INDEPENDENT ORBITER ASSESSMENT

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

26 FEBRUARY 1988

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MCDONNELL DOUGLAS ASTRONAUTICS COMPANY HOUSTON DIVISION

SPACE TRANSPORTATION SYSTEM ENGINEERING AND OPERATIONS SUPPORT

WORKING PAPER NO. 1.0-WP-VA88003-15

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

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Assessment of the Electrical Power Generation/Power Reactant
Storage and Distribution Subsystem FMEA/CIL

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 effort first completed an analysis of the Electrical Power Generation/Power Reactant Storage and Distribution (EPG/PRSD) subsystem hardware, generating draft failure modes and potential critical items. To preserve independence, this analysis was accomplished without reliance upon the results contained within the NASA FMEA/CIL documentation. The IOA results were then compared to the NASA FMEA/CIL baselines with proposed Post 51-L updates included. A resolution of each discrepancy from the comparison is provided through additional analysis as required. This report documents the results of that comparison for the Orbiter EPG/PRSD hardware.

In the analysis report, the PRSD hardware was divided into seven sections. However, in the assessment report, the PRSD has been divided into eight sections for the hardware divisions and the FMEA/CIL count comparison. Some of the components in the sections were moved to other sections to facilitate the comparison.

The IOA product for the EPG/PRSD analysis consisted of one hundred sixty-two failure mode "worksheets" that resulted in eighty-two potential critical items being identified. Comparison was made to the NASA baseline (as of 23 July 1986) which consisted of ninety-two FMEAs and fifty-eight CIL items. additional comparison was conducted to an updated FMEA/CIL list (as of 18 March 1987) which consisted of sixty-six FMEAs and thirty-nine CIL items. The comparison caused the IOA to generate four additional failure modes to match the NASA FMEAs, but four others were considered non-credible, and deleted. The final comparison was conducted with a revised FMEA/CIL list (as of 7 January 1988). This revision consists of two, three, and four tank configurations, instead of the earlier baseline of just two The baselines are broken down as follows: 2-Tank) sixtyfour FMEAs and thirty-nine CIL items, 3-Tank) sixty-seven FMEAs and forty-two CIL items, and 4-Tank) sixty-seven FMEAS and fortytwo CIL items. The comparisons and the discussion with the NASA subsystem manager reduced the EPG/PRSD analysis to seventy-seven failure mode worksheets and thirty-two critical items.

Figure 1 presents a comparison of the proposed post 51-L NASA three or four tank baseline, with IOA recommended baseline, and issues. The IOA column is the number of FMEA and CILs after they were mapped (grouped) together so a direct comparison could be made with NASA's failure modes (IOA was more likely to produce a report for each item, while NASA, where possible, group similar items under the same failure mode).

The comparison determined if there were any results which had been found by the IOA but were not in the NASA baseline. This comparison produced agreement on all but twenty-seven FMEAs and nine CIL items. The discrepancy between the number of IOA findings and NASA FMEAs can be partially explained by the different approaches used by IOA and NASA to group failure modes together to form one FMEA. Also, several IOA items represented inner tank components and ground operations failure modes which were not in the NASA baseline. The remaining issues arose due to differences between the NASA and IOA FMEA/CIL preparation instructions. NASA had used an older ground rules document which has since been superseded by the NSTS 22206 used by the IOA.

HOLCF - H2 & O2 Lines, Components, and Fittings
HRVFP - Hydrogen Relief Valve/Filter Package
HVM - Hydrogen Valve Module
ORVFP - Oxygen Relief Valve/Filter Package
OVM - Oxygen Valve Module
QDCAP - H2 & O2 Fill and Vent ODs, Horizontal Drain QDs, GSE Fill
T-O QDs and their Caps

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FMEA

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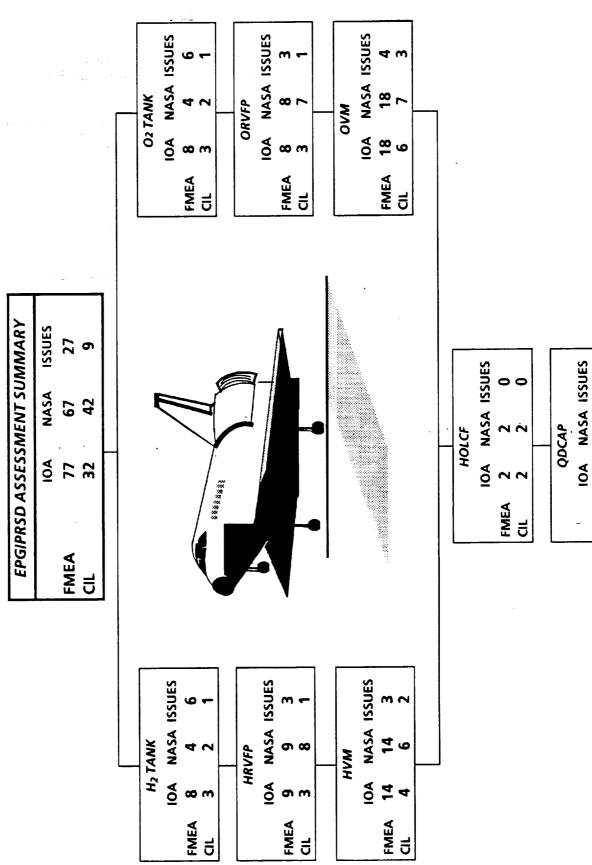


Figure 1 - EPG/PRSD FMEA/CIL ASSESSMENT

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 re-evaluating the FMEA/CIL for the Space Shuttle design. The MDAC is providing an independent assessment of the proposed Post 51-L 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 proposed Post 51-L NASA and Prime Contractor FMEA/CIL. The IOA analysis approach is summarized in the following Steps 1.0 through 3.0. Step 4.0 summarizes the assessment of the NASA and Prime Contractor FMEA/CIL which is documented in this report.

- 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 Ground Rules and Assumptions

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

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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 Fuel Cell Powerplants (FCP) and Atmospheric Revitalization Pressure Control Subsystem (ARPCS). Reference Figures 2 and 3. The grouping of the EPG/PRSD components has changed slightly from the analysis report, in order to facilitate the FMEA, CIL, and issues count comparison. The check valves, tank relief valves, and relief ports were relocated to the relief valve/filter packages. 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, and fill and vent Quick Disconnects (QD) with caps. The reactant flow to the fuel cells is regulated by the heater controller. Reference Figure 4.
- 2. There is a H2 Relief Valve/Filter Package (HRVFP) for each H2 tank. All HRVFPs have a filter, and tank relief valve and the ones for tanks 1 and 2 contain a manifold relief valve, while those for tanks 1 through 4 contain a check valve. Packages 1, 2, and 4 share relief port 1, and packages 3 and 5 share relief port 2. 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 (HVM). Both HVMs contain 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 its position indicator and a GSE Time Zero (T-O) 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.

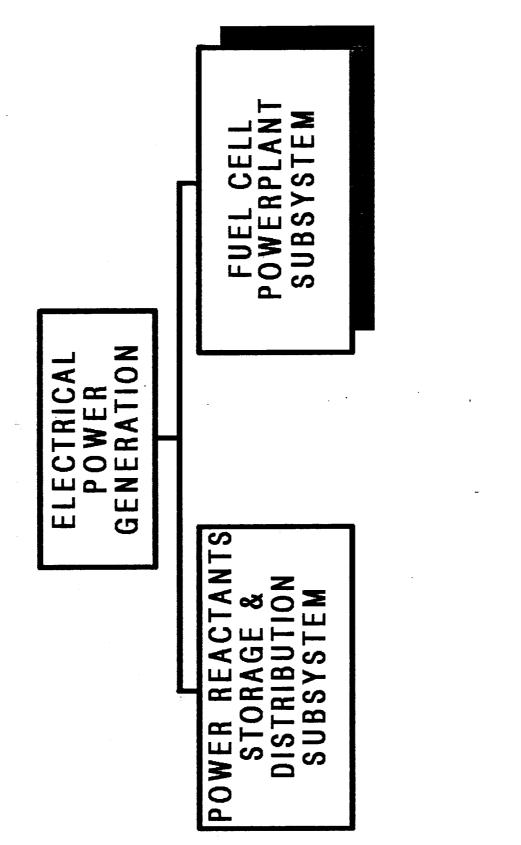
- 4. The Oxygen (O2) tanks flown on a mission can number from 2 to 5. The O2 reactant is stored in the tank at an initial temperature of -300 degrees F. Each tank contains heaters labeled A1, A2, B1 and B2, with one heater assembly consisting of A1 and B1 and the other containing A2 and B2. The tanks also consist of a temperature sensor for each heater assembly, fluid temperature sensor, quantity sensor, pressure sensor, heater controller pressure sensor, 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 (ORVFP) for each O2 tank. All ORVFPs have a filter and tank relief valve, plus the ones for tanks 1 and 2 contain a manifold relief valve, while those for tanks 1 through 4 contain a check valve. All packages share a relief port. Reference Figure 8.
- 6. There are two O2 Valve Modules (OVM). Both OVMs contain a manifold shutoff valve and its position indicator, a manifold pressure sensor, and an Environmental Control and Life Support System (ECLSS) system supply valve and its position sensor. OVM 1 contains one fuel cell reactant supply valve and its position sensor, while OVM 2 contains two of each. OVM 1 contains a GSE valve and its position indicator, and a GSE fill T-O QD. OVM 2 contains a horizontal drain QD and cap. Reference Figure 9.
- 7. The H2 and O2 lines, components, and fittings (HOLCF) made up two separate hardware categories outside of the six major divisions, but were grouped together into one category for the FMEA and CIL issue count comparison.
- 8. The H2 and O2 fill and vent QDs, horizontal drain QDs, GSE fill T-O QDs and their caps (QDCAP) were grouped together as a category only for the FMEA and CIL issue count comparison.

3.2 Interfaces and Locations

The EPG/PRSD interfaces directly with the FCP and ARPCS. Hydrogen and Oxygen are supplied to the FCPs 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 hardware, respectively, and the corresponding subcomponents. The PRSD subsystems are depicted in Figures 4 through 9.



EPG INTERFACE BUT NOT CONSIDERED IN THIS ANALYSIS.

Figure 2 - EPG SUBSYSTEM OVERVIEW

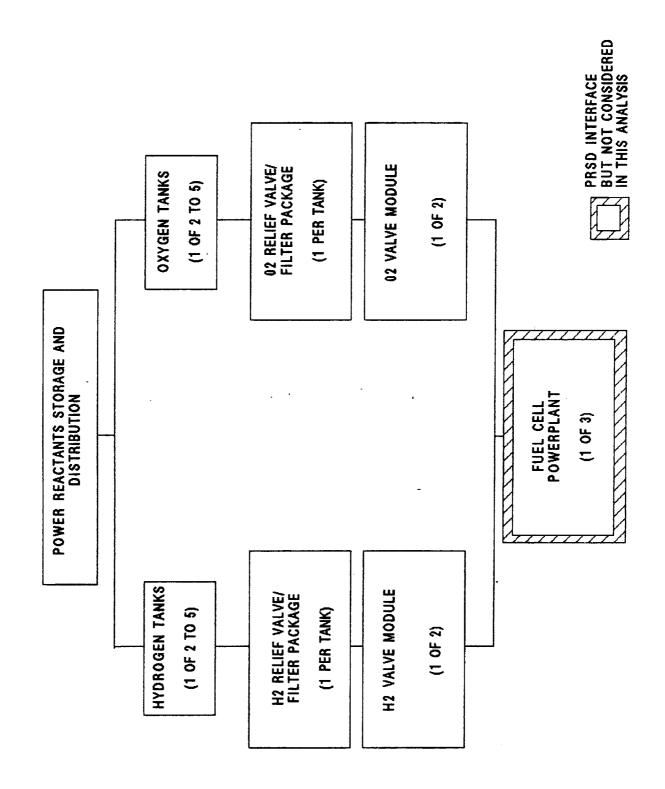


Figure 3 - PRSD SUBSYSTEM OVERVIEW

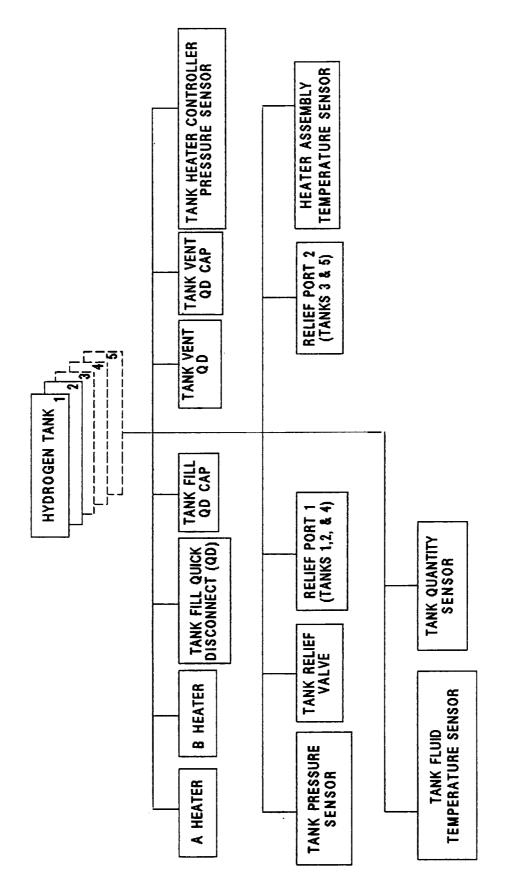


Figure 4 - PRSD HYDROGEN TANKS

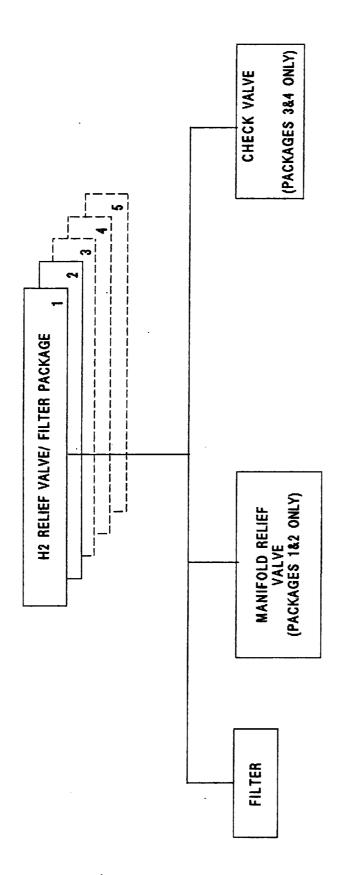


Figure 5 - PRSD H2 RELIEF VALVE/FILTER PACKAGES

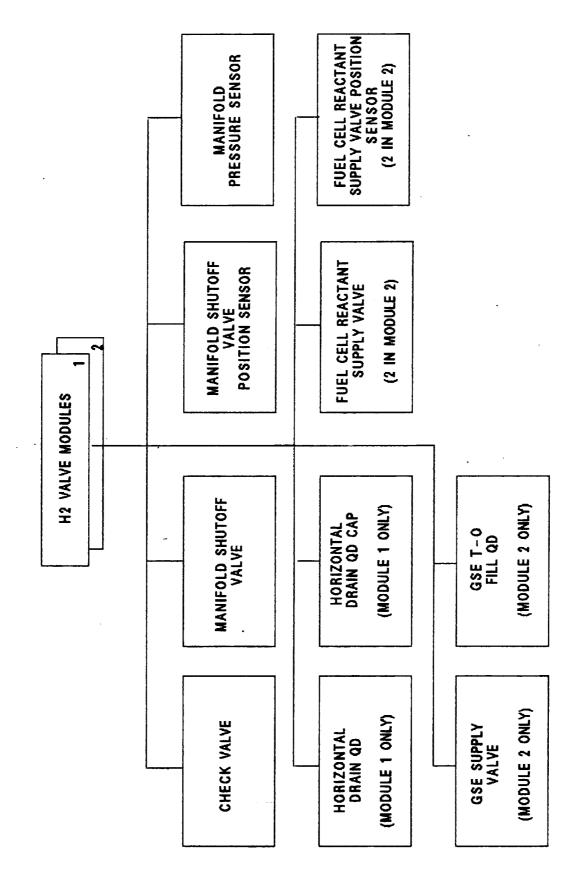


Figure 6 - PRSD H2 VALVE MODULES

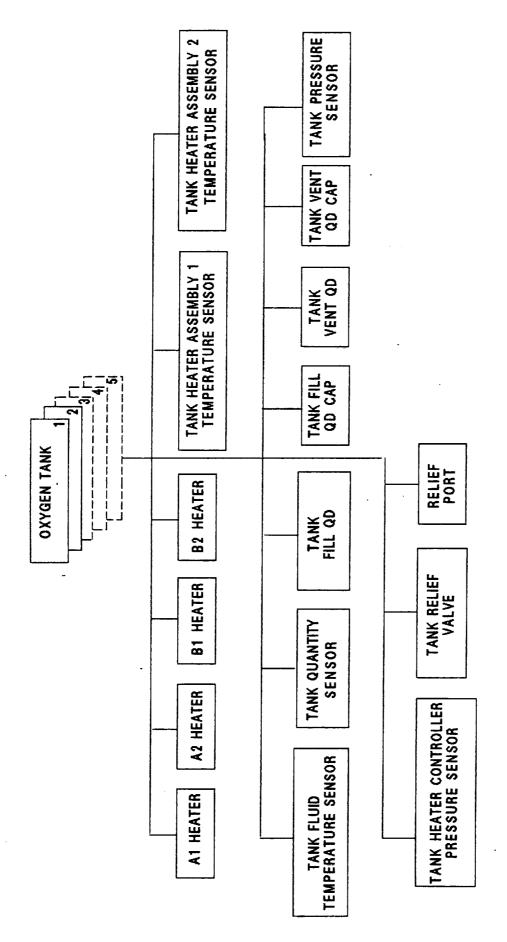


Figure 7 - PRSD OXYGEN TANKS

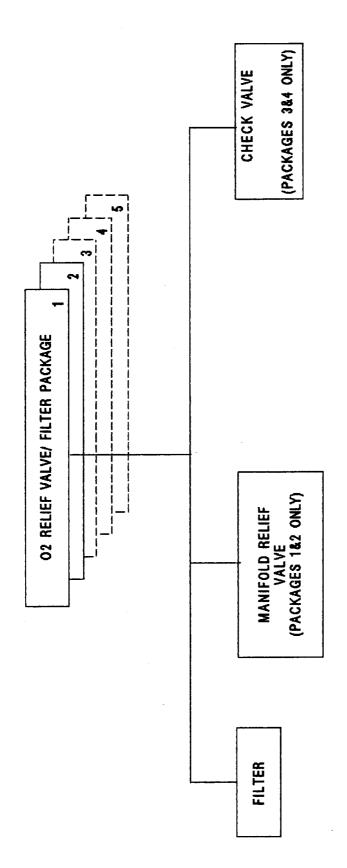


Figure 8 - PRSD O2 RELIEF VALVE/FILTER PACKAGES

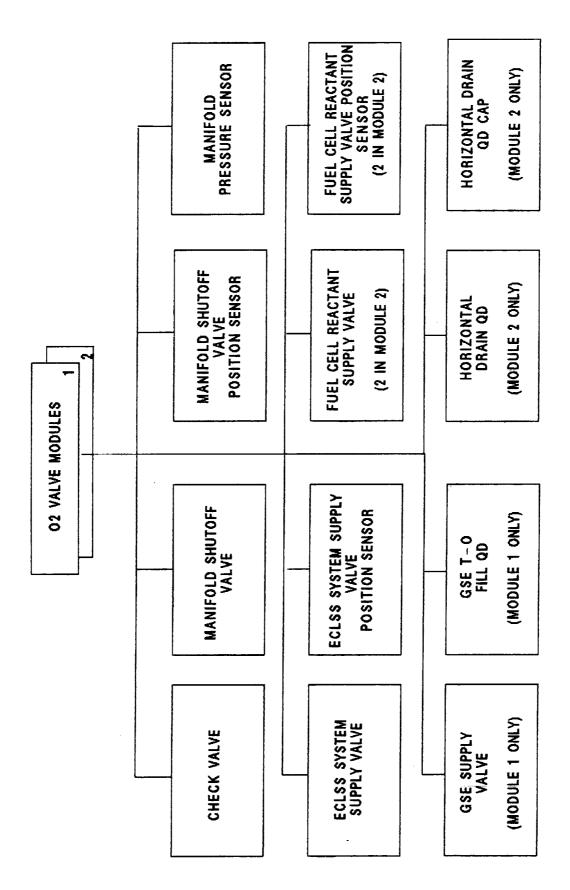


Figure 9 - PRSD 02 VALVE MODULES

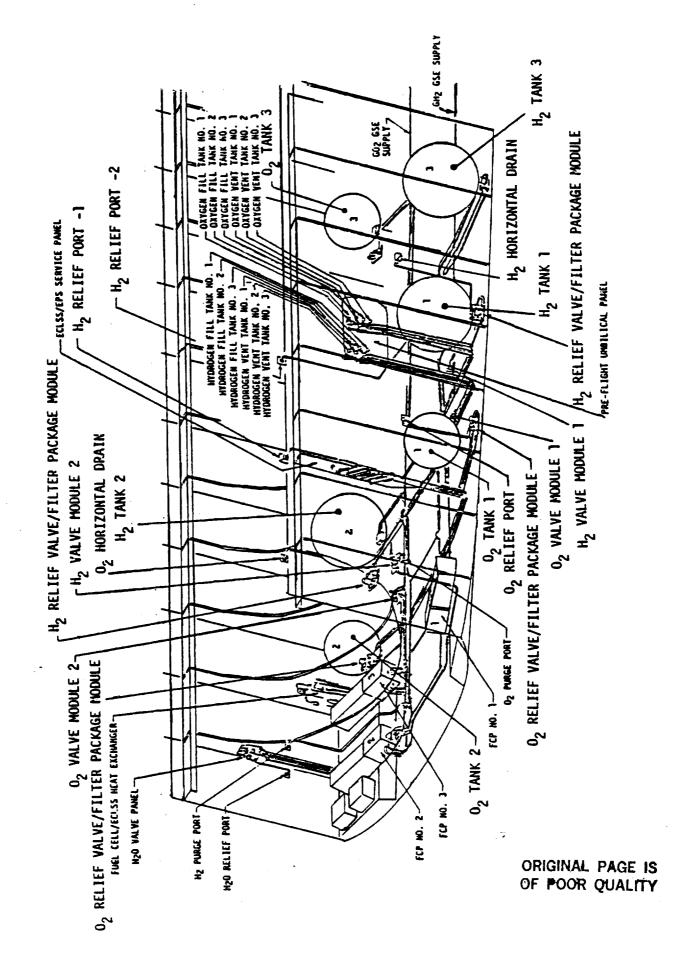


Figure 10 - PRSD COMPONENT LOCATIONS

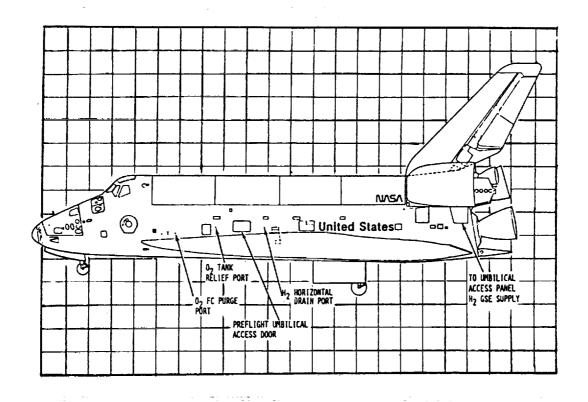


Figure 11 - PRSD PORTS - LEFT SIDE

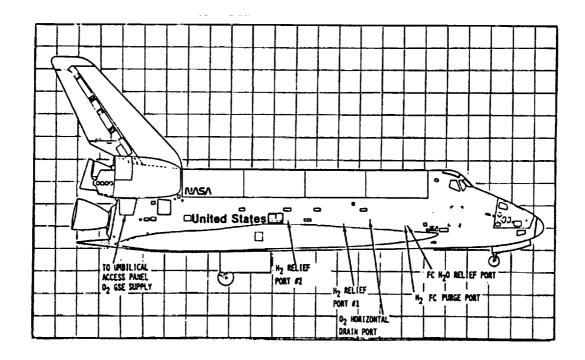


Figure 12 - PRSD PORTS - RIGHT SIDE

4.0 ASSESSMENT RESULTS

The IOA analysis of the EPG/PRSD hardware initially generated one hundred sixty two failure mode worksheets and identified eighty—two Potential Critical Items (PCIs) before starting the assessment process. In order to facilitate comparison, four additional failure mode analysis worksheets were generated. These analysis results were first compared to the proposed NASA Post 51-L baseline of ninety-two FMEAs and fifty-eight CIL items, and then to the updated version of sixty-six FMEAs and thirty-nine CIL items, and finally to three different baseline configurations: 2-Tank) Sixty-four FMEAs and thirty-nine CIL items, 3&4-Tank) Sixty-seven FMEAs and forty-two CIL items. The discrepancy between the number of IOA and NASA FMEAs can be explained by four different reasons:

- 1) Eight issues arose from inner tank component FMEAs that had not been covered by NASA, but which may have been covered by the tank manufacturer, Beech Aircraft.
- 2) Two issues were due to FMEAs the NASA subsystem manager thought should be covered under the ground operations FMEAs.
- 3) Thirteen issues were caused by the differences between the Rockwell International reliability desk instructions No. 100-2G and the NSTS 22206.
- 4) Four issues can be explained by the different approach used by NASA and IOA to group failure modes.

Upon completion of the assessment, and after discussions with the NASA subsystem manager, nineteen of the seventy-seven recommended FMEAs were in agreement. Of the fifty-eight that remained, twenty-seven had minor discrepancies that did not affect criticality.

In the analysis report, the PRSD was divided into seven sections according to hardware and location. However, in the assessment report the PRSD has been divided into eight sections to facilitate comparison to the NASA FMEAs. Some of the components in the sections were moved to other sections while the QDs and caps were grouped into a new section called QDCAP.

In the tabulation below, the various failure mode and FMEA counts are compared. The unmapped IOA column is the raw number of IOA failure mode worksheets. The mapped IOA column is the number of IOA failure modes after they have been mapped into the NASA FMEAs for comparison. The NASA column is the number of FMEAs for the three or four tank baseline.

EPG/PRSD Sections	Unmapped IOA	Mapped IOA	NASA	Issues
H2 Tank	20		4	6
HRVFP	15	9	9	3
HVM	21	14	14	3
02 Tank	23	8	4	6
ORVFP	14	8	8	3
OVM	27	18	18	4
HOLCF	30	2	2	0
QDCAP	16	10	8	2
TOTAL	166	77	67	27

A summary of the quantity of NASA FMEAs three or four tank baseline assessed, versus the IOA five tank configuration baseline, and identified issues is presented in Table I.

Table I Summary of IOA FMEA Assessment							
Component	NASA	IOA	Issues				
H2 Tank HRVFP	4 9	8 9	6 3				
HVM O2 Tank ORVFP	14 4 8	14 8 8	· 3 6 3				
OVM HOLCF	18 2	18 2	4				
QDCAP	8	10	2				
TOTAL	67	77	27				

The IOA FMEA total is ten greater than the NASA FMEA total, because IOA, for completeness, recommends the addition of ten new FMEAs. Unmapped there are 26 assessment worksheets of criticality flight HDW/FUNC: 3/3, and three assessment worksheets of criticality flight HDW/FUNC: 3/1R that NASA may want to consider adding.

A summary of the quantity of NASA CIL items for three or four tank baseline assessed, versus IOA five tank baseline, any issues identified is presented in Table II.

Table II Summary of IOA CIL Assessment						
Component	NASA	IOA	Issues			
H2 Tank HRVFP	2 8	3 3	1			
HVM O2 Tank ORVFP	6 2 7	3 3	2 1 1			
OVM HOLCF	7 2	6 2	3 0			
QDCAP	8	8	. 0			
TOTAL	42	32	9			

Starting at section 4.1 the FMEA and CIL issues are discussed for the above component divisions. Appendix C presents the detailed assessment worksheets for each failure mode identified and assessed. Appendix D highlights the NASA Critical Items and corresponding IOA worksheet ID. Appendix E contains IOA analysis worksheets supplementing previous analysis results reported in Space Transportation System Engineering and Operations Support (STSEOS) Working Paper No. 1.0-WP-VA86001-11, Analysis of the EPG/PRSD, 12 December 1986. Appendix F provides a cross reference between the NASA FMEA and corresponding IOA worksheet(s). IOA recommendations are also summarized.

Table III presents a summary of the IOA recommended failure criticalities for the three or four tank Post 51-L FMEA baseline. Further discussion of each of these subdivisions and the applicable failure modes is provided in subsequent paragraphs.

TABLE III Summary of IOA Recommended Failure Criticalities							
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
H2 Tank HRVFP HVM O2 Tank ORVFP OVM HOLCF QDCAP	2 - 2 - 2 -	3 4 - 3 6 - 6		4 6 1 2 5 1 - 2	- 1 - 1 -	2 - 8 4 - 10 - 2	8 9 14 8 8 18 2 10
TOTAL	6	22	-	21	2	26	77

Of the failure modes analyzed, thirty-two were determined to be critical items. A summary of the IOA recommended critical items is presented in Table IV.

TABLE IV Summary of IOA Recommended Critical Items							
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
H2 Tank HRVFP HVM O2 Tank ORVFP OVM HOLCF QDCAP	2 - 2 - 2 -	3 4 - 3 6 - 6	1111111	1 - 1 - - 2			3 4 3 3 6 2 8
TOTAL	6	22	-	4	-	_	32

The scheme for assigning IOA assessment (Appendix C) and analysis (Appendix E) worksheet numbers is shown in Table V.

	Table V IOA Worksheet Numbers
Component	IOA ID Number
H2 Tank	PRSD-203 to 210, 216 to 227
HRVFP	PRSD-211, 212, 214, 215, 230 to 232, 234, 235, 237, 238, 240, 241, 243, 244
HVM	PRSD-249 to 253, 255, 256, 258, 259, 261, 262, 264, 265, 267, 268, 350, 351, 356, 357, 362X, 363X
02 Tank	PRSD-318 to 332, 337 to 344
ORVFP	PRSD-272, 273, 307, 308, 310, 311, 313, 314, 333 to 335, 358 to 360
OVM	PRSD-275, 276, 278, 279, 281, 282, 286 to 290, 292, 293, 295, 296, 301, 302, 304, 305, 348, 349, 352 to 355, 364X, 365X
HOLCF	PRSD-213, 228, 229, 233, 236, 239, 242, 245, 254, 257, 260, 263, 266, 269, 274, 277, 280, 283, 291, 294, 297, 303, 306, 309, 312, 315 to 317, 336, 361
QDCAP	PRSD-200 to 202, 246 to 248, 270, 271, 284, 285, 298, 299, 300, 345 to 347

To facilitate comparison with the NASA FMEAs, several IOA failure modes were moved to other sections, a new section was created, and four new worksheets were written. This combined effect causes comparison of the before and after unmapped worksheet counts to be difficult. This effect can be seen on the next page.

Component	Analysis Report Worksheets	Assessment Report Worksheets
H2 Tank	28	20
HRVFP	10	15
HVM	36	21
02 Tank	30	23
ORVFP	10	14
OVM	44	27
HOLCF	4	30
QDCAP	=	16
TOTAL	162	166

The previous tables have dealt with comparing IOA's five tank baseline to NASA's three or four tank baseline. The main difference between these tank configurations is the number of items to consider - this has not effected the criticality. The two tank configuration have differences when compared to the other baselines that does effect criticality, and in eight cases the failure mode does not occur in the two tank baseline. These differences in FMEA/CIL are listed in Table VI.

TABLE VI Baseline Comparisons							
		NASA		IOA			
Component	NASA ID #	IOA ID #	FMEA	CI	FMEA	PCI	
HRVFP	CVO30-1 (3&4) CVO30-2 (3&4) VPO45-1 (3&4)	237 238 215	2/1R 2/1R 2/1R	X X X	2/1R 3/1R 3/1R	x	
HVM	LV031-2 (2) (3&4) (2) (3&4) LV044-2 (3&4)	253 265 262	2/1R 3/1R 2/1R 3/1R 1/1	X X X X	2/2R 3/2R 2/2R 3/2R 2/1R	x	
ORVFP	CV010-1 (3&4) CV010-2 (3&4)	313 314	2/1R 2/1R	X X	2/1R 3/1R	х	
OVM	LV011-2 (2) (3&4) (2) (3&4)	293 296 302	2/1R 3/1R 2/1R 3/1R 1/1	X X X X	2/2R 3/2R 2/2R 3/2R 2/1R	x	
HOLCF	LV024-2 (3&4) AOIFSH-1 (3&4) AO1FSO-1 (3&4)	239 315	1/1 1/1 1/1	X X	1/1 1/1	X X	

Prefixes for NASA ID #s are: (2) = 04-1B-

(3) = M4-1B1-

(4) = M4-1B2-

Prefix for IOA ID #s is: PRSD-

Table VI shows the issues that have been resolved since NASA has adopted three baseline configurations versus the former two tank baseline. In the remarks section of the assessment worksheets in appendix C, the differences between baseline configurations are listed.

4.1 H2 Tank Assessment Results

The assessment between the IOA recommended failure modes and the latest NASA FMEA baseline produced six FMEA issues and one CIL issue. Four issues are due to inner tank components that NASA had not covered. These are the failure modes of the tank heater elements failing off (PRSD-210), tank heater assembly temperature sensors (PRSD-219 to 221), tank fluid temperature sensors (PRSD-222 to 224), and tank quantity sensors (PRSD-225 to 227). Two issues are created by a difference in mapping. For the tank subassemblies, the IOA recommends that the failure mode of external leakage (PRSD-216) be separate from FMEA 04-1-TK030-1, which also covers rupture. For the tank heater controller pressure transducers, the IOA recommends that the failure mode of zero output (PRSD-207) be separate from FMEA 04-1-MT039-1, because it has a vastly different effect on PRSD operation than does full output. PRSD-216 is also a CIL issue because it is a criticality 1/1. The failure mode of the tank heater elements failing on (PRSD-209) was deleted because it is covered by the EPD&C/PRSD analysis. The component changes from the analysis report were the moving of the tank relief valves and relief ports 1 and 2 into the HRVFP section.

4.2 HRVFP Assessment Results

The assessment produced three FMEA issues and one CIL issues. The three FMEA issues are the failure modes of the tank relief valves failing open (PRSD-211), relief port 1 having restricted flow (PRSD-214), and manifold relief valves failing open (PRSD-231 and 234). These are caused by NSTS 22206 stating that screen B should be NA because these components are standby redundant. The CIL issue is PRSD-231 and 234 because changing screen B to NA allows it to be deleted from the CIL. The component changes from the analysis report were the additions of the tank relief valves and relief ports 1 and 2, and the combining of the check valves.

4.3 HVM Assessment Results

The assessment produced three FMEA issues and two CIL issues. All three FMEA issues involved passing screen B due to NSTS 22206 because there is a valve position indicator. These are the failure modes of the fuel cell reactant supply valves failing open (PRSD-255,258, and 261), manifold crossover valves failing open (PRSD-252 and 264) and GSE supply valve failing closed (PRSD-267). The IOA also recommended that the hardware criticality for PRSD-252 and 264 be changed from a 2 to a 3. If the manifold crossover valves failed open, all reactant could be depleted out failed open tank and manifold relief valves. The latter two FMEA issues also are CIL issues because the IOA recommended changes cause them to no longer qualify as CILs. During the IOA

assessment, two failure modes were developed to cover the GSE valve position indicator failure modes of reading open when the valve is closed (PRSD-362X) and reading closed when the valve is open (PRSD-363X). The component changes from the analysis report were the deletion of a check valve and the addition of a GSE supply valve position indicator.

4.4 02 Tank Assessment Results

The assessment produced six FMEA issues and one CIL issue. Four issues are due to inner tank components that NASA had not covered. These are the failure modes of the tank quantity sensors (PRSD-318 to 320), tank fluid temperature sensors (PRSD-321 to 323), tank heater assembly temperature sensors (PRSD-324 to 329), and tank heater elements failing off (PRSD-338). Two issues are created by a difference in mapping. For the tank subassemblies, the IOA recommends that the failure mode of external leakage (PRSD-330) be separate from FMEA 04-1-TK010-1, which also covers rupture. For the tank heater controller pressure transducers, the IOA recommends that the failure mode of zero output (PRSD-340) be separate from FMEA 04-1-MT018-1 because it has a vastly different effect on PRSD operation than does full output. PRSD-330 is also a CIL issue because it is a criticality 1/1. The failure mode of the tank heater elements failing on (PRSD-337) was deleted because it is covered by the EPD&C/PRSD analysis. The component changes from the analysis report were the moving of the tank relief valves and relief port into the ORVFP section.

4.5 ORVFP Assessment Results

The assessment produced three FMEA issues and one CIL issues. The three FMEA issues are the failure modes of the relief port (PRSD-333), tank relief valves failing open (PRSD-334), and manifold relief valves failing open (PRSD-307 and 310). These are caused by NSTS 22206 stating that screen B should be NA because these components are standby redundant. The CIL issue is represented by PRSD-307 and 310. This should be deleted from the CIL because screen B is NA. The component changes from the analysis report were the additions of the tank relief valves, relief port, and the combining of the check valves.

4.6 OVM Assessment Results

The assessment produced four FMEA issues and three CIL issues. All four FMEA issues involved passing screen B due to NSTS 22206 because there is a valve position indicator. These are the failure modes of the GSE supply valve failing open (PRSD-275), ECLSS system supply valves failing open (PRSD-278 and 281), manifold crossover valves failing open (PRSD-292 and 295), and fuel cell reactant supply valves failing open (PRSD-289,301, and 304). The IOA also recommends that the hardware criticality for PRSD-292 and

295 be changed from a 2 to a 3. If the manifold crossover valves failed open, all reactant could be depleted out failed open tank and manifold relief valves. The first three FMEA issues listed above are also CIL issues because passing screen B allows them to be deleted from the CIL. During the IOA assessment, two failure modes were developed to cover the GSE supply valve position indicator failure modes of reading open when the valve is closed (PRSD-364X) and reading closed when the valve is open (PRSD-365X). The component changes from the analysis report were the deletion of a check valve and the addition of a GSE supply valve position indicator.

4.7 HOLCF Assessment Results

The assessment produced zero FMEA issues and zero CIL issues. This section has two FMEAs dealing with external leakage for all the lines, fittings, and most components. The only components with separate FMEAs for external leakage were QDs and caps. The failure modes for the H2 (PRSD-229) and O2 (PRSD-317) lines, components, and fittings having restricted flow were deleted because this was considered non-credible.

4.8 QDCAP Assessment Results

The assessment produced two FMEA issues and zero CIL issues. The failure modes on the inability of the H2 (PRSD-201,247, and 271), and O2 (PRSD-285,299, and 347) fill and vent, horizontal drain, and GSE fill T-O QDs to mate/demate were not covered by the NASA subsystem manager because it was thought these were covered under ground operations. The IOA recommends they be included in the PRSD category. This section is entirely new and was created for ease of comparison between the IOA and NASA FMEAs. All of the QD and cap failure modes were grouped into this section because they were in a couple analysis section groupings.

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- 4. VS70-945102, Integrated System Schematic, Orbiter OV-102, EPS, Rev. G04, 6-19-84.
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- 7. Rockwell International, Reliability Desk Instruction No. 100-2G, Flight Hardware FMEA & CIL, 1-31-84.
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APPENDIX A ACRONYMS

:	AOA	_	Abort Once Around
	ARPCS	_	Atmospheric Revitalization Pressure Control Subsystem
	Assy	_	Assembly
	ATO	_	Abort To Orbit
•	CI	-	Critical Item
-	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
-	rettr .		Engineer
	EPG	_	Electrical Power Generation
	EPS	_	
		_	
_	F		
	FCP	_	
	FMEA	-	<u> </u>
	GFE	-	
	GSE	-	
	HOLCF	-	H2 & O2 Lines, Components, and Fittings
	HR	-	Hour Date of the Control of the Cont
in modil	HRVFP	-	
_	H2	-	Hydrogen
	HVM	-	Hydrogen Valve Module
	HW	=	Hardware
- '	IOA	_	Independent Orbiter Assessment
	JSC	-	Lyndon B. Johnson Space Center
	LB	-	Pound
<u> </u>	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
_	02	_	Oxygen
	OVM	_	Oxygen Valve Module
	PCI	_	Potential Critical Item
	PLS	_	Primary Landing Site
	PRCB	_	Program Requirements Control Board
	PRCB	_	Power Reactant Storage and Distribution
		_	Pounds Per Square Inch
_	psi Paia	_	Pounds Per Square Inch Gauge
	psig	-	Loding Let pringte then garde

ACRONYMS

QD Quick Disconnect H2 & O2 Fill and Vent QDs, Horizontal Drain QDs, GSE Fill T-O QDs and their caps QDCAP Revision Rev Right Hand RH Rockwell International RI RTLS . Return to Landing Site Space Transportation System STS Transatlantic Abort Landing TAL T-0 Time Zero Xo X Axis of Orbiter

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DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

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

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

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

<u>EARLY MISSION TERMINATION</u> - termination of onorbit phase prior to planned end of mission

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

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

<u>MAJOR MODE (MM)</u> - 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

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

OPS - software operational sequence

្នុង ខ្មែរ ស្រុកមានស្លាក់ ការ គេសាវ៉ា ស្រុក ការបានសំនើ

<u>PRIMARY MISSION OBJECTIVES</u> - 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)

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

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

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

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

APPENDIX B DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.2 IOA Project Level Ground Rules and Assumptions

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.

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APPENDIX B DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

- 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 ≥ 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.</p>
 - 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 02 reaction chambers cannot be purged.
 - k. Fuel cell end-cell heater failing on.
 - 1. 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. Inadvertent 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).

19. Inadvertent 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).

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APPENDIX C DETAILED ASSESSMENT

This section contains the IOA assessment worksheets generated during the assessment of this subsystem. The information on these worksheets facilitates the comparison of the NASA FMEA/CIL (Pre and Post 51-L) to the IOA detailed analysis worksheets included in Appendix E. Each of these worksheets identifies the NASA FMEA being assessed, corresponding MDAC Analysis Worksheet ID (Appendix E), hardware item, criticality, redundancy screens, and recommendations. For each failure mode, the highest assessed hardware and functional criticality is compared and discrepancies noted as "N" in the compare row under the column where the discrepancy occurred.

LEGEND FOR IOA ASSESSMENT WORKSHEETS

Hardware Criticalities:

- = Loss of life or vehicle 1
- Loss of mission or next failure of any redundant item (like or unlike) could cause loss of life/vehicle
- = 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 Screens A, B and C:

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

NASA Data:

Baseline = NASA FMEA/CIL New = Baseline with Proposed Post 51-L Changes

CIL Item :

X = Included in CIL

Compare Row:

N = Non compare for that column (deviation)

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-200 M4-182-P	D030-1	NASA DATA BASELINE NEW			
SUBSYSTEM: MDAC ID:	EPG 200			ICK DISCONNE	CT (4) & VEN	ΙΤ
LEAD ANALYST:	B. E. AM	ES				
ASSESSMENT:						
CRITICALI FLIGHT	C				CIL ITEM	
HDW/FUN	iC	A	В	С		
NASA [2 /1R IOA [3 /1R] [P] P]	[F] [F]	[P] [P]	[X] * [X]	
COMPARE [N /] []	[]	[]	[]	
RECOMMENDATIONS:	(If di	fferent	from NAS	SA)		
1] []	[]	[] (AI	[] DD/DELETE)	
* CIL RETENTION F	RATIONALE	: (If a	pplicable	a)		
		•	•	ADEQUATE INADEQUATE	[X]	
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE RETENTION RATIONA H2 COULD ACCUMULA EXPLOSION.	IS FAILS	OPEN O	R EXTERNA ABLE. IF	AL LEAKAGE. THE CAP ALS	SO LEAKED,	N

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			NASA DATA: BASELINE [] NEW []				
SUBSYSTEM: MDAC ID: ITEM: QD'S (5)	EPG 201 H2 (PRE-FLIGHT)	FILL QUICE	C DISCONNEC	CT (4)	& VENT		
LEAD ANALYST:	B. E. AMES			-			
ASSESSMENT:							
CRITICAL FLIGH	T	ANCY SCREENS		CIL ITEM			
HDW/FU	NC A	В	С				
NASA [/ IOA [3 /3] []] [NA]	[NA] [NA]	[]	*		
COMPARE [N /N] [N]	[N] [n j	[]			
RECOMMENDATIONS:	(If different	from NASA)					
[3 /3] [NA]	[NA] [[]	ETE)		
* CIL RETENTION	RATIONALE: (If a	,	ADEQUATE	[]			
REMARKS: THE FMEAS DID NO MATE/DEMATE). F WRITING A FMEA F	OR COMPLETENESS	, nasa may v					

ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-202 NASA FMEA #: M4-1B2-PC030-1							0-1	NASA DATA: BASELINE [] NEW [X]															
SUBSYSTEM MDAC ID:	M:				EP 20	G 2				GHT)) 7	VEN	T	QD	CA	\PS	(!	∌)	
LEAD ANA	LY:	5T	:		в.	E	. A	MES	3														
ASSESSME	T	:																					
(F	L	CAL: IGH: /FUI	C			RE A	D	UNDA	M	CY B	sc	CREE	NS	S C					IL FEN		
				•																			
NASA IOA	[1 3		/1 /1R]		[NA P]		[NA F]		[NA P]			[X]	*
COMPARE	[N		/N]		[N]		[N]		[N]			[]	
RECOMMENI	DA:	ΓI	O	NS:		(I:	f d	iff	e:	rent	: 1	fro	m	NAS	A))							
	[,	/]		[J		[]		[] -	•	(A	[,DD,	/DI		ETE
* CIL RET	ľEI	ΥT	Ί(ON I	RAT	IOI	IAL.	E:	(If a	ıpı	oli	Ca		•			UA!			x]	
REMARKS:									_											L	1	J	
ALSO NASA																				D F	:AS	3 7	AN.
ALLOWABLE	3	LE.	A)	K R	YΤ̈́E	, 1	'HI	S F	A.	LUF	Œ	CC	UI	LD R	ES	UL	T	IN	TH	E			
ACCUMULATE EXPLOSION										BITE FION)SS	II	3LE
EVETOSTO	٠.		11	nc i	C I	L'N'I	TIO	M K	LΔ.	TTON	W	ظر	TS	NO	1	ΑV	Wi	ו אינו.	عدد	•			

ASSESSME ASSESSME NASA FME	NT I	D:	PRSD	-203	r030-	NASA DATA: BASELINE [] NEW [X]						
SUBSYSTE MDAC ID:	M:		EPG 203 H2 T	'ANK I	PRESS	URE S	ENSO	R (5)				
LEAD ANA	LYSI	!:	B. E	. AMI	ES							
ASSESSME	NT:											
	F	LIGH				DANCY				CII		
	HD	W/FU	NC	2	Ą	E	3	C	!			
NASA IOA	[3	/3]	í] í]	NA] NA]	[N [N	IA] IA]	[N	IA] IA]	[]	*
COMPARE	[/]	[]	[J	[]	C]	
RECOMMEN	DATI	ONS:	(I	f di	ffere	nt fr	om N	ASA)				
	ָנ	/	1	C	1	[]	[] ([ADD/D		TE)
* CIL RE	TENT	NOI	RATIC)NALE	: (If	appl	icab.	Ä	DEQUATE]	,
REMARKS: ALSO NAS THE FAIL							M4-1	B1-M1	030-1.	w u		

ASSESSME ASSESSME NASA FME	ESSMENT DATE: 2/17/88 ESSMENT ID: PRSD-204 A FMEA #: M4-1B2-MT030-1											NASA BASI	DATA LINE NEW	[]		
SUBSYSTE MDAC ID:				20	4	ΙK	PRI	ESSU	JRE		SENSOF		- Falls 5)			*		
LEAD ANA	LYS	T:		в.	E.	Al	ŒS											
ASSESSME	NT:																	
							RE	DUNE	AN	C	Y SCRI	EENS	5				7	
			IGH /FU	NC			A				В		c			EM	1	
NASA IOA	[3	/3 /3]		[NA NA]	[NA] NA]	[NA] NA]		[]	*
COMPARE	[/]		[•]	[]	[]		[]	
RECOMMEN	DAT	'IC	NS:		(If	d:	lff	erer	ıt	£	rom NA	\SA))					
	[/]		[,]	Ţ]	[]	(A		'DE		TE)
* CIL RE	TEN	TI	ON	RAT:	IONA	L	E :	(If	ap	p.	licabl							
												I	ADEQU VADEQU	JATE	[]	
REMARKS: ALSO NAS THE FAII	A F									D	M4-1E							

ASSESSME ASSESSME NASA FME	D:		-205	1]	NASA DAT BASELIN NE]			
SUBSYSTE MDAC ID: ITEM:	M:		EPG 205 H2 T	ANK	PRESS	URE S	ENSO	R (5)	·)			
LEAD ANA	LYST	':	B, E	. AM	ES							
ASSESSME	NT:											
	F	LIGH	ITY T NC			DANCY E			c	CII ITE		
NASA		•				_	-	r 1	ר גדא	r	٦.	*
IOA	[3	/3 /3	j	[NA] NA]	[]	IA] IA]	[]	NA] NA]	[]	•
COMPARE	[/	1	[]	[]	[]	[]	
RECOMMEN	DATI	ons:	(I	f di	ffere	nt fr	om N	ASA)				
	[/] -	. [1	C	,]	[] ([ADD/D) ELE'	TE)
* CIL RE	TENT	'ION	RATIO	NALE	: (If	appl	icab.		ADEQUATE ADEQUATE	•]	
ALSO NAS							M4-1	B1M	r030-1.			- +

ASSESSMI ASSESSMI NASA FMI	ENT ENT EA	D: #:	ATE: D:	2/ PR M4	RSD-206 BASELI									NE				
MDAC ID ITEM:	SUBSYSTEM: EPG MDAC ID: 206 ITEM: H2 TANK HEATER CONTROLLER PRESSURE SENSOR/TRANSDUCER (4) LEAD ANALYST: B. E. AMES											Œ						
LEAD AN	ALÝ	ST	:	В.	E.	Al	ÆS	5						٠				
ASSESSM	ENT	:																
		F	ICAL: LIGH	r				EDUN	DAN		sc	REEN				CIL		
		HD	W/FUI	NC			A			В			C					
NASA IOA]	3 3	/1R /1R]		[P P]	[P P]	[[P P]		[]	*
COMPARE	[/]		[]	[]	[]		[]	
RECOMME	NDA	TI	ons:		(If	đ	Ĺfí	ere	nt	fro	om	NASA)					
	(-	/]		[]	[]	[1	(AI	[DD/D	ELI	ETE)
* CIL R	ETE	NT:	ION I	RAT	'ION	\LI	3:	(If	ap	pl:	Lca	ble)						
												I	IA IAV	DEQUAT DEQUAT	'E 'E	[]	
REMARKS ALSO NAS		FM	EA'S	04	-1B-	-M'	rō3	39-1	AN	D I	14 –							
THE FAIR OF OUTPO	LUR UT	E I	MODE CLUD	IS ING	FUI ERI	501 7D	JO OE(TPU' SUS	T.	TI	HIS	NAS	A I	FAILUR	EN	IODE	IS	LOSS

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	NASA DATA BASELINE NEW	-							
SUBSYSTEM: MDAC ID:	EPG 207 H2 TANK HEATER CONT								
LEAD ANALYST:	B. E. AMES	•							
ASSESSMENT:									
CRITICAL FLIGH	ITY REDUNDANCY	SCREENS	CIL ITEM						
	NC A B	С	* * * * * *						
NASA [3 /1R IOA [1 /1] [P] [P]] [P]] [P]	[
COMPARE [N /N] [] [] []	[N]						
RECOMMENDATIONS:	(If different from	m NASA)							
[/	1 [1 [] [] (A	[] DD/DELETE)						
* CIL RETENTION	RATIONALE: (If appli	cable) ADEQUATE INADEQUATE							
	04-1B-MT039-1 AND M								
IS LOSS OF OUTPU	MODE IS ZERO OUTPUT. T INCLUDING ERRONEOU	S SIGNAL. THE T	ANK COULD						
	35 HOURS AFTER TANK OF THE SWITCH IS A								
HEATERS OF BOTH	TANKS 1 AND 2 OR 3 A	ND 4 ARE SELECTE							
AUTOMATIC MODE, THE CRITICALITY WOULD BE 3/1R, BECAUSE THEIR TANK SENSOR LOGIC WOULD BE CONNECTED, AND BOTH TANK PAIR'S SENSORS WOULD HAVE TO FAIL. IT IS RECOMMENDED THAT A SEPARATE FMEA BE									
	FAILURE MODE BECAUS								

DIFFERENT FROM A FAILURE OF FULL OUTPUT.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-208 M4-1B2-MT0	39-1	BASELINE NEW	
MDAC ID:		ATER CONTROLLER	PRESSURE	
LEAD ANALYST:	B. E. AMES	•		
ASSESSMENT:				
CRITICAL FLIGH HDW/FU	T	DUNDANCY SCREEN B	rs C	CIL ITEM
NASA [3 /1R IOA [1 /1] [P]] [P] [] [P]	P] P]	[x] *
COMPARE [N /N] [] [][1	[N]
RECOMMENDATIONS:	(If diff	erent from NASA	۷)	
[/	.] [] [] [] (A)	[] DD/DELETE)
* CIL RETENTION	RATIONALE:		ADEQUATE NADEQUATE	
REMARKS: ALSO NASA FMEA'S THE IOA FAILURE				ewer ertine
MODE IS LOSS OF	OUTPUT INCL	UDING ERRONEOUS	SIGNAL.	THIS COULD
CAUSE A RANGE OF REACTANT DEPLETI				
RESIDUAL LEVEL I	S REACHED.	SENSOR READING	S NEAR ZER	COULD CAUSE
THE TANK HEATERS OR 3 AND 4 ARE S	ELECTED TO	THE AUTOMATIC M	ODE. THE	REDUNDANT
PATH IS PUTTING	THE HEATER	SWITCH IN THE C	FF POSITION	Ν.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-209	NASA DATA: BASELINE [] NEW []						
	EPG 209 H2 TANK HEATER	ELEMENT A (5), H2 TANK HEATER					
LEAD ANALYST:	B. E. AMES							
ASSESSMENT:								
CRITICALI FLIGHT	TY REDUNDA	NCY SCREENS	CIL ITEM					
HDW/FUN	C A	в с						
NASA [/ IOA [1 /1] [·]	[] [[P] [P] [x] *					
COMPARE [N /N] [N]	[и] [и] [N]					
RECOMMENDATIONS:	(If different	from NASA)	·					
1	1. []	[] [] [] (ADD/DELETE)					
* CIL RETENTION R	ATIONALE: (If a	A	DEQUATE [] DEQUATE []					
	IS RECOMMENDED E MODE IS REALI TER SWITCH FAIL	IS COMPONENT THAT THE MDA Y ONLY AN EF ING ON. THI	. THE FAILURE MODE C FMEA BE DELETED FECT THAT IS THE					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW					
MDAC ID:	EPG 210 H2 TANK HEATER E	LEMENT A (5), H2 TAI	NK HEATER				
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:			e e e e				
CRITICAL FLIGH	ITY REDUNDAN	CY SCREENS	CIL ITEM				
	NC A	ВС	TIEM				
NASA [/ IOA [3 /1R] [P] [P] [P]	[] *				
COMPARE [N /N) [и) [N] [N]	[]				
RECOMMENDATIONS:	(If different	from NASA)					
[3 /1R] [P] [P] [P] (AI	[DD/DELETE)				
* CIL RETENTION	RATIONALE: (If app						
		ADEQUATE INADEQUATE					
REMARKS: NASA DOES NOT HAVE A FMEA FOR THIS COMPONENT. THE FAILURE MODE IS FAILS OFF. INOPERATIVE HEATERS WILL CAUSE LOSS OF H2 PRESSURE TO THE FUEL CELLS.							

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-21 M4-1B2-1	1 RV030-1	N	ASA DATA: BASELINE NEW	((x]
SUBSYSTEM: MDAC ID:	EPG 211		LVE (4)-RV	030,RV040		00,RV560
LEAD ANALYST:	B. E. Al	MES		•		4,1
ASSESSMENT:						
FLIGH'	r		Y SCREENS		CIL ITEM	
HDW/FUI	NC	A	в с			
NASA [1 /1 IOA [2 /1R] [NA] [P] [NA] [N. F] [P	A]]	[X] *]
COMPARE [N /N] [и] [и] [и]	[]
RECOMMENDATIONS:	(If d	ifferent f	rom NASA)			
[- /] [] [NA] [] (ADI	[D/DE] LETE)
* CIL RETENTION 1	RATIONALI	E: (If app	A	DEQUATE DEQUATE		
REMARKS: ALSO NASA FMEA'S RV030, RV040 AND RV030, RV040, RV9 LEAKAGE. SCREEN 2.3.4.b.2.a. BECK HARDWARE CRITICAL SHOULD BE A 3 FOR WOULD ALLOW DELET	M4-1B1-1 500. THI B SHOULI AUSE THE LITY R GREATEI	RV030-1 FO E FAILURE D BE NA PE RELIEF VA R THAN TWO	R H2 TANK TANK TANK TANK SETS	RELIEF VAI ILED OPEN 06 SECTION NDBY REDUI . CHANGIN	LVE OR N NDAN	(3) - INTERNAL T. THE
HOOLD ALLOW DELE	LION OF	IUIS LWIFO	RE MODE FR	JM THE CIT	 •	

ASSESSME ASSESSME NASA FME	NT NT A	D. I:	ATE: D:	2/ PR M4	PRSD-212 BASELII						[]									
SUBSYSTE MDAC ID: ITEM:				EP 21 H2	2	١K	RI	ELIEI	F V	7 <u>7</u> 4	ALV	Æ	(4)) – :	RV(030,1	RV04(ο,	RV!	500) , R	7560
LEAD ANA	ГĀ	ST	:	в.	E.	Al	ME:	5														
ASSESSME	ASSESSMENT:																					
	CRITICALITY FLIGHT						RI	EDUNI	DAN	ıc	CY	sc	RE	EN	S				IL TEI			
			W/FU				A	15			В				С		_	Τ.	1 C.	1		
NASA IOA	[2	/1R /1R]		[P P]	[• :	NA P]		[P P]		[X]	*	
COMPARE	[N	/]		[]	[•	N]		[1		[N]		
RECOMMEN	DA	TI(ons:		(If	d :	if:	fere	nt,	f	fro	m	NA:	SA)							-
•	[/]		[J	{	•]		[]			/DI		ETE)	
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []																						
REMARKS: ALSO NAS	A	FM	EA'S	: 0	4-1I	3-1	RV	030-2	2	F	FOF	Н	2 !	ΓA	NK	REL	EF V	JA:	LVI	Ξ ((2)	
RV030, R	VO	40 40	AND RV	M4 500	-1B1	L-1 [H]	RV(E 1	030-2 Faili	2 F JRF	rc I	OR MC	H2 DE	T.	AN S	K I Fa:	RELII [LED	EF VA	SE.	VE D.	(3	3) : [F]	- THE
SAME TAN	RV030, RV040, RV500. THE FAILURE MODE IS FAILED CLOSED. IF THE SAME TANK'S CHECK VALVE ALSO FAILED CLOSED, AN EXPLOSION COULD OCCUR DUE TO CONDUCTIVE HEAT TRANSFER INTO THE TANK. SCREEN B IS																					
NA PER N	E ST	TO S	CON 2220	DUC 6 S	ECT:	ا ن [0]	HEA N	AT TH	KAN 1. L).	2.	a.	B)	EC.	AUS L'L	E TI	ANK. IE RI	ĒL.	SCI IEI	KE L	in i	LS
NA PER NSTS 22206 SECTION 2.3.4.b.2.a. BECAUSE THE RELIEF VALVE IS STANDBY REDUNDANT.																						

TOTAL TOTAL CONTRACTOR STATE OF THE STATE OF

ASSESSMENT ASSESSMENT NASA FMEA	T DATE T ID: #:	: 2/17/ PRSD- M4-1B	88 213 2-A	O1FSH	-1			NASA D BASEL		[]	
SUBSYSTEMS MDAC ID: ITEM:		EPG 213 H2 TA	NK	RELIE	f V	ALVE (4)-R	V030,R	V04	O,F	₹ V 5	00	,RV560
LEAD ANALY	YST:	в. Е.	AM	ŒS									
ASSESSMEN'	ASSESSMENT:												
CI	RITICA FLIG			REDUNDANCY SCREENS				•		CI II	L EM		
	HDW/F	UNC		A		В		С					
NASA IOA	[1 /1 [1 /1]]	NA] NA]	[[NA] NA]	[NA] NA]		[X X]	*
COMPARE	[/]	[]	[]	[]		[]	
RECOMMENDA	ATIONS	: (If	di	ffere	nt 1	from N	ASA)						
!	[/	j	[]	[]	[.]	(A)		'DE		TE)
* CIL RET	ENTION	RATION	ALE	: (If	apı	plicab		ADEQUA	тE	г	x	1	•
DEMARKS.								ADEQUA					
REMARKS: ALSO NASA FMEA'S: 04-1B-A01FSH-1 FOR H2 TANK RELIEF VALVE (2) - RV030, RV040 AND M4-1B1-A01FSH-1R FOR H2 TANK RELIEF VALVE (3) - RV030, RV040, RV500. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.													

ASSESSMEN ASSESSMEN NASA FMEA	T I	D:	PRSD-	-214		1			ASA DATA BASELINE NEW]
SUBSYSTEM MDAC ID: ITEM:			EPG 214 H2 RE	LIEF	POR	T 1 (1)				
LEAD ANAI	LYSI	r:	в. Е.	AME	S						
ASSESSMEN	T:										
c		ricali Flight		R	EDUN	DANCY	SCRE	ENS		CIL	
			NC .	A		В		С		1111	•
NASA IOA	[2	2 /1R 3 /1R]	[P]	[F]	[P [P]	[X [] *]
COMPARE	[]	1 /]	[J	[N]	[]	[N]
RECOMMEND	TAC	ons:	(If	dif	fere	nt fr	om NA	SA)			
	1	/	1	[]	[N.	A]	Γ] (A)	[DD/DI] ELETE)
* CIL RET	ENT	TION I	RATION	IALE:	(If	appl	icabl	A	EQUATE EQUATE	, x]
REMARKS: ALSO NASA											
THE FAILU											

CONDUCTIVE HEAT TRANSFER INTO THE TANK. SCREEN B SHOULD BE NA PER NSTS 22206 SECTION 2.3.4.b.2.a. BECAUSE THE RELIEF PORT

IS STANDBY REDUNDANT.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	DDCD-21E		BASELINE NEW		
MDAC ID:	EPG 215 H2 RELIE	F PORT 2	(1)		
LEAD ANALYST:	B. E. AMI	ES			
ASSESSMENT:					
CRITICAL FLIGH	ITY I	REDUNDANC	CY SCREENS	:	CIL ITEM
		A	В	С	
NASA [2 /1R IOA [3 /1R] []	P] [P] [NA] [P] [P] P]	[X] *
COMPARE [N /) [] [и] []	[N]
RECOMMENDATIONS:	(If di:	fferent f	rom NASA)		
[2 /1R		P] [NA] [[] DD/DELETE)
* CIL RETENTION	RATIONALE	: (If app	·	ADEQUATE	
REMARKS: ALSO NASA FMEA # FLOW. SCREEN B BECAUSE THE RELI CRITICALITY SHOU FAILED CLOSED, A TRANSFER INTO TH	SHOULD BE EF PORT IS LD BE A 2 N EXPLOSIO	NA PER N S STANDBY . IF A C	THE FAILU ÍSTS 22206 REDUNDAN CHECK VALV	TRE MODE IS SECTION 2 T. THE HAVE FOR TANK	S RESTRICTED 2.3.4.b.2.a. ARDWARE K 3 OR 5 ALSO

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-216 M4-1B2-TK0	30-1	NASA DATA BASELINE NEW	•
SUBSYSTEM: MDAC ID:	EPG 216	BASSEMBLY (4)	, (3), OR (2)
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
CRITICAL: FLIGH		DUNDANCY SCRE	ENS	CIL ITEM
HDW/FU		 B	C	
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA]] [NA]	[NA] [NA]	[X] * [X]
COMPARE [/] [] []	[]	[]
RECOMMENDATIONS:	(If diffe	erent from NA	SA)	
[/] [] []	[] (A)	[DD/DELETE)
* CIL RETENTION I	RATIONALE:	(If applicabl	e) ADEQUATE INADEQUATE	[X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE 2.3.3.h., A SING CRITICALITY 1/1. MODES OF EXTERNAL RECOMMENDED THAT AND ITEM PER NSTS	IS EXTERNA LE FAILURE I THE NEW FI L LEAKAGE AI A SEPARATE	L LEAKAGE. P RESULTING IN MEA REVIEW CO ND RUPTURE IN FMEA BE WRIT	ER NSTS 22204 LEAKAGE OF HI MBINED THE FA TO ONE FMEA. TEN ON THIS I	2 IS A AILURE IT IS
				•

ASSESSME	ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-217 NASA FMEA #: M4-1B2-TK030-1						NASA DATA: BASELINE [] NEW [X]						
SUBSYSTE MDAC ID:	M:		EPG 217 H2 T	'ANK S	SUBAS	SEMBL	У (4), (3	s), OI	R (2))		
LEAD ANA	LYST:		в. Е	. AMI	ES			**					
ASSESSME	NT:												
	CRITI FL	CAL:		I	REDUN	IDANCY	SCR	EENS			CIL		
	HDW	/FUI	7C	1	A	В	3	C	2				
NASA IOA	[1	/1 /1]	i]	NA] NA]	[N	A] A]	1] 1]	NA] NA]		x] x]	' [} []	t
COMPARE	[/	1	[]	[]	[]		[]	
RECOMMEN	DATIO	NS:	(I	f di	ffere	ent fr	om N	ASA)			, =		
	.[/]]	ι]	[,]	(A	[DD/D] ELET	ΓE)
* CIL RE	TENTI	ON 1	RATIC	NALE:	: (If	appl	icab	7	ADEQUA ADEQUA			[]	
REMARKS: ALSO NAS THE FAIL						AND	M4-1	B1-TI	K030-:	1.			

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-21 M4-1B2-	8 TK030-2	NASA DAT BASELIN NE	
SUBSYSTEM: MDAC ID:	EPG 218		4), (3), OR (2)
LEAD ANALYST:	B. E. A	MES		
ASSESSMENT:		·		
CRITICALI FLIGHT		REDUNDANCY SO	CREENS	CIL ITEM
HDW/FU	1C	A B	C	
NASA [1 /1 IOA [3 /1R] [NA] [NA] P] [F]	[NA] [P]	[X] * [X]
COMPARE [N /N] [N] [N]	[и]	[]
RECOMMENDATIONS:	(If d	ifferent from	NASA)	
[/] [1 [, 1	[]	[ADD/DELETE)
* CIL RETENTION F	RATIONAL	E: (If applica	ble) ADEQUATE INADEQUATE	
REMARKS: ALSO FMEA NASA'S THE FAILURE MODE BE DEPLETED DURING COULD LOSE THE OF	IS LOSS NG RE-EN'	OF ANNULUS VA	1B1-TK030-2. CUUM. THE REA	ACTANT COULD

ASSESSMEN ASSESSMEN NASA FME	NT ID:				NASA DATA BASELINE NEW			
SUBSYSTER MDAC ID: ITEM: V45T21(-	M: 5)07A	EPG 219 H2 TANK	HEATER	ASSEMBLY	TEMPERATURE	SEN	SOR (5)	
LEAD ANA	LYST:	B. E. A	MES					
ASSESSME	NT:							
•	CRITICAL FLIGH		REDUND	ANCY SCRE	ENS	CIL		
		NC	A	В	С	I I E,	ri	
NASA IOA	[3 /3] [] NA]	[NA]	[] [NA]	[] *	
COMPARE	[N /N] [и ј	[N]	[N]	[]	
RECOMMENI	DATIONS:	(If d	ifferen	t from NA	SA)			
	[3 /3] [NA]	[NA]	[NA]	[.DD/D:] ELETE)	
	rention :	RATIONAL	E: (If a	applicable	e) ADEQUATE INADEQUATE]	
REMARKS: THE FMEAS DID NOT INCLUDE THIS FAILURE MODE (FULL OUTPUT) OR COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.								

ASSESSMEN ASSESSMEN NASA FMEA	T ID:				NASA DATA BASELINE NEW				
SUBSYSTEM MDAC ID: ITEM: V45T21(-5									
LEAD ANAI	LYST:	B. E. A	ÆS						
ASSESSMEN	T:								
c	CIL ITEM								
	FLIGHT HDW/FUN		A	В	C	TIEM			
NASA IOA	[/ / 3] [] [AN	NA]	[] [NA]	[] *			
COMPARE	[N /N] [и] [N]	[N]	[]			
RECOMMENI	DATIONS:	(If d	ifferent	from NAS	SA)				
	[3 /3] [NA] [NA]	[NA] . (Al	[DD/DELETE)			
* CIL RET	TENTION I	RATIONALI	E: (If ap	plicable	ADEQUATE				
REMARKS: THE FMEAS DID NOT INCLUDE THIS FAILURE MODE (ZERO OUTPUT) OR COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.									

ASSESSMENT D ASSESSMENT I NASA FMEA #:				SA DATA: ASELINE [NEW []				
MDAC ID:	EPG 221 H2 TA A	NK HEATER AS	ERATURE SEI	NSOR (5)					
LEAD ANALYST	: B. E.	AMES							
ASSESSMENT:									
F	LIGHT	REDUNDANC		CI					
HD	W/FUNC	A	В С						
NASA [IOA [3	/3]] [] [AN]] [] NA] [NA]	<u>[</u>] *				
COMPARE [N	/N]	[N] [иј [и]	. []				
RECOMMENDATI	ONS: (If	different f	rom NASA)						
[3	/3]	[AN]	NA] [NA]	[(ADD/I] DELETE)				
* CIL RETENT	ION RATION	ALE: (If app	ADI	QUATE []				
THERE IS NO COMPONENT.	REMARKS: THERE IS NO FMEA FOR THIS FAILURE MODE (OUT OF TOLERANCE) OR								

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			NASA DATA: BASELINE [] NEW []						
The same of the sa	EPG 222 H2 TANK FLUID T		SENSOR (5)	V45T21(-					
LEAD ANALYST:	B. E. AMES								
ASSESSMENT:									
CRITICAL FLIGH HDW/FU		NCY SCREENS	c ·	CIL ITEM					
1154710		2	•						
NASA [/ IOA [3 /3] []] [NA]	[NA] [NA]	[] *					
COMPARE [N /N] [N]	[и]	и]	[]					
RECOMMENDATIONS:	(If different	from NASA)							
[3 /3] [NA]	[MA]	NA]	[] D/DELETE)					
* CIL RETENTION	RATIONALE: (If a		ADEQUATE	[] []					
REMARKS:									
COMPONENT. FOR	THERE IS NO FMEA FOR THIS FAILURE MODE (FULL OUTPUT) OR								

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		2/17/88 NASA DATA: PRSD-223 BASELINE [] NEW []						
SUBSYSTEM: MDAC ID: ITEM: 4)01A	EPG 223 H2 TANK							
LEAD ANALYST:	B. E. A	MES						
ASSESSMENT:								
CRITICAL FLIGH		REDUND	ANCY SCR	EENS	CII			
HDW/FU	NC	A	В	С				
NASA [/ IOA [3 /3] [NA]	[NA]	[] [NA]	[[] *]		
COMPARE [N /N] [и]	[N]	[N]	[]		
RECOMMENDATIONS:	(If d	ifferen	t from N	ASA)		,		
[3 /3] [NA]	[NA]	[NA]	[ADD/I] DELETE)		
* CIL RETENTION	RATIONAL	E: (If	applicab	le) ADEQUATE INADEQUATE]		
REMARKS: THERE IS NO FMEA COMPONENT. FOR FMEA FOR THIS FA	COMPLETE	NESS, N	RE MODE ASA MAY	(ZERO OUTPUT WANT TO CONS	OR IDER	WRITING	; A	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW	[]
MDAC ID:	EPG 224 H2 TANK FLUID TEMPER	ATURE SENSOR (5)	V45T21(-
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			a wa
CRITICAL: FLIGHT HDW/FUI			CIL ITEM
NASA [/ IOA [3 /3] [] [] [AN] [[]	[] [AA]	[] *
COMPARE [N /N] [N] [N]	[N]	[]
RECOMMENDATIONS:	(If different from	NASA)	
[3 /3] [NA] [NA]		[] D/DELETE)
	RATIONALE: (If application	able) ADEQUATE INADEQUATE	[]
REMARKS: THERE IS NO FMEA COMPONENT. FOR C FMEA FOR THIS FAI	FOR THIS FAILURE MODE COMPLETENESS, NASA MAY LURE MODE.	E (OUT OF TOLERA WANT TO CONSID	NCE) OR ER WRITING A

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	• •	NASA DATA: BASELINE NEW	[]				
	EPG 225 H2 TANK QUANTITY S						
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:							
CRITICAL FLIGH	CIL ITEM						
HDW/FU	NC A B	3 C	,				
NASA [/ IOA [3 /3] [] [NA] [N] [] NA] [NA]	[] *				
COMPARE [N /N] [N] [N	[и]	[]				
RECOMMENDATIONS:	(If different fr	om NASA)					
[3 /3] [NA] [N		[] DD/DELETE)				
	RATIONALE: (If appl	licable) ADEQUATE INADEQUATE	[]				
REMARKS: THERE IS NO FMEA COMPONENT. FOR FMEA FOR THIS FA	FOR THIS FAILURE M COMPLETENESS, NASA TLURE MODE.	ODE (FULL OUTPUT) MAY WANT TO CONSII	OR DER WRITING A				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-226			NASA DATA: BASELINE [] NEW []			
MDAC ID:	EPG 226 H2 TANK (QUANTITY	SENSOR (5) V45Q21(-	-5) 05A		
LEAD ANALYST:	B. E. AMI	ES					
ASSESSMENT:							
CRITICALITY REDUNDANCY SCREENS FLIGHT					CIL ITEM		
HDW/FU	NC A	A	В	C ,			
NASA [/ IOA [3 /3] [] [NA] [] [NA] [NA]	[] *		
COMPARE [N /N] [1	и] [и	и][и	N]	[]		
RECOMMENDATIONS:	(If di	fferent f	rom NASA)			
[3 /3	J [1	NA] [[NA] [NA']	[] DD/DELETE)		
* CIL RETENTION	RATIONALE:	: (If app	licable)				
			e e e e e e e e e e e e e e e e e e e	ADEQUATE NADEQUATE			
REMARKS: THERE IS NO FMEA FOR THIS FAILURE MODE (ZERO OUTPUT) OR COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.							

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-227	NASA DATA: BASELINE NEW	[]	
SUBSYSTEM: MDAC ID: ITEM:	EPG 227 H2 TANK QUANTITY	SENSOR (5) V45Q21(-5) 05A	
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
CRITICAL FLIGH	ITY REDUNDANC T	Y SCREENS	CIL ITEM	
HDW/FU		в с		
NASA [/ IOA [3 /3] [NA] [] [] NA] [NA]	[] *	
COMPARE [N /N	ј [и] [:	и] [и]	[]	
RECOMMENDATIONS:	(If different f	rom NASA)		
[3 /3] [NA] [NA] [NA] (A	[] DD/DELETE)	
* CIL RETENTION	RATIONALE: (If app	licable) ADEQUATE	r 3	
		INADEQUATE		
REMARKS: THERE IS NO FMEA COMPONENT. FOR FMEA FOR THIS FA	COMPLETENESS, NASA	MODE (OUT OF TOLER, MAY WANT TO CONSI	ANCE) OR DER WRITING A	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-228	(-1	NASA DATA BASELINE NEW	
MDAC ID:	EPG 228 H2 LINES, COM	IPONENTS, &	FITTINGS	<u></u> .
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				•
CRITICALI FLIGHT		DANCY SCRE	ENS	CIL ITEM
HDW/FUR		В		TIEM
NASA [1 /1 IOA [1 /1] [NA]] [NA]	[NA] [NA]	[NA] [NA]	[X] * [X]
COMPARE [/] []	[]	[]	[]
RECOMMENDATIONS:	(If differe	nt from NA	SA)	
[/	.T []	[]	[] (AI	[] DD/DELETE)
* CIL RETENTION B	RATIONALE: (If	applicabl	e) ADEQUATE INADEQUATE	[X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE THE COMPONENTS CO	IS EXTERNAL L	EAKAGE. I	T IS RECOMMEN	IDED THAT ALI

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			ASA DATA: BASELINE [] NEW []
	EPG 229 H2 LINES, COMP	PONENTS, & FITT	rings
LEAD ANALYST:	B. E. AMES		<u>-</u>
ASSESSMENT:			
CRITICAL FLIGH	ITY REDUND		CIL ITEM
HDW/FU	NC A	ВС	
NASA [/ IOA [2 /1R] [p]	[] [P] [] * [x]
COMPARE [N /N] [N]	[N] [N] [N]
RECOMMENDATIONS:	(If differen	t from NASA)	
, , ,	1. [1	ז נ	[] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If		
		AI INAI	DEQUATE [] DEQUATE []
FAILURE COULD RE	SULT IN SHUTTIN COMMENDED THAT	RE MODE (RESTI	RICTED FLOW). THIS EL CELLS DUE TO LACE BE DELETED SINCE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-23 M4-1B2-1	0 FL030-1		NASA DATA BASELINE NEW	•
SUBSISIEM.	230),FL500,FL5	60
LEAD ANALYST:	B. E. Al	MES			
ASSESSMENT:					
		REDUNDA	NCY SCREEN	ıs	CIL
FLIGHT HDW/FUI	4C r.	A	В	С	ITEM
NASA [2 /1R IOA [3 /1R] [P] P]	[P] [[P] [P] P]	[X] *
COMPARE [N /] []	[] []	[N]
RECOMMENDATIONS:	(If d	ifferent	from NASA	v)	
1] []	נ ז' נ	[] (A	[] DD/DELETE)
* CIL RETENTION I	RATIONALI	E: (If a	pplicable)		
- 1 to \$1.00		· · · · · ·]	ADEQUATE NADEQUATE	[X]
REMARKS:			-	~	
ALSO NASA FMEA'S	: 04-1-F	L030-1 F	OR H2 FILT	ER (2) - F	L030, FL040
AND M4-1B-FL030-1	L FOR H2	FILTER	(3) - FL03	0, FL040,	FL040.
THE FAILURE MODE					
A 2 BECAUSE IF TH					
AN EXPLOSION COUI	LD OCCUR	DUE TO (CONDUCTIVE	HEAT TRAN	SPER INTO THE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-231 M4-1B2-RV031-1	NASA DA BASELI N	
SUBSYSTEM:	EPG	ELIEF VALVE (1) RV	031
LEAD ANALYST:	B. E. AMES		v v pro≡
ASSESSMENT:			
FLIGH'	ITY REDUNDAN T NC A	NCY SCREENS B C	CIL ITEM
NASA [2 /1R IOA [2 /1R] [P]] [P]	[F] [P]	[X] *
COMPARE [/] []	[] []	[]
RECOMMENDATIONS:	(If different	from NASA)	
[/	1	[NA] []	[D] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If a	pplicable) ADEQUAT INADEQUAT	E [X]
THE FAILURE MODE RETENTION RATIONS SHOULD BE A 3. 2.3.4.b.2.a. BEC	IS FAILED OPEN (ALE IS NOT AVAIL SCREEN B SHOULD I AUSE THE RELIEF V	ND M4-1B1-RV031-1. OR INTERNAL LEAKAG ABLE. THE HARDWAR BE NA PER NSTS 222 VALVE IS STANDBY R THIS TO BE DELETE	E. THE CIL E CRITICALITY 06 SECTION EDUNDANT.

ASSESSME ASSESSME NASA FME		. .		~ ~ ~	7031-2	2			NASA BASE	DATA: LINE NEW	[
SUBSYSTE MDAC ID: ITEM:			EPG 232 H2 MA	NIFC	OLD 1	REL	JEF	VALVE	(1)	RV031	•	-	
LEAD ANA	LYST	:	B. E.	AME	ES								
ASSESSME	NT:												
	F	LIGHT	_			DANC	Y SC				CIL	1	
	HD	W/FUN	1C	A	L		В		Ç				
NASA IOA	[3	/1R /1R]	[E))	[NA] P]	[P] P]		[]	*
COMPARE	[/]	ſ]	Ţ	n j	[]		[]	
RECOMMEN	DATI	ons:	(If	dif	fere	ņt f	rom	NASA)					•
	[.	/] .	[]	[]	[1	(AL	[DD/DI] ELE	TE)
* CIL RE	TENT	ION F	RATION	ALE:	(<u>I</u> f	app	lica		ADEQU ADEQU	ATE ATE]]	
REMARKS: ALSO NAS THE FAIL SECTION REDUNDAN	URE 1 2.3.4	MODE 4.b.2	IS FA	ILS ECAU	CLOSI ISE TI	ED. HE R	SCF	REEN B	IS N VE IS	A PER		S	22206

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	DECD-23	2		NASA DATA: BASELINE [] NEW [X]					
MDAC ID:	EPG 233 H2 MANI	···							
LEAD ANALYST:	B. E. A	MES			• • •				
ASSESSMENT:									
CRITICAL: FLIGH		REDUNDAN	CY SCREE	ns	CIL ITEM				
HDW/FUI		A	В	C .	4 4 40 4				
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] NA]	[NA] [NA]	[X] *				
COMPARE [/] [] []	[]	[]				
RECOMMENDATIONS:	(Íf d	lifferent	from NAS	A)	g e e e e e e e e e e e e e e e e e e e				
[/] [.]	[] (A	[DD/DELETE)				
* CIL RETENTION	RATIONAL	Æ: (If ap	plicable	ADEQUATE	[X]				
REMARKS: ALSO NASA FMEA'S 04-1B-A01FSH-1 AND M4-1B1-A01FSH-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-234 M4-1B2-R	V031–1		NASA DATA: BASELINE NEW					
	234	OLD 2 RE	LIEF VALV	E (1) RV041	L				
LEAD ANALYST:	B. E. AM	ES							
ASSESSMENT:									
FLIGH	T		CY SCREEN		CIL ITEM				
HDW/FU	NC	A	В .	С					
NASA [2 /1F IOA [2 /1F		P] [P] [F] [P] P]	[X] * [X]				
COMPARE [/] [] [] []	[]				
RECOMMENDATIONS:	(If di	fferent	from NASA	.)					
	j [] [Ņ A] [] . (AI	[D] DD/DELETE)				
* CIL RETENTION	RATIONALE	: (If ap	plicable)	ADEQUATE					
	•		I	NADEQUATE					
REMARKS: ALSO NASA FMEA'S	04-1B-RV	031-1 AN	D M4-1B1-	RV031-1	G Andrew Person				
THE FAILURE MODE	IS FAILE	D OPEN O	R INTERNA	L LEAKAGE.	THE CIL				
RETENTION RATION									
SHOULD BE A 3.									
2.3.4.B.2.A. BEC	MUDE THE	YUTTER A	WTAT TO D	TAUDDI KEDU	INDANT.				

FAILING SCREEN B WOULD ALLOW THIS TO BE DELETED FROM THE CIL.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	5		NASA DATA: BASELINE NEW						
	EPG 235 H2 MANII	FOLD 2 REI	LIEF VALV	E (1) RV041	1				
LEAD ANALYST:	B. E. AM	ŒS	* 4						
ASSESSMENT:									
CRITICAL: FLIGHT	CRITICALITY REDUNDANCY SCREENS CIL ITEM								
HDW/FU		A	В	С	TIEM				
NASA [3 /1R IOA [3 /1R] [P] [P] [NA] [P] [P] P]	[] *				
COMPARE [/] [] [ן ת [3	[]				
RECOMMENDATIONS:	(If di	ifferent f	rom NASA)	u titu				
[1 () [] [[] DD/DELETE)				
* CIL RETENTION I	RATIONALI	E: (If app	olicable)	A DECLIAME					
	1. 1. 10. 4.1 1.		_ I	ADEQUATE NADEQUATE					
REMARKS: ALSO NASA FMEA'S 04-1B-RV031-2 AND M4-1B1-RV031-2. THE FAILURE MODE IS FAILS CLOSED. SCREEN B IS NA PER NSTS 22206 SECTION 2.3.4.b.2.a. BECAUSE THE RELIEF VALVE IS STANDBY REDUNDANT.									

ASSESSME ASSESSME NASA FME	11777 4	F.D.	550	m	_	H-1		*· .	NASA BASE	DATA: LINE NEW	[]	
SUBSYSTEM: EPG MDAC ID: 236 ITEM: H2 MANIFOLD 2 RELIEF VALVE (1) RV04								RV041	L		•		
LEAD ANA	LYSI	r:	в.	E. Al	ÆS								
ASSESSME	ASSESSMENT:												
FLIGHT							CIL						
	, HI)W/FU	NC		A		В		C				
NASA IOA	[]	/1 /1]	[NA] NA]	[NA] NA]	[NA] NA]		[X [X]	*
COMPARE	[/]	[]	[]	[]		[]	
RECOMMEN	DATI	ons:	(If di	ffer	ent i	from	NASA)					
•	c	, , , , , , , , , , , , , , , , , , ,		[]	. []	[]	(AI	[D/D		ETE) .
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []													
REMARKS: ALSO NASA FMEA'S 04-1B-A01FSH-1 AND M4-1B1-A01FSH-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.													

ACCTCCMT	יאיי דו.	T DATE: 2/17/88 T ID: PRSD-237 #: M4-1B2-CV030-1				NASA DATA: BASELINE [] 1 NEW [X]						
SUBSYSTE MDAC ID: ITEM:		EPG 237 H2 CHI	eck v	ALVE	(2)	CV03:	L,CV	041				
LEAD ANALYST: B. E. AMES												
ASSESSME	ASSESSMENT:											
	CRITICAL FLIGH	T	RE	EDUND#					CIL			
	HDW/FU	NC	A		В		С	l				
NASA IOA	[2 /1R [2 /1R]	[P]	[F]	[P]	[X [X] *		
COMPARE	[/	1	[]	[]	[1	[]		
RECOMMEN	DATIONS:	(If	diff	ferent	fr.	om NAS	SA)					
	[3 /1R	.]	[P]	[P]	[P	(A	[.DD/D] ELETE)		
* CIL RE	TENTION	RATION	ALE:	(If a	appl	icable		DEQUATE	r	7		
								DEQUATE	[j		
REMARKS: ALSO NAS									V031	. •		

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-23 M4-1B2-	8 CV030-2		NASA DATA BASELINE NEW					
SUBSYSTEM: MDAC ID:	EPG 238		(2) CV031,	CV041					
LEAD ANALYST:	B. E. A	MES							
ASSESSMENT:									
		REDUNDAN	ICY SCREEN	S	CIL				
FLIGH HDW/FU	NC	A	В	C	ITEM				
NASA [2 /1R IOA [3 /1R] [P] [P] [P] [P] P]	[X] *				
COMPARE [N /] [] [] []	[N]				
RECOMMENDATIONS:	(If d	ifferent	from NASA)					
[2 /1R] [P] [P] [P] (A	[] DD/DELETE)				
* CIL RETENTION	RATIONAL	E: (If ap	-	ADEQUATE NADEQUATE					
REMARKS: ALSO NASA FMEA # M4-1B1-CV030-2 FOR H2 CHECK VALVE CV031. THE									
ALSO NASA FMEA # FAILURE MODE IS									
CRITICALITY SHOULD BE A 2 BECAUSE IF THE SAME TANK'S RELIEF VALVE									
	ALSO FAILED CLOSED, AN EXPLOSION COULD OCCUR DUE TO CONDUCTIVE HEAT TRANSFER INTO THE TANK. THE ASSESSMENT WORKSHEET								
COVERING THE OTH									

241.

ASSESSME ASSESSME NASA FME	NT I	D:	PRS		9	FSH-	1					DATA ELINE NEW	[]	
SUBSYSTE MDAC ID:	м:		EPC 239 H2		K V	ALVE	(2	2)	CV0:	31,0	W041					
LEAD ANA	LYSI	: :	в.	E. Al	MES											
ASSESSMENT:																
	I	ICAL LIGH W/FU	T		RE A	DUND	ANC	EY B	SCRI	EENS	c C			IL FEN	1	
NASA IOA	[]	/1]	[NA NA]	[]		NA] NA]		[X X]	*
COMPARE	Į.	/]	[]	[]	[]		[]	
RECOMMEN	DAŢI	ons:		(If d	iff	eren	t 1	fro	m NZ	ASA)				-		
,	[/]	[]	[,]	. []	(A] ,dd	/DF	eri J	ETE)
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE [] REMARKS:																
ALSO NASA FMEA # M4-1B1-A01FSH-1 FOR H2 CHECK VALVE CV031. THE FAILURE MODE IS EXTERNAL LEAKAGE.																

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:				NASA DATA BASELINE NEW	
MDAC ID:	EPG 240 H2 CHECK	VALVE	(1) CV030)	
LEAD ANALYST:	B. E. AM	IES			
ASSESSMENT:					
CRITICAL FLIGH	r		NCY SCREI		CIL ITEM
HDW/FU	NC	Α .	В	С	
NASA [2 /1R IOA [2 /1R] [P] P]	[F] [F]	[P] [P]	[X] *
COMPARE [/] []	[]		[]
RECOMMENDATIONS:	(If di	fferent	from NAS	SA)	
[\] [J	[]	[] (A)	[] DD/DELETE)
* CIL RETENTION	RATIONALE	: (If a	pplicable	ADEQUATE INADEQUATE	
REMARKS: ALSO NASA FMEA'S THE FATLURE MODE					

HARDWARE CRITICALITY SHOULD BE A 3.

ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-241 NASA FMEA #: M4-1B2-CV030-2 NEW									
SUBSYSTEM: MDAC ID: ITEM:	EPG 241		(1) CV03	0					
LEAD ANALYST:	B. E.	AMES							
ASSESSMENT:									
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM									
	FUNC	A	В	, C					
NASA [2 / IOA [3 /	1R] 1R]	[P] [P]	[P] [P]	[P] [P]	[X] *				
COMPARE [N /]	[]	[]	[]	[N]				
RECOMMENDATION	S: (Îf	different	t from NA	SA)					
[, , /	· 1	[]	[]	[] (A	[] DD/DELETE)				
* CIL RETENTIO	N RATIONA	LE: (If a	applicabl	ADEQUATE					
REMARKS: ALSO NASA FMEA'S 04-1B-CV030-2 AND M4-1B1-CV030-2. THE FAILURE MODE IS FAILED CLOSED OR RESTRICTED FLOW. THE HARDWARE CRITICALITY IS A 2 BECAUSE IF THE SAME TANK'S RELIEF VALVE ALSO FAILED CLOSED, AN EXPLOSION COULD OCCUR DUE TO CONDUCTIVE HEAT TRANSFER INTO THE TANK. THE RETENTION RATIONALE IS NOT AVAILABLE.									

ASSESSMENT ASSESSMENT NASA FMEA #	DATE: ID: :	2/17/88 PRSD-242 M4-1B2-2	2 A01FSH-1			DATA: ELINE [NEW [
SUBSYSTEM: MDAC ID: ITEM:		EPG 242 H2 CHECI								
LEAD ANALYS	T:	B. E. AM	MES							
ASSESSMENT:							-			
	TICALI FLIGHT	TY	REDUNDA	NCY SC	REENS	CI: IT:				
		ic	A	В	C		LM			
NASA [IOA [1 /1 1 /1] [NA] NA]	[NA] [NA]	[NA] [NA]	[]	X] * X]			
COMPARE [/] []	[]	[]	[]			
RECOMMENDAT	ions:	(If di	ifferent	from l	NASA)					
, , , ,	/] []	[]	[]	[(ADD/)] DELETE)			
* CIL RETEN	TION R	RATIONALE	E: (If a	pplical	ble) ADEQU INADEQU		x]			
REMARKS: ALSO NASA F THE FAILURE LEAKAGE OF THE SAME, I	MEA'S MODE MOST C	IS EXTER	RNAL LEA TS IN ON	KAGE.	-1B1-A01FS	SH-1. ERED THE	EXTERNAL			

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-243 M4-1B2-0	3		NASA DA BASELI N	
SUBSYSTEM: MDAC ID: ITEM:	EPG 243 H2 CHECK	VALVE	(1) CV	040	avanti i i i i i i i i i i i i i i i i i i
LEAD ANALYST:	B. E. AM	ŒS			
ASSESSMENT:					
CRITICAL FLIGH		REDUND	ANCY SCI	REENS	CIL ITEM
HDW/FU		A	В	C	11211
NASA [2 /1R IOA [2 /1R] [P] P]	[F] [F]	[P] [P]	[X] * [X]
COMPARE [/	1]	[]	[]	[]
RECOMMENDATIONS:	(If di	ifferen	t from 1	NASA)	
[/] []	[]	. []	[] (ADD/DELETE)
* CIL RETENTION	RATIONALE	E: (If	applicak	ADEQUA	• •
REMARKS:				INADEQUAT	
ALSO NASA FMEA'S THE FAILURE MODE HARDWARE CRITICA	IS FAILE	ED OPEN	OR INT		

ASSESSMENT DA ASSESSMENT ID NASA FMEA #:	TE: 2/17/88 PRSD-24 M4-1B2-	3 14 -CV030-2		NASA DATA BASELINE NEW	: [
SUBSYSTEM: MDAC ID: ITEM:	EPG)	
LEAD ANALYST:	B. E. 2	AMES			
ASSESSMENT:					: =
FL	CALITY IGHT /FUNC			ens C	
NASA [2 IOA [3	/1R] /1R]	[P] [P]	[P] [P]	[P] [P]	[X] *
COMPARE [N	/]	[]	[]	[]	[N]
RECOMMENDATIO	NS: (If	lifferent	from NAS	5 A)	
. [/]		[]	[]	[DD/DELETE)
* CIL RETENTI	ON RATIONAI	LE: (If a	ipplicable	e) ADEQUATE INADEQUATE	[x]
REMARKS: ALSO NASA FME THE FAILURE M HARDWARE CRIT VALVE ALSO FA CONDUCTIVE HE RATIONALE IS	ODE IS FAID CICALITY IS LIED CLOSED AT TRANSFER	LS CLOSED A 2 BECA D, AN EXP R INTO TH	OR RESTI LUSE IF TH PLOSION CO	RICTED FLOW. HE SAME TANK OULD OCCUR DO	'S RELIEF JE TO

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-245 M4-1B1-A01	FSH-1		NASA DATA BASELINE NEW				
MDAC ID:	EPG 245 H2 CHECK V	ALVE (1)	CV040					
LEAD ANALYST: B. E. AMES								
ASSESSMENT:								
CRITICAL FLIGH HDW/FU	T	DUNDANCY B		c C	CIL ITEM			
NASA [1 /1 IOA [1 /1] [NA] [NA	[N.	A] [A] [NA] NA]	[X] * [X]			
COMPARE [/] [] [] [1	[]			
RECOMMENDATIONS:	(If diff	erent fr	om NASA)				
] [] [] [] (A)	[] DD/DELETE)			
* CIL RETENTION	RATIONALE:	(If appl	icable)					
We the second			I	ADEQUATE NADEQUATE	[X]			
REMARKS: ALSO NASA FMEA'S 04-1B-A01FSH-1 AND M4-1B1-A01FSH-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.								

ASSESSMENT DATE:	2/17/88		NASA DATA				
ASSESSMENT ID:	PRSD-246		BASELINE []				
ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	M4-1B2-PD0	32-1	NEW	[X]			
MDAC ID:	246	TAL DRAIN QD	(1) TYPE II,	CLASS 8			
LEAD ANALYST:	B. E. AMES	1					
ASSESSMENT:							
CRITICAL: FLIGHT		DUNDANCY SCRE		CIL			
	IC A	B	C	ITEM			
NASA [2 /1R] [P] [F]	[P]	[X]*			
NASA [2 /1R IOA [2 /1R] [P	j [Fj	[P]	[X] * [X]			
COMPARE [/	J (] []	[]	[]			
RECOMMENDATIONS:	(If diff	erent from NA	SA)				
\]] [] []	[] (A)	[DD/DELETE)			
* CIL RETENTION F	RATIONALE:	(If applicabl	ADEQUATE	[]			
			INADEQUATE	įχj			
REMARKS: ALSO NASA FMEA'S							
THE FAILURE MODE RATIONALE IS NOT		L LEAKAGE. T	HE CIL RETENT	rio n			

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			NASA DATA BASELINE NEW	[]				
	EPG 247 H2 HORIZONI	EPG 147 12 HORIZONTAL DRAIN QD (1) TYPE II,						
LEAD ANALYST:	B. E. AMES	B. E. AMES						
ASSESSMENT:	ASSESSMENT:							
CRITICAL	CIL							
FLIGH HDW/FU	INC A	В	С	ITEM				
NASA [/ IOA [3 /3] []]	[] [AN]	[] [NA]	[] *				
COMPARE [N /N] [N]	[N]	[N]	[]				
RECOMMENDATIONS:	(If diffe	erent from NA	ASA)	e e la companya de				
[3 /3] [NA]	[NA]		[] DD/DELETE)				
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []								
REMARKS: NASA DOES NOT HAVE A FMEA ON THIS FAILURE MODE (INABILITY TO MATE/DEMATE) FOR THIS COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.								

ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-248 NASA FMEA #: M4-1B2-PC030-1 SUBSYSTEM: FPG				E	[]																
SUBSYSTE MDAC ID:	11.1 •			24	•								AP	(:	L)								
LEAD ANA	LY	ST	:	в.	E.	Al	MES	3															
ASSESSME	ENT	:																					
		F	ICAL LIGH	Т				EDUN	IDAN	ıc		sc	REE	NS						ΓI	L EM	I	
		HDI	W/FU	NC			A				В				C			1940	i i				
NASA IOA	[1 2	/1 /1R]]	NA P	\]	[:	NA F]]	NA P	.]			-]	X X]	*
COMPARE	[N	/N]		[N]	[•	N]		[N]				[]	
RECOMMEN	IDA'	ΓI	ons:		(If	đ:	ifí	ere	ent	Í	ŗo	m	NAS	A))								
	[Z .	1]	. [•]		[]		(.	ΑD	[D/	DE] LF	ETE
* CIL RE	ete:	NT:	ION 1	RAT	IONA	LI	Ξ:	(If	ap	Þ	li	.ca					UA' UA'			[[]	
REMARKS: ALSO NAS		EM1	FAIC	04	_1 R-	. Dr	יחי		AN	r	. M	[A _	1 R 1	_ T	ാഗവ	30	_1			·		•	
THE FAII ALLOWABI ACCUMULA EXPLOSIO	LUR LE LTI	E 1 LEZ ON	MODE AK R	IS ATE H2	EXT TH IN T	EI II S THI	RNA S F	L I AII RBI	LEAK LURE TER	ÇA }	GE CO MI	UL D	BE D R FUS	C# ES	US SUL LAG	E T E	THI IN ANI	E (T)	QD HE A	H	IAS	A	

ASSESSME ASSESSME NASA FME	NO TO	١.	DDGD	PRSD-249 BASELINE					x]				
SUBSYSTE MDAC ID:	M:		EPG 249 H2 M	ANI	FOLD	PRES	SURE	SENS	OR (2)		-		
LEAD ANA	LYST:		B. E. AMES										
ASSESSMENT:													
CRITICALITY REDUNDANCY SCREENS FLIGHT						CIL ITEM							
		/FU			A		В		С				
NASA IOA	[3 [3	/3 /3]	[NA]	[NA] NA]	[[NA] NA]		[[]	*
COMPARE	[/]	[]	[]	[]		[]	
RECOMMEN	DATIC	ns:	(I	f d	iffer	ent :	from	NASA)				
	(/]	ĺ]	[]	[].	(A	[DD/1	DELE	TE)
* CIL RE	* CIL RETENTION RATIONALE: (If applicable) ADEQUATE []												
REMARKS:								Il	NADEQU	ATE	[]	
REMARKS: ALSO NASA FMEA'S 04-1B-MT032-1 AND M4-1B1-MT032-1. THE IOA FAILURE MODE IS FULL OUTPUT. THE NASA FAILURE MODE IS LOSS OF OUTPUT OR ERRONEOUS SIGNAL.													

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		-1	NASA DATA BASELINE NEW					
MDAC ID:	EPG 250 H2 MANIFOLD	PRESSURE SEN	ISOR (2)	STATE OF THE SERVE				
LEAD ANALYST:	B. E. AMES		- A.					
ASSESSMENT:								
CRITICAL: FLIGHT		NDANCY SCREE	ens	CIL ITEM				
HDW/FUI	NC A	В	С					
NASA [3 /3 IOA [3 /3] [NA]] [NA]	[NA] [NA]	[NA] [NA]	[] *				
COMPARE [/] []	[]	[]	[]				
RECOMMENDATIONS:	(If differ	ent from NAS	;A)					
[/] []	[]	[] (A)	[] DD/DELETE)				
* CIL RETENTION I	RATIONALE: (I	f applicable	e) ADEQUATE INADEQUATE	[]				
REMARKS: ALSO NASA FMEA'S 04-1B-MT032-1 AND M4-1B1-MT032-1. THE IOA FAILURE MODE IS ZERO OUTPUT. THE NASA FAILURE MODE IS								

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA BASELINE 1 NEW	=					
SUBSYSTEM: MDAC ID: ITEM:	EPG 251 H2 MANIFOLD P	RESSURE SENSOR (2)						
LEAD ANALYST:	B. E. AMES							
ASSESSMENT:								
CRITICAL FLIGH		DANCY SCREENS	CIL					
HDW/FU	NC A	ВС						
NASA [3 /3 IOA [3 /3] [NA]] [NA]	[NA] [NA] [NA] [NA]	[] *					
COMPARE [/] []	[] []	[]					
RECOMMENDATIONS:	(If differe	nt from NASA)						
] [j .	(A)	[] DD/DELETE)					
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []								
	MODE IS OUT OF	AND M4-1B1-MT032-1. TOLERANCE. THE NASA SIGNAL.	FAILURE MODE					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-252 M4-1B2-LV031-J	L	NASA DATA BASELINE NEW	: [x]			
	EPG 252 H2 MANIFOLD 1	SOLENOID	CROSSOVER VA	LVE (1) LV031			
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:							
	ITY REDUNE	DANCY SCR	EENS	CIL			
FLIGH HDW/FU		В	C	ITEM			
NASA [2 /1R IOA [3 /1R	[P] [P]	[F] [P]	[P] [P]	[X] *			
COMPARE [N /] []	[א]	[]	[N]			
RECOMMENDATIONS:	(If differen	nt from Na	ASA)				
[3 /] []	['P]	[] (A	[D] DD/DELETE)			
* CIL RETENTION	RATIONALE: (If	applicab.					
	1.5		ADEQUATE INADEQUATE	[] [X]			
REMARKS:	04 10 177021 1	- 	D1 T11001 1				
ALSO NASA FMEA'S THE FAILURE MODE				IT IS			
RECOMMENDED THAT							
THE TANK 1 RELIE							
THE LEAK BY CLOS							
3. EXTERNAL LEAT							
	AN ADDITIONAL FAILURE BECAUSE NSTS 22206 SECTION 2.3.3.h. ALREADY DEFINES THIS AS A CRITICALITY 1/1. SCREEN B SHOULD BE						
PASSED PER NSTS	22206 SECTION 2	.3.5.a. I	BECAUSE THE FA	AILURE IS			
DETECTABLE WITH '				WOULD ALLOW			

RATIONALE IS NOT AVAILABLE.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-253 M4-1B2-LV031-2	NASA BASI	DATA: ELINE [] NEW [X]
MDAC ID:	EPG 253 H2 MANIFOLD 1 S	SOLENOID CROSSOVI	ER VALVE (1) LV031
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL FLIGH	ITY REDUNDA	ANCY SCREENS	CIL ITEM
	NC A	ВС	LIEA
NASA [3 /1R IOA [3 /2R	[P]	[F] [P] [P] [P]	[X] * []
COMPARE [/N] []	[N]	[N]
RECOMMENDATIONS:	(If different	from NASA)	touting the second of the seco
()] []		[] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If a	ADEQU	JATE [X] JATE []
THE HARDWARE CRI	RITICALITY FLIGHT OSED. THE VALVE PRESSURE RELIEF F TICALITY WOULD E D BE LOST IF THE VARE CRITICALITY	IT HDW/FUNC: 2/11 E IS USED FOR LEAD PATH. FOR A TWO BE A 2 DURING ASO TANK 2 RELIEF VA SHOULD BE A 3 FO	A. THE FAILURE AK ISOLATION AND TANK SET SYSTEM, CENT BECAUSE TWO ALVE FAILED OR GREATER THAN

DELETED.

RELIEF VALVE FAILS CLOSED AND HEATERS FAIL ON. THIS DOES NOT

MEET THE CRITERIA TO BE A CIL ITEM, AND SHOULD BE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-254 M4-1B2-7	i AO1FSH-1		NASA DATA: BASELINE NEW			
MDAC ID:	EPG 254 H2 MANIE	FOLD 1 SO	LENOID CRO		LVE (1) LV031		
LEAD ANALYST:	B. E. AM	ŒS	1 11				
ASSESSMENT:							
CRITICAL: FLIGHT		REDUNDAN	CY SCREENS	3	CIL ITEM		
	NC	A	В	C	IIIM		
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] [NA] [NA] NA]	[X] * [X]		
COMPARE [/] [] [] []	[]		
RECOMMENDATIONS:	(If di	ifferent :	from NASA)			
1 /] []. [ĵ (] (AD	[] DD/DELETE)		
* CIL RETENTION I	RATIONALE	E: (If ap		ADEQUATE NADEQUATE	[X]		
REMARKS: ALSO NASA FMEA'S 04-1B-A01FSH-1 AND M4-1B1-A01FSH-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.							

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE [] NEW [X]
SUBSYSTEM: MDAC ID:	EPG	ACTANT SUPPLY VALVE
LEAD ANALYST:	B. E. AMES	
ASSESSMENT:		
CRITICAL FLIGH		ITEM
HDW/FU	NC A B	Ċ
NASA [2 /1R IOA [2 /1R	[P] [F] [E] [P] [P] [P] [P] [P]	P] [X] * P] [X]
COMPARE [/] [] [] [] []
RECOMMENDATIONS:	(If different from NASA)	
[/] [P] [[] (ADD/DELETE)
-		ADEQUATE [] ADEQUATE [X]
THE FAILURE MODE CRITICALITY IS A REQUIRING FUEL COUPPLY VALVES TO SCREEN B SHOULD	O4-1B-LV033-1 AND M4-1B1-L IS FAILS OPEN OR INTERNAL 2 BECAUSE IT WILL ONLY TAK ELL SHUTDOWN, PLUS A FAILUR CAUSE THE POSSIBLE LOSS OF BE PASSED PER NSTS 22206 SE POSITION INDICATOR. THE C	LEAKAGE. THE HARDWARE E A FUEL CELL FAILURE E OF THE REACTANT THE ORBITER. CTION 2.3.5.a. BECAUSE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-256 M4-1B2-LV033-2	NASA DATA BASELINE NEW					
SUBSYSTEM: MDAC ID: ITEM: (1) LV033	256	1 SOLENOID REACTANT SU	PPLY VALVE				
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:							
CRITICAL: FLIGHT	TY REDUNI	DANCY SCREENS	CIL ITEM				
HDW/FU	ic A	в с					
NASA [2 /1R IOA [2 /1R] [P]] [P]	[P]	[X] * [X]				
COMPARE [/] []	[] [] .	[]				
RECOMMENDATIONS:	(If differen	nt from NASA)					
[/] []	(A	[] .DD/DELETE)				
* CIL RETENTION I	RATIONALE: (If	applicable) ADEQUATE INADEQUATE	[X]				
THE FAILURE MODE	IS FAILS CLOSE PHASE ALSO BECA	AND M4-1B1-LV033-2. ED. THE CRITICALITY S AUSE LOSS OF A FUEL CE	HOULD BE 2/1R				

ASSESSME ASSESSME NASA FME	NT DATE: NT ID: A #:	2/17/88 PRSD-25 M4-1B2-	8 57 -A01FSH-	1	NASA DATA: BASELINE [] NEW [X]					
SUBSYSTE MDAC ID: ITEM: (1) LV03	M:	257			D REACTANT S	UPPLY VALVE				
LEAD ANA	LYST:	B. E. 2	AMES							
ASSESSME	NT:									
·	CRITICAL FLIGH HDW/FU		REDUND A	ANCY SCRI	eens C	CIL				
WAGA	·									
NASA IOA]	NA]	[NA] [NA]	[NA]	[X] * [X]				
COMPARE	[/]]	[]	[]	[]				
RECOMMEN	DATIONS:	(If o	lifferen	t from NA	ASA)					
•	[/	1 .	[]	[]	[] ([] ADD/DELETE)				
		RATIONA	LE: (If	applicab	le) ADEQUATE INADEQUATE					
THE FAIL	A FMEA'S URE MODE OF MOST	E IS EXTI	ERNAL LE NTS IN O	AKAGE. 1		THE EXTERNAI HE EFFECT IS				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-258 M4-1B2-I	3 LV033-1	N.	: [x] [x]	
SUBSYSTEM: MDAC ID: ITEM: (1) LV043	EPG 258 H2 FUEL	CELL 2 SO	LENOID REA	CTANT SUI	PPLY VALVE
LEAD ANALYST:	B. E. AM	MES			
ASSESSMENT:					
		REDUNDANC	Y SCREENS		CIL ITEM
FLIGH HDW/FU	INC	A	в с		IIEM
NASA [2 /11 IOA [2 /11	[]	P] [P] [F] [P P] [P]	[X] *
COMPARE [/] [) [и] []	[]
RECOMMENDATIONS:	(If di	ifferent f	rom NASA)		
[/) [] [P] [] (AI	[] DD/DELETE)
* CIL RETENTION	RATIONALE	E: (If app	A	DEQUATE DEQUATE	
REMARKS:	. 04 1D TI	7022 - 1 - 3 ND		-	[4]
ALSO NASA FMEA'S THE FAILURE MODE CRITICALITY IS A FUEL CELL SHUTDO TO CAUSE THE POS BE PASSED PER NS VALVE POSITION	IS FAILS DECAUS WIN, PLUS SIBLE LOS STS 22206	S OPEN OR SE IT WILL A FAILURE SS OF THE SECTION 2	INTERNAL LI ONLY TAKE OF THE RE ORBITER. 8 .3.5.a. BE	EAKAGE. A FAILUF ACTANT SU SCREEN B CAUSE THI	RE REQUIRING UPPLY VALVE SHOULD ERE IS A
AUTAR LOSTITON 1	ひしてんなものな。	· IIII CIL	1/11/11/11/11/11	TOTAL	TO 110 T

AVAILABLE.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-259 M4-1B2-LV033	-2	ASA DATA: BASELINE [] NEW [X]						
MDAC ID:	EPG 259 H2 FUEL CELL	2 SOLENOID REAG	CTANT SUPPLY VALVE						
LEAD ANALYST:	B. E. AMES								
ASSESSMENT:									
CRITICALI FLIGHT		NDANCY SCREENS	CIL ITEM						
	NC A	в с	4 4 MA 4						
NASA [2 /1R IOA [2 /1R] [P]] [P]	[P] [P [P] [X] *] [X]						
COMPARE [/] []] []] []						
RECOMMENDATIONS:	(If differ	ent from NASA)							
\]	1 . [1	[] [] [] (ADD/DELETE)						
* CIL RETENTION I	RATIONALE: (I	Al	DEQUATE [X] DEQUATE []						
INADEQUATE [] REMARKS: ALSO NASA FMEA'S 04-1B-LV033-2 AND M4-1B1-LV033-2. THE FAILURE MODE IS FAILS CLOSED. THE CRITICALITY SHOULD BE 2/1R FOR THE ONORBIT PHASE ALSO, BECAUSE LOSS OF A FUEL CELL CAUSES A PRIORITY FLIGHT DECISION.									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-260 M4-1B2-A) \01FSH-1	NASA DATA: BASELINE [] NEW [X]					
SUBSYSTEM: MDAC ID:	EPG 260			REACTANT SU	PPLY VALVE			
LEAD ANALYST:	B. E. AM	ŒS						
ASSESSMENT:								
CRITICAL: FLIGHT HDW/FUI	_	REDUNDA:	ns C	CIL ITEM				
NASA [1 /1 IOA [1 /1] [NA] NA]	[NA] [NA]	[NA] [NA]	[X] *			
COMPARE [/] []	[]	[]	[]			
RECOMMENDATIONS:	(If di	fferent	from NAS	A)				
[/] []	[]		[] OD/DELETE)			
* CIL RETENTION I	RATIONALE	: (If a	pplicable) ADEQUATE	r Y 1			
DEVI DVC	· -			INADEQUATE				
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE LEAKAGE OF MOST OF THE SAME, IT IS A	IS EXTER	NAL LEAD	KAGE. NA	SA COVERS TH				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-26 M4-1B2-1	1 LV033-1	<u>-</u>	NASA DATA BASELINE NEW	
MDAC ID:	EPG 261 H2 FUEL	CELL 3	SOLENOID	REACTANT SU	PPLY VALVE
LEAD ANALYST:	B. E. A	MES			
ASSESSMENT:					· · · · · ·
CRITICAL FLIGH		REDUNDA	NCY SCRE	ENS	CIL ITEM
HDW/FU	NC	A	В	С	
NASA [2 /1R IOA [2 /1R] [P] P]	[F] [P]	[P] [P]	[X] * [X]
COMPARE [/] []	[N]	[]	[]
RECOMMENDATIONS:	(If d	ifferent	from NA	SA)	
[/] (,]	[P]	(A)	[] DD/DELETE)
* CIL RETENTION	RATIONAL	E: (If a	pplicabl	e) ADEQUATE INADEQUATE	
REMARKS:			ivni izali i i n		a kata wa ma
ALSO NASA FMEA'S THE FAILURE MODE	IS FAIL	S OPEN O	R INTERN	AL LEAKAGE.	
CRITICALITY IS A FUEL CELL SHUTDO					
TO CAUSE POSSIBL BE PASSED PER NS	E LOSS O	F THE OR	BITER.	SCREEN B SHO	ULD
VALVE POSITION I					
AVAILABLE.					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-262 M4-1B2-1	2 LV044-2	NASA DATA: BASELINE [] NEW [X]							
	EPG			REACTANT SU	PPLY VALVE					
LEAD ANALYST:	B. E. A	MES								
ASSESSMENT:										
FLIGH	Ţ·	REDUNDANC A		ns C	CIL ITEM					
NASA [1 /1 IOA [2 /1R] [NA] [P] [NA] P]	[NA] [P]	[X] *					
COMPARE [N /N] [и ј [N _j	[и]	[]					
RECOMMENDATIONS:	(If d	ifferent 1	from NAS	A)						
[/] [] []	[] (A)	[] DD/DELETE)					
* CIL RETENTION I	RATIONALI	E: (If app) ADEQUATE INADEQUATE	[X]					
REMARKS: ALSO NASA FMEA # THE FAILURE MODE FOR THE ONORBIT I PRIORITY FLIGHT I	IS FAILS PHASE ALS	S CLOSED. SO, BECAUS	THE CR	ITICALITY SI	HOULD BE 2/1F					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-263 M4-1B2-A01FSH-	NASA DATA BASELINI -1 NEV	ATA: INE [] NEW [X]		
MDAC ID:	263	3 SOLENOID REACTANT S	UPPLY VALVE		
LEAD ANALYST:	B. E. AMES				
ASSESSMENT:					
CRITICA FLIG	łT	DANCY SCREENS	CIL ITEM		
HDW/F	JNC A	ВС			
NASA [1 /1 IOA [1 /1] [NA]] [NA]	[NA] [NA] [NA] [NA]	[X] * [X]		
COMPARE [/	1 []	[] []	[]		
RECOMMENDATIONS	(If differen	nt from NASA)	•		
[/] []		[] ADD/DELETE)		
* CIL RETENTION	RATIONALE: (If	applicable) ADEQUATE INADEQUATE			
THE FAILURE MODI	E IS EXTERNAL LI COMPONENTS IN (INADEQUATE 1 AND M4-1B1-A01FSH-1 EAKAGE. NASA COVERED ONE FMEA, AND SINCE TI	THE EXTERNAL		

ASSESSMI ASSESSMI NASA FMI	ent ent ea	D. #:	ATE: D:	2/ PR M4	2/17/88 NASA DATA PRSD-264 BASELINE M4-1B2-LV031-1 NEW									[
SUBSYSTE MDAC ID:	EM:			EP	PG .							oss	SOVE	R VA	LV:	E :	(1)	L	V041		
LEAD ANA	\LY	ST	:	в.	E.	A	ME	s													
ASSESSMENT:																					
	CR		ICAL LIGH				R	EDU	NDAI	10	Y	SC	REEN	s				CIL ITEM			
			W/FU				A				В			С			4.	LEF	1		
NASA IOA			/1R /1R			[P P]			F P]	[[P P]		[X]	*	
COMPARE	[N	/	j		[]	1		N]	[]		[N]		
RECOMMEN	IDA	TI	ons:		(If	d.	if:	fer	ent	f	ro	om 1	NASA)							
·	[3	1.]		[]		•	P]	[]	(Al		D / DE		ETE))
* CIL RE	TE	NT	ION 1	RAT:	ION	AL	Е:	(I	f ap	qo	1 i	cal	ole)	ΔΙ	FOIL	ATE	[1		
REMARKS:													I			ATE		X]		
ALSO NAS		FM	EA'S	04	-1B	-T.	vo:	31-	1 AN	ın) N	14-	1B1-	T.V(31-	1 _					
THE FAIL																	I	נ ב	ſS	-	-
RECOMMEN																					IF
THE TANK	(2	R	ELIE:	F V	ALV	E Z	ANI	D M	ANII	0	L	2	REL	IEI	VA]	LVE I	:A]				
ALL REAC																				INC	
			LEA																		
AN ADDIT																		h.	A	LRE	EADY
DEFINES																					
PASSED F																					۱W
REMOVAL																					, 41

RATIONALE IS NOT AVAILABLE.

ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-265 NASA FMEA #: M4-1B2-LV031-2 NASA FMEA #: M4-1B2-LV031-2 NASA FMEA #: NASA DATA: BASELINE [] NEW [X]
SUBSYSTEM: EPG MDAC ID: 265 ITEM: H2 MANIFOLD 2 SOLENOID CROSSOVER VALVE (1) LV041
LEAD ANALYST: B. E. AMES
ASSESSMENT:
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM
HDW/FUNC A B C
NASA [3 /1R] [P] [P] [P] [X] * IOA [3 /2R] [P] [P] [P] []
COMPARE [/N] [] [] [N]
RECOMMENDATIONS: (If different from NASA)
[/] [] [] (ADD/DELETE)
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []
REMARKS: ALSO NASA FMEA'S 04-1B-LV031-2 AND M4-1B1-LV031-2. FOR 04-1B-LV031-2 NASA'S CRITICALITY FLIGHT HDW/FUNC: 2/1R. THE FAILURE MODE IS FAILS CLOSED. THE VALVE IS USED FOR LEAK ISOLATION AND AS A REDUNDANT PRESSURE RELIEF PATH. FOR A TWO TANK SET SYSTEM, THE HARDWARE CRITICALITY WOULD BE A 2 DURING ASCENT BECAUSE TWO FUEL CELLS COULD BE LOST IF THE TANK 1 RELIEF VALVE FAILED OPEN. THE HARDWARE CRITICALITY SHOULD BE A 3 FOR GREATER THAN TWO TANK SETS, BECAUSE AN EXPLOSION COULD OCCUR
IF A TANK'S RELIEF VALVE FAILS CLOSED AND HEATERS FAIL ON. THIS

DELETED.

DOES NOT MEET THE CRITERIA TO BE A CIL ITEM, AND SHOULD BE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-266 M4-1B2-A01FS	SH-1	NASA DATA: BASELINE [] NEW [X]							
SUBSYSTEM: MDAC ID:	EPG 266	2 SOLENOID C	ROSSOVER VAL	VE (1) LV041						
LEAD ANALYST:	B. E. AMES	f.e.								
ASSESSMENT:										
FLIGHT	<u>r</u>	UNDANCY SCREEN		CIL ITEM						
HDW/FU	IC A	В	C							
NASA [1 /1 IOA [1 /1] [NA]] [NA]	[NA] [NA]	[NA] [NA]	[X] * [X]						
COMPARE [/] []	[] [[]	[]						
RECOMMENDATIONS:	(If differ	rent from NASA	A)							
[,/.] []	[] [[] (AD:	[] D/DELETE)						
* CIL RETENTION I	RATIONALE: (1	If applicable))							
]	ADEQUATE INADEQUATE	[X] []						
REMARKS:	04 10 101			-						
ALSO NASA FMEA'S THE FAILURE MODE	04-1B-A01FSI	H-1 AND M4-1B]	1-A01FSH-1.	HE EYPEDNAT.						
LEAKAGE OF MOST OF THE SAME, IT IS	COMPONENTS IN									
	<u></u>									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-267 M4-1B2-LV045-1	NASA DATA: BASELINE [] NEW [X]						
MDAC ID:	267	SUPPLY VALVE (1) L	.V045					
LEAD ANALYST:	B. E. AMES							
ASSESSMENT:								
CRITICAL FLIGH	ITY REDUNDAI	NCY SCREENS	CIL ITEM					
	NC A	В С	11211					
NASA [2 /1R IOA [2 /1R] [P]] [P]	[F] [P] [F] [P]	[X] * [X]					
COMPARE [/] []	[] []	[]					
RECOMMENDATIONS:	(If different	from NASA)						
] []	[P] [] ([D] ADD/DELETE)					
* CIL RETENTION	RATIONALE: (If a	pplicable) ADEQUATE						
REMARKS:	e per de la companya	INADEQUATE						
ALSO NASA FMEA'S		ND M4-1B1-LV045-1. R INTERNAL LEAKAGE.						
CRITICALITY SHOU	LD BE A 3. THE	RETENTION RATIONALE	IS NOT					
2.3.5.a. BECAUSE	THERE IS A VALV	ASSED PER NSTS 2220 E POSITION INDICATO DELETED FROM THE CI	R. PASSING					
SCREEN D WOULD A	LLOW TRIS TO BE	DELETED FROM THE CI	.ш•					

ASSESSMENT DATE: 2/17/88 ASSESSMENT ID: PRSD-268 NASA FMEA #: M4-1B2-LV045-2									NASA DATA: BASELINE [] NEW [X]							
SUBSYSTE MDAC ID:								E 5	SUPPL	Y VA	LVE	(1) LV	7045			
LEAD ANALYST: B. E. AMES																
ASSESSME	ENT:	:														
FLIGHT						REDUNDANCY SCREENS							CIL ITEM			
	F	IDV	V/FU	NC			A		-	В		C				
NASA IOA	[3 3	/3 /3]		[NA]	æ]	NA] NA]	[NA]		[[]	*
COMPARE	[/]		[]		[]	[]		[]	
RECOMMEN	radı	ric	ons:		(If	d:	iffe	rent	: 1	from 1	NASA)				
	ľ		/]		[]		[]	[]	(A	[\DD/I] DELE	ETE)
* CIL RI		(T)	ON	RAT	IONZ	LI	E: (If a	pp	plical	·		QUATE QUATE]	
ALSO NAS	REMARKS: ALSO NASA FMEA'S 04-1B-LV045-2 AND M4-1B1-LV045-2. THE FAILURE MODE IS FAILS CLOSED.															

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-26	9		NASA DATA BASELINE NEW	
	EPG 269 H2 SOLE	NOID GSE	SUPPLY VA	LVE (1) LV	045
LEAD ANALYST:	B. E. A	MES			
ASSESSMENT:					
CRITICAL: FLIGHT	CIL				
HDW/FU		A	В	c	. LIEM
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] [NA] NA]	[X] * [X]
COMPARE [/) [] [] [1	[]
RECOMMENDATIONS:	(If d	ifferent	from NASA)	
[/] [] [ז נ] (A	[DD/DELETE)
* CIL RETENTION 1	RATIONAL	E: (If ap	7	ADEQUATE NADEQUATE	
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE LEAKAGE OF MOST OF THE SAME, IT IS	IS EXTE	RNAL LEAK TS IN ONE	AGE. NAS	A COVERED	THE EXTERNAL

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-270]	ASA DATA: BASELINE [] NEW [X]
	EPG 270 H2 FILL GSE SU	PPLY T-0 QUIC	K DISCONNECT (1)
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL FLIGH HDW/FU	T	ANCY SCREENS B C	CIL
NASA [2 /1R IOA [2 /1R] [P]] [P]	[F] [P [P] [X] *
COMPARE [/] []	[] [] []
RECOMMENDATIONS:	(If differen	t from NASA)	- एक वर्त्व में १००० व
[/] []	[] [] [] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If	Al	DEQUATE [] DEQUATE [X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE IS FAILS OPEN. RETENTION RATION	IS EXTERNAL LE THE HARDWARE CR	AND M4-1B1-PD0 AKAGE. THE NA ITICALITY SHOU	035-1. ASA FMEA FAILURE MODE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		l	NASA DATA BASELINE NEW	[]
	271	GSE SUPPLY T	-o Quick discon	NECT (1)
LEAD ANALYST:	B. E. AM			49.1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.
ASSESSMENT:				
FLIGH	T	REDUNDANCY SO	CREENS C	CIL ITEM
•			-	[] *
NASA [/ IOA [3 /3	; [NA] [NA]	[NA]	
COMPARE [N /N] [и] [и]	[N]	[]
RECOMMENDATIONS:	(If di	ifferent from	NASA)	ti it i
[3 /3) (NA] [NA]	[NA]	[] .DD/DELETE)
* CIL RETENTION	RATIONALE	E: (If application	ADEQUATE	[]
REMARKS:			INADEQUATE	į
NASA DOES NOT HA MATE/DEMATE) FOR TO CONSIDER WRIT	THIS COM	APONENT. FOR	COMPLETENESS,	ILITY TO NASA MAY WANT

ASSESSMENT ID: NASA FMEA #:	DDSD-272	010-1		LINE [] NEW [X]	
SUBSYSTEM: MDAC ID: ITEM:	EPG 272 02 CHECK V	VALVE (1)	CV010		
LEAD ANALYST:	B. E. AMES	3			
ASSESSMENT:					
CRITICAL FLIGH		EDUNDANCY	SCREENS	CIL ITEM	
HDW/FU	_	В	С	11154	
NASA [2 /1R IOA [2 /1R] [P] [P] [P] [F] [P]] [P]	[x]	*
COMPARE [/] [] [N] []	[N]	
RECOMMENDATIONS:	(If diff	ferent fro	om NASA)		
[/.] []. [] []	[] (ADD/DELE	TE)
* CIL RETENTION	RATIONALE:	(If appli	•	ATE []	
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE CRITICALITY SHOU	IS FAILS O		4-1B1-CV010-	1.	RDWARE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-27 M4-1B2-	3 •CV010-2	N	ASA DATA BASELINE NEW	
SUBSYSTEM:	EPG 273	K VALVE (
LEAD ANALYST:	B. E. A	MES			
ASSESSMENT:					
CRITICAL FLIGH		REDUNDAN	CY SCREENS		CIL ITEM
HDW/FU		A	В . С		
NASA [2 /1R IOA [3 /1R] [P] [P] [P] [P P]]	[X] *
COMPARE [N /] [] [] []	[N]
RECOMMENDATIONS:	(If d	ifferent	from NASA)		
[/	J . (] [] [] (AI	[] DD/DELETE)
* CIL RETENTION	RATIONAL	E: (If ap			_
en e	ty filatoria Personalista			DEQUATE DEQUATE	
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE HARDWARE CRITICA VALVE ALSO FAILE CONDUCTIVE HEAT RATIONALE IS NOT	IS FAIL LITY IS D CLOSED TRANSFER	S CLOSED A 2 BECAU), AN EXPL INTO THE	OR RESTRICT SE IF THE S OSION COULD	ED FLOW. AME TANK OCCUR DO	S RELIEF JE TO

ASSESSMEI ASSESSMEI NASA FME	NT DA NT II A #:	ATE: D:	2/17 PRSD M4-1	/88)-274 .B2-2	4 A01FS) - 1				DATA: LINE NEW	[
SUBSYSTEM MDAC ID:	M:		EPG 274		X VAL								
LEAD ANA	LYST	:	в. Е	. Al	MES								
ASSESSME	NT:				•								
(ICAL: LIGH	ITY r		REDU	IDANC	Y SCI	REENS	5		CII ITI		
			NC		A	•	В		С			J	
NASA IOA	[1	/1 /1]	[NA] NA]	[NA] NA]	[NA] NA]		[]	х ј х ј	*
COMPARE	[/]	[]	[]	[] .		[]	
RECOMMEN	DATI	ons:	(I	f d	iffere	ent f	rom l	NASA)					
	[/]	[1.	.[]	[,]) DEL	ETE)
* CIL RE	rent:	ION 1	RATIO	NALI	E: (I1	app	lical		ADEQU IADEOU	IATE IATE	[]	K]	
REMARKS: ALSO NASA THE FAILA LEAKAGE O THE SAME	URE I	MODE OST (IS E	XTEI NENT	RNAL I	LEAKA	GE.	-1B1- NASA	A01FS	0-1. RED T	HE	EX	TERNAL

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-275 M4-1B2-LV015-1	NASA DATA: BASELINE [] NEW [X]
MDAC ID:	EPG 275 02 SOLENOID GSE SUPPLY VA	LVE (1) LV015
LEAD ANALYST:	B. E. AMES	•
ASSESSMENT:		
CRITICAL FLIGH		S CIL ITEM
HDW/FU		C
NASA [2 /1R IOA [2 /1R		P] [X] * P] [X]
COMPARE [/] [] [] [] []
RECOMMENDATIONS:	(If different from NASA)	
] [] [P] [[D] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If applicable)	ADEQUADE ()
7777 PVG	II	ADEQUATE [] NADEQUATE [X]
THE FAILURE MODE CRITICALITY SHOU AVAILABLE SCREEN 2.3.5.a. BECAUSE	3 04-18-LV015-1 AND M4-181-1 3 IS FAILS OPEN OR INTERNAL 3 ID BE A 3. THE RETENTION 1 4 B SHOULD BE PASSED PER NS 5 THERE IS A VALVE POSITION 5 ILLOW THIS TO BE DELETED FRO	LEAKAGE. THE HARDWARE RATIONALE IS NOT IS 22206 SECTION INDICATOR. PASSING

ASSESSME ASSESSME NASA FME	NT I	D:	PRSI	276	V015-	-2			NASA I	LINE			
SUBSYSTE MDAC ID:			EPG 276 02 S	OLENG	OID G	SSE S	SUPPLY	VAI	VE (1) LV	015		
LEAD ANA	LYST	:	В. Е	. AMI	ES								
ASSESSME	NT:												
	F	LIGH	ITY T NC			IDANG	CY SCR	REENS	c ·		CII		
		•			-		_					-	
NASA IOA	[3	/3]	[]	NA J NA]	[NA] NA]	[NA]		[]	*
COMPARE	ľ	/]	[]	[]	[]		[J	
RECOMMEN	DATI	ons:	(I	f di	ffere	ent i	from N	ASA)					•
	[/]	[]	[3	[]	(· A l	[DD/I] DELE	TE)
* CIL RE	TENT	ION	RATIC	NALE:	: (If	app	olicab	•	ADEQUA				
REMARKS: ALSO NAS THE FAIL	A FM							.B1-I		2.			24

ASSESSMENT DATE ASSESSMENT ID: NASA FMEA #:	: 2/17/88 PRSD-27 M4-1B2-	7 A01FSO-1	<u>-</u>	NASA DATA BASELINE NEW	[]
SUBSYSTEM: MDAC ID: ITEM:	EPG			VALVE (1) LV	015
LEAD ANALYST:	B. E. A	MES			
ASSESSMENT:					
CRITICA FLIG	LITY HT	REDUNDA	NCY SCREI	ens	CIL ITEM
HDW/F	UNC			C	
NASA [1 /1 IOA [1 /1] [NA] NA]	[NA] [NA]	[NA] [NA]	[X] *
COMPARE [/] []		[]	[]
RECOMMENDATIONS	: (If d	ifferent	from NAS	SA)	
1	.] []	[]	[] (AI	[] DD/DELETE)
* CIL RETENTION	RATIONAL	E: (If a	pplicable	e) ADEQUATE INADEQUATE	[X]
REMARKS: ALSO NASA FMEA'	C 04-15-3	01550-1	3 N/D W4-11	-	ı J
THE FAILURE MOD LEAKAGE OF MOST THE SAME, IT IS	E IS EXTE	RNAL LEAD TS IN ON	KAGE. N	ASA COVERED T	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW	
SUBSYSTEM: MDAC ID: ITEM: LV012	EPG 278 02 SOLENOID ECLS	SS SYSTEM 1 SUPPLY VA	ALVE (1)
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL: FLIGHT	TY REDUNDAN	ICY SCREENS	CIL ITEM
HDW/FUI		В С	TIEM
NASA [3 /1R IOA [2 /1R] [P]] [P]	[F] [P] [P] [P]	[X] * [X]
COMPARE [N /] [] [ן וא ן	[]
RECOMMENDATIONS:	(If different	from NASA)	
[/] [] [[P] [] (AI	[D] DD/DELETE)
* CIL RETENTION I	RATIONALE: (If ag	oplicable) ADEQUATE INADEQUATE	[] [X]
THE FAILURE MODE CRITICALITY SHOUL 22206 SECTION 2.3 INDICATOR. THE 1	IS FAILS OPEN OF LD BE A 3. SCREE 3.5.a. BECAUSE TH RETENTION RATIONA	ND M4-1B1-LV012-1. R INTERNAL LEAKAGE. EN B SHOULD BE PASSED HERE IS A VALVE POSITALE IS NOT AVAILABLE. S TO BE DELETED FROM	TION

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA BASELINE NEW	
MDAC ID:	EPG 279 02 SOLENOID ECLSS	SYSTEM 1 SUPPLY V	ALVE (1)
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL FLIGH		SCREENS	CIL ITEM
HDW/FUI		3 C	11111
NASA [3 /1R IOA [2 /1R] [P] [F]	P] [P]	[x] *
COMPARE [N /	1 [1 [] []	[N]
RECOMMENDATIONS:	(If different fr	com NASA)	
[/	1 [] [] [] (A)	[DD/DELETE)
* CIL RETENTION	RATIONALE: (If appl	licable) ADEQUATE INADEQUATE	[]
THE FAILURE MODE HARDWARE CRITICAL	04-1B-LV012-2 AND IS FAILS CLOSED. LITY IS A 3. THE C	M4-1B1-LV012-2. THE IOA AGREES THE CREW HAS ENOUGH OX	AT THE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-280 M4-1B2-A01F	°S0-1	NASA DATA: BASELINE NEW	
SUBSYSTEM: MDAC ID: ITEM: LV012	EPG 280 02 SOLENOID	ECLSS SYSTEM	1 SUPPLY VA	ALVE (1)
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
FLIGH		DUNDANCY SCREEN B	c ·	CIL ITEM
NASA [1 /1 IOA [1 /1] [NA]	[NA] [[NA] [NA] NA]	[X] *
COMPARE [/] []] [] [1	[]
RECOMMENDATIONS:	(If diffe	erent from NASA)	
[/ ·], []] (AI	[DD/DELETE)
* CIL RETENTION	RATIONALE: (ADEQUATE NADEQUATE	[X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE LEAKAGE OF MOST THE SAME, IT IS	IS EXTERNAI COMPONENTS I	L LEAKAGE. NAS	A COVERED T	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-281 M4-1B2-LV012-1	2/17/88 NASA DATA: PRSD-281 BASELINE M4-1B2-LV012-1 NEW						
	281							
LEAD ANALYST: B. E. AMES								
ASSESSMENT:								
FLIGH			CIL ITEM					
HDW/FU	NC A E	B C						
NASA [3 /1R IOA [2 /1R] [P] [F]	?] [P] P] [P]	[X] * [X]					
COMPARE [N /] [] [%	4] []	[]					
RECOMMENDATIONS:	(If different fr	rom NASA)						
[/] [] [•	?] [] (Ai	[D] DD/DELETE)					
* CIL RETENTION	RATIONALE: (If appl	ADEQUATE	[] [x]					
INADEQUATE [X] REMARKS: ALSO NASA FMEA'S 04-1B-LV012-1 AND M4-1B1-LV012. THE FAILURE MODE IS FAILS OPEN OR INTERNAL LEAKAGE. THE HARDWARE CRITICALITY SHOULD BE A 3. SCREEN B SHOULD BE PASSED PER NSTS 22206 SECTION 2.3.5.a. BECAUSE THERE IS A VALVE POSITION INDICATOR. THE RETENTION RATIONALE IS NOT AVAILABLE. PASSING SCREEN B WOULD ALLOW THIS TO BE DELETED FROM THE CIL.								

ASSESSME ASSESSME NASA FME	ENT ENT EA #	DAT ID:	E:	2/: PR: M4	17/8 SD-2 -1B2	8 82 -I	'AC)12·	-2						ASA DA BASEL		[-	1
SUBSYSTE MDAC ID: ITEM: LV022				EP0 28: 02	2	EN	IOI	D 1	ECL	SS	5 5	SYS'	TEM :	2 8	SUPPL	y v	λL/	Æ	(1)
LEAD ANA	LYS	T:		в.	E.	AM	ŒS	3												
ASSESSME	ENT:																			
		TIC FLI DW/	GHT				RE A	DUI	NDA	NC	CY B	SC	REENS	s C				[L [EN		
NASA IOA	[3 /	1R 1R]]	P P]		[[P P]	[P P]		[x]	*
COMPARE	[N /]		[1		[]	[]		[N]	
RECOMMEN	IDAT	ION	s:		(If	di	.ff	er	ent	1	fro	om 1	NASA)).						
	[/]		[]		[]	[]	(AI		/DI] ELE'	TE)
* CIL RE	ETEN	TIO	N F	RAT:	IONA	LE	:	(I:	f a	pį) 1:	[ca]	ble)	Al	DEQUA'	ГE	[1	
DEMARKS.													Il		DEQUA		į		j	
REMARKS: ALSO NAS THE FAII HARDWARE CABIN FO	EA F LURE E CR	MO ITI	DE CAI	IS IT	FAI Y IS	LS	3	LO:	SED TH	E	CI	CHE SEW	IOA	A	012-2 GREES NOUGH	THA	T	TH	ΙE	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #: SUBSYSTEM:	2/17/88 PRSD-28 M4-1B2-	3 A01FSO-1	NASA DATA: BASELINE NEW			
MDAC ID:	283	NOID ECLSS SYSTEM	2 SUPPLY VA	LVE (1)		
LEAD ANALYST:	B. E. A	MES				
ASSESSMENT:						
FLIGH	T	REDUNDANCY SCREEN		CIL ITEM		
·	INC		С			
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] [NA] [NA] NA]	[X] * [X]		
COMPARE [/] [] [] []	[]		
RECOMMENDATIONS:	(If d	ifferent from NASA)			
	.] [] [] [] (AD	[] D/DELETE)		
* CIL RETENTION	RATIONAL	E: (Îf applicable) T	ADEQUATE NADEQUATE	[X]		
THE FAILURE MODE	E IS EXTE	01FSO-1 AND M4-1B1 RNAL LEAKAGE. NAS TS IN ONE FMEA, AN	-A01FSO-1. A COVERED T	HE EXTERNAL		

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-284 M4-1B2-1	4 PD015-1		NASA DATA BASELINI NEV	
MDAC ID:	EPG 284 02 FILL	GSE SUI	PPLY T-0	QUICK DISCOR	NNECT (1)
LEAD ANALYST:	B. E. AM	MES			
ASSESSMENT:					
CRITICAL: FLIGHT	r		ANCY SCRI		CIL ITEM
HDW/FU	NC	A	В	С	
NASA [2 /1R IOA [2 /1R] [P] P]	[F] [F]	[P] [P]	[X] * [X]
COMPARE [/] [1	[]	[]	[]
RECOMMENDATIONS:	(If di	ifferent	t from NA	ASA)	
[/] []	[]	[]	ADD/DELETE)
* CIL RETENTION I	RATIONALE	E: (If a	applicabl	Le) ADEQUATE	r 1
				INADEQUATE	• •
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE SHOULD BE A 3.	IS EXTER	RNAL LEA	AKAGE. 1	31-PD015-1. THE HARDWARE IS NOT AVAII	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-28	5		NASA DATA BASELINE NEW	[]				
MDAC ID:	EPG 285 02 FILI	. GSE SUPP	PLY T-O QU	ICK DISCON	NECT	(1)				
LEAD ANALYST:	B. E. A	MES				-				
ASSESSMENT:										
FLIGH			CY SCREEN	s c	CIL	м				
NASA [/ IOA [3 /3] [] [AN] [NA] [] NA]	[] *				
COMPARE [N /N] [и] [и	и ј [и]	[]				
RECOMMENDATIONS:	· (If d	lifferent	from NASA	·,						
[3 /3] [NA] [NA] [NA]	[DD/D1	·] ELETE)				
* CIL RETENTION	RATIONAL	E: (If ap	plicable)							
	ere de les		I	ADEQUATE NADEQUATE]				
REMARKS: NASA DOES NOT HAVE A FMEA ON THIS FAILURE MODE (INABILITY TO MATE/DEMATE). FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.										

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	5565	2/17/88 NASA DATA: PRSD-286 BASELINE 14-1B2-MT012-1 NEW							
MDAC ID:	EPG 286 02 MANIFOLD	PRESSURE SENSOR (2)							
LEAD ANALYST:	B. E. AMES								
ASSESSMENT:									
CRITICALI FLIGHT	CIL ITEM								
HDW/FUN		в с	TIEM						
NASA [3 /3 IOA [3 /3] [NA]] [NA]	[NA] [NA] [NA] [NA]	[] *						
COMPARE [/] []	[] []	[]						
RECOMMENDATIONS:	(If differe	ent from NASA)							
. [/] []	[] [] .	[] (ADD/DELETE)						
* CIL RETENTION F	RATIONALE: (I	f applicable) ADEQUA INADEQUA							
REMARKS: ALSO NASA FMEA'S 04-1B-MT012-1 AND M4-1B1-MT012-1. THE IOA FAILURE MODE IS FULL OUTPUT. THE NASA FMEA FAILURE MODE IS LOSS OF OUTPUT OR ERRONEOUS SIGNAL.									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-287								
MDAC ID:	EPG 287 02 MANIFOLI	PRESSURE S	ENSOR (2)						
LEAD ANALYST: B. E. AMES									
ASSESSMENT:		,							
CRITICAI FLIGH	CIL								
HDW/FU		В	· . C						
NASA [3 /3 IOA [3 /3] [NA]	[NA] [NA]	[NA] [NA]	[] *					
COMPARE [/] []	[]	[]	[]					
RECOMMENDATIONS:	(If diffe	erent from N	IASA)						
	j []	[]	[] (A	[] ADD/DELETE)					
* CIL RETENTION	RATIONALE:	(If applicab	ole) ADEQUATE INADEQUATE						
REMARKS: ALSO NASA FMEA'S 04-1B-MT012-1 AND M4-1B1-MT012-1. THE IOA FAILURE MODE IS ZERO OUTPUT. THE NASA FMEA FAILURE MODE IS LOSS OF OUTPUT OR ERRONEOUS SIGNAL.									

ASSESSMENT DATE ASSESSMENT ID: NASA FMEA #:	: 2/17/88 PRSD-288 M4-1B2-MT012-	2/17/88 NASA DATA: PRSD-288 BASELINE M4-1B2-MT012-1 NEW							
SUBSYSTEM: MDAC ID: ITEM:	EPG 288 02 MANIFOLD P	 -							
LEAD ANALYST:	B. E. AMES	. E. AMES							
ASSESSMENT:									
FLIC	LITY REDUN HT UNC A		CIL ITEM						
NASA [3 /3 IOA [3 /3] [NA]] [NA]	[NA] [NA] [NA] [NA]	[] *						
COMPARE [/] []	[] []	[]						
RECOMMENDATIONS	: (If differe	nt from NASA)							
[/] _ []		[] (ADD/DELETE)						
	RATIONALE: (If	applicable) ADEQUAT INADEQUAT	E [] E []						
REMARKS: ALSO NASA FMEA'S 04-1B-MT012-1 AND M4-1B1-MT012-1. THE IOA FAILURE MODE IS OUT OF TOLERANCE. THE NASA FMEA FAILURE MODE IS LOSS OF OUTPUT OR ERRONEOUS SIGNAL.									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			: [] [x]						
SUBSYSTEM: MDAC ID: ITEM: (1) LV013	EPG 289 02 FUEL	CELL 1 SOLENOID	PPLY VALVE						
LEAD ANALYST:	B. E. A	MES							
ASSESSMENT:									
CRITICAL FLIGH		REDUNDANCY SCRE	ENS	CIL ITEM					
HDW/FU		A B	C	TIEN					
NASA [2 /1R IOA [2 /1R] [P] [F] P] [P]	[P] [P]	[X] * [X]					
COMPARE [/] [] [N]	[]	[]					
RECOMMENDATIONS:	(If d	ifferent from NA	SA)						
] . [] [Þ]	(A)	[] DD/DELETE)					
* CIL RETENTION	RATIONAL	E: (If applicabl	e) ADEQUATE INADEQUATE						
REMARKS: ALSO NASA FMEA'S 04-1B-LV013-1 AND M4-1B1-LV013-1. THE FAILURE MODE IS FAILS OPEN OR INTERNAL LEAKAGE. SCREEN B SHOULD BE PASSED PER NSTS 22206 SECTION 2.3.5.a. BECAUSE THERE IS A VALVE POSITION INDICATOR. THE CIL RETENTION RATIONALE IS NOT AVAILABLE.									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-290 M4-1B2-LV013	; -2	NASA DATA: BASELINE NEW	
SUBSYSTEM: MDAC ID:	EPG 290	. 1 SOLENOID RI	EACTANT SUI	PLY VALVE
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
CRITICAL FLIGH HDW/FU	r	INDANCY SCREENS B	Б С	CIL ITEM
NASA [2 /1R IOA [2 /1R] [P]	[P] [[P] [P] P]	[X] *
COMPARE [/] []	[] []	[]
RECOMMENDATIONS:	(If differ	ent from NASA)	
[./] []	[] [] (AI	[DD/DELETE)
* CIL RETENTION	RATIONALE: (I		ADEQUATE NADEQUATE	[X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE 2/1R FOR THE ONO	IS FAILS CLO RBIT PHASE AI	SED. THE CRIT SO BECAUSE LOS	TICALITY SH	

ASSESSME ASSESSME NASA FME	NT I NT I A #:	DATE:	2/1 PRS M4-	17/88 5D-29 -1B2-	1 A 0	1FSO-	·1				NASA D BASEL	DATA: LINE [] NEW [X]				
SUBSYSTE MDAC ID: ITEM: (1) LV01			291	91 2 FUEL CELL 1 SOLENOID REACTANT SUF							PPI	Ľ¥	VA	LVE		
LEAD ANA	LYSI	:	в.	E. A	ME	5										
ASSESSME	NT:			_ 2		-						ž				
CRITICALITY FLIGHT HDW/FUNC														CIL ITEM		
	HI)W/FU	NC		A			В			С					
NASA IOA	[]	/1]]	NZ NZ	A] A]	[NA NA	A] A]	[NA] NA]		[X X]	*
COMPARE	[/)	[)	[]	[]		[}	
RECOMMEN	DAT]	ONS:	((If d	if	feren	it	fro	om NA	SA)					
	[/)	Ĺ]	[]	[]] ELE	TE)
* CIL RE	TENT	NOI	RATI	ONAL	Æ:	(If	ap	pli	icabl		ADEQUA NADEQUA	TE TE	[X]	
REMARKS: ALSO NAS THE FAIL LEAKAGE THE SAME	A FN URE OF N	Mode Most	IS COME	EXTE PONEN	RN. TS	AL LE	AK	AGI	E. N	B1 AS	-A01FSO A COVER	-1 ED '	rhi	E E	EXT	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-292 M4-1B2-L	: .V011-1		NASA DATA: BASELINE [] NEW [X]			
SUBSYSTEM: MDAC ID: ITEM:	EPG 292 02 MANIF	OLD 1 SOI	LENOID CRO	SSOVER VA	LVE (1) LV011		
LEAD ANALYST:	B. E. AM	ŒS					
ASSESSMENT:							
CRITICAL FLIGH	CRITICALITY REDUNDANCY SCREENS						
HDW/FU	_	A	B	C	ITEM		
NASA [2 /1R IOA [3 /1R] [P] [P] [F] [P] [P] P]	[X] *		
COMPARE [N /] [) [и] [1	[N]		
RECOMMENDATIONS:	(If di	fferent i	from NASA)				
[3 /.] [] [P] [[D] DD/DELETE)		
* CIL RETENTION	RATIONALE	: (If app	•	ADEQUATE ADEQUATE			
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE RECOMMENDED THAT THE TANK 1 RELIE ALL REACTANT COU THE LEAK BY CLOS 3, AND ECLSS SYS IS NOT INCLUDED SECTION 2.3.3.h SCREEN B SHOULD THE FAILURE IS D	IS FAILS THE HARD F VALVE A LD BE DEP ING LV021 TEM 1. E AS AN ADD ALREADY D BE PASSED	OPEN OR WARE CRITAND MANIFO PLETED OUT WOULD ST EXTERNAL IN OUTIONAL R OFFINES TH	INTERNAL FICALITY B OLD 1 RELI FITHE RELI FILL SHUTD LEAKAGE OF FAILURE BE HIS AS A C 5 22206 SE	LEAKAGE. BE CHANGED EF VALVE EF PORT. OWN FUEL CLINES AND CAUSE NST: CRITICALITY ECTION 2.3	TO A 3. IF FAILED OPEN, ISOLATING CELLS 1 AND D COMPONENTS S 22206 Y 1/15.a. BECAUSE		

THIS WOULD ALLOW REMOVAL OF THIS FAILURE MODE FROM THE CIL. THE

RETENTION RATIONALE IS NOT AVAILABLE.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-293 M4-1B2-LV0	011-2	NASA DATA BASELINE NEW	
MDAC ID:	EPG 293 02 MANIFOL	LD 1 SOLENOID C	ROSSOVER VAI	LVE (1) LV011
LEAD ANALYST:	B. E. AMES	3		-
ASSESSMENT:				
CRITICAL FLIGH		EDUNDANCY SCREE	ens	CIL ITEM
HDW/FU		В	С	IIEM
NASA [3 /1R IOA [3 /2R	[P] [P]] [P]	[P] [P]	[X] *
COMPARE [/N] [] []	[]	[N]
RECOMMENDATIONS:	(If diff	ferent from NAS	(A)	
] [] []	[] (AI	[] OD/DELETE)
* CIL RETENTION REMARKS:	RATIONALE:	,	ADEQUATE	[X]
ALSO NASA FMEA'S LV031-2 NASA'S C FAILURE MODE IS	RITICALITY FAILS CLOSE	FLIGHT HDW/FUNED. THE VALVE	C: 2/1R. THE IS USED FOR	HE LEAK

ALSO NASA FMEA'S 04-1B-LV011-2 AND M4-1B1-LV011-2. FOR 04-1B-LV031-2 NASA'S CRITICALITY FLIGHT HDW/FUNC: 2/1R. THE FAILURE MODE IS FAILS CLOSED. THE VALVE IS USED FOR LEAK ISOLATION AND AS A REDUNDANT PRESSURE RELIEF PATH. FOR A TWO TANK SET SYSTEM, THE HARDWARE CRITICALITY WOULD BE A 2 DURING ASCENT BECAUSE TWO FUEL CELLS COULD BE LOST IF THE TANK 2 RELIEF VALVE FAILED OPEN. THE HARDWARE CRITICALITY SHOULD BE A 3 FOR GREATER THAN TWO TANK SETS, BECAUSE AN EXPLOSION COULD OCCUR IF A TANK'S RELIEF VALVE FAILS CLOSED AND HEATERS FAIL ON. THIS DOES NOT MEET THE CRITERIA TO BE A CIL ITEM, AND SHOULD BE DELETED.

ASSESSME ASSESSME NASA FME	NT NT A #	DATE: ID:	2/17 PRSD M4-1	/88 -29 .B2-2	4 A01FSC	0-1			NASA I BASEI		[
SUBSYSTE MDAC ID: ITEM:			EPG 294 02 M	(ANI	FOLD 1	ı soı	ENOIL) CR	OSSOVEI	R VAI	LVE	(1)	LV011
LEAD ANA	LYS	r:	в. Е	. A	MES								
ASSESSME	NT:												
		TICAL FLIGH			REDU	NDANC	CY SCR	REEN	5		CIL		
	_		NC		A		В		С				
NASA IOA	[]	1 /1 1 /1]	[NA] NA]	[NA] NA]	[NA] NA]		[X]	*
COMPARE	[/]	(]	(]	[1		[]	
RECOMMEN	DAT:	ions:	(I	f d	iffere	ent f	rom N	IASA)			-	
	[/	1	[]	(]	[] .	(AI	[DD/D		ETE)
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X]													
INADEQUATE [] REMARKS: ALSO NASA FMEA'S 04-1B-A01FSO-1 AND M4-1B1-A01FSO-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME IT IS AGREEABLE.													

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE [] NEW [X]
	EPG 295 02 MANIFOLD 2 SOLENOID CRO	SSOVER VALVE (1) LV021
LEAD ANALYST:	B. E. AMES	
ASSESSMENT:		
	TTY REDUNDANCY SCREENS	CIL ITEM
FLIGHT HDW/FUN		C
NASA [2 /1R IOA [3 /1R] [P] [F] [] [P] [P] [X] * P]
COMPARE [N /] [N][] [N]
RECOMMENDATIONS:	(If different from NASA)	
[3 /] [] [P] [] [D] (ADD/DELETE)
* CIL RETENTION R		ADEQUATE [] IADEQUATE [X]
ALSO NASA FMEA'S THE FAILURE MODE RECOMMENDED THAT THE TANK 2 RELIEF ALL REACTANT COUL THE LEAK BY CLOSI 3, AND ECLSS SYST IS NOT INCLUDED A SECTION 2.3.3.h. 1/1. SCREEN B SH BECAUSE THE FAILU	04-1B-LV011-1 AND M4-1B1-L IS FAILS OPEN OR INTERNAL THE HARDWARE CRITICALITY E VALVE AND MANIFOLD 2 RELI ING LV011 WOULD STILL SHUTE TEM 2. EXTERNAL LEAKAGE OF AS AN ADDITIONAL FAILURE BE ALREADY DEFINES THIS AS A HOULD BE PASSED PER NSTS 22 JRE IS DETECTABLE WITH THE WOULD ALLOW REMOVAL OF THI	LEAKAGE. IT IS BE CHANGED TO A 3. IF EF VALVE FAILED OPEN, EF PORT. ISOLATING OWN FUEL CELLS 2 AND LINES AND COMPONENTS CAUSE NSTS 22206 CRITICALITY 206 SECTION 2.3.5.a. VALVE POSITION

THE CIL. THE RETENTION RATIONALE IS NOT AVAILABLE.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-296 M4-1B2-L	5 LV011-2	N	IASA DATA: BASELINE NEW	[x]		
SUBSYSTEM:	EPG				LVE (1) LV02		
LEAD ANALYST:	B. E. AM	MES .					
ASSESSMENT:							
		REDUNDANC	SCREENS		CIL ITEM		
FLIGH HDW/FU	nc Nc	A 1	3 0		TTEM		
NASA [3 /1R IOA [3 /2R] [P] []	?] [F	,]	[X] *		
COMPARE [/N] [] [] []	[N]		
RECOMMENDATIONS:	•		·	_			
[/] [] [J [J (AD	[] DD/DELETE)		
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []							
REMARKS: ALSO NASA FMEA'S	04-1B-LV	7011-2 AND	M4-1B1-LV	'011-2. F	OR 04-1B-		
LV031-2 NASA'S C THE FAILURE MODE	IS FAILS	CLOSED.	THE VALVE	IS USED	FOR LEAK		
ISOLATION AND AS	A REDUND	DANT PRESSI	JRE RELIEF	'PATH. F	FOR A TWO		
ASCENT BECAUSE T							
RELIEF VALVE FAI							
FOR GREATER THAN IF A TANK'S RELI	TWO TANK EF VALVE	FAILS CLOS	SED AND HE	ATERS FAI	L ON. THIS		
DOES NOT MEET TH	E CRITERI	TA TO BE A	CIL ITEM,	AND SHOU	JLD BE		
DELETED.		E 100 % 10 10 E 10 E 10 F 10 F 10 F 10 F 10 F 1		*			

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-297	NASA DATA BASELINI NET	
MDAC ID:	EPG 297 02 MANIFOLD 2 S	OLENOID CROSSOVER V	ALVE (1) LV021
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL: FLIGH HDW/FU	r	NCY SCREENS B C	CIL ITEM
•] [NA]] [NA]	[NA] [NA] [NA] [NA]	[X] *
COMPARE [/] []	[] []	
RECOMMENDATIONS:	(If different	from NASA)	er tegera vær
ι /	1 . [1	[] [] ([] ADD/DELETE)
* CIL RETENTION	RATIONALE: (If a	pplicable) ADEQUATE INADEQUATE	
THE FAILURE MODE	IS EXTERNAL LEA COMPONENTS IN ON	AND M4-1B1-A01FSO-1 KAGE. NASA COVERED E FMEA, AND SINCE T	THE EXTERNAL

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-298		NASA DATA: BASELINE NEW				
MDAC ID:	EPG 298 02 HORIZONT	TAL DRAIN QD (1)					
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:							
CRITICAL: FLIGHT		DUNDANCY SCREENS		CIL ITEM			
HDW/FUI		В	C				
NASA [2 /1R IOA [2 /1R] [P]] [F] [] [F] [P] P]	[X] * [X]			
COMPARE [/	1 []] [] []	[]			
RECOMMENDATIONS:	(If diffe	erent from NASA)		•			
[/ · .] [:] [] [] (AD	DD/DELETE)			
* CIL RETENTION 1	RATIONALE:			ra <u>.</u>			
· · · <u> · · · · · · · · · · · · · ·</u>	P		ADEQUATE ADEQUATE	[x]			
	REMARKS: ALSO NASA FMEA'S 04-1B-PD025-1 AND M4-1B1-PD025-1.						
THE FAILURE MODE NOT AVAILABLE.	IS EXTERNAL	L LEAKAGE. THE	RETENTION	RATIONALE IS			

ASSESSMENT DAT ASSESSMENT ID: NASA FMEA #:			NASA DATA BASELINE NEW					
SUBSYSTEM: MDAC ID: ITEM:	EPG 299 02 HORIZONTA	AL DRAIN QD (1	.)					
LEAD ANALYST:	B. E. AMES			• • · · · · · · · =				
ASSESSMENT:								
CRITIC.	ALITY REDU	UNDANCY SCREEN	is	CIL ITEM				
	TUNC A	В	С	IIEM				
NASA [/ IOA [3 /] [] 3] [NA]] []] [AN]	NA]	[] *				
COMPARE [N /	і ј [иј	ן מן	ן א					
RECOMMENDATION	: (If differ	rent from NASA	')					
[3 /] [NA]	[AN]	NA]	[DD/DELETE)				
* CIL RETENTION	RATIONALE: (If applicable)	ADEQUATE	r 1				
DEMADEC.		I	NADEQUATE					
NASA DOES NOT MATE/DEMATE) F	REMARKS: NASA DOES NOT HAVE A FMEA ON THIS FAILURE MODE (INABILITY TO MATE/DEMATE) FOR THIS COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.							

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-300 M4-1B2-1) PC010-1	1	VASA DATA: BASELINE NEW	
SUBSYSTEM: MDAC ID:	EPG 300		IN CAP (1)	l	
LEAD ANALYST:	B. E. A	ŒS			
ASSESSMENT:					
CRITICALI FLIGHT		REDUNDANC	Y SCREENS		CIL
HDW/FU		A	В	3	11111
NASA [2 /1R IOA [2 /1R] [P] [P] [F] [F F] [F	?]	[X] * [X]
COMPARE [/] [] [] []	[]
RECOMMENDATIONS:	(If di	ifferent f	rom NASA)		
[/] [`] [1, [[DD/DELETE
* CIL RETENTION I	RATIONALI	E: (If app	. A	ADEQUATE ADEQUATE	
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE ALLOWABLE LEAK RA ACCUMULATION OF C EXPLOSION. THE I	IS EXTER ATE, THIS 2 IN THE	RNAL LEAKA FAILURE CORBITER	GE. BECAU COULD RESU MID FUSELA	JSE THE QD JLT IN THE AGE AND A	: POSSIBLE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-30: M4-1B2-	1 LV013-1		NASA DATA BASELINE NEW	
MDAC ID:	301	-		EACTANT SU	PPLY VALVE
LEAD ANALYST:	B. E. A	MES			
ASSESSMENT:					
FLIGH		REDUNDAN	CY SCREENS	s C	CIL ITEM
· ·		P] [P] [F] [P] [P] P]	[X] *
COMPARE [/] [] [и] [1	[]
RECOMMENDATIONS:	(If d	ifferent	from NASA)	
[/] [] [P] [[] DD/DELETE)
* CIL RETENTION	RATIONAL	E: (If ap	•	ADEQUATE NADEQUATE	[x]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE SHOULD BE PASSED A VALVE POSITION AVAILABLE.	IS FAIL: PER NST:	S OPEN OR S 22206 S	INTERNAL ECTION 2.	LEAKAGE. 3.5.a. BEC	AUSE THERE IS

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-30 M4-1B2-	2 LV024-2	NASA DA: BASELII NI	TA: NE [] EW [X]
	302	CELL 3 SOLE	ENOID REACTANT S	SUPPLY VALVE
LEAD ANALYST:	B. E. A	MES		
ASSESSMENT:				
CRITICAL FLIGH HDW/FU	T	REDUNDANCY A B	SCREENS C	CIL ITEM
NASA [1 /1 IOA [2 /1R] [NA] [NA P] [P	NA] [NA]	[X] * [X]
COMPARE [N /N] [и ј [и] [N]	[]
RECOMMENDATIONS:	(If d	ifferent fro	om NASA)	
[/] [] [] []	[] (ADD/DELETE)
* CIL RETENTION	RATIONAL:	E: (If appli	icable) ADEQUATI INADEQUATI	
REMARKS: ALSO NASA FMEA # THE FAILURE MODE 2/1R FOR THE ONO CAUSES A PRIORIT	IS FAIL RBIT PHA	S CLOSED. T SE ALSO, BEC	THE CRITICALITY	SHOULD BE A

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-30: M4-1B2-2	3 A01FSO-1		NASA DATA BASELINE NEW	[]		
SUBSYSTEM: MDAC ID: ITEM: (1) LV024		CELL 3	SOLENOID	REACTANT SU	PPLY VALVE		
LEAD ANALYST:	B. E. Al	MES					
ASSESSMENT:							
FLIGH	ITY T NC			ens C	CIL ITEM		
NASA [1 /1 IOA [1 /1] [NA] NA]	[NA] [NA]	[NA] [NA]	[X] * [X]		
COMPARE [/] []	[]	[]	[]		
RECOMMENDATIONS:	(If d	ifferent	from NA	SA)			
[/] []	[]		DD/DELETE)		
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []							
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE LEAKAGE OF MOST THE SAME, IT IS	IS EXTE	RNAL LEAD TS IN ON	KAGE. N	B1-A01FSO-1. ASA COVERED	THE EXTERNAL		

ASSESSME ASSESSME NASA FME	NT DATE: NT ID: A #:	2/17/88 PRSD-30 M4-1B2-	4 LV013-1		NASA DATA BASELINE NEW	= -
SUBSYSTE MDAC ID: ITEM: (1) LV02	IM:	EPG 304			REACTANT SU	PPLY VALVE
LEAD ANA	LYST:	B. E. A	MES			
ASSESSME	NT:					ta a control to
	CRITICAL FLIGH		REDUNDA	NCY SCRE		CIL ITEM
***	HDW/FU	NC	A	В	C ····································	
NASA IOA	[2 /1R [2 /1R] [P] P]	[F] [P]	[P] [P]	[X] * [X]
COMPARE	[/	.] .[]	[и]	[]	[]
RECOMMEN	DATIONS:	(If d	ifferent	from NA	SA)	
	[/	. 1]	[P]	[] (A	[] DD/DELETE)
* CIL RE	TENTION	RATIONAL	E: (If a	plicabl	e)	<u>g</u> a sas
DEMARKS.					ADEQUATE INADEQUATE	[x]
REMARKS: ALSO NAS	A FMEA'S	04-1B-L	V013-1 AN	ID M4-1B	1-LV013-1	
THE FAIL	URE MODE	IS FAILS	OPEN OF	INTERN	AL LEAKAGE.	SCREEN B
					2.3.5.a. BECKENTION RATION	

AVAILABLE.

ASSESSME ASSESSME NASA FME	NT I	D:	PRSD-	305	5 LV01	.3-2	NASA BASE 2							[]	
SUBSYSTE MDAC ID: ITEM: (1) LV02			EPG 305 02 FU	EL	CEI	L 2	S	OLI	ENOID	RE	EACI	ANT	SUE	PI	ĽΥ	VA	LVE
LEAD ANA	LYST	!:	B. E.	Al	MES												
ASSESSME	NT:																
		ICAL	ITY F		REI	DUND	ANG	CY	SCRE	ENS	3				L EN		
	HD	W/FUI	NC		A	•		В			С						
NASA IOA	[2 [2	/1R /1R]	[P]]	P P]	[P] P]]	X X]	*
COMPARE	[/]	[]		[]	[]	, ·		[]	
RECOMMEN	DATI	ONS:	(If	d:	iffe	eren	t i	fro	om NA	SA)							
	[/]	[]	Ţ	[]	[]		(AI	[DD/	'DI] ELE	TE)
* CIL RE	TENT	I MOI	RATION	ALI	E: (Ίf	apı	pl:	icabl	·		EQUA' EQUA'		[x]	
REMARKS: ALSO NAS THE FAIL 2/1R FOR CAUSES A	URE THE	MODE ONO	IS FA RBIT P	IL: HA:	S CI SE <i>P</i>	LOSE ALSO	D. Bl	EC!	THE C	1-I RIT	LVOI	13-2 ALIT	Y SI	iot	JLI		

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-306 M4-1B2-A01FSO-1	NASA DATA: BASELINE [] NEW [X]					
SUBSYSTEM: MDAC ID:	EPG	REACTANT SUPPLY VALVE					
LEAD ANALYST:	B. E. AMES						
ASSESSMENT:		and the second second					
CRITICALI FLIGHT HDW/FUN	ַ <u></u>	NS CIL ITEM C					
NASA [1 /1 IOA [1 /1] [NA] [NA]] [NA] [NA]	[NA] [X] * [NA] [X]					
COMPARE [/] [] []	[] []					
RECOMMENDATIONS:	(If different from NASA	4)					
[/] [] []	[] [] (ADD/DELETE)					
* CIL RETENTION F	RATIONALE: (If applicable)	ADEQUATE [X]					
THE FAILURE MODE	04-1B-A01FSO-1 AND M4-1B: IS EXTERNAL LEAKAGE. NAS COMPONENTS IN ONE FMEA, AN	L-A01FSO-1. SA COVERED THE EXTERNAL					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-307 M4-1B2-RV011-1	: [
SUBSYSTEM: MDAC ID:	EPG 307	LIEF VALVE (1) RV01	1	
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
CRITICAL FLIGH	CIL			
	NC A	в с	ITEM	
NASA [2 /1R IOA [2 /1R] [P] [] [P]	F] [P] F] [P]	[X] [X] *	
COMPARE [/] [] [] []	[]	
RECOMMENDATIONS:	(If different	from NASA)	** 4	
[/	1 [[1 [[[D] .DD/DELETE)	
	RATIONALE: (If app	plicable) ADEQUATE INADEQUATE	[
THE FAILURE MODE RETENTION RATION SHOULD BE A 3 SC 2.3.4.b.2.a. BEC	ALE IS NOT AVAILA REEN B SHOULD BE I AUSE THE RELIEF V	R INTERNAL LEAKAGE.	CRITICALITY ECTION NOT	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-308 M4-1B2-1	8 RV011-2	NASA DATA: BASELINE NEW		
	EPG 308 O2 MANI	FOLD 1 RE	LIEF VALVE	(1) RV01:	1
LEAD ANALYST:	B. E. Al	MES			
ASSESSMENT:					
		REDUNDAN	CY SCREENS		CIL ITEM
FLIGH HDW/FU	NC	A	В	С	TIEM
NASA [3 /1R IOA [3 /1R] [P] [P] [NA] []	P] P]	[] *
COMPARE [/] [) [и ј [1	[]
RECOMMENDATIONS:	(If d	ifferent	from NASA)		
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* CIL RETENTION	RATIONAL	E: (If ap			
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REMARKS:					
ALSO NASA FMEA'S	04-1B-R	V011-2 AN	D M4-1B1-R	V011-2.	
THE FAILURE MODE					
WOULD RESULT IF					
WITH A TANK RELI	EF VALVE	FAILED C	LOSED, AND	THAT SAMI	E TANK'S
HEATERS FAILED O BURST. SCREEN B	N. THE	PINES COO	LD BE OVER! 2206 SECTIO	JM 3 3 4 1 PKE22AKIZI	LU ANU
DONOI. SCREEN D	TO NY L	TV NOTO 4	CECO DECIT	J14 E . J . 4 . Y	J. 6 . a .

BECAUSE THE RELIEF VALVE IS STANDBY REDUNDANT.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-30 M4-1B2-	9 A01FSO-1	L	NASA DATA BASELINE NEW					
MDAC ID:	EPG 309 02 MANI	FOLD 1 F	. 1						
LEAD ANALYST:	B. E. A	MES							
ASSESSMENT:									
CRITICAL FLIGH HDW/FU	T	REDUNDA	ANCY SCRE	ENS C	CIL ITEM				
nDw/ FU.	NC	A	Б	C					
NASA [1 /1 IOA [1 /1] [NA] NA]	[NA] [NA]	[NA] [NA]	[X] * [X]				
COMPARE [/] []	[]	[]	[]				
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* CIL RETENTION	RATTONAL.	E: (If a	ipplicabl	e)					
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REMARKS:				INADEQUATE	. L J				
ALSO NASA FMEA'S 04-1B-A01FSO-1 AND M4-1B1-A01FSO-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.									

ASSESSM ASSESSM NASA FM	ENT ENT EA	D: I:	ATE:	2/ PR M4	17/88 SD-310 -1B2-RV011-1											DATA ELINE NEW	[]		
SUBSYST MDAC II ITEM:	Int'l •			31	G						LVI	3 ((1)	RV02	1						
LEAD AN	ALY	ST	:	в.	E	A١	ŒS	5													-
ASSESSM	ENT	:																			
	CR						RE	DUND.	AN	CY	sc	REI	ENS	3				IL	_		
	:		LIGH' W/FUI				A			В				С			11	ren	1		
NASA IOA	. [2	/1R /1R]	5]	P P]	[F F]		[P P]		[X X]	*	
COMPARE	[/]		[]	[]		[]		[]		
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	ſ		/]		ָנ _.]	[NZ	A]		[]	(A				ETE)	
* CIL F	ETE	NT:	ION 1	RAT	IONA	LE	:	(If	apj	ol:	ica	ble		AI IAI	DEQU DEQU	JATE JATE	Ţ	X]		
REMARKS															•		•		•		
ALSO NA																		STATE OF THE PARTY			
THE FAI																-		CHE	_		ıυ
SHOULD								IOULD													. 1
2.3.4.b																					TOT
FAILING																					

	NT A	II #:):						-2								: [] [x]		
MDAC ID:				31	1	NI	FO:	LD 2	RE	LI	EF V	VALV	E	(1)	RV02	1			
LEAD ANA	LYS	ST	:	В.	E.	Al	ME	5										-	
ASSESSME	NT:	:																	
	CR:		CAL LIGH		7		R	EDUN	IDAN	CY	SCI	REEN				CI:			
	I	HDV	/FU	NC			A			E	}		С			11.	DM.		
NASA IOA]	3	/1R /1R]		[P]	[N	[A]	[P P]		[[]	*	
COMPARE	[/]		[]	[N	ן ז	[]		[]		
RECOMMEN	DA'	ric	ons:		(If	d :	if	fere	ent	fr	om 1	NASA)						
	[/·]		[]	[]	(٠] .	(A	[.DD/1] DELI	ETE)	
* CIL RE	TEI	T	ON 1	RA'I	ION	AL	E:	(If	ap	pl	ical			DEQU	ATE ATE	[j		
REMARKS: ALSO NAS THE FAII WOULD RE	A 1 URI SUI	E 1 LT	MODE IF	IS BO	FA.	IL:	S (CLOS OLD	ED. REL	ΙE	A FU	1B1- JNCT ALVE	RV(IOI S	D11- VAL FAII	2. CRIT	ICA SED	LITY , Al	OF 1	
WITH A THEATERS BURST. THE RELI	FA: SCI	I LI REI	ED O	N. IS	THI NA	E]	LII ER	NES NSI	COU	LE 22	BE 06 S	OVE:	RPI	RESS	URIZ	ED 2	AND		

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-312 M4-1B1-2	2 A01FSO-1		NASA DATA BASELINE NEW	
SUBSYSTEM: MDAC ID: ITEM:	312	FOLD 2 REL	JEF VALVE	E (1) RV02	
LEAD ANALYST:	B. E. Al	MES			
ASSESSMENT:					
FLIGH'	r	Y SCREENS		CIL ITEM	
HDW/FU	NÇ	A	В	C	
NASA [1 /1 I I I I I I I I I I I I I I I I I] [NA] [NA] [NA] [NA] [NA] NA]	[X] *
COMPARE [/] [) [] [1	[]
RECOMMENDATIONS:	(If d	ifferent f	rom NASA)		•
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* CIL RETENTION	RATIONALI	E: (If app	licable)		
		,		ADEQUATE IADEQUATE	[X]
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE LEAKAGE OF MOST OF THE SAME, IT IS	IS EXTER	RNAL LEAKA TS IN ONE	GE. NASA	COVERS TH	

ASSESSME ASSESSME NASA FME	NT II):	PRSD-	2/17/88 NAS PRSD-313 BA M4-1B2-CV010-1							x]	
SUBSYSTE MDAC ID:			EPG 313 02 CH	IECK	VALV	E (2)	CV0	21				
LEAD ANA	LYST	:	в. Е.	AME	S							
ASSESSME	NT:											
	CRITI	[CAL]		R	EDUN	DANCY	SCR	EENS			L EM	
	HDV	V/FUI	1C	A		В		(C			
NASA IOA	[2 [2	/1R /1R]	[P]	[F [F]	[]	P] P]]	x]	*
COMPARE	[/]	[]	[1	[]	[и]	
RECOMMEN	DATI	ons:	(If	dif	fere	nt fro	om N	ASA)				
·	[.	/	1	[1.	[1 .	Ĺ]] (ADD)	DEL/	ETE
* CIL RE	TENT	ON I	RATION	IALE:	(If	appl	icab		a DEOUAM	TO F	,	
REMARKS:									ADEQUAT ADEQUAT]	
ALSO NAS	A FMI						NTER	NAL :	LEAKAGE			

ASSESSMENT DATASSESSMENT ID:	2/17/88 PRSD-314 M4-1B2-0	4 CV010-2		NASA DATA BASELINE NEW	[]		
SUBSYSTEM: MDAC ID: ITEM:	EPG 314 02 CHEC	- ·						
LEAD ANALYST:	B. E. Al	MES						
ASSESSMENT:								
FLI	LITY HT UNC		Y SCREENS B	G C	CIL			
NASA [2 / IOA [3 /	R] [R] [P] [P] [P] [P] [P] P]	[X [] *		
COMPARE [N /] [) [] [1	[N]		
RECOMMENDATION	: (If d	ifferent f	rom NASA))				
. [2 /	R] [P] [P] [P] (A	[DD/DE] LETE)		
* CIL RETENTION	RATIONALI	E: (If app	licable)		_	_		
			·	ADEQUATE NADEQUATE	•]		
REMARKS: ALSO NASA FMEA THE HARDWARE C RELIEF VALVE A CONDUCTIVE HEA	ITICALITY SO FAILED	SHOULD BE CLOSED, A	N EXPLOS					

ASSESSME ASSESSME NASA FME	NT ID:	PRSD-3	315	FSO-	1				A DATA SELINI NEV] 3]	
SUBSYSTE MDAC ID:		EPG 315 02 CH	eck v	ALVE	(2) CV(021		,		- •	
LEAD ANA	LYST:	B. E.	AMES	3								
ASSESSME	NT:											
	CRITICAL FLIGH		RE	DUND	ANC	Y SCI	REENS	3			IL TEM	
	HDW/FU	_	A			В		С		1.	LEM	
NASA IOA	[1 /1 [1 /1]	[NA	\]	[NA] NA]	[NA] NA]		[х ј х ј	*
COMPARE	[/]	[1	[]	C	1		[]	
RECOMMEN	DATIONS:	(If	diff	eren	t f	rom 1	NASA)		. •	A	1. 2 2.1.	
¥	, 1 , 1 ,	1.	(]	[1	[]	(2	ZDD/	DEL	ETE)
* CIL RE	TENTION	RATIONA	ALE:	(If	app	licak	ole)				_	
							IN		QUATE QUATE	[[]	
REMARKS: ALSO NAS LEAKAGE.	A FMEA #	M4-1B3	L-A01	.FSO-	1.	THE	FAII	URE	MODE	IS	EXT	ERNAI

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	****	NASA DA BASELI D-1	ATA: INE [] NEW [X]
SUBSYSTEM: MDAC ID: ITEM:	EPG 316 02 LINES, COM	MPONENTS, & FITTINGS	
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL FLIGH		NDANCY SCREENS	CIL ITEM
HDW/FU		. в с	*****
NASA [1 /1 IOA [1 /1] [NA]] [NA]	[NA] [NA] [NA] [NA]	[X] * [X]
COMPARE [/] []	[] []	[]
RECOMMENDATIONS:	(If differe	ent from NASA)	
	1 [1	[] []	[] (ADD/DELETE)
* CIL RETENTION	RATIONALE: (I1	f applicable) ADEQUAT INADEQUAT	
THE FAILURE MODE	IS EXTERNAL I	-1 AND M4-1B1-A01FSO- LEAKAGE. IT IS RECON S FMEA BE LISTED IN 1	-1. MMENDED THAT ALI

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE [] NEW []
SUBSYSTEM: MDAC ID: ITEM:	EPG 317 02 LINES, COMPONENTS, & F	ITTINGS
LEAD ANALYST:	B. E. AMES	
ASSESSMENT:		
CRITICAL FLIGH	ITY REDUNDANCY SCREENS	S CIL ITEM
HDW/FU		C
NASA [/ IOA [2 /1R] [] [] [] [P] [P] [X] *
COMPARE [N /N] [и] [и] [N] [N]
RECOMMENDATIONS:	(If different from NASA))
[/] [] [] [] [] · (ADD/DELETE)
* CIL RETENTION	RATIONALE: (If applicable)	ADEQUATE [] NADEQUATE []
THIS FAILURE COU LACK OF 02. IT	VE A FMEA ON THIS FAILURE I LD RESULT IN SHUTTING DOWN IS RECOMMENDED THAT THE MD RE MODE IS NON-CREDIBLE.	MODE (RESTRICTED FLOW) THE FUEL CELLS DUE TO

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		•	NASA DATA BASELINE NEW		
SUBSYSTEM: MDAC ID: ITEM:	EPG 318 02 TANK Q	QUANTITY SENSOR (S	5) V45Q11(·	-5) 05A	
LEAD ANALYST:	B. E. AME	ES			
ASSESSMENT:					
FLIGH		REDUNDANCY SCREENS	c c	CIL ITEM	
NASA [/ IOA [3 /3] [N] [] [[AN]	NA]	[]	*
COMPARE [N /N] [N	[и] [и]	иј	[]	
RECOMMENDATIONS:	(If dif	fferent from NASA)	ı		
[3 /3] [N	[AN] [AN .		[] DD/DELE	TE)
	RATIONALE:	(If applicable)	ADEQUATE		
REMARKS: NASA DOES NOT HA COMPONENT. FOR FMEA FOR THIS FA	COMPLETENE	ON THIS FAILURE NESS, NASA MAY WANT	ODE (FULL TO CONSII	OUTPUT DER WRI) OR TING A

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-319			NASA DATA: BASELINE NEW	[]
SUBSYSTEM: MDAC ID: ITEM:	EPG 319 02 TANK (QUANTITY	SENSOR (5) V45Q11(-	-5) 05A
LEAD ANALYST:	B. E. AMI	ES		+ · · · · · · · · · · · · · · · · · · ·	
ASSESSMENT:					
CRITICAL FLIGH		REDUNDANC	Y SCREEN	S	CIL ITEM
HDW/FU		A	В	С	
NASA [/ IOA [3 /3] [1] [NA] [] [NA] [] NA]	[] *
COMPARE [N /N] []	и] [и] [и ј	[]
RECOMMENDATIONS:	(If di	fferent f	rom NASA	 .)	e de la companya del companya de la companya de la companya del companya de la co
[3 /3] [1	NA [']] [NA] [NA]	[] DD/DELETE)
* CIL RETENTION RATIONALE: (If applicable)					
220 270		_	I	ADEQUATE NADEQUATE	
REMARKS: NASA DOES NOT HAVE A FMEA ON THIS FAILURE MODE (ZERO OUTPUT) OR COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-320		
	320	SENSOR (5) V45Q11(-5) 05A
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICAL: FLIGHT	ITY REDUNDANC	CY SCREENS	CIL ITEM
	NC A	В С	
NASA [/ IOA [3 /3] [] [] [NA] [] [] NA] [NA]	[] *
COMPARE [N /N] [N][и] [и]	[]
RECOMMENDATIONS:	(If different i	from NASA)	
[3 /3] [NA] [NA] [NA] (ÁI	[] DD/DELETE)
* CIL RETENTION I	RATIONALE: (If app	olicable) ADEQUATE INADEQUATE	[]
OR COMPONENT. FO		FAILURE MODE (OUT O	OF TOLERANCE)

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			NASA DATA BASELINE NEW	•
MDAC ID:	EPG 321 02 TANK FLUID	TEMPERATUR	E SENSORS (5) V45T11(-
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				. m the #
CRITICA FLIG	LITY REDUN	DANCY SCREE	NS	CIL ITEM
	JNC A	В	C	
NASA [/ IOA [3 /3] []] [NA]	[] [NA]	[] [NA]	[] *
COMPARE [N /N] [N]	[N]	[и]	[]
RECOMMENDATIONS	(If differen	nt from NAS	A)	
[3 /3] [NA]	[NA]	[NA] (A	[DD/DELETE)
* CIL RETENTION	RATIONALE: (If) ADEQUATE INADEQUATE	
REMARKS: NASA DOES NOT HAVE A FMEA ON THIS FAILURE MODE (FULL OUTPUT) OR COMPONENT. FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-322	NASA DATA: BASELINE [NEW []
MDAC ID:	EPG 322 02 TANK FLUID TEMPERATURE	SENSORS (5)	V45T11(-
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICALI FLIGHT	TTY REDUNDANCY SCREENS		L EM
HDW/FU		C	LM
NASA [/ IOA [3 /3] [] [] [] [] [] [] [] [] [] [] [NA] [] *
COMPARE [N /N] [N] [N] [и][]
RECOMMENDATIONS:	(If different from NASA)		
[3 /3] [NA] [NA] [] DELETE)
* CIL RETENTION I	RATIONALE: (If applicable)		_
	IN	ADEQUATE [ADEQUATE []
	VE A FMEA ON THIS FAILURE M COMPLETENESS, NASA MAY WANT CLURE MODE.		

ASSESSMENT ASSESSMENT NASA FMEA	r ID:				NASA DATA BASELINE NEW		
SUBSYSTEM: MDAC ID: ITEM: 5)01A		EPG 323 02 TANK	FLUID TI	EMPERATURE	SENSORS (5) V45T11(-	
LEAD ANALY	ST:	B. E. Al	MES				
ASSESSMENT	r:						
CF	RITICALI FLIGHT		REDUNDA	NCY SCREEN	s	CIL ITEM	
		4C	A .	В	С	IIEM	
NASA [IOA [[/ [3 /3] [NA]	[] [[NA] [NA]	[] *	
COMPARE [N /N] [N]	[и] [N]	[]	
RECOMMENDA	ATIONS:	(If d	ifferent	from NASA)		
(3 /3] [NA]	[NA] [[DD/DELETE)	
* CIL RETE	ENTION I	RATIONALI	E: (If a				
				I	ADEQUATE NADEQUATE		
REMARKS: NASA DOES OR COMPONE WRITING A	ENT. FO	OR COMPLI	ETENESS,	FAILURE NASA MAY		OF TOLERANCI	E)

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:			NASA DATA BASELINE NEW	
SUBSYSTEM: MDAC ID: ITEM: V45T11(-5)07A		TER ASSEMBLY	1 TEMPERATU	RE SENSOR (5)
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
FLIGH				CIL ITEM
HDW/FU	NC A	В	С	
NASA [/ IOA [3 /3] []] [NA]	[] [AA]	[] [NA]	[] *
COMPARE [N /N] [N]	[N]	[14]	[]
RECOMMENDATIONS:	(If differ	cent from NA	SA)	
[3 /3] [NA]	[NA]	[NA]	[] .DD/DELETE)
* CIL RETENTION	RATIONALE: (If applicabl	e) ADEQUATE INADEQUATE	[]
REMARKS: NASA DOES NOT HA COMPONENT. FOR FMEA FOR THIS FA	COMPLETENESS			

2/17/88 PRSD-325	NASA DATA: BASELINE NEW	
325	TEMPERATURE	E SENSOR (5)
B. E. AMES		
${f T}$		CIL ITEM
] [] [] [] [] [] [] [] [] [] [] NA]	[] * []
] [и] [и] [N]	[]
(If different from NASA))	
] [NA] [NA] [[] D/DELETE)
II VE A FMEA ON THIS FAILURE I COMPLETENESS, NASA MAY WAN	MODE (ZERO (OUTPUT) OR
	PRSD-325 EPG 325 O2 TANK HEATER ASSEMBLY 1 B. E. AMES LITY REDUNDANCY SCREENS TO A B [PRSD-325 BASELINE NEW EPG 325 O2 TANK HEATER ASSEMBLY 1 TEMPERATURE B. E. AMES LITY REDUNDANCY SCREENS TO A B C [

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE [] NEW []
MDAC ID:	EPG 326 O2 TANK HEATER ASSEMBLY 1	TEMPERATURE SENSOR (5)
LEAD ANALYST:	B. E. AMES	
ASSESSMENT:		A Section 1
FLIGHT	ITY REDUNDANCY SCREENS I' NC A B	CIL ITEM C
nbw/ ror	TC A B	C
NASA [/ IOA [3 /3] [] [] [] [] [] [] [] [] [] [] [] * NA] []
COMPARE [N /N] [N] [N] [и] []
RECOMMENDATIONS:	(If different from NASA)	
[3 /3] [NA] · [NA] [] (ADD/DELETE)
* CIL RETENTION I		ADEQUATE [] ADEQUATE []
OR COMPONENT. FO	VE A FMEA ON THIS FAILURE M OR COMPLETENESS, NASA MAY W OR THIS FAILURE MODE.	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-327		ASA DATA: BASELINE [NEW []
SUBSYSTEM: MDAC ID: ITEM: V45T11(-5)09A	EPG 327 O2 TANK HEATER A	SSEMBLY 2 TI	EMPERATURE	SENSOR (5)
LEAD ANALYST:	B. E. AMES			
ASSESSMENT:				
CRITICAL FLIGH HDW/FU		CY SCREENS B C		IL TEM
NASA [/ IOA [3 /3] [] [] [AN]] [NA] [NA] [] *
COMPARE [N /N] [N] [и ј [и] []
RECOMMENDATIONS:	(If different	from NASA)		
[3 /3] [NA] [NA] [NA] /DELETE)
* CIL RETENTION	RATIONALE: (If ap	ΑI	DEQUATE []
	VE A FMEA ON THIS COMPLETENESS, NAS ILURE MODE.	FAILURE MOI	DE (FULL O	TTPUT) OR

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW	[]
SUBSYSTEM: MDAC ID: ITEM: V45T11(-5)09A		SEMBLY 2 TEMPERATUR	RE SENSOR (5)
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICALI FLIGHT HDW/FUN	7	Y SCREENS B C	CIL ITEM
NASA [/ IOA [3 /3] [] [] [NA] [] [] NA] [NA]	[] *
COMPARE [N /N] [N] [и] [и]	[]
RECOMMENDATIONS:	(If different f	rom NASA)	
[3 /3] [NA] [[] DD/DELETE)
* CIL RETENTION F	RATIONALE: (If app		
		ADEQUATE INADEQUATE	
	COMPLETENESS, NASA	FAILURE MODE (ZERO MAY WANT TO CONSII	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE [] NEW []	
MDAC TD:	EPG 329 O2 TANK HEATER ASSE	MBLY 2 TEMPERATURE SENSOI	R (5)
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:		<u> </u>	
CRITICAL FLIGH	ITY REDUNDANCY	SCREENS CIL ITEM	
	NC A B	C	
NASA [/ IOA [3 /3] [] [NA]] [] *	
COMPARE [N /N] [N] [N		1421
RECOMMENDATIONS:	(If different fro		
[3 /3] [NA] [NA	.] [NA] [] (ADD/DELET)	E)
* CIL RETENTION	RATIONALE: (If appli	cable) ADEQUATE [] INADEQUATE []	
OR COMPONENT. F		ILURE MODE (OUT OF TOLERA A MAY WANT TO CONSIDER	ANCE)

ASSESSME	ESSMENT DATE: 2/17/88 ESSMENT ID: PRSD-330 A FMEA #: M4-1B2-TK010-1									NASA DATA: BASELINE [] NEW [X]									
SUBSYSTE MDAC ID: ITEM:				EP 33 02	0	NK	su	BASS	EM!	BLY	(4),	((3),	OR	(2)				
LEAD ANA	LY	ST	;	в.	E.	A	MES												
ASSESSME	ENT	:																	
	CR		CAL LIGH				RE	DUND.	AN	CY S	CREE	NS	5				IL FEM	ſ	
	1	HDV	V/FU	NC			A			В			С						
NASA IOA	[1 1	/1 /1]		[NA NA]] [NA] NA]		[[NA]			[[X X]	*
COMPARE	[/]		[]	[]		[]			Ţ]	
RECOMMEN	IDA'	ric	ons:		(If	d:	iff	eren	t :	from	n NAS	A)							
•	[/]		[]	[]		[]		· (AD	[D/	′DE] :LF	ETE
* CIL RE		T	ON	RAT	ION	ALI	€:	(If	app	plic				QUAT QUAT		[x]	
ALSO NAS		FMI	EA'S	04	-1B	- T]	K01	0-1	ANI	D M4	-1B1	-7	KO1	.0-1.					

ALSO NASA FMEA'S 04-1B-TK010-1 AND M4-1B1-TK010-1.
THE FAILURE MODE IS EXTERNAL LEAKAGE. THE NASA FMEA REVIEW
COMBINED THE FAILURE MODES OF EXTERNAL LEAKAGE AND RUPTURE INTO
ONE FMEA. IT IS RECOMMENDED THAT A SEPARATE FMEA BE WRITTEN ON
THIS FAILURE MODE AND ITEM PER NSTS 22206 SECTION 2.3.1.a.1.

ASSESSMENT DATE ASSESSMENT ID: NASA FMEA #:			DATA: LINE [] NEW [X]					
MDAC ID:	EPG 331 O2 TANK SUBASS	SUBASSEMBLY (4), (3), OR (2)						
LEAD ANALYST:								
ASSESSMENT:								
CRITICA: FLIG		ANCY SCREENS	CIL ITEM					
HDW/F		ВС						
NASA [1 /1 IOA [1 /1] [NA]] [NA]	[NA] [NA] [NA]	[X] * [X]					
COMPARE [/] []	[] []	[]					
RECOMMENDATIONS	: (If differen	t from NASA)	gram of a role of					
] []	[] []	[] (ADD/DELETE)					
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []								
REMARKS: ALSO NASA FMEA':	S 04-1B-TK010-1	AND M4-1B1-TK010-	1. THE FAILURE					

ASSESSMENT ASSESSMENT NASA FMEA #	}			ASA DAT BASELIN NE								
SUBSYSTEM: MDAC ID: ITEM:		EPG 332 O2 TAN	IK :	SUBASS	EMBLY	7 (4),	(3), OR (2)			
LEAD ANALYS	T:	B. E.	AM	ES								
ASSESSMENT:												
	FLIGH:					SCREE			C]	L EM	Ī	
Н	DW/FUI	1C	4	A	В		С		-			
) ASAN] AOI	2 /1R 3 /1R]	֡֞֞֝֟֝֟֝֟֝֟֝֟֟֝֓֓֓֓֓֓֓֓֓֓֓֟֟֝֓֓֓֓֟֝֟֝֟֓֓֟֝֓֓֓֓֟֝֓֓֓֟֝֓֓֓֟֝	P] P]	[F [F]	[P]]	X X]	*
COMPARE [N /]	[]	ĵ.]	[]	[]	
RECOMMENDAT	ions:	(If	di:	fferen	t fro	m NAS	A)					
C C	/		[]	ĺ]	[] ([ADD/	DE] ELE	ETE)
* CIL RETEN	TION 1	RATIONA	LE	: (If	appli		A	DEQUATE		x]	
							INA	DEQUATE	Ĭ		j	
REMARKS: ALSO NASA F THE FAILURE COULD BE DE THIS COULD	MODE	IS LOS DURIN	ig i	OF ANN RE-ENT	ULUS	VACUU	М.	ALL TH				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-333	2015-1	NASA DATA: BASELINE [] NEW [X]							
MDAC ID:	EPG 333 O2 RELIEF	F PORT (1)								
LEAD ANALYST:	B. E. AME	ES	-							
ASSESSMENT:										
FLIGHT	r	REDUNDANCY	SCREENS		CIL ITEM					
HDW/FU	NC A	А В	С		-					
NASA [2 /1R IOA [3 /1R] [F	?] [F ?] [P] [P] [P]	[X] * []					
COMPARE [N /] [] [N	1, []	[N]					
RECOMMENDATIONS:	(If dif	fferent fro	om NASA)							
[/] (] [N2	A] [[] D/DELETE)					
* CIL RETENTION I	RATIONALE:	(If appl:			P 32 3					
				EQUATE EQUATE	[X] []					
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE FAILED CLOSED, AN TRANSFER INTO THE SECTION 2.3.4.b.2	IS RESTRI N EXPLOSIC E TANK. S	CTED FLOW ON COULD OF SCREEN B SI	. IF A TA CCUR DUE T HOULD BE N	NK CHECK O CONDUC A PER NS	TIVE HEAT TS 22206					
REDUNDANT.	s.a. BECAU	JOE THE RE	DIEF FORT	TO STAND	DI					

ASSESSMEN ASSESSMEN NASA FME	2/17/88 PRSD-334 M4-1B2-RV010-1					NASA DATA: BASELINE [] NEW [X]												
SUBSYSTEM MDAC ID: ITEM:			EPG 334 02		ΙK	RE	LIEF	V	AL V	Æ	(4)	RV(010,R	V020),F	₹V4	10,	RV460
LEAD ANA	LYST:	;	в.	E.	AM	ŒS												
ASSESSME	NT:																	
•	CRITI FI	CALI	CTY r			RE	DUND.	AN	CY	SC	CREEN	S			CIL ITEM			
	HDV	V/FUI	1C			A			В			С						
NASA IOA	[2 [2	/1R /1R]		[P P]	[P F]]	P P]		[X X] *]	
COMPARE	[/]		[]	[N]	[]		[]	
RECOMMEN	DATIC	ons:	(If	di	.ff	eren	t :	fro	om	NASA	.)						
	[′]		[]	[N?	A]	[]	(AI		'DE] LET	E)
* CIL RE	FENTI	ON I	RATI	ONA	LE	:	(If a	apı	91 i	ica		ΑI	DEQUA'					
REMARKS: ALSO NASA FMEA'S: 04-1B-RV010-1 FOR O2 TANK RELIEF VALVE (2) - RV010, RV020 AND M4-1B1-RV010-1 FOR O2 TANK RELIEF VALVE (3) - RV010, RV020, RV410. THE FAILURE MODE IS FAILED OPEN OR INTERNAL LEAKAGE. THE NEW NASA FMEA MENTIONS THIS FAILURE IS NOT DETECTABLE IN FLIGHT, YET IT STILL PASSES THEIR SCREEN B. THE RELIEF VALVE IS A STANDBY REDUNDANT SYSTEM AND THEREFORE THE B SCREEN SHOULD BE NA PER NSTS 22206 SECTION 2.3.4.b.2.a. THE HARDWARE CRITICALITY SHOULD BE A 3 FOR GREATER THAN TWO TANK SETS. CHANGING THIS WOULD ALLOW DELETION OF THIS FAILURE MODE FROM THE CIL.																		

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-335 M4-1B2-RV010-2	7/88 NASA DATA: D-335 BASELINE [1B2-RV010-2 NEW [X						
MDAC ID:	335	VALVE (4) RV010,RV02	20,RV410,RV460					
LEAD ANALYST:	B. E. AMES							
ASSESSMENT:								
FLIGH	ITY REDUNDA T NC A	ANCY SCREENS B C	CIL					
NASA [2 /1R IOA [3 /1R] [P]] [P]	[NA] [P] [P]	[X] *					
COMPARE [N /] []	[и] [и]	[N]					
RECOMMENDATIONS:	(If different	from NASA)	and a second of the second					
\]] []	[] []	[] ADD/DELETE)					
* CIL RETENTION	RATIONALE: (If a	applicable) ADEQUATE INADEQUATE	[x]					
RV010, RV020 AND RV010, RV020, RV SAME TANK'S CHEC OCCUR DUE TO CON	M4-1B1-RV010-2 410. THE FAILUR K VALVE ALSO FAI DUCTIVE HEAT TRA 6 SECTION 2.3.4.	FOR 02 TANK RELIEF VECTOR O2 TANK RELIEF VECTOR O2 TANK RELIEF VECTOR O2 TANK RELIEF VECTOR O2 TANK O2 THE TANK O2 THE FETTING	VALVE (3) - SED. IF THE OSION COULD SCREEN B IS					

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-336 M4-1B2-2	6 A01FSO-1		NASA DATA: BASELINE NEW			
MDAC ID:	EPG 336 O2 TANK	RELIEF V	ALVE (5)	RV010,RV020),RV410,RV460		
LEAD ANALYST:	B. E. A	MES					
ASSESSMENT:							
CRITICAL: FLIGH		REDUNDAN	CY SCREEN	S	CIL ITEM		
	ИĊ		В	С			
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] [NA] [NA] NA]	[X] * [X]		
COMPARE [/] [] [] [3	[]		
RECOMMENDATIONS:	(If d	ifferent :	from NASA)			
[/] [] [.] [] (AI	[DD/DELETE)		
* CIL RETENTION	RATIONAL	E: (If app		ADEQUATE			
INADEQUATE [] REMARKS:							
ALSO NASA FMEA'S 04-1B-A01FSO-1 AND M4-1B1-A01FSO-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. NASA COVERED THE EXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SINCE THE EFFECT IS THE SAME, IT IS AGREEABLE.							

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:				NASA DATA BASELINI NEV				
MDAC TD:	EPG 337 O2 TANK	HEATER	ELEMENT	A1(5), A2(5)), B1(4 OR 3)			
LEAD ANALYST:	B. E. A	MES						
ASSESSMENT:								
CRITICAL FLIGH		REDUND	ANCY SCRE	EENS	CIL ITEM			
HDW/FU		A	В	С	, 			
NASA [/ IOA [1 /1] [p]	[P]	[_P]	[x] *			
COMPARE [N /N] [N]	[N]	[и]	[N]			
RECOMMENDATIONS:	(If d	ifferen	t from NA	•				
[/] []	[]	[]	ADD/DELETE)			
* CIL RETENTION	RATIONAL	E: (If	applicabl	•	2			
				ADEQUATE INADEQUATE				
REMARKS: NASA DOES NOT HAVE A FMEA FOR THIS COMPONENT. THE FAILURE MODE IS FAILS ON. IT IS RECOMMENDED THAT THE MDAC FMEA BE DELETED SINCE THIS FAILURE MODE IS REALLY ONLY AN EFFECT THAT IS THE RESULT OF THE HEATER SWITCH FAILING ON. THIS FAILURE MODE IS COVERED IN THE MDAC EPD&C/PRSD ANALYSIS.								

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW	
MDAC ID:	EPG 338 O2 TANK HEATER	ELEMENT A1(5), A2(5),	B1(4 OR 3),
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
CRITICALI FLIGHT	TY REDUNDA	ANCY SCREENS	CIL ITEM
	IC A	ВС	TIEM
NASA [/ IOA [3 /1R] []]]	[] [] [P] [P]	[] * []
COMPARE [N /N] [N]	[и] [и]	[]
RECOMMENDATIONS:	(If different	from NASA)	
[3 /1R] [P]		[] DD/DELETE)
* CIL RETENTION F	RATIONALE: (If a	applicable) ADEQUATE INADEQUATE	į j
	OPERATIVE HEATE	INADEQUATE HIS COMPONENT. THE FA ERS WILL CAUSE LOSS OF	LILURE MODE

•	ASSESSME ASSESSME NASA FME	NT NT A	Di II #:	ATE:	2/ PR M4	17/ RSD- -1B	88 339 2 - 1	9 MT (018-	1					ASA DAT BASELIN NI	NE	[X		
	SUBSYSTE MDAC ID: ITEM: SENSOR/T					9 TA	NK	н	EATE)	R C	נימכ	rrc	LLE		RESSURI		eries .		
	LEAD ANA	LYS	ST	:	в.	E.	Al	MES	3										
	ASSESSME	NT	:		•														
		CR:		ICAL LIGH		?		RI	EDUN	DAN	CY	sc	REE	NS			CIL		
		I		W/FU				A			В			С			ITEN	1	
	NASA IOA	[3	/1R /1R]		[P P]	[P P]		[P]		[]	*
	COMPARE	[/]		[]	[]		[]		[]	
	RECOMMEN	DA'	ric	ONS:		(If	d :	ifi	fere	nt 1	fro	m	NAS	A)					
		·[/]	•	[]	[]	1	[(AD	[D/DI] ELE	TE)
	* CIL RE		YT:	ION :	RAT	'ION	AL	E:	(If	apı	91 i	ica	•	A	DEQUATE DEQUATE		[]	
	REMARKS: ALSO NAS THE ICA IS LOSS CAUSE IN	FA: OF	ILI Ol	JRE I	MOD T I	E I	S 1 UD:	FUI INC	LL O	UTPI RONI	JT.	JS	THE	NA:	SA FME				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-340 M4-1B2-MT018-1	NASA DATA BASELINE NEW	: [x]
SUBSYSTEM: MDAC ID: ITEM: SENSOR/TRANSDUCER	EPG 340 O2 TANK HEATER CO R (4)	ONTROLLER PRESSURE	
LEAD ANALYST:	B. E. AMES		
ASSESSMENT:			
FLIGHT	r	CY SCREENS B C	CIL
NASA [3 /1R IOA [1 /1] [P] [] [P]	P] [P] P] [P]	[] * [x]
COMPARE [N /N] [] [] []	[N]
RECOMMENDATIONS:	(If different f	from NASA)	
. [/] [][] [] (A:	[] DD/DELETE)
* CIL RETENTION R	RATIONALE: (If app	olicable) ADEQUATE INADEQUATE	[]
THE IOA FAILURE M IS LOSS OF OUTPUT RUPTURE STARTING THE OFF POSITION HEATERS OF BOTH T AUTOMATIC MODE, T TANK SENSOR LOGIC SENSORS WOULD HAV FMEA BE WRITTEN F	MODE IS ZERO OUTPUT INCLUDING ERRONE 9 HOURS AFTER TAN OF THE SWITCH IS FANKS 1 AND 2 OR 3 FHE CRITICALITY WO C WOULD BE CONNECT /E TO FAIL. IT IS	M4-1B1-MT018-1. JT. THE NASA FMEA TO THE TAX SIGNAL. THE TAX RESIDUAL LEVEL IS A REDUNDANCY. IF TO THE TAX SELECTED BE A 3/1R, BECAUSE AND BOTH TANK TO THE TAX SELECTED THAT THE TAX SELECTED THAT TAX SELECTED TAX SELECTED THAT TAX SELECTED TAX SELECTED TAX SELECTED TAX SELECTED TAX SELECTED TAX SELECTED TAX	FAILURE MODE ANK COULD S REACHED. THE D TO THE AUSE THEIR PAIR'S A SEPARATE

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-34J M4-1B2-N	1 MT018-1	N	IASA DATA: BASELINE NEW								
MDAC TD:	EPG 341 O2 TANK R (4)	HEATER CO	NTROLLER F	RESSURE								
LEAD ANALYST: B. E. AMES												
ASSESSMENT:												
			Y SCREENS		CIL ITEM							
HDW/FU	NC	A	В	2								
NASA [3 /1R IOA [1 /1] [P] [P] [P] [F P] [F	·]	[
COMPARE [N /N] [] [) []	[N]							
RECOMMENDATIONS:	(If di	ifferent f	rom NASA)									
[/	1 [] [] [[] DD/DELETE)							
* CIL RETENTION	RATIONALE	E: (If app		DEQUATE	[]							
ADEQUATE [] INADEQUATE [] REMARKS: ALSO NASA FMEA'S 04-1B-MT018-1 AND M4-1B1-MT018-1. THE IOA FAILURE MODE IS OUT OF TOLERANCE. THE NASA FMEA FAILURE MODE IS LOSS OF OUTPUT INCLUDING ERRONEOUS SIGNAL. THIS COULD CAUSE A RANGE OF RESULTS, FROM REACTANT PRESSURE BEING TOO LOW TO REACTANT DEPLETION AND A TANK RUPTURE STARTING 9 HOURS AFTER THE TANK RESIDUAL LEVEL IS REACHED. SENSOR READINGS NEAR ZERO COULD CAUSE THE TANK HEATERS TO BE ON IF THE HEATERS OF BOTH TANKS 1 AND 2, OR 3 AND 4 ARE SELECTED TO THE AUTOMATIC MODE. THE REDUNDANT PATH IS PUTTING THE HEATER SWITCH IN THE OFF POSITION.												

ASSESSME ASSESSME NASA FME	NT II	D:	PRS	D-342	? ! T010-	·1	NASA DATA: BASELINE [] NEW [X]						
SUBSYSTE MDAC ID: ITEM:			EPG 342 02		PRESS	SURE S	SENSOR (5)						
LEAD ANA	LYST	:	в.	E. AN	ŒS								
ASSESSMENT:													
	CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM												
			NC NC		A	1	3		С		TTE	M	
NASA IOA	[3 [3	/3 /3]]	NA] NA]	[]	NA] NA]	[NA] NA]		[]	*
COMPARE	[/]	[]	[]	[]		[]	
RECOMMEN	DATI	ONS:	(If di	ffere	nt fi	com N	ASA)					
	Ţ	/]	[1	[]	[]	(AD	[D/D		TE
* CIL RE	TENT:	ION :	RATI	ONALE	E: (If	app	licab	le)			_	_	
								IN	ADEQU <i>A</i> ADEQU <i>A</i>]	
	REMARKS: ALSO NASA FMEA'S 04-1B-MT010-1 AND M4-1B1-MT010-1. THE FAILURE MODE IS FULL OUTPUT.												

ASSESSME ASSESSME NASA FME	NO TO	DDCD		0-1			.: : [/ [2	(]			
SUBSYSTE MDAC ID: ITEM:		EPG 343 02 T	ANK PRE	SSURE	SENSC	R (5)				
LEAD ANALYST: B. E. AMES											
ASSESSMENT:											
	CRITICA FLIG	HT		UNDAN	CY SCR			CII	_		
	HDW/F	UNC	A		В		С				
NASA IOA	[3 /3 [3 /3]	[NA] [NA]	[NA] NA]	[NA] NA]	[] *		
COMPARE	[/	1	[]	[1	[]	[]		
RECOMMEN	DATIONS	: (I	f diffe	rent	from N	(ASĀ)					
·	[/	1	[]	[]	[[ZDD/I] DELETE)		
* CIL RE		RATIO	NALE: (If ap	plicab		ADEQUATE ADEQUATE]		
ALSO NAS		S 04-1	B-MT010	-1 AN	D M4-1	B1-M	T010-1.				

THE FAILURE MODE IS ZERO OUTPUT.

ASSESSME ASSESSME NASA FME	ENT	II	D:	PR	2/17/88 PRSD-344 M4-1B2-MT010-1						NASA DATA: BASELINE [] NEW [X]							
SUBSYSTE MDAC ID:				34														
LEAD ANA	LYS	T	:	в.	E.	Al	ÆS											
ASSESSME	ENT:	;																
CRITICALITY REDUNDANCY SCREENS FLIGHT HDW/FUNC A B C											CII							
	H	IDV	/FU	INC			A				В		С					
NASA IOA]	3	/3 /3]		[NA NA]	[[NA] NA]	[[NA] NA]			[]	*
COMPARE	[/]		[]	[]	[1			[]	
RECOMMEN	ľADI	TIC	ONS:		(If	d:	lff	erei	nt	f	rom N	IASA)					
	[/]		[]	[.]	[]			[DD/D		ETE)
* CIL RE	=	T	ION	RAT	IONA	ΔLI	ጀ:	(If	ap	p	licab	·		QUAT:]	
REMARKS: ALSO NAS THE FAII	SA E											.B1-	MT01	0-1.				

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-345 M4-1B2-PC	2010-1	NASA DATA: BASELINE [] NEW [X]									
SUBSYSTEM: MDAC ID: ITEM: (9), M4-1B1-(7),	EPG 345 O2 (PRE-F	LIGHT) FI		IT QD CAPS M4-1B2-								
LEAD ANALYST:	B. E. AME	S										
ASSESSMENT:												
CRITICAL FLIGH HDW/FU	-			CIL ITEM								
NASA [2 /1R IOA [3 /1R] [P)] [P] [x] *								
COMPARE [N /] [] [] [] []								
RECOMMENDATIONS:	(If dif	ferent fr	om NASA)									
[/] [] [] [] [] (ADD/DELETE)								
* CIL RETENTION	RATIONALE:	(If appl	AL	DEQUATE [] DEQUATE [X]								
REMARKS: ALSO NASA FMEA'S 04-1B-MT010-1 AND M4-1B1-MT010-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. BECAUSE THE QD HAS AN ALLOWABLE LEAK RATE, THIS FAILURE COULD RESULT IN THE ACCUMULATION OF 02 IN THE ORBITER MID FUSELAGE AND A POSSIBLE EXPLOSION. SCREEN B SHOULD BE NA PER NSTS 22206 SECTION 2.3.4.b.2.a. BECAUSE THE CAP IS A STANDBY REDUNDANT ITEM TO THE QD.												

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:		NASA DATA: BASELINE NEW	[x]							
SUBSYSTEM: MDAC ID:	CTS (4) AND									
LEAD ANALYST:	B. E. AMES		•							
ASSESSMENT:										
CRITICAL: FLIGHT HDW/FUI		NCY SCREENS B C	CIL ITEM							
NASA [2 /1R IOA [3 /1R] [P]] [P]	[F] [P] [F] [P]	[X] * [X]							
COMPARE [N /	1 []	[] []	[]							
RECOMMENDATIONS:	(If different	from NASA)	, •							
[/] []	[] [] IA)	DD/DELETE)							
* CIL RETENTION 1	RATIONALE: (If a	pplicable) ADEQUATE INADEQUATE	[]							
REMARKS: ALSO NASA FMEA'S 04-18-PD010-1 AND M4-181-PD010-1. THE FAILURE MODE IS FAILS OPEN OR EXTERNAL LEAKAGE. THE RETENTION RATIONALE IS NOT AVAILABLE. IF THE CAP ALSO LEAKED, OR COULD ACCUMULATE IN THE MID FUSELAGE AND POSSIBLY RESULT IN AN EXPLOSION.										

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-347		- v	NASA DATA: BASELINE [] NEW []							
SUBSYSTEM: MDAC ID: ITEM: VENT QD'S (5)	EPG 347 O2 (PRE-1	FLIGHT)	FILL QUI	CK DISCONNE	CTS (4) AND						
LEAD ANALYST: B. E. AMES											
ASSESSMENT:											
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM											
HDW/FU	_	A	В	C	IIEM						
NASA [/ IOA [3 /3] [] [] [AN	NA]	[] [NA]	[] . *						
COMPARE [N /N] [1	и] [[א]	[N]	[]						
RECOMMENDATIONS:	(If di	fferent	from NAS	A)							
{ 3 /3] [1	NĀ] [NA]		[] DD/DELETE)						
* CIL RETENTION	RATIONALE:	: (If ap	plicable	en un promite de estado.	. 24						
ADEQUATE [] INADEQUATE []											
REMARKS: THE FMEA DID NOT INCLUDE THIS FAILURE MODE (INABILITY TO MATE/DEMATE). FOR COMPLETENESS, NASA MAY WANT TO CONSIDER WRITING A FMEA FOR THIS FAILURE MODE.											

ASSESSME ASSESSME NASA FME	NT NT A #	DATE: ID:	2/ PR: M4	17/88 SD-34 -1B2-	8 ·LV0]	L3 - 3			NASA BASE		[]	
SUBSYSTE MDAC ID: ITEM: (3) V45X	M:		348 02	G 8 FUEI	CEI	LL REA	CTANI		/E POS	ITION	IN	DICA	TORS
LEAD ANA	LYS	T:	в.	E. 7	MES								
ASSESSMENT:													
										CIL			
	H	DW/F	JNC		A		В		С			11	
NASA IOA	[3 /3 3 /3]	[NA] NA]	[NA] NA]	[[NA] NA]		[] *]	
COMPARE	[/]	(]	ι []	Ţ]		[]	
RECOMMEN	DAT	IONS	:	(If d	iffe	erent	from	NASA)					
•	ĺ	/]	[]	. []	[]	(AD	[D/D] ELET	E)
* CIL RE	TEN	TION	RAT	IONAI	Æ: ((If ap	plica		ADEQUA NADEQUA	ATE ATE	[]	
REMARKS: ALSO NAS	አ ፔ	MEAL	2 04	_1 R_T	37013	1-3 AN	D M 4-						
THE FAIL	URE	MOD	EIS	REAL	S OF	SEN MH	EN TE	ie vai	JAR TR	CLOS	ED.	TH.	
NASA FMEA INCLUDES ANALYSIS ON THE O2 FUEL CELL VALVES WITH THE FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS OPEN. IT IS													
RECOMMENDED THAT THE NASA FMEA ITEM BE CHANGED TO THE POSITION INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE													
INDICATO OPERATIN	RR	ATHE	R TH	AN TH	E VA	LVE I	TSELF	F, SIN	NCE TH	E VAL	VE N T	COUL	D BE
FAILURE													THE

INDICATOR READS CLOSED, BUT THE VALVE IS OPEN.

ASSESSMI ASSESSMI NASA FMI	ENT ENT EA	D: I :	ATE: D:	2/ PR M4	17/8 SD-3 -1B2	38 349 2-1) LV013-	4		•	NASA BASE		[x]	
SUBSYSTI MDAC ID: ITEM: (3) V452	:			34 02	9 FUI		CELL Y			' VAL	VE POS	ITIO	N II	NDIC	ATORS
LEAD AND	ALY:	ST	:	В.	E.	Al	MES .								
ASSESSMENT:															
	ICAI LIGH				REDUNDANCY SCREENS					CIL ITEM					
]	HDI	W/FU	INC			A		В		C				
NASA IOA]	3 3	/3 /3]]	NA] NA]]	NA]]	NA] NA]		[]	*
COMPARE	[/]		[]	[]	C]		[]	
RECOMMEN	IDA!	rI(ONS:		(If	d:	ffere	nt :	from	NASA))			٠	
	[/]		[Ì	[]	[]		[DD/I) DELE	TE)
* CIL RI	ETEI	YT:	ION	RAT	IONA	ALİ	E: (If	apj	plica	•	ADEQU NADEQU	ATE ATE	[]	
ADEQUATE [] INADEQUATE [] REMARKS: ALSO NASA FMEA'S 04-1B-LV013-4 AND M4-1B1-LV013-4. THE FAILURE MODE IS READS OPEN WHEN THE VALVE IS CLOSED. THE NASA FMEA INCLUDES ANALYSIS ON THE 02 FUEL CELL VALVES WITH THE FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS OPEN. THESE SHOULD READ FAILS CLOSED, NOT OPEN. IT IS RECOMMENDED THAT THE NASA FMEA ITEM BE CHANGED TO THE POSITION INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE OPERATING PERFECTLY.															

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-350 M4-1B2-1	NASA DATA: 50 BASELINE [] -LV033-3 NEW [X]									
SUBSYSTEM: MDAC ID: ITEM: (3) V45X2150E, V	EPG 350 H2 FUEL 45X2155E	CELL REA	CTANT VALV	/E POSITION	N INDICATORS						
LEAD ANALYST:	B. E. AM	MES			•						
ASSESSMENT:											
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM											
HDW/FU	NC	A	В	C							
NASA [3 /3 IOA [3 /3] [NA] [NA] [NA] [NA] [NA] NA]	[] *						
COMPARE [/] [] [] [1	[]						
RECOMMENDATIONS:	(If di	ifferent	from NASA)	-							
[/	ĵ (] [] [] (Al	[] DD/DELETE)						
* CIL RETENTION	RATIONALI	E: (If ap	plicable) IN	ADEQUATE NADEQUATE	[]						
REMARKS: ALSO NASA FMEA'S	04-19-11	7022-2 AN									
THE FAILURE MODE											
NASA FMEA INCLUD											
FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS OPEN. THESE SHOULD READ FAILS CLOSED, NOT OPEN. IT IS RECOMMENDED POSITION											
INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE											
OPERATING PERFECTAR	TLY. THE	E NASA FM	EA IS INCO	ONSISTENT	IN THE						
FAILURE DETECTABLE IN FLIGHT SECTION; THE FMEA MENTIONS THAT THE INDICTOR READS CLOSED, BUT THE VALVE IS OPEN.											

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-35 M4-1B2-		NASA DATA BASELINE NEW									
SUBSYSTEM: MDAC ID: ITEM:	MDAC ID: 351 ITEM: H2 FUEL CELL REACTANT VALVE POSITION INDICATORS (3) V45X2150E, V45X2155E, V45X2160E											
LEAD ANALYST: B. E. AMES												
ASSESSMENT:												
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM												
	NC	A	В	С								
NASA [3 /3 IOA [3 /3] [NA] [NA] [NA] [NA] [NA] NA]	[] *							
COMPARE [/] [] [] [1	[]							
RECOMMENDATIONS:	(If d	ifferent	from NASA)								
] [] [] [[DD/DELETE)							
* CIL RETENTION	* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []											
REMARKS: ALSO NASA FMEA'S 04-1B-LV033-4 AND M4-1B1-LV033-4. THE FAILURE MODE IS READS CLOSED WHEN THE VALVE IS OPEN. THE NASA FMEA INCLUDES ANALYSIS ON THE H2 FUEL CELL VALVES WITH THE FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS OPEN. THESE												
SHOULD READ FAILS CLOSED, NOT OPEN. IT IS RECOMMENDED THAT THE FMEA ITEM BE CHANGED TO THE POSITION INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE OPERATING PERFECTLY.												

ASSESSMENT DATE	E: 2/17/88 PRSD-35	3 32	NASA DATA: BASELINE [LV012-3 NEW [X									
NASA FMEA #:	M4-1B2-	·LV012-3		NEW	7 [X]							
SUBSYSTEM: MDAC ID: ITEM: (2) V45X1080E,			SUPPLY	VALVE POSITI	ON INDICATOR							
LEAD ANALYST: B. E. AMES												
ASSESSMENT:												
	ALITY SHT	REDUNDA	NCY SCRE		CIL ITEM							
	FUNC	A	В	С	IIEM							
NASA [3 /: IOA [3 /:	B] [NA] NA]	[NA] [NA]	[NA] [NA]	* [] * []							
COMPARE [/] [1	[]	[]	[]							
RECOMMENDATIONS	3: (If d	lifferent	from NA	SA)								
[/] [1	[]	[]	[] ADD/DELETE)							
* CIL RETENTION	, RATIONAI	Æ: (If a	pplicabl	e)								
	, 1411101111	(FF	ADEQUATE INADEQUATE	[]							
REMARKS: ALSO NASA FMEA THE FAILURE MOI NASA FMEA INCLI MODE BEING SWI' RECOMMENDED THE	DE IS READ JDES ANALY TCH POSITI AT THE NAS	S OPEN W SIS ON T ON INDIC A FMEA I	HEN THE HE ECLSS ATOR FAI TEM BE C	1-LV012-3. VALVE IS CLC VALVES WITH LS OPEN. IT HANGED TO TH	OSED. THE I THE FAILURE I IS IE POSITION							
INDICATOR RATH	EK IMAN IN	E VALVE		SINCE IND AN	7745 COOPD BE							

OPERATING PERFECTLY. THE NASA FMEA IS INCONSISTENT IN THE FAILURE DETECTABLE IN FLIGHT SECTION; THE FMEA MENTIONS THAT THE INDICATOR READS CLOSED, BUT THE VALVE IS OPEN.

ASSESSME ASSESSME NASA FME SUBSYSTE	ENT ENT EA #	ID:	re:	PR M4	17/8 SD-3 -182	38 353 2-1	3 LV012-	4					LINE NEW	[
SUBSYSTE MDAC ID: ITEM: (2) V45X				35 02	ECI	LSS	S SYST				ALV:	E PO	SITI	ON I	INDI	CATO	R
LEAD ANA	LYS	ST:		в.	E.	AM	ÆS										
ASSESSME	NT:	:															
		FL	[GH]	ľ			REDUN	DANG		CREE				CII			
	F	HDW/	/FUI	1C			A		В		С						
NASA IOA]	3 /	/3 /3]		[NA] NA]]	NA] NA]		[N.	A] A]		[]	*	
COMPARE	[/	/]		[]	[]		[1		[]		
RECOMMEN	(ADI	rioi	1S:		(If	di	iffere	nt i	from	NAS.	A)						
:	[,	/]		[j	[]		(]	(A)	[DD/I		TE)	
* CIL RE		VTIC	I NO	RAT	'IONZ	ALI	E: (If	app	olic		A		ATE ATE]		
REMARKS: ALSO NAS		FME2	A'S	04	-1B-	-Ľ.	7012-4	ANI) M4	-1B1	-LV	012-	4.				
THE FAIL																HE	.
MODE BEI	NG	SW	[TCI	I F	OSI	CIC	ON IND	ICA?	ror	FAIL	5 0	PEN.	TH	ESE	SHC	ULD	C
READ FAI																	
VALVE IT																	

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-354 M4-1B2-LV011-	3	NASA DATA BASELINE NEW										
SUBSYSTEM: MDAC ID:	EPG 354 02 MANIFOLD V		ON INDICATO	PRS (2)									
LEAD ANALYST:	B. E. AMES												
ASSESSMENT:													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C													
NASA [3 /3 IOA [3 /3] [NA]] [NA]	[NA] [NA]	[NA] [NA]	[] *									
COMPARE [/] []	[]	[]	[]									
RECOMMENDATIONS:	(If differe	nt from NAS	;A)										
1] []	[]	[] (A)	[DD/DELETE)									
* CIL RETENTION	RATIONALE: (If	applicable	adequate INADEQUATE										
REMARKS: ALSO NASA FMEA'S THE FAILURE MODE													
NASA FMEA INCLUD FAILURE MODE BEI	ES ANALYSIS ON	BOTH 02 MA	NIFOLD VALV	ES WITH THE									
RECOMMENDED THAT	THE NASA FMEA	ITEM BE CH	IANGED TO TH	E POSITION									
INDICATOR RATHER OPERATING PERFEC	TLY. THE NASA	FMEA IS IN	CONSISTENT	IN THE									
FAILURE DETECTAB INDICATOR READS	LE IN FLIGHT SI CLOSED, BUT TH	ECTION; THE E VALVE IS	FMEA MENTI OPEN.	ONS THAT THE									

ASSESSME ASSESSME NASA FME	NT NT A	DA II #:	ATE:	2/17/88 NASA DA PRSD-355 BASELI M4-1B2-LV011-4 N									[]	
SUBSYSTE MDAC ID: ITEM: V45X1141	***			35 02	5 Mai					TION	N INDIC	CATO	RS ((2)	
LEAD ANA	LYS	ST:	:	в.	E.	Al	MES								
ASSESSME	NT:	}													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C															
NASA IOA	[3	/3 /3]]	NA] NA]	[NA] NA]	[NA] NA]		[]	*
COMPARE	[/]		[]	[]	[]		[]	
RECOMMEN	DAT	ric	NS:		(If	đ:	iffere	nt i	from N	IASA)					
	[/]		[]	[]	[]	(AI	[DD/D		ETE)
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []															
REMARKS: ALSO NASA FMEA'S 04-1B-LV011-4 AND M4-1B1-LV011-4. THE FAILURE MODE IS READS CLOSED WHEN THE VALVE IS OPEN. THE NASA FMEA INCLUDES ANALYSIS ON BOTH 02 MANIFOLD VALVES WITH THE FAILURE MODE BEING SWITCH POSITION INDICATORS FAILS CLOSED. IT IS RECOMMENDED THAT THE NASA FMEA ITEM BE CHANGED TO THE POSITION INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE OPERATING PERFECTLY.															

ASSESSME ASSESSME NASA FME	NT NT A	Di I! #:	ATE: D:	2/17/88 PRSD-356 M4-1B2-LV031-3						NASA BASE	DATA LINE NEW	: [x]		
SUBSYSTE MDAC ID: ITEM: V45X2141	M:			EP 35 H2	G 6 MAN						N INDI				
LEAD ANA	LYS	ST	:	в.	E.	Al	ÆS								
ASSESSME	NT:	:													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C															
	I	ID!	W/FU	NC			A		В		С		11	EM	
NASA IOA]	3	/3 /3]		[NA] NA]	[NA] NA]	[NA] NA]		[] *	
COMPARE	[/]		[]	[]	[1		[]	
RECOMMEN	IDA:	ri	ons:		(If	d:	iffere	nt :	from	NASA)				
	[/]		[]	[]	[]	(A)] DELET	E)
* CIL RE	TE	NT:	ION	RAT	IONA	L	E: (If	apı	plica	able) Il	ADEQUANADEQUA	ATE ATE]]	
REMARKS:															
ALSO NAS															c
NASA FMI	IOKI IA	LN(CLUD	ES	ALA ANAI	Y	SIS ON	BO'	CH H	MAN	IFOLD '	VALV	ES	WITH S	E THE
FAILURE	MOI	DE	BEI	NG	SWIT	'CI	I POSI	TIO	N INI	DICAT	OR FAI	LS O	PÉN	. IT	IS
RECOMMEN															
INDICATO OPERATIN) BE
FAILURE	DE'	re(CTAB	LE	IN F	L	GHT S	ECT.	ION;	THE	FMEA M	ENTI	ONS	THAT	THE

INDICATOR READS CLOSED, BUT THE VALVE IS OPEN.

ASSESSMI ASSESSMI NASA FMI	ent Ent Ea	D: I:	ATE: D:	2/1 PRS M4-	2/17/88 NASA DATA: PRSD-357 BASELINE [] M4-1B2-LV031-4 NEW [X]										
SUBSYST	EM:			EPG 357 H2	MANI					ITIO	N INDICA	TOI	RS (2)	
LEAD AN	ALY	ST	:	В.	E. A	MES	3								
ASSESSM	ENT	:													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C															
NASA [3 /3] [NA] [NA] [NA] [] * IOA [3 /3] [NA] [NA] [NA] []															
COMPARE	[/]	[]	[]	[1		[]	
RECOMME	NDA'	TI	ons:	(If d	ifi	fere	ent i	from 1	NASA)				
	[/]	(]	[1	. [1	(AI	ָ מ/מכ		ETE)
* CIL R		NT	ION	RATI	ONAI	E:	(If	app	olical		ADEQUAT NADEQUAT	E	[]	
ALSO NASTHE FAILURE RECOMMENTO POSITION	ADEQUATE [] INADEQUATE [] REMARKS: ALSO NASA FMEA'S 04-1B-LV031-4 AND M4-1B1-LV031-4. THE FAILURE MODE IS READS CLOSED WHEN THE VALVE IS OPEN. THE NASA FMEA INCLUDES ANALYSIS ON BOTH H2 MANIFOLD VALVES WITH THE FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS CLOSED. IT IS RECOMMENDED THAT THE NASA FMEA ITEM BE CHANGED TO THE POSITION INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE OPERATING PERFECTLY.														

ASSESSMENT DATE ASSESSMENT ID: NASA FMEA #:												
SUBSYSTEM: MDAC ID: ITEM:	EPG 358 02 FILT	'ER (4)	FL010,FL0	20,FL410,FL	1 60							
LEAD ANALYST:	B. E. A	MES										
ASSESSMENT:												
CRITICALITY REDUNDANCY SCREENS CIL ITEM												
	UNC	A	В	С	TTEM							
NASA [2 /: IOA [3 /:	R] [P] P]	[P] [P]	[P] [P]	* [X]							
COMPARE [N /] [1	[]	[]	[N]							
RECOMMENDATIONS	: (If d	lifferen	t from NA	SA)								
[/) [3	[]	[.]	[] ADD/DELETE)							
* CIL RETENTION	* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []											
REMARKS: ALSO NASA FMEA AND M4-1B1-FLO: THE FAILURE MOI A 2 BECAUSE IF	0-1 FOR C E IS REST THE SAME	2 FILTE RICTED TANK'S	R (3) - F FLOW. TH RELIEF VA	ILTER (2) - L010, FL020, E HARDWARE (LVE ALSO FA)	FL010, FL020, FL410 CRITICALITY IS							

TANK.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	PRSD-359	NASA DATA BASELINE 1 NEW										
SUBSYSTEM: MDAC ID: ITEM:	EPG 359 02 CHECK VALV	E (1) CV020										
LEAD ANALYST:	B. E. AMES											
ASSESSMENT:												
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM												
HDW/FU	NC A	ВС										
NASA [2 /1R IOA [2 /1R] [P]] [P]	[F] [P] [F]	[] * [x]									
COMPARE [/] []	[] []	[N]									
RECOMMENDATIONS:	(If differe	nt from NASA)										
.[/] []	[] [] (A)	[] DD/DELETE)									
CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []												
REMARKS:		INADEQUATE	r 1									
	IS FAILS OPEN	AND M4-1B1-CV010-1. OR INTERNAL LEAKAGE.	THE HARDWARE									

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #: SUBSYSTEM:	PRSD-360 M4-1B2-CV	010-2	N.F.	SA DATA: BASELINE NEW								
MDAC ID:	EPG 360 02 CHECK											
LEAD ANALYST:	B. E. AME	S										
ASSESSMENT:												
CRITICALI FLIGHT	TY R	EDUNDANCY	SCREENS		CIL ITEM							
	ic A	В	С									
NASA [2 /1R IOA [3 /1R] [P] [P] [P] [P] [P]	[X] * []							
COMPARE [N /] [] [] [1	[N]							
RECOMMENDATIONS:	(If dif:	ferent fro	om NASA)									
[/	J _. [] [] [] (AD	[] D/DELETE)							
* CIL RETENTION F	RATIONALE:	(If appli		DEQUATE DEQUATE	[] [x]							
ADEQUATE [] INADEQUATE [X] REMARKS: ALSO NASA FMEA'S 04-1B-CV010-2 AND M4-1B1-CV010-2. THE FAILURE MODE IS FAILS CLOSED OR RESTRICTED FLOW. THE HARDWARE CRITICALITY IS A 2 BECAUSE IF THE SAME TANK'S RELIEF VALVE ALSO FAILED CLOSED, AN EXPLOSION COULD OCCUR DUE TO CONDUCTIVE HEAT TRANSFER INTO THE TANK. THE RETENTION RATIONALE IS NOT AVAILABLE.												

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	DDGD 36	-		NASA DATA: BASELINE NEW									
MDAC ID:	EPG 361 02 CHEC	K VALVE (1) CV020										
LEAD ANALYST:	B. E. A	MES											
ASSESSMENT:													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C													
HDW/FU													
NASA [1 /1 IOA [1 /1] [NA] [NA] [NA] [NA] [NA] NA]	[X] * [X]								
COMPARE [/] [] [] []	[]								
RECOMMENDATIONS:	(If d	ifferent f	rom NASA)									
. [/] [] [] [] (Al	[] DD/DELETE)								
* CIL RETENTION RATIONALE: (If applicable) ADEQUATE [X] INADEQUATE []													
REMARKS: ALSO NASA FMEA'S 04-1B-A01FSO-1 AND M4-1B1-A01FSO-1. THE FAILURE MODE IS EXTERNAL LEAKAGE. THE NASA FMEA COEXTERNAL LEAKAGE OF MOST COMPONENTS IN ONE FMEA, AND SIEFFECT IS THE SAME, IT IS AGREEABLE.													

ASSESSME ASSESSME NASA FME	NT NT A	D/ II #:	ATE:	2 / PF M4	2/17/88 PRSD-362X M4-1B2-LV045-4					NASA DATA: BASELINE [] NEW [X]									
SUBSYSTE MDAC ID: ITEM: V45X2195	M:			EF 36	G 2			LY VA			OSIT	IOI	1 IN	DIC	CAI	OR.	(1)	l	
LEAD ANA	LYS	ST	:	в.	E.	AM	ÆS												
ASSESSME	NT	:																	
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C																			
NASA IOA	[3 3	/3 /3]		[NA] NA]	[N. N.	A] A]]]	N2 N2	4] 4]			[]	*	
COMPARE	[/]		[]	[]	[]			[]		
RECOMMEN	DA:	ric	ONS:	:	(If	d:	iffe	rent	fr	om 1	NASA	.)				-			
	[/]		[]	. []	. []	1	(AI	[DD/D			
* CIL RE	(ADD/DELETE) * CIL RETENTION RATIONALE: (If applicable) ADEQUATE [] INADEQUATE []																		
REMARKS:											•						,		
ALSO NAS																	_		
THE FAIL																			Ţ
FAILURE																			
RECOMMEN	DEI	0 :	CHA'	r TH	E N	AS?	A FM	EA IT	EM	BE	CHA	NGI	ED T	ני סי	CHE	PO	SII	MOI	
INDICATO						THE	E VA	LVE I	TS:	ELF,	, SI	NCI	TH	E	/AI	VE	COU	ILD B	F
OPERATIN	G]	PEI	RFE(CTLY	•														

ASSESSME ASSESSME NASA FME	NT NT A	DA II	ATE:	2/ PR M4	PRSD-363X M4-1B2-LV045-3						NASA DATA: BASELINE [] NEW [X]							
SUBSYSTE MDAC ID: ITEM: V45X2195				EP 36 H2	3	E S	SUP	PLY	VA	LV	E P	osi:	T]	ON INDI	CA!	ror	(1)	
LEAD ANA	LYS	ST:	;	в.	E.	Al	ŒS	;										
ASSESSME	ASSESSMENT:																	
CRITICALITY REDUNDANCY SCREENS CIL ITEM																		
	F	IDW	/FU	NC			A			В				С				
NASA IOA]	3	/3 /3]		[NA NA	.]		N.				NA] NA]		[] ,	ŧ
COMPARE	[/]		[]	[]		[]		[]	
RECOMMEN	DA'	ric	NS:		(If	đ	iff	ere	nt	fr	om 1	NAS	A)					
	[/]		[]	[]		[1	(Al	[DD/D	ELET	TE)
* CIL RE	TEI	ITV	ON	RAT	'ION?	LI	Ξ:	(If	ap	pl	ical	•	•	ADEQUAT IADEQUAT		[]	
REMARKS:	'A 1	- MT	אוגי	04	_1 D_	_ T T	70 A	5_2	ÄN	n i	M			-		•	•	
THE FAIL	ALSO NASA FMEA'S 04-1B-LV045-3 AND M4-1B1-LV045-3. THE FAILURE MODE IS READS CLOSED WHEN THE VALVE IS OPEN. THE VASA FMEA INCLUDES ANALYSIS OF THE H2 GSE SUPPLY VALVE, WITH THE FAILURE MODE BEING SWITCH POSITION INDICATOR FAILS CLOSED. IT I																	
RECOMMEN	E NA	\SI	A FMEA ITEM BE CHANG						AN	NGED TO THE POSITION NCE THE VALVE COULD BE								

OPERATING PERFECTLY.

ASSESSMENT DATE: ASSESSMENT ID: NASA FMEA #:	2/17/88 PRSD-364X M4-1B2-LV0)15-4	NASA DAT BASELIN NE										
SUBSYSTEM: MDAC ID: ITEM: V45X1195E	EPG 364 O2 GSE SUE	PPLY VALVE POS	SITION INDIC	ATOR (1)									
LEAD ANALYST:	B. E. AMES	3	•										
ASSESSMENT:													
CRITICALITY REDUNDANCY SCREENS CIL FLIGHT ITEM HDW/FUNC A B C													
HDW/FU	VC A	В	С										
NASA [3 /3 IOA [3 /3] [NA	NA] [NA]	[NA] [NA]	[] * [] ₋ :									
COMPARE [/] [] []	[]	[]									
RECOMMENDATIONS:	(If diff	erent from N	ASA)										
[/] [1 []	[] ([] ADD/DELETE)									
* CIL RETENTION I	RATIONALE:	(If applicab	le) ADEQUATE INADEQUATE	· [] []									
REMARKS:	04 10 11101	5 4 NVD W4 11											
ALSO NASA FMEA'S THE FAILURE MODE NASA FMEA INCLUD	IS READS C ES ANALYSIS	PEN WHEN THE OF THE O2 GS	VALVE IS CI SE SUPPLY VA	LVE, WITH THE									
FAILURE MODE BEING RECOMMENDED THAT INDICATOR RATHER	THE NASA F	MEA ITEM BE	CHANGED TO I	HE POSITION									

OPERATING PERFECTLY.

APPENDIX C ASSESSMENT WORKSHEET

ASSESSME NASA FME			, ,		X V015-	3			NASA DA' BASELII N			
SUBSYSTE MDAC ID: ITEM: V45X1195			EPG 365 02 GS	SE S	SUPPLY	VAL	VE PO	SITI	ON INDI	CATOR	(1)	
LEAD ANA	LYST	:	B. E	. AM	ŒS							
ASSESSME	NT:											
	F	LIGH	ITY T NC		REDUN		Y SCR B		C	CII ITI		
NASA IOA	[3	/3 /3]	[NA] NA]	[]	NA] NA]	[] []	NA] NA]]] *	
COMPARE	[/]	[]	[1	ſ	1	[]	
RECOMMEN	DATI	ons:	(I:	f di	ffere	nt f	rom N	IASA)				
•	[/_]	C]	[3	[]] DELETE)
* CIL RE	TENT	ION :	RATIO	NALE	: (If	app:	licab	Ĭ	ADEQUATI ADEQUATI]	
REMARKS: ALSO NAS THE FAIL NASA FME FAILURE	A FM URE I A IN MODE	MODE CLUD BEI	IS RI ES ANI NG SWI	EADS ALYS ITCH	CLOS: SIS OF POSI	ED WI THE TION	HEN T 02 G INDI	B1-L'THE VISE SI	V015-3. ALVE IS UPPLY VI R FAILS	OPEN ALVE, CLOSI	WITH TED. IT	r I
RECOMMEN	DED '	ТНАТ	THE	KZAN	FMEA	TTE	W BE	CHANG	SED TO	PHE PO	STTTO	1

INDICATOR RATHER THAN THE VALVE ITSELF, SINCE THE VALVE COULD BE

OPERATING PERFECTLY.

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APPENDIX D

CRITICAL ITEMS

APPENDIX D CRITICAL ITEMS

MDAC		
ID	ITEM	FAILURE MODE
200	H2 (PRE-FLIGHT) FILL QUICK DISCONNECT (4) & VENT QD'S (5)	EXTERNAL LEAKAGE
202	H2 (PRE-FLIGHT) FILL AND	EXTERNAL LEAKAGE
211	H2 TANK RELIEF VALVE (5) - RV030,RV040,RV500,RV560	FAILED OPEN (ALSO INTERNAL LEAKAGE)
218	H2 TANK SUBASSEMBLY (5)	
229	H2 LINES, COMPONENTS, & FITTINGS	RESTRICTED FLOW
231	H2 MANIFOLD 1 RELIEF VALVE (1) RV031	FAILED OPEN (ALSO INTERNAL LEAKAGE)
234	H2 MANIFOLD 2 RELIEF VALVE	FAILED OPEN (ALSO INTERNAL LEAKAGE)
237	(1) RV041 H2 CHECK VALVE (2) CV031,CV041	FAILS OPEN (ALSO INTERNAL
240	H2 CHECK VALVE (1) CV030	LEAKAGE) FAILS OPEN (ALSO INTERNAL
243	H2 CHECK VALVE (1) CV040	FAILS OPEN (ALSO INTERNAL
		LEAKAGE) EXTERNAL LEAKAGE
246	H2 HORIZONTAL DRAIN QD (1) TYPE II, CLASS 8	
248	H2 HORIZONTAL DRAIN CAP (1)	EXTERNAL LEAKAGE
255	H2 HORIZONTAL DRAIN CAP (1) H2 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1) LV033	FAILS OPEN (INCLUDES
•	REACTANT SUPPLY VALVE (1) LV033	INTERNAL LEAKAGE)
256		FAILS CLOSED
258	H2 FUEL CELL 2 SOLENOID REACTANT	FAILS OPEN (INCLUDES
	SUPPLY VALVE (1) LV043	INTERNAL LEAKAGE)
259	H2 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1) LV043	FAILS CLOSED
261	H2 FUEL CELL 3 SOLENOID REACTANT	FAILS OPEN (INCLUDES
	SUPPLY VALVE (1) LV044	INTERNAL LEAKAGE) FAILS CLOSED
262	H2 FUEL CELL 3 SOLENOID REACTANT SUPPLY VALVE (1) LV044	
267	H2 SOLENOID GSE SUPPLY VALVE (1) LV045	FAILS OPEN (INCLUDES INTERNAL LEAKAGE)
270	H2 FILL GSE SUPPLY T-0 QUICK DISCONNECT (1) PD035	EXTERNAL LEAKAGE
272	O2 CHECK VALVE (1) CV010	FAILS OPEN (INTERNAL LEAKAGE ALSO)
275	02 SOLENOID GSE SUPPLY VALVE	FAILS OPEN (INTERNAL LEAKAGE ALSO)
270	(1) LV015 02 SOLENOID ECLSS SYSTEM 1	FAILS OPEN (INTERNAL
278	SUPPLY VALVE (1) LV012	LEAKAGE ALSO)

MDAC		
ID	ITEM	FAILURE MODE
279	02 SOLENOID ECLSS SYSTEM 1	FAILS CLOSED
2,,,	SUPPLY VALVE (1) LV012	
281	02 SOLENOID ECLSS SYSTEM 2	FAILS OPEN (INTERNAL
	SUPPLY VALVE (1) LV022	LEAKAGE ALSO)
282	02 SOLENOID ECLSS SYSTEM 2 SUPPLY VALVE (1) LV022 02 SOLENOID ECLSS SYSTEM 2	FAILS CLOSED
	SUPPLY VALVE (1) LV022	
284	02 FILL GSE SUPPLY T-0 QUICK	EXTERNAL LEAKAGE
201	DISCONNECT (1) PD015	
289	02 FUEL CELL 1 SOLENOID REACTANT SUPPLY VALVE (1) LV013	FAILS OPEN (INCLUDES
290	02 FUEL CELL 1 SOLENOID REACTANT	FAILS CLOSED
	SUPPLY VALVE (1) LV013	
298	02 HORIZONTAL DRAIN QD (1)	EXTERNAL LEAKAGE
300	02 HORTZONTAL DRATH CAP (1)	EXTERNAL LEAKAGE
301	02 FUEL CELL 3 SOLENOID REACTANT	FAILS OPEN (INCLUDES
	SUPPLY VALVE (1) LV024	INTERNAL LEAKAGE)
302	02 FUEL CELL 3 SOLENOID REACTANT	FAILS CLOSED
	SUPPLY VALVE (1) LV024	
304	02 FUEL CELL 2 SOLENOID REACTANT SUPPLY VALVE (1) LV023	FAILS OPEN (INCLUDES
	SUPPLY VALVE (1) LV023	INTERNAL LEAKAGE)
305	02 FUEL CELL 2 SOLENOID REACTANT	FAILS CLOSED
	SUPPLY VALVE (1) LV023	
307	SUPPLY VALVE (1) LV023 O2 MANIFOLD 1 RELIEF VALVE	FAILED OPEN (ALSO
	III KVUII	INTERNAL LEAKAGE)
310	· ·	FAILED OPEN (ALSO
	(1) RV021	INTERNAL LEAKAGE)
313	02 CHECK VALVE (2) CV021	FAILS OPEN (INTERNAL
		LEAKAGE ALSO)
317	02 LINES, COMPONENTS, & FITTINGS	RESTRICTED FLOW
332	O2 TANK SUBASSEMBLY (5)	LOSS OF ANNULUS VACUUM
334	O2 TANK SUBASSEMBLY (5) O2 TANK RELIEF VALVE (5) RV010,RV020,RV410,RV460 O2 (PRE-FLIGHT) FILL AND VENT	FAILED OPEN (ALSO
0.45	RV010, RV020, RV410, RV460	INTERNAL LEAKAGE)
345	OZ (PRE-FLIGHT) FILL AND VENT	EXTERNAL LEAKAGE
246	QD CAPS (9)	DVMDDNAT TEAUACE
346		EXTERNAL LEAKAGE
250	DISCONNECTS (4) AND VENT QD'S (5)	FAILS OPEN (INTERNAL
359	02 CHECK VALVE (1) CV020	LEAKAGE ALSO)
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APPENDIX E DETAILED ANALYSIS

This appendix contains the IOA analysis worksheets supplementing previous results reported in STSEOS Working Paper 1.0-WP-VA86001-11, Analysis of the EPG/PRSD, (5 December 1986). Prior results were obtained independently and documented before starting the FMEA/CIL assessment activity. Supplemental analysis was performed to address failure modes not previously considered by the IOA. Each sheet identifies the hardware item being analyzed, parent assembly and function performed. For each failure mode possible causes are identified, and hardware and functional criticality for each mission phase are determined as described in NSTS 22206. Instructions for Preparation of FMEA and CIL, 10 October 1986. Failure mode effects are described at the bottom of each sheet and worst case criticality is identified 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: 12/31/86 HIGHEST CRITICALITY HDW/FUNC SUBSYSTEM: EPG FLIGHT: 3/3

MDAC ID: 362 ABORT: 3/3

ITEM: H2 GSE SUPPLY VALVE POSITION INDICATOR (1)

V45X2195E

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 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:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:

THE SENSOR IS USED TO TELL THE CREW OF VALVE'S POSITION.

NORMALLY THE VALVE IS CLOSED AFTER PRELAUNCH ACTIVITIES. THE

FAILURE MAY NOT BE ABLE TO BE VERIFIED.

INDEPENDENT ORBITER ASSESSMENT ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/31/86 HIGHEST CRITICALITY HDW/FUNC

SUBSYSTEM: EPG FLIGHT: 3/3 MDAC ID: 363 ABORT: 3/3

ITEM: H2 GSE SUPPLY VALVE POSITION INDICATOR (1)

V45X2195E

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 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:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:

THE SENSOR IS USED TO TELL THE CREW OF VALVE'S POSITION.
NORMALLY THE VALVE IS CLOSED AFTER PRELAUNCH ACTIVITIES. THE
FAILURE MAY NOT BE ABLE TO BE VERIFIED.

INDEPENDENT ORBITER ASSESSMENT ORBITER SUBSYSTEM ANALYSIS WORKSHEET

HIGHEST CRITICALITY HDW/FUNC DATE: 12/31/86 FLIGHT: 3/3 SUBSYSTEM: EPG

ABORT: 3/3 MDAC ID: 364

O2 GSE SUPPLY VALVE POSITION INDICATOR (1) ITEM:

V45X1195E

FAILURE MODE: READS OPEN WHEN VALVE CLOSED

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

BREAKDOWN HIERARCHY:

- EPG 1)
- 2) PRSD
- OXYGEN DISTRIBUTION 3)
- 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:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:

THE SENSOR IS USED TO TELL THE CREW OF VALVE'S POSITION. NORMALLY THE VALVE IS CLOSED AFTER PRELAUNCH ACTIVITIES. THE FAILURE MAY NOT BE ABLE TO BE VERIFIED.

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INDEPENDENT ORBITER ASSESSMENT ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/31/86 HIGHEST CRITICALITY HDW/FUNC

SUBSYSTEM: EPG FLIGHT: 3/3 MDAC ID: 365 ABORT: 3/3

ITEM: O2 GSE SUPPLY VALVE POSITION INDICATOR (1)

V45X1195E

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 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:

CAUSES: ELECTRICAL FAILURE, CORROSION, VIBRATION, SHOCK

EFFECTS/RATIONALE:

THE SENSOR IS USED TO TELL THE CREW OF VALVE'S POSITION. NORMALLY THE VALVE IS CLOSED AFTER PRELAUNCH ACTIVITIES. THE FAILURE MAY NOT BE ABLE TO BE VERIFIED.

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APPENDIX F NASA FMEA TO IOA WORKSHEET CROSS REFERENCE/RECOMMENDATIONS

This section provides a cross reference between the NASA FMEA and corresponding IOA analysis worksheet(s) included in Appendix E. The Appendix F identifies: NASA FMEA Number, IOA Assessment Number, NASA criticality and redundancy screen data, and IOA recommendations.

Appendix F Legend

Code Definition

- 1 IOA recommends that a FMEA for this failure mode be written.
- 2 IOA recommends maintaining all the components listed on this sheet in the NASA FMEA/CIL list to ensure visibility whenever more than two tank sets fly.
- 3 IOA concurs with NASA's re-evaluation.
- 4 IOA recommends changing the hardware criticality to a 3.
- 5 IOA recommends changing the hardware criticality to a 3 for greater than two tank sets.
- 6 IOA recommends that screen B be NA per NSTS 22206 section 2.3.4.b.2.a. because the component is standby redundant.
- 7 IOA recommends passing screen B per NSTS 22206 section 2.3.5.a. because the failure mode is detectable with a valve position indicator.
- The CIL retention rationale was not available for review.
- 9 IOA recommends that the NASA FMEA item be changed from the valve to the valve position indicator.
- 10 IOA recommends that a separate FMEA be written for this failure mode.
- 11 IOA generated a non-credible failure mode.
- 12 IOA generated a failure mode covered by EPD&C.
- 13 IOA recommends that the NASA FMEA hardware criticality be a 2 for the onorbit phase also, because loss of a fuel cell impacts the mission.

APPENDIX F

NASA FMEA TO IOA WORKSHEET CROSS REFERENCE / RECOMMENDATIONS

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