

SRB CRITICAL ITEMS LIST

SUBSYSTEM: RANGE SAFETY COMMAND DESTRUCT

ITEM NAME: Range Safety Distributor (RSD)

PART NO. 10406-0147

FM CODE: A22

ITEM CODE: 70-09

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 1

DATE: March 31, 2000

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 1997

FMEA PAGE NO.: F-30

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SHEET 1 OF 6

APPROVED: S. Parvathaneni

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FAILURE MODE AND CAUSES: Unscheduled RS Inhibit A and B (requires two failures) caused by:

- o Optical isolators failed shorted.

FAILURE EFFECT SUMMARY: Loss of SRB destruct capability, leading to loss of life or injury to the public.

REDUNDANCY SCREENS AND MEASUREMENTS;

1. Pass- Checked during bench test ATP, ACO, SIT and ordnance installation. Not applicable during countdown.
2. Fail - Unable to detect unless an RSS arm command is issued.
3. Pass- No known credible causes.

RETENTION RATIONALE:

A. DESIGN:

- O One of the functions of the RSD is to provide the inhibit for the PIC arm switches. The Range Safety Distributor (RSD) is totally redundant with regard to failed functions. The design provides one common housing with a cast aluminum wall separating the two redundant systems (System A and System B) such that no electrical failure in one system can propagate to the other.
- O Two RSD functions are to execute the Arm and Fire commands that are issued by the IRDs. These commands are implemented functionally by setting the arm latch switch to supply power to the fire latch switch and the PIC capacitor charging circuitry and then setting the fire latch switch

to supply power to the PIC capacitor discharge circuitry. The PIC discharges the stored capacitor energy into an associated NSI device via output connectors and cables. The design of the RSD implements these functions in hardware by providing connectors, wiring harnesses, function blocks, controller boards, PIC boards, and associated power sources and command functions. The specific RSD design feature that was implemented to mitigate all of the listed failure causes is true parallel redundancy.

- O There is a single vendor source for RSD: Bendix, Guidance Systems Division. The RSD has completed qualification to the twenty mission level (Ref. Qual Test Report EE-QTR-91-001). The mission qualification is documented in COQ A-RSS-3113-4 and COQ A-RSS-3113-5.
- O All electrical and electromechanical component parts used in the RSD have traceability requirements per SE-019-33-2H. In addition, a log book is generated for each RSD assembly at the start of acceptance testing, and a complete historical record is maintained for the life of the RSD.
- O Optical isolator failed shorted. The 4N49 optical isolators are screened per 10REQ-0036 requirements and are mounted on the controller cards. The 4N49s used for the inhibit functions are very conservatively derated. They are derated by more than a factor of ten for current, and a factor of ten for voltage.
- O The design features noted and the use of high reliability parts selected from or screened to 10REQ-0036 mitigate the probability of the failure causes referenced in this failure mode.

B. TESTING:

VENDOR RELATED TESTING

- O Optical couplers receive one hundred percent inspection and functional testing at Bendix. (All Failure Causes)
- O All printed wire assemblies (PWA) are acceptance tested with the power input and signal inputs at the minimum and maximum voltage. The test temperature is 30°F above the maximum case temperature of the RSD assembly. The elevated temperature and increased input voltage variations are used to mitigate failure of the PWAs when exposed to the RSD level temperature and voltage requirements (Per Acceptance Test Procedures 5136115-GTS, 5136251-GTSP and 5136994-GTSP). (All Failure Causes)
- O The optical isolators, located in the RS controller module, are tested at the board level and again after module is installed into the RSD. The completed RSD has a complete functional and environmental test performed (Per Acceptance Test Procedures 5135181-GTSP and 5135123-GTSP). Acceptance testing establishes the absence of a shorted optical isolator at the time of testing. (All Failure Causes)

KSC RELATED TESTING

- The firing/inhibit/reset function is tested during ACO per 10REQ-0021, para. 1.2.2.15.
- Verify arm latch switch operation during open loop testing per OMRSD File II, Vol. 1, requirement number S00000.380. (All Failure Causes)
- The inhibit function is monitored during SIT, ordnance installation part II, and final countdown by event measurements B55X1881X (A inhibit) and B55X1882X (B inhibit)
- The above referenced OMRSD testing is performed every flight.

REFURBISHMENT/RECERTIFICATION TESTING

- Previously Flown RSD's are Refurbished and Recertified for flight per 10SPC-0131 and applicable RODs.
- All USA SRBE/TBE Recertified RSD's are Acceptance Tested per design specification 10SPC-0148. (All Failure Causes)
- ESD Protection Requirements are imposed per OMRS 10REQ-0021, Para. 4.11

C. INSPECTION

VENDOR RELATED INSPECTION

- Transistors, optical couplers, and diodes receive one hundred percent functional testing at Bendix. Capacitors and resistors are sampled at Bendix, one percent AQL. Magnetics have one hundred percent visual, dimensional, and functional acceptance by Bendix Quality. USA SRBE PQAR verifies test data on electrical parts and screening data per USA SRBE, SIP 1091. (All Failure Causes)
- Bendix QA inspects printed wire boards to the requirements of 50M60420.
- USA SRBE PQAR verifies traceability records per USA SRBE SIP 1091.
- Bendix QA and USA SRBE PQAR verify that all test procedures are correct and approved and verify all board level test data per USA SRBE SIP 1091, and Bendix Flow Chart 5116726.
- Bendix QA inspects one hundred percent of the solder and crimp connections that go into the harness per Bendix Flow Chart 5116726. USA SRBE PQAR performs visual inspection of harness and visual inspection of assembly of harness in chassis per USA SRBE SIP 1091. (BI-1841)
- The final loading of the modules into the distributor is witnessed by Bendix QA per Bendix Flow Chart 5116726. USA SRBE PQAR performs visual inspection of unit after installation of plug-in boards per USA SRBE SIP 1091.

- Final acceptance testing is witnessed by Bendix Quality Per Bendix Flow chart 6116726. USA SRBE PQAR witnesses final manual acceptance testing and verifies data for all automated final acceptance testing per USA SRBE SIP 1091. (All Failure Causes)
- Critical Processes/Inspections/Operations:
 - Soldering per NHB 5300.4(3A-1) (BI-1903R1)
 - Conformal Coating per MSFC-PROC-508
 - Staking per MSFC-STD-136

KSC RELATED INSPECTIONS

- USA SRBE Quality monitors and accepts distributor bench testing. (All Failure Causes) CN 038
- USA SRBE Quality witnesses torquing of distributor to equipment panel and electrical bonding resistance between distributor and panel.
- Data from the Following OMRSD Required Test is verified to be Acceptable by a Quality Representative:
 - RSD Functional Test per 10REQ-0021, paragraph 1.2.2.13 after installation. (All Failure Causes) CN 038
 - RSD Output data on all RSD's during Cross Strap Test per OMRSD File II, Vol. I, Requirements S00000.200, S00000.210, S00000.220, S00000.230. (All Failure Causes)
 - RSD Output data on all five RSS Subsystems during Final Ordnance Installation Test on the Pad Per OMRSD File II, Vol. I, Requirement S00000.380/390. (All Failure Causes)

REFURBISHMENT/RECERTIFICATION INSPECTION

- RSD's are inspected externally after each Flight per 10SPC-0131 for bent or broken connector pins and other visible damage. CN 038
- RSDs are inspected internally after every third flight or five years, which ever come first for bent or broken connector pins, cracked solder joints, loose or broken components, arcing or burning of conformal coating, physical damage, torque or other items as applicable to product quality. The S&A, PIC, and controller modules are not disassembled for inspection. The RSD Assembly is cleaned and cosmetic damages repaired. If anomalies beyond the repairable limits outlined in 10SPC-0131 are noted, the RSD is returned to the vendor for repair and acceptance testing. CN 038
- USB Quality Witness acceptance testing of all USA SRBE/TBE Florida Operations refurbished RSDs per applicable RODS(All Failure Causes)

D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. WAIVER/DAR

- o BI-1841, 6-21-90, CCBDB SB3-01-3470

- SPECIFIED REQUIREMENT:

Crimping of electrical connections shall be in accordance with JD-001.

- DEPARTURE:

RSDs do not meet crimping requirements of JD-001 paragraph 3.1.2, 3.4.2 and 3.2.1.4.

- JUSTIFICATION:

All crimps have undergone 100 percent visual inspection by certified operators and inspectors. No-flight failures have occurred due to improperly crimped connections.

Although the positioner is part of the crimp tool setup, proper positioner selection is verified by certified operators and inspectors prior to use of a tool in crimping operations.

- o BI-1903R1, 2-15-91, CCBDB SB3-01-3982A

- SPECIFIED REQUIREMENT

Removal of Flux and Residue from each soldered connection shall be in accordance with NHB 5300.4(3A-1), para. 3A802.

- DEPARTURE:

Inaccessibility of solder joint between Transistor Q2 and the series regulator PWB does not allow for proper cleaning of the solder flux and residue from each soldered connection.

- JUSTIFICATION:

All solder joints on Q2 RSD series regulators have been inspected by X-ray to verify solder connections. All RSD PWAs were built using SN63 solder with RMA Flux. The area in question is sealed to moisture by conformal coating prior to the series regulator PWB being installed in the SRB RSD. The RSD is a sealed unit with the seal integrity verified prior to each flight. Conformal coating and inert environment reduce the possibility of organic/inorganic growth. Voltage regulation is functionally tested during ATO, ACO, SIT, Ordnance installation and final countdown. Regulated voltage LCC exists to terminate a countdown if violated.

O BI-1981, PN 10406-0147-851, SN 1000120, 01/04/96, CCBD SB3-01-5009 (BI-077 - BI-999)

- SPECIFIED REQUIREMENT:

10CEI-0001

Paragraph 3.2.7.2.1 - Ascent Vibration, Acoustic and Shock environments Paragraph 3.2.7.2.2 - Reentry Vibration, Acoustic and Shock environments

- DEPARTURE:

The RSD's have always been Tested with an imposed Acceleration Spectral Density Tolerance of +3/-1.5 DB. The vendor had vibration abort limits set significantly higher during Acceptance Test for repaired RSD's.

- JUSTIFICATION:

The exceedance was within the Flight/Reentry Qualification Vibration Envelope. The Qualification Unit (IEA) has been through 20 Flight Qualification Missions. The Flight Qualification is to the maximum expected environments over the life of the RSD. This is a High Frequency narrow band spike that is separated by over 1 octave from the broad resonances.

O BI-1984, PN 10406-0147-854, SN 1000133, 1000139, 02/08/96, CCBD SB3-01-5022 (BI078-BI999)

- SPECIFIED REQUIREMENT:

10CEI-0001

Paragraph 3.2.7.2.1 - Ascent Vibration, Acoustic and Shock environments Paragraph 3.2.7.2.2 - Reentry Vibration, Acoustic and Shock environments

- DEPARTURE:

The RSD's have always been Tested with an imposed Acceleration Spectral Density Tolerance of +3/-1.5 DB. The vendor had vibration abort limits set significantly higher during Acceptance.

- JUSTIFICATION:

The exceedance was within the Flight/Reentry Qualification Vibration Envelope. The Qualification Unit (RSD) has been through 20 Flight Qualification Missions. The Flight Qualification is to the maximum expected environments over the life of the RSD. This is a High Frequency narrow band spike that is separated by over 1 octave from the broad resonances.

- O BI-1987, PN 10406-0147-851, SN 1000113, 1000139, 03/18/96, CCBD SB3-01-5036
- O BI-1987a, PN 10406-0147-851, SN 1000112, 1000115, PN 10406-0147-854, SN 1000135, 05/07/96, CCBD SB3-01-5065
- O BI-1987b, PN 10406-0147-851, SN 1000108, 1000109, 1000125, 1000126, PN 10406-0147-854, SN 1000107, 1000116, 1000123, 1000131, 1000137, 1000138, 07/11/96, CCBD SB3-01-5081

- SPECIFIED REQUIREMENT:

10CEI-0001

Paragraph 3.2.7.2.1 - Ascent Vibration, Acoustic and Shock environments Paragraph 3.2.7.2.2 - Reentry Vibration, Acoustic and Shock environments

- DEPARTURE:

The RSD's have always been Tested with an imposed Acceleration Spectral Density Tolerance of +3/-1.5 DB. The vendor had vibration abort limits set significantly higher during Acceptance.

- JUSTIFICATION:

The exceedance was within the Flight/Reentry Qualification Vibration Envelope. The Qualification Unit (RSD) has been through 20 Flight Qualification Missions. The Flight Qualification is to the maximum expected environments over the life of the RSD. This is a High Frequency narrow band spike that is separated by over 1 octave from the broad resonances.