

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP  
ASS'Y P/N:

SHEET: 1

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	HOW / FUNC. Z/TR CRITICALITY	RATIONALE FOR ACCEPTANCE
4440	1	BACKUP DRIVE SWITCH QTY: 1 P/N WE425-0102-7405	<p>MODE: SHORTED CONTACTS.</p> <p>CAUSE(S): (1) +, OR - CONTACTS CONTAMINATION.</p>	<p>JOINTS CAN ONLY BE DRIVEN IN ONE DIRECTION IN BACKUP.</p> <p>BRAKE ON SELECTED JOINT WILL BE DISENGAGED WHILE BACKUP MODE IS SELECTED. BDA WILL BE COMMANDING ZERO RATE TO JOINT SELECT.</p> <p>WORST CASE</p> <p>BACKUP INOPERATIVE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE AND DIRECT</p>	<p>DESIGN FEATURES</p>	<p>TOGGLE SWITCHES USED ON THE D&amp;C PANEL ARE HERMETICALLY SEALED, AND OF A MATURE AND PROVEN DESIGN. THESE SWITCHES ARE IN COMMON USE ON THE ORBITER VEHICLE.</p> <p>THE SWITCHES ARE CONTROLLED BY ROCKWELL INTERNATIONAL SPECIFICATION MC 452-0102 AND HAVE BEEN QUALIFIED TO THE REQUIREMENTS OF THIS SPECIFICATION.</p> <p>ELECTRICAL CONNECTIONS TO THE SWITCH ARE ACHIEVED BY MEANS OF SOLDERABLE TERMINALS.</p> <p>WIRING TO SWITCH TERMINALS UTILIZES NICKEL PLATED CONDUCTORS WITH A POLYAMID INSULATION. SOLDERING OF THE NICKEL PLATED WIRE TO THE SWITCH TERMINALS IS CONTROLLED BY CAE PROCESS SPECIFICATION PD 91059.</p> <p>THE WIRING HARNESS IS DESIGNED TO BE CAPABLE OF SEPARATE TESTING (FOR INSULATION RESISTANCE, DIELECTRIC STRENGTH, AND CONTINUITY).</p> <p>MOUNTING OF THE SWITCH TO THE D&amp;C PANEL IS BY MEANS OF A 15/32 NUT WHICH ENGAGES A THREADED BUSHING ON THE SWITCH. A KEYED WASHER PROVIDES ROTATION RESTRAINT. AFTER INSTALLATION AND TORQUING, THE NUT IS STAKED TO THE PANEL BY A BLOB OF EPOXY ADHESIVE. A STAINLESS STEEL GUARD PROTECTS THE SWITCH LEVER AGAINST DAMAGE OR INADVERTENT OPERATION.</p> <p>ANALYSIS OF THE BASIC PANEL STRUCTURE HAS DEMONSTRATED THAT THERE ARE NO RESONANCES IN THE RELEVANT VIBRATION FREQUENCY SPECTRUM. THIS ANALYSIS HAS BEEN VERIFIED BY VIBRATION TESTING OF THE D&amp;C PANEL ASSEMBLY.</p> <p>APPLICATION ANALYSIS HAS CONFIRMED THAT ADEQUATE ELECTRICAL STRESS MARGINS ARE ACHIEVED.</p> <p>AT THE PART LEVEL, QUALIFICATION/CERTIFICATION TESTING IS DEFINED BY ROCKWELL INTERNATIONAL SPECIFICATION MC452-0102. THIS TEST REQUIREMENT INCLUDES: INSULATION RESISTANCE, DIELECTRIC STRENGTH, CONTACT RESISTANCE, RANDOM VIBRATION (48 MINUTES PER AXIS), LEAKAGE AT ONE ATMOSPHERE DIFFERENTIAL PRESSURE, TOGGLE STRENGTH. FOR SWITCH OPERATIONAL CYCLES REFER TO TABLE 13.</p> <p>ALL UNITS ARE SUBJECTED TO ACCEPTANCE TESTS WHICH INCLUDE PRE-ACCEPTANCE RUN-IN, DIELECTRIC STRENGTH, INSTALLATION RESISTANCE, CONTACT RESISTANCE, ACCEPTANCE VIBRATION, SEAL TEST, VISUAL EXAMINATION, AND RADIOGRAPHIC INSPECTION.</p> <p>ALL RESISTORS AND CAPACITORS USED IN THE DESIGN ARE SELECTED FROM ESTABLISHED RELIABILITY (ER) TYPES. LIFE EXPECTANCY IS INCREASED BY ENSURING THAT ALL ALLOWABLE STRESS LEVELS ARE DERATED IN ACCORDANCE WITH SPAR-RMS-PA.003. ALL CERAMIC AND ELECTROLYTIC CAPACITORS ARE ROUTINELY SUBJECTED TO RADIOGRAPHIC INSPECTION.</p>

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP  
ASS'Y P/N:

SHEET: 2

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4440	1	BACKUP DRIVE SWITCH QTY-1 P/N ME425-0102-7405	MODE: SHORTED CONTACTS.  CAUSE(S): (1) + OR - CONTACTS CONTAMINATION.	JOINTS CAN ONLY BE DRIVEN IN ONE DIRECTION IN BACKUP.  BRAKE ON SELECTED JOINT WILL BE DISENGAGED WHILE BACKUP MODE IS SELECTED. BOA WILL BE COMMANDING ZERO RATE TO JOINT SELECT.  WORST CASE ----- BACKUP INOPERATIVE.  REDUNDANT PATHS REMAINING ----- SINGLE AND DIRECT		ACCEPTANCE TESTS ----- THE HARDWARE ITEM IS SUBJECTED TO THE FOLLOWING ACCEPTANCE ENVIRONMENTAL TESTS AS PART OF THE D&C PANEL ASSEMBLY.  O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 1  O THERMAL: +110 DEGREES F TO PLUS 10 DEGREES F (2 CYCLES - 9.5 HRS/CYCLE.)  THE D&C PANEL ASSEMBLY IS FURTHER TESTED AS PART OF THE RMS SYSTEM TESTS (TP518 RMS STRONGBACK TEST AND TP552 FLAT FLOOR TEST) WHICH VERIFIES THE ABSENCE OF THE FAILURE MODE.  QUALIFICATION TESTS ----- THE SWITCH ITEM HAS BEEN QUALIFIED FOR ORBITER USE. THE D&C PANEL ASSEMBLY HAS BEEN SUBJECTED TO THE FOLLOWING QUALIFICATION TEST ENVIRONMENTS.  O VIBRATION: LEVEL AND DURATION - REFERENCE TABLE 1  O SHOCK: 20G/11 MS - 3 AXES (6 DIRECTIONS)  O THERMAL: 130 DEGREES F TO -23 DEGREES F (12 HRS PER CYCLE) (6 CYCLES)  O HUMIDITY: 95% (120 DEGREES F TO 82 DEGREES F CYCLE IN 16 HRS) 10 CYCLES TOTAL.  O EMC: MIL-STD-461 AS MODIFIED BY SL-E-0002 (TEST CE01, CE02, CE03, CS01 (DC/AC), CE03, CS01 (DC/AC), CS02, CS06, RE02 (B/W), RS02, RS03, RS04)  FLIGHT CHECKOUT ----- PDRS OPS CHECKLIST (ALL VEHICLES) JSC 16987

PREPARED BY: MFWG

SUPERSEDING DATE: 28 OCT 86

APPROVED BY:

DATE:

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP  
ASS'Y P/N:

SHEET: 3

FMEA REF.	REV.	NAME QTY & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	HDM / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4440	1	BACKUP DRIVE SWITCH QTY-1 P/N ME425-0102-7405	<p>MODE: SHORTED CONTACTS.</p> <p>CAUSE(S): (1) +, OR - CONTACTS CONTAMINATION.</p>	<p>JOINTS CAN ONLY BE DRIVEN IN ONE DIRECTION IN BACKUP.</p> <p>BRAKE ON SELECTED JOINT WILL BE DISENGAGED WHILE BACKUP MODE IS SELECTED. ODA WILL BE COMMANDING ZERO RATE TO JOINT SELECT.</p> <p>WORST CASE</p> <p>BACKUP INOPERATIVE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE AND DIRECT</p>	QA/INSPECTIONS	<p>HERMETICALLY SEALED TOGGLE SWITCHES ARE PROCURED TO ROCKWELL SPECIFICATION MC452-0102. ROCKWELL PART NO. ME452-0102-.... QUALIFICATION AND ACCEPTANCE TESTING OF SWITCHES IS PERFORMED TO R.1. SPEC. MC452-0102.</p> <p>RECEIVING INSPECTION VERIFIES THAT SWITCHES RECEIVED ARE AS IDENTIFIED IN THE PROCUREMENT DOCUMENTS, THAT NO PHYSICAL DAMAGE HAS OCCURRED TO SWITCHES DURING SHIPMENT, THAT THE RECEIVING DOCUMENTS PROVIDE ADEQUATE TRACEABILITY INFORMATION AND ACCEPTANCE TEST DATA IDENTIFIES ACCEPTABLE PARTS.</p> <p>PARTS ARE INSPECTED THROUGHOUT MANUFACTURE AND ASSEMBLY AS APPROPRIATE TO THE MANUFACTURING STAGE COMPLETED. THESE INSPECTIONS INCLUDE,</p> <p>COMPONENT MOUNTING TO FRONT PANEL INSPECTION, SOLDERING OF WIRES TO SWITCH CONTACTS, WIRE ROUTING, STRESS RELIEF OF WIRES ETC., OPERATORS AND INSPECTORS ARE TRAINED AND CERTIFIED TO NASA MHB 5300.4(3A) STANDARD, AS MODIFIED BY JSC08000A.</p> <p>PRE-TEST INSPECTION OF D&amp;C PANEL ASSY INCLUDES AN AUDIT OF LOWER TIER INSPECTION COMPLETION, AS BUILT CONFIGURATION VERIFICATION TO AS DESIGN ETC. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p> <p>A TEST READINESS REVIEW (TRR) WHICH INCLUDES VERIFICATION OF TEST PERSONNEL, TEST DOCUMENTS, TEST EQUIPMENT CALIBRATION/ VALIDATION STATUS AND HARDWARE CONFIGURATION IS CONVENED BY QUALITY ASSURANCE IN CONJUNCTION WITH ENGINEERING, RELIABILITY, CONFIGURATION CONTROL, SUPPLIER AS APPLICABLE, AND THE GOVERNMENT REPRESENTATIVE, PRIOR TO THE START OF ANY FORMAL TESTING (ACCEPTANCE OR QUALIFICATION).</p> <p>ACCEPTANCE TESTING (ATP) INCLUDES AMBIENT PERFORMANCE, THERMAL AND VIBRATION TESTING, (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT).</p> <p>INTEGRATION OF D&amp;C PANEL, RHC, THC AND MCIU, INSPECTIONS ARE PERFORMED AT EACH STAGE OF INTEGRATION, WHICH INCLUDES GROUNDING CHECKS, INTER CONNECT CABLE VERIFICATION, CONNECTOR INSPECTION FOR BENT OR PUSHBACK CONTACTS ETC.</p> <p>SUB-SYSTEM PERFORMANCE TESTING (ATP), INCLUDES AN AMBIENT PERFORMANCE TEST. (MANDATORY INSPECTION POINT).</p> <p>SRMS SYSTEMS INTEGRATION, THE INTEGRATION OF MECHANICAL ARM SUBASSEMBLIES AND THE FLIGHT CABIN EQUIPMENT TO FORM THE SRMS. INSPECTIONS ARE PERFORMED AT EACH PHASE OF INTEGRATION WHICH INCLUDES GROUNDING CHECKS, THRU WIRING CHECKS, WIRING ROUTING, INTERFACE CONNECTORS FOR BENT OR PUSH BACK CONTACTS ETC.</p> <p>SRMS SYSTEMS TESTING - STRONGBACK AND FLAT FLOOR AMBIENT PERFORMANCE TEST. (SPAR/GOVERNMENT REP. - MANDATORY INSPECTION POINT)</p>

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
 ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP  
 ASS'Y P/N: \_\_\_\_\_

SHEET: 4

FMEA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HOUR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4440	1	BACKUP DRIVE SWITCH QTY-1 P/N ME425-0102-7405	MODE: SHORTED CONTACTS. CAUSE(S): (1) + OR - CONTACTS CONTAMINATION.	JOINTS CAN ONLY BE DRIVEN IN ONE DIRECTION IN BACKUP.  BRAKE ON SELECTED JOINT WILL BE DISENGAGED WHILE BACKUP MODE IS SELECTED. BDA WILL BE COMMANDING ZERO RATE TO JOINT SELECT.  WORST CASE ----- BACKUP IMOPERATIVE.  REDUNDANT PATHS REMAINING ----- SINGLE AND DIRECT	FAILURE HISTORY -----	NO EEE PARTS FAILURES HAVE OCCURRED SUBSEQUENT TO ASSEMBLY OF PARTS.

PREPARED BY: MWG

SUPERCEDING DATE: 28 OCT

APPROVED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

**CRITICAL ITEMS LIST**

PROJECT: SRMS  
ASS'Y NOMENCLATURE: BACK-UP

SYSTEM: BACK-UP  
ASS'Y P/R:

SHEET: 5

FREA REF.	REV.	NAME, QTY, & DRAWING REF. DESIGNATION	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	HDMR / FUNC. 2/1R CRITICALITY	RATIONALE FOR ACCEPTANCE
4440	2	BACKUP DRIVE SWITCH QTY-1 P/N ME425-0102-7405	<p>MODE: SHORTED CONTACTS.</p> <p>CAUSE(S): (1) + OR - CONTACTS CONTAMINATION.</p>	<p>JOINTS CAN ONLY BE DRIVEN IN ONE DIRECTION IN BACKUP.</p> <p>BRAKE ON SELECTED JOINT WILL BE DISENGAGED WHILE BACKUP MODE IS SELECTED. BDA WILL BE COMMANDING ZERO RATE TO JOINT SELECT.</p> <p>WORST CASE</p> <p>BACKUP INOPERATIVE.</p> <p>REDUNDANT PATHS REMAINING</p> <p>SINGLE AND DIRECT</p>		<p>OPERATIONAL EFFECTS</p> <p>LOSS OF NEXT REDUNDANT PATH RESULTS IN BEING ONE FAILURE AWAY FROM INABILITY TO CRADLE ARM. JOINT WILL NOT DRIVE IN BACKUP ONCE PRIMARY MODES HAVE FAILED. THE BACKUP STANDBY SYSTEM WILL NOT PROVIDE THE CAPABILITY TO CRADLE THE ARM. ARM CAN BE JETTISONED.</p> <p>CREW ACTION</p> <p>PERFORM AN EVA TO STOP THE ARM OR JETTISON.</p> <p>CREW TRAINING</p> <p>NONE</p> <p>MISSION CONSTRAINT</p> <p>ARM SHOULD NOT BE MANEUVERED TO POSITION WHERE JETTISON CANNOT BE SAFELY PERFORMED.</p> <p>SCREEN FAILURES</p> <p>B: N/A ( STANDBY REDUNDANT )</p> <p>OMRSD OFFLINE</p> <p>IN BACKUP MODE, SET BACKUP DIRECT DRIVE SWITCH TO NEUTRAL (OFF) POSITION. VERIFY DIRECT DRIVE COMMAND VOLTAGES AT D&amp;C PANEL OUTPUT.</p> <p>OMRSD OFFLINE INSTALLATION</p> <p>IN BACKUP MODE, SET BACKUP DIRECT DRIVE SWITCH TO NEUTRAL (OFF) POSITION. VERIFY DIRECT DRIVE COMMAND VOLTAGES AT LONGERON INTERFACE.</p> <p>OMRSD ONLINE TURNAROUND</p> <p>IN BACKUP MODE, SET BACKUP DIRECT DRIVE SWITCH TO NEUTRAL (OFF) POSITION. SELECT WRIST ROLL. VERIFY NO JOINT MOTION.</p>

PREPARED BY: NFWG

SUPERSEDING DATE: 06 OCT 97

APPROVED BY:

RMS/BACK-UP 20