

SRB CRITICAL ITEMS LIST

SUBSYSTEM: THRUST VECTOR CONTROL

ITEM NAME: Gas Generator Valve Module

PART NO.: 5902651
5912183 (alternate)

FM CODE: A15

CN 035

ITEM CODE: 20-01-14

REVISION: Basic

CRITICALITY CATEGORY: 1R

REACTION TIME: Seconds

NO. REQUIRED: 2

DATE: March 31, 1999

CN 035

CRITICAL PHASES: Boost, Separation

SUPERCEDES: March 31, 1997

CN 035

FMEA PAGE NO.: A-56B

ANALYST: B. Snook/ S. Parvathaneni

CN 035

SHEET 1 OF 3

APPROVED: P. Kalia

FAILURE MODE AND CAUSES: Pulse (Primary) control valve (NO) fails to close or remain closed (Systems A and/or B) caused by:

- o Electrical short circuit (power to ground, power to return)

FAILURE EFFECT SUMMARY: Failure of valves will result in loss of TVC control due to loss of redundant power buses (A and B) which will lead to 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 measurements B46R1406C, B46R1407C, B46R1408C, B46R1409C; Bus voltage measurements B76V1600C, B76V1601C.
- 3) Pass - No single credible cause.

RATIONALE FOR RETENTION:

A. DESIGN

- o The Gas Generator Valve Module is designed and qualified in accordance with end item specification 10SPC-0050. (Electrical Short Circuit) (BI-1883)
- o The pulse control valve is a 28 VDC direct acting poppet type solenoid. (Electrical Short Circuit)

- o Electrical connector, wiring and solenoid for PCV and SOV are physically separated. (Electrical Short Circuit)
- o The APU controller has BITE capability to verify operation of the valves. (Electrical Short Circuit)
- o Qualification testing verified design requirements as reported in Sundstrand Qualification Test Report AER-1539-6, Rev. B and AER 1539-10, Rev. Basic. (Electrical Short Circuit)

B. TESTING

- o Acceptance testing of the GGVM is performed per Marotta ATP 281951-9002 on each new unit. This includes dielectric strength test, insulation resistance test, resistance check, pull-in voltage, drop-out voltages response and valve cycle test. (Electrical Short Circuit)
- o 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)
- o Acceptance testing of the assembled APU is performed per Sundstrand ATP TS 2409. This includes resistance checks, fuel pulse valve verification, verification of proper valve operation at all rated turbine speeds. (Electrical Short Circuit)
- o During refurbishment and prior to reuse, the GGVM is tested per Sundstrand ATP TS 2409. (Electrical Short Circuit)
- o HPU BITE test verifying speed control valve operation is performed per 10REQ-0021, para. 2.3.4. (Electrical Short Circuit)
- o BITE test verifying APU speed control valve operation is performed per OMRSD File V, Vol. 1 requirement number B42AP0.050 prior to rollout. (Electrical Short Circuit)
- o APU BITE test verifying speed control valve operation is performed during launch countdown (approximately T-11 hour) per OMRSD File V, Vol. 1 requirement numbers B42AP0.050 and .060. This is the last check of valve operation prior to APU startup. (Electrical Short Circuit)

The above referenced OMRSD testing is performed every flight.

C. INSPECTION

VENDOR RELATED INSPECTIONS

- o Vendor inspection and test records are verified per SIP 1128 by USBI QAR. (Electrical Short Circuit) (BI-1883)
- o Verification of test data from Marotta is performed per SIP 1128 by USBI QAR. (Electrical Short Circuit)
- o Witnessing of acceptance testing is performed per SIP 1128 by USBI QAR. (Electrical Short Circuit)

- o Verifications that are required on new units are performed on refurbished units per SIP 1128 by USBI QAR. (Electrical Short Circuit)
- o Critical Processes/Inspections:
 - Solder per Marotta FS281951-9002 and NHB5300.4 (3A-1)(BI-1883)

KSC RELATED INSPECTIONS

- o Proper function of the TVC system is demonstrated during Hotfire operations per 10REQ-0021, para. 2.3.16. (Electrical Short Circuit)
- o Verification of APU BITE test per OMRSD File V, Vol. 1 requirement numbers B42AP0.050 and .060 (Electrical Short Circuit)
- o Verification of proper performance of BITE test per OMRSD File V, Vol. 1 requirement numbers B42AP0.050 and .060. (Electrical Short Circuit)

D. FAILURE HISTORY

- o Failure Histories may be obtained from the PRACA database.

E. OPERATIONAL USE

- o Not applicable to this failure mode.

F. Waivers

- o BI-1883, dt 11-19-90, Level III approval SB3-01-3891, Level II approval PRCBD-S92144C
 - o 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).
 - o Departure from Requirement: Soldering of GGVM electrical connector do not meet paragraph 3A704 of NHB 5300.4 (3A-1). Soldering joints have (i) Improper tinning, (ii) Separation of wire strands and (iii) Excessive solder.
 - o Rationale for Approval of the Waiver: The original qualifications of APUs were 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 USBI 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.