

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE  
NUMBER:M8-1SS-E052 -X**

**SUBSYSTEM NAME: ECLSS - ISS NITROGEN TRANSFER SYSTEM  
REVISION: 1 10/22/97**

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**PART DATA**

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	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	:LINES & FITTINGS	M072-643415
LRU	:LINES & FITTINGS	V028-643053
LRU	:LINES & FITTINGS	M072-643416
LRU	:LINES & FITTINGS	V076-643036
LRU	:LINES & FITTINGS	ME276-0054-1001
SRU	:LINES & FITTINGS MULTIPLE SOURCES	MULTIPLE P/N'S

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
ISS NITROGEN TRANSFER LINES, FITTINGS, & QUICK DISCONNECTS**

**QUANTITY OF LIKE ITEMS: 1  
ONE SET PER SUBSYSTEM**

**FUNCTION:**  
PROVIDES A SINGLE SUPPLY PATH OF NITROGEN FROM THE PAYLOAD BAY MMU INTERFACE PANEL TO A QUICK DISCONNECT LOCATED AT THE DOCKING BASE/PMA INTERFACE. NITROGEN LINES BETWEEN THE MMU INTERFACE PANEL AND DOCKING BASE ARE MOUNTED OUTSIDE OF THE EXTERNAL AIRLOCK. NITROGEN LINES THAT EXTEND FROM THE DOCKING BASE BULKHEAD TO THE ISS ARE ROUTED INSIDE THE DOCKING BASE AND ISS PMA.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -NON-CIL HARDWARE  
NUMBER: MB-1SS-E062-X**

**REFERENCE DOCUMENTS:** VB28-643053  
VS28-643001  
V076- 643036  
M072-643415  
M072-643416

**FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE**

**NUMBER: M8-1SS-E052-01**

**REVISION#: 0            04/08/97**

**SUBSYSTEM NAME: ECLSS - ISS NITROGEN TRANSFER SYSTEM**

**LRU: ISS NITROGEN TRANSFER LINES**

**CRITICALITY OF THIS**

**ITEM NAME: LINES, FITTINGS, & QUICK DISCONNECTS**

**FAILURE MODE: 1R3**

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**FAILURE MODE:**

**EXTERNAL LEAKAGE (GROSS)**

**MISSION PHASE:        OO ON-ORBIT  
                          DO DE-ORBIT**

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:    103 DISCOVERY  
    104 ATLANTIS  
    105 ENDEAVOUR**

**CAUSE:**

**CORROSION, MECHANICAL SHOCK, EXCESSIVE VIBRATION**

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

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**REDUNDANCY SCREEN        A) PASS  
    B) N/A  
    C) PASS**

**PASS/FAIL RATIONALE:**

**A)**

**B)**

**N/A - REDUNDANCY PROVIDED BY WORKAROUNDS ARE IN STANDBY UNTIL REQUIRED.**

**C)**

**METHOD OF FAULT DETECTION:**

**INSTRUMENTATION - REDUCED OR LOSS OF ORBITER GN2 SYSTEM PRESSURE INDICATION. PPO2 DETECTORS WITHIN ORBITER MID DECK COULD ACTIVATED THE CAUTION AND WARNING SYSTEM IF OXYGEN LEVELS WERE REDUCED DUE TO A LONG TERM NITROGEN LEAK. AN INTERNAL LEAK OF N2 THAT WOULD RESULT IN HABITABLE PRESSURE EXCEEDING 15.2 PSIA WOULD SOUND A CLASS II ALARM.**

**CORRECTING ACTION: MANUAL**

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**CORRECTING ACTION DESCRIPTION:**

A FLOW RESTRICTOR (ORIFICE) LOCATED IN THE NITROGEN LINE NEAR THE ORBITER INTERFACE WILL REDUCE THE FLOW RATE OF NITROGEN TO 25 +/- 1 LBM/HR, IN THE EVENT A LEAK DOWNSTREAM OCCURS. CREW CAN ISOLATE LEAKAGE BY: (1) CLOSING THE N2 MANUAL SHUT-OFF VALVE IF LEAK IS DOWNSTREAM OF THE DOCKING BASE O2/N2 PANEL; OR (2) CLOSING THE SYS 1 MMU ISO VALVE IF LEAK IS DOWNSTREAM OF THE PAYLOAD BAY MMU INTERFACE PANEL. IN THE EVENT EXTERNAL LEAKAGE CANNOT BE ISOLATED, THE CREW CABIN AREA CONTAINS SUFFICIENT NITROGEN FOR CREW SURVIVAL DURING ABORTED MISSION DE-ORBIT AND LANDING PHASES.

**REMARKS/RECOMMENDATIONS:**

A SINGLE PATH PROVIDES NITROGEN TO THE ISS FROM THE ORBITER GN2 SYSTEM. NITROGEN LINES DOWNSTREAM OF MMU SYS 1 ISO VALVE ARE NOT PRESSURIZED UNTIL NITROGEN TRANSFER TO ISS TAKES PLACE. ISS GN2 TRANSFER CAN OCCUR DURING SLEEP CYCLES, DURING CREW OR CARGO TRANSFERS BETWEEN ORBITER AND ISS, OR DURING EVA ACTIVITY.

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

NITROGEN SUPPLY IS DIVERTED BEFORE IT REACHES THE SPACE STATION.

**(B) INTERFACING SUBSYSTEM(S):**

GROSS EXTERNAL LEAKAGE COULD RESULT IN INADEQUATE N2 SUPPLY FOR CREW CABIN AIR MAKEUP, WATER TANKS, AND EXTERNAL AIRLOCK REPRESSURIZATION. POSSIBLE HIGH NITROGEN PRESSURE IN DOCKING BASE AND ISS PMA IF LEAKAGE OCCURS FROM A LINE OR FITTING LOCATED INTERNAL TO THE HABITABLE VOLUME. HIGH CONCENTRATIONS OF N2 COULD REDUCE THE PERCENT OF OXYGEN BELOW THAT NEEDED FOR HUMAN SURVIVAL.

**(C) MISSION:**

LOSS OF MISSION OBJECTIVES ASSOCIATED WITH TRANSFERRING GN2 TO SPACE STATION. INCREASED USE OF ORBITER NITROGEN SUPPLY WOULD RESULT IN EARLY MISSION TERMINATION.

**(D) CREW, VEHICLE, AND ELEMENT(S):**

EXTERNAL LEAKAGE OF NITROGEN COULD PREMATURELY DEplete ORBITER NITROGEN SUPPLY FOR CONSUMABLE MAKEUP CAPABILITY WHEN REQUIRED RESULTING IN LOSS OF CREW AND VEHICLE. INABILITY TO SHUTDOWN LEAKAGE OF N2 WITHIN DOCKING BASE AND PMA COULD RESULT IN HIGH LEVELS OF N2 WITHIN THESE AREAS. HIGH CONCENTRATIONS OF N2 COULD POTENTIALLY REDUCE THE PERCENTAGE OF OXYGEN BELOW THAT NEEDED FOR HUMAN SURVIVAL CAUSING CREW ASPHYXIATION. LOSS OF N2 SUPPLY TO ISS COULD IMPACT SPACE STATION

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OPERATIONS. POTENTIAL FOR CREW INJURY OR LOSS DUE TO A HIGH PRESSURE JET FROM AN EXPOSED GN2 LINE PIN HOLE LEAK DURING AN IVA OR EVA.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

FIRST FAILURE (EXTERNAL LEAKAGE OF LINE, FITTING, OR QUICK DISCONNECT) - GN2 IS DIVERTED AWAY FROM THE SPACE STATION RESULTING IN POTENTIAL IMPACT TO SPACE STATION OPERATIONS. INCREASED USE OF ORBITER NITROGEN SUPPLY.  
SECOND FAILURE (FAILURE TO CLOSE MMU SYS 1 ISO VALVE) - INABILITY TO ISOLATE A DOWNSTREAM N2 LEAK USING THIS VALVE. INCREASE USE OF CONSUMABLES WOULD RESULT IN PREMATURE DEPLETION OF GN2 TANKS. LOSS OF EVA CAPABILITIES DUE TO INABILITY TO REPRESSURIZE EXTERNAL AIRLOCK RESULTING FROM LACK OF CONSUMABLES. CREW WOULD HAVE TO RELY ON CONSUMABLES REMAINING IN CREW CABIN DURING ORBITER'S RETURN TO EARTH. UNCONTROLLED EXTERNAL LEAKAGE OF NITROGEN WOULD RESULT IN EARLY MISSION TERMINATION. - CRITICALITY 2R3 CONDITION.

**DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 2R3**

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

THIRD FAILURE (EXTERNAL LEAKAGE OF CABIN PRESSURE) - LOSS OF CABIN PRESSURE WITH NO N2 MAKEUP CAPABILITY WOULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION.

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**- TIME FRAME -**

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**TIME FROM FAILURE TO CRITICAL EFFECT: DAYS**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS**

**TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: SECONDS**

**IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?  
YES**

**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:**

CREW WOULD HAVE AMPLE TIME TO CLOSE GN2 ISOLATION VALVE TO STOP EXTERNAL LEAKAGE BEFORE PROBLEM BECAME CATASTROPHIC.

**HAZARD REPORT NUMBER(S): ORBI 071, ORBI 404, ORBI 405, ORBI 406**

**HAZARD(S) DESCRIPTION:**

INADEQUATE NITROGEN SUPPLY TO MAINTAIN CABIN PRESSURE (ORBI 071). IVA CREW HAZARDS DUE TO ISS ODS: HIGH PRESSURE LEAK JETS IN GN2 LINES (ORBI 404). EVA CREW HAZARDS DUE TO ISS ODS: HIGH PRESSURE LEAK JETS IN GN2 LINES (ORBI 405). LOSS OF HABITABLE ENVIRONMENT IN THE CREW CABIN/ODS HABITABLE VOLUME DUE TO FLOODING OF VOLUME WITH GASEOUS NITROGEN (ORBI 406).

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- APPROVALS -

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SS & PAE  
DESIGN ENGINEER

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: K. J. KELLY

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