	INTERNAL / FYTERNAL DOWER SW	FATL TO INTERNAL
100	2/2	INIEMARD, EXIEMARD I OWER OW	POSTTION
125	2/2	MATH DOWER SWITCH	FATL ON
160	2/2	TSOLATION VALVE TIMED	FAIL OFF
162	2/2	TSOLATION VALVE TIMER	TOO SHORT
174	2/2	THE TSOLATE SWITCH	FATL OFF
175	2/2	AUTOMATIC ATTITUDE HOLD SW	FATL ON
177	2/2	ALTERNATE CONTROL MODES SW	FAIL OFF
184	2/2	EXTERNAL POWER CONNECTOR	FAIL OPEN 1 OR
104	4/4	MAIN POWER SWITCH ISOLATION VALVE TIMER ISOLATION VALVE TIMER THC ISOLATE SWITCH AUTOMATIC ATTITUDE HOLD SW ALTERNATE CONTROL MODES SW EXTERNAL POWER CONNECTOR	MORE PINS
185	2/2	HEATERS	FATL OFF
190	2/2	ARM LENGTH ADJUST	FATL UNLATCHED
191	2/2	ARM LENGTH ADJUST	FAIL LATCHED SHORT
192	2/2	ARM LENGTH ADJUST	FAIL LATCHED LONG
194	2/2	EXTERNAL POWER CONNECTOR	FAIL CONNECTED
195	2/2	EXTERNAL POWER CONNECTOR	FAIL DISCONNECTED
198	$\frac{2}{2}$	MMU BATTERY LATCHES	FAIL UNLATCHED
199	272	MMU BATTERY LATCHES	FAIL LATCHED
200	2/2	BACKUP ARM LATCH	FAIL LATCHED
201	2/2	BACKUP ARM LATCH	FAIL UNLATCHED
203	2/2	BATTERY THERMAL COVER	FAIL OPEN DURING
		HEATERS ARM LENGTH ADJUST ARM LENGTH ADJUST ARM LENGTH ADJUST EXTERNAL POWER CONNECTOR EXTERNAL POWER CONNECTOR MMU BATTERY LATCHES MMU BATTERY LATCHES BACKUP ARM LATCH BACKUP ARM LATCH BATTERY THERMAL COVER BACKUP PLSS LATCHES GAS ACTUATED NUTS (4) PLSS LATCHES FILTER	STOWAGE
207	2/2	BACKUP PLSS LATCHES	FAIL CLOSED
220	2/2	GAS ACTUATED NUTS (4)	FAIL CLOSED
197	3/2R	PLSS LATCHES	FAIL CLOSED
222	3/2R	FILTER	FRACTURE

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