INDEPENDENT ORBITER ASSESSMENT

ASSESSMENT
OF THE
BODY FLAP
SUBSYSTEM

05 FEBRUARY 1988

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
HOUSTON DIVISION

SPACE TRANSPORTATION SYSTEM ENGINEERING AND OPERATIONS SUPPORT

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INDEPENDENT ORBITER ASSESSMENT ASSESSMENT OF THE BODY FLAP SUBSYSTEM FMEA/CIL

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Independent Orbiter Assessment
Assessment of the Body Flap Subsystem FMEA/CIL

1.0 EXECUTIVE SUMMARY

The McDonnell Douglas Astronautics Company (MDAC) was selected in June 1986 to perform an Independent Orbiter Assessment (IOA) of the Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL). Direction was given by the STS Orbiter and GFE Projects Office to perform the hardware analysis using the instructions and ground rules defined in NSTS 22206, Instructions for Preparation of FMEA and CIL.

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

The IOA product for the BF analysis consisted of forty-three failure mode "worksheets" that resulted in nineteen potential critical items being identified. Comparison was made to the NASA baseline (as of 7 December 1987) which consisted of (Note 1) thirty-four FMEAs and fifteen CIL items. The comparison determined if there were any results which had been found by the IOA but were not in the NASA baseline. This comparison produced agreement on all CIL items. Based on the pre 51-L baseline, all non-CIL FMEAs were also in agreement. Based on discussions with the NASA subsystem manager, no additional non-CIL FMEAs are anticipated for the Post 51-L update. Figure 1 presents a comparison of the propsed Post 51-L NASA baseline, with the IOA recommended baseline, and any issues.

Note 1. The correlation and comparison of NASA FMEA Non-CIL items is based on the Pre 51-L baseline since all Post 51-L FMEAs have not been received as of the date of this report.

BODY FLAP ACTUATOR ASSESSMENT OVERVIEW

BF ACTUATOR ASSESSMENT SUMMARY							
ORIGINAL ASSESSMENT*				FINAL RESOLUTION**			
	IOA	NASA	ISSUES		IOA	NASA	ISSUES
FMEA	43	36	7	FMEA	34	34	0
CIL	19	17	3	CIL	15	15	0

POWER DRIVE UNIT

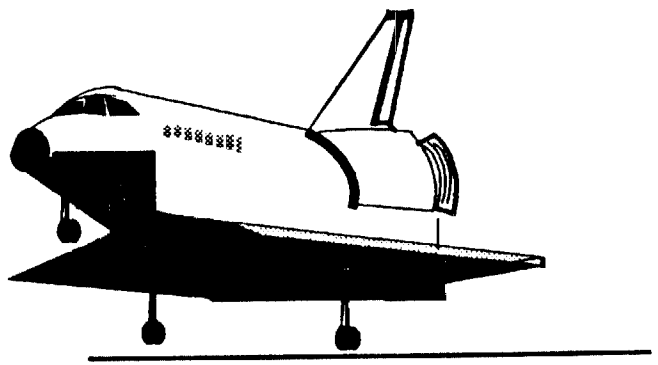
	IOA	NASA	ISSUES
FMEA	40	33	7
CIL	16	14	3

ROTARY ACTUATOR

	IOA	NASA	ISSUES
FMEA	2	2	0
CIL	2	2	0

DRIVE SHAFT

	IOA	NASA	ISSUES
FMEA	1	1	0
CIL	1	1	0



* *NASA PROPOSED BASELINE AS OF 20 MAY 1987*

** *FINAL NASA CIL ITEMS BASELINE AS OF 7 DEC 1987 AND NASA NON-CIL FMEAS - PRE 51-L BASELINE*

Figure 1 - BODY FLAP FMEA/CIL ASSESSMENT

2.0 INTRODUCTION

2.1 Purpose

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

2.2 Scope

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

2.3 Analysis Approach

The independent analysis approach is a top-down analysis utilizing as-built drawings to breakdown the respective subsystem into components and low-level hardware items. Each hardware item is evaluated for failure mode, effects, and criticality. These data are documented in the respective subsystem analysis report, and are used to assess the proposed Post 51-L NASA and Prime Contractor FMEA/CIL. The IOA analysis approach is summarized in the following Steps 1.0 through 3.0. Step 4.0 summarizes the assessment of the NASA and Prime Contractor FMEA/CIL which is documented in this report.

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

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

Step 3.0 Failure events definition
- 3.1 Construct matrix of failure modes
- 3.2 Document IOA analysis results

Step 4.0 Compare IOA analysis data to NASA FMEA/CIL
- 4.1 Resolve differences
- 4.2 Review in-house
- 4.3 Document assessment issues
- 4.4 Forward findings to Project Manager

2.4 Ground Rules and Assumptions

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

3.0 SUBSYSTEM DESCRIPTION

The following sections describe the BF actuator system hardware. This hardware comprises a PDU, rotary actuators, and torque tubes. An overview of the system components is shown in Figure 2.

3.1 Design and Function

The BF is a large aerosurface at the trailing edge of the lower aft fuselage of the Orbiter. The proper function of the BF is essential during the ascent phases of flight. During ascent, the BF trails in a fixed position. For entry, the BF provides elevon load relief, trim control, and acts as a main engine heat shield.

The BF system design provides a triple redundancy, electronically controlled hydro-mechanical drive system. The Flight Control System (FCS) provides signals to the Aerosurface Servo Amplifier (ASA) which commands valve packs supplying pressurized fluid to power hydraulic motors. These motors drive torque tubes which power rotary actuators and move the BF aerosurface.

The BF PDU comprises three in-line filters, three enable solenoid valves, six pilot solenoid valves, three power spool assemblies, one summing link, three hydraulic motor/brake assemblies, and a PDU geartrain assembly (Figure 3).

Three Orbiter hydraulic loops, each corresponding to an Auxiliary Power Unit (APU), supply fluid pressure for the BF drive system. Each PDU is protected by an in-line hydraulic fluid filter upstream of the solenoid valves. Nominally, three hydraulic loops are used to drive the BF. Full BF performance can be maintained using two hydraulic systems. One hydraulic drive system can power the BF at full force, but at half rate.

Each enable solenoid valve (Figure 4) controls the flow of hydraulic fluid to the downstream pilot solenoid valves. These solenoids contains a normally closed valve. A coil spring provides the restoring force which maintains a closed valve position. When energized by an ASA signal, the solenoid provides a force which overcomes the return spring and allows fluid to pressurize downstream pilot solenoid valves.

The BF pilot solenoid valves divert hydraulic fluid and pressure to the downstream control actuator or power spool. The upstream enable solenoid valve must be opened before hydraulic fluid and pressure can flow to the pilot solenoid valves. When an up or down pilot solenoid valve is selected and activated, hydraulic fluid flows thru the control actuator and rotates the hydraulic motor in the corresponding direction.

The power spools control the flow of hydraulic fluid and pressure to the hydraulic motor/brake assemblies. The power spools are situated downstream of the hydraulic inlet and the enable/pilot

solenoid valves. The three power spools are mechanically connected by two summing links. The actuators will translate in one direction for an up command and in the opposite direction for a down command.

The BF actuator recirculation valve is used to divert hydraulic fluid around the actuator if system pressure drops below 850 psi. When hydraulic system pressure is in a nominal range (approximately 3000 psi), the recirculation valve is open and fluid pressurizes the BF actuator.

The summing link is designed to mechanically synchronize the movement of the BF power spools. If one power spool fails to operate (i.e. jammed solenoid valve, loss of ASA signal, etc.), one piston is capable of dragging the remaining two systems thru the summing link to their proper positions. This will direct hydraulic fluid to the motor/brake assemblies and permit them to operate nominally.

The hydraulic motor/brake assembly comprises a hydraulic motor and brake (Figure 5). The hydraulic motor and brake share a common centerline shaft. Each of three hydraulic motor/brake assemblies convert 3000 psi fluid pressure to rotary shaft motion. The assemblies also prevent the differential gearbox from back-driving when the systems are unpressurized.

The hydraulic motor converts hydraulic fluid pressure to rotary motion of the differential gearbox input torque tubes. The motor contains a rotating barrel housing multiple pistons. As each piston passes by the inlet, hydraulic pressure forces each piston out of the rotary barrel transferring force to the motor's fixed ramp wobble-plate which rotates the shaft. This shaft extends out of the motor housing into the hydraulic brake portion of the assembly.

The hydraulic brake is situated between the hydraulic motor and the differential gearbox input torque tubes. The brake is normally engaged, preventing the common motor/brake assembly shaft from rotating or back-driving. When fluid pressure is diverted to the hydraulic brake, it disengages and the shaft transmits rotary power to its corresponding torque tube.

The PDU geartrain assembly (Figure 6) comprises three input torque tubes, a differential gearbox, and one output driveshaft. The splined input torque tubes transmit rotary shaft power from the hydraulic motor/brake assembly to the differential gearbox. The differential gearbox sums the input of three hydraulic motor torque tubes into one output shaft. The gearbox uses two sets of planetary gears to sum the torque tube inputs. One driveshaft transmits the output of the differential gearbox to a beveled gear. The full performance of the BF can be maintained with two torque tube inputs. The BF can be driven at half-speed with one torque tube input.

The PDU geartrain assembly contains two 35-watt heaters mounted to the gearbox. These heaters are used when the vehicle's attitude is thermally cold.

The PDU geartrain assembly output driveshaft position is measured by a four Rotary Variable Differential Transformers (RVDTs) mounted on a common bracket. Any one of the four RVDTs is capable of measuring the driveshaft position. ASA channel four receives the RVDTs output and transmits them to the GPCs for determining BF position.

The rotary actuators (Figure 7) connect the BF to the Orbiter and provide the hinge-moment required to move the surface up or down. The rotary actuators receive torque and power from four torque tubes (Figure 8) connected to the beveled gear at the PDU gearbox driveshaft.

3.2 Interfaces and Locations

The BF system hardware is located at the trailing edge of the Orbiter's lower fuselage. The BF system interfaces with the Orbiter's three hydraulic systems (each corresponding to one APU). The BF system hardware interfaces with the ASAs which in turn interface with the FCS portion of the GPCs for system control actuation and feedback.

3.3 Hierarchy

Figure 2 illustrates the hierarchy of the BF hardware and the corresponding subcomponents. Figures 3 through 8 comprise the detailed system representations.

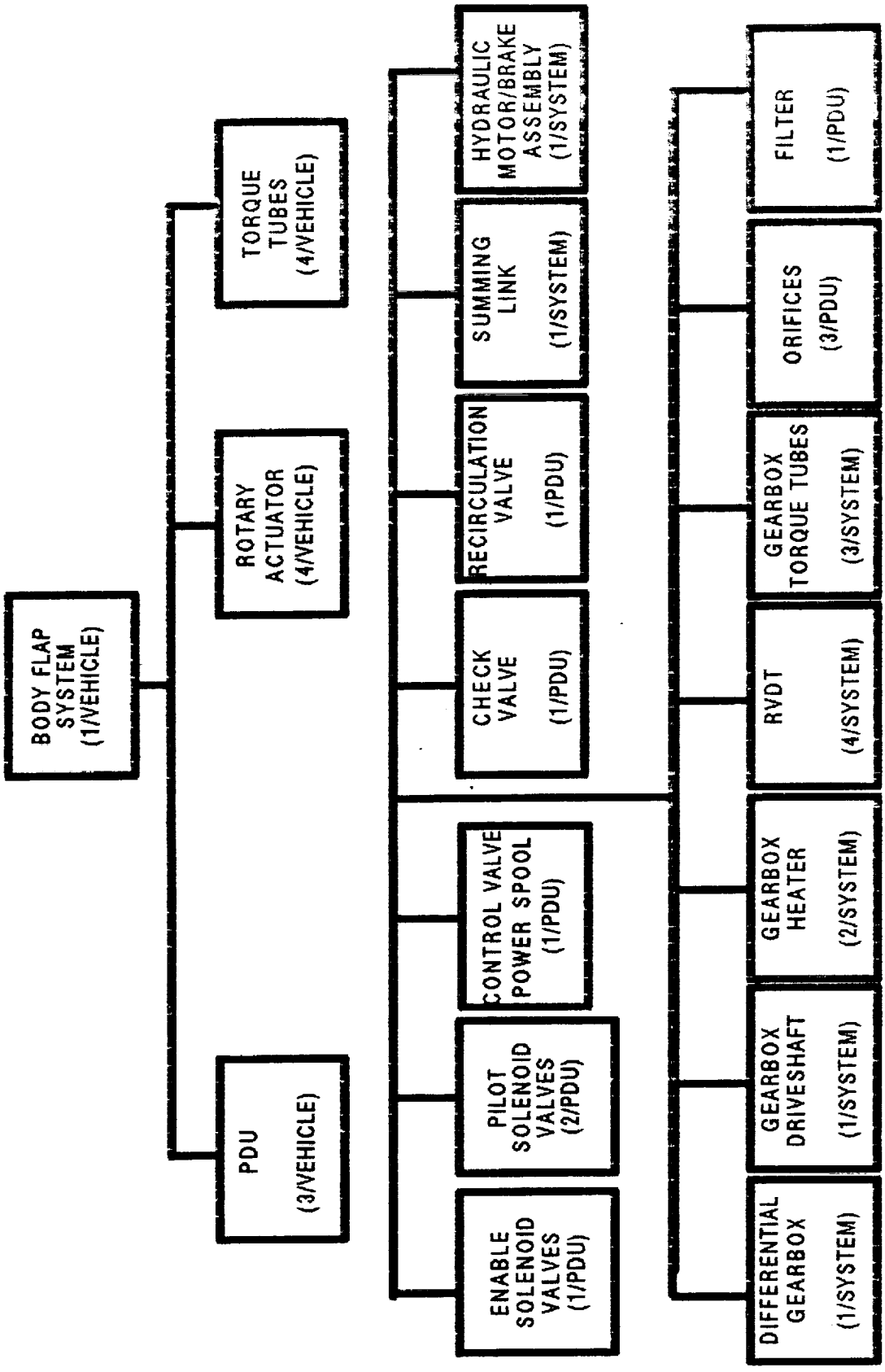


Figure 2 - BODY FLAP SUBSYSTEM OVERVIEW

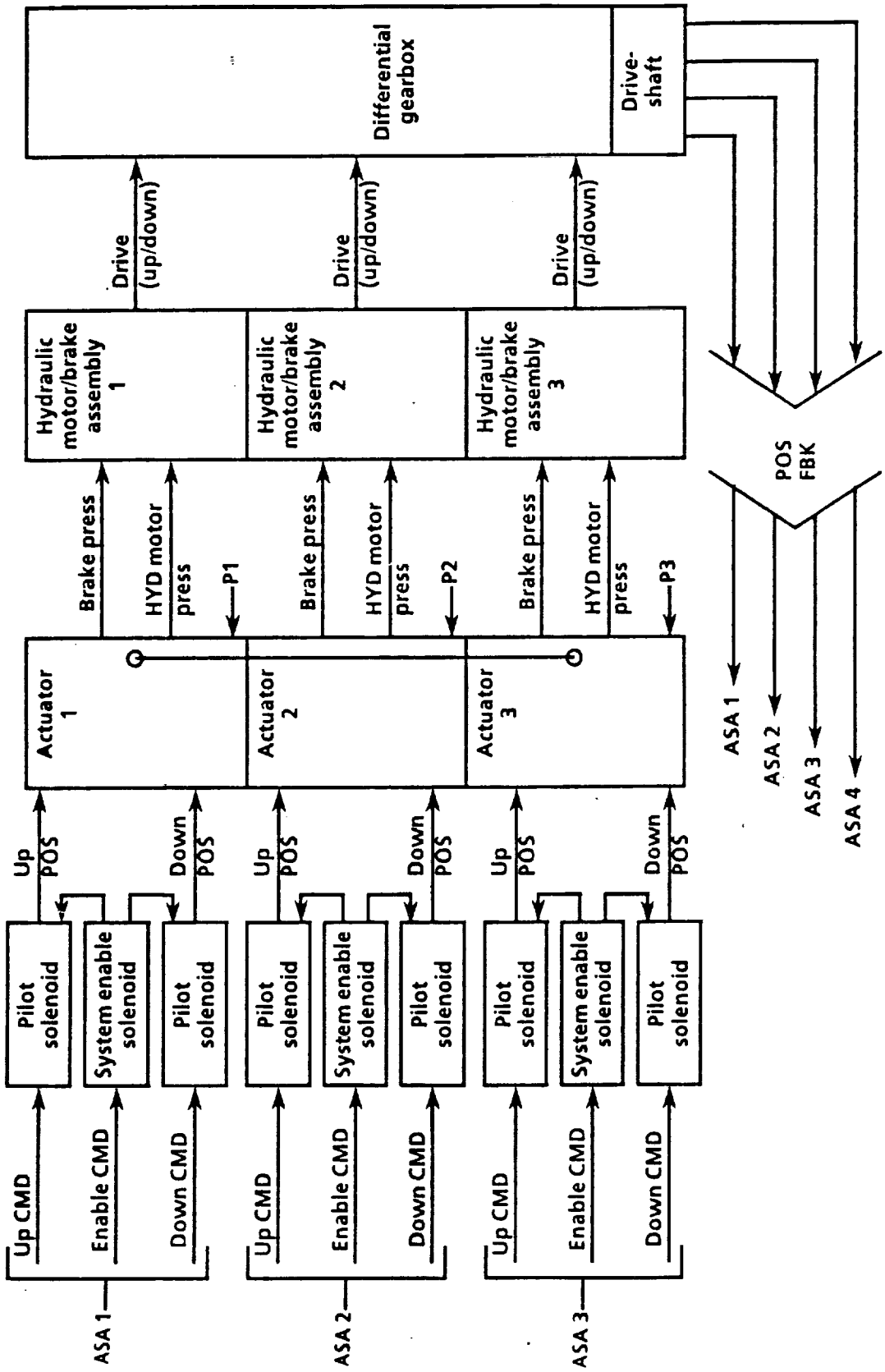


Figure 3 - BODY FLAP POWER DRIVE UNIT

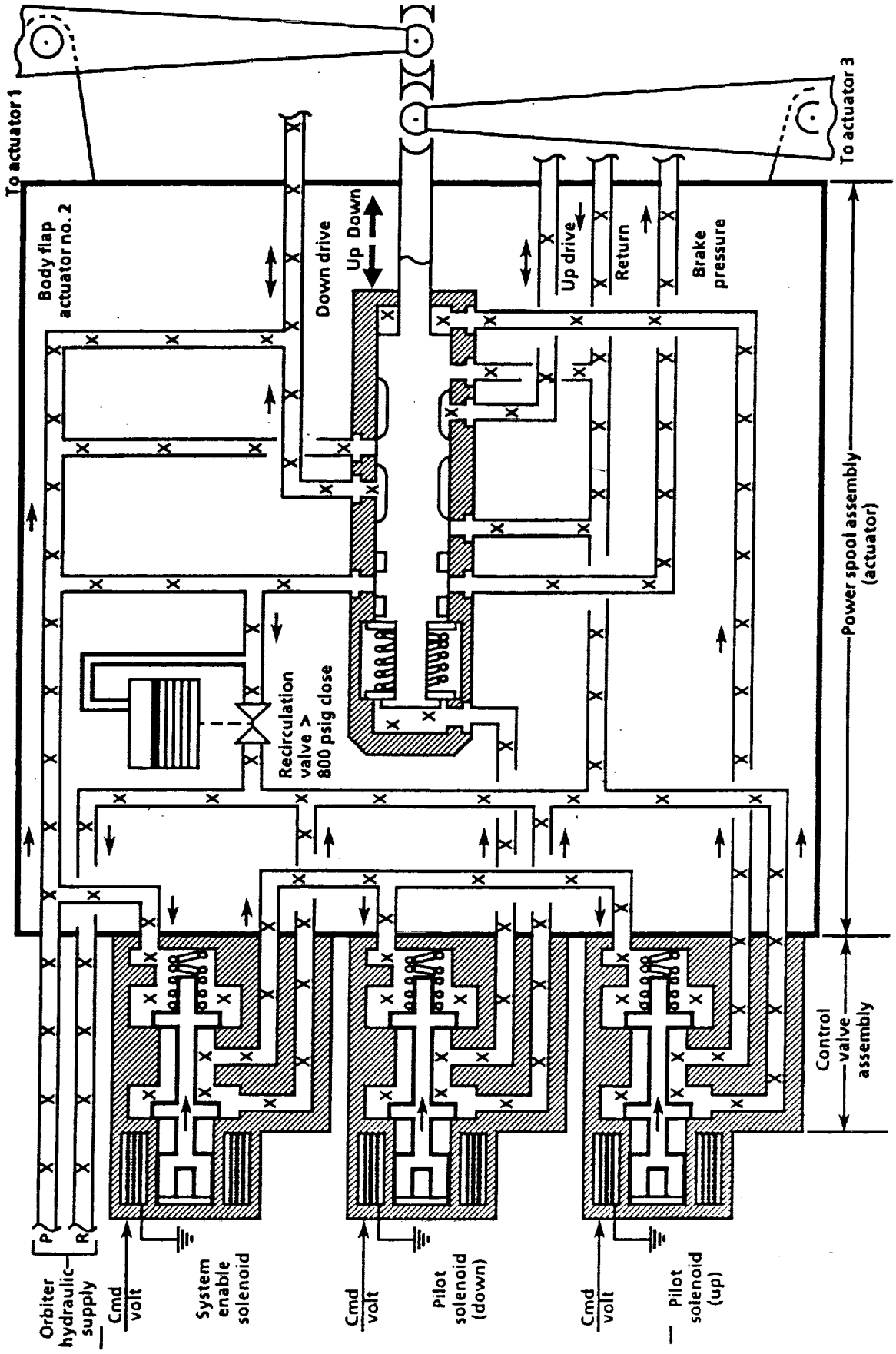


Figure 4 - BODY FLAP SOLENOIDS AND HYDRAULIC ACTUATORS

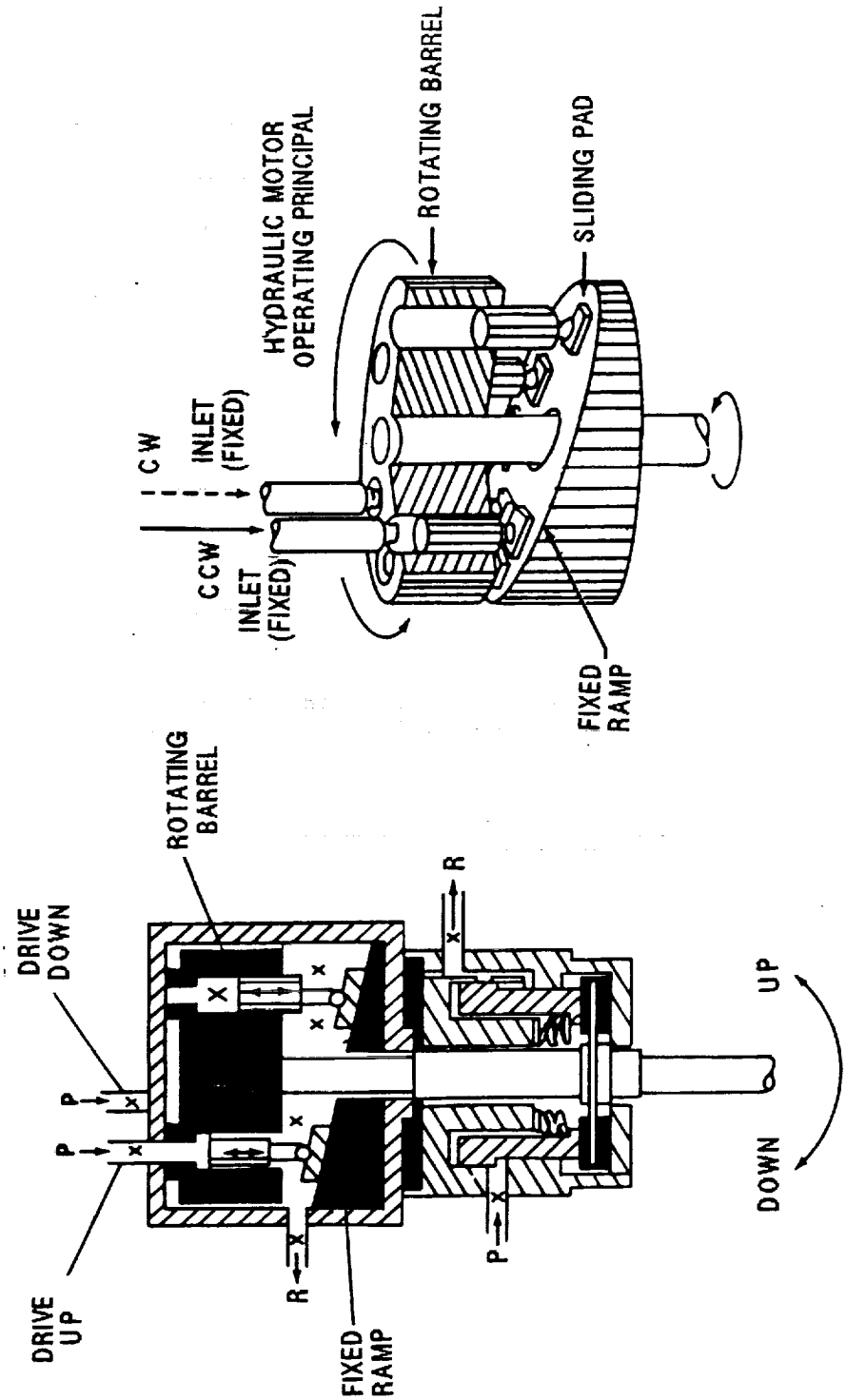


Figure 5 - HYDRAULIC MOTOR/BRAKE ASSEMBLY

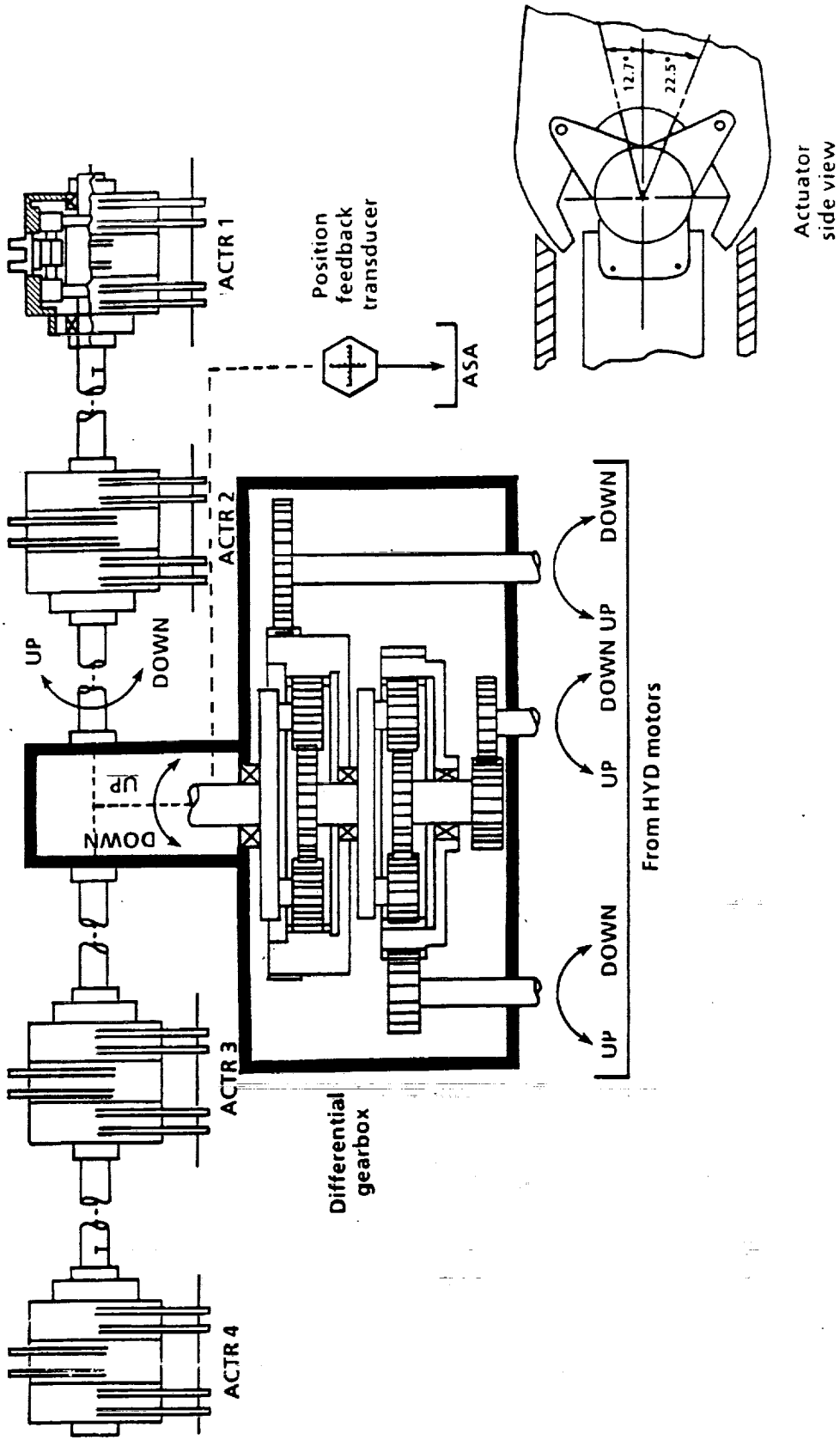


Figure 6 - BODY FLAP DIFFERENTIAL GEARBOX AND ROTARY ACTUATOR

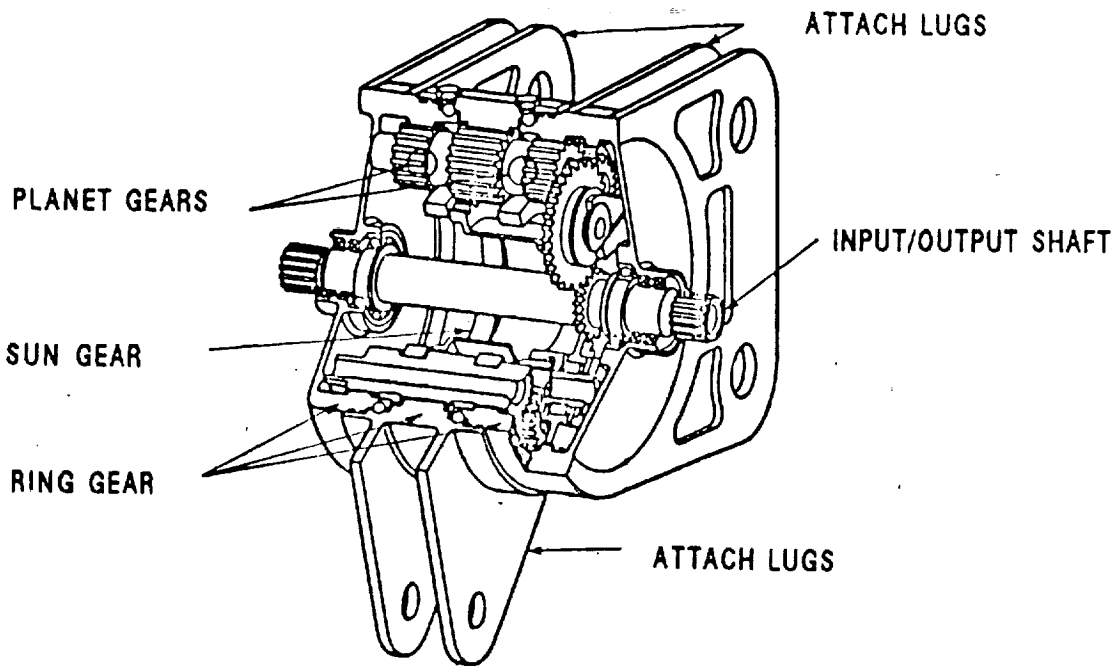


Figure 7 - GEARED ROTARY ACTUATOR

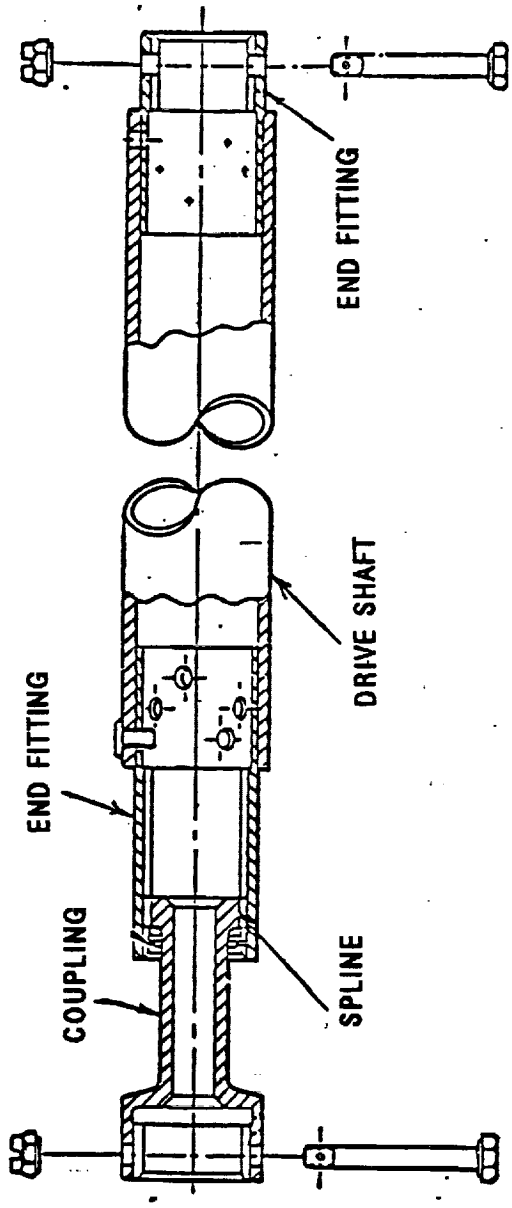


Figure 8 - TYPICAL TORQUE TUBE

4.0 ASSESSMENT RESULTS

The IOA analysis of the BF hardware initially generated thirty-six failure mode worksheets and identified nineteen Potential Critical Items (PCIs) before starting the assessment process. In order to facilitate comparison, seven additional failure mode analysis worksheets were generated. These analysis results were compared to the proposed NASA Post 51L baseline (20 May 1987) of (Note 1) 34 and 20 CIL items and the updated (7 December 1987) version (Note 1) 34 FMEAs and 15 CIL items. The discrepancy between the number of IOA and NASA FMEAS can be explained by the different approach used by NASA and IOA to group failure modes. Upon completion of the assessment and after discussions with the NASA subsystem manager, an agreement between the NASA FMEA/CIL items and the IOA failure modes was reached.

Note 1: Have received Post 51-L CIL items only. Have not received all the Post 51-L NASA FMEAs as of the date of this report. Non-CIL items comparison was based on review of NASA Pre 51-L baseline and IOA analysis.

In the following, the unmapped IOA column is the raw number of IOA failure modes. The mapped IOA column is the number of IOA failure modes after they have been mapped into the NASA FMEAs. The issues column is the IOA failure modes that were unable to be mapped into NASA FMEAs.

BF Elements	IOA Unmapped	IOA Mapped	NASA	Issues
PDU	41	32	32	0
Rotary Actuator	1	1	1	0
Drive Shafts	1	1	1	0
	43	34	34	0

Appendix C presents the detailed assessment worksheets for each failure modes identified and assessment. Appendix D highlights the NASA critical items and corresponding IOA worksheet ID. Appendix E contains IOA analysis worksheets supplementing previous analysis results reported in STS Engineering and Operations Support (STSEOS) Working Paper 1.0-WP-VA86001-23, Analysis of the RSB, 3 December 1986. Appendix F provides a cross reference between the NASA FMEA and corresponding IOA worksheets. IOA recommendations are also summarized.

A summary of the quantity of NASA FMEAs assessed, versus the recommended IOA baseline and any issues identified is presented in Table I.

Table I Summary of IOA FMEA Assessment			
Component	NASA	IOA	Issues
o PDU	5	5	0
o Enable Valve	3	3	0
o Pilot Valve	2	2	0
o Control Valve	1	1	0
o Supply Orifice	4	4	0
o Filter	1	1	0
o Check Valve	2	2	0
o Recirculation Valve	2	2	0
o Summing Link	1	1	0
o Motor/Brake	5	5	0
o Differential	4	4	0
o Position X-DCER	2	2	0
o Rotary Actuator	1	1	0
o Drive Shafts	1	1	0
TOTAL	34	34	0

A summary of the quantity of NASA CIL items assessed, versus the recommended IOA baseline, and any issues identified is presented in Table II.

Table II Summary of IOA CIL Assessment			
Component	NASA	IOA	Issues
o PDU	0	0	0
o Enable Valve	1	1	0
o Pilot Valve	-	-	0
o Control Valve	1	1	0
o Supply Orifice	1	1	0
o Filter	1	1	0
o Check Valve	-	-	0
o Recirculation Valve	-	-	0
o Summing Link	1	1	0
o Motor/Brake	4	4	0
o Differential	3	3	0
o Position X-DCER	1	1	0
o Rotary Actuator	1	1	0
o Drive Shafts	1	1	0
TOTAL	15	15	0

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

TABLE III Summary of IOA Recommended Failure Criticalities

Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
o PDU	-	-	-	-	-	5	5
o Enable Valve	-	1	-	-	-	2	3
o Pilot Valve	-	-	-	-	-	2	2
o Control Valve	1	-	-	-	-	-	1
o Supply Orifice	-	-	-	1	-	3	4
o Filter	-	-	-	1	-	-	1
o Check Valve	-	-	-	-	-	2	2
o Recirculation Valve	-	-	-	-	-	2	2
o Summing Link	1	-	-	-	-	-	1
o Motor/Brake	2	1	-	2	-	-	5
o Differential	2	1	-	1	-	-	4
o Position X-DCER	1	-	-	1	-	-	2
o Rotary Actuator	1	-	-	-	-	-	1
o Drive Shafts	1	-	-	-	-	-	1
TOTAL	9	3	-	6	-	16	34

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

TABLE IV Summary of IOA Recommended Failure Criticalities

Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
o PDU	-	-	-	-	-	-	-
o Enable Valve	-	1	-	-	-	-	1
o Pilot Valve	-	-	-	-	-	-	-
o Control Valve	1	-	-	-	-	-	1
o Supply Orifice	-	-	-	1	-	-	1
o Filter	-	-	-	1	-	-	1
o Check Valve	-	-	-	-	-	-	-
o Recirculation Valve	-	-	-	-	-	-	-
o Summing Link	1	-	-	-	-	-	1
o Motor/Brake	2	1	-	1	-	-	4
o Differential	2	1	-	-	-	-	3
o Position X-DCER	1	-	-	-	-	-	1
o Rotary Actuator	1	-	-	-	-	-	1
o Drive Shafts	1	-	-	-	-	-	1
TOTAL	9	3	-	3	-	-	15

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

Table V IOA Worksheet Numbers

Component	IOA ID Number
o PDU	BF-101; 102; 193; 194; 125; 126; 127; 204; 205
o PDU Elements	BF-105 thru BF-123; BF-128; BF-131 thru BF-136; BF-201; 202; 203
o Rotary Actuator	BF-129; 129A
o Drive Shafts	BF-124; 130

4.1 PDU

Failures which were related to the PDU as an entity were analyzed. Critical failures resulting in loss of vehicle/crew were associated with gross loss of hydraulic fluid due to complete seal failure, rupture of servoactuator in and downstream of the switching valve (manifold, return lines, LEE plugs) and hydraulic supply line rupture (one system). These failures result in depletion of all three hydraulic supplies.

Non-critical failures were associated with internal components which leaked hydraulic fluid. These leaks are contained within the PDU and do not cause depletion of the hydraulic system supplies. Other failures which were not critical were associated with the PDU heater blankets which are considered redundant.

4.2 PDU Elements

Components which make up the PDU were individually analyzed. In most cases, failures were included under one common assessment when the failures of a component had the same effect on the system operation. Those component failures which were analyzed separately and had the system effect were correlated with the NASA FMEA/CIL which combined like failures. Criticality 1 failures were associated with contamination of hydraulic fluid which clogged filters and caused jamming of the hydraulic power valve spool. Both failures result in loss of the BF function. Mechanical failures (sheared shaft/spline or damaged barrel/valve plate) of the hydraulic motor/brake assembly resulted in criticality 1 failures resulting in loss of the BF function. Mechanical failures also result in loss of the differential and mixer gearboxes causing loss of the BF function. The failures were caused by fractures of gear shafts, splines or gears and seized bearings. The failure of the position transducer assembly (four transducers gauged together) also results in loss of the RSB function. A mechanical failure in the transducer drive train will result in loss of all four sanction transducers.

In summary, criticality I failures were due to 1) hydraulic contamination and 2) mechanical failures in gear drive trains.

4.3 Rotary Actuators

Analysis of the rotary actuators which provide the torque required to move the BF surfaces showed that either an open (gear shaft spline sheared, gear teeth broken) or a jam (seized gear or bearing, overload resulted in the loss of an actuator. loss of any one of the four actuators would result in overloading the remaining actuators causing them to fail with the resultant loss of the BF function hence loss of vehicle control.

4.4 Drive Shafts

The ten drive shafts transmit RPM/torque between the PDU and the rotary actuators. Critical failures of the shafts were fractures and gears shearing from the shaft spline. Three failures result in loss of drive to or between the four rotary actuators with resultant loss of BF control.

5.0 REFERENCES

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

1. FCS/Effectors Training Manual 2102 02-86
2. Space Shuttle Systems Handbook, JSC 11174, 09-13-86
3. SD72-SH-0102 System Definition Manual, Mechanical Systems, Hydraulics, 10-28-75
4. R/I Integrated Schematics (V370-580996)
5. Shuttle Master Measurement List
6. FDF (Ascent, On-Orbit, Entry) (Several Different Missions)
7. OMRSD/OMI, FCS Cross Reference - V58AGO, V79ANO, V79ADO, V58AZO 04-08-86
8. Mechanical Console Handbook JSC18341, Feb 86
9. GN&C Console Handbook, JSC12843, 4/25/86
10. Sketches, drawings reviewed with subsystem manager
11. Handouts from preboard reviews 10-10-86
12. SD72-SH-0102-9 Requirements Definition Document, Aero Flight Control Subsystem
13. NSTS 22206, Instructions for Preparation of Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL) 10-10-86

APPENDIX A
ACRONYMS

APU	- Auxiliary Power Unit
ASA	- Aerosurface Servo Amplifier
ASSY	- Assembly
BF	- Body Flap
BRK	- Brake
CIL	- Critical Items List
F	- Functional
FCS	- Flight Control System
FM	- Failure Mode
FMEA	- Failure Modes and Effects Analysis
GPC	- General Purpose Computer
HYD	- Hydraulic, Hydraulics
HW	- Hardware
IOA	- Independent Orbiter Assessment
MDAC	- McDonnell Douglas Astronautics Company
MTR	- Motor
NA	- Not Applicable
NASA	- National Aeronautics and Space Administration
NSTS	- National Space Transportation System
PCI	- Potential Critical Item
PDU	- Power Drive Unit
psi	- Pounds Per Square Inch
psid	- Pounds Per Square Inch Differential
RVDT	- Rotary Variable Differential Transformer
RI	- Rockwell International
VLV	- Valve
xducer	- Transducer

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.

B.3 BF-Specific Ground Rules and Assumptions

The IOA analysis was performed to the component or assembly level of the BF subsystem. The analysis considered the worst case effects of the hardware or functional failure on the subsystem, mission, and crew and vehicle safety.

APPENDIX C
DETAILED ASSESSMENT

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

LEGEND FOR IOA ASSESSMENT WORKSHEETS

Hardware Criticalities:

- 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 Screens A, B and C:

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

NASA Data :

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

CIL Item :

- X = Included in CIL

Compare Row :

- N = Non compare for that column (deviation)

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-101
NASA FMEA #: 02-4C-021102-2

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 101
ITEM: ENABLE SOLENOID VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-102
NASA FMEA #: 02-4C-021102-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 102
ITEM: ENABLE SOLENOID VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. SUMMING LINK WILL DRAG CONTROL ACTUATORS (POWER SPOOLS) TO THE PROPER OPERATING POSITION. THREE HYDRAULIC MOTORS WILL DRIVE THE BF. NO PERFORMANCE DEGRADATION. ALSO COVER BF-104.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-103
NASA FMEA #: 02-4C-021100-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 103
ITEM: ENABLE SOLENOID VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[2 /1R]	[P]	[P]	[P]	[X] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[N /]	[ ]	[ ]	[ ]	[N]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA CRITICALITY. NASA LISTED FAILURE MODE AS EXTERNAL LEAKAGE - SAME RESULT AS FRACTURED HOUSING. HARDWARE WAS BROKEN-DOWN TO A LOWER LEVEL FOR IOA ANALYSIS. NEXT ASSOCIATED FAILURE WILL RESULT IN A LOSS OF LIFE OR VEHICLE. NOTE - THIS NASA FMEA ALSO COVERS BF-107.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-104
NASA FMEA #: NONE

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 104
ITEM: ENABLE SOLENOID VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
SAME AS FAILED CLOSED. ONLY TWO SYSTEMS DRIVER. SAME AS BF-102. DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-105
NASA FMEA #: 02-4C-021103-2

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 105
ITEM: PILOT SOLENOID VALVE (UP OR DOWN)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA FMEA - SUMMING LINK WILL DRAG CONTROL ACTUATORS (POWER SPOOLS) TO THE PROPER OPERATING POSITION. THREE HYDRAULIC MOTORS ARE FULLY OPERATIONAL.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-106
NASA FMEA #: 02-4C-021103-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 106
ITEM: PILOT SOLENOID VALVE (UP OR DOWN)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA FMEA - SUMMING LINK WILL DRAG CONTROL ACTUATORS (POWER SPOOLS) TO THE PROPER OPERATING POSITION. THREE MOTORS DRIVE THE BF. NO PERFORMANCE DEGRADATION.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-107
NASA FMEA #: 02-4C-021100-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 107
ITEM: PILOT SOLENOID VALVE (UP OR DOWN)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[2 /1R]	[P]	[P]	[P]	[X] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[N /]	[ ]	[ ]	[ ]	[N]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA CRITICALITY. NASA LISTED FAILURE MODE AS EXTERNAL LEAKAGE, SAME RESULT AS FRACTURED HOUSING. NEXT ASSOCIATED FAILURE WILL RESULT IN A LOSS OF LIFE OR VEHICLE. NOTE - THIS NASA FMEA ALSO COVERS BF-103.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-108
NASA FMEA #: NONE

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 108
ITEM: PILOT SOLENOID VALVE (UP OR DOWN)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
SAME AS FAILED CLOSED - ONLY TWO DRIVING SYSTEMS. SAME AS BF-107. AGREE TO DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-109
NASA FMEA #: NONE

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 109
ITEM: ACTUATOR-CONTROL VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[2 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA. SAME AS BF-111. AGREE TO DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-110
NASA FMEA #: NONE

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 110
ITEM: ACTUATOR-CONTROL VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[N /N]	[N]	[N]	[N]	[N]
RECOMMENDATIONS: (If different from NASA)	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA. SAME AS BF-111. AGREE TO DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-111
NASA FMEA #: 02-4C-021104-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 111
ITEM: ACTUATOR-CONTROL VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. FAIL IN DRIVE OPEN/DRIVE CLOSED POSITION. THE FAILURES COVERED UNDER BF-109 AND BF-110 ARE DUPLICATE OF THIS FAILURE. DELETE BF-109 AND BF-110.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-112
NASA FMEA #: 02-4C-021108-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 112
ITEM: CHECK VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-113
NASA FMEA #: 02-4C-021101-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 113
ITEM: RECIRCULATION VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[P]	[P]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-114
NASA FMEA #: 02-4C-021116-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 114
ITEM: SUMMING LINK

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-115
NASA FMEA #: NONE

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 115
ITEM: SUMMING LINK

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /1R]	[P]	[F]	[P]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA. SAME AS BF-114. AGREE TO DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-116
NASA FMEA #: 02-4C-021109-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 116
ITEM: HYDRAULIC MOTOR

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[P]	[P]	[ ] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[N]	[ ]	[N]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. LOSS OF HYDRAULIC SYSTEM WOULD BE DETECTABLE THROUGH INSTRUMENTATION. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-117
NASA FMEA #: 02-4C-021109-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 117
ITEM: HYDRAULIC MOTOR

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-118
NASA FMEA #: 02-4C-021110-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 118
ITEM: HYDRAULIC BRAKE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[2 /1R]	[P]	[NA]	[P]	[X] *
IOA	[2 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[N]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. FAILURE WOULD BE DETECTABLE THROUGH INSTRUMENTATION (SHOWING NO BF RESPONSE TO COMMANDS). BF WOULD TRAIL.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-119
NASA FMEA #: 02-4C-021110-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 119
ITEM: HYDRAULIC BRAKE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. TO RECOVER FROM A BROKEN BRAKE SHAFT, SPLINE SHEARED OR SHAFT SEIZED, ALL APUs MUST BE SHUT-DOWN THEN INDIVIDUALLY RESTARTED AND AN AEROSURFACE MOTION TEST PERFORMED TO IDENTIFY THE FAILED BRAKE. THE APU CORRESPONDING TO THE FAILED UNIT MUST THEN BE SHUT-DOWN TO PREVENT TORQUE SPILL-OUT. PROCEDURE COULD NOT BE PERFORMED DURING DEORBIT. ALSO COVERS BF-120.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-120X
NASA FMEA #: 02-4C-021110-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 120
ITEM: HYDRAULIC BRAKE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA FAILURE INCLUDED UNDER ONE NASA FMEA. AGREE TO INCLUDE BF-119 AND BF-120 UNDER ONE FMEA.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-121
NASA FMEA #: 02-4C-021111-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 121
ITEM: DIFFERENTIAL GEARBOX

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-122
NASA FMEA #: 02-4C-021111-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 122
ITEM: DIFFERENTIAL GEARBOX

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[2 /1R]	[P]	[F]	[P]	[X] *
IOA	[2 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. FIRST STAGE JAMMED GEARS, ONE SET. IF A PARTIAL JAM OF THE PDU GEAR TRAIN OCCURRED, IT WOULD NOT BE DETECTABLE IN-FLIGHT. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-123
NASA FMEA #: 02-4C-021111-3

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 123
ITEM: DIFFERENTIAL GEARBOX

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[P]	[P]	[ ] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[N]	[ ]	[N]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
NASA ANALYSIS ASSUMED JAM OF ONE DIFFERENTIAL SET - IOA ANALYSIS ASSUMED ONE SHAFT JAMMED. CONCUR WITH NASA CRITICALITY. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-124
NASA FMEA #: 02-4C-021111-5

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 124
ITEM: DRIVESHAFT

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-125
NASA FMEA #: 02-4C-021115-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 125
ITEM: PDU GEARBOX HEATER

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-126
NASA FMEA #: 02-4C-021115-3

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 126
ITEM: PDU GEARBOX HEATER

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-127
NASA FMEA #: 02-4C-021115-2

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 127
ITEM: PDU GEARBOX HEATER

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-128
NASA FMEA #: 02-4C-021113-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 128
ITEM: RVDT (4-UNITS)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[P]	[P]	[ ] *
IOA	[3 /1R]	[P]	[P]	[P]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-129
NASA FMEA #: 02-4C-021300-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 129
ITEM: ROTARY ACTUATORS

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. SEE NASA FMEA 02-4C-021300-1 (JAMMED ACTUATOR). FMEA COVERS BOTH FAILURES BF-129 AND BF-129A - ACTUATOR JAMMED AND OPEN.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-129A
NASA FMEA #: 02-4C-021300-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 129
ITEM: ROTARY ACTUATORS

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. SEE NASA FMEA 02-4C-021300-1 - COVERS BOTH FAILURES JAMMED TO OPEN (BF-129 AND BF-129A)

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-130
NASA FMEA #: 02-4C-021200-1

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 130
ITEM: TORQUE TUBE (FOR ROTARY ACTUATORS)

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-131
NASA FMEA #: 02-4C-021110-3

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 131
ITEM: HYDRAULIC BRAKE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[F]	[P]	[X] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-132
NASA FMEA #: 02-4C-021114-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 132
ITEM: FILTER

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[F]	[P]	[X] *
IOA	[3 /1R]	[P]	[F]	[P]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-133
NASA FMEA #: 02-4C-021105-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 133
ITEM: SUPPLY ORIFICE #1

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[F]	[P]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. ALTHOUGH BRAKE WILL BE RELEASED, LOCKED HYDRAULIC FLUID WILL NOT ALLOW HYDRAULIC MOTOR TO SPILL-OUT TORQUE. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-134
NASA FMEA #: 02-4C-021107-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 134
ITEM: ORIFICE #2

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. THIS FMEA IS BASED ON NASA BASELINE INFORMATION.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-135
NASA FMEA #: 02-4C-021106-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 135
ITEM: ORIFICE #3

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS. BASED ON NASA BASELINE INFORMATION.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-136
NASA FMEA #: 02-4C-021113-2

NASA DATA:
BASELINE [ ]
NEW [X]

SUBSYSTEM: BODY FLAP
MDAC ID: 136
ITEM: RVDT

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[NA]	[NA]	[NA]	[X] *
IOA	[1 /1]	[NA]	[NA]	[NA]	[X]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/] [ ] [ ] [ ] [ ]
(ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [X]
INADEQUATE [ ]

REMARKS:
CONCUR WITH NASA ANALYSIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-201X
NASA FMEA #: 02-4C-021108-2

NASA DATA: ,
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 201
ITEM: CHECK VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
THIS FMEA WAS PERFORMED POST-IOA ANALYSIS. CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-202X
NASA FMEA #: 02-4C-021101-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 202
ITEM: RECIRCULATION VALVE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
THIS FMEA WAS PERFORMED POST-IOA ANALYSIS. CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-203X
NASA FMEA #: 02-4C-021105-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 203
ITEM: SUPPLY ORIFICE #1

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
THIS FMEA WAS PERFORMED POST-IOA ANALYSIS. CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-204X
NASA FMEA #: 02-4C-021100-2

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 204
ITEM: PDU

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
THIS FMEA WAS PERFORMED POST-IOA ANALYSIS. CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-205X
NASA FMEA #: 02-4C-021112-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 205
ITEM: PDU STOP MECHANISM

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[3 /3]	[NA]	[NA]	[NA]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
THIS FMEA WAS PERFORMED POST-IOA ANALYSIS. CONCUR WITH NASA ANALYSIS. NO ISSUE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-901X
NASA FMEA #: 02-4C-021400-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 901
ITEM: SENSOR STRAIN GAGE

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[NA]	[NA]	[NA]	[ ] *
IOA	[/]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
NO IOA FMEA PERFORMED FOR THIS ITEM. EQUIPMENT WAS DFI ONLY.
DELETE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 12/20/87
ASSESSMENT ID: BF-902X
NASA FMEA #: 02-4C-021114-1

NASA DATA:
BASELINE [X]
NEW [ ]

SUBSYSTEM: BODY FLAP
MDAC ID: 902
ITEM: FILTER

LEAD ANALYST: R. WILSON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[P]	[P]	[ ] *
IOA	[/]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[N]	[N]	[N]	[ ]
RECOMMENDATIONS: (If different from NASA)					
	[/]	[ ]	[ ]	[ ]	[ ] (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
ADEQUATE [ ]
INADEQUATE [ ]

REMARKS:
CONSIDERED BY NASA PREBOARD TO BE A NON-CREDIBLE FAILURE.
DELETE.

APPENDIX D
POTENTIAL CRITICAL ITEMS

NASA FMEA	MDAC-ID	ITEM	FAILURE MODE
02-4C-021100-1	103	PDU	EXTERNAL LEAK, COMPLETE SEAL FAILURE
02-4C-021100-1	107	PDU	EXTERNAL LEAK, FRACTURED HOUSING
02-4C-021104-1	111	ACTUATOR CONTROL VALVE	FAIL DRIVE OPEN/ DRIVE CLOSED POSITION
02-4C-021116-1	114	SUMMING LINK	JAMMED
02-4C-021109-2	117	HYDRAULIC MOTOR	FRACTURED SHAFT, NO TORQUE OUTPUT OPEN DRIVELINE
02-4C-021110-2	118	HYDRAULIC BRAKE	FAILS TO BRAKE, FRACTURED ACTUATING SPRING, PRESSURE PLATE
02-4C-021110-1	119	HYDRAULIC BRAKE	FRACTURED SHAFT, SPLINE SHEARED, LOSS OF TORQUE OUTPUT
02-4C-021110-1	120	HYDRAULIC BRAKE	SHAFT SEIZED
02-4C-021111-1	121	DIFFERENTIAL GEARBOX - 2ND STAGE	FRACTURED GEAR, SHAFT, SPLINE SEIZED BEARING, NO TORQUE OUTPUT
02-4C-021111-2	122	DIFFERENTIAL GEARBOX - 1ST STAGE	ONE SET GEAR MESH JAM, SEIZED BEARING
02-4C-021111-5	124	DRIVESHAFT	FRACTURED OUTPUT SHAFT, SPLINE OR GEAR - NO TORQUE OUTPUT OR OPEN
02-4C-021300-1	129	ROTARY ACTUATORS	JAMMED, OR OPEN FAILS TO TRANSMIT RPM/ TORQUE
02-4C-021300-1	129A	ROTARY ACTUATORS	SEIZED BEARING, BROKEN GEAR TEETH
02-4C-021200-1	130	DRIVE SHAFT (TORQUE TUBE)	FRACTURED SHAFT- SHEARED SPLINE OPEN DRIVELINE
02-4C-021110-3	131	HYDRAULIC BRAKE	FAILS TO RELEASE, INTERNAL LEAK, STUCK BRAKE SLIDE
02-4C-021114-2	132	FILTER (ONE OF THREE)	CLOGGED
02-4C-021105-2	133	SUPPLY ORIFICE #1	CLOGGED, LOSS OF BRAKE
02-4C-021113-2	136	POSITION TRANSDUCER	LOSS OF MECHANICAL EXPERT/ELECTRICAL OUTPUT, ALL TRANSDUCERS

APPENDIX E
DETAILED ANALYSIS

This appendix contains the IOA analysis worksheets supplementing previous results reported in STSEOS Working Paper 1.0-WP-VA86001-23, Analysis of the Body Flap Subsystem, (3 December 1986). Prior results were obtained independently and documented before starting the FMEA/CIL assessment activity. Supplemental analysis was performed to address failure modes not previously considered by the IOA. Each sheet identifies the hardware item being analyzed, parent assembly and function performed. For each failure mode possible causes are identified, and hardware and functional criticality for each mission phase are determined as described in NSTS 22206, Instructions for Preparation of FMEA and CIL, 10 October 1986. Failure mode effects are described at the bottom of each sheet and worst case criticality is identified at the top.

LEGEND FOR IOA ANALYSIS WORKSHEETS

Hardware Criticalities:

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

Functional Criticalities:

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

Redundancy Screen A:

- 1 = Is Checked Out PreFlight
- 2 = Is Capable of Check Out PreFlight
- 3 = Not Capable of Check Out PreFlight
- NA = Not Applicable

Redundancy Screens B and C:

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

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/30/87 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: 3/1R
MDAC ID: 120 ABORT: 3/1R

ITEM: HYDRAULIC BRAKE
FAILURE MODE: SHAFT SPLINE SHEARED

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) ENABLE SOLENOID VALVE
3) PILOT SOLENOID VALVE
4) POWER SPOOL-CONTROL VALVE
5) SUMMING LINK
6) HYDRAULIC MOTOR/BRAKE ASSEMBLY
7) HYDRAULIC BRAKE
8)
9)

CRITICALITIES

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

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

LOCATION: AFT FUSELAGE
PART NUMBER: MC621-0056-0053

CAUSES: FATIGUE

EFFECTS/RATIONALE:
SHAFT SHEARS INTERNAL TO BRAKE HOUSING - HYDRAULIC SYSTEMS MUST BE SHUT-DOWN TO DETECT FAILED UNIT AND ENGAGE BRAKE TO PREVENT TORQUE SPILL-OUT - REMAINING TWO SYSTEMS DRIVE BODY FLAP NOMINALLY.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86
SUBSYSTEM: BODY FLAP
MDAC ID: 201

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

ITEM: CHECK VALVE
FAILURE MODE: FAILS CLOSED

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) ENABLE SOLENOID VALVE
3) PILOT SOLENOID VALVE
4) POWER SPOOL
5) CHECK VALVE
6)
7)
8)
9)

CRITICALITIES

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

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

LOCATION:
PART NUMBER: MC621-0056-053

CAUSES: JAMMED, CONTAMINATED

EFFECTS/RATIONALE:
NO EFFECT - POWER SPOOL RECEIVES PRIMARY PRESSURE - BF IS DRIVEN NOMINALLY. NOTE - THIS FMEA WAS PERFORMED AFTER THE BF ANALYSIS WAS COMPLETED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: 3/3
MDAC ID: 202 ABORT: 3/3

ITEM: RECIRCULATION VALVE
FAILURE MODE: FAILS OPEN

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) ENABLE SOLENOID VALVE
3) PILOT SOLENOID VALVE
4) POWER SPOOL
5) RECIRCULATION VALVE
6)
7)
8)
9)

CRITICALITIES

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

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

LOCATION:
PART NUMBER: MC621-0056-0053

CAUSES: JAMMED, CONTAMINATED

EFFECTS/RATIONALE:
NO EFFECT ON SUBSYSTEM PERFORMANCE. LIMITED PRESSURE BLEEDS TO RETURN - MINIMAL PERFORMANCE DEGREDATION. NOTE - THIS FMEA WAS PERFORMED AFTER THE BF ANALYSIS WAS COMPLETED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: 3/3
MDAC ID: 203 ABORT: 3/3

ITEM: SUPPLY ORIFICE #1
FAILURE MODE: FAILS OPEN

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) ENABLE SOLENOID VALVE
3) PILOT SOLENOID VALVE
4) POWER SPOOL
5) SUPPLY ORIFICE #1
6)
7)
8)
9)

CRITICALITIES

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

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

LOCATION:
PART NUMBER: MC621-0056-0053

CAUSES: JAMMED, CONTAMINATED HYDRAULIC FLUID

EFFECTS/RATIONALE:
NO EFFECT ON SUBSYSTEM PERFORMANCE. SYSTEM OPERATES NORMALLY.
NOTE - THIS FMEA WAS PERFORMED AFTER THE BF ANALYSIS WAS COMPLETED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: 3/3
MDAC ID: 204 ABORT: 3/3

ITEM: PDU
FAILURE MODE: INTERNAL LEAKAGE

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) PDU
3)
4)
5)
6)
7)
8)
9)

CRITICALITIES

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

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

LOCATION:
PART NUMBER: MC621-0056-0053

CAUSES: SEAL FAILURE

EFFECTS/RATIONALE:
INTERNAL SEAL FAILURE - FLUID LEAKS TO RETURN LINE. MINIMAL SYSTEM PERFORMANCE DEGREDATION. NOTE - THIS FMEA WAS PERFORMED AFTER THE BF ANALYSIS WAS COMPLETED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: 3/3
MDAC ID: 205 ABORT: 3/3

ITEM: PDU STOP MECHANISM
FAILURE MODE: FAILS TO STOP

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

BREAKDOWN HIERARCHY:
1) BODY FLAP
2) PDU
3) PDU STOP MECHANISM
4)
5)
6)
7)
8)
9)

CRITICALITIES

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

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

LOCATION:
PART NUMBER: MC621-0056-0053

CAUSES: FRACTURED SHAFT OR GEAR

EFFECTS/RATIONALE:
NO EFFECT, VEHICLE CAN WITHSTAND LIMITED CONTACT WITH BF. NOTE - THIS FMEA WAS PERFORMED AFTER THE BF ANALYSIS WAS COMPLETED.

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: /
MDAC ID: 901 ABORT: /

ITEM: SENSOR STRAIN GAGE
FAILURE MODE:

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

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

CRITICALITIES

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

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

LOCATION:
PART NUMBER:

CAUSES:

EFFECTS/RATIONALE:

REFERENCES:

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 12/18/86 HIGHEST CRITICALITY HDW/FUNC
SUBSYSTEM: BODY FLAP FLIGHT: /
MDAC ID: 902 ABORT: /

ITEM: FILTER
FAILURE MODE:

LEAD ANALYST: R. WILSON SUBSYS LEAD: J. RICCIO

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

CRITICALITIES

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

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

LOCATION:
PART NUMBER:

CAUSES:

EFFECTS/RATIONALE:

REFERENCES:

APPENDIX F

NASA FMEA TO IOA WORKSHEET CROSS REFERENCE/RECOMMENDATIONS

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

Appendix F Legend

Code Definition

None. All initial IOA criticality and redundancy screen differences were resolved with the NASA subsystem manager. In addition, the combining of like failures under one FMEA were agreed to.

APPENDIX F

NASA FMEA TO IOA WORKSHEET CROSS REFERENCE / RECOMMENDATIONS

IDENTIFIERS		NASA		IOA RECOMMENDATIONS *			
NASA FMEA NUMBER	IOA ASSESSMENT NO.	CRIT HW/F	SCREENS A B C	CRIT HW/F	SCREENS A B C	OTHER (SEE LEGEND CODE)	ISSUE
02-4C-021100-1	BF-103	2/1R	P P P	/			
	BF-107	2/1R	P P P	/			
02-4C-021100-2	BF-204X	3/3	NA NA NA	/			
02-4C-021101-1	BF-202X	3/3	NA NA NA	/			
02-4C-021101-2	BF-113	3/1R	P P P	/			
02-4C-021102-1	BF-102	3/3	NA NA NA	/			
02-4C-021102-2	BF-101	3/3	NA NA NA	/			
02-4C-021103-1	BF-106	3/3	NA NA NA	/			
02-4C-021103-2	BF-105	3/3	NA NA NA	/			
02-4C-021104-1	BF-111	1/1	NA NA NA	/			
02-4C-021105-1	BF-203X	3/3	NA NA NA	/			
02-4C-021105-2	BF-133	3/1R	P F P	/			
02-4C-021106-1	BF-135	3/3	NA NA NA	/			
02-4C-021107-1	BF-134	3/3	NA NA NA	/			
02-4C-021108-1	BF-112	3/3	NA NA NA	/			
02-4C-021108-2	BF-201X	3/3	NA NA NA	/			
02-4C-021109-1	BF-116	3/1R	P P P	/			
02-4C-021109-2	BF-117	1/1	NA NA NA	/			
02-4C-021110-1	BF-119	1/1	NA NA NA	/			
	BF-120X	1/1	NA NA NA	/			
02-4C-021110-2	BF-118	2/1R	P NA P	/			
02-4C-021110-3	BF-131	3/1R	P F P	/			
02-4C-021111-1	BF-121	1/1	NA NA NA	/			
02-4C-021111-2	BF-122	2/1R	P F P	/			
02-4C-021111-3	BF-123	3/1R	P P P	/			
02-4C-021111-5	BF-124	1/1	NA NA NA	/			
02-4C-021112-1	BF-205X	3/3	NA NA NA	/			

NASA FMEA IOA WORKSHEET CROSS REFERENCE / RECOMMENDATIONS

IDENTIFIERS		NASA		IOA RECOMMENDATIONS *			
NASA FMEA NUMBER	IOA ASSESSMENT NO.	CRIT HW/F	SCREENS A B C	CRIT HW/F	SCREENS A B C	OTHER (SEE LEGEND CODE)	ISSUE
02-4C-021113-1	BF-128	3/1R	P P P	/			
02-4C-021113-2	BF-136	1/1	NA NA NA	/			
02-4C-021114-1	BF-902X	3/1R	P P P	/			
02-4C-021114-2	BF-132	3/1R	P F P	/			
02-4C-021115-1	BF-125	3/3	NA NA NA	/			
02-4C-021115-2	BF-127	3/3	NA NA NA	/			
02-4C-021115-3	BF-126	3/3	NA NA NA	/			
02-4C-021116-1	BF-114	1/1	NA NA NA	/			
02-4C-021200-1	BF-130	1/1	NA NA NA	/			
02-4C-021300-1	BF-129	1/1	NA NA NA	/			
	BF-129A	1/1	NA NA NA	/			
02-4C-021400-1	BF-901X	3/3	NA NA NA	/			
NONE	BF-104	/		/			
	BF-108	/		/			
	BF-109	/		/			
	BF-110	/		/			
	BF-115	/		/			