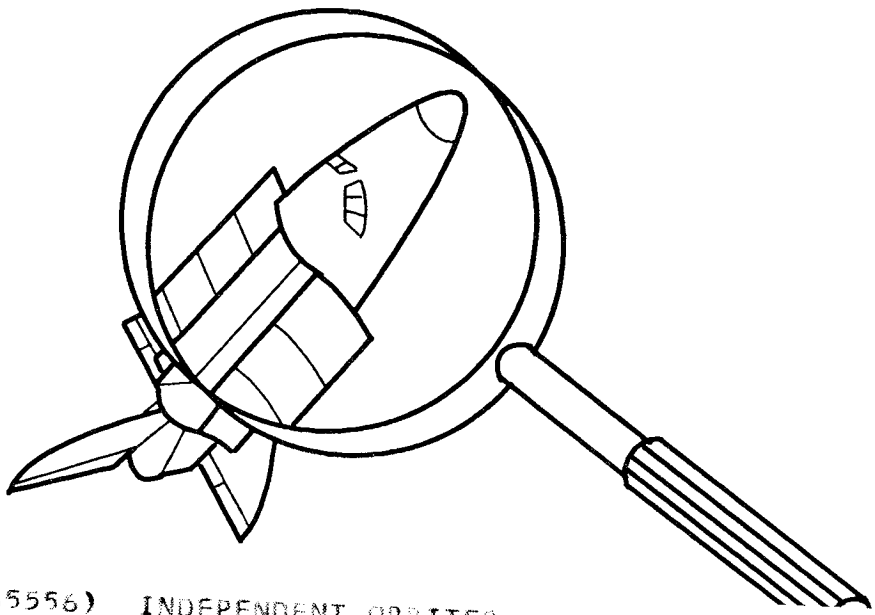
CR-185556

INDEPENDENT ORBITER ASSESSMENT

ANALYSIS OF THE ELECTRICAL POWER GENERATION/POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM



(NASA-CR-185556) INDEPENDENT ORBITER ASSESSMENT (IOA): ANALYSIS OF THE ELECTRICAL POWER GENERATION/POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM (McDonnell-Douglas Astronautics Co.) 205 p

N90-10918

CSCL 22B G3/16

Unclas
0211581

MCDONNELL DOUGLAS

INDEPENDENT ORBITER ASSESSMENT

ANALYSIS OF THE ELECTRICAL POWER GENERATION/POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM

5 DECEMBER 1986

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
HOUSTON DIVISION

SPACE TRANSPORTATION SYSTEM ENGINEERING AND OPERATIONS SUPPORT

WORKING PAPER NO. 1.0-WP-VA86001-11

INDEPENDENT ORBITER ASSESSMENT ANALYSIS OF THE ELECTRICAL POWER GENERATION/POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM

5 December 1986

This Working Paper is Submitted to NASA under
Task Order No. VA86001, Contract NAS 9-17650

PREPARED BY: S.M. Gotch
S.M. Gotch
EPG/PRSD Lead Analyst
Independent Orbiter
Assessment

APPROVED BY: M.R. Hiott
M.R. Hiott
EPG/PRSD Lead
Independent Orbiter
Assessment

APPROVED BY: G.W. Knori
G.W. Knori
Technical Manager
Independent Orbiter
Assessment

APPROVED BY: W.F. Huning
W.F. Huning
Deputy Program Manager
STSEOS

CONTENTS

List of Figures

List of Tables

Independent Orbiter Assessment
Analysis of the Electrical Power Generation/Power Reactant Storage and Distribution Subsystem

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 Orbiter Electrical Power Generation (EPG)/Power Reactants Storage and Distribution (PRSD) System hardware.

The EPG/PRSD hardware is required for performing critical functions of cryogenic hydrogen and oxygen storage and distribution to the Fuel Cell Powerplants (FCP) and Atmospheric Revitalization Pressure Control Subsystem (ARPCS). Specifically, the EPG/PRSD hardware consists of the following:

- o Hydrogen (H2) tanks
- o Oxygen (02) tanks
- o H2 Relief Valve/Filter Packages (HRVFP)
- o O2 Relief Valve/Filter Packages (ORVFP)
- o H2 Valve Modules (HVM)
- o 02 Valve Modules (OVM)
- o 02 and H2 lines, components, and fittings

The IOA analysis process utilized available EPG/PRSD hardware drawings and schematics for defining hardware assemblies, components, and hardware items. Each level of hardware was evaluated and analyzed for possible failure modes and effects. Criticality was assigned based upon the severity of the effect for each failure mode.

Figure 1 presents a summary of the failure criticalities for each of the seven major divisions of the EPG/PRSD. 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 Failure Modes By Criticality (HW/F)							
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
Number :	38	38	-	31	4	51	162

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

Summary of IOA Potential Critical Items (HW/F)						
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	TOTAL
Number :	38	38	-	6	-	82

EPG/PRSD OVERVIEW ANALYSIS SUMMARY

EPG/PRSD ANALYSIS SUMMARY

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	38	38	3/2R	4	0
2/1R	38	38	3/3	51	0
3/1R	31	6			

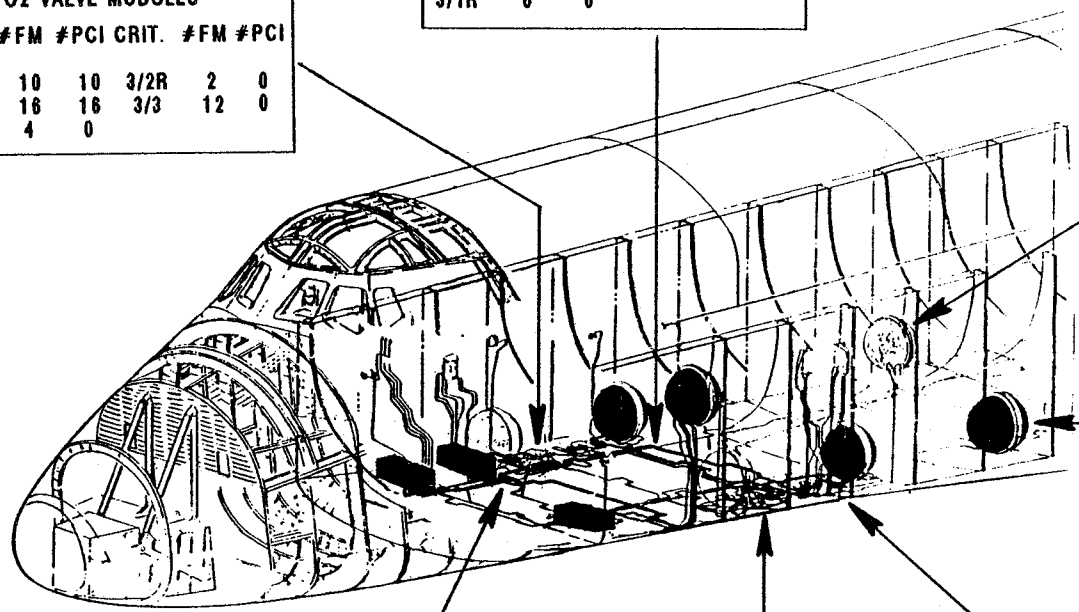
CRIT - CRITICALITY
FM - FAILURE MODE
PCI - POTENTIAL CRITICAL ITEM

O2 & H2 LINES & FITTINGS

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	2	2	3/2R	0	0
2/1R	2	2	3/3	0	0
3/1R	0	0			

O2 VALVE MODULES

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	10	10	3/2R	2	0
2/1R	16	16	3/3	12	0
3/1R	4	0			



O2 TANKS

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	6	6	3/2R	0	0
2/1R	1	1	3/3	16	0
3/1R	7	3			

H2 TANKS

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	6	6	3/2R	0	0
2/1R	1	1	3/3	-13	0
3/1R	8	3			

O2 RELIEF VALVE/FILTER PACKAGES

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	3	3	3/2R	0	0
2/1R	3	3	3/3	0	0
3/1R	4	0			

H2 VALVE MODULES

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	8	8	3/2R	2	0
2/1R	12	12	3/3	10	0
3/1R	4	0			

H2 RELIEF VALVE/FILTER PACKAGES

CRIT.	#FM	#PCI	CRIT.	#FM	#PCI
1/1	3	3	3/2R	0	0
2/1R	3	3	3/3	0	0
3/1R	4	0			

Figure 1 - EPG/PRSD 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 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 FMEAs/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 EPG/PRSD Ground Rules and Assumptions

The EPG/PRSD ground rules and assumptions used in the IOA are defined in Appendix B.

3.0 SUBSYSTEM DESCRIPTION

3.1 Design and Function

The EPG/PRSD consists of hardware that is required for cryogenic hydrogen and oxygen storage and distribution to the FCP and ARPCS. Reference Figures 2 and 3. The EPG/PRSD consists of the following divisions:

1. The Hydrogen (H2) tanks can number from 2 to 5 (each tank having a 1:1 correspondence to an oxygen tank). The H2 reactant is stored in the tank at an initial temperature of -424 degrees F. Each tank consists of an A and B heater, heater controller pressure sensor, tank pressure sensor, fluid temperature sensor, quantity sensor, heater assembly temperature sensor, relief valve and port, and fill and vent Quick Disconnects (QD) with caps. The reactant flow to the fuel cells is controlled by operation of the heaters which in turn are controlled by the heater controller. Reference Figure 4.

2. There is a H2 Relief Valve/Filter Package for each H2 tank. All HRVFP's have a filter, and the ones for tanks 1 and 2 contain a manifold relief valve, while those for tanks 3 and 4 contain a check valve. The filters extract reactant impurities which could degrade fuel cell performance. The manifold relief valves relieve excess manifold pressure by allowing reactants to flow into tanks 1 or 2. The check valves prevent reactants from flowing back into the tank in the event it is at a low pressure. Tanks 4 and 5 share a check valve. Reference Figure 5.

3. There are 2 H2 Valve Modules. Both HVMs contain a check valve (one for tank 1, one for tank 2), a manifold shutoff valve and its position indicator, and a manifold pressure sensor. HVM 1 contains a horizontal drain QD and cap. HVM 1 also contains one fuel cell reactant supply valve and its position sensor, while HVM 2 contains two of each. HVM 2 also contains a Ground Support Equipment (GSE) valve and GSE Time Zero (T-0) fill QD. The manifold valves can be used to isolate manifold 1 from 2. The GSE valve and fill QD allow the fuel cells to run on ground reactants before launch. Reference Figure 6.

4. The Oxygen (O2) tanks flown on a mission can number from 2 to 5. The O2 reactant is stored in the tank at an initial temperature of -300 degrees F. Each tank contains heaters labeled A1, A2, B1 and B2, with one heater assembly consisting of A1 and B1 and the other containing A2 and B2. The tanks also consist of a temperature sensor for each heater assembly, fluid temperature sensor, quantity sensor, pressure sensor, heater controller pressure sensor, relief valve and port, fill QD and cap, and vent QD and cap. In a five tank configuration, the B heater in tanks 4 and 5 are not operational. Reference Figure 7.

5. There is an O2 Relief Valve/Filter Package for each O2 tank. All ORVFP's have a filter, plus the ones for tanks 1 and 2 contain a manifold relief valve, while those for tanks 3 and 4 contain a check valve. Reference Figure 8.

6. There are 2 O2 Valve Modules. Both OVM's contain a check valve (one for tank 1, one for tank 2), a manifold shutoff valve and its position indicator, a manifold pressure sensor, and an ECLSS system supply valve and its position sensor. HVM 1 contains one fuel cell reactant supply valve and its position sensor, while HVM 2 contains two of each. HVM 1 contains a GSE valve and GSE fill T-O QD. HVM 2 contains a horizontal drain QD and cap. Reference Figure 9.

7. The O2 and H2 lines, components, and fittings made up a separate category outside of the six major divisions.

3.2 Interfaces and Locations

The EPG/PRSD interfaces directly with the FCP and ARPCS. Hydrogen and Oxygen are supplied to the FCP's while oxygen is supplied to the ARPCS. The PRSD subsystem components are installed in the mid-fuselage of the Orbiter beneath the payload bay liner. The H2 and O2 tanks are arranged on both sides of the mid-fuselage in a random type of order. Reference Figure 10. The O2 and H2 relief and drain ports are located on both sides of the Orbiter fuselage. Reference Figures 11 and 12.

3.3 Hierarchy

Figures 2 and 3 illustrate the hierarchy of the EPG and PRSD systems, respectively. The PRSD subsystems are depicted in Figures 4 through 9.

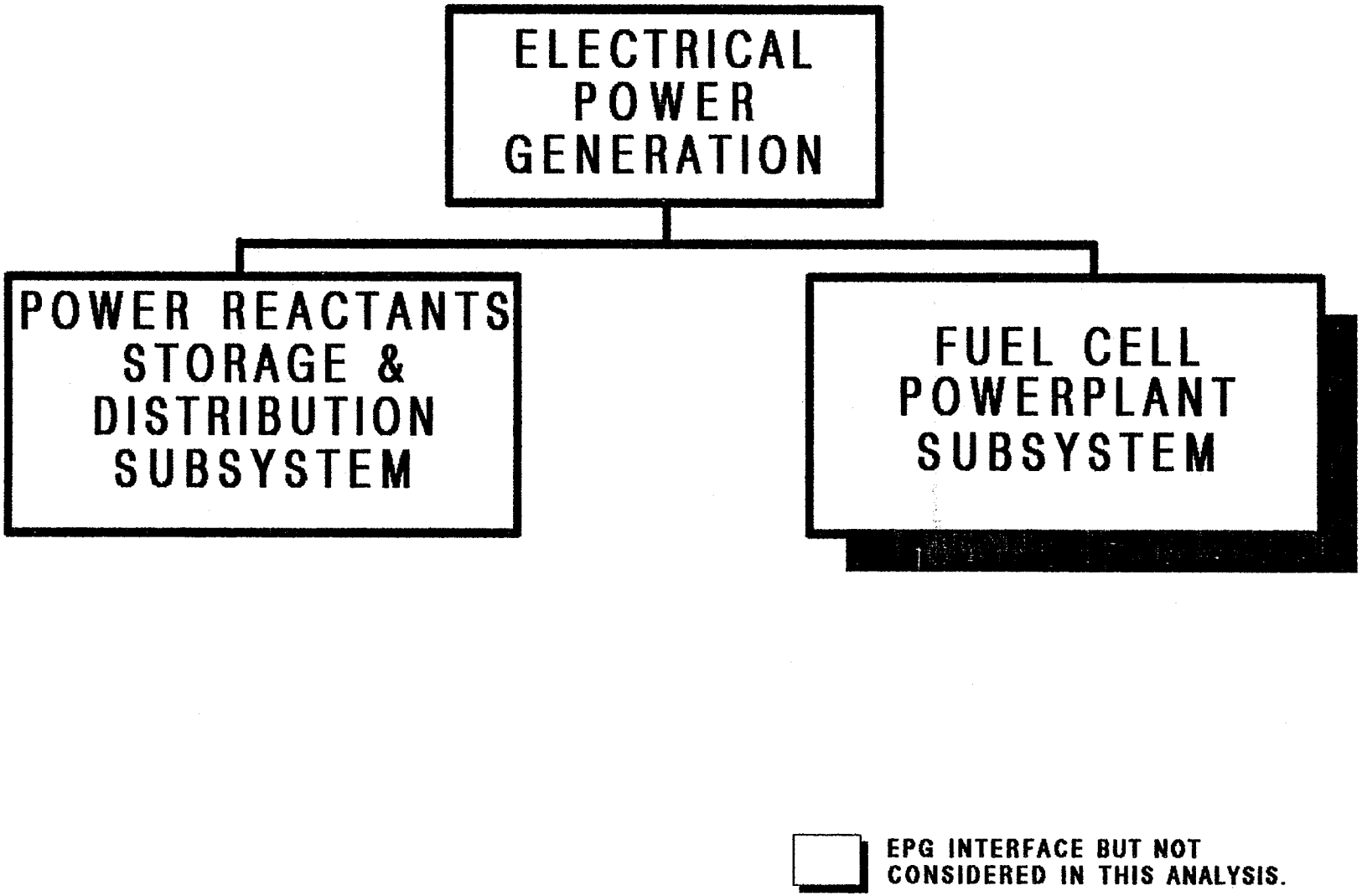


Figure 2 - EPG SUBSYSTEM OVERVIEW

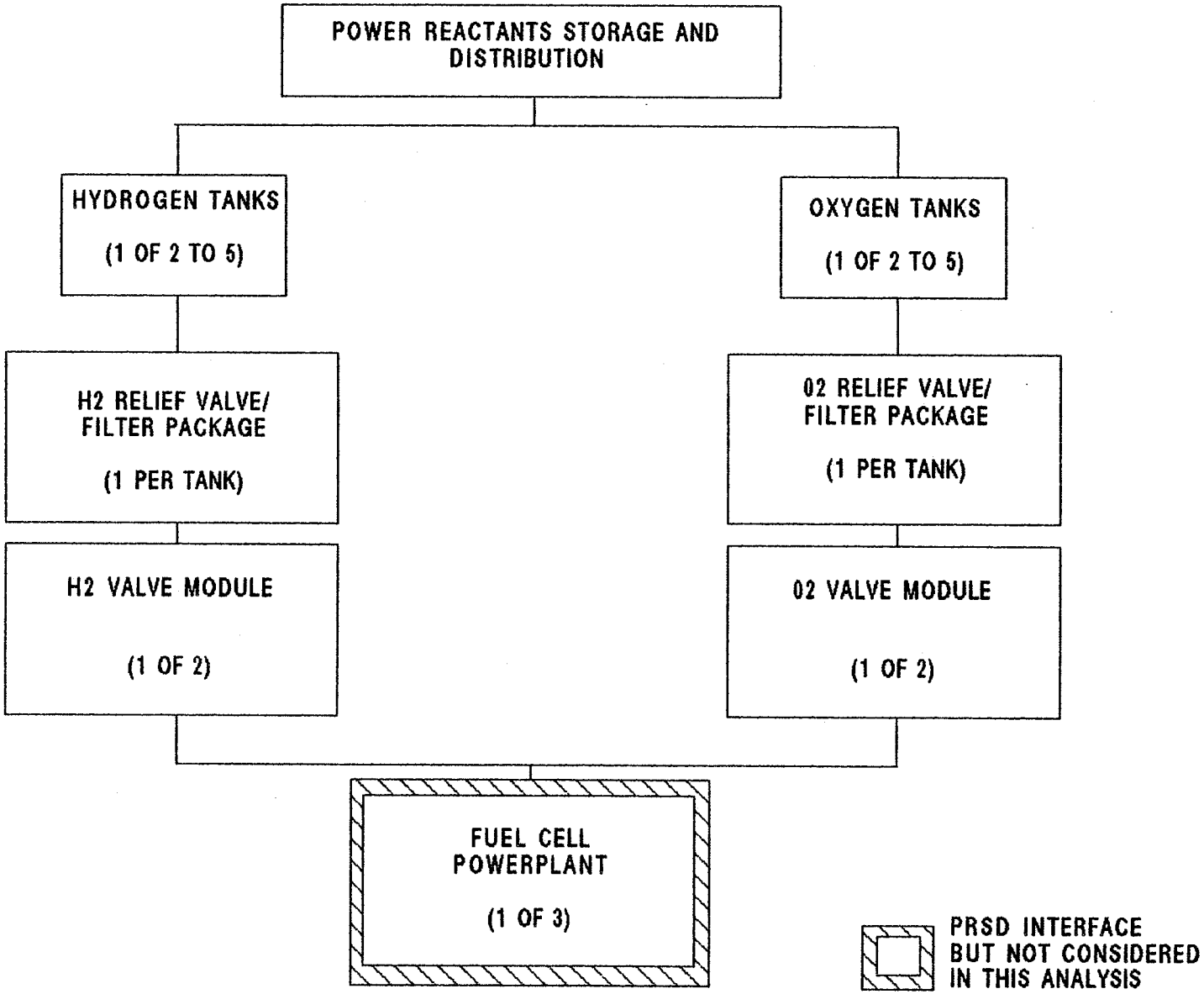


Figure 3 - PRSD SUBSYSTEM OVERVIEW

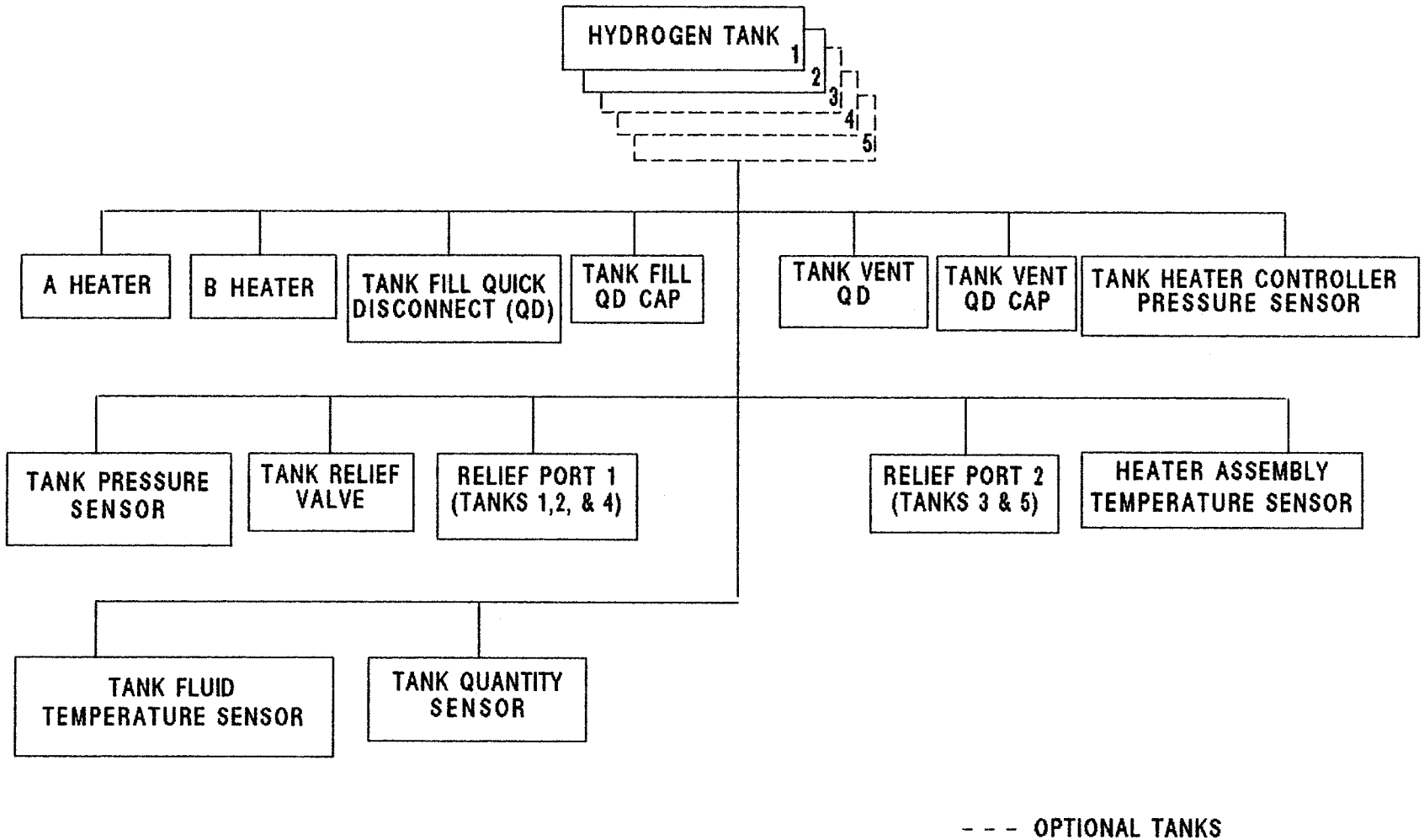


Figure 4 - PRSD HYDROGEN TANKS

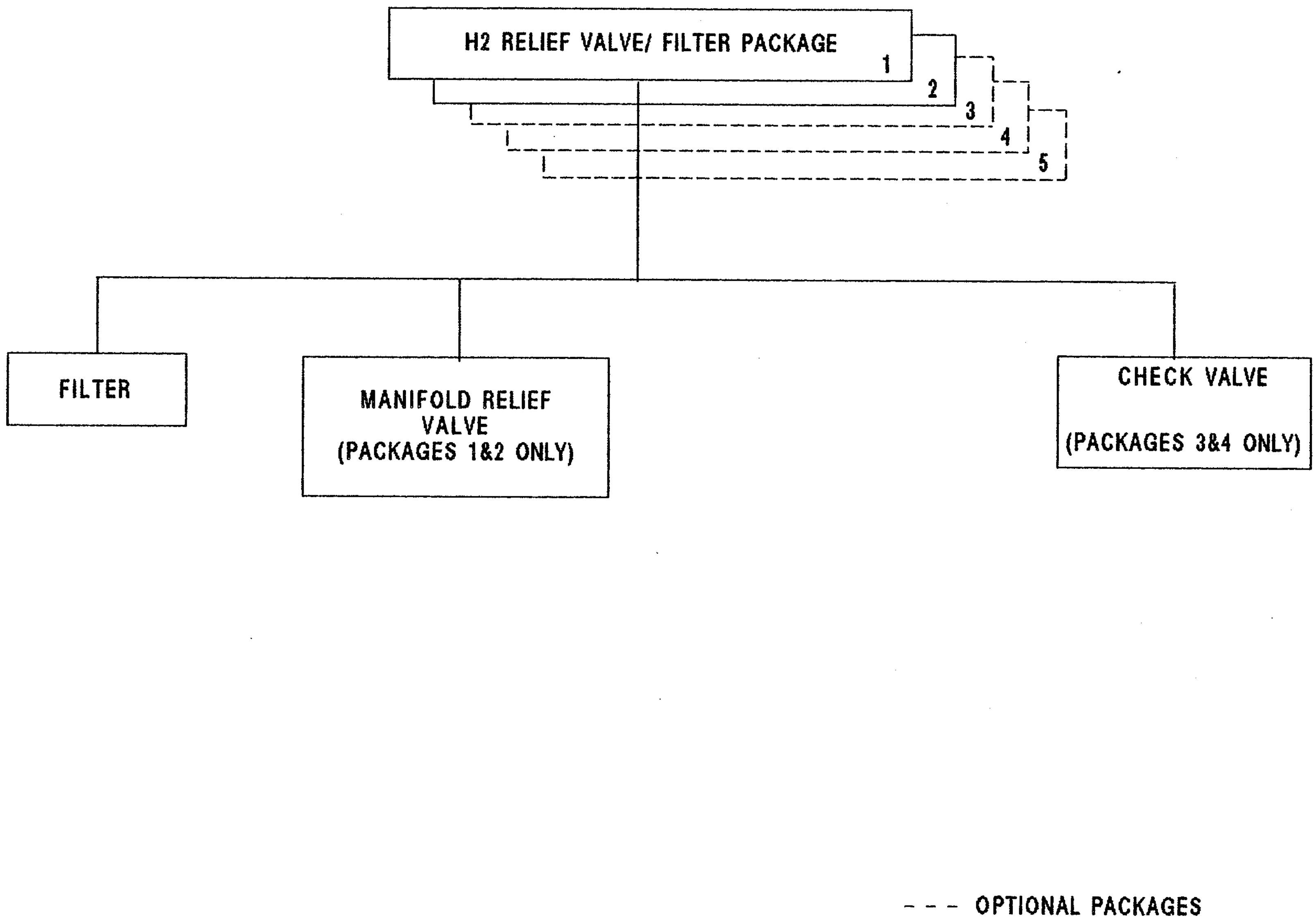


Figure 5 - PRSD H2 RELIEF VALVE/FILTER PACKAGES

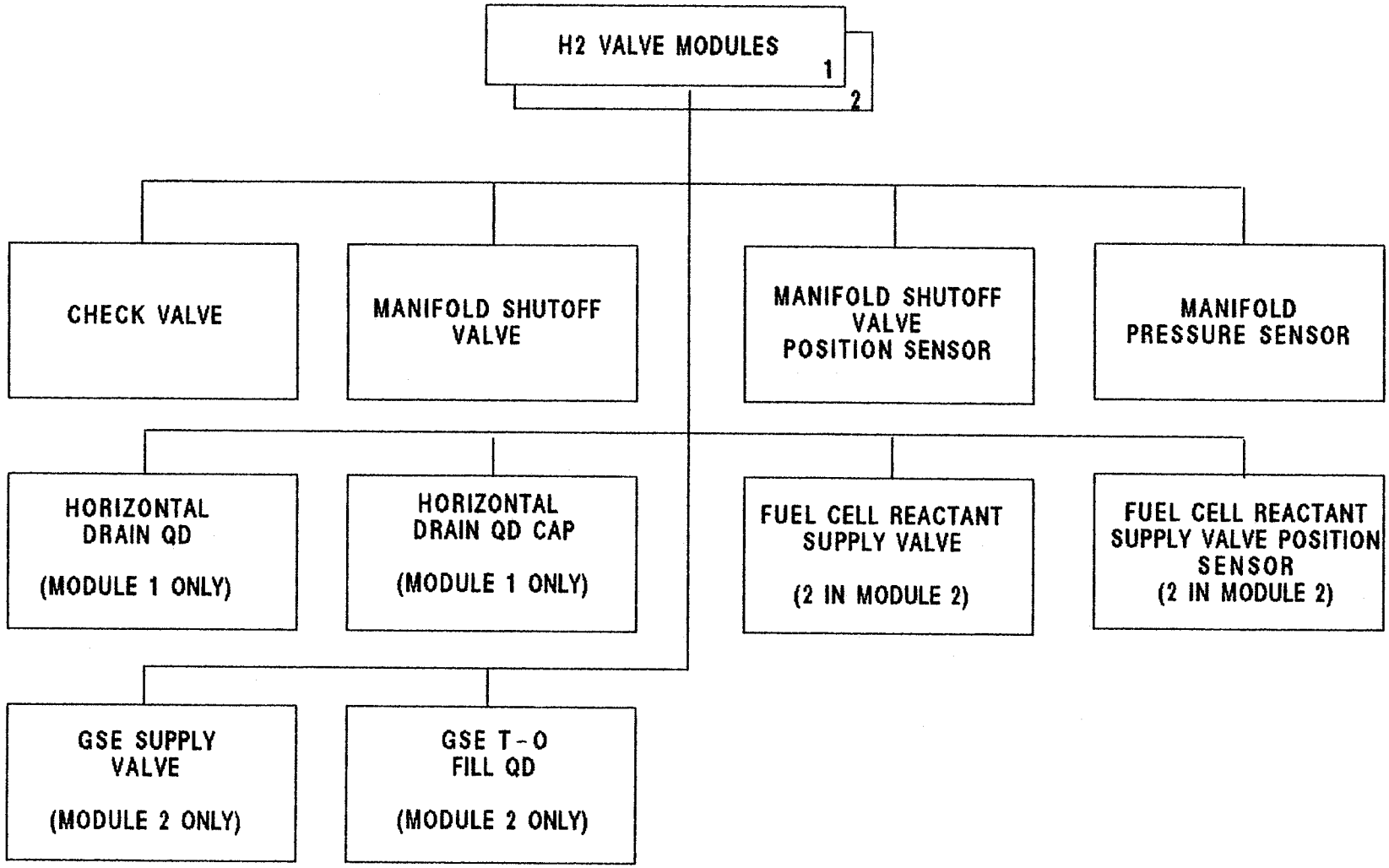


Figure 6 - PRSD H2 VALVE MODULES

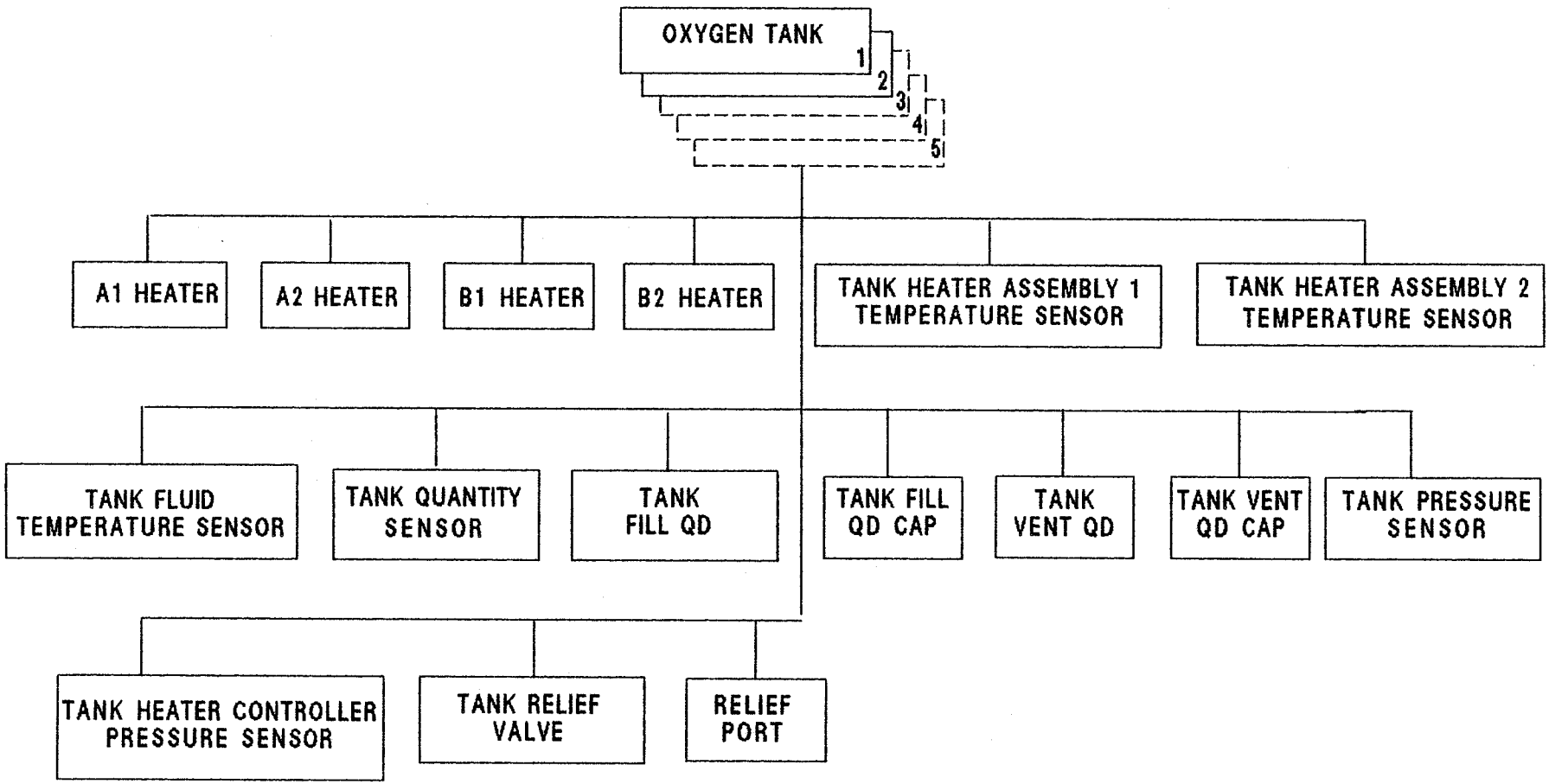


Figure 7 - PRSD OXYGEN TANKS

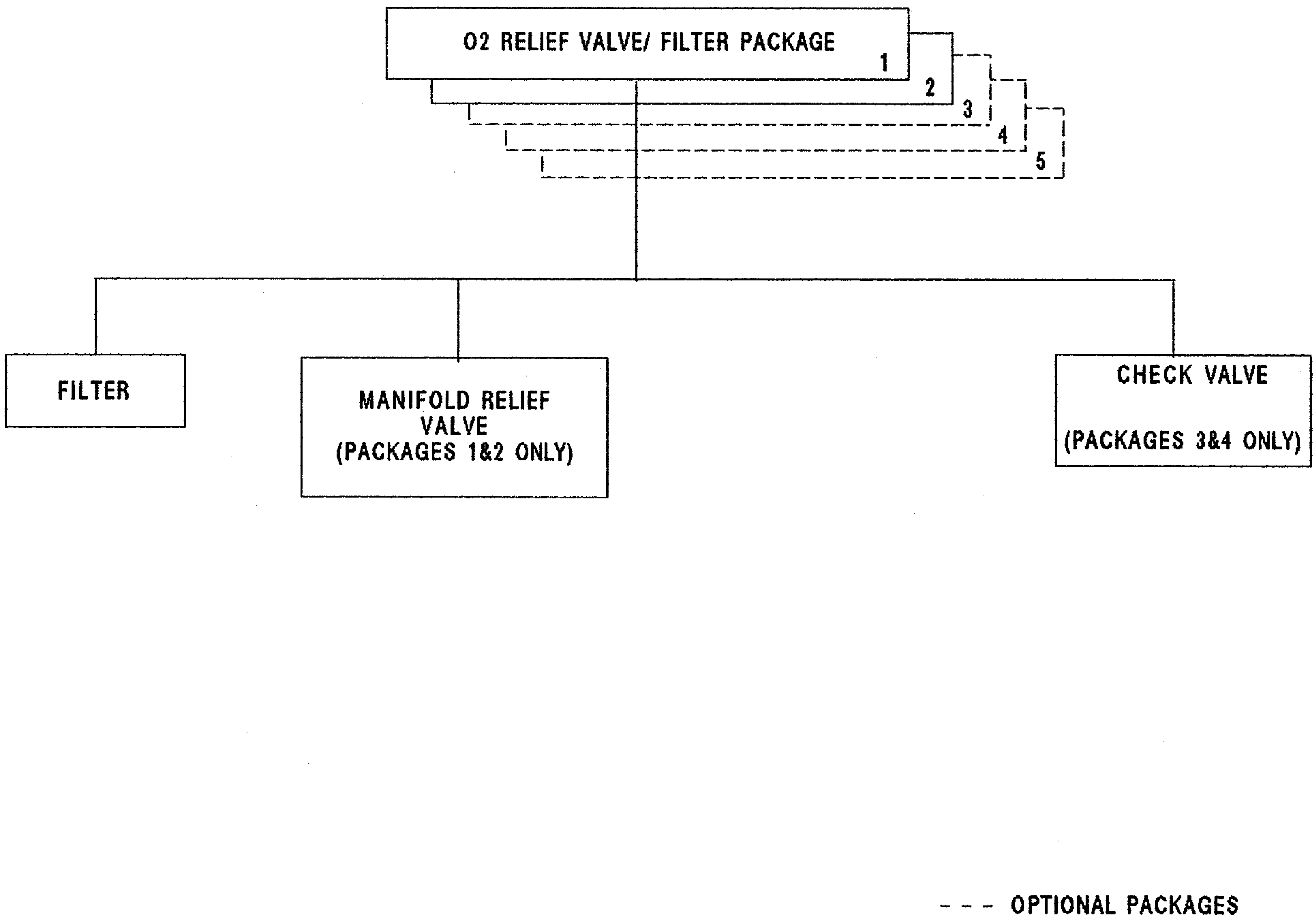


Figure 8 - PRSD O2 RELIEF VALVE/FILTER PACKAGES

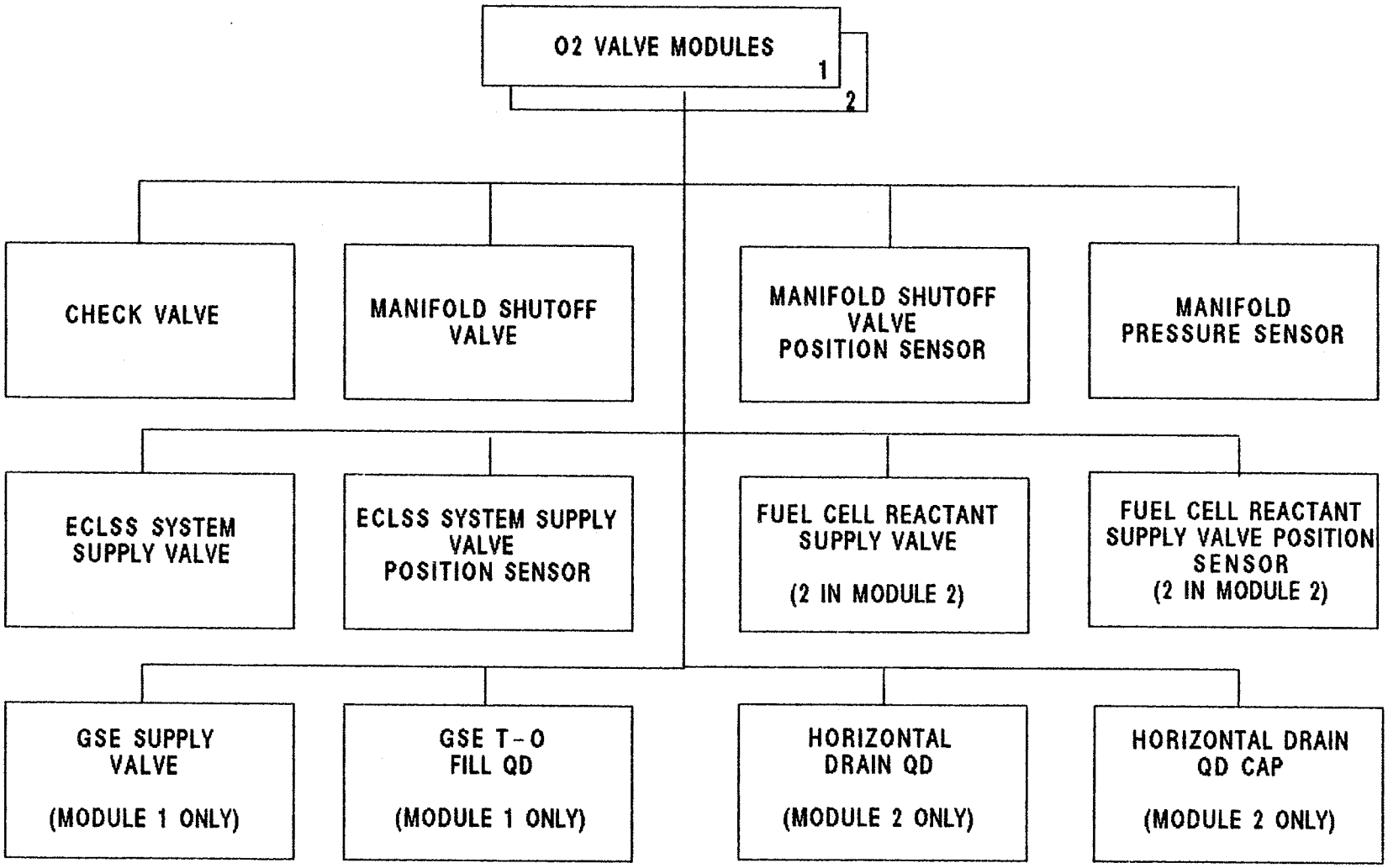


Figure 9 - PRSD 02 VALVE MODULES

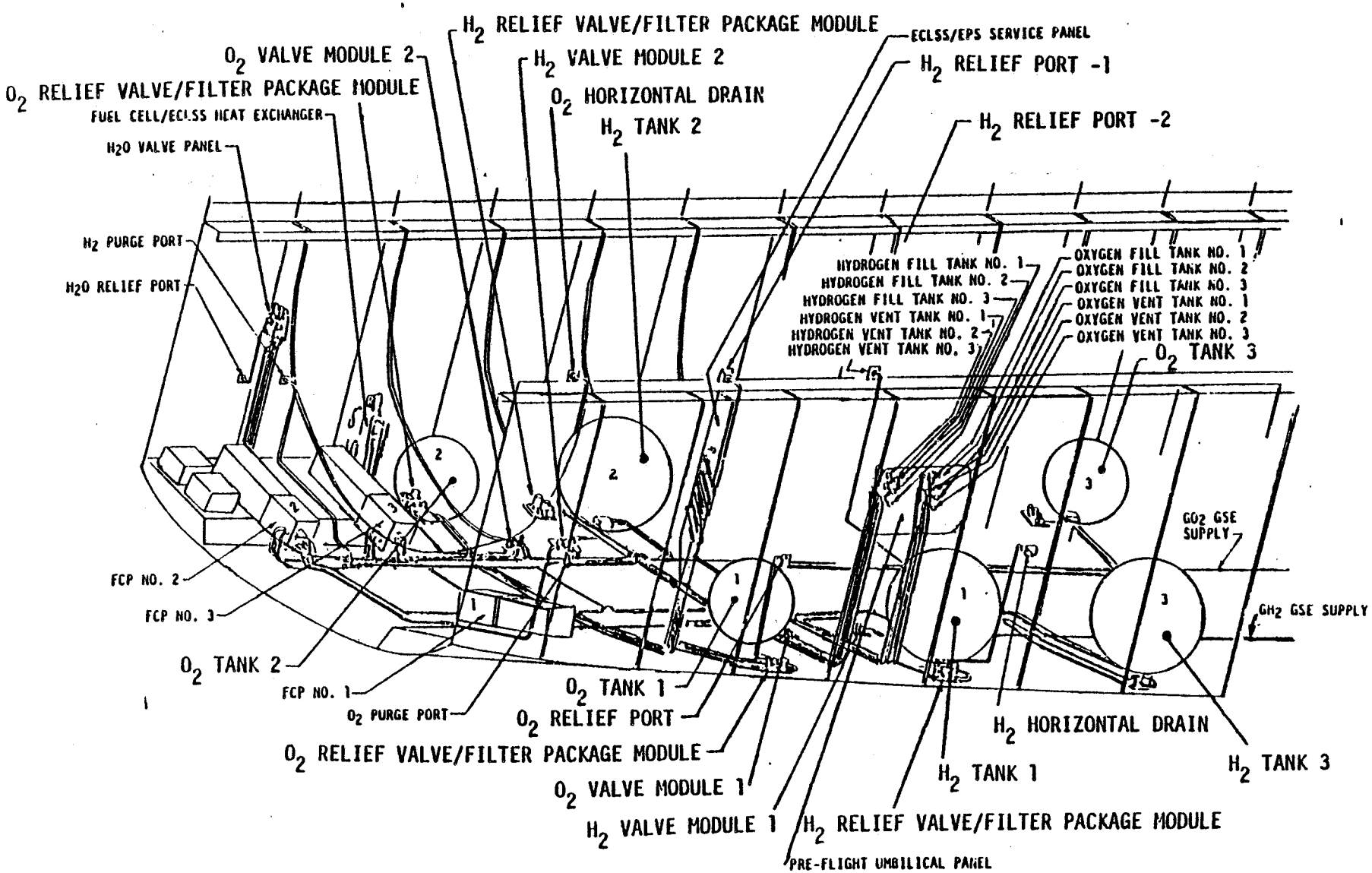


Figure 10 - PRSD COMPONENT LOCATIONS

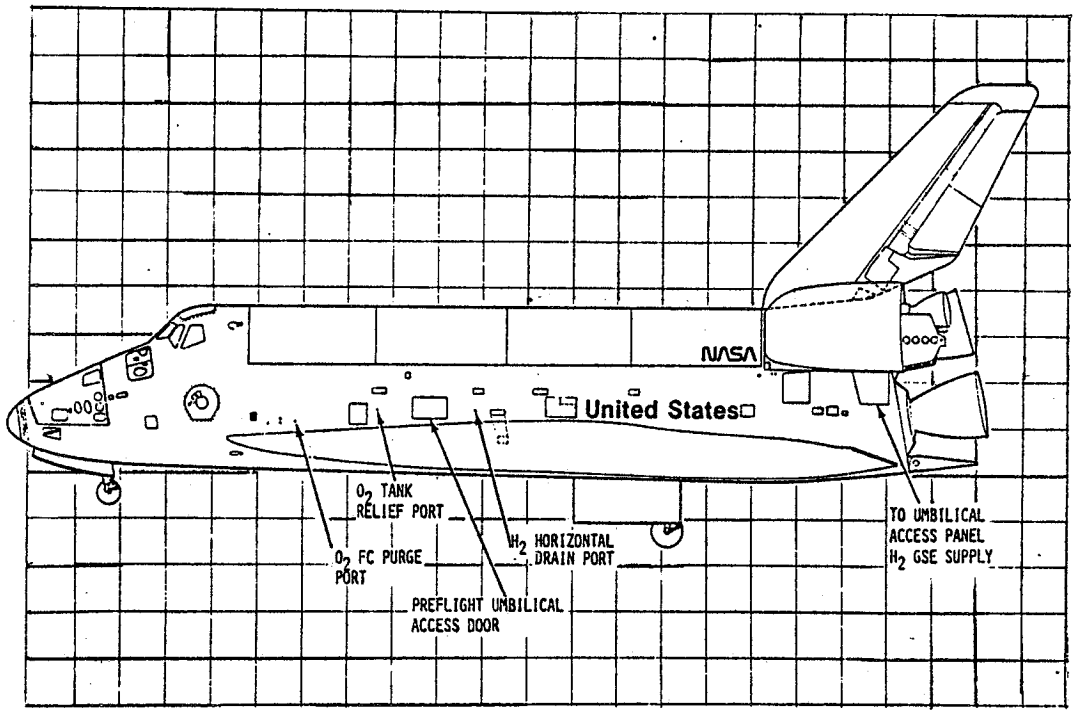


Figure 11 - PRSD PORTS - LEFT SIDE

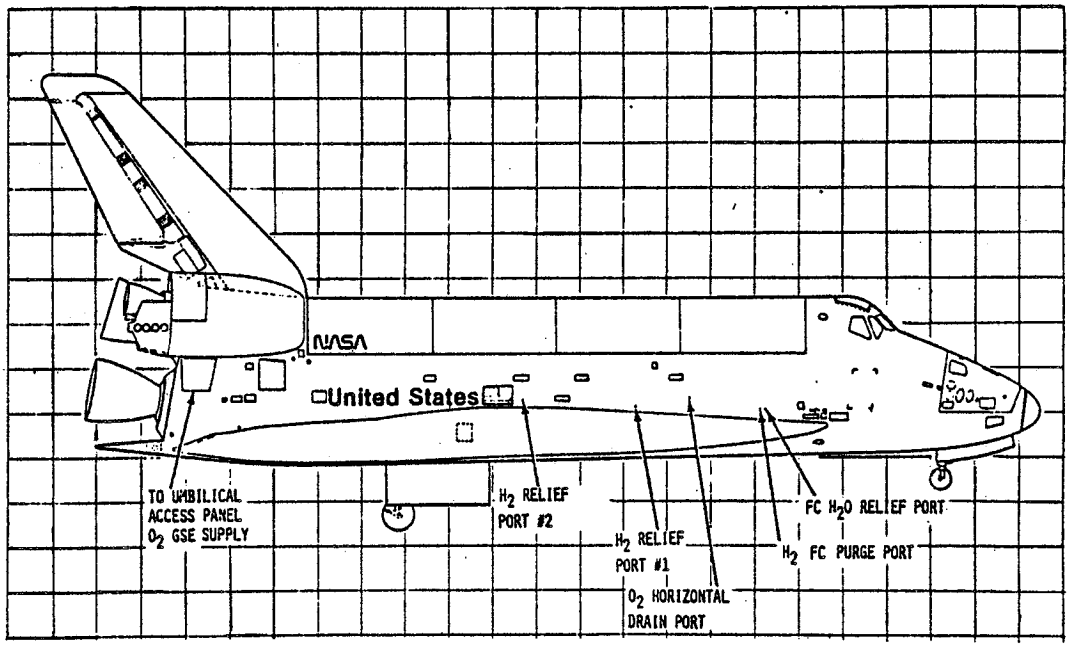


Figure 12 - PRSD PORTS - RIGHT SIDE

4.0 ANALYSIS RESULTS

Detailed analysis results for each of the identified failure modes are presented in Appendix C. Table I presents a summary of the failure criticalities for each of the seven major subdivisions of the EPG/PRSD. Further discussion of each of these subdivisions and the applicable failure modes is provided in subsequent paragraphs.

TABLE I Summary of IOA Failure Modes and Criticalities

Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
H2 Tanks	6	1	-	8	-	13	28
HRVFP	3	3	-	4	-	-	10
HVM	8	12	-	4	2	10	36
O2 Tanks	6	1	-	7	-	16	30
ORVFP	3	3	-	4	-	-	10
OVM	10	16	-	4	2	12	44
O2 & H2 Lines	2	2	-	-	-	-	4
TOTAL	38	38	-	31	4	51	162

Of the 162 failure modes analyzed, 82 were determined to be PCIs. A summary of the PCIs is presented in Table II. Appendix D presents a cross reference between each PCI and a specific work sheet in Appendix C.

TABLE II Summary of IOA Potential Critical Items

Criticality:	1/1	2/1R	2/2	3/1R	3/2R	TOTAL
H2 Tanks	6	1	-	3	-	10
HRVFP	3	3	-	-	-	6
HVM	8	12	-	-	-	20
O2 Tanks	6	1	-	3	-	10
ORVFP	3	3	-	-	-	6
OVM	10	16	-	-	-	26
O2 & H2 Lines	2	2	-	-	-	4
TOTAL	38	38	-	6	-	82

4.1 Analysis Results - Hydrogen Tanks

Failures related to the H2 tanks and outer components were analyzed. Critical failures were due to external leaks, ruptures, loss of annulus vacuum, mechanical failures of valves, and restricted flow out of relief ports. Noncritical failures involved faulty tank pressure outputs and the inability of QDs to mate/demate.

Components which make up the tanks were individually analyzed. Critical failures involved faulty heater controller output and malfunctioning heater elements. Noncritical failures involved faulty heater temperature, tank quantity, and fluid temperature outputs. Ten failures were identified to be PCIs.

4.2 Analysis Results - HRVFP

Critical failures of components involved clogged filters, mechanical failures of valves, and external leakage. There were no noncritical failures. Six failures were identified to be PCIs.

4.3 Analysis Results - HVM

Critical failures of components involved mechanical and electrical failures of valves, and external leakage. Noncritical failures involved the inability of QDs to mate/demate, faulty output of pressure and valve position sensors, and electrical failures of valves. Twenty failures were identified to be PCIs.

4.4 Analysis Results - Oxygen Tanks

Failures related to the O2 tanks and outer components were analyzed. Critical failures were due to external leaks, ruptures, loss of annulus vacuum, mechanical failures of valves, and restricted flow out of the relief port. Noncritical failures involved faulty tank pressure outputs and the inability of QDs to mate/demate.

Components which make up the tanks were individually analyzed. Critical failures involved faulty heater controller output and malfunctioning heater elements. Noncritical failures involved faulty heater temperature, tank quantity, and fluid temperature outputs. Ten failures were identified to be PCIs.

4.5 Analysis Results - ORVFP

Critical failures of components involved clogged filters, mechanical failures of valves, and external leakage. There were no noncritical failures. Six failures were identified to be PCIs.

4.6 Analysis Results - OVM

Critical failures of components involved mechanical and electrical valve failures, and external leakage. Noncritical failures involved the ability of QDs to mate/demate, faulty output of pressure and valve position sensors, and electrical failures of valves. Twenty-six failures were identified to be PCIs.

4.7 Analysis Results - O2 and H2 Lines, Components and Fittings

Critical failures involved external leakage and restricted flow. There were no noncritical failures. Four failures were identified to be PCIs.

5.0 REFERENCES

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

1. JSC-12820, STS Operational Flight Rules, Final, 12-16-85.

2. Space Shuttle Operations and Maintenance Requirements and Specification Document (OMRSD), V. 45 File III, Orbiter OMRSD - Electrical Power Generation/Power Reactant Storage and Distribution, 5-29-86.

3. VS70-945099, Integrated System Schematic, Electrical Power System (EPS), Orbiter Vehicles - 099, 103 & 104, Rev. AO8, 7-18-85.

4. VS70-945102, Integrated System Schematic, Orbiter OV-102, EPS, Rev. G04, 6-19-84.

5. Mission Operations Directorate, Systems Analysis Section, Training Guide, Space Shuttle Electrical Power System, Basic, 6-28-85.

6. JSC-19935, Environmental Systems Console Handbook, Volumes 1 & 2, Systems Division, Electrical and Environmental Systems Branch, Basic, Rev. A, 10-15-85.

7. Rockwell International, Reliability Desk Instruction No. 100-2G, Flight Hardware FMEA & CIL, 1-31-84.

8. NASA-JSC Orbiter Power Reactant Storage and Distribution Subsystem Handbook, Third Edition, 10-84.

9. JSC-10506, Flight Operations Directorate Drafting Standards, Revision B, 9-79.

10. JSC 12830, EGIL Console Procedures Handbook, Rev. C, 10-83.

11. Rockwell International, Numerical Index of Specifications Released at Space Systems Group, No. MA0501-1027, 1-28-84.

12. NASA Reference Publication 1113, Design Guide for High Pressure Oxygen Systems, 8-83.

13. JSC TD-128, Electrical Power System Workbook, EPS 2102, 8-20-82.

14. Rockwell International, SD 74-SH-0026-1, Subsystem Certification Plan, Power Reactant Storage and Distribution, 4-75.

15. JSC TD268, Shuttle Flight Operations Manual, Vol. 2, Electrical Power Systems, 11-28-84.

16. JSC-11174, Space Shuttle Systems Handbook, Vol. 1, Rev. C, DCN-5, 9-13-85.

17. JSC-08934, Shuttle Operational Data Book, Vol. 1, Rev. D, 10-84.

18. JSC-18691, Flight Data File, Malfunction Procedures, All Vehicle, Basic, Rev. B, 10-10-85.

19. JSC-18538, Flight Data File, Orbit Pocket Checklist, All Vehicle, Basic, Rev. B, 3-5-85.

20. JSC-18537, Flight Data File, Ascent Pocket Checklist, All Vehicle, Basic, Rev. A, 5-24-85.

21. JSC-18539, Flight Data File, Entry Pocket Checklist, All Vehicle, Basic, Rev. A, 5-24-85.

22. JSC-18547, Flight Data File, Ascent Checklist, Basic, Rev. A, 5-28-85.

23. Report M4001002, JSC Orbiter Full Problem Record (FPR), Electrical Power Generation Subsystem, 7-22-86.

24. Rockwell International Specifications for PRSD

    a. MC276-0010, Disconnect, Cryogenic Fluid, Rev. F, 7-18-80.
    b. MC276-0012, Disconnect, Gas Supply, Rev. C. 3-24-77.
    c. MC282-0063, Storage Assembly, Power Reactant - Orbiter, Rev. H, 6-4-82.
    d. MC284-0429, Valve, Shutoff, Unidirectional and Bidirectional O2 and H2, Rev. B. 10-30-75.
    e. MC284-0440, Valve, Pressure Relief, Cryogenic, Rev. C, 5-14-79.
    f. MC286-0054, Filter, Cryogenic, Rev. A, 9-17-75.
    g. MC449-0185, Sensor, Control Pressure, Rev. E, 2-01-79.
    h. MC999-0097, Metallic Pressure Vessel, Space Shuttle Orbiter, Requirements for, Rev. C, 11-10-75.
    i. ME273-0074, Coupling, Half, Quick Disconnect, Female Fitting, Rev. F, 7-21-75.
    j. ME273-0075, Coupling, Half, Quick Disconnect, Male Fitting, Rev. F, 7-10-75.
    k. ME284-0281, Valve, Solenoid, Latching, Rev. J. 11-1-74.

25. Rockwell International Drawings

a. VL70-008517, Electrical Power Subsystem - Intru-Schematic, Rev. E, 3-7-74.
b. VO70-454314, Panel - Hydrogen Control, LH Side, Assy. of, Rev. A, 1-27-76.
c. VO70-454315, Panel-Oxygen Control, LH Side, Assy. of, Rev. A, 2-20-76.
d. VO70-454374, Panel - H2 Pressure Relief, PRSD, Electrical Power Subsystem, Assy. of, 4-14-75.
e. VO70-454377, Panel - O2 Pressure Relief, PRSD Electrical Power Subsystem, Assy. of, 4-14-75.
f. VO70-454388, Panel - H2 Pressure Relief, Electrical Power Subsystem, Assy. of, Rev. B. 1-14-82.
g. VO70-454389, Panel - O2 Pressure Relief, Electrical Power Subsystem, Assy. of, Rev. D, 8-27-81.
h. VO70-454410, Panel - Oxygen Control, RH Side, Assy. of, 4-3-75.
i. VO70-454411, Panel - Hydrogen Control, RH Side, Assy. of, 4-3-75.
j. VO70-454710, Panel - Oxygen Control, LH Side, Assy. of, Rev. E, 3-12-82.
k. VO70-454712, Braze & Insulation - H2 Control Valves & Components, LH Side, Assy. of, Rev. C, 4-17-79.
l. VO70-454714, Panel - Oxygen Control, RH Side, Assy. of, Rev. F, 10-8-82.
m. VO70-454716, Braze & Insulation - H2 Control Valves & Components, RH Side, Assy. of, Rev. E, 4-86.
n. VO70-454898, Electrical Power Substation, LH Installation, Xo693 to Xo919, Rev. B, 12-85.
o. VO70-454899, Electrical Power Subsystem Instl-RH Side, Xo693 to Xo 919, Rev. B, 12-10-82.
p. VS70-458678, PRSD 102 & Subs, Schematic, Rev. A, 11-7-79.
q. V525-454158, Panel - Tank Set 4, H2 Pressuure Relief, Electrical Power Subsystem, Assy. of, Rev. C, 7-9-84.
r. V525-454161, Panel - Tank Set 4, O2 Pressure Relief, Electrical Power Subsystem, Assy. of, Rev. E, 7-6-84.
s. V544-454137, Panel - Tank Set 3, O2 Pressure Relief, Electrical Power Subsystem, Assy. of, Rev. A, 7-29-80.
t. V544-454155, Panel - Tank Set 3, H2 Pressure Relief, Electrical Power Subsystem, Assy. of, Rev. B, 7-9-84.

APPENDIX A
ACRONYMS

AOA	-	Abort Once Around
ARPCS	-	Atmospheric Revitalization Pressure Control Subsystem
Assy	-	Assembly
ATO	-	Abort To Orbit
CIL	-	Critical Items List
CRIT	-	Criticality
CRYO	-	Cryogenic
C&W	-	Caution and Warning System
ECLSS	-	Environmental Control and Life Support System
EGIL	-	Electrical, General Instrumentation, and Lighting Engineer
EPG	-	Electrical Power Generation
EPS	-	Electrical Power System
F	-	Functional
FCP	-	Fuel Cell Powerplant
FMEA	-	Failure Mode and Effect Analysis
GFE	-	Government Furnished Equipment
GSE	-	Ground Support Equipment
HR	-	Hour
HRVFP	-	Hydrogen Relief Valve/Filter Package
H2	-	Hydrogen
HVM	-	Hydrogen Valve Module
HW	-	Hardware
IOA	-	Independent Orbiter Assessment
JSC	-	Lyndon B. Johnson Space Center
LB	-	Pound
LH	-	Left Hand
MDAC	-	McDonnell Douglas Astronautics Company
MECO	-	Main Engine Cutoff
MPS	-	Main Propulsion Subsystem
NASA	-	National Aeronautics and Space Administration
NSTS	-	National Space Transportation System
NA	-	Not Applicable
OMRSD	-	Operations and Maintenance Requirements and Specification Document
OMS	-	Orbital Maneuvering Subsystem
ORVFP	-	Oxygen Relief Valve/Filter Package
O2	-	Oxygen
OVM	-	Oxygen Valve Module
PCI	-	Potential Critical Item
PLS	-	Primary Landing Site
PRCB	-	Program Requirements Control Board
PRSD	-	Power Reactant Storage and Distribution
psi	-	Pounds Per Square Inch
psig	-	Pounds Per Square Inch Gauge
QD	-	Quick Disconnect
Rev	-	Revision
RH	-	Right Hand

RI	-	Rockwell International
RTLS	-	Return to Landing Site
STS	-	Space Transportation System
TAL	-	Transatlantic Abort Landing
T-O	-	Time Zero
Xo	-	X Axis of Orbiter

APPENDIX B

DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.1 Definitions

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:

RTLS - 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

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

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

CREDIBLE (CAUSE) - 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

CONTINGENCY CREW PROCEDURES - 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 CRITICALITY - the highest functional criticality determined in the phase-by-phase analysis

MAJOR MODE (MM) - major sub-mode of software operational sequence (OPS)

MC - Memory Configuration of Primary Avionics Software System (PASS)

MISSION - 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.)

MULTIPLE ORDER FAILURE - describes the failure due to a single cause or event of all units which perform a necessary (critical) function

OFF-NOMINAL CREW PROCEDURES - 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:

PRELAUNCH PHASE - 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

DEORBIT PHASE - 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

The philosophy embodied in NSTS 22206, Instructions for Preparation of FMEA/CIL, 10 October 1986, 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.

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.

B.3 EPG/PRSD - Specific Ground Rules and Assumptions

1. Component age life will not be considered in the analysis.

   RATIONALE: Component age life analysis is beyond the scope of this task.

2. Cryogenic system pressure to the fuel cell will be assumed lost if unable to maintain minimum supply conditions of 100 PSI for H2 and/or O2 tanks.

   RATIONALE: Minimum requirements definition. Flight rule definition.

3. An O2 cryo tank will be assumed lost if both of its heaters fail to function (i.e., neither heater will function with the delta current sensors enabled).

   RATIONALE: Systems failure definition. Flight rule definition.

4. An H2 cryo tank will be assumed lost if neither of its heaters will function.

   RATIONALE: Systems failure definition. Flight rule definition.

5. An impending loss of all cryo O2 or all cryo H2 tanks will be cause to exercise the highest-priority abort mode the loss/leak will allow.

   RATIONALE: Flight rule definition.

6. Continue nominal ascent if 2/3/4 O2 (H2) tanks fail when flying 3/4/5.

   Enter next PLS daily go/no-go if two O2 (H2) tanks fail during lift-off and on-orbit.

   RATIONALE: Flight rules go/no-go criteria.

7. Ascent abort decision will be needed for any EPG/PRSD/FCP problems that will not support four hours on-orbit plus entry time.

   RATIONALE: Flight operations rules.

8. A fuel cell will be considered failed if the following conditions exist.

   a. An abnormal or unexplained voltage versus current performance loss of $\geq$0.5 volts for a single FC based on predicted performance data.

   b. Coolant pump or H2 pump/H2O separator is lost.

   c. Fuel cell stack-coolant temperature >255 degrees (242.5) degrees F or <175 degrees (182.5) degrees F.

   d. Coolant pressure >75 (71.4) PSIA and increasing.

   e. Fuel cell unable to discharge water to the ECLSS H2O storage tanks or overboard via the fuel cell H2O relief system.

   f. Local KOH concentration >48 percent (45 percent) dry or <24 percent (29 percent) wet as indicated by fuel cell stack-coolant temperature, condenser exit temperature, and current relationship.

   g. Fuel cell reactant valve fails closed.

   h. Cannot be connected to a main bus.

   i. Fuel cell H2O pH high confirmed.

   j. Fuel cell O2 reaction chambers cannot be purged.

   k. Fuel cell end-cell heater failing on.

   l. Fuel cell substack delta volts >150 millivolts and increasing.

      RATIONALE: Systems failure definition.

9. Loss of one fuel cell is considered cause for priority flight and abort decision.

      RATIONALE: Mission flight rule definition.

10. Loss of two fuel cells is considered cause for abort mission.

      RATIONALE: Contingency action summary. Flight Rule definition.

11. Loss of three fuel cells is considered loss of life/vehicle in all mission phases.

      RATIONALE: Flight rule definition.

12. Loss of two fuel cells in the first stage of ascent is considered loss of life/vehicle.

    RATIONALE: SRB loads are too high for one fuel cell to support. Voltage may go <25v which will shut down the GPCs.

13. Although the ECLSS product-water storage is a separate system from EPG, it will be considered as a failable redundant product-water relief line for purposes of the EPG functional criticality scenarios.

    RATIONALE: This assumption violates general ground rule 3.1.1.6 but is essential for evaluating failures associated with the water relief line.

14. Filter failure will only be considered in the case of total flow blockage. Cases of improper/insufficient filtering will not be considered except where obvious.

    RATIONALE: The effect of `poor' filter performance on downstream components is beyond the scope of our efforts.

15. The start/sustaining heater on the left-hand FCP (FCP #1) is assumed to be disconnected. Thus, this FCP cannot be maintained operational at no-load, and will be considered shutdown if the load cannot be maintained at greater than 2 KW.

    RATIONALE: Load needed to maintain operating temperature. RH FCP uses sustaining heater to maintain temperatures at no-load.

16. For all "failed open" failure modes for valves which are normally open, redundancy screen B will be assumed failed.

    RATIONALE: The failure is not detectable until the valve is required to be closed.

17. Five 02 and H2 tanks are being used as the baseline configuration under study.

    RATIONALE: The configuration for all redundant components is being considered for this analysis.

18. Inadvertant Fuel Cell shutdown during RTLS and TAL abort is considered loss of crew/vehicle.

    RATIONALE: Loss of FCP 1/Bus A is loss of OMS Engine Purge Capability (required for TAL) and Aft Compartment MPS Helium Purge Capability (required for RTLS and TAL).

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

Redundancy Screens B and C:

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

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 200 ABORT: 3/1R

ITEM: H2 (PRE-FLIGHT) FILL QUICK DISCONNECT (4) & VENT QD'S (5)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0210

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
EACH TANK HAS FILL AND VENT QD'S, WITH THE EXCEPTION OF TANKS 4 AND 5 WHICH SHARE A FILL QD. ALL QD'S ARE ALSO CAPPED FOR ADDITIONAL REDUNDANCY. FAILURE OF A QD ALONE IS NOT DETECTABLE. BOTH CAP AND QD HAVE TO LEAK FOR A TANK LEAK TO OCCUR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 201 ABORT: 3/3

ITEM: H2 (PRE-FLIGHT) FILL QUICK DISCONNECT (4) & VENT QD'S (5)
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0210

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
THE MISSION COULD BE DELAYED IF THE TANKS CANNOT BE FILLED OR THE QD CANNOT BE RELEASED. THE FILL QD ALSO FUNCTIONS AS A VERTICAL DRAIN AT PAD.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86
SUBSYSTEM: EPG
MDAC ID: 202

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/1R
ABORT: 3/1R

ITEM: H2 (PRE-FLIGHT) FILL AND VENT QD CAPS (9)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0260

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
EACH TANK HAS ITS OWN VENT QD CAP AND FILL QD CAP, EXCEPT TANKS 4 AND 5 WHICH SHARE A FILL QD CAP. THE QD'S THEMSELVES ARE A LEVEL OF REDUNDANCY TO STOP LEAKS. BOTH CAP AND QD HAVE TO LEAK FOR A TANK LEAK TO OCCUR. FAILURE OF THE CAP ALONE IS NOT DETECTABLE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 203 ABORT: 3/3

ITEM: H2 TANK PRESSURE SENSOR (5)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-003

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
THESE PRESSURE SENSORS HAVE NO EFFECT ON OTHER COMPONENTS; THEY ONLY DRIVE GAUGES. FULL OUTPUT WOULD CAUSE THE CREW TO TURN OFF THE HEATERS. THE CREW WOULD CHECK RELIEF VALVE CRACK PRESSURE, AND QUANTITY AND TEMPERATURE SENSORS TO SEE IF THE PRESSURE SENSOR WAS ACCURATE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	11/04/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	3/3
MDAC ID:	204	ABORT:	3/3

ITEM: H2 TANK PRESSURE SENSOR (5)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-003

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE THE CREW TO TURN THE HEATERS ON. THE CREW WOULD CHECK THE TEMPERATURE AND QUANTITY SENSORS TO SEE IF THE PRESSURE READING WAS ACCURATE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 205 ABORT: 3/3

ITEM: H2 TANK PRESSURE SENSOR (5)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-003

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE THE CREW TO MANUALLY OPERATE THE HEATERS, TO KEEP THE PRESSURE READING WITHIN TOLERANCES. THE CREW COULD USE THE TEMPERATURE AND QUANTITY SENSORS TO SEE IF THE PRESSURE READING WAS ACCURATE. A SMALL ERROR WILL NOT CAUSE ANY PROBLEMS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/24/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 206 ABORT: 3/1R

ITEM: H2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-033

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
FULL OUTPUT WOULD CAUSE THE HEATERS NOT TO COME ON IN THE AUTOMATIC MODE. THE PRESSURE WOULD HAVE TO DROP TO BELOW 100 PSI BEFORE THE TANK IS CONSIDERED LOST, WHICH WOULD HAPPEN AFTER OMS 2. THE CREW COULD CHECK THE TANK PRESSURE AND TEMPERATURE SENSORS TO FIND THE PROBLEM. THE CREW ACTIVATES TANK 1 AND 2 A HEATERS AFTER OMS1. THIS IS 3/1R BECAUSE THE TANK RELIEF VALVES STUCK OPEN COULD CAUSE LOSS OF PRESSURE EARLY. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/24/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 207 ABORT: 1/1

ITEM: H2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-033

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE THE HEATERS TO BE ON ALWAYS IN THE AUTOMATIC MODE. THE RELIEF VALVE WOULD VENT H2 AND DEPLETE IT-RELIEF VALVE FLOW RATE AT FULL FLOW PRESSURE IS 97 LB/HR WHILE TANK QUANTITY IS 92.0 LB.
ALSO, THE TANK COULD RUPTURE STARTING 35 HOURS AFTER THE TANK RESIDUAL LEVEL IS REACHED AND THE HEATERS ARE STILL ON, THUS 1/1. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	9/24/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	1/1
MDAC ID:	208	ABORT:	1/1

ITEM: H2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-033

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
THIS FAILURE DEPENDS ON THE DEGREE OF BEING OUT OF TOLERANCE-WORST CASE IS THE UNION OF ZERO AND FULL OUTPUT. THIS COULD CAUSE THE HEATERS TO OPERATE ERRATICALLY. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 209 ABORT: 1/1

ITEM: H2 TANK HEATER ELEMENT A (5), H2 TANK HEATER ELEMENT B (5)
FAILURE MODE: FAILS ON

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, MECHANICAL SHOCK, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
EACH TANK HAS AN A AND B 105 WATT HEATER ELEMENT. THIS IS CRITICALITY 3/1R BECAUSE THE RELIEF VALVE WOULD VENT THE RESULTANT EXCESSIVE PRESSURE IN THE TANK AND DEPLETE THE H2. THE RELIEF VALVE FLOW RATE AT FULL FLOW PRESSURE IS 97 LB/HR, WHILE THE TANK QUANTITY IS 92.0 LB. THE TANK COULD RUPTURE STARTING 35 HOURS AFTER THE TANK RESIDUAL LEVEL IS REACHED, RESULTING IN CRITICALITY 1/1. THIS IS DETECTABLE FROM TEMPERATURE AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 210 ABORT: 3/1R

ITEM: H2 TANK HEATER ELEMENT A (5), H2 TANK HEATER ELEMENT B (5)
FAILURE MODE: FAILS OFF

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, MECHANICAL SHOCK, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
WHEN THE PRESSURE FALLS BELOW 100 PSI, THE TANK IS CONSIDERED LOST. THIS WILL ALLOW COMPLETION OF ALL ABORTS AND ASCENTS SINCE THE EFFECT WOULD NOT OCCUR UNTIL AFTER OMS 2. THE CREW COULD DETECT THE PROBLEM FROM TEMPERATURE, QUANTITY, AND PRESSURE SENSORS. HOWEVER, THE CRITICALITY IS 3/1R IF A COMBINATION OF TANK RELIEF VALVES AND MANIFOLD RELIEF VALVES FAIL OPEN.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	11/04/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	2/1R
MDAC ID:	211	ABORT:	2/1R

ITEM: H2 TANK RELIEF VALVE (5)-RV030,RV040,RV500,RV560
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0402

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
EARLY DEPLETION OF H2 REACTANT WILL CAUSE FUEL CELL SHUTDOWN, AND ALSO REDUCE TANK PRESSURE. IF SOME TANK'S CHECK VALVE FAILED OPEN, THIS COULD LOSE ALL REACTANT, THUS RESULTING IN CRITICALITY 2/1R. THIS FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 212 ABORT: 3/1R

ITEM: H2 TANK RELIEF VALVE (5)-RV030,RV040,RV500,RV560
FAILURE MODE: FAILED CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0402

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
IF THE TANK PRESSURE GETS TOO HIGH, THE TANK COULD RUPTURE, CAUSING LOSS OF REACTANT, FUEL CELL SHUTDOWN, AND LOSS OF THE ORBITER. THE CRITICALITY IS 3/1R IF A TANK HEATER FAILS ON AND ALL TANK RELIEF VALVES FAIL CLOSED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 213 ABORT: 1/1

ITEM: H2 TANK RELIEF VALVE (5)-RV030,RV040,RV500,RV560
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0402

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT LEAKING UNDER THE PAYLOAD BAY LINER COULD RESULT IN THE EARLY DEPLETION OF H2 REACTANT, PLUS A POSSIBLE EXPLOSION. THE LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 214 ABORT: 3/1R

ITEM: H2 RELIEF PORT 1 (1)
FAILURE MODE: RESTRICTED FLOW

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: 40V45VP035

CAUSES: BLOCKAGE, CONTAMINATION,DEBRIS

EFFECTS/RATIONALE:
H2 RELIEF PORT 1 VENTS H2 FROM TANKS 1, 2, AND 4 RELIEF VALVES. IF RESTRICTED, IT WOULD NOT RELIEVE OVERPRESSURIZATION AND A TANK COULD RUPTURE. THERE IS A SEPARATE RELIEF PORT FOR TANKS 3 & 5. THIS IS CRITICALITY 3/1R BECAUSE SAME TANK'S HEATERS WOULD HAVE TO FAIL ON AND ITS CHECK VALVE FAIL CLOSED. THIS IS DETECTABLE FROM TANK PRESSURE GAUGES OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 215 ABORT: 3/1R

ITEM: H2 RELIEF PORT 2 (1)
FAILURE MODE: RESTRICTED FLOW

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: 40V45VP045

CAUSES: BLOCKAGE, CONTAMINATION, DEBRIS

EFFECTS/RATIONALE:
H2 RELIEF PORT 2 VENTS H2 FROM TANKS 3 & 5 RELIEF VALVES. IF RESTRICTED, IT WOULD NOT RELIEVE OVERPRESSURIZATION AND A TANK COULD RUPTURE. THIS CAN DETECTED BY LOOKING AT TANK PRESSURE GAUGES OVER A PERIOD OF TIME. THERE IS A SEPARATE RELIEF PORT FOR TANKS 1, 2, AND 4. THIS IS CRITICALITY 3/1R BECAUSE HEATERS WOULD HAVE TO FAIL ON AND THE CHECK VALVE FAIL CLOSED FOR THE SAME TANK.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 216 ABORT: 1/1

ITEM: H2 TANK SUBASSEMBLY (5)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: CORROSION, FATIGUE, TEMPERATURE, POROSITY, OVERPRESSURIZATION

EFFECTS/RATIONALE:
A LEAK IN TANK OR THROUGH RELIEF VALVE WOULD CAUSE DEPLETION OF H2 AND FUEL CELL SHUTDOWN. LEAKAGE UNDER THE PAYLOAD BAY MAY CAUSE OTHER SYSTEMS TO FREEZE AND A POSSIBLE EXPLOSION. THIS IS DETECTABLE THROUGH QUANTITY SENSORS AND CONSOLE CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 217 ABORT: 1/1

ITEM: H2 TANK SUBASSEMBLY
FAILURE MODE: RUPTURE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: OVERPRESSURIZATION, TEMPERATURE, FATIGUE

EFFECTS/RATIONALE:
THE H2 IN THE TANK WOULD BE LOST, AND OTHER EXPLOSIONS MAY RESULT. SHRAPNEL MAY PUNCTURE OTHER SYSTEMS AND THE EXTERIOR OF THE ORBITER. THIS IS DETECTABLE THROUGH QUANTITY AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 218 ABORT: 3/1R

ITEM: H2 TANK SUBASSEMBLY
FAILURE MODE: LOSS OF ANNULUS VACUUM

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: HOLE IN OUTER TANK

EFFECTS/RATIONALE:
CONDUCTIVE AND CONVECTIVE HEAT TRANSFER COULD OCCUR WITHOUT A VACUUM, CAUSING THE REACTANT TO HEAT UP AND BE DEPLETED QUICKLY. THE CAUSE COULD BE FAILURE OF THE VACUUM IONIZATION PUMP AND VAC ION PUMP PRESSURE SENSOR ON GROUND. THIS IS DETECTABLE FROM TANK QUANTITY SENSORS AND CONSOLE QUANTITY CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 219 ABORT: 3/3

ITEM: H2 TANK HEATER ASSEMBLY TEMPERATURE SENSOR (5)
V45T21(-5)07A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
FAILURE OF THE SENSOR CAN BE DETECTED BY CHECKING THE TANK FLUID TEMPERATURE OR PRESSURE SENSORS. THE SENSOR IS ONLY CONNECTED TO A GAUGE; IT DOES NOT AFFECT HEATER OPERATION. FULL OUTPUT NORMALLY INDICATES THAT HEATERS ARE CONTINUOUSLY ENERGIZED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 220 ABORT: 3/3

ITEM: H2 TANK HEATER ASSEMBLY TEMPERATURE SENSOR (5)
V45T21(-5)07A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT NORMALLY INDICATES THAT THE HEATERS ARE NOT OPERATING. LOSS OF THE SENSOR HAS NO HAZARDOUS EFFECT ON THE MISSION OR CREW.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 221 ABORT: 3/3

ITEM: H2 TANK HEATER ASSEMBLY TEMPERATURE SENSOR (5)
V45T21(-5)07A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE THE CREW TO WANT TO MANUALLY OPERATE HEATERS, TO KEEP THE TEMPERATURE READING WITHIN TOLERANCES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 222 ABORT: 3/3

ITEM: H2 TANK FLUID TEMPERATURE SENSOR (5) V45T21(-4)01A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
FAILURE OF THE SENSOR HAS NO EFFECT ON HEATER OPERATION. FAILURE OF SENSOR CAN BE DETECTED BY CHECKING HEATER ASSEMBLY TEMPERATURE SENSOR OR TANK PRESSURE SENSOR. FULL OUTPUT WOULD NORMALLY INDICATE THAT THE HEATERS WERE CONTINUALLY ENERGIZED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 223 ABORT: 3/3

ITEM: H2 TANK FLUID TEMPERATURE SENSOR (5) V45T21(-4)01A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD NORMALLY INDICATE THAT THE HEATERS WERE NOT OPERATING. LOSS OF THE SENSOR HAS NO HAZARDOUS EFFECT ON THE CREW OR MISSION.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 224 ABORT: 3/3

ITEM: H2 TANK FLUID TEMPERATURE SENSOR (5) V45T21(-4)01A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE CREW TO WANT TO MANUALLY OPERATE HEATERS, TO KEEP THE TEMPERATURE READING WITHIN TOLERANCES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 225 ABORT: 3/3

ITEM: H2 TANK QUANTITY SENSOR (5) V45Q21(-5)05A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
FAILURE OF THE SENSOR HAS NO EFFECT ON HEATER OPERATION. THE SENSOR FAILURE CANNOT BE VERIFIED BY LOOKING AT OTHER INSTRUMENTATION. THE CREW WOULD ONLY KNOW THAT TANK CANNOT ALWAYS BE FULL. CREW MIGHT BE ABLE TO FIGURE OUT APPROXIMATE QUANTITY BY TURNING HEATERS ON FOR A CERTAIN TIME AND MEASURE CORRESPONDING FLUID TEMPERATURE OR PRESSURE RISE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 226 ABORT: 3/3

ITEM: H2 TANK QUANTITY SENSOR (5) V45Q21(-5)05A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD HAVE NO AUTOMATIC EFFECT ON THE HEATERS. ZERO OUTPUT WOULD CAUSE THE CREW TO WANT TO TURN HEATERS OFF AND DEACTIVATE TANK.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 227 ABORT: 3/3

ITEM: H2 TANK QUANTITY SENSOR (5) V45Q21(-5)05A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN STORAGE
4) H2 TANKS
5) H2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0200

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE CREW TO CHANGE THE TANK MANAGEMENT SCHEME. THE CREW COULD OPERATE THE TANK MISTAKENLY BELOW ITS REDLINE LIMIT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 228 ABORT: 1/1

ITEM: H2 LINES, COMPONENTS, & FITTINGS
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4)
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: V070-454898

CAUSES: SHOCK, VIBRATION, FATIGUE, OVERPRESSURE, BRITTLENESS DUE TO TEMPERATURE

EFFECTS/RATIONALE:
ALL REACTANT COULD BE DEPLETED AND CAUSE FUEL CELL SHUTDOWN; ALSO, A LEAK COULD CAUSE CRYO TO FREEZE OTHER SYSTEMS UNDER THE PAYLOAD BAY. THE LEAKING H2 COULD ALSO CAUSE AN EXPLOSION. LEAKING IS DETECTABLE FROM TANK QUANTITY AND PRESSURE SENSORS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 229 ABORT: 1/1

ITEM: H2 LINES, COMPONENTS, & FITTINGS
FAILURE MODE: RESTRICTED FLOW

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4)
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	1/1
LIFTOFF:	2/1R	TAL:	1/1
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

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

LOCATION: MID FUSELAGE
PART NUMBER: VO70-454898

CAUSES: CONTAMINATION, DEBRIS

EFFECTS/RATIONALE:
RESTRICTED FLOW COULD CAUSE NO REACTANT TO REACH THE FUEL CELLS, AND THUS CAUSE THEM TO BE SHUTDOWN. OVERPRESSURE COULD BE VENTED OUT THE TANK RELIEF VALVES AND MANIFOLD RELIEF VALVES. THIS IS DETECTABLE FROM TANK PRESSURE SENSORS. THIS IS CRITICALITY 1/1 FOR TAL BECAUSE A BLOCKAGE IN LINE TO FUEL CELL 1 WOULD CAUSE LOSS OF OMS PURGE CAPABILITY. THIS IS CRITICALITY 1/1 FOR RTLS BECAUSE A BLOCKAGE IN LINE TO FUEL CELL 1 WOULD CAUSE LOSS OF AFT COMPARTMENT MPS HELIUM PURGE CAPABILITY.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/29/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 230 ABORT: 3/1R

ITEM: H2 FILTER (5) FL030,FL040,FL500,FL560
FAILURE MODE: RESTRICTED FLOW, CLOGGED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) H2 DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

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

LOCATION: MID FUSELAGE
PART NUMBER: MC286-0054-0001

CAUSES: CONTAMINATION, DEBRIS, DAMAGED ELEMENT

EFFECTS/RATIONALE:
EACH H2 AND 02 CRYO TANK HAS A FILTER FOR ITS REACTANT POSITIONED AHEAD OF ITS CHECK VALVE. THE FILTER IS REPLACED EVERY 15 FLIGHTS. IF THE FILTER CLOGS, REACTANTS ARE UNABLE TO GET TO THE FUEL CELLS, AND REACTANT IS DEPLETED OUT THE TANK RELIEF VALVE. THIS FAILURE IS DETECTED USING THE TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/09/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 231 ABORT: 2/1R

ITEM: H2 MANIFOLD 1 RELIEF VALVE (1) RV031
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
LOSS OF RV031 BY ITSELF WOULD HAVE NO EFFECT. LOSS OF RV041 ALSO, STILL WOULD HAVE NO EFFECT. IF THE TANK 1 RELIEF VALVE ALSO FAILED OPEN, IT COULD LOSE ALL REACTANT, THUS THE CRITICALITY IS 2/1R. IT MAY BE POSSIBLE TO DETECT THIS FAILURE OVER A PERIOD OF TIME WITH THE TANK 1 QUANTITY SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/09/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 232 ABORT: 3/1R

ITEM: H2 MANIFOLD 1 RELIEF VALVE (1) RV031
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
A PRESSURE BUILDUP AND POSSIBLE LINE RUPTURE COULD RESULT IF BOTH RV031 AND RV041 WERE CLOSED. ANY TANK WOULD HAVE TO HAVE ITS OWN RELIEF VALVE FAILED CLOSED, PLUS ITS HEATERS FAILED ON (OR IN MANUAL MODE) TO PRESSURIZE THE LINES ABOVE 302 PSIG.
THIS IS DETECTABLE FROM THE MANIFOLD PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/09/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 233 ABORT: 1/1

ITEM: H2 MANIFOLD 1 RELIEF VALVE (1) RV031
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
THIS IS CRITICALITY 1/1 BECAUSE A LEAK COULD CAUSE POSSIBLE EXPLOSION OR FREEZING UNDER THE PAYLOAD BAY. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 234 ABORT: 2/1R

ITEM: H2 MANIFOLD 2 RELIEF VALVE (1) RV041
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
LOSS OF RV041 BY ITSELF WOULD HAVE NO EFFECT. LOSS OF RV031 ALSO WOULD STILL HAVE NO EFFECT. IF TANK 2 RELIEF VALVE ALSO FAILED OPEN, IT COULD LOSE ALL REACTANT, THUS THE CRITICALITY IS 2/1R. IT MAY BE POSSIBLE TO DETECT THIS FAILURE OVER A PERIOD OF TIME WITH THE TANK 2 QUANTITY SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 235 ABORT: 3/1R

ITEM: H2 MANIFOLD 2 RELIEF VALVE (1) RV041
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
A PRESSURE BUILDUP AND POSSIBLE LINE RUPTURE COULD RESULT IF BOTH RV031 AND RV041 FAIL CLOSED. THE CAUSE OF AN EXCESSIVE PRESSURE BUILDUP WOULD BE TANK HEATERS FAILED ON. IT IS CRITICALITY 3/1R IF A TANK'S HEATERS FAIL ON AND TANK RELIEF VALVE FAILS CLOSED. THIS IS DETECTABLE FROM THE MANIFOLD PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 236 ABORT: 1/1

ITEM: H2 MANIFOLD 2 RELIEF VALVE (1) RV041
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0004

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
THIS IS CRITICALITY 1/1 BECAUSE A LEAK COULD CAUSE POSSIBLE EXPLOSION OR FREEZING UNDER PAYLOAD BAY. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/30/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 237 ABORT: 2/1R

ITEM: H2 CHECK VALVE (2) CV031,CV041
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV031 CHECKS FLOW INTO TANK 3, CV041 CHECKS FLOW INTO TANKS 4 AND 5. HIGHER PRESSURE DOWNSTREAM OF THE CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO THE TANK LINE. LOW PRESSURE IN THE TANK OR A LEAK WOULD HAVE TO OCCUR ALSO, IN ADDITION TO A CHECK VALVE FAILURE. THE RESULT COULD BE LOWER CRYO FLOW TO THE FUEL CELLS AND A POSSIBLE SHUTDOWN. THIS FAILS SCREEN B BECAUSE A TANK LEAK OR RELIEF VALVE FAILED OPENED IS NEEDED FOR THE FAILURE TO BE DETECTABLE. THIS IS CRITICALITY 2/1R BECAUSE A COMBINED FAILURE OF THE TANK RELIEF VALVE OPEN COULD LOSE ALL REACTANTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/30/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 238 ABORT: 3/1R

ITEM: H2 CHECK VALVE (2) CV031,CV041
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT IS UNABLE TO LEAVE THE TANK. THIS DEPLETES H2 OUT OF THE RELIEF VALVE AND COULD FORCE FUEL CELL SHUTDOWN. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR. FAILURE ALSO OF THE TANK RELIEF VALVE CLOSED, HEATERS ON IN MANUAL MODE, OR FAILED ON, COULD CAUSE AN EXPLOSION, THUS THE CRITICALITY IS 3/1R.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/30/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 239 ABORT: 1/1

ITEM: H2 CHECK VALVE (2) CV031,CV041
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT DEPLETION INTO THE AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION, OR FREEZE OTHER SYSTEMS. THIS MAY RESULT IN LOW OR NO CRYO FLOW INTO FUEL CELLS. THIS IS DETECTABLE FROM TANK QUANTITY AND PRESSURE SENSORS AND MANIFOLD PRESSURE SENSORS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 240 ABORT: 2/1R

ITEM: H2 CHECK VALVE (1) CV030
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV030 CHECKS FLOW INTO TANK 1. HIGHER PRESSURE DOWNSTREAM OF CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO TANK LINE. LOW PRESSURE IN TANK OR A LEAK WOULD HAVE TO OCCUR IN ADDITION TO THE CHECK VALVE FAILURE. THE RESULT COULD BE LOWER CRYO FLOW TO FUEL CELLS AND POSSIBLE SHUTDOWN. THIS FAILS SCREEN B BECAUSE NEED A TANK LEAK OR RELIEF VALVE FAILED OPEN TO DETECT. THIS IS CRITICALITY 2/1R BECAUSE COMBINED FAILURE OF TANK RELIEF VALVE OPEN COULD LOSE THE VEHICLE DUE TO REACTANT LOSS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/01/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	3/1R
MDAC ID:	241	ABORT:	2/1R

ITEM: H2 CHECK VALVE (1) CV030
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	2/1R
LIFTOFF:	3/1R	TAL:	2/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT IS UNABLE TO LEAVE TANK. THIS DEPLETES H2 OUT THE RELIEF VALVE AND COULD CAUSE FUEL CELL SHUTDOWN. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR. FAILURE ALSO OF RELIEF VALVE COULD CAUSE TANK EXPLOSION, IF HEATER IS ON IN MANUAL MODE OR FAILED ON. THIS IS CRITICALITY 2/1R SINCE IF CV030 AND LV031 FAILED CLOSED DURING TAL AND RTLS COULD LOSE OMS PURGE CAPABILITY, AND MPS HELIUM PURGE CAPABILITY RESPECTIVELY.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 242 ABORT: 1/1

ITEM: H2 CHECK VALVE (1) CV030
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT DEPLETION INTO THE AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION OR FREEZE OTHER SYSTEMS. THIS MAY RESULT IN LOW OR NO CRYO FLOW INTO FUEL CELLS. THIS FAILURE IS DETECTABLE FROM TANK QUANTITY SENSORS AND CONSOLE QUANTITY CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86
SUBSYSTEM: EPG
MDAC ID: 243

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 2/1R
ABORT: 2/1R

ITEM: H2 CHECK VALVE (1) CV040
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV040 CHECKS FLOW INTO H2 TANK 2. HIGHER PRESSURE DOWNSTREAM OF CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO TANK. LOW PRESSURE IN TANK OR LEAK WOULD HAVE TO OCCUR IN ADDITION TO CHECK VALVE FAILURE. THE RESULT COULD BE LOWER CRYO FLOW TO FUEL CELLS AND POSSIBLE SHUTDOWN. FAILS SCREEN B BECAUSE NEED A TANK LEAK OR RELIEF VALVE FAILED OPEN TO DETECT. 2/1R BECAUSE COMBINED FAILURE OF TANK RELIEF VALVE OPEN COULD LOSE VEHICLE DUE TO REACTANT LOSS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 244 ABORT: 3/1R

ITEM: H2 CHECK VALVE (1) CV040
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT IS UNABLE TO LEAVE TANK. THIS DEPLETES H2 OUT THE RELIEF VALVE AND COULD CAUSE FUEL CELL 2 SHUTDOWN IF LV041 WAS CLOSED. THIS IS DETECTABLE FROM TANK PRESSURE SENSOR. FAILURE ALSO OF RELIEF VALVE COULD CAUSE TANK EXPLOSION, IF HEATER IS ON IN MANUAL MODE OR FAILED ON.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 245 ABORT: 1/1

ITEM: H2 CHECK VALVE (1) CV040
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT DEPLETION INTO THE AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION OR FREEZE OTHER SYSTEMS. THIS MAY RESULT IN LOW OR NO CRYO FLOW INTO FUEL CELLS. THIS FAILURE IS DETECTABLE FROM TANK QUANTITY SENSORS AND CONSOLE QUANTITY CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 246 ABORT: 2/1R

ITEM: H2 HORIZONTAL DRAIN QD (1) TYPE II, CLASS 8
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0280

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
HORIZONTAL DRAIN IS USED AFTER LANDING TO DRAIN REMAINING REACTANT FROM PRSD. IF QD AND CAP BOTH LEAK, LOSS OF ALL REACTANT COULD OCCUR, POSSIBLY CAUSING FUEL CELL SHUTDOWN. CAP AND FILL QD'S ARE REDUNDANT ITEMS FOR THIS QD.
CANNOT DETECT LOSS OF QD ITSELF.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 247 ABORT: 3/3

ITEM: H2 HORIZONTAL DRAIN QD (1) TYPE II, CLASS 8
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0280

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
DRAIN QD IS NOT USED AT LAUNCH PAD. NO EFFECT AFTER LANDING BECAUSE MISSION HAS ALREADY ENDED AND CAN DRAIN H2 THROUGH FILL QD.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 248 ABORT: 2/1R

ITEM: H2 HORIZONTAL DRAIN CAP (1)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0260

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
THE CAP IS A LEVEL OF REDUNDANCY OVER THE QD. REACTANT CANNOT LEAK OUT UNLESS THE QD ALSO LEAKS. IF BOTH THE CAP AND QD LEAK, COULD LOSE ALL H2. CANNOT DETECT LOSS OF CAP ALONE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 249 ABORT: 3/3

ITEM: H2 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME 449-0177-2501

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
MANIFOLD 1 SENSOR MEASURES PRESSURE BETWEEN TANK 1 CHECK VALVE, FUEL CELL 1 SUPPLY VALVE, MANIFOLD 1 RELIEF VALVE, AND MANIFOLD 1 CROSSOVER VALVE. MANIFOLD 2 SENSOR MEASURES PRESSURE BETWEEN TANK 2 CHECK VALVE, FUEL CELL 2 SUPPLY VALVE, H2 GSE SUPPLY VALVE, MANIFOLD 2 CROSSOVER VALVE AND MANIFOLD 2 RELIEF VALVE. THESE SENSORS HAVE NO EFFECT ON OTHER COMPONENTS. MANIFOLD RELIEF VALVE WOULD DISSIPATE EXCESS PRESSURE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 250 ABORT: 3/3

ITEM: H2 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME 449-0177-2501

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE THE CREW TO CHECK FUEL CELL H2 FLOW METERS AND TANK PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 251 ABORT: 3/3

ITEM: H2 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME 449-0177-2501

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
INACCURATE READING MAY CAUSE THE CREW TO CHECK FUEL CELL H2 FLOWMETERS AND TANK PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/27/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 252 ABORT: 3/1R

ITEM: H2 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV031
FAILURE MODE: FAILS OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRIC SIGNAL

EFFECTS/RATIONALE:
LV031 IS USED TO ISOLATE H2 FLOW IN TANK 1 AND VALVE MODULE 1 (FUEL CELL 1) FROM FUEL CELL 3 AND VALVE MODULE 2 (FUEL CELL 2) AND THE OTHER TANKS. IF THERE IS A LOW PRESSURE PROBLEM IN VALVE MODULE 1, LV041 WOULD NEED TO BE CLOSED TO PREVENT LOSS OF ALL REACTANT. TANK 1 RELIEF VALVE AND MANIFOLD 1 RELIEF VALVE WOULD HAVE TO FAIL OPEN TO LOSE ALL REACTANT. CLOSING LV041 WOULD STILL SHUTDOWN FUEL CELLS 1 AND 3.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/27/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/2R
MDAC ID: 253 ABORT: 2/1R

ITEM: H2 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV031
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	3/2R	TAL:	2/1R
ONORBIT:	3/2R	AOA:	3/2R
DEORBIT:	3/2R	ATO:	3/2R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRIC SIGNAL

EFFECTS/RATIONALE:
IF BOTH CROSSOVER VALVES FAIL SHUT, TANKS 1 AND 2 WOULD DEPLETE FASTER SINCE EACH WOULD HAVE TO FEED A FUEL CELL ALONE. ANY FAILURES THAT PREVENT THE DISTRIBUTION OF THE CONTENTS OF TANKS 1 AND 2 COULD SHUTDOWN 2 FUEL CELLS. 2/1R FOR TAL BECAUSE FAILURE OF TANK 1 OR ITS CHECK VALVE COULD CAUSE FUEL CELL 1 SHUTDOWN AND OMS PURGE LOSS. ALSO, THIS IS CRITICALITY 2/1R FOR RTLS BECAUSE HELIUM PURGE CAPABILITY WOULD BE LOST. DETECTABLE FROM VALVE POSITION INDICATOR. 3/2R IF TANK 1 HAS ITS CHECK VALVE OR FILTER CLOSED , OR TANK RELIEF VALVE OPEN.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/27/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	1/1
MDAC ID:	254	ABORT:	1/1

ITEM: H2 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV031
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION OR POSSIBLE FREEZING OF OTHER SYSTEMS. IF ONLY LV031 LEAKS, CAN USE LV041 TO ISOLATE LEAK, BUT MAY LOSE FUEL CELLS 1 AND 3. IF BOTH MANIFOLD CROSSOVER VALVES LEAK, MAY CAUSE LOSS OF ALL REACTANTS. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/03/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	2/1R
MDAC ID:	255	ABORT:	2/1R

ITEM: H2 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV033
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
IF LV033 FAILS OPEN, CAN USE LV031 AND IF NEEDED, LV041 TO ISOLATE FUEL CELL 1. THIS IS CRITICALITY 2/1R BECAUSE IF FUEL CELL IS SHUT DOWN BECAUSE OF ONE OF ITS COMPONENTS, THEN THE REACTANT FLOW HAS TO BE STOPPED OR AN EXPLOSION COULD OCCUR. IF CREW CANNOT CLOSE VALVE, MISSION ABORT DECISION WOULD RESULT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/03/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 256 ABORT: 1/1

ITEM: H2 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV033
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	1/1
LIFTOFF:	2/1R	TAL:	1/1
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV033 IS USED TO CONTROL H2 FLOW INTO FUEL CELL 1. 2/1R FOR ABORT/ASCENT BECAUSE IF 2 FUEL CELL REACTANT VALVES FAIL, THEN ORBITER IS LOST. EARLIEST ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. CAN DETECT USING FUEL CELL FLOW METER. 1/1 FOR TAL BECAUSE OMS PURGE CAPABILITY WILL BE LOST, AND 1/1 FOR RTLS BECAUSE HELIUM PURGE CAPABILITY WILL BE LOST. FAILURE ONORBIT CAUSES PRIORITY FLIGHT DECISION.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/03/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 257 ABORT: 1/1

ITEM: H2 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV033
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. LEAK MAY PREVENT FUEL CELL FROM RECEIVING ADEQUATE REACTANT.
LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

C-2

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 258 ABORT: 2/1R

ITEM: H2 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV043
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, JAMMING, CONTAMINATION, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
IF LV043 FAILS OPEN, CREW CAN USE LV041 AND IF NEEDED, LV031 TO ISOLATE FUEL CELL 2. THIS IS CRITICALITY 2/1R BECAUSE IF FUEL CELL IS SHUT DOWN BECAUSE OF ONE OF ITS COMPONENTS, THEN THE REACTANT FLOW HAS TO BE STOPPED OR AN EXPLOSION COULD OCCUR. IF CANNOT CLOSE VALVE, MISSION ABORT DECISION WOULD RESULT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 259 ABORT: 2/1R

ITEM: H2 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV043
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV043 IS USED TO CONTROL H2 FLOW INTO FUEL CELL 2. 2/1R FOR ABORT/ASCENT BECAUSE IF 2 FUEL CELL REACTANT VALVES FAIL, THEN ORBITER IS LOST. THE EARLIEST THE ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. DETECTABLE USING FUEL CELL FLOWMETER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 260 ABORT: 1/1

ITEM: H2 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV043
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: CORROSION, FATIGUE VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. LEAK MAY PREVENT FUEL CELL FROM RECEIVING ADEQUATE REACTANT. LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/06/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	2/1R
MDAC ID:	261	ABORT:	2/1R

ITEM: H2 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV044
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, JAMMING, CONTAMINATION, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV044 IS USED TO CONTROL H2 FLOW INTO FUEL CELL 3. IF LV044 FAILS, CREW WOULD HAVE TO USE BOTH LV041 AND LV031 TO ISOLATE FUEL CELL 3. THIS IS CRITICALITY 2/1R BECAUSE IF FUEL CELL IS SHUT DOWN BECAUSE OF ONE OF ITS COMPONENTS, THEN THE REACTANT FLOW HAS TO BE STOPPED OR AN EXPLOSION COULD OCCUR. IF CREW CANNOT CLOSE VALVE, MISSION ABORT DECISION WOULD RESULT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 262 ABORT: 2/1R

ITEM: H2 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV044
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
THIS IS CRITICALITY 2/1R FOR ASCENT/ABORT BECAUSE IF 2 REACTANT VALVES FAIL CLOSED, THE ORBITER IS LOST. THE EARLIEST THE ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. THE FAILURE CAN BE DETECTED FROM FUEL CELL FLOWMETER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 263 ABORT: 1/1

ITEM: H2 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV044
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4200

CAUSES: CORROSION, FATIGUE, CONTAMINATION, VIBRATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. LEAK MAY PREVENT FUEL CELL FROM RECEIVING ADEQUATE REACTANT. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 264 ABORT: 3/1R

ITEM: H2 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV041
FAILURE MODE: FAILS OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV041 IS USED TO ISOLATE H2 FLOW IN TANK 2 AND VALVE MODULE 2 (FUEL CELL 2) FROM FUEL CELL 3 AND VALVE MODULE 1 (FUEL CELL 1) AND THE OTHER TANKS. IF THERE IS LOW PRESSURE IN VALVE MODULE 2, CREW CAN USE LV031 TO STOP LOSS OF ALL REACTANT, BUT THIS MAY CAUSE SHUTDOWN OF FUEL CELLS 3 AND 2. ASCENT AND ABORT REQUIRE AT LEAST 2 FUEL CELLS UNTIL MECO. TANK 2 RELIEF VALVE AND MANIFOLD 2 RELIEF VALVE WOULD HAVE TO FAIL OPEN TO LOSE ALL REACTANT. LOSS PRELAUNCH WOULD CAUSE MISSION DELAY.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/2R
MDAC ID: 265
ABORT: 3/2R

ITEM: H2 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV041
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/2R
LIFTOFF:	3/2R	TAL:	3/2R
ONORBIT:	3/2R	AOA:	3/2R
DEORBIT:	3/2R	ATO:	3/2R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
3/2R IF TANK 2 RELIEF VALVE FAILS OPEN OR CHECK VALVE FAILS CLOSED. TANK 2 WOULD DEPLETE FASTER SINCE IT ALONE COULD FEED FUEL CELL 2. FAILURE IS DETECTABLE FROM VALVE POSITION INDICATOR. IF BOTH CROSSOVER VALVES FAIL SHUT, TANK 1 WOULD ALSO DEPLETE FASTER SINCE IT ALONE WOULD BE FEEDING FUEL CELL 1.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 266 ABORT: 1/1

ITEM: H2 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV041
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4210

CAUSES: CORROSION, FATIGUE VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. IF ONLY LV041 LEAKS, CAN USE LV031 TO STOP LEAK, BUT COULD LOSE FUEL CELLS 2 AND 3. IF BOTH MANIFOLD SHUTOFF VALVES LEAK, ALL FUEL CELLS MAY BE SHUTDOWN.
THIS LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/06/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 267 ABORT: 2/1R

ITEM: H2 SOLENOID GSE SUPPLY VALVE (1) LV045
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4220

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV045 CONTROLS GROUND OPERATION FLOW OF FUEL CELL REACTANT. THIS IS CRITICALITY 3/3 DURING PRELAUNCH BECAUSE VALVE IS OPEN UNTIL T-0. CRITICALITY 2/1R OTHER PHASES BECAUSE REACTANT WOULD ONLY BE CONTAINED BY H2 FILL T-0. LEAK COULD BE ISOLATED BY CLOSING LV041. FUEL CELL 2 WOULD PROBABLY BE SHUT DOWN. LEAK COULD CAUSE LOSS OF ALL REACTANT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/06/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	3/3
MDAC ID:	268	ABORT:	3/3

ITEM: H2 SOLENOID GSE SUPPLY VALVE (1) LV045
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4220

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
VALVE IS NORMALLY CLOSED EXCEPT FOR BEFORE T-0. A FAILURE PRELAUNCH WOULD CAUSE LAUNCH DELAY. THERE IS NO EFFECT AT OTHER TIMES. VALVE FAILING CLOSED AT LAUNCH SITE MAY CAUSE BACK PRESSURE ON GSE SUPPLY LINE TO ORBITER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/06/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	1/1
MDAC ID:	269	ABORT:	1/1

ITEM: H2 SOLENOID GSE SUPPLY VALVE (1) LV045
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4220

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. THE FAILURE IS DETECTED OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 270 ABORT: 2/1R

ITEM: H2 FILL GSE SUPPLY T-0 QUICK DISCONNECT (1) PD035
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0012-0210

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
THE H2 GSE SUPPLY T-0 QD HAS NO CAP AND ITS ONLY BACKUP IS THE GSE SUPPLY VALVE. AN EXTERNAL LEAK COULD ONLY OCCUR IF THE VALVE ALSO LEAKED, BUT IF BOTH LEAKED, COULD LOSE ALL REACTANT. A LEAK COULD BE ISOLATED BY USING LV041 BUT PROBABLY FUEL CELL 2 WOULD BE SHUT DOWN.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/07/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	3/3
MDAC ID:	271	ABORT:	3/3

ITEM: H2 FILL GSE SUPPLY T-0 QUICK DISCONNECT (1) PD035
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0012-0210

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
IF QD CANNOT MATE OR DEMATE AT LAUNCH PAD, THE MISSION WILL BE DELAYED. NO EFFECT ANY OTHER TIMES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 272 ABORT: 2/1R

ITEM: O2 CHECK VALVE (1) CV010
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV010 CHECKS O2 FLOW INTO TANK 1. HIGHER PRESSURE DOWNSTREAM OF CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO TANK LINE. LOWER PRESSURE IN TANK OR LEAK WOULD HAVE TO OCCUR IN ADDITION TO CHECK VALVE FAILURE. RESULT COULD BE LOWER CYRO FLOW TO FUEL CELLS AND POSSIBLE SHUTDOWN. FAILS SCREEN B BECAUSE NEED A TANK LEAK OR RELIEF VALVE FAILED OPEN TO NOTICE. THIS IS CRITICALITY 2/1R BECAUSE COMBINED FAILURE OF TANK RELIEF VALVE OPEN COULD LOSE VEHICLE DUE TO REACTANT LOSS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 273 ABORT: 2/1R

ITEM: O2 CHECK VALVE (1) CV010
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	2/1R
LIFTOFF:	3/1R	TAL:	2/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT IS UNABLE TO LEAVE TANK. THIS DEPLETES H2 OUT THE RELIEF VALVE AND COULD CAUSE FUEL CELL SHUTDOWN. THIS IS DETECTABLE FROM THE TANK PRESSURE SENSOR. FAILURE OF RELIEF VALVE CLOSED ALSO COULD CAUSE TANK EXPLOSION, IF HEATERS ON IN MANUAL MODE OR FAILED ON. 2/1R BECAUSE IF CV010 AND LV011 FAIL CLOSED, COULD LOSE OMS PURGE CAPABILITY FOR TAL, AND HELIUM PURGE CAPABILITY FOR RTLS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 274 ABORT: 1/1

ITEM: O2 CHECK VALVE (1) CV010
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT LEAKAGE INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION OR FREEZE OTHER SYSTEMS. LEAK MAY RESULT IN LOW OR NO CRYO FLOW INTO FUEL CELLS. THIS IS DETECTABLE FROM TANK QUANTITY AND PRESSURE SENSORS AND MANIFOLD PRESSURE SENSORS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/08/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 275 ABORT: 2/1R

ITEM: 02 SOLENOID GSE SUPPLY VALVE (1) LV015
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4100

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV015 CONTROLS GROUND OPERATION FLOW OF FUEL CELL REACTANT. THIS IS 3/3 DURING PRELAUNCH BECAUSE VALVE IS OPEN UNTIL T-0. IT IS 2/1R OTHER PHASES BECAUSE FAILURE OF 02 GSE T-0 QD WOULD CAUSE 02 LEAK AND POSSIBLE LOSS OF ALL REACTANT. LEAK COULD BE ISOLATED BY CLOSING LV011, BUT FUEL CELL 1 AND SUPPLY TO ECLSS SYSTEM 1 COULD BE LOST.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/08/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 276 ABORT: 3/3

ITEM: 02 SOLENOID GSE SUPPLY VALVE (1) LV015
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4100

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
VALVE IS NORMALLY CLOSED, EXCEPT FOR BEFORE T-0. FAILURE PRELAUNCH WOULD CAUSE LAUNCH DELAY, AND POSSIBLE BACKPRESSURE IN GSE SUPPLY LINE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/08/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 277 ABORT: 1/1

ITEM: 02 SOLENOID GSE SUPPLY VALVE (1) LV015
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4100

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. FAILURE MIGHT BE DETECTED BY MANIFOLD PRESSURE SENSOR, ALSO OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 278 ABORT: 2/1R

ITEM: 02 SOLENOID ECLSS SYSTEM 1 SUPPLY VALVE (1) LV012
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
VALVE IS NORMALLY OPEN. LV012 AND LV022 SUPPLY BREATHABLE OXYGEN TO THE CREW. FAILURE COULD PREVENT CREW FROM ISOLATING LOW PRESSURE DOWNSTREAM, AND STOPPING POSSIBLE EXPLOSION OR FREEZING OF OTHER SYSTEMS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 279 ABORT: 2/1R

ITEM: 02 SOLENOID ECLSS SYSTEM 1 SUPPLY VALVE (1) LV012
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
IF BOTH LV012 AND LV022 ARE FAILED CLOSED, THE CREW WILL NOT BE ABLE TO BREATHE FOR LONG. FAILURE IS DETECTABLE BY FLOW METERS AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 280 ABORT: 1/1

ITEM: 02 SOLENOID ECLSS SYSTEM 1 SUPPLY VALVE (1) LV012
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. FAILURE IS DETECTABLE OVER PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 281 ABORT: 2/1R

ITEM: 02 SOLENOID ECLSS SYSTEM 2 SUPPLY VALVE (1) LV022
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
VALVE IS NORMALLY OPEN. LV022 AND LV012 SUPPLY BREATHABLE OXYGEN TO THE CREW. FAILURE COULD PREVENT CREW FROM ISOLATING LOW PRESSURE DOWNSTREAM AND STOPPING POSSIBLE EXPLOSION OR FREEZING OF OTHER SYSTEMS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 282 ABORT: 2/1R

ITEM: 02 SOLENOID ECLSS SYSTEM 2 SUPPLY VALVE (1) LV022
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
IF BOTH LV012 AND LV022 ARE FAILED CLOSED, THE CREW WILL NOT BE ABLE TO BREATHE FOR LONG. FAILURE IS DETECTABLE BY FLOW METERS AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 283 ABORT: 1/1

ITEM: 02 SOLENOID ECLSS SYSTEM 2 SUPPLY VALVE (1) LV022
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4101

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
EXTERNAL LEAK INTO AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 284 ABORT: 2/1R

ITEM: 02 FILL GSE SUPPLY T-0 QUICK DISCONNECT (1) PD015
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0012-0110

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
THE O2 GSE SUPPLY T-0 QD HAS NO CAP AND ITS ONLY BACKUP IS THE 02 GSE SUPPLY VALVE TO PREVENT LEAKS. A LEAK COULD BE ISOLATED BY LV015, LV011, AND LV021 IN ORDER. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 285 ABORT: 3/3

ITEM: 02 FILL GSE SUPPLY T-0 QUICK DISCONNECT (1) PD015
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0012-0110

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
IF THE QD CANNOT MATE ON THE PAD, THE FUEL CELLS CANNOT USE GROUND REACTANT. IF QD CANNOT DEMATE, THE MISSION WILL BE DELAYED. NO EFFECT ANY OTHER TIMES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 286 ABORT: 3/3

ITEM: 02 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME 449-0177-2503

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
MANIFOLD 1 SENSOR MEASURES PRESSURE BETWEEN TANK 1 CHECK VALVE, ECLSS SYSTEM 1 SUPPLY VALVE, FUEL CELL 1 SUPPLY VALVE, MANIFOLD 1 RELIEF VALVE, 02 GSE SUPPLY VALVE, AND THE MANIFOLD 1 CROSSOVER VALVE. MANIFOLD 2 SENSOR MEASURES PRESSURE BETWEEN TANK 2 CHECK VALVE, MANIFOLD 2 CROSSOVER VALVE, FUEL CELL 2 SUPPLY VALVE, ECLSS SYSTEM 2 SUPPLY VALVE, AND MANIFOLD 2 RELIEF VALVE. THESE SENSORS HAVE NO EFFECT ON OTHER COMPONENTS. MANIFOLD RELIEF VALVES WOULD DISSIPATE EXCESS PRESSURE.
CREW WOULD MAKE SURE ALL VALVES ARE OPEN TO FUEL CELLS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 287 ABORT: 3/3

ITEM: 02 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME449-0177-2503

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE THE CREW TO CHECK FUEL CELL FLOW METERS AND TANK PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 288 ABORT: 3/3

ITEM: 02 MANIFOLD PRESSURE SENSOR (2)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: ME449-0177-2503

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE THE CREW TO CHECK FUEL CELL FLOWMETER AND TANK PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 289 ABORT: 2/1R

ITEM: 02 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV013
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV013 IS USED TO CONTROL 02 FLOW INTO FUEL CELL 1. IF FUEL CELL 1 IS SHUTDOWN, VALVE WOULD NEED TO BE CLOSED OR COULD LOSE VEHICLE. COULD USE LV011 AND LV021 IF NEEDED TO ISOLATE FUEL CELL, BUT COULD NOT STOP REACTANT FLOW.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 290 ABORT: 1/1

ITEM: 02 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV013
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	1/1
LIFTOFF:	2/1R	TAL:	1/1
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
THE CRITICALITY IS 2/1R FOR ASCENT AND ATO/AOA ABORTS BECAUSE IF 2 FUEL CELL REACTANT VALVES FAIL, THEN ORBITER IS LOST. THE EARLIEST AN ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. CAN DETECT FAILURE BY USING FUEL CELL FLOWMETER. 1/1 FOR TAL ABORT BECAUSE FUEL SHUTDOWN LOSES OMS PURGE CAPABILITY. 1/1 FOR RTLS BECAUSE HELIUM PURGE CAPABILITY WOULD BE LOST. FAILURE ONORBIT CAUSES PRIORITY FLIGHT DECISION.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/14/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 291 ABORT: 1/1

ITEM: 02 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1)
LV013
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
02 LEAKING INTO AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. A LEAK MAY PREVENT THE FUEL CELL FROM RECEIVING ADEQUATE REACTANT. THE FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 292 ABORT: 3/1R

ITEM: 02 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV011
FAILURE MODE: FAILS OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV011 IS USED TO ISOLATE 02 FLOW FROM TANK 1 AND VALVE MODULE 1 (FUEL CELL 1 AND ECLSS SYSTEM 1) FROM THE OTHER FUEL CELLS AND TANKS. IF THERE IS A LOW PRESSURE PROBLEM IN VALVE MODULE 1, LV021 WOULD NEED TO BE CLOSED TO PREVENT LOSS OF ALL REACTANT. TANK 1 RELIEF VALVE AND MANIFOLD 1 RELIEF VALVE WOULD HAVE TO FAIL OPEN TO LOSE ALL REACTANT. CLOSING LV021 WOULD STILL SHUTDOWN FUEL CELLS 1 AND 3.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/2R
MDAC ID: 293 ABORT: 2/1R

ITEM: 02 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV011
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	3/2R	TAL:	2/1R
ONORBIT:	3/2R	AOA:	3/2R
DEORBIT:	3/2R	ATO:	3/2R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
2/1R FOR TAL BECAUSE IF TANK 1 RELIEF VALVE FAILS OPEN, COULD LOSE FUEL CELL 1 AND OMS PURGE CAPABILITY. 2/1R FOR RTLS BECAUSE HELIUM PURGE CAPABILITY WOULD BE LOST. TANK 1 WOULD DEPLETE FASTER SINCE IT ALONE COULD FEED FUEL CELL 1 AND ECLSS SYSTEM 1. FAILURE IS DETECTABLE FROM VALVE POSITION INDICATOR. 3/2R FOR ASCENTS AND OTHER ABORTS IF TANK 1 HAS ITS CHECK VALVE OR FILTER CLOSED, OR TANK RELIEF VALVE OPEN.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 294 ABORT: 1/1

ITEM: O2 MANIFOLD 1 SOLENOID CROSSOVER VALVE (1) LV011
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 1
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. IF ONLY LV011 LEAKS, CAN USE LV021 TO ISOLATE LEAK, BUT MAY LOSE FUEL CELLS 1 AND 3. IF BOTH CROSSOVER VALVES LEAK, MAY CAUSE ALL FUEL CELLS TO BE SHUTDOWN. FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 295 ABORT: 3/1R

ITEM: 02 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV021
FAILURE MODE: FAILS OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV021 IS USED TO ISOLATE 02 FLOW FROM TANK 2 AND VALVE MODULE 2 (FUEL CELL 2 AND ECLSS SYSTEM 2) FROM THE OTHER FUEL CELLS AND TANKS. IF THERE IS A LOW PRESSURE PROBLEM IN VALVE MODULE 2, LV011 WOULD HAVE TO BE CLOSED TO PREVENT LOSS OF ALL REACTANT. TANK 2 RELIEF VALVE AND MANIFOLD 2 RELIEF VALVE WOULD HAVE TO FAIL OPEN TO LOSE ALL REACTANT. CLOSING LV011 WOULD STILL SHUTDOWN FUEL CELLS 2 AND 3.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/2R
MDAC ID: 296 ABORT: 3/2R

ITEM: 02 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV021
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/2R
LIFTOFF:	3/2R	TAL:	3/2R
ONORBIT:	3/2R	AOA:	3/2R
DEORBIT:	3/2R	ATO:	3/2R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
THE CRITICALITY IS 3/2R IF TANK 2 RELIEF VALVE FAILS OPEN OR CHECK VALVE FAILS CLOSED. TANK 2 WOULD DEPLETE FASTER SINCE IT ALONE COULD FEED FUEL CELL 2 AND ECLSS SYSTEM 2. FAILURE IS DETECTABLE FROM VALVE POSITION INDICATOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 297 ABORT: 1/1

ITEM: 02 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV021
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4110

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
LEAK INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. IF ONLY LV021 LEAKS, CAN USE LV011 TO ISOLATE LEAK, BUT MAY LOSE FUEL CELLS 3 AND 2 AND ECLSS SYSTEM 2. IF BOTH CROSSOVER VALVES LEAK, MAY CAUSE ALL FUEL CELLS TO BE SHUT DOWN. FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 298 ABORT: 2/1R

ITEM: 02 HORIZONTAL DRAIN QD (1)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0180

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
THE HORIZONTAL DRAIN IS USED AFTER LANDING TO DRAIN REMAINING REACTANT FROM PRSD. A CAP PROVIDES A LEVEL OF REDUNDANCY. IF QD AND CAP BOTH LEAK, LOSS OF ALL REACTANT COULD OCCUR, POSSIBLY CAUSING FUEL CELL AND ECLSS SYSTEMS SHUTDOWN. CANNOT DETECT LOSS OF QD ALONE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 299 ABORT: 3/3

ITEM: 02 HORIZONTAL DRAIN QD (1)
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0180

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
THE DRAIN QD IS NOT USED AT LAUNCH PAD. THERE IS NO EFFECT AFTER LANDING BECAUSE THE MISSION HAS ALREADY ENDED AND CAN DRAIN O2 THROUGH FILL QD.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 300 ABORT: 2/1R

ITEM: 02 HORIZONTAL DRAIN CAP (1)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC 276-0010-0160

CAUSES: CONTAMINATION, FATIGUE, CORROSION

EFFECTS/RATIONALE:
THE CAP IS A LEVEL OF REDUNDANCY OVER QD. REACTANT CANNOT LEAK OUT UNLESS QD ALSO LEAKS. IF BOTH CAP AND QD LEAK, COULD LOSE ALL 02. CANNOT DETECT LOSS OF CAP.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 301 ABORT: 2/1R

ITEM: 02 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV024
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4103

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV024 IS USED TO CONTROL 02 FLOW INTO FUEL CELL 3. IF FUEL CELL 3 IS SHUT DOWN, VALVE WOULD NEED TO BE CLOSED OR COULD LOSE VEHICLE. LV021 OR LV011 COULD BE USED TO ISOLATE FUEL CELL, BUT COULD NOT STOP REACTANT FLOW.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 302 ABORT: 2/1R

ITEM: 02 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV024
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4103

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
THE CRITICALITY IS 2/1R FOR ASCENT AND ABORTS BECAUSE IF 2 FUEL CELL REACTANT VALVES FAIL, THEN ORBITER IS LOST. THE EARLIEST AN ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. CAN DETECT FAILURE USING FUEL CELL FLOWMETER.
FAILURE ONORBIT CAUSES PRIORITY FLIGHT DECISION.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 303 ABORT: 1/1

ITEM: 02 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1)
LV024
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4103

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
02 LEAKING INTO AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. A LEAK MAY PREVENT FUEL CELL FROM RECEIVING ADEQUATE REACTANT. A FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 304 ABORT: 2/1R

ITEM: 02 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV023
FAILURE MODE: FAILS OPEN (INCLUDES INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	2/1R	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	2/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
LV023 IS USED TO CONTROL 02 FLOW INTO FUEL CELL 2. IF FUEL CELL 2 IS SHUT DOWN, VALVE WOULD NEED TO BE CLOSED OR COULD LOSE VEHICLE. COULD USE LV021 OR LV011 TO ISOLATE FUEL CELL, BUT COULD NOT STOP REACTANT FLOW.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 305 ABORT: 2/1R

ITEM: 02 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV023
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE, LOSS OF ELECTRICAL SIGNAL

EFFECTS/RATIONALE:
THIS IS CRITICALITY 2/1R FOR ASCENT AND ABORTS BECAUSE IF 2 FUEL CELL REACTANT VALVES FAIL, THEN ORBITER IS LOST. THE EARLIEST AN ORBITER CAN OPERATE ON ONLY 1 FUEL CELL IS AFTER MECO. CAN DETECT FAILURE USING FUEL CELL FLOWMETER.
FAILURE ONORBIT CAUSES PRIORITY FLIGHT DECISION.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 306 ABORT: 1/1

ITEM: 02 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1)
LV023
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0429-4102

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
02 LEAKING INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION AND FREEZE OTHER SYSTEMS. A LEAK MAY PREVENT FUEL CELL FROM RECEIVING ADEQUATE REACTANT. A FAILURE IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 307 ABORT: 2/1R

ITEM: O2 MANIFOLD 1 RELIEF VALVE (1) RV011
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/1		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
LOSS OF RV011 BY ITSELF AND COMBINED WITH LOSS OF RV021 WOULD HAVE NO EFFECT. IF TANK 1 RELIEF VALVE ALSO FAILED OPEN COULD LOSE ALL REACTANT, THUS 2/1R. NEED FAILURE UPSTREAM ALSO TO DETECT WITH MANIFOLD 1 PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 308 ABORT: 3/1R

ITEM: O2 MANIFOLD 1 RELIEF VALVE (1) RV011
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
A PRESSURE BUILDUP AND POSSIBLE LINE RUPTURE COULD RESULT IF BOTH RV011 AND RV021 WERE CLOSED. THE CAUSE OF AN EXCESSIVE PRESSURE BUILDUP WOULD BE TANK HEATERS FAILED ON. IT IS CRITICALITY 3/1R IF A TANK'S HEATERS FAIL ON AND ITS TANK RELIEF VALVE FAILS CLOSED. THIS IS DETECTABLE FROM THE MANIFOLD PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 309 ABORT: 1/1

ITEM: O2 MANIFOLD 1 RELIEF VALVE (1) RV011
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
THIS IS CRITICALITY 1/1 BECAUSE A LEAK COULD CAUSE POSSIBLE EXPLOSION OR FREEZING UNDER PAYLOAD BAY. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 310 ABORT: 2/1R

ITEM: 02 MANIFOLD 2 RELIEF VALVE (1) RV021
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
LOSS OF RV021 BY ITSELF OR COMBINED WITH RV011 WOULD HAVE NO EFFECT. IF TANK 2 RELIEF VALVE ALSO FAILED OPEN, COULD LOSE ALL REACTANT, THUS 2/1R. NEED FAILURE UPSTREAM TO DETECT WITH MANIFOLD 2 PRESSURE SENSOR.
THE FUNCTION OF THE VALVE IS PRESSURE CONTROL OF THE MANIFOLD.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:	10/17/86	HIGHEST CRITICALITY	HDW/FUNC
SUBSYSTEM:	EPG	FLIGHT:	3/1R
MDAC ID:	311	ABORT:	3/1R

ITEM: O2 MANIFOLD 2 RELIEF VALVE (1) RV021
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
A PRESSURE BUILDUP AND POSSIBLE LINE RUPTURE COULD RESULT IF BOTH RV011 AND RV021 WERE CLOSED. THIS FAILURE IS DETECTABLE FROM THE MANIFOLD PRESSURE SENSOR. THE CRITICALITY IS 3/1R IF A TANK'S HEATERS FAIL ON AND ITS TANK RELIEF VALVE FAILS CLOSED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 312 ABORT: 1/1

ITEM: O2 MANIFOLD 2 RELIEF VALVE (1) RV021
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0003

CAUSES: VIBRATION, CORROSION, FATIGUE, CONTAMINATION

EFFECTS/RATIONALE:
A LEAK COULD CAUSE POSSIBLE EXPLOSION OR FREEZING UNDER PAYLOAD BAY. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 313 ABORT: 2/1R

ITEM: 02 CHECK VALVE (2) CV021
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV021 CHECKS FLOW INTO TANK 3 AND THE OTHER CHECK VALVE CHECKS FLOW INTO TANKS 4 AND 5. HIGHER PRESSURE DOWNSTREAM OF CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO TANK. LOW PRESSURE IN TANK OR LEAK WOULD HAVE TO OCCUR IN ADDITION TO CHECK VALVE FAILURE. RESULT COULD BE LOWER CYRO FLOW TO FUEL CELLS AND POSSIBLE SHUTDOWN. FAILS SCEEN B BECAUSE NEED A TANK LEAK OR RELIEF VALVE FAILED OPEN TO DETECT. THIS IS 2/1R BECAUSE COMBINED FAILURE OF TANK LEAK OR RELIEF VALVE STUCK OPEN COULD DEPLETE ALL 02.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 314 ABORT: 3/1R

ITEM: 02 CHECK VALVE (2) CV021
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT UNABLE TO LEAVE TANK-THIS DEPLETES H2 OUT THE RELIEF VALVE AND COULD CAUSE FUEL CELL SHUTDOWN. FAILURE OF RELIEF VALVE ALSO COULD CAUSE TANK EXPLOSION, IF THE HEATER IS ON IN MANUAL MODE OR FAILED ON.
THIS IS DETECTABLE FROM TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 315 ABORT: 1/1

ITEM: 02 CHECK VALVE (2) CV021
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT LEAK INTO AREA UNDER THE PAYLOAD BAY COULD CAUSE EXPLOSION OR FREEZE OTHER SYSTEMS. MAY RESULT IN LOW OR NO 02 FLOW INTO FUEL CELLS. THIS IS DETECTABLE FROM TANK QUANTITY SENSORS AND CONSOLE QUANTITY CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 316 ABORT: 1/1

ITEM: 02 LINES, COMPONENTS, & FITTINGS
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4)
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: V070-454898

CAUSES: SHOCK, VIBRATION, FATIGUE, OVERPRESSURE, BRITTLENESS DUE TO TEMPERATURE.

EFFECTS/RATIONALE:
THIS IS CRITICALITY 1/1 BECAUSE ALL REACTANT COULD DEPLETE AND CAUSE FUEL CELL SHUTDOWN; ALSO LEAK COULD CAUSE 02 TO FREEZE OTHER SYSTEMS UNDER THE PAYLOAD BAY AND ALSO CAUSE EXPLOSION. THIS IS DETECTABLE FROM TANK QUANTITY SENSORS AND CONSOLE QUANTITY SENSORS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 317 ABORT: 1/1

ITEM: 02 LINES, COMPONENTS, & FITTINGS
FAILURE MODE: RESTRICTED FLOW

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4)
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	1/1
LIFTOFF:	2/1R	TAL:	1/1
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	3/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

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

LOCATION: MID FUSELAGE
PART NUMBER: V070-454898

CAUSES: CONTAMINATION, DEBRIS

EFFECTS/RATIONALE:
RESTRICTED FLOW COULD CAUSE NO REACTANT TO REACH FUEL CELL, AND THUS CAUSE THEM TO BE SHUTDOWN. THIS IS 1/1 FOR TAL IF BLOCKAGE AFFECTS FUEL CELL 1 BECAUSE IT WOULD CAUSE LOSS OF OMS PURGE CAPABILITY. ALSO 1/1 FOR RTLS BECAUSE SAME BLOCKAGE WOULD CAUSE LOSS OF HELIUM PURGE CAPABILITY. FAILURE ONORBIT CAUSES PRIORITY FLIGHT DECISION. OVERPRESSURE COULD BE VENTED OUT TANK OR MANIFOLD RELIEF VALVES. THIS IS DETECTABLE FROM TANK PRESSURE SENSORS OR FUEL CELL FLOW METERS. 2/1R FOR ASCENT AND OTHER ABORTS BECAUSE BLOCKAGE TO 2 FUEL CELLS WOULD LOSE VEHICLE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 318 ABORT: 3/3

ITEM: 02 TANK QUANTITY SENSOR (5) V45Q11(-5)05A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
SENSOR FAILURE HAS NO EFFECT ON HEATER OPERATION. SENSOR FAILURE CANNOT BE VERIFIED BY LOOKING AT OTHER INSTRUMENTATION. CREW WOULD ONLY KNOW THAT TANK CANNOT ALWAYS BE FULL. CREW MIGHT BE ABLE TO FIGURE OUT APPROXIMATE QUANTITY BY TURNING HEATERS ON FOR A CERTAIN TIME AND MEASURE CORRESPONDING FLUID TEMPERATURE OR PRESSURE RISE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 319 ABORT: 3/3

ITEM: 02 TANK QUANTITY SENSOR (5) V45Q11(-5)05A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD HAVE NO AUTOMATIC EFFECT ON HEATERS. ZERO OUTPUT WOULD CAUSE CREW TO WANT TO TURN HEATERS OFF.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86
SUBSYSTEM: EPG
MDAC ID: 320

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/3
ABORT: 3/3

ITEM: 02 TANK QUANTITY SENSOR (5) V45Q11(-5)05A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
AN INACCURATE READING MAY CAUSE THE CREW TO CHANGE TANK MANAGEMENT SCHEME. CREW COULD OPERATE TANK MISTAKENLY BELOW ITS REDLINE LIMIT.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 321 ABORT: 3/3

ITEM: 02 TANK FLUID TEMPERATURE SENSORS (5) V45T11(-5)01A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
FAILURE OF SENSOR HAS NO EFFECT ON HEATER OPERATION. FAILURE CAN BE DETECTED BY CHECKING HEATER ASSEMBLY TEMPERATURE SENSOR OR TANK PRESSURE SENSOR. FULL OUTPUT WOULD CAUSE CREW TO WANT TO TURN OFF HEATERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 322 ABORT: 3/3

ITEM: 02 TANK FLUID TEMPERATURE SENSORS (5) V45T11(-5)01A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE CREW TO WANT TO TURN HEATERS ON.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 323 ABORT: 3/3

ITEM: 02 TANK FLUID TEMPERATURE SENSORS (5) V45T11(-5)01A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
INACCURATE READING MAY CAUSE CREW TO WANT TO MANUALLY OPERATE HEATERS TO KEEP TEMPERATURE READING WITHIN TOLERANCES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 324 ABORT: 3/3

ITEM: O2 TANK HEATER ASSEMBLY 1 TEMPERATURE SENSOR (5)
V45T11(-5)07A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
HEATER ASSEMBLY 1 CONSISTS OF HEATERS A1 AND B1 IN EACH 02 TANK. IF 5 TANKS FLY, THE B HEATERS IN TANKS 4 AND 5 WILL NOT BE OPERATIONAL. THE SENSOR IS ONLY CONNECTED TO A GAUGE; IT DOES NOT AFFECT HEATER OPERATION. FULL OUTPUT WOULD CAUSE CREW TO WANT TO TURN HEATERS OFF. FAILURE CAN BE DETECTED BY CHECKING TANK FLUID TEMPERATURE OR PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 325 ABORT: 3/3

ITEM: O2 TANK HEATER ASSEMBLY 1 TEMPERATURE SENSOR (5)
V45T11(-5)07A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) 02 TANKS
5) 02 TANK SUB-ASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE CREW TO WANT TO TURN HEATERS ON.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
RBITER SUBSYSTEM ANALYSIS WORKSHEET

10/20/86 HIGHEST CRITICALITY HDW/FUNC
PG FLIGHT: 3/3
26 ABORT: 3/3

O2 TANK HEATER ASSEMBLY 1 TEMPERATURE SENSOR (5)

OUT OF TOLERANCE

S. GOTCH SUBSYS LEAD: M. HIOTT

RARCHY:

TORAGE

SUB-ASSEMBLY

CRITICALITIES

ASE	HDW/FUNC	ABORT	HDW/FUNC
NCH:	3/3	RTLS:	3/3
F:	3/3	TAL:	3/3
T:	3/3	AOA:	3/3
T:	3/3	ATO:	3/3
G/SAFING:	3/3		

REENS: A [NA] B [NA] C [NA]

MID FUSELAGE
MC282-0063-0100

ATION, SHOCK, CORROSION, ELECTRICAL FAILURE

NALE:
ADING MAY CAUSE CREW TO WANT TO MANUALLY OPERATE
EP TEMPERATURE READING WITHIN TOLERANCES.

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 327 ABORT: 3/3

ITEM: O2 TANK HEATER ASSEMBLY 2 TEMPERATURE SENSOR (5)
V45T11(-5)09A
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5) O2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
HEATER ASSEMBLY 2 CONSISTS OF HEATERS A2 AND B2 IN EACH O2 TANK. IF 5 TANKS FLY, THE B HEATERS IN TANKS 4 AND 5 WILL NOT BE OPERATIONAL. THE SENSOR IS ONLY CONNECTED TO A GAUGE; IT DOES NOT AFFECT HEATER OPERATION.
FULL OUTPUT WOULD CAUSE CREW TO WANT TO TURN THE HEATERS OFF.
FAILURE CAN BE DETECTED BY CHECKING TANK FLUID TEMPERATURE OR PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 328 ABORT: 3/3

ITEM: O2 TANK HEATER ASSEMBLY 2 TEMPERATURE SENSOR (5)
V45T11(-5)09A
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5) O2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE CREW TO WANT TO TURN HEATERS ON.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 329 ABORT: 3/3

ITEM: O2 TANK HEATER ASSEMBLY 2 TEMPERATURE SENSOR (5)
V45T11(-5)09A
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5) O2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, SHOCK, CORROSION, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
INACCURATE READING MAY CAUSE CREW TO WANT TO MANUALLY OPERATE HEATERS TO KEEP TEMPERATURE READING WITHIN TOLERANCES.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 330 ABORT: 1/1

ITEM: O2 TANK SUBASSEMBLY (5)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: CORROSION, FATIGUE, TEMPERATURE, POROSITY, OVERPRESSURIZATION

EFFECTS/RATIONALE:
LEAK IN TANK COULD CAUSE O2 TO FREEZE OTHER SYSTEMS UNDER PAYLOAD BAY AND ALSO CAUSE EXPLOSION. O2 COULD BE DEPLETED. THIS IS DETECTABLE THROUGH QUANTITY SENSORS AND CONSOLE CHARTS OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 331 ABORT: 1/1

ITEM: O2 TANK SUBASSEMBLY (5)
FAILURE MODE: RUPTURE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: OVERPRESSURIZATION, TEMPERATURE, FATIGUE

EFFECTS/RATIONALE:
RUPTURE COULD CAUSE DEPLETION OF O2 AND POSSIBLY OTHER EXPLOSIONS. SHRAPNEL MAY PUNCTURE OTHER SYSTEMS, OR EXTERIOR OF ORBITER. THIS IS DETECTABLE THROUGH QUANTITY AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 332 ABORT: 3/1R

ITEM: O2 TANK SUBASSEMBLY (5)
FAILURE MODE: LOSS OF ANNULUS VACUUM

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: HOLE IN OUTER TANK

EFFECTS/RATIONALE:
CONDUCTIVE AND CONVECTIVE HEAT TRANSFER COULD OCCUR WITHOUT A VACUUM, CAUSING THE REACTANT TO HEAT UP AND BE DEPLETED QUICKLY. FAILURE COULD BE CAUSED BY VACUUM IONIZATION PUMP AND VACUUM ION PUMP PRESSURE SENSOR ON GROUND. THIS IS DETECTABLE FROM TANK QUANTITY SENSOR AND CONSOLE QUANTITY CHARTS OVER PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/20/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 333 ABORT: 3/1R

ITEM: O2 RELIEF PORT (1)
FAILURE MODE: RESTRICTED FLOW

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: 40V45VP015

CAUSES: BLOCKAGE, CONTAMINATION, DEBRIS

EFFECTS/RATIONALE:
THERE IS ONLY ONE O2 RELIEF PORT FOR FIVE O2 TANKS. IF BLOCKED, COULD NOT RELIEVE OVERPRESSURIZATION AND TANKS WOULD RUPTURE. THE CRITICALITY IS 3/1R IF SAME TANK'S HEATERS FAIL ON AND CHECK VALVE FAILS CLOSED. THIS CAN BE DETECTED BY LOOKING AT TANK PRESSURE GAUGES OVER A PERIOD OF TIME.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 334 ABORT: 2/1R

ITEM: O2 TANK RELIEF VALVE (5) RV010,RV020,RV410,RV460
FAILURE MODE: FAILED OPEN (ALSO INTERNAL LEAKAGE)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0401

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
EACH TANK RELIEF VALVE RELIEVES EXCESS PRESSURE BUILDUP IN THE TANKS ABOVE 1005 PSIG. IF VALVE IS FAILED OPEN, EARLY DEPLETION OF O2 CAN RESULT. THE CRITICALITY IS 2/1R BECAUSE IF SAME TANKS CHECK VALVE IS ALSO FAILED OPEN, COULD LOSE ALL O2.
DETECTABLE FROM TANK QUANTITY AND PRESSURE SENSORS AND OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.'

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 335 ABORT: 3/1R

ITEM: O2 TANK RELIEF VALVE (5) RV010,RV020,RV410,RV460
FAILURE MODE: FAILED CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0401

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
POSSIBLE RUPTURE OF TANK IF PRESSURE CANNOT BE RELIEVED. THIS COULD CAUSE LOSS OF REACTANT AND ORBITER. THE CRITICALITY IS 3/1R IF SAME TANKS HEATERS FAIL ON AND CHECK VALVE FAILS CLOSED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 336 ABORT: 1/1

ITEM: O2 TANK RELIEF VALVE (5) RV010,RV020,RV410,RV460
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0440-0401

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
EARLY DEPLETION OF O2 REACTANT, PLUS POSSIBLE EXPLOSION OR FREEZING DUE TO REACTANT LEAKING UNDER THE PAYLOAD BAY. A LEAK IS DETECTABLE OVER A PERIOD OF TIME FROM CONSOLE QUANTITY CHARTS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 337 ABORT: 3/1R

ITEM: O2 TANK HEATER ELEMENT A1(5), A2(5), B1(4 OR 3), B2(4 OR 3)
FAILURE MODE: FAILED ON

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5) O2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	3/1R
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, MECHANICAL SHOCK, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
THE B HEATERS ARE NOT OPERATIONAL IN A 5 TANK CONFIGURATION, I.E. 3 SETS FOR 5 TANKS. EACH ELEMENT IS 250 WATTS. EACH TANK HAS 2 HEATER ASSEMBLIES, EACH WITH AN A AND B HEATER. FAILURE IS DETECTABLE FROM TEMPERATURE AND PRESSURE SENSORS.
THIS IS CRITICALITY 3/1R BECAUSE RELIEF VALVES WOULD VENT RESULTANT EXCESSIVE PRESSURE IN TANK AND DEPLETE THE O2. RELIEF VALVE FLOW RATE AT FULL FLOW PRESSURE IS 164 LB/HR WHILE TANK QUANTITY IS 781 LB. TANK COULD ALSO RUPTURE 35 HOURS AFTER TANK RESIDUAL LEVEL IS REACHED, THUS 1/1.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 338 ABORT: 3/1R

ITEM: O2 TANK HEATER ELEMENT A1(5), A2(5), B1(4 OR 3), B2(4 OR 3)
FAILURE MODE: FAILS OFF

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5) O2 TANK SUBASSEMBLY
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC282-0063-0100

CAUSES: VIBRATION, MECHANICAL SHOCK, ELECTRICAL FAILURE

EFFECTS/RATIONALE:
WHEN PRESSURE FALLS BELOW 100 PSI, TANK IS CONSIDERED LOST. THIS WILL ALLOW COMPLETION OF ALL ABORTS AND ASCENTS SINCE EFFECT WOULD NOT OCCUR UNTIL AFTER OMS-2. HOWEVER THE CRITICALITY IS 3/1R IF A COMBINATION OF TANK RELIEF VALVES AND MANIFOLD RELIEF VALVES FAIL OPEN. THIS COULD BE DETECTED FROM TEMPERATURE, QUANTITY, AND PRESSURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 339 ABORT: 3/1R

ITEM: O2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
FULL OUTPUT WOULD CAUSE HEATERS TO REMAIN OFF IN AUTOMATIC MODE. PRESSURE WOULD HAVE TO DROP TO BELOW 100 PSI BEFORE TANK IS CONSIDERED LOST, WHICH WOULD HAPPEN AFTER OMS2. CREW COULD CHECK TANK PRESSURE AND TEMPERATURE SENSORS TO SOLVE PROBLEM. THIS IS CRITICALITY 3/1R AT LIFTOFF BECAUSE TANK RELIEF VALVES STUCK OPEN COULD CAUSE LOSS OF PRESSURE EARLY. DETECTABLE FROM TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 340 ABORT: 3/1R

ITEM: O2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	3/1R
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE HEATERS TO BE ON ALWAYS IN AUTOMATIC MODE AND RELIEF VALVE WOULD VENT O2 AND DEPLETE IT. RELIEF VALVE FLOW RATE AT FULL FLOW PRESSURE IS 164 LB/HR WHILE TANK QUANTITY IS 781 LB.
ALSO TANK COULD RUPTURE STARTING 35 HOURS AFTER TANK RESIDUAL LEVEL IS REACHED AND HEATERS STILL ON, THUS 1/1. THIS IS DETECTABLE FROM TANK PRESSURE AND TEMPERATURE SENSORS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 341 ABORT: 3/1R

ITEM: O2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	1/1	AOA:	3/1R
DEORBIT:	1/1	ATO:	3/1R
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0185-001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
DEPENDS ON DEGREE OF BEING OUT OF TOLERANCE - WORST CASE IS UNION OF ZERO AND FULL OUTPUT. COULD CAUSE HEATERS TO OPERATE ERRATICALLY. DETECTABLE FROM TANK PRESSURE SENSOR.
A TANK COULD RUPTURE STARTING 35 HOURS AFTER THE TANK RESIDUAL LEVEL IS REACHED AND ITS HEATERS ARE STILL ON, THUS 1/1.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 342 ABORT: 3/3

ITEM: O2 TANK PRESSURE SENSOR (5)
FAILURE MODE: FULL OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0105-0001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
THESE PRESSURE SENSORS HAVE NO EFFECT ON OTHER COMPONENTS, THEY ONLY DRIVE GAUGES. FULL OUTPUT WOULD CAUSE CREW TO TURN OFF HEATERS. CREW WOULD CHECK RELIEF VALVE CRACK PRESSURE, AND QUANTITY AND TEMPERATURE SENSORS TO SEE IF PRESSURE READING WAS ACCURATE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 343 ABORT: 3/3

ITEM: O2 TANK PRESSURE SENSOR (5)
FAILURE MODE: ZERO OUTPUT

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0105-0001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
ZERO OUTPUT WOULD CAUSE CREW TO TURN HEATERS ON. CREW WOULD CHECK TANK TEMPERATURE AND QUANTITY SENSORS TO SEE IF PRESSURE READING WAS ACCURATE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 344 ABORT: 3/3

ITEM: O2 TANK PRESSURE SENSOR (5)
FAILURE MODE: OUT OF TOLERANCE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC449-0105-0001

CAUSES: VIBRATION, SHOCK, ELECTRICAL FAILURE, CONTAMINATION

EFFECTS/RATIONALE:
INACCURATE READING MAY CAUSE CREW TO WANT TO MANUALLY OPERATE HEATERS TO KEEP PRESSURE READING WITHIN TOLERANCE. CREW COULD USE TEMPERATURE AND QUANTITY SENSORS TO SEE IF PRESSURE READING IS ACCURATE. A SMALL ERROR WILL NOT CAUSE ANY PROBLEMS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 345 ABORT: 3/1R

ITEM: O2 (PRE-FLIGHT) FILL AND VENT QD CAPS (9)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0160

CAUSES: CONTAMINATION, WEARS OUT, CORROSION

EFFECTS/RATIONALE:
EACH TANK HAS ITS OWN VENT QD CAP AND FILL QD CAP, EXCEPT TANKS 4 AND 5 WHICH SHARE A FILL QD CAP. THE QD'S THEMSELVES ARE A LEVEL OF REDUNDANCY TO STOP LEAKS. BOTH CAP AND QD HAVE TO LEAK FOR A TANK LEAK TO OCCUR.
FAILURE OF CAP ALONE IS NOT DETECTABLE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 346 ABORT: 3/1R

ITEM: O2 (PRE-FLIGHT) FILL QUICK DISCONNECTS (4) AND VENT QD'S (5)
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0110

CAUSES: CONTAMINATION, WEARS OUT, CORROSION

EFFECTS/RATIONALE:
EACH TANK HAS ITS OWN FILL AND VENT QD'S, EXCEPT TANKS 4 AND 5 SHARE 1 FILL QD. ALL QD'S ARE ALSO CAPPED FOR ADDITIONAL REDUNDANCY. BOTH CAP AND QD HAVE TO LEAK FOR A TANK LEAK TO OCCUR.
ALSO FAILURE OF TANK CHECK VALVE OPEN OR MANIFOLD RELIEF VALVE FAILED OPEN COULD CAUSE LOSS OF ALL REACTANT. FAILURE OF QD ALONE IS NOT DETECTABLE.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 347 ABORT: 3/3

ITEM: O2 (PRE-FLIGHT) FILL QUICK DISCONNECTS (4) AND VENT QD'S (5)
FAILURE MODE: INABILITY TO MATE/DEMATE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN STORAGE
4) O2 TANKS
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC276-0010-0110

CAUSES: CORROSION, BINDING, DEBRIS

EFFECTS/RATIONALE:
MISSION DELAYED IF CAN'T FILL TANKS OR RELEASE QD. ONLY PRELAUNCH PHASE IS AFFECTED. THE FILL QD ALSO FUNCTIONS AS A VERTICAL DRAIN AT PAD.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 348 ABORT: 3/3

ITEM: O2 FUEL CELL REACTANT VALVE POSITION INDICATORS
(3) V45X1150E, V45X1155E, V45X1160E
FAILURE MODE: READS OPEN WHEN VALVE CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. NORMALLY, ALL VALVES ARE OPEN. COULD VERIFY ACCURACY FROM FUEL CELL FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 349 ABORT: 3/3

ITEM: O2 FUEL CELL REACTANT VALVE POSITION INDICATORS (3) V45X1150E, V45X1155E, V45X1160E
FAILURE MODE: READS CLOSED WHEN VALVE OPEN

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
COULD VERIFY ACCURACY FROM FUEL CELL FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 350 ABORT: 3/3

ITEM: H2 FUEL CELL REACTANT VALVE POSITION INDICATORS (3) V45X2150E, V45X2155E, V45X2160E
FAILURE MODE: READS OPEN WHEN VALVE CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. NORMALLY, ALL VALVES ARE OPEN. COULD VERIFY ACCURACY FROM FUEL CELL FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 351 ABORT: 3/3

ITEM: H2 FUEL CELL REACTANT VALVE POSITION INDICATORS (3) V45X2150E, V45X2155E, V45X2160E
FAILURE MODE: READS CLOSED WHEN VALVE OPEN

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
COULD VERIFY ACCURACY FROM FUEL CELL FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 352 ABORT: 3/3

ITEM: O2 ECLSS SYSTEM SUPPLY VALVE POSITION INDICATOR
(2) V45X1080E, V45X1083E
FAILURE MODE: READS OPEN WHEN VALVE CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. NORMALLY, ALL VALVES ARE OPEN. COULD VERIFY ACCURACY FROM FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 353 ABORT: 3/3

ITEM: O2 ECLSS SYSTEM SUPPLY VALVE POSITION INDICATOR
(2) V45X1080E, V45X1083E
FAILURE MODE: READS CLOSED WHEN VALVE OPEN

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
COULD VERIFY ACCURACY FROM FLOWMETERS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 354 ABORT: 3/3

ITEM: O2 MANIFOLD VALVE POSITION INDICATORS (2)
V45X1141E, V45X1146E
FAILURE MODE: READS OPEN WHEN VALVE CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. NORMALLY, ALL VALVES ARE OPEN. THE FAILURE CAN BE VERIFIED FROM FLOWMETER.

REFERENCES:

C-3

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 355 ABORT: 3/3

ITEM: O2 MANIFOLD VALVE POSITION INDICATORS (2)
V45X1141E, V45X1146E
FAILURE MODE: READS CLOSED WHEN VALVE OPEN

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) O2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. THE FAILURE CAN BE VERIFIED FROM FLOWMETER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 356 ABORT: 3/3

ITEM: O2 MANIFOLD VALVE POSITION INDICATORS (2)
V45X2141E, V45X2146E
FAILURE MODE: READS OPEN WHEN VALVE CLOSED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. NORMALLY, ALL VALVES ARE OPEN. THE FAILURE CAN BE VERIFIED FROM THE FLOWMETER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/04/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/3
MDAC ID: 357 ABORT: 3/3

ITEM: O2 MANIFOLD VALVE POSITION INDICATORS (2)
V45X2141E, V45X2146E
FAILURE MODE: READS CLOSED WHEN VALVE OPEN

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) HYDROGEN DISTRIBUTION
4) H2 VALVE MODULES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/3
LIFTOFF:	3/3	TAL:	3/3
ONORBIT:	3/3	AOA:	3/3
DEORBIT:	3/3	ATO:	3/3
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:
SENSOR IS USED TO TELL CREW OF VALVE'S POSITION. THE FAILURE CAN BE VERIFIED FROM THE FLOWMETER.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 358 ABORT: 3/1R

ITEM: 02 FILTER (5) FL010,FL020,FL410,FL460
FAILURE MODE: RESTRICTED FLOW, CLOGGED

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) 02 DISTRIBUTION
4) 02 RELIEF VALVE/FILTER PACKAGES
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/3		

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

LOCATION: MID FUSELAGE
PART NUMBER: MC286-0054-0001

CAUSES: CONTAMINATION, DEBRIS, DAMAGED ELEMENT

EFFECTS/RATIONALE:
EACH H2 AND O2 CYRO TANK HAS A FILTER FOR ITS REACTANT POSITIONED AHEAD OF ITS CHECK VALVE. THE FILTER IS REPLACED EVERY 15 FLIGHTS. IF FILTER CLOGS, REACTANTS ARE UNABLE TO GET TO FUEL CELLS, AND REACTANT IS DEPLETED OUT TANK RELIEF VALVE.
THE FAILURE CAN BE DETECTED USING TANK PRESSURE SENSOR.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 2/1R
MDAC ID: 359 ABORT: 2/1R

ITEM: 02 CHECK VALVE (1) CV020
FAILURE MODE: FAILS OPEN (INTERNAL LEAKAGE ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/3	RTLS:	2/1R
LIFTOFF:	2/1R	TAL:	2/1R
ONORBIT:	2/1R	AOA:	2/1R
DEORBIT:	2/1R	ATO:	2/1R
LANDING/SAFING:	3/3		

REDUNDANCY SCREENS: A [1] B [F] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
CV020 CHECKS FLOW INTO TANK 2. HIGHER PRESSURE DOWNSTREAM OF CHECK VALVE THAN UPSTREAM WOULD FORCE REACTANT INTO TANK LINE. LOWER PRESSURE IN TANK OR LEAK WOULD HAVE TO OCCUR IN ADDITION TO CHECK VALVE FAILURE. RESULT COULD BE LOWER CYRO FLOW TO FUEL CELLS AND POSSIBLE SHUTDOWN. FAILS SCREEN B BECAUSE NEED A TANK LEAK OR RELIEF VALVE FAILED OPEN TO NOTICE. THIS IS CRITICALITY 2/1R BECAUSE COMBINED FAILURE OF TANK RELIEF VALVE OPEN COULD LOSE VEHICLE DUE TO REACTANT LOSS.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 3/1R
MDAC ID: 360 ABORT: 3/1R

ITEM: 02 CHECK VALVE (1) CV020
FAILURE MODE: FAILS CLOSED (RESTRICTED FLOW ALSO)

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	3/1R	RTLS:	3/1R
LIFTOFF:	3/1R	TAL:	3/1R
ONORBIT:	3/1R	AOA:	3/1R
DEORBIT:	3/1R	ATO:	3/1R
LANDING/SAFING:	3/1R		

REDUNDANCY SCREENS: A [1] B [P] C [P]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION, JAMMING, FATIGUE

EFFECTS/RATIONALE:
REACTANT IS UNABLE TO LEAVE TANK. THIS DEPLETES H2 OUT THE RELIEF VALVE AND COULD CAUSE FUEL CELL SHUTDOWN. THIS IS DETECTABLE FROM TANK PRESSURE SENSOR. FAILURE OF RELIEF VALVE CLOSED ALSO COULD CAUSE TANK EXPLOSION, IF HEATER IS ON IN MANUAL MODE OR FAILED ON.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/22/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: EPG FLIGHT: 1/1
MDAC ID: 361 ABORT: 1/1

ITEM: 02 CHECK VALVE (1) CV020
FAILURE MODE: EXTERNAL LEAKAGE

LEAD ANALYST: S. GOTCH SUBSYS LEAD: M. HIOTT

BREAKDOWN HIERARCHY:
1) EPG
2) PRSD
3) OXYGEN DISTRIBUTION
4) 02 VALVE MODULE 2
5)
6)
7)
8)
9)

CRITICALITIES

FLIGHT PHASE	HDW/FUNC	ABORT	HDW/FUNC
PRELAUNCH:	1/1	RTLS:	1/1
LIFTOFF:	1/1	TAL:	1/1
ONORBIT:	1/1	AOA:	1/1
DEORBIT:	1/1	ATO:	1/1
LANDING/SAFING:	1/1		

REDUNDANCY SCREENS: A [NA] B [NA] C [NA]

LOCATION: MID FUSELAGE
PART NUMBER: MC284-0428-0010

CAUSES: CORROSION, FATIGUE, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
REACTANT LEAKAGE INTO AREA UNDER PAYLOAD BAY COULD CAUSE EXPLOSION OR FREEZE OTHER SYSTEMS. LEAK MAY RESULT IN LOW OR NO CRYO FLOW INTO FUEL CELLS. FAILURE IS DETECTABLE FROM TANK QUANTITY AND PRESSURE SENSORS AND MANIFOLD PRESSURE SENSORS OVER A PERIOD OF TIME.

REFERENCES:

APPENDIX D
POTENTIAL CRITICAL ITEMS

MDAC ID	ITEM	FAILURE MODE
200	H2 (pre-flight) fill and vent QD's	External leakage
202	H2 (pre-flight) fill and vent QD caps	External leakage
207	H2 tank heater controller pressure sensor/transducer	Zero output
208	H2 tank heater controller pressure sensor/transducer	Out of tolerance
209	H2 tank heater elements A&B	Fails on
211	H2 tank relief valve	Fails open (also internal leakage)
213	H2 tank relief valve	External leakage
216	H2 tank subassembly	External leakage
217	H2 tank subassembly	Rupture
218	H2 tank subassembly	Loss of annulus vacuum
228	H2 lines, components and fittings	External leakage
229	H2 lines, components and fittings	Restricted flow
231	H2 manifold 1 relief valve RV031	Fails open (also internal leakage)
233	H2 manifold 1 relief valve RV031	External leakage
234	H2 manifold 2 relief valve RV041	Fails open (also internal leakage)
236	H2 manifold 2 relief valve RV041	External leakage
237	H2 check valves - CV031, CV041	Fails open (also internal leakage)
239	H2 check valves - CV031, CV041	External leakage
240	H2 check valve - CV030	Fails open (also internal leakage)
242	H2 check valve - CV030	External leakage
243	H2 check valve - CV040	Fails open (also internal leakage)
245	H2 check valve - CV040	External leakage
246	H2 horizontal drain QD	External leakage
248	H2 horizontal drain cap	External leakage
254	H2 manifold 1 solenoid crossover valve - CV031	External leakage
255	H2 fuel cell 1 solenoid reactant supply valve LV033	Fails open (also internal leakage)
256	H2 fuel cell 1 solenoid reactant supply valve LV033	Fails closed

257	H2 fuel cell 1 solenoid reactant supply valve LV033	External leakage
258	H2 fuel cell 2 solenoid reactant supply valve LV043	Fails open (also internal leakage
259	H2 fuel cell 2 solenoid reactant supply valve LV043	Fails closed
260	H2 fuel cell 2 solenoid reactant supply valve LV043	External leakage
261	H2 fuel cell 3 solenoid reactant supply valve LV044	Fails open (also internal leakage
262	H2 fuel cell 3 solenoid reactant supply valve LV044	Fails closed
263	H2 fuel cell 3 solenoid reactant supply valve LV044	External leakage
266	H2 manifold 2 solenoid crossover valve - LV041	External leakage
267	H2 solenoid GSE supply valve - LV045	Fails open (also internal leakage)
269	H2 solenoid GSE supply valve - LV045	External leakage
270	H2 fill GSE supply T-O QD - PD035	External leakage
272	02 check valve - CV010	Fails open (also internal leakage)
274	02 check valve - CV010	External leakage
275	02 solenoid GSE supply valve - LV015	Fails open (also internal leakage)
277	02 solenoid GSE supply valve - LV015	External leakage
278	02 solenoid ECLSS system 1 supply valve - LV012	Fails open (also internal leakage)
279	02 solenoid ECLSS system 1 supply valve - LV012	Fails closed
280	02 solenoid ECLSS system 1 supply valve - LV012	External leakage
281	02 solenoid ECLSS system 2 supply valve - LV022	Fails open (also internal leakage)
282	02 solenoid ECLSS system 2 supply valve - LV022	Fails closed
283	02 solenoid ECLSS system 2 supply valve - LV022	External leakage
284	02 fill GSE supply T-0 QD - PD015	External leakage
289	02 fuel cell 1 solenoid reactant supply valve LV013	Fails open (also internal leakage)
290	02 fuel cell 1 solenoid reactant supply valve LV013	Fails closed
291	02 fuel cell 1 solenoid reactant supply valve LV013	External leakage
294	02 manifold 1 solenoid crossover valve - LV011	External leakage
297	02 manifold 2 solenoid crossover valve - LV021	External leakage

298	02 horizontal drain QD	External leakage
300	02 horizontal drain cap	External leakage
301	02 fuel cell 3 solenoid reactant supply valve LV024	Fails open (also internal leakage)
302	02 fuel cell 3 solenoid reactant supply valve LV024	Fails closed
303	02 fuel cell 3 solenoid reactant supply valve LV024	External leakage
304	02 fuel cell 2 solenoid reactant supply valve LV023	Fails open (also internal leakage)
305	02 fuel cell 2 solenoid reactant supply valve LV023	Fails closed
306	02 fuel cell 2 solenoid reactant supply valve LV023	External leakage
307	02 manifold 1 relief valve - RV011	Fails open (also internal leakage)
309	02 manifold 1 relief valve - RV011	External leakage
310	02 manifold 2 relief valve - RV021	Fails open (also internal leakage)
312	02 manifold 2 relief valve - RV021	External leakage
313	02 check valve - CV021	Fails open (also internal leakage)
315	02 check valve - CV021	External leakage
316	02 lines, components and fittings	External leakage
317	02 lines, components and fittings	Restricted flow
330	02 tank subassembly	External leakage
331	02 tank subassembly	Rupture
332	02 tank subassembly	Loss of annulus vacuum
334	02 tank relief valves	Fails open (also internal leakage)
336	02 tank relief valves	External leakage
337	02 tank heater elements A1, A2, B1, B2	Fails on
340	02 tank heater controller pressure sensor/transducer	Zero output
341	02 tank heater controller pressure sensor/transducer	Out of tolerance
345	02 (pre-flight) fill and vent QD caps	External leakage
346	02 (pre-flight) fill and vent QD's	External leakage
359	02 check valve - CV020	Fails open (also internal leakage)
361	02 check valve - CV020	External leakage