INDEPENDENT ORBITER ASSESSMENT

ANALYSIS
OF THE
GUIDANCE, NAVIGATION,
AND CONTROL SUBSYSTEM

19 DECEMBER 1986
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Independent Orbiter Assessment
Analysis of the Guidance, Navigation, and Control Subsystem

1.0 EXECUTIVE SUMMARY

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

The function of the GNC hardware is to respond to guidance, navigation, and control software commands to effect vehicle control and to provide sensor and controller data to GNC software. The GNC hardware for which failure modes analysis was performed consists of the following:

- Rotational Hand Controller (RHC)
- Translational Hand Controller (THC)
- Rudder Pedal Transducer Assembly (RPTA)
- Speed Brake Thrust Controller (SBTC)
- Inertial Measurement Unit (IMU)
- Star Tracker (ST)
- Crew Optical Alignment Site (COAS)
- Air Data Transducer Assembly (ADTA)
- Orbiter Rate Gyro Assembly (ORGA)
- SRB Rate Gyro Assembly (SRGA)
- Accelerometer Assembly (AA)
- Aerosurface Servo Amplifier (ASA)
- Reaction Jet Driver (RJD)
- Ascent Thrust Vector Control (ATVC)
- GNC Function Switches and Circuits
- Power Switches and Circuits

The IOA analysis process utilized available GNC hardware drawings, workbooks, specifications, schematics, and systems briefs for defining hardware assemblies, components, and circuits. Each hardware item was evaluated and analyzed for possible failure modes and effects. Criticality was assigned based upon the severity of the effect for each failure mode.
Figure 1 presents a summary of the failure criticalities for each of the sixteen major subdivisions of the GNC subsystem. A summary of the number of failure modes, by criticality, is also presented below with Hardware (HW) criticality first and Functional (F) criticality second.

<table>
<thead>
<tr>
<th>Criticality:</th>
<th>1/1</th>
<th>2/1R</th>
<th>2/2</th>
<th>3/1R</th>
<th>3/2R</th>
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<tbody>
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<td>Number</td>
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<td>8</td>
<td>67</td>
<td>21</td>
<td>30</td>
<td>141</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Criticality:</th>
<th>1/1</th>
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<th>2/2</th>
<th>3/1R</th>
<th>3/2R</th>
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<td>Number</td>
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<td>12</td>
<td>8</td>
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<td>24</td>
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</table>
Figure 1 - GNC OVERVIEW ANALYSIS SUMMARY - CONTINUED

<table>
<thead>
<tr>
<th>ADTA</th>
<th>ATVC</th>
<th>AA</th>
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</thead>
<tbody>
<tr>
<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
</tr>
<tr>
<td>3/1R 2 0</td>
<td>2/1R 2 2</td>
<td>3/1R 2 0</td>
</tr>
<tr>
<td></td>
<td>3/1R 3 0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST</th>
<th>IMU</th>
<th>COAS</th>
</tr>
</thead>
<tbody>
<tr>
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<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
</tr>
<tr>
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<td>3/1R 1 0</td>
</tr>
<tr>
<td></td>
<td>3/1R 1 1</td>
<td>3/3 1 0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>ORGA</th>
<th>RJD</th>
<th>ASA</th>
<th>SRGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
<td>CRIT #FM #PCI</td>
</tr>
<tr>
<td>3/1R 2 0</td>
<td>1/1 2 2</td>
<td>2/1R 1 1</td>
<td>3/1R 2 0</td>
</tr>
<tr>
<td></td>
<td>3/1R 4 0</td>
<td>3/1R 7 0</td>
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</tr>
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</table>
2.0 INTRODUCTION

2.1 Purpose

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

2.2 Scope

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

2.3 Analysis Approach

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

Step 1.0 Subsystem Familiarization
1.1 Define subsystem functions
1.2 Define subsystem components
1.3 Define subsystem specific ground rules and assumptions

Step 2.0 Define subsystem analysis diagram
2.1 Define subsystem
2.2 Define major assemblies
2.3 Develop detailed subsystem representations

Step 3.0 Failure events definition
3.1 Construct matrix of failure modes
3.2 Document IOA analysis results
Step 4.0 Compare IOA analysis data to NASA FMEA/CIL

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

2.4 GNC Ground Rules and Assumptions

The GNC ground rules and assumptions used in the IOA are defined in Appendix B.
3.0 SUBSYSTEM DESCRIPTION

3.1 Design and Function

The function of the GNC hardware is to respond to guidance, navigation, and control software commands to effect vehicle control and to provide sensor and controller data to GNC software.

The functions of the GNC software can be divided into flight control, guidance, navigation, hardware data processing, and crew display. The specific tasks of each function, as well as the GNC hardware used to support them, vary with mission phase.

Figure 2 is an overview of the GNC hardware for which failure modes analysis was performed. For the analysis, the hardware was divided into the following three categories:

I. MAJOR COMPONENTS (BLACK BOXES) - This category includes the sensors, manual controllers, and effector interfaces listed below:

1. RHC
2. THC
3. RPTA
4. SBTC
5. IMU
6. ST
7. COAS
8. ADTA
9. RGA (ORB)
10. RGA (SRB)
11. AA
12. ASA
13. RJD
14. ATVC

Figures 3 - 16 provide a hardware breakdown of each of the above components.

II. FUNCTION SWITCHES AND CIRCUITS - This category consists of switches/circuits whose primary purpose is to select a particular mode of operation for the GNC software. Twelve groups were identified and are listed below:

1. TRIM ENABLE/INHIBIT SWs
2. TRIM SWs
3. TRIM ON/OFF SWs
4. SENSE -Z/-X SW
5. P,R/Y CSS/AUTO PBIs
6. SPD BK/THROT PBIs
7. BODY FLAP CNTL CKT
8. ATT REF PBI
9. ENTRY MODE SW CKT
10. ABORT MODE CKT
11. DAP PBIs
12. FCS CHNL CNTL CKT

7
III. POWER SWITCHES AND CIRCUITS - This category consists of groups of switches/circuits that provide electrical power to the major components and Flight Control System (FCS) annunciator lamps. Twelve groups were identified and are listed below:

(1) FLT_CNTL RWR CKT
(2) IMU PWR CKT
(3) ST PWR CKT
(4) COAS PWR CKT
(5) ADTA PWR CKT
(6) RGA (ORB) PWR CKT
(7) RGA (SRB) PWR CKT
(8) AA PWR CKT
(9) ASA PWR CKT
(10) RJD PWR CKT
(11) ATVC PWR CKT
(12) FCS SW ANNUN CKT

A brief description of the major components and function switches and circuits is provided below.

1. Three RHCs, two forward and one aft, provide manual attitude control.

2. Two THCs, one at the CDRs station and one aft, provide manual translation control with the use of the RCS system.

3. Two RPTAs, one connected to the CDRs pedals and one to the PLTs, send rudder and nose wheel steering commands to the GPCs.

4. Two SBTCs, one at the CDRs station and one at the PLTs, control the speed brake during entry. The pilot's SBTC can also be used for main engine throttle control during ascent.

5. Three IMUs, attached to the NAV base, provide acceleration and attitude data to the GPCs.

6. Two STs, mounted on the NAV base, are used to align the IMUs and to provide line of site vectors during rendezvous missions.

7. One COAS that can be mounted at the CDRs station or the aft station is a backup to the STs for use in IMU alignment.

8. Four ADTAs, located in the forward avionics bay, provide pressure data to the GPCs. This data is used during entry to calculate angle of attack, relative speed, mach number, and barometric altitude.

9. Four orbiter RGAs, mounted at the bottom of the aft bulkhead, provide attitude rates about each body axis to flight control for stability augmentation during ascent and entry. The RGAs also drive the rate needles of the ADIs during ascent.
10. Four SRB RGAs, two on the left and two on the right SRB, provide pitch and yaw rates to flight control to assist in SRB TVC and to provide stability augmentation during ascent until SRB separation.

11. Four AAs, located in the forward avionics bays, measure normal and lateral body acceleration for use in flight control to provide stability augmentation during ascent and entry.

12. Four ASAs, located in the aft avionics bays, derive aerosurface actuator position error commands and perform fault detection.

13. Four RJDs, two forward and two aft, in response to flight control commands, send signals to open/close the oxidizer and fuel valves associated with each RCS jet.

14. Four ATVCs, located in the aft avionics bays, provide SRB and main engine gimbal control for slewing engine bells prior to liftoff, gimbaling engines to control trajectory during flight, positioning the main engines to a dump position, and stow position.

15. Two TRIM ENABLE/INHIBIT switches, CDRs and PLTs, allow the software to accept or reject trim commands from the panel trim switches and the RHC trim switches.

16. Six TRIM switches, a roll, pitch, yaw set at the CDRs and PLTs station, allow the crew to make small changes in the vehicles attitude via commands to the aerosurfaces.

17. Two panel TRIM ON/OFF switches, CDRs and PLTs, provide power to the associated TRIM switches when in the "ON" position.

18. One SENSE -Z/-X switch located on the aft panel A6, is used onorbit to make the aft RHC, THC, and ADI correspond to the line of sight.

19. Two sets of PITCH, ROLL/YAW CSS/AUTO PBIs exist (eight switches total) that allow the CDR or PLT to select auto or manual (CSS) attitude control during ascent and entry.

20. Two SPD BK/THROT PBIs, CDRs and PLTs station, allow the crew to switch to auto from manual throttle control during ascent and to auto or manual speed brake control during entry.

21. The BODY FLAP CONTROL CIRCUIT consists of two BODY FLAP UP/DOWN switches and two BODY FLAP AUTO/MANUAL PBIs that allow manual or auto control from either the CDRs or PLTs station.
22. Three ATT REF PBIs, located at the CDRs, PLTs, and aft crew stations, allow the crew to select a reference frame from which attitude errors will be displayed on the three Attitude Direction Indicators (ADI). The ATT REF PBI is also used to take "marks" when the COAS is used for IMU alignment.

23. The ENTRY MODE SWITCH CIRCUIT provides capability for the crew to change DAP control modes during entry via the ENTRY MODE switch.

24. The ABORT MODE SWITCH CIRCUIT provides capability for the crew to select and initiate an abort mode during ascent via the ABORT MODE ROTARY switch and the ABORT push button.

25. Forty eight DAP PBIs (24 fwd and 24 aft) provide crew flexibility in selecting translational and rotational control options with the ONORBIT and TRANS DAPS.

26. Four FCS CHANNEL CONTROL CIRCUITS provide power and control to one of four ASASs and ATVCs via the four FCS CHANNEL switches on panel C3.

3.2 Interfaces and Locations

The GNC hardware is located throughout the Orbiter. The precise location for each component/switch/circuit is provided on the analysis worksheets in Appendix C.

The GNC hardware is interfaced with the software via the flight critical MDMs. Switch and power status is monitored via the flight critical MDMs and operational instrumentation.

3.3 Hierarchy

Figure 2 illustrates the breakdown of the GNC into its hardware components, and Figures 3 - 16 are the detailed systems representations.
GNC SUBSYSTEM OVERVIEW

Figure 2 - GNC SUBSYSTEM OVERVIEW
Figure 3 - GNC ROTATIONAL HAND CONTROLLER (RHC)
GNC TRANSLATIONAL HAND CONTROLLER

Figure 4 - GNC TRANSLATIONAL HAND CONTROLLER (THC)
Figure 5 - GNC RUDDER PEDAL TRANSDUCER ASSEMBLY (RPTA)
Figure 7 - GNC INERTIAL MEASUREMENT UNIT (IMU)
Figure 8 - GNC STAR TRACKER (ST)
Figure 9 - GNC CREW OPTICAL ALIGNMENT SITE (COAS)
GNC AIR DATA TRANSDUCER ASSEMBLY

Figure 10 - GNC AIR DATA TRANSDUCER ASSEMBLY (ADTA)
GNC ORBITER RATE GYRO ASSEMBLY

Figure II - GNC ORBITER RATE GYRO ASSEMBLY (ORGA)
GNC SOLID ROCKET BOOSTER RATEGYRO ASSEMBLY

Figure 12 - GNC SRB RATE GYRO ASSEMBLY (SRGA)
GNC ACCELEROMETER ASSEMBLY

Figure 13 - GNC ACCELEROMETER ASSEMBLY (AA)
Figure 14 - GNC AEROSURFACE SERVO AMPLIFIER
Figure 15 - GNC REACTION JET DRIVER (RJD)
GNC ASCENT THRUST VECTOR CONTROL

Figure 16 - GNC ASCENT THRUST VECTOR CONTROL (ATVC)

GNC ASCENT THRUST VECTOR CONTROL
  ATVC - 1
  ATVC - 2
  ATVC - 3
  ATVC - 4

- ISOLATE COMMAND CIRCUIT
- POSITION COMMAND CIRCUIT
- SECONDARY DELTA-P FEEDBACK CIRCUIT
4.0 ANALYSIS RESULTS

The GNC analysis was divided into the following three categories:

I. MAJOR COMPONENTS (BLACK BOXES)

II. FUNCTION SWITCHES AND CIRCUITS - primary purpose is to select a particular mode of operation for the GNC software.

III. POWER SWITCHES AND CIRCUITS - these provide electrical power to the GNC major components and DAP annunciation lamps.

Table I summarizes the total number of identified failure modes and their criticalities. Table II summarizes the total number of PCIs.

<table>
<thead>
<tr>
<th>Criticality:</th>
<th>1/1</th>
<th>2/1R</th>
<th>2/2</th>
<th>3/1R</th>
<th>3/2R</th>
<th>3/3</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>Number</td>
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<td>8</td>
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</tbody>
</table>

<table>
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<th>Criticality:</th>
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<th>2/2</th>
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<th>3/2R</th>
<th>3/3</th>
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<td>8</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>24</td>
</tr>
</tbody>
</table>

The three categories are summarized below, with the detailed analysis results for each of the identified failure modes presented in Appendix C.

4.1 ANALYSIS RESULTS - GNC MAJOR COMPONENTS

Fourteen components were included in this category. Table III lists the components and summarizes the failure mode criticalities for each component. Table IV summarizes the number of PCIs for this category.
### TABLE III  GNC MAJOR COMPONENTS
Summary of IOA Failure Modes and Criticalities

<table>
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<th>Criticality:</th>
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<th>3/2R</th>
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<tr>
<td>2. THC</td>
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<td>1</td>
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<td>3. RPTA</td>
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<tr>
<td>4. SBTC</td>
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<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>5. IMU</td>
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<td>-</td>
<td>1*</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>6. ST</td>
<td></td>
<td></td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>7. COAS</td>
<td></td>
<td></td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. ADTA</td>
<td></td>
<td></td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>9. RGA (ORB)</td>
<td></td>
<td></td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>10. RGA (SRB)</td>
<td></td>
<td></td>
<td>-</td>
<td>2</td>
<td>-</td>
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<tr>
<td>11. AA</td>
<td></td>
<td></td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
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<td>12. ASA</td>
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<td>-</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>8</td>
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<tr>
<td>13. RJD</td>
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<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>6</td>
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<td>14. ATVC</td>
<td></td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
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</tbody>
</table>

*PCI due to Screen C failure.

### TABLE IV  GNC MAJOR COMPONENTS
Summary of IOA Potential Critical Items

<table>
<thead>
<tr>
<th>Criticality:</th>
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<th>2/2</th>
<th>3/1R</th>
<th>3/2R</th>
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<tbody>
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<td>9</td>
<td>-</td>
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<td>-</td>
<td>12</td>
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</tbody>
</table>
4.2 ANALYSIS RESULTS - GNC FUNCTION SWITCHES AND CIRCUITS

Twelve groups of switches and circuits make up this category. Table V lists the individual groups and summarizes the failure mode criticalities for each. Table VI summarizes the number of PCIs for this category.

<table>
<thead>
<tr>
<th>Criticality:</th>
<th>1/1</th>
<th>2/1R</th>
<th>2/2</th>
<th>3/1R</th>
<th>3/2R</th>
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<tbody>
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<td>1. TRIM ENABLE INHIB SW'S</td>
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</tr>
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<td>2. TRIM SW'S</td>
<td>-</td>
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<td>-</td>
<td>-</td>
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<td>2</td>
</tr>
<tr>
<td>3. TRIM ON/OFF SW'S</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4. SENSE -Z/-X SW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5. P,R/Y CSS/AUTO PBI'S</td>
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<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>6. SPD BK/THROT PBI</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
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4.3 ANALYSIS RESULTS - GNC POWER SWITCHES AND CIRCUITS

Twelve groups of switches and circuits make up this category. Table VII lists the individual groups and summarizes the failure mode criticalities for each group. Table VIII summarizes the number of PCIs for this category.

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### TABLE VIII GNC POWER SWITCHES AND CIRCUITS
Summary of IOA Potential Critical Items

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### 4.4 LIST OF MDAC ANALYSIS WORKSHEET IDENTIFICATION NUMBERS

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5.0 REFERENCES

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

1. JSC-18863, Guidance and Control Systems Briefs, 9-30-85
2. CONT 2102, Controllers Workbook, 2-1-82
3. GNC HS OV 2102, GNC Hardware/Software Overview, 5-17-84
4. JSC-12820, STS operational Flight Rules, PCN-1, 2-14-86
5. VS70-971099, Integrated System Schematic - GNC & Data Processing, OV-099 & OV-103, 4-11-86
6. VS70-790129, Schematic Diagram - Rotational Hand Controller, 10-22-80
7. VS70-790159, Schematic Diagram - Translational Hand Controller, 1-14-81
8. VS70-790149, Schematic Diagram - Rudder Pedal Transducer Assembly, 1-12-81
9. VS70-971099, Schematic Diagram - Speed Brake Thrust Controller, 11-17-80
10. VS70-710109, Schematic Diagram, Inertial Measurement Unit, 11-12-80
11. VS70-710149, Schematic Diagram, Star Tracker, 11-18-80
12. VS70-590309, Schematic Diagram, Air Data Probe Deployment and Heater, 11-12-80
13. VS70-710152, Schematic Diagram, Orbiter Rate Gyro & Navigation Subsystem, 3-24-75
14. VS70-790119, Schematic Diagram, Accelerometer Assembly, 10-30-80
15. VS70-790229, Schematic Diagram, Aerosurface Servo Amplifier, 12-10-80
16. VS70-420109, 209, 309, Schematic Diagram, RCS Fwd, Aft Right, & Aft Left Modules, March 1980
17. VS70-790239, Schematic Diagram, Ascent Thrust Vector Control-Flt Control Subsystem, 3-18-81
### APPENDIX A

#### ACRONYMS

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TAL - Transatlantic Abort Landing
TD - Touch Down
THC - Translational Hand Controller
TRANS - Translation
TVC - Thrust Vector Control
VDC - Volts Direct Current
VERN - Vernier
Y - Yaw
APPENDIX B

DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.1 Definitions
B.2 Project Level Ground Rules and Assumptions
B.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

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

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

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

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

HIGHEST CRITICALITY - the highest functional criticality determined in the phase-by-phase analysis

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

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

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

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

OPS - software operational sequence

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

PHASE DEFINITIONS:

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

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

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

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

LANDING/SAFING PHASE - begins at first main gear touchdown and ends with the completion of post-landing safing operations
APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.2 IOA Project Level Ground Rules and Assumptions

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

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

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

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

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

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

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

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

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

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

   RATIONALE: Failures caused by human operational error are out-of-scope of this task.
6. All hardware analyses will, as a minimum, be performed at the level of analysis existent within NASA/Prime Contractor Orbiter FMEA/CILs, and will be permitted to go to greater hardware detail levels but not lesser.

RATIONALE: Comparison of IOA analysis results with other analyses requires that both analyses be performed to a comparable level of detail.

7. Verification that a telemetry parameter is actually monitored during AOS by ground-based personnel is not required.

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

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

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

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

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

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

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

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

RATIONALE: Clarify definition of emergency systems to ensure consistency throughout IOA project.
APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.3 GNC - Specific Ground Rules and Assumptions

1. The failure analyses will be conducted to the black box level for components whose output serves only one function unless a lower level is required to be consistent with the existing FMEAs.

   RATIONALE: The definition credible failure modes are oriented toward the black box functional output.

2. For black boxes whose output serves more than one function, the analysis will go to a level that effects each of the different functions.

   RATIONALE: The defined credible failure modes are oriented toward the black box functional output.

3. Credible failure modes for most black boxes are defined to be

   (1) No output
   (2) Erroneous output (Output that redundancy management will detect as a failure.)
   (3) Premature output (Output occurs without command. This may not be credible for all black boxes.)

   RATIONALE: Covers worst case effects on function.

4. Credible failures for switches are defined to be

   (1) Fails on (Power cannot be shut off by switch.)
   (2) Fails off (Power cannot be turned on.)
   (3) Short to ground
   (4) Internal short (Short across switch contacts.)

   RATIONALE: Covers worst case effects on function.

5. Power circuits analysis does not include the resistors that reside between the power circuit and a MDM.

   RATIONALE: These resistors provide signal conditioning for the MDM and are not a part of the power circuit.
APPENDIX C
DETAILED ANALYSIS

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

LEGEND FOR IOA ANALYSIS WORKSHEETS

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

Functional Criticalities:
1R = Redundant hardware items (like or unlike) all of which, if failed, could cause loss of life or vehicle.
2R = Redundant hardware items (like or unlike) all of which, if failed, could cause loss of mission.

Redundancy Screen A:
1 = Is Checked Out PreFlight
2 = Is Capable of Check Out PreFlight
3 = Not Capable of Check Out PreFlight
NA = Not Applicable

Redundancy Screens B and C:
P = Passed Screen
F = Failed Screen
NA = Not Applicable
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/11/86
SUBSYSTEM: GNC
MDAC ID: 101

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

ITEM: RHC
FAILURE MODE: PHYSICAL BINDING/JAMMING OF_CNTL STICK

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC
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LOCATION: 30V73A5,A6,A7
PART NUMBER: MC621-0043-3046

CAUSES: CONTAMINATION, MECH SHOCK, MISHANDLING, VIBRATION

EFFECTS/RATIONALE:
LOSS OF 1 RED RHC FUNCTION. 2 FWD AND 1 AFT RHC'S.
OPS-2 IFM ALLOWS REPLACEMENT OF RHC'S.

REFERENCES:

REPORT DATE 12/15/86 C-2
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/11/86
SUBSYSTEM: GNC
MDAC ID: 102
HIGHEST CRITICALITY
FLIGHT: 3/1R
ABORT: 3/1R

ITEM: RHC
FAILURE MODE: NO XDCR OUTPUT ON A CMD CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC
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LOCATION: 30V73A5,A6,A7
PART NUMBER: MC621-0043-3046

CAUSES: LOSS OF EXCITATION VOLTAGE, TRANSDUCER CIRCUIT FAIL OPEN.

EFFECTS/RATIONALE:
NONE: LOSS OF 1 OF 3 REDUNDANT CHANNELS.
2 FWD AND 1 AFT RHC'S. OPS-2 IFM ALLOWS REPLACEMENT OF RHC'S.

REFERENCES:

REPORT DATE 12/15/86 C-3
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/11/86
SUBSYSTEM: GNC
MDAC ID: 103

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

ITEM: RHC
FAILURE MODE: ERRONEOUS XDCR OUTPUT ON A CMD CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC
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LOCATION: 30V73A5,A6,A7
PART NUMBER: MC621-0043-3046

CAUSES: XDCR CIRCUIT FAILURE, VIBR, TEMP.

EFFECTS/RATIONALE:
NONE: LOSS OF 1 OF 3 REDUNDANT CHANNELS.
2 FWD AND 1 AFT RHC'S. OPS-2 IFM ALLOWS REPLACEMENT OF RHC'S.

REFERENCES:

REPORT DATE 12/15/86 C-4
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/11/86
SUBSYSTEM: GNC
MDAC ID: 104

ITEM: RHC
FAILURE MODE: NO OUTPUT ON A TRIM SW CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC

CRITICALITIES

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LOCATION: 30V73A5,A6,A7
PART NUMBER: MC621-0043-3046

CAUSES: SW CONT FAILED OPEN, SW SHORTED TO GROUND.

EFFECTS/RATIONALE:
LOSS OF TRIM SW FUNCTION (BY AXIS). PNL AND RHC TRIM SW'S.
LOSS OF TRIM SW FUNCTION CAUSES SOME INCR IN CREW WORKLOAD.

REFERENCES:

REPORT DATE 12/15/86  C-5
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/11/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 105  ABORT: 3/3

ITEM: RHC
FAILURE MODE: TRIM SW CHN FAILS ON.

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC
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LOCATION: 30V73A5,A6,A7
PART NUMBER: MC621-0043-3046

CAUSES: SWITCH CONTACTS SHORTED (VIBR, MECH SHOCK, CONTAMINATION).

EFFECTS/RATIONALE:
NONE: 1 OF 2 SW CONT'S (REDUNDANT CHN'S) FAILED ON.
TRIM SW CMD ON WITH 2 CHN'S FLD ON, PNL TRIM SW TO INHIBIT.

REFERENCES:

REPORT DATE 12/15/86  C-6
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/03/86
SUBSYSTEM: GNC
MDAC ID: 110

ITEM: CIRCUIT-FLT CNTLR PWR
FAILURE MODE: CB OR SW FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC, SBTC, RPTA, THC
3) FLT CNTLR PWR CIRCUIT
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LOCATION: SW'S: PNL F7A5S2, F8A8S1, A6A1S2. CB'S: PNL 014 CB30, 31, 015 CB29, 30, 016 CB22, 23.
PART NUMBER: SW'S (ME452-0102-7352), CB'S (MC454-0026-2075).

CAUSES: CB OR SW CONTACTS SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: IF 1 OF 3 OR ALL SW CHN'S FL ON, CNTLR PWR CAN BE TURNED OFF ON ALL 3 CHN'S BY THE 2 REDUNDANT CB'S. IF 1 OF 2 CB'S FL ON, CNTLR POWER CAN BE TURNED OFF WITH THE CNTLR SWITCH.
THIS IS TRUE FOR THE LEFT, RIGHT, AND AFT CNTLR PWR CIRCUIT. B-SCREEN: MCC HAS SUFFICIENT DATA DISPLAYED TO MONITOR THE CNTLR PWR STATUS. POWER FAILED ON MAY EFFECT POWER CONSUMABLES AND MISSION LENGTH.

REFERENCES:

REPORT DATE 12/15/86  C-7
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/03/86
SUBSYSTEM: GNC
MDAC ID: 111

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

ITEM: CIRCUIT-FLT CNTLR PWR
FAILURE MODE: CB OR SW FAILS OPEN, OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O’DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RHC, SBTC, RPTA, THC
3) FLT CNTLR PWR CIRCUIT

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LOCATION: SW'S: PNL F7A5S2, F8A8S1, A6A1S2. CB'S: PNL 014
CB30, 31, 015 CB29, 30, 016 CB22, 23.
PART NUMBER: SW'S (ME452-0102-7352), CB'S (MC454-0026-2075).

CAUSES: CONTAMINATION, VIBR, PIECE-PART STRUCTURAL FAILURE,
TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
NONE: 1 SW CHN FL OPEN, WILL REMOVE PWR FROM ONLY 1 CNTLR CHN.
ALL 3 SW CHN'S FL OPEN WILL REMOVE PWR FROM ALL 3 CNTLR CHN'S.
THIS PERTAINS TO BOTH LFT, RT, AFT CNTLR PWR CIRCUITS.
2 CB'S FL OPEN, WILL REMOVE PWR FROM ALL CNTLR CHN'S. THIS
PERTAINS TO BOTH LFT, RT, AFT CNTLR PWR CIRCUIT. B-SCREEN: MCC
HAS SUFFICIENT DATA DISPLAYED TO MONITOR THE CNTLR PWR STATUS.

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 120  ABORT: 3/3

ITEM: SWITCH-TRIM ENABLE/INHIBIT
FAILURE MODE: SWITCH CONTACT FAILS CLOSED (INHIBIT POSITION).

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM ENABLE/INHIBIT SWITCH
3) ...

CRITICALITIES

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PART NUMBER: SW'S (ME452-0102-7201), RESISTORS (RWR80S1211FR).

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: 1 OF 2 SWITCH CONTACTS FAILED ON. 2 CONTACTS FAILED ON WILL INHIBIT TRIM. TRIM CAN BE PERFORMED FROM THE OTHER CREWMEMBER'S POSITION.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-9
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86
SUBSYSTEM: GNC
MDAC ID: 121

ITEM: SWITCH-TRIM ENABLE/INHIBIT
FAILURE MODE: SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM ENABLE/INHIBIT SWITCH
3) ...

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PART NUMBER: SW'S (ME452-0102-7201), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
NONE: 1 OF 2 SWITCH CONTACTS FAILED OFF WILL RESULT IN INHIBIT SWITCH DISAGREE (TRIM ENABLE). PNL TRIM SWITCHES CAN BE POWERED OFF WITH PWR ON/OFF SWITCHES.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-10
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM:  GNC   FLIGHT:  3/3
MDAC ID:  130  ABORT:  3/3

ITEM:  SWITCH-TRIM
FAILURE MODE:  SWITCH CONTACT FAINS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM SWITCH
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PART NUMBER:  SW'S: (ME452-0102-7205).

CAUSES:  SW CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: 1 OF 2 SW CONTACTS (CHN) FAILED ON. 2 CONTACTS FAILED ON WILL TURN TRIM ON. PNL TRIM SW'S CAN BE POWERED OFF WITH PWR ON/OFF SWITCHES. TRIM SWITCHES ARE USED TO DECREASE CREW WORKLOAD.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-11
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/07/86
SUBSYSTEM: GNC
MDAC ID: 131

ITEM: SWITCH-TRIM
FAILURE MODE: SWITCH CONTACT FAILS OPEN, OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM SWITCH
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Part Number:  SW'S: (ME452-0102-7205).

Causes: Contamination, Vibration, Piece-Part Structure Failure, Temp, Overload Current.

Effects/Rationale:
None: 1 of 2 SWITCH CONTACTS (CHN) FAILED OFF WILL RESULT IN TRIM SWITCH DISAGREE STATE. TRIM CAN BE PERFORMED FROM THE OTHER CREWMEMBER'S POSITION. TRIM SWITCHES ARE USED TO DECREASE CREW WORKLOAD.

Sufficient data is on the telemetry downlink and displayed in the MCC to monitor system status.

References:

Report Date 12/15/86  C-12
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/08/86  
SUBSYSTEM: GNC  
MDAC ID: 140  

ITEM: SWITCH-TRIM ON/OFF  
FAILURE MODE: SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL  
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM ON/OFF SWITCH
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LOCATION:  SW'S: PNL F3 S3, S5. RESISTORS: PNL F6 A12R8, R16.
PNL F8 A12R9, R18.
PART NUMBER:  SW's (ME452-0102-7201), RESISTORS (RWR80S1211FR).

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:  
NONE: 1 OF 2 SWITCH CONTACTS FAILED ON. 2 CONTACTS FAILED ON WILL ACTIVATE THE CORRESPONDING TRIM SWITCH OUTPUT. TRIM SWITCH OUTPUT CAN BE INHIBITED FROM PANEL INHIBIT SWITCH. TRIM SWITCH OUTPUT MEASUREMENTS CAN BE USED TO DETERMINE POWER SWITCH STATUS.

REFERENCES:  

REPORT DATE 12/15/86  C-13
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/08/86
SUBSYSTEM: GNC
MDAC ID: 141

ITEM: SWITCH-TRIM ON/OFF
FAILURE MODE: SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS
OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) TRIM ON/OFF SWITCH
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PART NUMBER: SW'S (ME452-0102-7201), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
NONE: 1 OF 2 SWITCH CONTACTS FAIL OFF WILL RESULT IN TRIM SWITCH DISAGREE STATE. TRIM CAN BE PERFORMED FROM THE OTHER CREWMAN'S POSITION.
TRIM SWITCH OUTPUT MEASUREMENTS CAN BE USED TO DETERMINE POWER SWITCH STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-14
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86
SUBSYSTEM: GNC
MDAC ID: 150

ITEM: SWITCH-SENSE
FAILURE MODE: SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SENSE SWITCH
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PART NUMBER: SW: (ME452-0102-7301), RESISTORS (RWR80S1211FR).

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: FOR 1 OF 3 CONTACTS FAILED ON, RM WILL FAIL CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT POSITION. SWITCH DEFAULT POSITION IS -Z.
LOSS OF SENSE SWITCH FUNCTION MAY INCREASE ONORBIT CREW WORKLOAD AND MISSION COMPLEXITY. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-15
### INDEPENDENT ORBITER ASSESSMENT
### ORBITER SUBSYSTEM ANALYSIS WORKSHEET

**DATE:** 10/10/86  
**SUBSYSTEM:** GNC  
**MDAC ID:** 151  
**ITEM:** SWITCH-SENSE  
**FAILURE MODE:** SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

**LEAD ANALYST:** ROBERT O'DONNELL  
**SUBSYS LEAD:** Lester DrapeLA

**BREAKDOWN HIERARCHY:**
1) GNC  
2) SENSE SWITCH  
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**REDUNDANCY SCREENS:**  

**LOCATION:** SW'S: PNL A6 S1. RESISTORS: PNL A6A1 A6R1, A6R2, A6R3.  
**PART NUMBER:** SW: (ME452-0102-7301), RESISTORS (RWR80S1211FR).  
**CAUSES:** CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.  
**EFFECTS/RATIONALE:**  
NONE: FOR 1 OF 3 CONTACTS FAILED OFF, RM WILL FAIL CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT POSITION. SWITCH DEFAULT POSITION IS -Z.  
LOSS OF SENSE SWITCH FUNCTION MAY INCREASE ONORBIT CREW WORKLOAD AND MISSION COMPLEXITY. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

**REFERENCES:**

**REPORT DATE** 12/15/86  C-16
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86
SUBSYSTEM: GNC
MDAC ID: 160

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

ITEM: SWITCH- P, R/Y, CSS/AUTO
FAILURE MODE: SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: Lester Drapela

BREAKDOWN HIERARCHY:
1) GNC
2) P, R/Y, CSS/AUTO SWITCH
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LOCATION: SW'S: PNL F2 S2, S3, S5, S6. PNL F4 S2, S3, S5, S6.
REF DWG VS70-790209.

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINNAION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: FOR 1 OF 3 CONTACTS FAILED ON, RM WILL FAIL CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT POSITION. IF AUTO POSITION FAILED ON, MANUAL OVERRIDE POSSIBLE IF CSS HELD DEPRESSED. NO OVERRIDE FOR CSS FAIL ON. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/23/86 C-17
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/10/86
SUBSYSTEM: GNC
MDAC ID: 161

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

ITEM: SWITCH-P, R/Y, CSS/AUTO

FAILURE MODE: SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) P, R/Y, CSS/AUTO SWITCH
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LOCATION: SW'S: PNL F2 S2, S3, S5, S6. PNL F4 S2, S3, S5, S6. REF DWG VS70-790209.

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
NONE: FOR 1 OF 3 CONTACTS FAILED OFF, RM WILL FAIL CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT POSITION. AUTO/CSS CAN BE SELECTED FROM THE OTHER CREWMEMBER'S POSITION.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/23/86 C-18
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/05/86
SUBSYSTEM: GNC
MDAC ID: 201

ITEM: THC
FAILURE MODE: LOSS OF ONE CHANNEL

LEAD ANALYST: TRAHAN, W. H.
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) THC
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LOCATION: PNL F5 & A6
PART NUMBER: MC621-0043-3140

CAUSES: TEMP., VIBRATION, MECH SHOCK, PIECE PART FAIL.

EFFECTS/RATIONALE:
NONE. 3LVL REDUNDANT CHANNEL; RESLECTABLE BY CREW
NONE. IN FLIGHT MAINTENANCE ALLOWS INTERCHANGE OF THC'S

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/10/86
SUBSYSTEM: GNC
MDAC ID: 202

ITEM: THC
FAILURE MODE: IMMOBILE THC

LEAD ANALYST: TRAHAN, W. H.
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) THC
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LOCATION: PNL F5 & A6
PART NUMBER: MC621-0043-3140

CAUSES: CONTAMINATION, MECH SHOCK, VIBRATION

EFFECTS/RATIONALE:
OTHER THC AVAILABLE - ONORBIT ONLY. MANUAL - Z TRANSLATION FOR ET SEP INHIBITED - MAY CAUSE VEHICLE DAMAGE.
IN FLIGHT MAINTENANCE ALLOWS INTERCHANGE OF THC'S

REFERENCES:

REPORT DATE 12/15/86   C-20
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/10/86  HIGHEST CRITICALITY  HDW/FUNC FLIGHT: 2/1R  ABORT: 2/1R
SUBSYSTEM: GNC
MDAC ID: 203

ITEM: THC
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: TRAHAN, W. H.  SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) THC
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LOCATION: PNL F5 & A6
PART NUMBER: MC621-0043-3140

CAUSES: TEMP., VIBRATION, MECH SHOCK, PIECE PART FAIL.

EFFECTS/RATIONALE:
NONE. RM USE MAJORITY VOTE SCHEME.
NONE. CAPABILITY TO SEL/DES VIA KEYBOARD.

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/16/86

SUBSYSTEM: GNC
MDAC ID: 301

ITEM: RPTA
FAILURE MODE: NO OUTPUT ON ONE CHANNEL

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RPTA
3) 
4) 
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8) 
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CRITICALITIES

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LOCATION: 30V73A14,A15
PART NUMBER: MC621-0043-3440

CAUSES: ELECTRICAL SHORT,VIBRATION,CONTAMINATION

EFFECTS/RATIONALE:
NO EFFECT- FDIR WILL DOWNMODE THE SF TO 2-LEVEL AND AVERAGE THE VALUES TO PRODUCE A GOOD OUTPUT.THE OTHER RPTA SF USES MVS.

REFERENCES:

REPORT DATE 12/15/86 C-22
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/16/86
SUBSYSTEM: GNC
MDAC ID: 302

ITEM: RPTA
FAILURE MODE: ERRONEOUS OUTPUT ON ONE CHANNEL

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RPTA
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LOCATION: 30V73A14, A15
PART NUMBER: MC621-0043-3440

CAUSES: ELECTRICAL SHORT, VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
NO EFFECT—FDIR WILL DOWNMODE THE SF TO 2-LEVEL AND AVERAGE THE VALUES TO PRODUCE A GOOD OUTPUT. THE OTHER RPTA SF USES MVS.

REFERENCES:

REPORT DATE 12/15/86 C-23
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/16/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 303  ABORT: 3/1R

ITEM: RPTA
FAILURE MODE: INADVERTENT OUTPUT ON ONE CHANNEL

LEAD ANALYST: LES DRAPELA  SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RPTA
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LOCATION: 30V73A14,A15
PART NUMBER: MC621-0043-3440

CAUSES: VIBRATION, CONTAMINATION

EFFECTS/RATIONALE:
NO EFFECT—FDIR WILL DOWNMODE THE SF TO 2-LEVEL AND AVERAGE THE VALUES TO PRODUCE A GOOD OUTPUT. THE OTHER RPTA SF USES MVS.

REFERENCES:

REPORT DATE 12/15/86  C-24
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/16/86
SUBSYSTEM: GNC
MDAC ID: 304

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

ITEM: RPTA
FAILURE MODE: LOSS OF ONE RPTA

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RPTA

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


LOCATION: 30V73A14,A15
PART NUMBER: MC621-0043-3440

CAUSES: FAILURE OF THE MECHANICAL ARM INTERACTION WITH THE RPTA

EFFECTS/RATIONALE:
LEAVES ONE RPTA (3 CHANNELS)—THIS IS ADEQUATE, BUT IF DETECTED
EARLY IN THE MISSION, COULD FORCE AN EARLY RETURN.

REFERENCES:

REPORT DATE 12/15/86 C-25
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/15/86
SUBSYSTEM: GNC
MDAC ID: 401

ITEM: SBTC
FAILURE MODE: PHYSICAL BINDING/JAMMING OF CNTL LEVER

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
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LOCATION: PNL L2 (31V73A2A2), C3 (35V73A3A3).
PART NUMBER: MC621-0043-3240

CAUSES: CONTAMINATION, MECH SHOCK, MIS HANDLING, VIBRATION

EFFECTS/RATIONALE:
PLT SBTC MAN THRUST FUNCTION LOST, BACKUP FOR AUTO MODE.
LOST 1 OF 2 SBTC SPD BRK CMD FUNCTION.

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT  
ORBITER SUBSYSTEM ANALYSIS WORKSHEET  

DATE: 9/15/86  
SUBSYSTEM: GNC  
MDAC ID: 402

ITEM: SBTC  
FAILURE MODE: NO XDCR OUTPUT ON A CMD CHN

LEAD ANALYST: ROBERT O'DONNELL  
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC  
2) SBTC  
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LOCATION: PNL L2 (31V73A2A2), C3 (35V73A3A3).  
PART NUMBER: MC621-0043-3240

CAUSES: LOSS OF EXCITATION VOLTAGE, XDCR CIRCUIT FAIL OPEN

EFFECTS/RATIONALE:  
NONE: FOR PLT MAN THRUST FUNCTION, 1ST FL IS AUTO GUID DOWNMODE.  
NONE: THE SPD BRK CMD FUNCT USES CDR(PLT) PNL L2(C3) SBTC'S.

REFERENCES:

REPORT DATE 12/15/86  C-27
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/15/86
SUBSYSTEM: GNC
MDAC ID: 403

ITEM: SBTC
FAILURE MODE: ERRONEOUS XDCR OUTPUT ON A CMD CHN

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
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LOCATION: PNL L2 (31V73A2A2), C3 (35V73A3A3).
PART NUMBER: MC621-0043-3240

CAUSES: XDCR CIRCUIT FAILURE, VIBR, TEMP

EFFECTS/RATIONALE:
NONE: FOR PLT MAN THRUST FUNCTION, 1ST FL IS AUTO GUID DOWNMODE.
NONE: THE SPD BRK CMD FUNCT USES CDR(PLT) PNL L2(C3) SBTC'S.

REFERENCES:

REPORT DATE 12/15/86 C-28
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/15/86
SUBSYSTEM: GNC
MDAC ID: 404

HIGHEST CRITICALITY

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

ITEM: SBTC
FAILURE MODE: NO OUTPUT ON A TAKEOVER SW CHN

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
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LOCATION: PNL L2 (31V73A2A2), C3 (35V73A3A3).
PART NUMBER: MC621-0043-3240

CAUSES: SW CONT FAILED OPEN, SW SHORTED TO GROUND

EFFECTS/RATIONALE:
NONE: PLT MAN THRUST TAKEOVER, 1ST FL IS AUTO GUID DOWNMODE.
NONE: SPD BRK CMD TAKEOVER USES CDR(PLT) PNL L2(C3) SBTC'S.

REFERENCES:

REPORT DATE 12/15/86 C-29
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/15/86

SUBSYSTEM: GNC
MDAC ID: 405

ITEM: SBTC
FAILURE MODE: TAKEOVER SW CHN FAILS ON

LEAD ANALYST: ROBERT O’DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
3) SBTC
4) SBTC
5) SBTC
6) SBTC
7) SBTC
8) SBTC
9) SBTC

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LOCATION: PNL L2 (31V73A2A2), C3 (35V73A3A3).
PART NUMBER: MC621-0043-3240

CAUSES: SWITCH CONTACTS SHORTED(VIBR, MECH SHOCK, CONTAMINATION)

EFFECTS/RATIONALE:
FOR PLT MAN THRUST TAKEOVER, 1ST FAILURE IS THE NEED FOR DOWNMODE FROM AUTO TO MANUAL. IF PLT'S SBTC TAKEOVER SWITCH FAILS ON DURING ASCENT, THERE IS NO RECOVERY FROM MANUAL THRUST TAKEOVER. SPD BRK CMD TAKEOVER USES CDR & PLT SBTC'S. IF PLT'S TAKEOVER SW FLRS ON DURING ENTRY, PLT HAS MAN_CNTL ONLY AND CDR IS IN AUTO UNLESS HE HOLDS IN THE TAKEOVER SW. IF CDR'S TAKEOVER SW FLRS ON DURING ENTRY, CDR REMAINS IN MAN AND PLT REMAINS IN AUTO.

REFERENCES:

REPORT DATE 12/15/86  C-30
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86
SUBSYSTEM: GNC
MDAC ID: 410

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: SWITCH-SPD BK/THROT PBI
FAILURE MODE: SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
3) SPD BK/THROT PBI SWITCH
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PART NUMBER: SW'S: (ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
NONE: FOR 1 OF 3 CONTACTS FAILED ON, RM WILL FAIL THE CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT SW. IF SW FAILS ON (AUTO MODE), SBTC TAKEOVER SW HELD IN WILL OVERRIDE AUTO.
IF SBTC TAKEOVER SWITCH FAILS ON, NO RECOVERY FROM MANUAL MODE BY THE SPD BK/THROT PBI AUTO SWITCH. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-31
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/16/86
SUBSYSTEM: GNC
MDAC ID: 411

ITEM: SWITCH-SPD BK/THROT PBI
FAILURE MODE: SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) SBTC
3) SPD BK/THROT PBI SWITCH
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PART NUMBER: SW'S: (ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
NONE: 1 OF 3 CONTACTS FAILED OFF. RM WILL FAIL CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL DISAGREE STATE WILL INHIBIT THE USE OF THAT POSITION. AUTO MODE CAN BE SELECTED FROM THE OTHER CREWMEMBER'S POSITION.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-32
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/22/86

SUBSYSTEM: GNC
MDAC ID: 501

ITEM: IMU
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) IMU

CRITICALITIES

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LOCATION: 30V71A13,30V71A14,30V71A15
PART NUMBER: MC409-0004-0010

CAUSES: SEE ATTACHMENT 501

EFFECTS/RATIONALE:
RM WILL DETECT (FDI, BITE, COMMFAULT) THE FIRST FAILURE AND
DESELECT THE FAILED IMU. RM MIGHT NOT ISOLATE A SECOND FAILURE
IF THE FAILURE LIES ON THE LINE OF AMBIGUITY, CAUSING LOSS OF
VEHICLE.

REFERENCES:

REPORT DATE 12/15/86 C-33
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/22/86

HIGHEST CRITICALITY
SUBSYSTEM: GNC
MDAC ID: 502

ITEM: IMU
FAILURE MODE: NO OUTPUT

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) IMU
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4)
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8)
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CRITICALITIES

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LOCATION: 30V71A13, 30V71A14, 30V71A15
PART NUMBER: MC409-0004-0010

CAUSES: INTERNAL POWER SUPPLY FAILURE - CONTAMINATION, VIBRATION, MECHANICAL SHOCK, LOSS OF/IMPROPER INPUT, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
NO EFFECT FOR PASS S/W, IMU'S ARE TRIPLE REDUNDANT-FAILED IMU WILL BE DESELECTED (FDI, COMM FAULT, BITE) BY RM.
NO EFFECT FOR BFS S/W, IMU'S ARE TRIPLE REDUNDANT-FAILED IMU WILL BE DESELECTED (COMM FAULT, BITE, MCC) BY BFS OR CREW.

REFERENCES:

REPORT DATE 12/15/86 C-34
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 510  ABORT: 3/1R

ITEM: IMU POWER CIRCUIT
FAILURE MODE: ONE BRANCH OF CIRCUIT FAILED OPEN

LEAD ANALYST: J.M. HIOTT  SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) IMU
3) IMU POWER CIRCUIT
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LOCATION:
S10,S11,RPC5,RPC6,RPC7,A4R1,A4R2,A5R1,A5R2,CR11,CR12,CR20,CR21,
CR27,CR28-PNL014,PNL015,PNL016

PART NUMBER: ME452-0102-7201,MC450-0017-2100,RWR80S1211FR,JANTX1N188R

CAUSES: RESISTOR (RWR80S1211FR) SHORTED TO GROUND, ONE SWITCH CONTACT(ME452-0102-7201) FAILED OPEN, RPC (MC450-0017-2100) FAILED OPEN, DIODE (JANTX1N188R) FAILED OPEN - CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
NONE - POWER WILL BE SUPPLIED TO THE IMU THROUGH THE OTHER BRANCH

REFERENCES:

REPORT DATE 12/15/86  C-35
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86
SUBSYSTEM: GNC
MDAC ID: 511

ITEM: IMU POWER CIRCUIT
FAILURE MODE: POWER CIRCUIT FAILED OPEN

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) IMU
3) IMU POWER CIRCUIT

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LOCATION: S10,S11-PNL014,PNL015,PNL016
PART NUMBER: ME452-0102-7201

CAUSES: POWER SWITCH JAMMED - PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
LOSS OF ONE IMU - 2 REMAINING IMU'S ARE SUFFICIENT TO PERFORM THE MISSION

REFERENCES:

REPORT DATE 12/15/86  C-36
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86

SUBSYSTEM: GNC
MDAC ID: 512

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

ITEM: IMU POWER CIRCUIT
FAILURE MODE: 1 CIRCUIT FAILED CLOSED

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) IMU
3) IMU POWER CIRCUIT

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 [N/A] B [N/A] C [N/A]

LOCATION: S10, S11, RPC1, RPC2, RPC7-PNL014, PNL015, PNL016
PART NUMBER: ME452-0102-7201, MC450-0017-2100

CAUSES: SWITCH OR RPC FAILURE - VIBRATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
IMU CANNOT BE POWERED OFF - POSSIBLE POWER CONSUMPTION PROBLEM

REFERENCES:

REPORT DATE 12/15/86 C-37
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/22/86
SUBSYSTEM: GNC
MDAC ID: 601

HIGHEST CRITICALITY

| HDW/FUNC | FLIGHT: 3/1R | ABORT: 3/3 |

ITEM: STAR TRACKER
FAILURE MODE: NO OUTPUT

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) STAR TRACKER
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LOCATION: 10V71A7(-Y),A6(-Z)
PART NUMBER: MC431-0128-0012

CAUSES: SHUTTER MECHANISM FAILED, IMAGE DISSECTOR TUBE (IDT) FAILED, ST DOOR FAILED CLOSED

EFFECTS/RATIONALE:
LOSS OF ONE ST IS NOT CRITICAL- REDUNDANCY REMAINS WITH THE OTHER ST AND COAS

REFERENCES:

REPORT DATE 12/15/86 C-38
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/22/86
SUBSYSTEM: GNC
MDAC ID: 602

ITEM: STAR TRACKER
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) STAR TRACKER
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LOCATION: 10V71A7(-Y), A6(-Z)
PART NUMBER: MC431-0128-0012

CAUSES: LENS DEGRADATION, FOCUS FIELD CIRCUIT SHORTED, SHORT IN DEFLECTION COILS, ST MISALIGNED DUE TO VIBRATION OR TEMPERATURE

EFFECTS/RATIONALE:
SELF TEST WILL DETECT ERRORS- THE OTHER ST AND COAS CAN BE USED AS BACKUP

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

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ITEM: CIRCUIT-STAR TRACKER POWER
FAILURE MODE: CB OR SW FAILS CLOSED

LEAD ANALYST: LES DRAPELA  SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) STAR TRACKER
3) POWER CIRCUIT

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LOCATION: PANELS 06,014,015
PART NUMBER: 2 CB'S (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: INTERNAL SHORT DUE TO CONTAMINATION

EFFECTS/RATIONALE:
NONE - THE WORKING ELEMENT (CB OR SW) CAN BE USED TO TURN THE POWER OFF

REFERENCES:

REPORT DATE 12/15/86  C-40
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/25/86

HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC
MDAC ID: 611
FLIGHT: 3/1R
ABORT: 3/3

ITEM: CIRCUIT-STAR TRACKER POWER
FAILURE MODE: FAILS OPEN
LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) STAR TRACKER
3) POWER CIRCUIT
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LOCATION: PANELS 06,014,015
PART NUMBER: 2 CB'S (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: INTERNAL SHORT DUE TO CONTAMINATION IN CB OR SW

EFFECTS/RATIONALE:
LOSS OF THAT STAR TRACKER - THE OTHER ST AND COAS CAN BE USED AS BACKUP

REFERENCES:

REPORT DATE 12/15/86 C-41
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/25/86
SUBSYSTEM: GNC
MDAC ID: 612

HIGHEST CRITICALITY

ITEM: CIRCUIT-STAR TRACKER POWER
FAILURE MODE: SWITCH SHORTS TO GROUND

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) STAR TRACKER
3) POWER CIRCUIT
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LOCATION: PANELS 06,014,015
PART NUMBER: 2 CB'S (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: CONTAMINATION

EFFECTS/RATIONALE:
LOSS OF THAT STAR TRACKER - CB WILL SHUT POWER SUPPLY OFF - THE OTHER ST AND COAS PROVIDE REDUNDANCY

REFERENCES:

REPORT DATE 12/15/86 C-42
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86
SUBSYSTEM: GNC
MDAC ID: 701

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

ITEM: COAS
FAILURE MODE: COAS LIGHT OUT

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
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LOCATION: PANEL 01 (CMD'S STATION), OVERHEAD WINDOW W7 (AFT STATION)
PART NUMBER: V620-660-810

CAUSES: LOSS OF POWER, LAMP BROKEN DUE TO VIBRATION, ELECTRICAL SHORT

EFFECTS/RATIONALE:
NO EFFECT - 2 ST'S AVAILABLE - A FLASHLIGHT CAN BE USED TO LIGHT THE RETICLE

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86
SUBSYSTEM: GNC
MDAC ID: 702

ITEM: COAS
FAILURE MODE: RETICLE BROKEN

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
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2) COAS
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LOCATION: PANEL 01 (CMD'S STATION), OVERHEAD WINDOW W7 (AFT STATION)
PART NUMBER: V620-660-810

CAUSES: VIBRATION, SHOCK

EFFECTS/RATIONALE:
LOSS OF COAS - 2 ST'S AVAILABLE

REFERENCES:

REPORT DATE 12/15/86 C-44
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86 HIGHEST CRITICALITY HDW/func
SUBSYSTEM: GNC FLIGHT: 3/3
MDAC ID: 710 ABORT: 3/3

ITEM: CIRCUIT - COAS POWER
FAILURE MODE: CB OR SWITCH FAILS CLOSED

LEAD ANALYST: LES DRAPELA SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) COAS
3) POWER CIRCUIT
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LOCATION: PANELS 01, 019, L4
PART NUMBER: 1 CB (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: INTERNAL SHORT DUE TO CONTAMINATION

EFFECTS/RATIONALE:
NONE - THE WORKING ELEMENT(CB OR SW) CAN BE USED TO TURN THE POWER OFF

REFERENCES:

REPORT DATE 12/15/86 C-45
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86

SUBSYSTEM: GNC
MDAC ID: 711

HIGHEST CRITICALITY

FLIGHT: 3/3
ABORT: 3/3

ITEM: CIRCUIT - COAS POWER
FAILURE MODE: SWITCH FAILS OPEN

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) COAS
3) POWER CIRCUIT

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LOCATION: PANELS 01, 019, L4
PART NUMBER: 1 CB (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: INTERNAL SHORT DUE TO CONTAMINATION

EFFECTS/RATIONALE:
NONE - THE OTHER POWER SWITCH CAN BE USED

REFERENCES:

REPORT DATE 12/15/86 C-46
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/02/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 712  ABORT: 3/3

ITEM: CIRCUIT - COAS POWER
FAILURE MODE: CB FAILS OFF

LEAD ANALYST: LES DRAPELA  SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) COAS
3) POWER CIRCUIT
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LOCATION: PANELS 01, 019, L4
PART NUMBER: 1 CB (MC454-0026-2030), 2 SW'S (ME452-0102-7101)

CAUSES: INTERNAL SHORT DUE TO CONTAMINATION

EFFECTS/RATIONALE:
LOSS OF THE FWD & AFT POWER CIRCUITS, BUT A FLASHLIGHT CAN BE USED TO LIGHT THE RETICLE - 2 ST'S SERVE AS BACKUP

REFERENCES:

REPORT DATE 12/15/86  C-47
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
HIGHEST CRITICALITY: 3/3
HDW/FUNC: 3/1R
FLIGHT: 3/1R
ABORT: 3/1R

SUBSYSTEM: GNC
MDAC ID: 801

ITEM: ADTA
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ADTA
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LOCATION: 82V71A2, 81V71A1, 81V71A3, 81V71A4
PART NUMBER: MC409-0011-0006

CAUSES: ATTACHMENT 801

EFFECTS/RATIONALE:
NO EFFECT: FOR PASS S/W, ERRONEOUS OUTPUT WILL BE DETECTED (FDI, BITE, COMM FAULT) BY RM AND THE ASSOCIATED ADTA WILL BE Deselected BY RM
NO EFFECT: FOR BFS, S/W ERRONEOUS OUTPUT WILL BE DETECTED (BITE, COMM FAULT, MCC) AND THE ASSOCIATED ADTA WILL BE Deselected BY BFS OR CREW. NOTE: LOSS OF INPUT FROM ONE PROBE (SINGLE PNEUMATIC INPUT INCLUDED) WILL CAUSE LOSS OF TWO ADTA'S

REFERENCES:

REPORT DATE 12/22/86 C-48
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
SUBSYSTEM: GNC
MDAC ID: 802

ITEM: ADTA
FAILURE MODE: NO OUTPUT

LEAD ANALYST: J.M. HIOTT         SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ADTA
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LOCATION: 82V71A2,81V71A1,81V71A3,81V71A4
PART NUMBER: MC409-0011-0006

CAUSES: INTERNAL POWER SUPPLY FAILURE

EFFECTS/RATIONALE:
NO EFFECT: FOR PASS S/W, NO OUTPUT WILL BE DETECTED(FDI, BITE, COMM FAULT) BY RM AND THE ASSOCIATED ADTA WILL BE DESELECTED BY RM.
NO EFFECT: FOR BFS S/W, NO OUTPUT WILL BE DETECTED(BITE, COMM FAULT, MCC) AND THE ASSOCIATED ADTA WILL BE DESELECTED BY BFS OR CREW.

REFERENCES:

REPORT DATE 12/22/86 C-49
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 810  ABORT: 3/1R

ITEM: ADTA POWER CIRCUIT
FAILURE MODE: CIRCUIT FAILED OPEN

LEAD ANALYST: J.M. HIOTT  SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ADTA
3) ADTA POWER CIRCUIT

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LOCATION: CB19-PNL016,CB20-PNL016,CB25-PNL015,CB26-PNL014
PART NUMBER: MC454-0026-2050

CAUSES: CB FAILURE - CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
LOSS OF ONE ADTA - 3 REMAINING ADTA'S ARE SUFFICIENT TO PERFORM MISSION

REFERENCES:

REPORT DATE 12/22/86  C-50
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/29/86
SUBSYSTEM: GNC
MDAC ID: 811

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

ITEM: ADTA POWER CIRCUIT
FAILURE MODE: CIRCUIT FAILED CLOSED

LEAD ANALYST: J.M. HIOTT    SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ADTA
3) ADTA POWER CIRCUIT
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REDUNDANCY SCREENS: A [N/A]  B [N/A]  C [N/A]

LOCATION: CB19-PNL016, CB20-PNL016, CB25-PNL015, CB26-PNL014
PART NUMBER: MC454-0026-2050

CAUSES: CB FAILURE - CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
ADTA CANNOT BE POWERED OFF - POSSIBLE POWER CONSUMPTION PROBLEM

REFERENCES:

REPORT DATE 12/22/86  C-51
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/03/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 812  ABORT: 3/3

ITEM: ADTA POWER CIRCUIT
FAILURE MODE: RESISTOR (RLR07C5101GR) SHORTS TO GROUND OR OPENS

LEAD ANALYST: J.M. HIOTT  SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ADTA
3) ADTA POWER CIRCUIT
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REDUNDANCY SCREENS: A [N/A]  B [N/A]  C [N/A]

LOCATION: A3R2-PNL014,PNL015,PNL016
PART NUMBER: RLR07C5101GR

CAUSES: VIBRATION, MECHANICAL SHOCK, STRUCTURAL FAILURE

EFFECTS/RATIONALE:
ADTA POWER CIRCUIT CANNOT BE MONITORED BY MDM - NOT CRITICAL TO FLIGHT

REFERENCES: SEE SECTION 1

C-2

REPORT DATE 12/22/86  C-52
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/24/86
HIGHEST CRITICALITY
SUBSYSTEM: GNC
MDAC ID: 901
FLIGHT: 3/1R
ABORT: 3/1R

ITEM: RGA
FAILURE MODE: LOSS OF OUTPUT

LEAD ANALYST: TRAHAH, W. H.  
SUBSYS Lead: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (ORB)
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LOCATION: PLB(33V73A14,15,16B)
PART NUMBER: MC493-0015-0011

CAUSES: TEMP., VIBRATION, MECH SHOCK, PIECE PART STRUCTURE FAIL

EFFECTS/RATIONALE:
NONE. MAX 4 LVL OF REDUNDANCY, POSS LOSS OF MISS DUE TO FLT RULES.
NONE. SECOND FAIL MAY NOT BE ANNUNCIATED, BUT MCC CAN DETECT.

REFERENCES:

REPORT DATE 12/22/86  C-53
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/24/86

SUBSYSTEM: GNC
MDAC ID: 902

ITEM: RGA
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: TRAHAN, W. H.

SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (ORB)
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LOCATION: PLB(33V73A14,15,16)
PART NUMBER: MC493-0015-0011

CAUSES: TEMP., VIBRATION, MECH SHOCK, PIECE PART STRUCTURE FAIL, IMPROPER INPUT.

EFFECTS/RATIONALE:
NONE. MAX 4 LVL OF REDUNDANCY, POSS LOSS OF MISS DUE TO FLT RULES.
NONE. SECOND FAIL MAY NOT BE ANNUNCIATED, BUT MCC CAN DETECT.

REFERENCES:

REPORT DATE 12/15/86 C-54
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/28/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 903  ABORT: 3/1R

ITEM: PWR SW RGA 1,2,3,4  FAILURE MODE: FAILS ON, FAILS OFF

LEAD ANALYST: TRAHAN, W. H.  SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (ORB)
3) POWER CIRCUIT
4) SWITCHES

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LOCATION: PLB(33V73A14,15,16)
PART NUMBER: VS70-710159

CAUSES: VIBRATION, MECHANICAL SHOCK, CONTAMINATION, PIECE PART STRU FAILURE.

EFFECTS/RATIONALE:
FAIL ON - NO EFFECT EXCEPT ON POWER CONSUMPTION, NO LOSS OF RGA
FAIL OFF - LOSS OF RGA, RM WILL USE OUTPUT FROM OTHER RGA'S.

REFERENCES:

REPORT DATE 12/15/86  C-55
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/28/86
SUBSYSTEM: GNC
MDAC ID: 904

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

ITEM: DIODES & RESIST (ORB)
FAILURE MODE: OPEN, FAIL TO CONDUCT

LEAD ANALYST: TRAHAN, W. H. SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (ORB)
3) POWER CIRCUIT
4) DIODES ABD RESISTORS
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LOCATION: PLB(33V73A14,15,16)
PART NUMBER: VS70-710159

CAUSES: VIBRATION, MECHANICAL SHOCK, CONTAMINATION, PIECE PART STRU FAILURE.

EFFECTS/RATIONALE:
LOSS OF THE EFFECTED RGA.
NONE: RM WILL DISCARD RGA AND DOWNMODE ON SUB FAILURES.

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/28/86
SUBSYSTEM: GNC
MDAC ID: 905
HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/1R
ABORT: 3/1R

ITEM: RPC'S (ORB)
FAILURE MODE: FAIL ON, FAIL OFF

LEAD ANALYST: TRAHAN, W. H.
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (ORB)
3) POWER CIRCUIT
4) REMOTE POWER CONTROLLERS (RPC'S)

CRITICALITIES

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LOCATION: PLB(33V73A14,15,16)
PART NUMBER: VS70-710159

CAUSES: VIBRATION, MECHANICAL SHOCK, CONTAMINATION, PIECE PART STRU FAILURE.

EFFECTS/RATIONALE:
FAIL ON - NO EFFECT EXPECT ON POWER CONSUMPTION
FAIL OFF - LOSS OF RGA'S 2 OR 3, RGA 1 & 4 HAVE TWO RED RPC'S, POSS LAUNCH DELAY.

REFERENCES:

REPORT DATE 12/15/86 C-57
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/05/86
SUBSYSTEM: GNC
MDAC ID: 950

ITEM: RGA (SRB)
FAILURE MODE: LOSS OF OUTPUT
LEAD ANALYST: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (SRB)
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LOCATION: LEFT SRB (RGA1 & 2-131A5,A6); RIGHT SRB(RGA2 & 4-231A5,A6)
PART NUMBER: MC493-0015-0105

CAUSES: TEMP, VIBRATION, MECH SHOCK, LOSS OF INPUT, PIECE PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
NONE - THE FAILED RGA WILL BE DESELECTED BY RM AND THE SEL FILTER WILL DOWNMODE TO MVS AND USE THE REMAINING RGA'S

REFERENCES:

REPORT DATE 12/15/86 C-58
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/05/86
SUBSYSTEM: GNC
MDAC ID: 951

ITEM: RGA (SRB)
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (SRB)
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LOCATION: LEFT SRB (RGA1 & 2-131A5,A6); RIGHT SRB (RGA2 & 4-231A5,A6)
PART NUMBER: MC493-0015-0105

CAUSES: TEMP, VIBRATION, MECH SHOCK, PIECE PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
NONE - THE FAILED RGA WILL BE DESELECTED BY RM AND THE SEL FILTER
WILL DOWNMODE TO MVS AND USE THE REMAINING RGA'S

REFERENCES:

REPORT DATE 12/15/86 C-59
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/05/86                 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC                   FLIGHT: 3/1R
MDAC ID: 960                     ABORT: 3/1R

ITEM: CIRCUIT - SRB RGA POWER
FAILURE MODE: FAILS OPEN

LEAD ANALYST: LES DRAPELA       SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (SRB)
3) POWER CIRCUIT

CRITICALITIES

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LOCATION:
PART NUMBER:

CAUSES: FAILURES IN THE RPC'S, VOLTAGE SENSING CKT, SWITCH CKT, RELAY, DIODES; GENERIC CAUSES: SHORTS, VIBRATION, MECH SHOCK

EFFECTS/RATIONALE:
LOSS OF THE RGA - BUT ONLY A FAILURE IN TWO COMPONENTS COULD CAUSE TOTAL LOSS OF PWR TO A SINGLE RGA. IF TOTAL PWR IS LOST, THE RGA WILL BE DESELECTED BY RM AND THE SF WILL DOWNSIDE TO MVS AND USE THE REMAINING RGA'S.

REFERENCES: ECN NO. 102-8019A

REPORT DATE 12/22/86  C-60
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/05/86
SUBSYSTEM: GNC
MDAC ID: 961

ITEM: CIRCUIT - SRB RGA POWER
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) RGA (SRB)
3) POWER CIRCUIT

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LOCATION:
PART NUMBER:

CAUSES: INTERNAL SHORT IN RPC

EFFECTS/RATIONALE:
CAN'T SHUT OFF PWR TO AN SRB PWR BUS PRIOR TO SEP - NO DAMAGE TO ORBITER - MAY CAUSE DAMAGE TO SRB

REFERENCES: ECN NO. 102-8019A

REPORT DATE 12/22/86 C-61
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86  HIGHEST CRITICALITY  HDW/ FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 1001  ABORT: 3/1R

ITEM: ACCELEROMETER ASSEMBLY
FAILURE MODE: NO OUTPUT ( ON EITHER AXIS OR ON ONE AXIS )

LEAD ANALYST: LES DRAPELA  SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ACCELEROMETER ASSEMBLY
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LOCATION:  AA1-AREA 81 BAY 1; AA2,3,4-AREA 82 BAY 2
PART NUMBER:  MC621-0043-2043

CAUSES:  LOSS OF INPUT POWER, POWER SUPPLY FAILURE, PICKOFF LAMP FAILURE, DIFF AMP FAILURE - VIBRATION, SHOCK, EXTREME TEMP. CAN CAUSE INTERNAL FAILURES

EFFECTS/ RATIONALE:
NONE - RM WILL NOT USE THE FAILED AA

REFERENCES:

REPORT DATE 12/15/86  C-62
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86

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

ITEM: ACCELEROMETER ASSEMBLY
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ACCELEROMETER ASSEMBLY
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LOCATION: AA1-AREA 81 BAY 1; AA2,3,4-AREA 82 BAY 2
PART NUMBER: MC621-0043-2043

CAUSES: POWER SUPPLY FAILURE, PICKOFF LAMP FAILURE, DIFF AMP FAILURE - VIBRATION, SHOCK, EXTREME TEMP. CAN CAUSE INTERNAL FAILURES

EFFECTS/RATIONALE:
NONE - RM WILL NOT USE THE FAILED AA

REFERENCES:

REPORT DATE 12/15/86 C-63
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86
SUBSYSTEM: GNC
MDAC ID: 1010

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

ITEM: CIRCUIT-AA'S 1 & 2 POWER
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ACCELEROMETER ASSEMBLY
3) AA'S 1 & 2 POWER CIRCUITS
4) 5) 6) 7) 8) 9)

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LOCATION: PANELS 014,015
PART NUMBER: 2 CB'S (MC454-0026-2030)

CAUSES: INTERNAL SHORT IN THE CIRCUIT BREAKER DUE TO CONTAMINATION

EFFECTS/RATIONALE:
AA'S 1 & 2 CAN NOT BE TURNED OFF.NO EFFECT EXCEPT ON ELECTRICAL POWER CONSUMABLES.MAY EFFECT MISSION LENGTH.

REFERENCES:

REPORT DATE 12/15/86 C-64
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86
SUBSYSTEM: GNC
MDAC ID: 1011

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

ITEM: CIRCUIT-AA'S 1 & 2 POWER
FAILURE MODE: FAILS OPEN

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ACCELEROMETER ASSEMBLY
3) AA'S 1 & 2 POWER CIRCUITS
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LOCATION: PANELS 014,015
PART NUMBER: 2 CB'S (MC454-0026-2030)

CAUSES: PIECE PART STRUCTURAL FAILURE IN CIRCUIT BREAKER

EFFECTS/RATIONALE:
LOSS OF THAT AA-THE DATA FROM THE OTHER 3 AA'S WILL BE USED

REFERENCES:

REPORT DATE 12/15/86 C-65
DATE: 10/15/86

SUBSYSTEM: GNC

MDAC ID: 1012

ITEM: CIRCUIT-AA'S 3 & 4 POWER

FAILURE MODE: FAILS OPEN

LEAD ANALYST: LES DRAPELA

SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:

1) GNC
2) ACCELEROMETER ASSEMBLY
3) AA'S 3 & 4 POWER CIRCUIT
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LOCATION: VS70-971099

PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, PIECE PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
AA'S 3 & 4 HAVE TWO POWER CIRCUITS. ONLY A FAILURE ON EACH OF THE CIRCUITS COULD RESULT IN AN OPEN CIRCUIT I.E. BOTH SW CONTACTS, BOTH RPC'S, BOTH RESISTORS, BOTH DIODES, OR VARIOUS COMBINATIONS.
ANY SINGLE FAILURE WOULD RESULT IN LOSS OF ONLY ONE OF THE TWO POWER CIRCUITS. IF TOTAL POWER IS LOST, RM WILL USE DATA FROM THE OTHER 3 AA'S.

REFERENCES:

REPORT DATE 12/15/86 C-66
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/15/86
SUBSYSTEM: GNC
MDAC ID: 1013

HIGHEST CRITICALITY HDW/FUNC
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

FLIGHT: 3/3
ABORT: 3/3

ITEM: CIRCUIT-AA'S 3 & 4 POWER
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: LES DRAPELA
SUBSYS LEAD: LES DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ACCELEROMETER ASSEMBLY
3) AA'S 3 & 4 POWER CIRCUIT
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LOCATION: VS70-971099
PART NUMBER: VS70-971099

CAUSES: INTERNAL SHORT IN SWITCH OR RPC

EFFECTS/RATIONALE:
AA'S 3 & 4 HAVE TWO POWER SUPPLY CIRCUITS. EITHER CIRCUIT COULD BE FAILED CLOSED BY A SINGLE FAILURE IN THE SW OR RPC. THE AA CANNOT BE TURNED OFF EXCEPT BY SHUTTING OFF THE BUSS POWER WHICH EFFECTS OTHER SYSTEMS. ELECTRICAL POWER CONSUMPTION IS AFFECTED. MAY AFFECT MISSION LENGTH.

REFERENCES:

REPORT DATE 12/15/86 C-67
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86

HIGHEST CRITICALITY

HDW/FUNC

SUBSYSTEM: GNC
MDAC ID: 1101

FLIGHT: 3/1R
ABORT: 3/1R

ITEM: ASA
FAILURE MODE: ISOL CMD FL OFF IN ONE CHN

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER: MC621-0043-6046

CAUSES: LOSS OF DRIVER POWER, DRIVER CIRCUIT FAIL OFF (VIBR, TEMP, MECH SHOCK).

EFFECTS/RATIONALE:
NONE: LOSS OF 1 OF 4 VLV CHN'S. TWO ISOL VALVE DRIVERS AND THEIR RESPECTIVE CHN MUST FAIL BEFORE AEROSURFACE CONTROL IS AFFECTED. FCS CHECKOUT (OPS-8) WILL DETECT THIS FAILURE PRIOR TO ENTRY. SEC DELTA P >2025 WILL INDICATE ISOL CMD FL IF NO ACTR CHN FL SIGNAL PRESENT.

REFERENCES:

REPORT DATE 12/15/86 C-68
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86
SUBSYSTEM: GNC
MDAC ID: 1102

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

ITEM: ASA
FAILURE MODE: ISOL CMD FL ON FOR ONE CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER: MC621-0043-6046

CAUSES: ISOL VLV CIRCUIT FL. ERRONEOUS FAULT DETECT or PS FL IND.

EFFECTS/RATIONALE:
NONE: 1 OF 4 ISOL VLV CHN'S COMMANDED TO BYPASS. ACTR SURFACE WILL BE CONTROLLED BY REMAINING CHN'S. REDUNDANCY SCREEN B IS SATISFIED BY ACTR CHN FAIL SIGNAL.

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE:  9/26/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM:  GNC  FLIGHT:  2/1R
MDAC ID:  1103  ABORT:  2/1R

ITEM:  ASA  FAILURE MODE:  NO POSITION ERR CMD TO ACTR CHN (NULL OUTPUT).

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION:  AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER:  MC621-0043-6046

CAUSES:  SERVO VLV DRIVER CIRCUIT OR PWR FAILURE.

EFFECTS/RATIONALE:
WITH 1 CHN CMD AT 0 (NULL) OUTPUT, OTHER 3 CHN'S WILL CNTRL
SURFACE POSITION. WITH 2 UNDETECTED NULL CHN FLS, ASA MAY FAIL
GOOD CHN'S AND PRIME SEL FAILED CHN'S DURING ENTRY. MCC MAY NOT
BE ABLE TO DETECT TWO NULL FAILURES EXISTING AT THE SAME TIME.
FOR PASS B SCREEN REQUIREMENT, SUFFICIENT DATA IS PRESENT IN MCC
TO DETERMINE SYSTEM REDUNDANCY.

REFERENCES:

REPORT DATE 12/15/86  C-70
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86

HIGHEST CRITICALITY

HDW/FUNC

FLIGHT: 3/1R

ABORT: 3/1R

SUBSYSTEM: GNC

MDAC ID: 1104

ITEM: ASA

FAILURE MODE: ERRONEOUS POSITION ERROR CMD TO ACTR.

LEAD ANALYST: ROBERT O'DONNELL

SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).

PART NUMBER: MC621-0043-6046

CAUSES: ASA CMD OR FEEDBACK CIRCUIT FAILURE (MECH SHOCK, TEMP, VIBR). ERRONEOUS POSITION CMD FROM GPC/MDM. FDBK XDUCR FL (LOSS OF PWR, OPEN CIR, NON LINEAR).

EFFECTS/RATIONALE:
NONE: THREE PCS CHN'S REMAINING AFTER THE FAILED CHN IS ISOLATED FROM THE ACTR CONTROL CIRCUIT. IF TWO UNDETECTED ERRONEOUS CMDS EXIST, A 2 ON 2 FORCE FIGHT WILL EXIST AND ASA MAY FAIL GOOD CHN'S AND PRIME SELECT FLD CHN'S.

FOR PASS B SCREEN REQUIREMENT, SUFFICIENT DATA IS PRESENT IN MCC TO DETERMINE SYSTEM REDUNDANCY.

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86
SUBSYSTEM: GNC
MDAC ID: 1105

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

ITEM: ASA
FAILURE MODE: NO OUTPUT, OR ERRONEOUS OUTPUT ON ONE POSITION FDBK XDR CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER: MC621-0043-6046

CAUSES: LOSS OF XDCR PWR, OPEN CIRCUIT, NON LINEAR CIRCUIT.

EFFECTS/RATIONALE:
NONE: ONLY 1 FAILURE OF 4 REDUNDANT XDUCR CHANNELS. COULD CAUSE FAILURE (ISOLATION) OF 1 OF 4 FCS ACTR CHN'S. MULTIFAILURES OF PFB CHN'S WILL AFFECT POSITION CMD'S FROM DAP.

REFERENCES:

REPORT DATE 12/15/86 C-72
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86
SUBSYSTEM: GNC
MDAC ID: 1106

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

ITEM: ASA
FAILURE MODE: NO OUTPUT/ERRONEOUS OUTPUT ON ONE SEC DELTA P FDBK XDCR CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).

PART NUMBER: MC621-0043-6046

CAUSES: OPEN CIR, LOSS OF PWR, NON LINEAR CIRCUIT (VIBR, TEMP).

EFFECTS/RATIONALE:
NONE: ONLY 1 FAILURE OF 4 REDUNDANT XDCR CHN'S. IT WILL
INTERFERE WITH NOMINAL OPERATION OF ISOL CMD DRIVER CHN, AND MAY
REQUIRE MANUAl CNTL (BYPASS/OVERRIDE) OF THE ISOL CMD.
IT WILL IMPACT SEC DELTA P FDBK FUNCTION TO REDUCE & DISTRIBUTE
PRESS DURING SERVO VALVE FORCE FIGHTS.

REFERENCES:

REPORT DATE 12/15/86 C-73
INDEPENDENT ORBITER ASSESSMENT ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86
SUBSYSTEM: GNC
MDAC ID: 1107

ITEM: ASA
FAILURE MODE: NO OUTPUT/ERRONEOUS OUTPUT ON 1 ELVN PRI DELTA P FDBK XDCR CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER: MC621-0043-6046

CAUSES: LOSS OF XDCR PWR, OPEN CIRCUIT, NONLINEAR CIRCUIT.

EFFECTS/RATIONALE:
NONE: ONLY 1 FAILURE OF 4 REDUNDANT XDCR CHN'S. ELVN PRI DELTA P FDBK IS SUMMED WITH POSITION CMD TO DETERMINE POSITION ERROR CMD TO ACTR SERVO VALVE CHN.
MULTIFAILURES WILL CAUSE RM TO SELECT INCORRECT PRI DELTA P FDBK FOR ASC DAP TO BIAS ELVN LOAD RELIEF SCHEDULE.

REFERENCES:

REPORT DATE 12/15/86   C-74
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 9/26/86
SUBSYSTEM: GNC
MDAC ID: 1108

ITEM: ASA
FAILURE MODE: BDY FLP CMD CHN (1 OF 3) INOPERATIVE.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
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LOCATION: AFT AV BAY 4(ASA-1), 5(ASA-2), 6(ASA-3,4).
PART NUMBER: MC621-0043-6046

CAUSES: PWR SUPPLY FL INHIBIT SIG TO BDY FLAP VLV DRIVERS, NO BDY FLAP ENA CMD, FAILURE OF BDY FLP UP/DWN VLV DRIVE CIRCUIT.

EFFECTS/RATIONALE:
NONE: ONLY 1 FAILURE OF 3 REDUNDANT BDY FLP CMD CHN'S.

REFERENCES:

REPORT DATE 12/15/86 C-75
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86  HIGHEST CRITICALITY: HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 1110  ABORT: 3/1R

ITEM: CIRCUIT-FCS CHN CNTL
FAILURE MODE: SWITCH CONTACT FAILS CLOSED (AT TRANSFER/PREMATURE).

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA/ATVC
3) FCS CHANNEL CONTROL CIRCUIT
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LOCATION:  PNL C3 A1 ( SW S6, S7, S8, S9 ). REF VS70-790209
SCH DIAG.
PART NUMBER:  SW'S: (ME452-0102-7356). REF VS70-733402.

CAUSES: SWITCH CONTACT SHORTED INTERNALLY (CONTAMINATION, PIECE-PART STRUCTURE FAILURE).

EFFECTS/RATIONALE:
OVERRIDE POSITION: 1 OF 3 CONTACTS FL ON, HAS NO EFFECT. 2 CONT DISAGREE, NO OVERRIDE FOR THAT CHANNEL. 3 CONT FAIL ON, OVERRIDE REMAINS ON, NO DELTA P ISOLATION FOR THAT CHN. OFF POSITION WILL REMOVE THE CHN (ISOLATE CMD ON).
AUTO POSITION: 1 OF 2 CONT FAIL ON, PWR IS APPLIED TO ASA/ATVC THROUGH THEIR RESPECTIVE PWR SW. WHEN SYS NOT REQ, PWR REMOVED BY PWR SW CIRCUIT. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK TO MONITOR SYS STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-76
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC   FLIGHT: 3/1R
MDAC ID: 1111   ABORT: 3/1R

ITEM: CIRCUIT-FCS CHN CNTL
FAILURE MODE: SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS
OPEN OR SHORTED TO GROUND (AT TRANSFER/PREMATURE).

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA/ATVC
3) FCS CHANNEL CONTROL CIRCUIT
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LOCATION: PNL C3 A1 (SW S6, S7, S8, S9). REF VS70-790209
SCH DIAG.
PART NUMBER: SW'S: (ME452-0102-7356). REF VS70-733402.

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE,
TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
OVERRIDE POSITION: 1 OF 3 CONTACTS FL OFF, HAS NO EFFECT. 2 CONT
DISAGREE, NO OVERRIDE FOR THAT CHANNEL. 3 CONT'S FAIL OFF, NO
OVERRIDE CAPABILITY FOR CHN. RESET CAPABILITY FROM SPEC 53 (OPS-
3) & 801 (OPS-8).
AUTO POSITION: 1 OF 2 CONTACTS FAIL OFF, LOSS OF ONLY 1 DUAL
REDUNDANT PWR SOURCE. 2 CONT FL OFF, LOSS OF PWR TO THE ASA/ATVC
CHANNEL (1 OF 4 CHANNELS). SUFFICIENT DATA IS ON THE TELEMETRY
DOWNLINK TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-77
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/17/86          HIGHEST CRITICALITY     HDW/FUNC
SUBSYSTEM: GNC       FLIGHT: 3/1R
MDAC ID: 1112       ABORT: 3/1R

ITEM: CIRCUIT-FCS CHN CNTL
FAILURE MODE: DIODE FAILS OPEN.

LEAD ANALYST: ROBERT O'DONNELL      SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA/ATVC
3) FCS CHANNEL CONTROL CIRCUIT
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LOCATION: PNL C3 A1 (SW S6, S7, S8, S9). REF VS70-790209
SCH DIAG.
PART NUMBER: SW'S: (ME452-0102-7356). REF VS70-733402.

CAUSES: VIBRATION, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
1 DIODE OPEN, LOSS OF ONLY 1 OF THE REDUNDANT CNTL BUS POWER TO ASA (ATVC) WHILE SWITCH IS IN OVERRIDE. 2 DIODES OPEN WILL RESULT IN NO CNTL BUS POWER TO ASA (ATVC) CHN WHILE IN OVERRIDE (ISOLATE CMDS ON).
TWO SERIAL DIODES SHORTED, WAS NOT CONSIDERED A CREDIBLE FAILURE. OVERRIDE CAPABILITY FROM SPEC 53 (OPS-3) AND 801 (OPS-8). SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK TO MONITOR SYS STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-78
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/27/86

HIGHEST CRITICALITY: HDW/FUNC

SUBSYSTEM: GNC

MDAC ID: 1130

FLIGHT: 3/1R

ABORT: 3/1R

ITEM: CIRCUIT-ASA'S 1,2,3,4 POWER

FAILURE MODE: POWER CIRCUIT FAILS OPEN (OFF), DURING POWER TRANSFER OR PREMATURELY.

LEAD ANALYST: ROBERT O'DONNELL

SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:

1) GNC
2) ASA
3) ASA'S 1,2,3,4 POWER CIRCUIT
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LOCATION: PNL 014 S10, 015 S9, 016 S8 S9. REF VS70-790229 SCH DIAG.

PART NUMBER: SW'S: (ME452-0102-7301). REF VS70-971099, 790229 SCH DIAG'S.

CAUSES: SWITCH CONTACT OR CURRENT LIMIT RESISTOR, RPC(5A,10A), OR DIODE(12A,35A) FAIL OPEN OR SHORTED TO GROUND. GENERIC CAUSES: VIBRATION, INTERNAL PART FAILURE, CONTAMINATION, MECH SHOCK, THERMAL.

EFFECTS/RATIONALE:

EACH OF THE FOUR ASA'S DRIVE A REDUNDANT FCS CHANNEL. A SINGLE FAILURE CAN REMOVE ASA-4 ISOL VALVE DRIVER POWER (VLV FLD CLOSED). TWO FAILURES ARE REQUIRED IN ALL OTHER CASES TO LOSE POWER TO AN ASA POWER SUPPLY OR ISOL VALVE DRIVER CIRCUIT. ACTUATOR ISOLATION VALVES WILL BE COMMANDED OPEN IF POWER IS LOST TO THE ASA POWER SUPPLY. IF POWER IS LOST TO THE ISOL VALVE DRIVERS, THE ACTUATOR ISOLATION VALVES WILL BE COMMANDED TO THE CLOSED POSITION.

REFERENCES:

REPORT DATE 12/15/86 C-79
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/27/86  HIGHEST CRITICALITY: HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 1131  ABORT: 3/3

ITEM: CIRCUIT-ASA'S 1,2,3,4 POWER
FAILURE MODE: POWER CIRCUIT FAILS CLOSED (ON), DURING POWER
TRANSFER OR PREMATURELY.

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ASA
3) ASA'S 1,2,3,4 POWER CIRCUIT
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9)

CRITICALITIES

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LOCATION: PNL 014 S10, 015 S9, 016 S8,S9. REF VS70-790229 SCH DIAG.
PART NUMBER: SW'S: (ME452-0102-7301). REF VS70-971099, 790229 SCH DIAG'S.

CAUSES: SWITCH CONTACTS OR RPC(5A, 10A) SHORTED INTERNALLY.
GENERIC CAUSES: VIBRATION, CONTAMINATION, INTERNAL PART FAILURE.

EFFECTS/RATIONALE:
EACH OF THE FOUR ASA'S DRIVE A REDUNDANT FCS CHNL. IF A SW
CONTACT OR RPC SHORTS IN A CLSD (ON) STATE, PWR WILL BE APPLIED
TO THE ASA PWR SUPPLY OR ISOLATION VLV DRIVERS. FOR PWR SW
CONTACTS SHORTED, ASA PWR SUPPLY CAN BE TURNED OFF BY THE FCS
CHNL SW.
THE ISOLATION VALVE DRIVERS WILL REMAIN POWERED (ISOL VALVE
COMMANDED TO OPEN) WITH FCS CHANNEL SWITCH OFF. FAILURE WILL
AFFECT POWER CONSUMABLES, AND MAY AFFECT MISSION LENGTH.

REFERENCES:

REPORT DATE 12/15/86  C-80
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1201

ITEM: RJDF
FAILURE MODE: NO OUTPUT TO JET

LEAD ANALYST: TRAHAN, W. H.
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDF
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LOCATION: FWD BAY
PART NUMBER: MC621-0043-6244

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU
FAIL

EFFECTS/RATIONALE:
NONE. S/W WILL SELECT ALTERNATE JET.
NONE. ORIENTATION OF JET ON OTHER MANIFOLDS ALLOWS SAME EFFECT.

REFERENCES:

REPORT DATE 12/15/86 C-81
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1203

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

ITEM: RJDA
FAILURE MODE: NO OUTPUT

LEAD ANALYST: TRAHAN, W. H.  SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDA
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CRITICALITIES

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LOCATION: AFT BAY
PART NUMBER: MC621-0043-6244

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL

EFFECTS/RATIONALE:
NONE. S/W WILL SELECT ALTERNATE JET.
NONE. ORIENTATION OF JET ON OTHER MANIFOLDS ALLOWS SAME EFFECT.

REFERENCES:

REPORT DATE 12/15/86  C-82
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86  HIGHEST CRITICALITY   HDW/FUNC
SUBSYSTEM: GNC   FLIGHT: 1/1
MDAC ID: 1205   ABORT: 3/1R

ITEM: RJDA
FAILURE MODE: INADVERTENT JET FIRING

LEAD ANALYST: TRAHAN, W. H.   SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDA
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CRITICALITIES

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LOCATION: AFT BAY
PART NUMBER: MC621-0043-6244

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU
FAIL, SHORTED.

EFFECTS/RATIONALE:
S/W WILL SHUT JET DWN. MINIMUM FIRING MAY OCCUR; MAY BE FATAL IF
PERSONNEL IN VICINITY OF JET PLUME
MAY CAUSE VEHICLE DAMAGE IF IN CLOSE PROXIMITY OF TGT VEHICLE.

REFERENCES:

REPORT DATE 12/15/86   C-83
INDEPENDENT ORBITER ASSESSMENT  
ORBITER SUBSYSTEM ANALYSIS WORKSHEET  

DATE: 10/24/86  
SUBSYSTEM: GNC  
MDAC ID: 1206  

ITEM: RJDF  
FAILURE MODE: INADVERTENT JET FIRING  

LEAD ANALYST: TRAHAN, W. H.  
SUBSYS LEAD: DRAPELA, LES  

BREAKDOWN HIERARCHY:  
1) GNC  
2) RJD  
3) RJDF  
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LOCATION: FWD BAY  
PART NUMBER: MC621-0043-6244  

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL, SHORTED.  

EFFECTS/RATIONALE:  
S/W WILL SHUT JET DWN. MINIMUM FIRING MAY OCCUR; MAY BE FATAL IF PERSONNEL IN VICINITY OF JET PLUME. MAY CAUSE VEHICLE DAMAGE IF IN CLOSE PROXIMITY OF TGT VEHICLE.  

REFERENCES:  

REPORT DATE 12/15/86  
C-84
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86  
SUBSYSTEM: GNC  
MDAC ID: 1207  

HIGHEST CRITICALITY

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ITEM: PC FEEDBACK
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: TRAHAN, W. H.  
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC  
2) RJD  
3) RJDF  
4) CHAMBER PRESSURE FEEDBACK
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LOCATION: FWD BAY
PART NUMBER: MC621-0043-6244

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL, SHORTED.

EFFECTS/RATIONALE:
NONE. RM WILL DETECT FAIL ON/OFF AND NOT SELECT JET.

REFERENCES:

REPORT DATE 12/15/86  
C-85
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1208
HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/1R
ABORT: 3/1R

ITEM: PC FEEDBACK
FAILURE MODE: ERRONEOUS OUTPUT

LEAD ANALYST: TRAHAN, W. H. SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDA
4) CHAMBER PRESSURE FEEDBACK
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LOCATION: AFT BAY
PART NUMBER: MC621-0043-6244

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL, SHORTED.

EFFECTS/RATIONALE:
NONE. RM WILL DETECT FAIL ON/OFF AND NOT SELECT JET.

REFERENCES:

REPORT DATE 12/15/86 C-86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86
SUBSYSTEM: GNC
MDAC ID: 1211

HIGHEST CRITICALITY
FLIGHT: 3/3
ABORT: 3/3

ITEM: POWER CIRCUIT
FAILURE MODE: CIRCUIT FAIL CLOSE (INADVERTENT OUTPUT)

LEAD ANALYST: TRAHAN, W. H.
SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJDF
3) POWER CIRCUIT

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LOCATION: FWD BAY
PART NUMBER: VS70-420109, 209, 309

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRUC.
FAIL, SHORTED.

EFFECTS/RATIONALE:
NONE. POWER SUPPLIED FOR LOGIC BUT NO CMD'S FROM GPC. MAY BE
ADDITIONAL POWER CONSUMPTION.
NONE.

REFERENCES:

REPORT DATE 12/15/86 C-87
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86

SUBSYSTEM: GNC
MDAC ID: 1212

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

ITEM: POWER CIRCUIT
FAILURE MODE: CIRCUIT FAIL CLOSE (INADVERTENT OUTPUT)

LEAD ANALYST: TRAHAN, W. H.  SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDA
4) POWER CIRCUIT
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LOCATION: AFT BAY
PART NUMBER: VS70-420109,209,309

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL, SHORTED.

EFFECTS/RATIONALE:
NONE. POWER SUPPLIED FOR LOGIC BUT NO CMDS FROM GPC. MAY BE ADDITIONAL POWER CONSUMPTION. NONE.

REFERENCES:

REPORT DATE 12/15/86  C-88
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86
SUBSYSTEM: GNC
MDAC ID: 1213

ITEM: POWER CIRCUIT
FAILURE MODE: CIRCUIT FAIL OPEN (NO OUTPUT)

LEAD ANALYST: TRAHAN, W. H.  SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDA
4) POWER CIRCUIT
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LOCATION: AFT BAY
PART NUMBER: VS70-420109, 209, 309

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU
FAIL, SHORTED TO GROUND.

EFFECTS/RATIONALE:
NONE. JETS ON THAT MANIFOLD WILL NOT FIRE.
OTHER MANIFOLDS ARE AVAILABLE. CREW CAN DISABLE THAT MANIFOLD.

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86

HIGHEST CRITICALITY
HDW/FUNC

SUBSYSTEM: GNC

MDAC ID: 1214

FLIGHT: 3/1R

ABORT: 3/1R

ITEM: POWER CIRCUIT

FAILURE MODE: CIRCUIT FAIL OPEN (NO OUTPUT)

LEAD ANALYST: TRAHAN, W. H.

SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) RJD
3) RJDF
4) POWER CIRCUIT
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LOCATION: FWD BAY

PART NUMBER: VS70-420109,209,309

CAUSES: MECH SHOCK, VIBRATION, CONTAMINATION, PIECE PART STRU FAIL, SHORTED TO GROUND.

EFFECTS/RATIONALE:
NONE. JETS ON THAT MANIFOLD WILL NOT FIRE.
OTHER MANIFOLDS ARE AVAILABLE. CREW CAN DISABLE THAT MANIFOLD.

REFERENCES:

REPORT DATE 12/15/86 C-90
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/1R
MDAC ID: 1301  ABORT: 3/1R

ITEM: ATVC
FAILURE MODE: ISOL CMD FL OFF IN ONE CHN.

LEAD ANALYST: ROBERT O'DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
3)
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LOCATION: AFT AV BAY 4(ATVC-1), 5(ATVC-2), 6(ATVC-3,4).
PART NUMBER: MC621-0043-6541

CAUSES: LOSS OF DRVR PWR, DRVR CIRCUIT FL OFF (VIBR, TEMP, MECH SHOCK).

EFFECTS/RATIONALE:
NONE: LOSS OF 1 OF 4 VLV CHN'S. TWO ISOL VLV DRIVERS AND THEIR RESPECTIVE CHN MUST FL BEFORE ASC THRUST VECTOR CNTL IS AFFECTED. NO WAY TO DETECT ISOL VLV FLD OFF. SEC DELTA P >2200 WILL INDICATE ISOL CMD FL IF NO ACTR CHN FL SIGNAL PRESENT.

REFERENCES:

REPORT DATE 12/15/86  C-91
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86
SUBSYSTEM: GNC
MDAC ID: 1302

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

ITEM: ATVC
FAILURE MODE: ISOL CMD FL ON FOR ONE CHN.

LEAD ANALYST: ROBERT O'DONNELL SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
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LOCATION: AFT AV BAY 4(ATVC-1), 5(ATVC-2), 6(ATVC-3,4).
PART NUMBER: MC621-0043-6541

CAUSES: ISOL VLV CIRCUIT FL, ERRONEOUS FAULT DETECT, FALSE PS FL IND.

EFFECTS/RATIONALE:
NONE: 1 OF 4 ISOL VLV CHN'S COMMANDED TO BYPASS. THRUST VECTOR CONTROL WILL BE MAINTAINED BY REMAINING CHN'S.
REDUNDANCY SCREEN B IS SATISFIED BY ACTR CHN FAIL SIGNAL.

REFERENCES:

REPORT DATE 12/15/86 C-92
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86   HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC   FLIGHT: 2/1R
MDAC ID: 1303   ABORT: 2/1R

ITEM: ATVC
FAILURE MODE: NO POSITION CMD TO ACTR CHN (NULL OUTPUT).

LEAD ANALYST: ROBERT O'DONNELL   SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
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LOCATION: AFT AV BAY 4(ATVC-1), 5(ATVC-2), 6(ATVC-3,4).
PART NUMBER: MC621-0043-6541

CAUSES: SERVO VLV DRVR PWR OR CIRCUIT FAILURE (MECH SHOCK, TEMP, VIBR).

EFFECTS/RATIONALE:
WITH 1 CHN CMD AT 0 (NULL) OUTPUT, OTHER 3 CHN'S WILL MAINTAIN
THRUST VECTOR CNTL. DURING FLIGHT, SUFFICIENT MCC DATA AVAILABLE
TO SATISFY REDUNDANCY SCREEN B FOR PASS. MCC MAY NOT BE ABLE TO
DETECT TWO NULL FAILURES EXISTING AT THE SAME TIME.
FOR 3.8 SEC DURING ENGINE IGNITION TO L/O, FORCED ATVC OVERRIDE
IS IN EFFECT. WITH TWO UNDETECTED FLD CHN CMDS, A 2 ON 2 FORCE
FIGHT WILL EXIST AND ATVC MAY FAIL GOOD CHN'S AND PRIME SELECT
FLD CHN'S DURING ASCENT CAUSING LOSS OF VEHICLE CONTROL.

REFERENCES:

REPORT DATE 12/15/86   C-93
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86
HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC FLIGHT: 2/1R
MDAC ID: 1304 ABORT: 2/1R

ITEM: ATVC
FAILURE MODE: ERRONEOUS POSITION CMD TO ACTR.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
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LOCATION: AFT AV BAY .4(ATVC-1), 5(ATVC-2), 6(ATVC-3,4).
PART NUMBER: MC621-0043-6541

CAUSES: ATVC CMD CIRCUIT FAILURE (MECH SHOCK, TEMP, VIBR).
ERRONEOUS POSITION CMD FROM GPC/MDM. SEC DELTA P REDUNDANT
CHANNEL EQUALIZATION CIRCUIT FAILURE (ERRONEOUS OUTPUT). SEC DELTA
P XDCR CIRCUIT FAILURE (ERRONEOUS OUTPUT).

EFFECTS/RATIONALE:
3 CMD CHN'S REMAIN AFTER THE FLD CMD IS DETECTED AND ISOLATED
FROM THE ACTR CONTROL CIRCUIT. DURING FLIGHT, SUFFICIENT MCC DATA
IS AVAILABLE TO SPO cây REDUNDANCY SCREEN B FOR PASS.
FOR 3.8 SEC DURING ENGINE IGNITION TO L/O, FORCED ATVC OVERRIDE
IS IN EFFECT. IF TWO UNDETECTED CHN CMD FL'S EXIST, A 2 ON
FORCE FIGHT WILL EXIST AND ATVC MAY FAIL GOOD CHN'S AND PRIME
SELECT FLD CHN'S DURING ASCENT.

REFERENCES:

REPORT DATE 12/15/86 C-94
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/01/86
SUBSYSTEM: GNC
MDAC ID: 1305

ITEM: ATVC
FAILURE MODE: NO OUTPUT/ERRONEOUS OUTPUT ON ONE SEC DELTA P FDBK XDCR CHN.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
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LOCATION: AFT AV BAY 4(ATVC-1), 5(ATVC-2), 6(ATVC-3,4).
PART NUMBER: MC621-0043-6541

CAUSES: OPEN CIRCUIT, LOSS OF PWR, NON LINEAR CIRCUIT (VIBR, TEMP).

EFFECTS/RATIONALE:
NONE: ONLY 1 FAILURE OF 4 REDUNDANT XDCR CHN'S. WILL INTERFERE WITH NOMINAL OPERATION OF THE ISOL CMD DRIVER CHN, AND MAY REQUIRE MANUAL CNTL (BYPASS/OVERRIDE) OF THE ISOL CMD CHN. FAILURE WILL IMPACT SEC DELTA P FDBK FUNCTION TO REDUCE AND DISTRIBUTE PRESS DURING SERVO VALVE FORCE FIGHTS. SUFFICIENT MCC DATA AVAILABLE TO SATISFY REDUNDANCY SCREEN B FOR PASS.

REFERENCES:

REPORT DATE 12/15/86 C-95
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/28/86
SUBSYSTEM: GNC
MDAC ID: 1310

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

ITEM: CIRCUIT- ATVC'S 1,2,3,4 POWER
FAILURE MODE: POWER CIRCUIT FAILS OPEN (OFF), DURING POWER
TRANSFER OR PREMATURELY.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
3) ATVC'S 1,2,3,4 POWER CIRCUIT

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LOCATION: PNL 014 S1, S2, S3, S4. REF VS70-790239 SCH DIAG.
PART NUMBER: SW'S: (ME452-0102-7301). REF VS70-971099, -790239
SCH DIAG'S.

CAUSES: SWITCH CONTACT OR CURRENT LIMIT RESISTOR, RPC(5A,3A), OR
DIODE(12A) FAIL OPEN OR SHORTED TO GROUND. GENERIC CAUSES:
VIBRATION, INTERNAL PART FAILURE, CONTAMINATION, MECH SHOCK,
THERMAL.

EFFECTS/RATIONALE:
EACH OF THE FOUR ATVC'S DRIVE A REDUNDANT FCS CHANNEL. A SINGLE
FAILURE CAN REMOVE ATVC ISOL VALVE DRIVER POWER (VLV FLD
CLOSED). TWO FAILURES ARE REQUIRED TO LOSE POWER TO AN ATVC POWER
SUPPLY.

ACTUATOR ISOLATION VALVES WILL BE COMMANDED OPEN IF POWER IS LOST
TO THE ATVC POWER SUPPLY. IF POWER IS LOST TO THE ISOL VALVE
DRIVERS, THE ACTUATOR ISOLATION VALVES WILL BE COMMANDED TO THE
CLOSED POSITION.

REFERENCES:

REPORT DATE 12/15/86 C-96
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/28/86
SUBSYSTEM: GNC
MDAC ID: 1311

HIGHEST CRITICALITY
FLIGHT: 3/3
ABORT: 3/3

ITEM: CIRCUIT-ATVC'S 1,2,3,4 POWER
FAILURE MODE: POWER CIRCUIT FAILS CLOSED (ON), DURING POWER
TRANSFER OR PREMATURELY.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ATVC
3) ATVC'S 1,2,3,4 POWER CIRCUIT
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LOCATION: PNL O14 S1, S2, S3, S4. REF VS70-790239 SCH DIAG.
PART NUMBER: SW'S: (ME452-0102-7301). REF VS70-971009, -790239
SCH DIAG'S.

CAUSES: SWITCH CONTACTS OR RPC(5A,3A) SHORTED INTERNALLY.

GENERIC CAUSES: VIBRATION, CONTAMINATION, INTERNAL PART FAILURE.

EFFECTS/RATIONALE:
EACH OF THE ATVC'S DRIVE A REDUNDANT FCS CHNL. IF A SW CONTACT OR
RPC SHORTS IN A CLSD (ON) STATE, PWR WILL BE APPLIED TO THE ATVC
PWR SUPPLY OR ISOLATION VLV DRIVERS. FOR PWR SW CONTACTS SHORTED,
ATVC PWR SUPPLY CAN BE TURNED OFF BY THE FCS CHN SW.
THE ISOLATION VALVE DRIVERS WILL REMAIN POWERED (ISOL VALVE
COMMENDED TO OPEN) WITH FCS CHANNEL SWITCH OFF. FAILURE WILL
AFFECT POWER CONSUMABLES, AND MAY AFFECT MISSION LENGTH.

REFERENCES:

REPORT DATE 12/15/86 C-97
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86
MDAC ID: 1400

ITEM: CIRCUIT-BODY FLAP CNTL
FAILURE MODE: BODY FLAP UP/DOWN SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) BODY FLAP CNTL CIRCUIT
3) ...

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LOCATION: PNL L2 AIS7, C3 AIS10, F2 S9, F4 S9. REF VS70-790209, 971099 SCH DIAG'S.
PART NUMBER: SW'S: (ME452-0102-7255, ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
IF 1 OF 2 SWITCH CONTACTS FAIL OFF (DISAGREE), THE OUTPUT COMMAND WILL BE SET OFF (ZERO OUTPUT). BODY FLAP CAN BE COMMANDED FROM THE OTHER CREWMEMBER'S POSITON.
SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-98
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86
SUBSYSTEM: GNC
MDAC ID: 1401

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

ITEM: CIRCUIT-BODY FLAP CNTRL
FAILURE MODE: BODY FLAP UP/DOWN SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) BODY FLAP CNTRL CIRCUIT
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LOCATION: PNL L2 A1S7, C3 A1S10, F2 S9, F4 S9. REF VS70-790209, 971099 SCH DIAG'S.
PART NUMBER: SW'S: (ME452-0102-7255, ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, piece-part structure failure, vibration.

EFFECTS/RATIONALE:
IF 1 OF 2 SWITCH CONTACTS FAILS CLOSED (ON), A DISAGREE CONDITION WILL EXIST AND NO OUTPUT COMMAND WILL BE ISSUED BY THE SOFTWARE. IF TWO SWITCH CONTACTS FAIL CLOSED (ON), AN ON COMMAND WILL BE ISSUED BY THE SOFTWARE.

UP COMMAND WILL OVERRIDE A DOWN COMMAND. THE BODY FLAP PBI SWITCH CAN MODE THE DAP FROM MANUAL TO AUTO. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC TO MONITOR SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-99
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY
SUBSYSTEM: GNC  HDW/FUNC
MDAC ID: 1402  FLIGHT: 3/1R
ABORT: 3/1R

ITEM: CIRCUIT-BODY FLAP CNTL
FAILURE MODE: BODY FLAP AUTO/MAN PBI SWITCH CONTACT OR CURRENT LIMIT RESISTOR FAILS OPEN OR SHORTED TO GROUND.

LEAD ANALYST: ROBERT O’DONNELL  SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) BODY FLAP CNTL CIRCUIT
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LOCATION: PNL L2 A1S7, C3 A1S10, F2 S9, F4 S9. REF VS70-790209, 971099 SCH DIAG’S.
PART NUMBER: SW’S: (ME452-0102-7255, ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, VIBRATION, PIECE-PART STRUCTURE FAILURE, TEMP, OVERLOAD CURRENT.

EFFECTS/RATIONALE:
FOR 1 OF 3 CONTACTS FAILED OFF (NO OUTPUT), RM WILL FAIL THE CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL RM DISAGREE CONDITION WILL INHIBIT THE USE OF THE SWITCH (ZERO OUTPUT).
AUTO/MAN MODES CAN BE SELECTED FROM THE OTHER CREWMEMBER’S POSITION. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86  C-100
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86
SUBSYSTEM: GNC
MDAC ID: 1403

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

ITEM: CIRCUIT-BODY FLAP_CNTL
FAILURE MODE: BODY FLAP AUTO/MAN PBI SWITCH CONTACT FAILS CLOSED.

LEAD ANALYST: ROBERT O'DONNELL
SUBSYS LEAD: LESTER DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) BODY FLAP_CNTL CIRCUIT
3) ...
4) ...
5) ...
6) ...
7) ...
8) ...
9) ...

CRITICALITIES

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LOCATION: PNL L2 A1S7, C3 A1S10, F2 S9, F4 S9. REF VS70-790209, 971099 SCH DIAG'S.
PART NUMBER: SW'S: (ME452-0102-7255, ME452-0061-7140), RESISTORS (RWR80S1211FR).

CAUSES: CONTAMINATION, PIECE-PART STRUCTURE FAILURE, VIBRATION.

EFFECTS/RATIONALE:
FOR 1 OF 3 CONTACTS FAILED ON, RM WILL FAIL THE CONTACT AND DOWNMODE TO THE 2-LVL. A 2-LVL RM DISAGREE STATE WILL INHIBIT THE USE OF THE SWITCH (ZERO OUTPUT). IF THREE SWITCH CONTACTS FAIL CLOSED (ON), AN ON COMMAND WILL BE ISSUED BY THE SOFTWARE. IF CDR'S OR PLT'S BODY FLAP PBI SWITCH FAILS ON, THE DAP WILL REMAIN IN THE LAST MODE SELECTED UNTIL FAILURE IS REMOVED. SUFFICIENT DATA IS ON THE TELEMETRY DOWNLINK AND DISPLAYED IN THE MCC FOR MONITORING SYSTEM STATUS.

REFERENCES:

REPORT DATE 12/15/86 C-101
**INDEPENDENT ORBITER ASSESSMENT**
**ORBITER SUBSYSTEM ANALYSIS WORKSHEET**

**DATE:** 11/13/86  |  **HIGHEST CRITICALITY**  |  **HDW/FUNC**  
**SUBSYSTEM:** GNC  |  **FLIGHT:** 2/1R  
**MDAC ID:** 1404  |  **ABORT:** 2/1R  

**ITEM:** CIRCUIT-BODY FLAP CNTL  
**FAILURE MODE:** BODY FLAP UP/DOWN CMD SWITCH JAMMED.  

**LEAD ANALYST:** ROBERT O’DONNELL  |  **SUBSYS LEAD:** LESTER DRAPELA  

**BREAKDOWN HIERARCHY:**  
1) GNC  
2) BODY FLAP CNTL CIRCUIT  
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**LOCATION:** PNL L2 A1S7, C3 A1S10, F2 S9, F4 S9. REF VS70-790209, 971099 SCH DIAG'S.  
**PART NUMBER:** SW'S: (ME452-0102-7255, ME452-0061-7140), RESISTORS (RWR80S1211FR).  

**CAUSES:** CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURE FAILURE.  

**EFFECTS/RATIONALE:**  
IF THE BODY FLAP SWITCH FAILS ON IN THE UP POSITION, A CONTINUOUS UP CMD WILL BE ISSUED BY THE BF CMD SOP TO THE DAP. UP COMMAND WILL OVERRIDE A DOWN CMD.  
IF EITHER OF THE BODY FLAP PBI'S FAIL ON IN MAN MODE, THERE IS NO WAY TO BRING THE BODY FLAP DOWN OR RETURN TO AUTO.  

**REFERENCES:**  

**REPORT DATE 12/22/86**  
**C-102**
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1501

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: A/B DAP PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) DAP PBI's
3) A/B PBI's (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST TWO FAILURES: NONE. THIRD FAILURE: ONORBIT DAP SELECTION COULD NOT BE CHANGED. HOWEVER, THE PARAMETER CHANGES CAN BE MADE VIA KEYBOARD.
IF FAILURE OCCURRED WHILE OPPOSITE POSITION WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86 C-103
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1502

HIGHEST CRITICALITY
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

ITEM: A/B DAP PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ        SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) DAP PBIs
3) A/B PBI'S (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: PBI WOULD BE INOPERATIVE, BUT OTHER PANEL COULD BE USED.
ALSO, THE PARAMETERS CAN BE CHANGED VIA THE KEYBOARD.

REFERENCES:

REPORT DATE 12/22/86  C-104
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1510

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

ITEM: FWD AUTO/MAN PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ   SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD AUTO/MAN PBI'S
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LOCATION: PANEL C3
PART NUMBER: S3,S4;ME452-0061-4152,3

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST TWO FAILURES: NONE. THIRD FAILURE: MODE WOULD REMAIN IN FAILED POSN.
IF FAILURE OCCURRED WHILE OPPOSITE POS WAS SELECTED, AN UNEXPECTED MODE CHANGE COULD OCCUR, POSSIBLY AT A CRITICAL TIME, E. G., ET SEP.

REFERENCES:

REPORT DATE 12/22/86   C-105
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86

HIGHEST CRITICALITY

SUBSYSTEM: GNC

HDW/FUNC

MDAC ID: 1511

FLIGHT: 3/2R

ABORT: 3/2R

ITEM: FWD AUTO/MAN PBI'S

FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ

SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:

1) GN&C
2) DAP PBIs
3) FWD AUTO/MAN PBI'S
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LOCATION: PANEL C3

PART NUMBER: S3,S4;ME452-0061-4152,3

CAUSES: SHORT, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FIRST FAILURE: NONE.
SECOND FAILURE: INABILITY TO PERFORM MODE CHANGES
IN TRANS DAP, THE CREW CAN FLY IN EITHER AUTO OR MAN. AFT PANEL COULD BE USED ON ORBIT.

REFERENCES:

REPORT DATE 12/22/86 C-106
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1515

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: AFT AUTO/MAN PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBI's
3) AFT AUTO/MAN PBI'S
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LOCATION: PANEL A6
PART NUMBER: S10, S11, ME452-0061-7142, 7183

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST TWO FAILURES: NONE. THIRD FAILURE: MODE WOULD REMAIN IN FAILED POSITION.
IF FAILURE OCCURRED WHILE OPPOSITE POS WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR. BOTH AUTO AND MAN ARE USED ON ORBIT.

REFERENCES:

REPORT DATE 12/22/86 C-107
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/21/86
SUBSYSTEM: GNC
MDAC ID: 1516

ITEM: AFT AUTO/MAN PBI'S
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT AUTO/MAN PBI'S

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LOCATION: PANEL A6
PART NUMBER: S10,S11;ME452-0061-7142,7183

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: MODE CHANGES WOULD HAVE TO
BE DONE WITH FWD PANEL. BOTH AUTO AND MAN ARE NECESSARY FOR ORBIT OPS.

REFERENCES:

REPORT DATE 12/22/86  C-108
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC FLIGHT: 3/2R
MDAC ID: 1520 ABORT: 3/2R

ITEM: NORM/VERN PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) NORM/VERN PBI'S (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST TWO FAILURES: NONE. THIRD FAILURE: RCS JET SELECTION WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE OPPOSITE POS WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86 C-109
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
SUBSYSTEM: GNC
MDAC ID: 1521
ITEM: NORM/VERN PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) NORM/VERN PBI'S (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: CHANGE WOULD HAVE TO BE DONE WITH OTHER PNL.
TRANSLATION REQUIRE NORM JETS. IF NORM JETS CANNOT BE ENABLED VIA PBI'S, TRANSITION TO OPS 3 COULD EFFECT THIS CHANGE.

REFERENCES:

REPORT DATE 12/22/86 C-110
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
SUBSYSTEM: GNC
MDAC ID: 1530

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: FWD DISC RATE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED
LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD DISC RATE ROT PBI'S

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LOCATION: PANEL C3
PART NUMBER: VS70-971099
CAUSES: SHORT, STRAY PARTICLE
EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: ROT MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.
REFERENCES:

REPORT DATE 12/22/86  C-111
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
SUBSYSTEM: GNC
MDAC ID: 1531

ITEM: FWD DISC RATE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD DISC RATE ROT PBI'S
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LOCATION: PANEL C3
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FAILED POSITION COULD NOT BE SELECTED ON TRANS DAP, BUT THE AUTO SYSTEM PROVIDES REDUNDANCY.
AFT PBI COULD BE USED ON ORBIT DAP.

REFERENCES:

REPORT DATE 12/22/86 C-112
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86
SUBSYSTEM: GNC
MDAC ID: 1535

ITEM: FWD PULSE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) DAP PBIs
3) FWD PULSE ROT PBI'S

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LOCATION: PANEL C3
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: ROT MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86 C-113
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/22/86   HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC   FLIGHT: 3/2R
MDAC ID: 1536   ABORT: 3/2R

ITEM: FWD PULSE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ   SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD PULSE ROT PBI'S

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LOCATION: PANEL C3
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
FAILED POSITION COULD NOT BE SELECTED ON TRANS DAP, BUT THE AUTO SYSTEM PROVIDES REDUNDANCY.
AFT PBI COULD BE USED ON ORBIT DAP.

REFERENCES:

REPORT DATE 12/22/86 C-114
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC
FLIGHT: 3/2R
MDAC ID: 1540
ABORT: 3/2R

ITEM: AFT DISC RATE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT DISC RATE ROT PBI'S
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LOCATION: PANEL A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: ROT MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86 C-115
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1541

ITEM: AFT DISC RATE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT DISC RATE ROT PBI'S
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LOCATION: PANEL A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
PBI WOULD BE INOPERATIVE.
FWD PBI COULD BE USED.

REFERENCES:

REPORT DATE 12/22/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1545

ITEM: AFT PULSE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT PULSE ROT PBI'S

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LOCATION: PANEL A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: ROT MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86 C-117
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC
FLIGHT: 3/2R
MDAC ID: 1546
ABORT: 3/2R

ITEM: AFT PULSE ROT PBI'S
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT PULSE ROT PBI'S

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LOCATION: PANEL A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
PBI WOULD BE INOPERATIVE.
FWD PBI COULD BE USED.

REFERENCES:

REPORT DATE 12/22/86 C-118
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1550

ITEM: ACCEL ROT PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) ACCEL ROT PBI'S (FWD & AFT)

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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: ROT MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:

REPORT DATE 12/22/86  C-119
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1551

HIGHEST CRITICALITY
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: ACCEL ROT PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) ACCEL ROT PBI'S (FWD & AFT)
4) 5) 6) 7) 8) 9)

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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
PBI WOULD BE INOPERATIVE.
PBI ON OPPOSITE PANEL COULD BE USED.

REFERENCES:

REPORT DATE 12/22/86 C-120
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1560

HIGHEST CRITICALITY HDW/FUNC
FLIGHT: 3/2R
ABORT: 3/2R

ITEM: TRANSLATION PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED CLOSED

LEAD ANALYST: K. PIETZ    SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) TRANSLATION PBI'S (FWD & AFT)

REDUNDANCY SCREENS:

LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT, STRAY PARTICLE

EFFECTS/RATIONALE:
FIRST FAILURE: NONE. SECOND FAILURE: TRANS MODE WOULD REMAIN IN FAILED POS.
IF FAILURE OCCURRED WHILE ANOTHER MODE WAS SELECTED, AN UNEXPECTED CHANGE COULD OCCUR.

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/24/86
SUBSYSTEM: GNC
MDAC ID: 1561

ITEM: TRANSLATION PBI'S (FWD & AFT)
FAILURE MODE: SWITCH CONTACT FAILED OPEN

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) TRANSLATION PBI'S (FWD & AFT)

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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: SHORT TO GROUND, BROKEN CONTACT, FAILED RESISTOR

EFFECTS/RATIONALE:
PBI WOULD BE INOPERATIVE.
PBI ON OPPOSITE PANEL COULD BE USED.

REFERENCES:

REPORT DATE: 12/22/86
C-122
### INDEPENDENT ORBITER ASSESSMENT

**ORBITER SUBSYSTEM ANALYSIS WORKSHEET**

**DATE:** 10/30/86  
**MDAC ID:** 1570  
**SUBSYSTEM:** GNC  
**HIGHEST CRITICALITY**  
**FLIGHT:** 3/2R  
**ABORT:** 3/2R

**ITEM:** A/B PBI'S (FWD & AFT)  
**FAILURE MODE:** PBI STUCK IN DEPRESSED POSITION

**LEAD ANALYST:** K. PIETZ  
**SUBSYS LEAD:** L. DRAPELA

**BREAKDOWN HIERARCHY:**
1. GN&C  
2. DAP PBIs  
3. A/B PBI'S (FWD & AFT)

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**REDUNDANCY SCREENS:**
- B [ P ]  
- C [ P ]

**LOCATION:** PANELS C3 & A6  
**PART NUMBER:** VS70-971099

**CAUSES:** BREAKAGE, JAMMING, BROKEN SPRING

**EFFECTS/RATIONALE:**
FAILED MODE WOULD BE PERMANENTLY SELECTED.  
THE ABILITY TO CHANGE PARAMETERS VIA KEYBOARD PROVIDES REDUNDANCY.

**REFERENCES:**
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 2/2
MDAC ID: 1575  ABORT: 2/2

ITEM: FWD AUTO PBI
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD AUTO PBI
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LOCATION: PANEL C3
PART NUMBER: S3,ME452-0061-4142

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
MAN MODE COULD BE SELECTED TEMPORARILY ONLY BY MOVING RHC.
AUTO SYSTEM PROVIDES REDUNDANCY ON TRANS DAP, BUT NOT ONORBIT.
BOTH AUTO AND MAN ARE USED ON ORBIT.

REFERENCES:
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86
SUBSYSTEM: GNC
MDAC ID: 1576

ITEM: FWD MAN PBI
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD MAN PBI

CRITICALITIES

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LOCATION: PANEL C3
PART NUMBER: S4,ME452-0061-4183

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
MANUAL MODE WOULD BE PERMANENTLY SELECTED.
MANUAL IS BACKUP TO AUTO ON TRANS DAP, BUT NOT ON ORBIT.

REFERENCES:

REPORT DATE 12/22/86 C-125
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY
SUBSYSTEM: GNC  HDW/FUNC
MDAC ID: 1577  FLIGHT: 2/2
ABORT: 2/2

ITEM: AFT AUTO/MAN PBI'S
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) AFT AUTO/MAN PBI'S
4) 
5) 
6) 
7) 
8) 
9) 

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LOCATION: PANEL A6
PART NUMBER: S10, S11; ME452-0061-7142, 7183

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED.
BOTH AUTO AND MANUAL ARE USED FOR ORBIT OPS.

REFERENCES:

REPORT DATE 12/22/86  C-126
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 2/2
MDAC ID: 1580  ABORT: 2/2

ITEM: NORM/VERN PBI'S (FWD & AFT)
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) NORM/VERN PBIs (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED. IF NORM JAMMED, PROX OPS WOULD BE IMPACTED.
IF VERN JAMMED, TRANSLATION COULD NOT BE PERFORMED WITHOUT GOING TO OPS 3.

REFERENCES:

REPORT DATE 12/22/86  C-127
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 2/2
MDAC ID: 1581  ABORT: 2/2

ITEM: FWD PULSE & D RATE ROT PBI's
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) FWD PULSE & DISC RATE ROT PBI's
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LOCATION: PANEL C3
PART NUMBER: VS70-971099

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED.
AUTO MODE WOULD STILL BE FUNCTIONAL. AUTO PROVIDES REDUNDANCY ON TRANS DAP.

REFERENCES:

REPORT DATE 12/22/86  C-128
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 2/2
MDAC ID: 1582  ABORT: 2/2

ITEM: AFT PULSE & D RATE ROT PBI'S
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBI's
3) AFT PULSE & DISC RATE ROT PBI'S
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LOCATION: PANEL A6
PART NUMBER: VS70-971099

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED.
AUTO MODE WOULD STILL BE FUNCTIONAL.

REFERENCES:

REPORT DATE 12/22/86 C-129
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86
SUBSYSTEM: GNC
MDAC ID: 1585

ITEM: ACCEL ROT PBI'S (FWD & AFT)
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GN&C
2) DAP PBIs
3) ACCEL ROT PBI'S (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED.
AUTO MODE WOULD STILL BE FUNCTIONAL.

REFERENCES:

REPORT DATE 12/22/86  C-130
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 10/30/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 2/2
MDAC ID: 1586  ABORT: 2/2

ITEM: TRANSLATION PBI'S (FWD & AFT)
FAILURE MODE: PBI STUCK IN DEPRESSED POSITION

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) DAP PBIs
3) TRANSLATION PBI'S (FWD & AFT)
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LOCATION: PANELS C3 & A6
PART NUMBER: VS70-971099

CAUSES: BREAKAGE, JAMMING, BROKEN SPRING

EFFECTS/RATIONALE:
FAILED MODE WOULD BE PERMANENTLY SELECTED.
AUTO MODE WOULD STILL BE FUNCTIONAL.

REFERENCES:

REPORT DATE 12/22/86  C-131
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/10/86
SUBSYSTEM: GNC
MDAC ID: 1590

ITEM: FC ANNUNCIATOR CIRCUIT
FAILURE MODE: NO OUTPUT

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) FC ANNUNCIATOR CIRCUIT
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LOCATION: PNLS C3,F2,F4,A6
PART NUMBER: MC424-0263-0001

CAUSES: LAMP BURNED OUT, OPEN LAMP DRIVER CIRCUIT

EFFECTS/RATIONALE:
THERE ARE DUAL REDUNDANT LAMPS FOR EACH ANNUNCIATOR.
IF LAMP DRIVER FAILS, THERE IS SUFFICIENT INFORMATION ON BOARD
AND/OR AT THE MCC TO DETERMINE THE STATE.

REFERENCES:

REPORT DATE 12/15/86  C-132
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/10/86  HIGHEST CRITICALITY  HDW/FUNC
SUBSYSTEM: GNC  FLIGHT: 3/3
MDAC ID: 1591  ABORT: 3/3

ITEM: FC ANNUNCIATOR CIRCUIT
FAILURE MODE: INADVERTENT OUTPUT

LEAD ANALYST: K. PIETZ  SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) FC ANNUNCIATOR CIRCUIT
3)...

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LOCATION: PNLS C3,F2,F4,A6
PART NUMBER: MC424-0263-0001

CAUSES: LAMP DRIVER ACTIVATED WITH NO INPUT FROM FSW.

EFFECTS/RATIONALE:
THIS IS AN EXTREMELY IMPROBABLE FAILURE MODE. THERE WOULD BE SUFFICIENT DATA ON BOARD AND/OR AT THE MCC TO DETERMINE THE CORRECT STATE.

REFERENCES:

REPORT DATE 12/15/86  C-133
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/10/86
SUBSYSTEM: GNC
MDAC ID: 1593

ITEM: FC ANNUNCIATOR CIRCUIT
FAILURE MODE: NO OUTPUT FROM ACA

LEAD ANALYST: K. PIETZ
SUBSYS LEAD: L. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) FC ANNUNCIATOR CIRCUIT
3)...

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LOCATION: PNLS C3,F2,F4,A6
PART NUMBER: MC424-0263-0001

CAUSES: CONTAMINATION, SHORT, PIECE PART STRUCTURE FRACTURE

EFFECTS/RATIONALE:
LOSS OF FUNCTION OF ONE ACA WOULD AFFECT MANY MORE SYSTEMS THAN
THE FCS, BUT WOULD NOT AFFECT MISSION, CREW, OR VEHICLE.
THE EXTREMELY UNLIKELY LOSS OF ALL 5 ACA'S COULD CREATE
SUFFICIENT CONFUSION TO JEAPORDIZE CREW/VEHICLE.

REFERENCES:

REPORT DATE 12/15/86 C-134
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/03/86
SUBSYSTEM: GNC
MDAC ID: 1601

ITEM: ENTRY MODE SWITCH CIRCUIT
FAILURE MODE: ERRONEOUS OUTPUT (INCORRECT NUMBER OF CONTACTS ENERGIZED)

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ENTRY MODE SWITCH CIRCUIT

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REDUNDANCY SCREENS: A [N/A] B [N/A] C [N/A]

LOCATION: PNL L2
PART NUMBER: ME452-0102-7459, RWR80S1211FR, JANTXV1N4246

CAUSES: CONTACT FAILED OPEN OR CLOSED, RESISTOR (RWR80S1211FR) SHORTED OR OPEN, DIODE (JANTXV1N4246) FAILED CLOSED. CONTAMINATION, MECHANICAL SHOCK, PIECE PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
FIRST FAILURE RM WILL SELECT CORRECT MODE - FAULT MESSAGE "G51 RL MODE SW" DISPLAYED TO CREW

REFERENCES:

REPORT DATE 12/15/86 C-135
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/03/86
SUBSYSTEM: GNC
MDAC ID: 1602

ITEM: ENTRY MODE SWITCH CIRCUIT
FAILURE MODE: JAMMED SWITCH

LEAD ANALYST: J.M. HIOTT
SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ENTRY MODE SWITCH CIRCUIT
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REdundancy Screens: A [N/A]  B [N/A]  C [N/A]

LOCATION: S25-PNLL2
PART NUMBER: ME452-0102-7459

CAUSES: CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
CONTROL MODE CAN BE RETURNED TO AUTO BY OPTION 42X ON OVERRIDE DISPLAY. LOW GAIN AND NO Y JET OPTIONS NO LONGER AVAILABLE. NOT CRITICAL TO VEHICLE OR MISSION

REFERENCES: C-136
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86
HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC
FLIGHT: 3/1R
ABORT: 3/1R
MDAC ID: 1801

ITEM: ABORT MODE SWITCH CIRCUIT

FAILURE MODE: ABORT MODE ROTARY SWITCH, S1 OR ABORT MODE PUSH
BUTTON SWITCH, S2 CONTACT FAILED OPEN OR A1R2,A1R2,AIR3 SHORTED
TO GROUND

LEAD ANALYST: J.M. HIOTT  SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ABORT MODE SWITCH CIRCUIT
3)
4)
5)
6)
7)
8)
9)

CRITICALITIES

<table>
<thead>
<tr>
<th>FLIGHT PHASE</th>
<th>HDW/FUNC</th>
<th>ABORT</th>
<th>HDW/FUNC</th>
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LOCATION: PNL6-S1MS2,A1R1,A1R2,A1R3
PART NUMBER: ME452-0093-5030,ME452-0061-4187,RW8051211FR

CAUSES: CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL
FAILURE

EFFECTS/RATIONALE:
FIRST FAILURE - NO EFFECT, SECOND FAILURE - DESIRED ABORT MODE
CANNOT BE SELECTED AND INITIATED VIA S1 & S2, DESIRED ABORT MODE
CAN STILL BE SELECTED AND INITIATED VIA MM601 OR OVERIDE DISPLAY
IF TIME PERMITS

REFERENCES:

REPORT DATE 12/15/86  C-137
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86

HIGHEST CRITICALITY HDW/FUNC

SUBSYSTEM: GNC

MDAC ID: 1802

FLIGHT: 2/1R

ABORT: 2/1R

ITEM: ABORT MODE SWITCH CIRCUIT

FAILURE MODE: ABORT MODE ROTARY SWITCH, S1 OR ABORT MODE PUSH BUTTON, S2 CONTACT FAILED CLOSED

LEAD ANALYST: J.M. HIOTT

SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ABORT MODE SWITCH CIRCUIT
3) 
4) 
5) 
6) 
7) 
8) 
9) 

CRITICALITIES

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LOCATION: PNLF6

PART NUMBER: ME452-0093-5030, ME452-0061-4187

CAUSES: CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
FIRST FAILURE - NO EFFECT, SECOND FAILURE - WRONG ABORT MODE MAY BE INITIATED CAUSING LOSS OFF VEHICLE

REFERENCES:

REPORT DATE 12/15/86
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/19/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: GNC FLIGHT: 2/1R
MDAC ID: 1803 ABORT: 2/1R

ITEM: ABORT MODE SWITCH CIRCUIT
FAILURE MODE: ABORT MODE PUSH BUTTON SWITCH, S2, FAILED OPEN OR
ROTARY SWITCH, S1, FAILED OPEN IN THE POSITION REQUIRED FOR
ABORT.

LEAD ANALYST: J.M. HIOTT SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ABORT MODE SWITCH CIRCUIT
3)
4)
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9)

CRITICALITIES

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LOCATION: PNL F6A8
PART NUMBER: ME452-0093-5030, ME452-0061-4187

CAUSES: CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL
FAILURE

EFFECTS/RATIONALE:
THE DESIRED ABORT MODE CANNOT BE SELECTED AND INITIATED USING S1
AND S2 - THE ABORT CAN STILL BE SELECTED AND INITIATE VIA MM601
OR THE OVERRIDE DISPLAY

REFERENCES:

REPORT DATE 12/15/86 C-139
ABORT MODE SWITCH CIRCUIT
FAILURE MODE: ABORT MODE PUSH BUTTON SWITCH FAILED CLOSED OR
ROTARY SWITCH FAILED CLOSED IN A POSITION OTHER THAN THE REQUIRED
ABORT MODE.

LEAD ANALYST: J.M. HIOTT SUBSYS LEAD: L.J. DRAPELA

BREAKDOWN HIERARCHY:
1) GNC
2) ABORT MODE SWITCH CIRCUIT
3) 
4) 
5) 
6) 
7) 
8) 
9) 

CRITICALITIES

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LOCATION: PNLF6
PART NUMBER: ME452-0093-5030, ME452-0061-4187

CAUSES: CONTAMINATION, MECHANICAL SHOCK, PIECE-PART STRUCTURAL FAILURE

EFFECTS/RATIONALE:
THE WRONG ABORT MODE MIGHT BE INITIATED CAUSING LOSS OF VEHICLE

REFERENCES:
**INDEPENDENT ORBITER ASSESSMENT**

**ORBITER SUBSYSTEM ANALYSIS WORKSHEET**

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**ITEM:** ATT REF PB

**FAILURE MODE:** CIRCUIT FAIL OPEN

**LEAD ANALYST:** TRAHAN, W. H.  
**SUBSYS LEAD:** DRAPELA, LES

**BREAKDOWN HIERARCHY:**

1) GNC  
2) SWITCH CIRCUIT  
3) ATT REF PB

**CRITICALITIES**

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

**LOCATION:** PLN F6,F8,A6

**PART NUMBER:** VS70-710149

**CAUSES:** CONTAMINATION, VIBRATION, TEMP, PIECE PART STRU FAIL.

**EFFECTS/RATIONALE:**  
NONE. TWO OTHER PUSHBUTTONS ARE AVAILABLE.

**REFERENCES:**


**REPORT DATE 12/15/86**  
**C-141**
INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 11/06/86
SUBSYSTEM: GNC
MDAC ID: 1902

ITEM: ATT REF PB
FAILURE MODE: CIRCUIT FAIL CLOSED

LEAD ANALYST: TRAHAN, W. H. SUBSYS LEAD: DRAPELA, LES

BREAKDOWN HIERARCHY:
1) GNC
2) SWITCH CIRCUIT
3) ATT REF PB

CRITICALITIES

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LOCATION: PLN F6,F8,A6
PART NUMBER: VS70-710149

CAUSES: CONTAMINATION, VIBRATION, TEMP PIECE PART STRU FAIL, RESISTOR OR CONTACT SHORT.

EFFECTS/RATIONALE:
FIRST FAILURE, NO EFFECT. SECOND FAILURE A CONTINUOUS UPDATE OF REF FRAME OR COAS MARK. MAY LOSE COAS FUNCTIONAL CAPABILITY. ADDITIONAL POWER CONSUMPTION. TWO OTHER REFERENCES AVAILABLE (INTL, LVHL) FOR ATTITUDE DISPLAY. CREW CAN DESELECT COAS FUNCTION VIA KYBD.

REFERENCES:

REPORT DATE 12/15/86 C-142
## APPENDIX D
### POTENTIAL CRITICAL ITEMS

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