SRB CRITICAL ITEMS LIST

SUBSYSTEM: RANGE SAFETY COMMAND DESTRUCT

ITEM NAME: NASA Standard Detonator, (NSD)

PART NO.: SEB 26100094-201 FM CODE: A03

ITEM CODE: 70-12 REVISION: Basic

CRITICALITY CATEGORY: 1 REACTION TIME: Immediate

NO. REQUIRED: 2 DATE: March 31, 1998 DCN 033

CRITICAL PHASES: Final Countdown, Boost SUPERCEDES: March 1, 1994 DCN 035

FMEA PAGE NO.: F-43 ANALYST: T.L. Burke/S. Roney DCN 035

SHEET 1 OF 3 APPROVED: P. Kalia DCN 033

FAILURE MODE AND CAUSES: Premature operation (one or both NSDs) caused by:

- o Electromagnetic Interference
- o Electrostatic Discharge
- o Increased Sensitivity Due to Contamination
- o High Temperature
- o Shock/Vibration

FAILURE EFFECT SUMMARY: Premature firing of the Range Safety System destruct ordnance during countdown or boost leads to fire and explosion of the Orbiter/ ET resulting in the loss of mission, vehicle and crew.

RATIONALE FOR RETENTION:

A. DESIGN

- o The NSD is GFE supplied by Johnson Space Center (JSC) and consists of a NASA Standard Initiator (NSI) (SEB26100001) with a backup ring welded to the body of the NASA Standard Detonator. The NSI is controlled by specification SKB26100066 and drawing SEB26100001. The NSD design is controlled by drawing SEB26100094 and specification SKB26100097. Detonator uses RDX and lead azide explosive mix for hi-temp protection. NSI meets EMI compatibility per MC999-0002. Firing circuitry consists of twisted shielded pairs for Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) protection. Pyro Initiator Controller (PIC) is two failure tolerant for protection against an erroneous output.

- o Qualification:

  Qualification Tests: Detonator originally qualification tested for Apollo in 1965. Additionally qualified for orbiter umbilical attach per

certification requirement (CR) 45-565330 and with the 3/4 inch frangiblenut autoignition test verified no fire when exposed to 340F for 1 hour (maximum expected temperature is ambient). NSI has been qualified to a no fire condition when subjected to 1 watt/1 amp for 5 minutes. CR-45-114-0018-0003, CR-45-453-0021-0009; SKB26100097.

Design Verification Test: NSI and wiring was tested for close proximity RFI susceptibility prior to Apollo-Soyuz Test Project (ASTP).

- The NSI passed exposure to test currents of 40 kiloamperes.The PIC/cable/NSI combination tested with no failures to at least 640 volts during lightning test on the shuttle SRB nozzle severence system. L&T report 629.

B. TESTING

VENDOR RELATED TESTING

- Acceptance Tests: Acceptance tests include tensile test (3 coupons from same heat treat), examination of product (weight, workmanship, finish, dimensions, construction, and certified M&P). Bridgewire resistance and 50 volt insulation resistance test for NSI. Neutron and X-ray (Presence of explosive mix, no foreign material, and proper assembly). Leakage (1 X 10-6 CC per sec helium), and weight (pryo charge and all other cartridge parts weighed pre- and post-assembly. Totals must be within specified tolerance). CR-45-453-0021-0009, ATP 5044; SKB26100097.

KSC RELATED TESTING

- Thefollowingtestscheckfortheeffectsofstray eletromagnetic interference.

- Integrated power ON Stray Voltage Test is performed per OMRSD File II, Vol. 1 requirement number S00000.140. (EMI, Electostatic Discharge)

- Integrated Power "OFF" Stray Voltage Test is checked per OMRSD File II, Vol. 1, requirement numbers S00GEN.635. (EMI, Electrostatic Discharge) DCN 033

- GO PIC test with live pyrotechnics per OMRSD File II, Volume 1,requirement no. S00000.410. (EMI, Electrostatic Discharge)

- GO PIC test with live pyrotechnics during launch countdown per OMRSD File II, Volume 1, requirement no. S00FA0.015. (EMI, Electrostatic Discharge)

The above referenced OMRSD testing is performed for every flight.

C. INSPECTION

VENDOR RELATED INSPECTION

- Receiving Inspection:

  Raw Material is verified by inspection to assure specific shuttle requirements are satisfied. (Contamination)

- Contamination Control:

  Contamination control and corrosion protection processes and storage environments are monitored and verified by inspection. (Contamination)

- Assembly/Installation:

  Selected manufacturing/assembly steps are identified by NASA and quality assurance and verified by Government Inspection Mandatory Inspection Points (MIPS). (All Failure Causes)

- Nondestructive Evaluation:

  Parts are X-rayed and N-rayed to verify correct assembly and presence of all detail parts and explosives. X-rays and N-rays are reviewed by vendor, DCMC, and NASA quality and engineering. (Contamination)

- Critical Processes:

  All manufacturing processes such as welding, plating, heat treating, passivation and anodizing are verified by inspection. (All Failures)

- Storage:

  Storage environment verified by inspection. (Contamination/High Temperature)

KSC RELATED INSPECTION

- Receiving inspection verifies that the NSDs have been flight certified by JSC as required by NSTS 08060 per OMRSD File V, Volume 1, requirement no. B000FL.002. (All Failure Causes)

- Verification that insulation resistance test is acceptable per OMRSD File V, Volume 1, requirement no. B000FL.001. (Electrostatic Discharge)

- Inspection for damage and contamination per OMRSD File V, Volume 1, requirement no. B000FL.001. (Contamination)

- Bonding between all metallic faying surfaces is verified per OMRSD File V, Volume 1, requirement no. B75000.020. (Electrostatic Discharge)

- Shelf life is verified by SPC Quality. (Increased Sensitivity due to Contamination)

D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.