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| 1) CIL ITEM: H109-01, H116-01, H118-01, H119-01, H120-01, H121-01, H122-01, H11B-AA-01, H11B-AB-01, H122-AA-01, H122-AB-01 | 7) PREPARED | : SSME RELIABILITY |
| 2) FMEA CODE : H109, H116, H118, H119, H120, H121, H122, H11B-AA, H11B-AB, H122-AA, H122-AB | 8) APPROVED | : |
| 3) COMPONENT : EXTENDED LIFE LIGHTNING BRAIDED ELECTRICAL HARNESS, 1W9, 1W16, 1W18, 1W19, 1W20, 1W21, 1W22 | 9) DATE | : 04-01-96 |
| 4) PART NUMBER : R0018409, R0018416, R0018418, R0018419, R0018420, R0018421, R0018422 | 10) REVISION/CHANGE | : -004/D |
| 5) SYSTEM/SUBSYSTEM : ELECTRICAL HARNESS/HKXX | 11) EFFECTIVITY | : -21/51/71/21/51/21/51 |
| 6) FAILURE MODE : OPEN OR SHORT CIRCUIT IN HARNESS. LOSS OF CONNECTOR. ERRONEOUS SIGNAL. | 12) HAZARD REFERENCE | : SEE LISTINGS BELOW |

ME3-01-3285

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H109, H122 FUEL FLOWMETER		
S MODE 4-4	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS SIGNALS FROM ONE OR MORE SENSORS WITHIN QUALIFICATION LIMITS BUT SUFFICIENT TO CAUSE OFF-NOMINAL MIXTURE RATIO MAY RESULT IN TURBINE DISCHARGE TEMPERATURE SLE INDICATION AND CONTROLLER INITIATED SHUTDOWN. MISSION SCRUB. LOSS OF VEHICLE DUE TO TURBINE OR HEAT EXCHANGER FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	TR HAZARD REF: ME-66S,A
M MODE 4-3	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS SIGNALS FROM ALL SENSORS OUTSIDE QUALIFICATION LIMITS RESULTS IN SENSOR DISQUALIFICATION(S), A MCF INDICATION, AND ELECTRICAL LOCKUP RESPONSE. MISSION ABORT MAY RESULT WHEN ELECTRICAL LOCKUP OCCURS DURING MAX Q THROTTLING. (SEE OPERATIONAL USE.)</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	TR HAZARD REF: ME-64H

H-91

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H109, H122 FUEL FLOWMETER (COMPT) M MODE 4-6	FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ONE OR MORE SENSOR(S) SUFFICIENT TO CAUSE OFF-NOMINAL MIXTURE RATIO OPERATION MAY RESULT IN AIR SLE INDICATION. CONTROLLER INITIATES SHUTDOWN. MISSION ABORT. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-G4N
SM	FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS SIGNALS FROM ONE OR MORE SENSOR(S) WITHIN QUALIFICATION LIMITS MAY RESULT IN OFF-NOMINAL MIXTURE RATIO. MISSION ABORT MAY RESULT IF OFF-NOMINAL PROPELLANT CONSUMPTION LEADS TO A SLE ENGINE SHUTDOWN OR PREMATURE ENGINE DEPLETION. (SEE OPERATIONAL USE) REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-G4N
H116 EMERGENCY SHUTDOWN PRESSURE M MODE 4-2	HARNESS FAILURE CAUSING BOTH QUALIFIED SENSORS OR REMAINING QUALIFIED SENSOR WITHIN PURGE AND ANCILLARY MONITOR LIMITS RESULTS IN LOSS OF MCF PROTECTION. MISSION ABORT DUE TO PREMATURE ENGINE SHUTDOWN MAY RESULT IF HYDRAULIC LOCKUP MODE IS ENTERED WITH EMERGENCY SHUTDOWN PRESSURE APPLIED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: FAIL. LOSS OF REDUNDANT HARDWARE ITEMS COULD RESULT FROM A SINGLE CREDIBLE EVENT. (SINGLE HARNESS)	1R HAZARD REF: NONE

H-92

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116 FUEL AND OXIDIZER PREBURNER SHUTDOWN PURGE PRESSURE S MODE 4-5	HARNESS FAILURE CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH QUALIFIED SENSORS OR REMAINING QUALIFIED SENSOR WITHIN REDLINE LIMITS RESULT IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO ASI LINE BURNOUT MAY RESULT IF FPB PURGE CHECK VALVE LEAKAGE EXISTS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: FAIL. LOSS OF REDUNDANT HARDWARE ITEMS COULD RESULT FROM A SINGLE CREDIBLE EVENT. (SINGLE HARNESS)	1R HAZARD REF: NE-925
H116, H118, H120, H122 MAIN CHAMBER PRESSURE P MODE 4-2	FAILURE OF MULTIPLE HARNESSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSOR PAIRS WITHIN LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO OXIDIZER DUCT RUPTURE MAY RESULT IF MCC FAILS TO IGNITE AND FAILURE IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: NE-635

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116 H118, H120, H122 MAIN CHAMBER PRESSURE (CON'T) S MODE 4-4	HARNESS FAILURE CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSOR PAIRS WITHIN IGNITION CONFIRMED LIMITS RESULTS IN LOSS OF IGNITION CONFIRM PROTECTION. LOSS OF VEHICLE DUE TO OXIDIZER DUCT RUPTURE MAY RESULT IF MCC FAILS TO IGNITE AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	IR HAZARD REF: ME-C3S
S MODE 4-6	FAILURE OF ONE OR MORE HARNESSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ONE OR BOTH SENSOR PAIRS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP/OPB FAILURE MAY RESULT IF LOW MAIN COMBUSTION CHAMBER PRESSURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	IR HAZARD REF: ME-C1S,M ME-D1S,M
M MODE 4-2	MULTIPLE HARNESS FAILURE CAUSING BOTH SENSOR PAIRS TO BE OUTSIDE OF QUALIFICATION LIMITS RESULTS IN Pc REF. USED IN VDT. ELECTRICAL LOCKUP RESPONSE. MISSION ABORT MAY RESULT WHEN ELECTRICAL LOCKUP OCCURS DURING MAX Q THROTTLING, (SEE OPERATIONAL USE). REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	IR HAZARD REF: ME-64M

H-94

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
N116 H11B, N120, N122 MAIN CHAMBER PRESSURE (CON'T) M NODE 4-3	<p>FAILURE OF ONE OR MORE HARNESSSES CAUSING ERRONEOUS SIGNAL(S) FROM ONE OR BOTH SENSOR PAIRS WITHIN QUALIFICATION LIMITS WILL RESULT IN OFF-NOMINAL THRUST AND MIXTURE RATIO OPERATION. MISSION ABORT MAY RESULT IF OFF-NOMINAL PROPELLANT CONSUMPTION LEADS TO A SLE ENGINE SHUTDOWN OR PREMATURE PROPELLANT DEPLETION. (SEE OPERATIONAL USE.)</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-64M</p>
M NODE 4-4	<p>MULTIPLE HARNESS FAILURES CAUSING BOTH SENSOR PAIRS TO BE OUTSIDE OF QUALIFICATION LIMITS WILL DISQUALIFY BOTH SENSOR PAIRS DELETING REDLINE MONITORING OF THIS PARAMETER. LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP/OPB FAILURE MAY RESULT IF LOW MAIN COMBUSTION CHAMBER PRESSURE OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C1S,M ME-D1S,M</p>
M NODE 4-5	<p>HARNESS FAILURES CAUSING BOTH SENSOR PAIRS OR REMAINING QUALIFIED SENSOR PAIR BELOW THE REDLINE LIMIT WILL RESULT IN ERRONEOUS ENGINE SHUTDOWN. MISSION ABORT.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-64M</p>

H - 05

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116 H118, H120, H122 MAIN CHAMBER PRESSURE (CONT) N MODE 4-6	FAILURE OF ONE OR MORE HARNESSSES CAUSING ERRONEOUS SIGNALS FROM ONE OR BOTH SENSOR PAIRS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP/OPB FAILURE MAY RESULT IF LOW MAIN COMBUSTION CHAMBER PRESSURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: NE-C1S,M NE-D1S,M
H116, H119 HPOTP INTERMEDIATE SEAL PURGE PRESSURE P MODE 4-3	HARNESS FAILURE CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS OR REMAINING QUALIFIED SENSOR WITHIN REDLINE LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO HPOTP FAILURE MAY RESULT IF HPOTP TURBINE SEAL FAILURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM; UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: NE-C1S,N

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116, H119 HPOTP INTERMEDIATE SEAL PURGE PRESSURE (CONT) S MODE 4-4	<p>HARNES FAILURE(S) CAUSING BOTH QUALIFIED SENSORS OR REMAINING QUALIFIED SENSOR TO BE WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNES SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C15,M</p>
H MODE 4-2	<p>MULTIPLE HARNES FAILURES CAUSING BOTH SENSORS TO BE OUTSIDE OF QUALIFICATION LIMITS RESULTS IN DISQUALIFICATION OF BOTH SENSORS. LOSS OF REDLINE MONITORING PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNES SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C15,M</p>
H MODE 4-3	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS SIGNALS FROM BOTH SENSORS OR REMAINING QUALIFIED SENSOR EXCEEDING REDLINE LIMITS WILL RESULT IN AN SLE INDICATION AND CONTROLLER INITIATED SHUTDOWN. MISSION ABORT.</p> <p>REDUNDANCY SCREENS: HARNES SYSTEM: LIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C4M</p>

H-97

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116, H119 HPOTP INTERMEDIATE SEAL PURGE PRESSURE (CON'T) N MODE 4-4	<p>FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS SIGNALS FROM ONE OR BOTH SENSORS WITHIN THE REDLINE LIMIT RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - PNEUMATIC SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: NE-C15,M</p>
C MODE 4-2	<p>FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS SIGNALS FROM ONE OR BOTH SENSORS WITHIN LIMITS RESULTS IN LOSS OF HPOTP 1/5 EMERGENCY SHUTDOWN LIMIT PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FIRE MAY RESULT IF HPOTP INSL PURGE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - PNEUMATIC SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: NE-C1A,C</p>

86-H-98

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116, H119 HPOTP SECONDARY SEAL CAVITY PRESSURE P MODE 4-2	FAILURE OF BOTH HARNESES CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS WITHIN QUALIFICATION LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO HPOTP FAILURE MAY RESULT IF HPOTP TURBINE SEAL FAILURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M
S MODE 4-4	FAILURE OF ONE OR BOTH HARNESES CAUSING ERRONEOUS SIGNALS FROM BOTH SENSORS OR REMAINING QUALIFIED SENSOR WITHIN REDLINE LIMITS RESULTS IN A LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP TURBINE SEAL FAILURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M
H MODE 4-2	FAILURE OF BOTH HARNESES CAUSING BOTH SENSORS TO BE OUTSIDE OF QUALIFICATION LIMITS RESULTS IN DISQUALIFICATION OF BOTH SENSORS, LOSS OF REDLINE MONITORING. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP TURBINE SEAL FAILURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M

11-66

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H116, H119 HPOTP SECONDARY SEAL CAVITY PRESSURE (CONT) M MODE 4-3	FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS SIGNALS FROM BOTH SENSORS, OR THE REMAINING QUALIFIED SENSOR, EXCEEDING THE REDLINE LIMIT RESULTS IN A SLE INDICATION AND CONTROLLER INITIATED SHUTDOWN. MISSION ABORT. REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-G4M
M MODE 4-4	FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS SIGNAL(S) FROM ONE OR BOTH SENSOR(S) WITHIN THE REDLINE LIMIT RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP FAILURE MAY RESULT IF HPOTP TURBINE SEAL FAILURE OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - HPOTP SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C1S,M
H118, H119 LPFTP DISCHARGE TEMPERATURE	FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ONE OR BOTH SENSORS WITHIN QUALIFICATION LIMITS WILL RESULT IN OFF-NOMINAL MIXTURE RATIO OPERATIONS AND DEPLETION OF PROPELLANTS DURING MAINSTAGE. MISSION ABORT MAY RESULT IF OFF-NOMINAL PROPELLANT CONSUMPTION LEADS TO A SLE ENGINE SHUTDOWN OR PREMATURE PROPELLANT DEPLETION. (SEE OPERATIONAL USE). REDUNDANCY SCREENS: SINGLE POINT FAILURE: N/A -----	1R HAZARD REF: ME-G4M

H-100

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H118, H12D POGO PRECHARGE PRESSURE P MODE 4-2	FAILURE OF BOTH HARNESSSES CAUSING BOTH QUALIFIED SENSORS OR REMAINING QUALIFIED SENSOR TO BE WITHIN LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO HPOTP FAILURE MAY RESULT IF POGO PRECHARGE FLOW IS NOT TERMINATED AND FAILURE IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - POGO SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M
S MCOE 4-5	FAILURE OF ONE OR BOTH QUALIFIED SENSORS WITHIN FLOW CHECK MONITORING LIMITS RESULTS IN LOSS OF MCF PROTECTION. LOSS OF VEHICLE DUE TO LOSS OF POGO ACCUMULATOR FUNCTION MAY RESULT IF POGO COX FLOW IS NOT ESTABLISHED AND FAILURE IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - POGO SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M
C MCOE 4-2	FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ONE OR BOTH QUALIFIED SENSOR WITHIN LIMITS RESULTS IN LOSS OF POGO EMERGENCY SHUTDOWN LIMIT PROTECTION. LOSS OF VEHICLE DUE TO OXIDIZER PUMP FAILURE MAY RESULT IF POGO POST-CHARGE IS NOT ACCOMPLISHED AND FAILURE IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - POGO SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C14,C ME-G10C,0

H-101

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
<p>H11B, H121 MPFTP SHAFT SPEED</p> <p>S MODE 4-4</p>	<p>FAILURE OF BOTH HARNESES CAUSING ERRONEOUS SIGNALS FROM BOTH SENSORS OR REMAINING QUALIFIED SENSOR WITHIN IGNITION CONFIRMED LIMITS RESULTS IN LOSS OF IGNITION CONFIRMED FUNCTION. LOSS OF VEHICLE DUE TO LOX-RICH OPERATION MAY RESULT IF FUEL PREBURNER FAILS TO IGNITE AND FAILURE IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-82S, ME-86S</p>
<p>H11B, H121 MPFTP BOOST STAGE DISCHARGE TEMPERATURE</p> <p>SM MODE 4-2</p>	<p>FAILURE OF BOTH HARNESES CAUSING ERRONEOUS SIGNALS FROM BOTH SENSORS WITHIN INTEGRITY MONITOR LIMITS RESULTS IN LOSS OF MCF PROTECTION. LOSS OF VEHICLE DUE TO FIRE FROM LOX IMPACT MAY RESULT IF SENSOR PROBE FAILS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - SENSOR SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C3S</p>

H-102

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
<p>R11B-RA, H12Z-AA HPFTP TURBINE DISCHARGE TEMPERATURE (THERMOCOUPLE) (CON'T) P MODE 4-3</p>	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM THREE OR MORE SENSORS WITHIN QUALIFICATION LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT AND ECC PROTECTION. LOSS OF VEHICLE DURING START DUE TO HPFTP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED OR OPEN AIR FIRE OR DETONATION MAY RESULT IF LEAKAGE EXISTS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: NE-D15,M.</p>
<p>S MODE 4-3</p>	<p>FAILURE IN ONE OR BOTH HARNESSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ALL QUALIFIED SENSORS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO TURBOPUMP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: NE-D15,M.</p>

H-103

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
N118-AA, H122-AA HPFTP TURBINE DISCHARGE TEMPERATURE (THERMOCOUPLE) (CONT)	<p>FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ALL SENSORS OUTSIDE OF QUALIFICATION LIMITS RESULTS IN SENSOR DISQUALIFICATION CAUSING A LOSS OF REDLINE MONITORING AND A MCF INDICATION. LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>TR HAZARD REF: ME-DTS,M</p>
M MODE 4-3	<p>FAILURE IN EITHER HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>TR HAZARD REF: ME-DTS,M</p>
M MODE 4-4	<p>FAILURE IN EITHER HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>TR HAZARD REF: ME-DTS,M</p>

H-104

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H11B-AB, H122-AB NPOTP TURBINE DISCHARGE TEMPERATURE (THERMOCOUPLE) P MODE 4-3	FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM THREE OR MORE SENSORS WITHIN QUALIFICATION LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT AND LCC PROTECTION. LOSS OF VEHICLE DURING START DUE TO NPOTP OR HEAT EXCHANGER FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M
S MODE 4-3	FAILURE IN ONE OR BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ALL QUALIFIED SENSORS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO NPOTP FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-B2S, ME-C15,M
H MODE 4-4	FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ALL SENSORS OUTSIDE OF QUALIFICATION LIMITS RESULTS IN SENSOR DISQUALIFICATION CAUSING A LOSS OF REDLINE MONITORING AND A MCP INDICATION. LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO NPOTP OR HEAT EXCHANGER FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED. REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY ----- A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.	1R HAZARD REF: ME-C15,M

H-105

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H118-AB, H122-AB HPOTP TURBINE DISCHARGE TEMPERATURE (THERMOCOUPLE) (COM'T) M MODE 4-5	<p>FAILURE OF BOTH HARNESES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ALL QUALIFIED SENSORS OUTSIDE LOWER REDLINE LIMIT RESULTS IN A SLE INDICATION AND CONTROLLER INITIATED SHUTDOWN, MISSION ABORT.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-G4W</p>
M MODE 4-7	<p>FAILURE IN EITHER HARNESS CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPOTP OR HEAT EXCHANGER FAILURE MAY RESULT IF TURBINE OVERTEMPERATURE CONDITION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	<p>1R HAZARD REF: ME-C15,M</p>

H-106

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H120, H121 HPFTP COOLANT LINER PRESSURE P MODE 4-2	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS OUTPUT FROM BOTH SENSORS WITHIN QUALIFICATION LIMITS RESULTS IN LOSS OF ENGINE START INHIBIT PROTECTION. LOSS OF VEHICLE DURING START DUE TO HPFTP FAILURE MAY RESULT IF COOLANT LINER OVERPRESSURIZATION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-D1S,M
S MODE 4-4	<p>FAILURE OF BOTH HARNESSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM BOTH SENSORS OR REMAINING QUALIFIED SENSOR WITHIN REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF COOLANT LINER OVERPRESSURIZATION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-D1S,M
H MODE 4-2	<p>FAILURE OF BOTH HARNESSES CAUSING BOTH SENSORS TO BE OUTSIDE OF QUALIFICATION LIMITS RESULTS IN PARAMETER DISQUALIFICATION. LOSS OF REDLINE MONITORING AND A WCF INDICATION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF COOLANT LINER OVERPRESSURIZATION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-D1S,M

H-107

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
H120, H121 HPFTP COOLANT LINER PRESSURE (CON'T) M MODE 4-3	<p>FAILURE OF BOTH HARNESSSES CAUSING ERRONEOUS SIGNAL FROM BOTH SENSORS OR THE REMAINING QUALIFIED SENSOR THAT EXCEEDS THE REDLINE LIMIT RESULTS IN A BLE INDICATION. CONTROLLER INITIATED SHUTDOWN. MISSION ABORT.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM: LIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: PASS. LOSS OF A REDUNDANT HARDWARE ITEM IS DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-GAM
M MODE 4-4	<p>FAILURE OF ONE OR BOTH HARNESSSES CAUSING ERRONEOUS OUTPUT SIGNALS FROM ONE OR BOTH SENSORS WITHIN THE REDLINE LIMITS RESULTS IN LOSS OF REDLINE PROTECTION. LOSS OF VEHICLE DUE TO HPFTP FAILURE MAY RESULT IF COOLANT LINER OVERPRESSURIZATION OCCURS AND IS NOT DETECTED.</p> <p>REDUNDANCY SCREENS: HARNESS SYSTEM - ENGINE SYSTEM: UNLIKE REDUNDANCY</p> <p>-----</p> <p>A: PASS. REDUNDANT HARDWARE ITEMS ARE CAPABLE OF CHECKOUT DURING NORMAL GROUND TURNAROUND. B: FAIL. LOSS OF A REDUNDANT HARDWARE ITEM IS NOT DETECTABLE DURING FLIGHT. C: PASS. LOSS OF REDUNDANT HARDWARE ITEMS COULD NOT RESULT FROM A SINGLE CREDIBLE EVENT.</p>	1R HAZARD REF: ME-DIS,M

H-108

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
CZL ITEM: H109-01, H116-01, H118-01, H119-01, H120-01, H121-01, H122-01, H118-AA-01, H118-AB-01, H120-AA-01, H118-AB-01		DOCUMENT REF.
H-109	<p>FAILURE CAUSE A: CONDUCTOR OR INSULATION DAMAGE CAUSED BY VIBRATION, FLEXURE, ROUTING, OR CLAMPING.</p> <p>MATERIAL SELECTION OF THE WIRES, INSULATORS, CONNECTORS, AND ASSEMBLY TECHNIQUES ARE CONTROLLED BY SPECIFICATION (1) TO GUARD AGAINST THE FAILURE OF THE HARNESS IN THE ENVIRONMENTS IT IS EXPOSED TO. THESE CONTROLS ARE ESTABLISHED BY GOVERNMENT SPECIFICATIONS FOR CONNECTORS (2) AND WIRE SELECTION (3), AND ARE KEYED TO THE FUNCTION AND USAGE OF THE HARDWARE. TO PRECLUDE SINGLE POINT ELECTRICAL FAILURES, REDUNDANT FUNCTIONS ARE IMPLEMENTED IN SEPARATE HARNESSES, ROUTED THROUGH DIFFERENT PATHWAYS. TO PREVENT DETERIORATION OF THE CONDUCTOR OR INSULATOR, WIRES ARE OF SUCH CROSS SECTION AS TO PROVIDE AMPLE AND SAFE CURRENT CARRYING CAPACITY. THE MAXIMUM DESIGN CURRENT IN ANY WIRE IS LIMITED SO THAT "WIRE TOTAL TEMPERATURE" WILL NEVER EXCEED THE RATED WIRE TEMPERATURE (1). HARNESS ASSEMBLIES INCORPORATE A FLEXIBLE GLASS FILLER CORD TO ENHANCE CABLE ROUNDING (1). THE CORD HELPS IN ELIMINATING EXCESSIVE BEND RADII THAT MAY CAUSE WIRE DAMAGE. TEFLON FILM WRAP AND TEFLON TAPE COVER THE WIRE BUNDLES TO PROTECT THE INSULATION FROM ABRASIVE DAMAGE. A WIRE MESH SHEATH PROTECTS THE ENTIRE WRAP FROM SHARP IMPACTS, HANDLING DAMAGE, AND PROVIDES EMI PROTECTION (4). A HEAT SHRINKABLE POLYOLEFIN SEMI-RIGID OVERMOLD IS USED TO PROVIDE HARNESS SUPPORT (4). BRAID WIRE TYPE, SIZE, AND COVERAGE ARE CONTROLLED BY SPECIFICATION (5). CABLE ROUTING IS CONTROLLED BY THE ASSEMBLY DRAWINGS (6) THAT ESTABLISH THE RETAINING CLAMPS AND RESTRAINING TIES. THE SECURING CLAMPS (7) INCORPORATE RUBBER GROMMETS THAT PREVENT PINCHING OR CUTTING OF THE INSTALLED HARNESS.</p>	<p>(1) RL10014 (2) 40M38294 40M39569 (3) 40M60577 (4) RL00995 (5) RA1613-004 (6) RS007007 (7) RE127-2018</p>
	<p>FAILURE CAUSES B, C, E, G: LOOSE, WORN, OR DAMAGED PIN OR PINS. DAMAGED CONTACT OR CRIMP. LOSS OF CONNECTOR: CONNECTOR SHELL FAILURE. LOCKING FEATURE FAILURE.</p> <p>CONNECTOR SELECTION OF THE ASSEMBLIES IS CONTROLLED BY SPECIFICATION REQUIREMENTS (1). THE REQUIREMENTS INCORPORATE CONTROLS (2) THAT ARE KEYED TO GUARD AGAINST THE ENVIRONMENTS THEY ARE EXPOSED TO. THE CONNECTORS MEET CEI REQUIREMENTS FOR HIGH CYCLE FATIGUE, LOW CYCLE FATIGUE, AND MINIMUM FACTORS OF SAFETY (3). THE CONNECTORS ARE SELECTED IN ACCORDANCE WITH NSFC STANDARDS FOR USE ON ROCKET PROPELLED VEHICLES (4). BENT OR WORN PINS ARE REMOVABLE AND REPLACEABLE. BAYONET LOCKING RINGS ARE PROVIDED TO PREVENT PRIMARY CONNECTORS FROM DENATING. EXTENDED LIFE HARNESS SECONDARY CONNECTORS (5) ARE A THREADED COUPLING WITH A RACHET TYPE LOCKING FEATURE. THE SELF-LOCKING FEATURE IS A MULTIPLE BALL RACHET DESIGN. THIS RACHET CONFIGURATION PROVIDES A GREATER COUNTER-CLOCKWISE RACHETING FORCE CREATING A SELF-LOCKING DESIGN. THIS DESIGN ELIMINATES THE NEED FOR CONNECTOR TORQUE LOCK (6). THE SELF-LOCKING CONNECTORS ARE MANUFACTURED FROM STAINLESS STEEL (3). STAINLESS STEEL PROVIDES AMPLE STRENGTH AND CORROSION RESISTANCE.</p>	<p>(1) RL10014 (2) RES1235, RE1731, RE1761 (3) RL00532, RSS-8546, CP320R0003H (4) 40M38294, 40M39569 (5) RE1731 RE1761 (6) ECP 797</p>

H-110

PHASE	FAILURE DESCRIPTION/EFFECT	CRITICALITY
	<p>FAILURE CAUSE 0: CORROSION OR MOISTURE.</p> <p>THE ELECTRICAL COMPONENTS OF THE WIRE HARNESS ARE PROTECTED FROM CORROSION BY INHERENT MATERIAL DESIGN AND PROTECTIVE EXTERNAL COVERING OF THE CABLE. THE WIRE INSULATION IS COMPOSED OF TEFLON (1). TEFLON HAS RESISTANCE TO FLUIDS AND ATMOSPHERIC VAPORS. THE CONNECTOR CONTACTS ARE PLATED WITH GOLD OVER NICKEL UNDERPLATE (2). GOLD IS RESISTANT TO WATER CORROSION AND HUMIDITY. EXCEPT FOR POTTED CONNECTORS, THE CONNECTOR BACKSHELL IS PROTECTED BY SILICON RUBBER (3) TO PROTECT THE CONNECTOR FROM THE MAXIMUM SPECIFIED OPERATIONAL ENVIRONMENTS. PIN INSERT INTERFACIAL SEALS (4) ARE PROVIDED TO REDUCE CORROSION. CONNECTORS ARE MAINTAINED IN THEIR SEALED BAGS UNTIL READY FOR ASSEMBLY. CONNECTORS ARE PROTECTED TO PREVENT DAMAGE OR CONTAMINATION RESULTING FROM CONTACT WITH EACH OTHER OR ADJACENT OBJECTS (5).</p> <p>ALL CAUSES:</p> <p>THE CONTROLLER SOFTWARE IS CONFIGURED TO DETECT AND RESPOND PROPERLY TO THE FAILURES IDENTIFIED, IMPLEMENT THE NECESSARY REDUNDANT CONTROLLER CHANNEL SWITCHING AND COMMAND A SAFE ENGINE STATE WHEN REDUNDANCY IS LOST (1). FUNCTIONS ARE CONTROLLED ON REDUNDANT HARNESSES. THE HARNESS BASIC DESIGN IS TESTED PER HARNESS DESIGN VERIFICATION TESTING (2), INCLUDING VIBRATION TESTING (3), SAFETY FACTOR CRITERIA TESTING (4), DURING SENSOR VIBRATION TESTING (5) WHERE THE FLIGHT DESIGNED HARNESS IS CONNECTED TO THE SENSOR UNDER TEST, AND DURING ENGINE DVS TESTING (6). EXTENDED LIFE HARNESS DESIGN CHANGES WERE CERTIFIED BY HOT-FIRE TESTING, LABORATORY TESTING, ANALYSIS, AND SIMILARITY (7). USE OF CHROMEL AND ALUMEL WIRES WAS VERIFIED DURING HOT-FIRE CERTIFICATION TESTING (8).</p>	<p>(1) 40MS0577 (2) MSFC-SPEC-250 (3) RL10014 (4) RC1235, RC1731, RC1761 (5) RL00995</p> <p>(1) CP406R0008 (2) DVS-SSME-202 (3) RSS-202-6 (4) RSS-202-20 (5) DVS-SSME-203 (6) DVS-SSME-101 (7) VRS344 (8) VRS514</p>

CIL ITEM: H109-01, H116-01, H118-01, H119-01, H120-01, H121-01, H122-01, H118-AA-01, H118-AB-01, H120-AA-01, H118-AB-01

POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
FAILURE CAUSE A:	<p>R0018409 - 1W9 EXTENDED LIFE HARNESS</p> <p>R0018416 - 1W16 EXTENDED LIFE HARNESS</p> <p>R0018418 - 1W18 EXTENDED LIFE HARNESS</p> <p>R0018419 - 1W19 EXTENDED LIFE HARNESS</p> <p>R0018420 - 1W20 EXTENDED LIFE HARNESS</p> <p>R0018421 - 1W21 EXTENDED LIFE HARNESS</p> <p>R0018422 - 1W22 EXTENDED LIFE HARNESS</p>		<p>R0018409</p> <p>R0018416</p> <p>R0018418</p> <p>R0018419</p> <p>R0018420</p> <p>R0018421</p> <p>R0018422</p>

CIL ITEM: H109-D1, H116-D1, H118-D1, H119-D1, H120-D1, H121-D1, H122-D1, H118-AA-01, H118-AB-01, H120-AA-01, H118-AB-01

POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
	<p>ASSEMBLY INTEGRITY</p> <p>INSTALLATION INTEGRITY</p>	<p>THE FOLLOWING TESTS AND INSPECTIONS ARE PERFORMED DURING MANUFACTURING AND ASSEMBLY ACCEPTANCE:</p> <ul style="list-style-type: none"> - LIGHTNING BRAID IS INSPECTED FOR ACCEPTABILITY. - ALL WIRES ARE SUBJECTED TO SPARK AND DIELECTRIC TESTING. - ALL CONTACTS IN THE CONNECTORS ARE SUBJECTED TO A RETENTION TEST. - A RESISTANCE TEST BETWEEN THE BRAID AND MATING CONNECTOR FLANGE IS PERFORMED ON THE LIGHTNING BRAID/CONNECTOR AND VERIFIED TO BE WITHIN SPECIFICATION. - EACH WIRE RUN IS VERIFIED FOR END-TO-END CONTINUITY. - INSULATION RESISTANCE BETWEEN EACH CONDUCTOR AND EVERY OTHER CONDUCTOR IS VERIFIED TO BE WITHIN SPECIFICATION. - A DIELECTRIC WITHSTANDING VOLTAGE TEST BETWEEN EACH CONDUCTOR AND EVERY OTHER CONDUCTOR, SHELL OR SHIELD VERIFIES THE LEAKAGE CURRENT TO BE WITHIN SPECIFICATION. - ALL SELF-LOCKING CONNECTOR MECHANISM ARE FUNCTIONAL TESTED. <p>INSTALLATION OF THE HARNESSSES IS VERIFIED PER SPECIFICATIONS DEFINING THE:</p> <ul style="list-style-type: none"> - INSPECTION OF HARNESSSES PRE- AND POST-INSTALLATION. - ROUTING REQUIREMENTS WHICH INCLUDE: <ul style="list-style-type: none"> INSTALLATION PATH, CLAMP LOCATIONS, AND SIZES. SEPARATION DISTANCE REQUIREMENTS FROM OBJECTS WHICH COULD CAUSE CABLE OR CONNECTOR DAMAGE. MINIMUM BEND RADIUS . - INSPECTION OF CONNECTORS PRIOR TO MATING. THIS INCLUDES BACKSHELL, PINS, CONNECTOR GASKETS AND CONNECTOR PERIPHERAL O-RING. - TORQUE REQUIREMENTS FOR THREADED CONNECTORS. 	<p>RL00995 40M50577 RL00995 RL00995 H100128 H100128 RL00128 RC1731 RC1761 RL00039 RS007007 RS007007 RL00039 RL00039 RL00039</p>
<p>FAILURE CAUSES B,C,E, G:</p>	<p>RE1235 - CONNECTOR RE1731 - CONNECTOR RE1761 - CONNECTOR</p>		<p>RE1235 RE1731 RE1761</p>

H - 111

CIL ITEM: H109-01, H116-01, H118-01, H119-01, H120-01, H121-01, H122-01, H118-AA-01, H118-AB-01, H120-AA-01, H118-AB-01			
POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
FAILURE CAUSE D:	HARNES/CONNECTOR ASSEMBLY INTEGRITY	HARNES/CONNECTOR ASSEMBLY PROCESSES ARE VERIFIED PER SPECIFICATIONS WHICH INCLUDE: - CRIMPING OF ELECTRICAL CONNECTOR CONTACTS. - USE OF FLEXIBLE INSULATION SLEEVING. - INSTALLATION OF OVERMOLD AND PROTECTIVE SLEEVE. - SELECTION AND USAGE OF PROTECTIVE CLOSURES. COMPLETED ASSEMBLY IS INSPECTED FOR CONTACT PIN RETENTION AND PROTECTIVE BRAID DAMAGE.	RA1613-005 RBD130-109 RAD605-018 RAD116-054 RL00995
	RES1235 - CONNECTOR RE1731 - CONNECTOR RE1761 - CONNECTOR		RE1235 RE1731 RE1761
	CLEANLINESS OF COMPONENTS	CLEANLINESS REQUIREMENTS ARE VERIFIED PER SPECIFICATION DURING MANUFACTURING OF THE HARNES ASSEMBLY. METAL TYPE DUST AND MOISTURE PROOF CAPS ARE VERIFIED INSTALLED ON THE CONNECTOR WHEN NOT IN USE.	RL00995 RL00995
	SURFACE FINISH	THE PLATING ON THE CONNECTOR CONTACTS ARE INSPECTED PER SPECIFICATION REQUIREMENTS.	RC1235 RC1731 RC1761
	ASSEMBLY INTEGRITY	PRIOR TO CONNECTOR MATING, THE CONNECTOR IS INSPECTED FOR ANY CORROSION OR DAMAGE WHICH WOULD ALLOW MOISTURE TO ENTER THE CONNECTOR.	RL00039

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CIL ITEM: H109-01, H116-01, H118-01, H119-01, H120-01, H121-01, H122-01, H118-AA-01, H118-AB-01, H120-AA-01, H118-AB-01

POSSIBLE CAUSES	SIGNIFICANT CHARACTERISTICS	INSPECTION(S)/TEST(S)	DOCUMENT REF.
ALL CAUSES:	R0018409 - 1W9 EXTENDED LIFE HARNESS		R0018409
	R0018416 - 1W16 EXTENDED LIFE HARNESS		R0018416
	R0018418 - 1W18 EXTENDED LIFE HARNESS		R0018418
	R0018419 - 1W19 EXTENDED LIFE HARNESS		R0018419
	R0018420 - 1W20 EXTENDED LIFE HARNESS		R0018420
	R0018421 - 1W21 EXTENDED LIFE HARNESS		R0018421
	R0018422 - 1W22 EXTENDED LIFE HARNESS		R0018422
	ASSEMBLY INTEGRITY	<p>ALL CONTROLLER DATA FROM THE PREVIOUS FLIGHT IS REVIEWED. ANY ANOMALOUS CONDITION NOTED REQUIRES FURTHER TESTING OR HARDWARE REPLACEMENT PRIOR TO THE NEXT FLIGHT.</p> <p>RE-TEST REQUIREMENTS AFTER HARNESS REPLACEMENT OR CONNECTOR DEMATE VERIFY THAT THE PROPER CONTROLLER ELECTRICAL CHECKOUTS ARE PERFORMED TO RE-VALIDATE THE HARNESS ASSEMBLY.</p> <p>HARNESSES ARE INSPECTED FOR DAMAGE, PROPER WIRING, AND PROPER TORQUE LOCK APPLICATION DURING POST FLIGHT EXTERNAL INSPECTION.</p> <p>HARNESS OPERATION IS VERIFIED EVERY MISSION FLOW AND AFTER ANY REPAIR OR REPLACEMENT BY THE FOLLOWING CONTROLLER ELECTRICAL CHECKOUTS: (LAST TEST)</p> <ul style="list-style-type: none"> - REDUNDANCY VERIFICATION. - SENSOR CHECKOUT. - FLIGHT READINESS TEST. - PNEUMATIC CHECKOUT. 	<p>NSFC PLN 1228</p> <p>OMRSD V412A0.010</p> <p>OMRSD V418A0.030</p> <p>OMRSD V41AND.030</p> <p>OMRSD V41A00.010</p> <p>OMRSD V41AS0.030</p> <p>OMRSD V41AS0.020</p>
FAILURE HISTORY:	<p>COMPREHENSIVE FAILURE HISTORY DATA IS MAINTAINED IN THE PROBLEM REPORTING DATABASE (PRMS/PRCA). REFERENCE: NASA LETTER 9A21/88/30B AND ROCKETDYNE LETTER 88RC09761.</p>		

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OPERATIONAL USE: FAILURE MODE CAN BE DETECTED IN REALTIME BY THE FLIGHT CONTROL TEAM WHO WILL EVALUATE EFFECTS UPON VEHICLE PERFORMANCE AND ABORT CAPABILITY. BASED ON THIS EVALUATION THE APPROPRIATE ABORT MODE OR SYSTEM CONFIGURATION WILL BE SELECTED. FAILURE DETECTION CUES AND ASSOCIATED SOME PERFORMANCE DATA HAVE BEEN COORDINATED BETWEEN THE ENGINEERING AND FLIGHT OPERATIONS ORGANIZATIONS WITH THE RESPONSES DOCUMENTED IN MISSION FLIGHT RULES.