SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Gas Generator Valve Module

PART NO.: 5902651
5912183 (alternate)

FM CODE: A07

ITEM CODE: 20-01-14

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 2000 CN 038

CRITICAL PHASES: Boost

SUPERCEDES: March 31, 1999 CN 038

FMEA PAGE NO.: A-50

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SHEET 1 OF 5

APPROVED: S. Parvathaneni CN 038

FAILURE MODE AND CAUSES: Shutoff (Secondary) control valve (NC) fails to open, or remain open (for phase A only), fails to remain open (for phase B only) (Systems A and B) caused by:

- o Electrical open circuit (connector, wiring and solenoid)
- o Bellows failure
- o Contamination

FAILURE EFFECT SUMMARY: Loss of TVC will lead to vehicle breakup and loss of mission, vehicle and crew. One success path remains after the first failure. Operation is not affected until both paths are lost.

REDUNDANCY SCREENS AND MEASUREMENTS:

1) Pass - All units are subject to ATP during turnaround and refurbishment.

2) Pass - APU turbine speed measurement B46R1406C, B46R1407C, B46R1408C, B46R1409C. Actuator power switching valve position measurements B58X1859X and B58X1860X. Secondary speed control valve closed events B46X1861X and B46X1863X.

3) Fail - Contamination.

RATIONALE FOR RETENTION:

A. DESIGN

- o The Gas Generator Valve Module is designed and qualified in accordance with end item specification 10SPC-0050. (All Failure Causes) (BI-1883)

- o The shutoff valve is spring loaded closed. (Electrical Open Circuit [Connector, Wiring and Solenoid])

- The shutoff valve is a 28 VDC direct acting poppet type solenoid. (Electrical Open Circuit [Connector, Wiring and Solenoid])
- APU surfaces exposed to hydrazine, except gas generator, are cleaned per 10PRC-0339. (Contamination)
- Bellows material is sulfer free nickel. Bellows assembly poppet and retainer material is CRES 304L. (Bellows Failure)
- The APU controller has BITE capability to verify operation of the valves. (All Failure Causes)
- Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B and AER 1539-10, Rev. Basic. (All Failure Causes)
- Hydrazine is filtered through two 25 micron filters upstream of the GGVM. (Contamination)

B. TESTING

- Acceptance testing is performed per Marotta ATP 281951-9002 on each new unit. This includes visual and dimensional examination, dielectric strength test, insulation resistance test, resistance check, pull-in voltage, drop-out voltage, response test and valve cycle test. (All Failure Causes)
- Abbreviated acceptance testing of units that only require rework of the solder joints is performed per Marotta AATP281951-9002. This includes visual and dimensional examination, internal leakage and cleanliness level check. (All Failure Causes)
- Acceptance testing of the assembled APU is performed per Sundstrand ATP TS2409. This includes resistance checks, fuel shutoff valve verification and verification of proper valve operation at all rated turbine speeds. (All Failure Causes)
- During refurbishment and prior to reuse, the GGVM is tested per Sundstrand ATP TS2409. (All Failure Causes)
- BITE test is performed per 10REQ-0021, para. 2.3.4. (All Failure Causes)
- TVC system functional test is performed during hotfire per 10REQ-0021, para. 2.3.16. (All Failure Causes)
- Helium is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board circuits per 10REQ-0021, para. 2.3.2.5. (Contamination)
- Hydrazine is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board hydrazine circuits per 10REQ-0021, para. 2.3.2.1 and OMRSD File V, Vol. 1, Requirement Number B42AP0.010. (Contamination)
- BITE test verifying APU speed control valve operation is performed per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060 prior to rollout. (All Failure Causes)

- o APU BITE test is conducted per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (All Failure Causes)

- o BITE test verifying speed control valve operation is performed during launch countdown (approximately T-11 hours) per OMRSD File V, Vol. 1 Requirement Numbers B42APO.050 and .060. This is the last check of valve operation prior to APU startup. (All Failure Causes)

- o GN2 (from MLP portable panels) is verified for cleanliness and composition (purity and particulate count) prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1 Requirement Number B42AP0.012. (Contamination)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Vendor inspection and test records are verified is performed per SIP 1128 by USA SRBE PQAR. (All Failure Causes) (BI-1883)

- o Verification of test data from Marotta is performed per SIP 1128 USA SRBE PQAR. (All Failure Causes)

- o Verification of material certifications is performed per SIP 1128 by Sundstrand and USA SRBE. (Material Defects)

- o Witnessing of acceptance testing is performed per SIP 1128 USA SRBE PQAR. (All Failure Causes)

- o Verifications that are required on new units are performed on refurbished units per SIP 1128 by USA SRBE PQAR. (All Failure Causes)

- o Critical Processes/Inspections:

  - Solder per Marotta PS281951-9002 and per NHB5300.4 (3A-1) (BI-1883)
  - Welding per Marotta Drawing 235272-9001 (Marotta procedure SP196-0071, AMS2680 & AMS2681)

KSC RELATED INSPECTIONS

- o Proper function of TVC system is demonstrated during hotfire operations per 10REQ-0021, para. 2.3.16 to include hotfire. (All Failure Causes)

- o Verification of proper valve operation during BITE per OMRSD File V, Vol. 1 Requirement Number B42AP0.050. (All Failure Causes)

- o Verification of APU BITE test per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (All Failure Causes)

- Helium cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board circuits per 10REQ-0021, para. 2.3.2.5. (Contamination)

- Precision cleaning of tubes/hoses is verified per 10REQ-0021, para. 2.3.0. (Contamination)

- Verification of proper performance of BITE test during launch countdown per OMRSD File V, Vol. 1 Requirement Numbers B42AP0.050 and .060. (All Failure Causes)

- GN2 (from MLP portable panels) cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1 Requirement Number B42AP0.012. (Contamination)

- TVC Couplings (Both SRB and GSE) are inspected each time prior to mating per 10REQ-0021 para. 2.3. After transfer to SPC they are inspected prior to mating per File V, Vol. I, requirement number B42GEN.070. (Contamination).

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- GN2 (from servicing cart) cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1 Requirement Number B42APO.012. (Contamination)

- Hydrazine (from servicing cart) cleanliness and composition (purity and particulate count) are verified prior to introduction to on-board hydrazine circuits per OMRSD File V, Vol. 1 Requirement Number B42APO.010. (Contamination)

D. FAILURE HISTORY

- Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- Not applicable to this failure mode.

F. Waiver

- BI-1883, dt 11-19-90, Level III approval SB3-01-3891, Level II approval PRCBD-S92144C

  - Requirement: Per 10CEI-0001 para. 3.3.5.4 soldering of electrical connectors on the SRB & GSE/STE that directly interface with a space shuttle element shall be per NHB 5300.4 (3A-1).

  - Departure from Requirement: Soldering of GGVM electrical connectors do not meet paragraph 3A704 of NHB 5300.4 (3A-1). Soldering joints have (i) Improper tinning, (ii) Separation of wire strands (iii) Excessive solder.

    - Rationale for Approval of the Waiver: The original qualification of APUs was completed with GGVMs soldered by the same technicians. A Delta Qualification was performed on additional GGVMs also soldered by the same technicians. GGVMs must pass ten functional and electrical tests at Sundstrand and USA SRBE prior to aisle transfer. The GGVM must also pass two Bite tests, the final test at T -9 Hrs, prior to launch. There is no case of a solder related failure on GGVMs.