VEHICLE ENGINEERING

	Presenter:
	Organization/Date: Orbiter/03-26-02

BOEING RELOCATION STATUS	To Be Presented
ORBITER	To Be Presented
GFE	To Be Presented
SOFTWARE	To Be Presented
FCE	No Constraints
FLIGHT READINESS STATEMENT	To Be Presented
BACKUP	

Orbiter and Flight Software

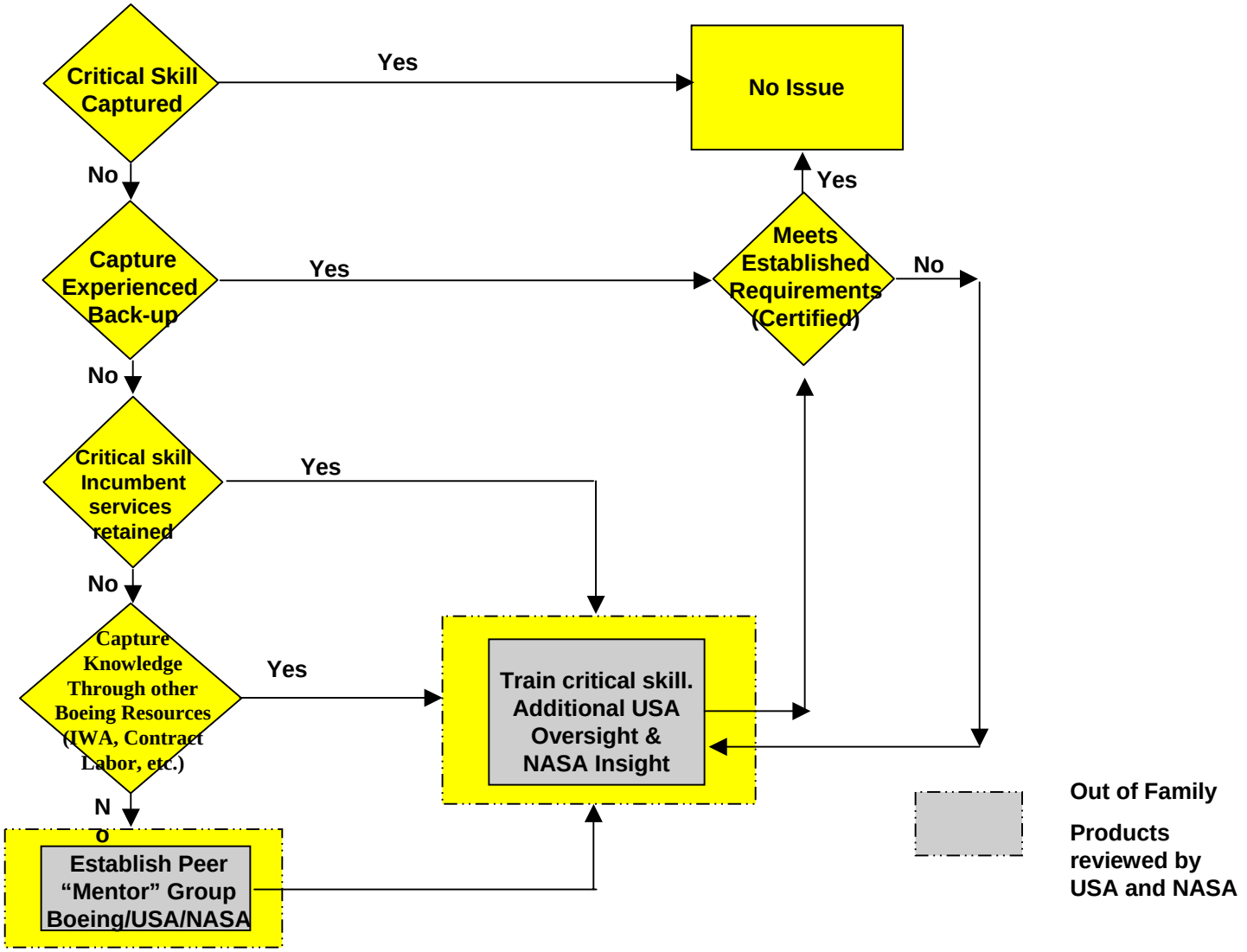
Boeing Relocation Status

MV/Ralph R. Roe, Jr.

Boeing Relocation Status

- Critical Skills Transition Process established.
  - Management level transition plan baselined.
- Criteria to certify the replacement Subsystem Managers (SSM's), Principle Function Managers (PFM's) and other critical skills established.
- Generic training plan has been defined.
- Process requires individual training plan for each replacement candidate.
  - Individual training plans tailored from generic plan based on replacement's skills and knowledge level.
  - Training plan utilizes the incumbent critical skill and other Boeing experts to perform the training.
- Prior to certification products from replacements will be treated as out of family.
- NASA approval required for transition complete.
  - SSM's and Critical Skills will require a formal board approval by NASA, USA and Boeing.
- Relocation progress and metrics are statused as part of the CoFR process.
- Relocation risk management added as SFOC Award Fee Area of Emphasis.

Critical Skills Transition Process



Boeing Orbiter and FSW Relocation Status

	Total	Captured (Existing/Moving)	Replacements Required	Replacements Filled	Incumbents Lost (Boeing/HSF&E)
SSM's	61	12/3	46	44	0/10
Orbiter PM	14	0/6	8	1	0/0
Orbiter Critical Skills	89	25/13	51	27	0/4
FSW	106	7/17	82	12	6/21
Total	270	44/39	187	84	6/35

Boeing Relocation Status

- SSM replacements hired from existing staff at local sites (21 Florida, 22 Houston)
  - This distribution of the Design Center workforce poses a management challenge
  - Boeing proposed using existing management infrastructure
  - NASA prefers to maintain clear lines of demarcation between Design and Operations teams to preserve the natural tension that is necessary as part of the program's checks and balances.
- Need to backfill technical staff at local sites.
- Present number of vacancies manageable but could become unmanageable if allowed to grow to potential (41 to 187)
- Primary issue is long-term retention of incumbents to support contracted tasks and train replacements
  - Internal Working Agreements (IWA's) established for those who have moved internal to Boeing
  - Adding retired personnel to supplement training of replacements

Orbiter STS-110 CoFR

- **Orbiter Critical Skills Transition Process has been assessed for impacts to the near term COFR process**

STS-110	STS-111	STS-107	STS-112	STS-113	STS-114

Green: Certified (SSMs)/Qualified (Critical Skills) personnel producing flight products

Yellow: Replacement personnel generating flight products with approved work around plan in place

Red: Critical skills unavailable

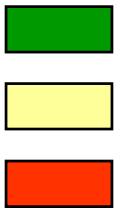
- **STS-110 is yellow because interim/acting SSM's are delivering flight products in the following subsystems:**

  EPD&C (H/W), Mass Properties, Ku-Band, EPD&C (Sys), Payloads Accommodations, EPD&C (MEC,EMEC,BFC,GCIL), Hydraulics/WSB, Comm & Track (Antennas, Coax)

- **USA oversight in each of these areas has been defined**
- **NASA oversight in each of these areas has been defined**
- **Projections beyond STS-110 can not be substantiated until detailed training plans and schedules are developed.**

Flight Software STS-110 CoFR

- **Flight Software Critical Skills Transition process has been assessed for impacts to the near term COFR process**



Green: Qualified personnel producing flight products

Yellow: Replacement personnel generating flight products with approved work around plan in place

Red: Critical skills unavailable

- **STS-110 is yellow because interim personnel are producing flight products**
  - **Replaced Ascent SSM with previous SSM**
  - **Recaptured previous Ascent Analysts with internal Boeing Agreement**
- **PFO changes require individual training plans and approval by SASCB**
- **ILO changes require individual training plans and approval by SASCB**
- **Projections beyond STS-110 can not be substantiated until detailed training plans and schedules are developed.**

Conclusions

- Good progress has been made in the selection of replacement critical skills and functions.
  - Exceptions are in the Flight Software area where only 4/82 have been filled.
- STS-110 COFR risk assessed as yellow or medium (snapshot).
- Overall SSP risk ranges from Medium to Very High.
- Where in the range each area's risk level falls is determined by at least 3 variables.
  - Number of quality replacements being captured
  - Number of incumbents services retained for training
  - Number of quality USA/NASA available for out of family support
- Next level of detail required in order to assess Overall Program risk level for each critical skill.
  - Experience level of replacement
  - Individual Training plan and schedule
  - Experience level of trainers (incumbents, mentors or peers)
  - Experience level and number of critical skills available to provide support
  - Experience level and number of USA available for oversight
  - Experience level and number of NASA available for oversight
- Boeing must address Design Center Management Structure to insure healthy tension between Design and Operations is maintained.

ORBITER

AGENDA

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Engineering Readiness Assessment

• Previous Flight Anomalies	To Be Presented
• Critical Process Changes	To Be Presented
• Engineering Requirement Changes	No Constraints
• Configuration Changes and Certification Status	To Be Presented
• Mission Kits	No Constraints
• Safety, Reliability and Quality Assessment	No Constraints

Special Topics — To Be Presented

- AMEC Output Drivers Failure Indication
- Connector Saver Concern

	Presenter:
	Organization/Date: Orbiter/03-26-02

PREVIOUS FLIGHT ANOMALIES

	Presenter:
	Organization/Date: Orbiter/03-26-02

STS-109
IN-FLIGHT ANOMALIES

PREVIOUS IN-FLIGHT ANOMALIES

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

STS-109 In-Flight Anomalies, Previous Mission:

- Seven orbiter problems identified as in-flight anomalies
  - STS-109-V-01 Freon Coolant Loop 1 Degraded Aft Cold Plate Flow
  - STS-109-V-02 Airlock A Hatch Locking Device Difficult to Actuate
  - STS-109-V-03 MPS LH2 4-Inch Recirculation Disconnect Slow to Close
  - STS-109-V-04 Forward THC -X Contact Lost During One Burn
  - STS-109-V-05 FES Actuator/Hi-Load Feedline B Heater System 2 Failure
  - STS-109-V-06 Primary RCS Thruster R3R Failed Off
  - STS-109-V-07 EV1 EMU Water Leak

All Anomalies and Funnies Have Been Reviewed and None Constrain STS-110 Flight

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Observation:

- Freon coolant loop (FCL) 1 aft cold plate (ACP) flow dropped from 305 to 225 lbs/hr after MECO

Concern:

- Flow rate reduction could result in loss of a FCL and early mission termination

Discussion:

- Approximately ten minutes after lift-off (MECO), the FCL 1 aft coldplate flow rate dropped from 305 lbs/hr to 225 lbs/hr, then to 195 lbs/hr when the FCL was reconfigured to rad flow
  - The flow rate stabilized for the remainder of the mission
- FCL 1 interchanger and payload heat exchanger indicated flow increased at the same time
  - This confirmed that a restriction in the aft coldplate leg caused the reduction in flow

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Discussion: (cont)

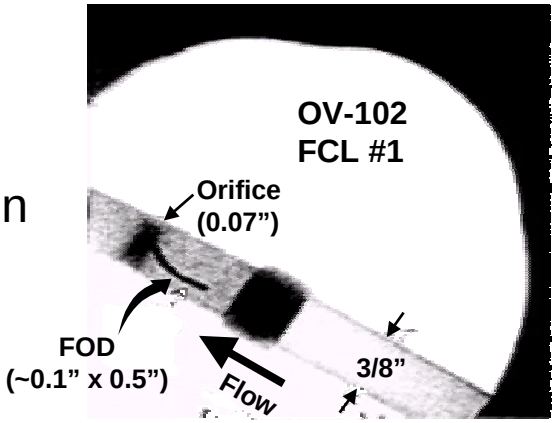
- Two FCLs are required to support normal operations
  - Flight rules declare loss of FCL if aft cold plate flow rate $\leq$ 236 lbs/hr (211 lbs/hr assumed for instrumentation error)
  - Loss of one FCL requires next PLS
  - Only one FCL is required to support mission abort
- Analysis determined that adequate flow would still be available to provide sufficient cooling for the remainder of STS-109 and protect required redundancy for the remainder of the mission

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Actions Taken:

- Evaluation during the flight determined the most probable cause to be contamination in the loop
  - STS-109 was OV-102's first flight after an OMM during which there was an extensive amount of work done on FCLs with an associated risk of introducing contaminants
    - In addition, a brazing issue resulted in FOD and required brazing rework and FOD removal from both FCLs
  - The appearance of the anomaly at MECO indicates that contaminant became dislodged due to launch vibration
- Post-flight troubleshooting on OV-102 has isolated the cause of the anomaly
  - A piece of debris was found stuck in the upstream side of the orifice between the FES and the aft coldplate network

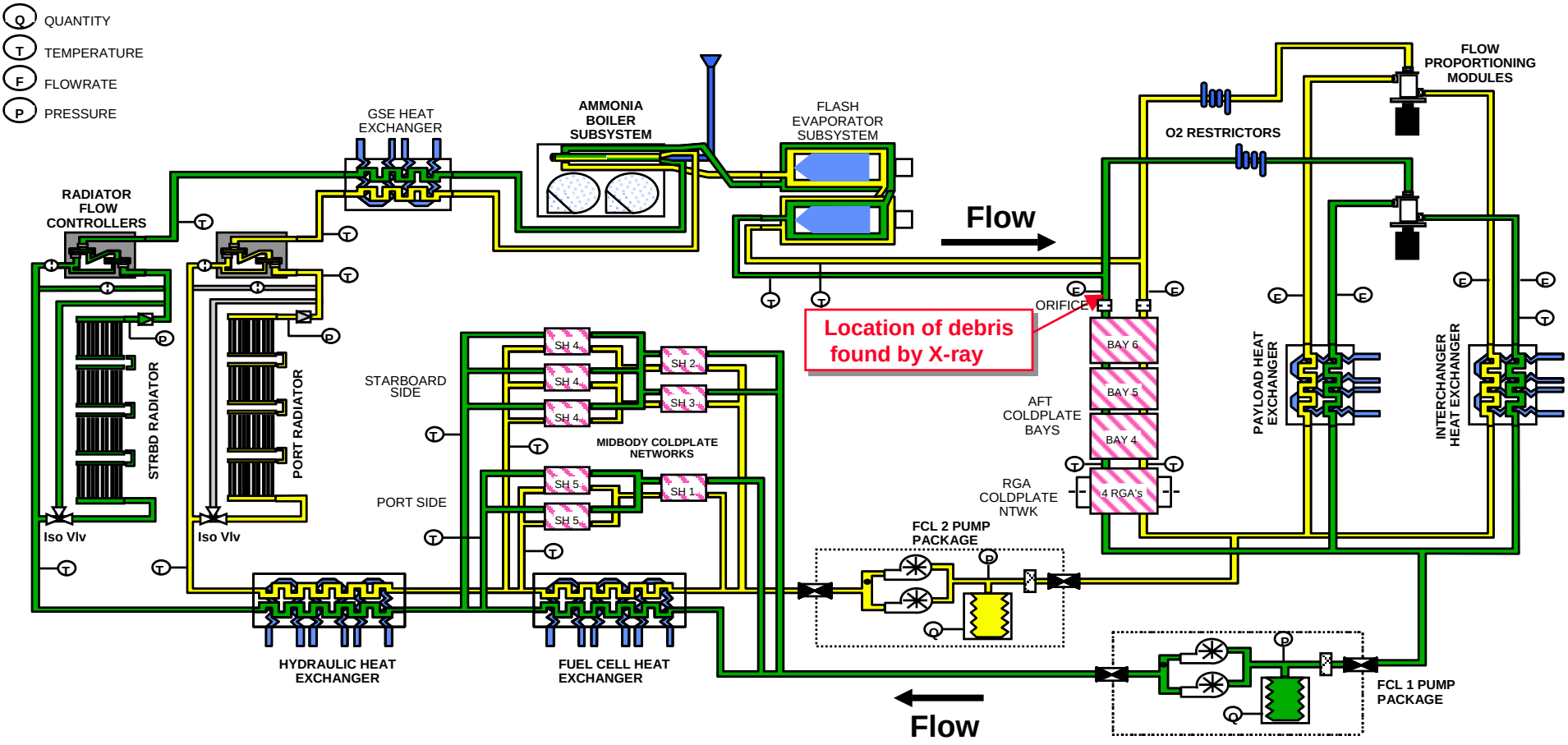


STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

ORBITER ACTIVE THERMAL CONTROL SYSTEM (ATCS)



STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Actions Taken: (cont)

- Most probable source of the debris is brazing preform introduced during OMM operations
  - OV-102 hardware was brazed using different equipment from previous OMMs (Palmdale replaced Lepel power supply with TOCCO power supply in March/April 2000)
- When the brazing anomaly was discovered in Palmdale, an investigation was conducted
  - TOCCO certification program data and vehicle NDE showed problem isolated to joint brazes on 0.75 inch freon lines in vertical orientation
    - Collection points below these brazes were all x-rayed
      - Six particles were found and removed by tygon hose vacuum or by cutting lines, removing debris and rebrazing
  - Follow-up x-rays were taken to confirm lines were free of FOD

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Actions Taken: (cont)

- The investigation determined that the root cause of the faulty brazes was the joints were being heated too rapidly by the new TOCCO unit power supply, resulting in portions of the melting preform dropping off before the braze could develop properly
- Brazing processes were reviewed and best practices have now been adopted – procedure changes documented
- Reviewed work performed on OV-104 FCLs since OMM
  - FCL 1 – no work since OMM (4 flights)
  - FCL 2 – no work since STS-104 flow (1 flight)
- Evaluated OV-104 FCL flow rates since last OMM – no flow degradation

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Risk Assessment:

- Freon coolant system is criticality 1R2
- Two FCLs are required to support normal vehicle operations
- Extremely low risk of flow restriction on OV-104
  - OV-104 OMM FCL brazes performed prior to equipment change
  - Four flights since major FCL braze work during OMM
  - One flight since FCL 2 work (at KSC with different equipment)
  - Flow rate data shows no degradation
- Loss of one loop results in next PLS
  - Procedure for single FCL abort is well documented

STS-109-V-01: FREON COOLANT LOOP 1 DEGRADED AFT COLD PLATE FLOW

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Acceptable for STS-110 Flight:

- OV-104 has flown four successful missions following OMM with no FCL issues
- The last work performed on OV-104 freon lines (FCL 2) was during the STS-104 processing flow
  - STS-104 was subsequently flown with no flow rate degradation
- Freon systems have been verified through OMRSD testing

STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Observation:

- When the crew first attempted to open the internal airlock “A” hatch during STS-109, the hatch actuator did not unlock when the lock tab was moved to the unlocked position
- The crew noticed that the removable handle was partially disengaged from the actuator, so they reseated it into the actuator
  - They were then able to unlock and unlatch the hatch successfully

Concern:

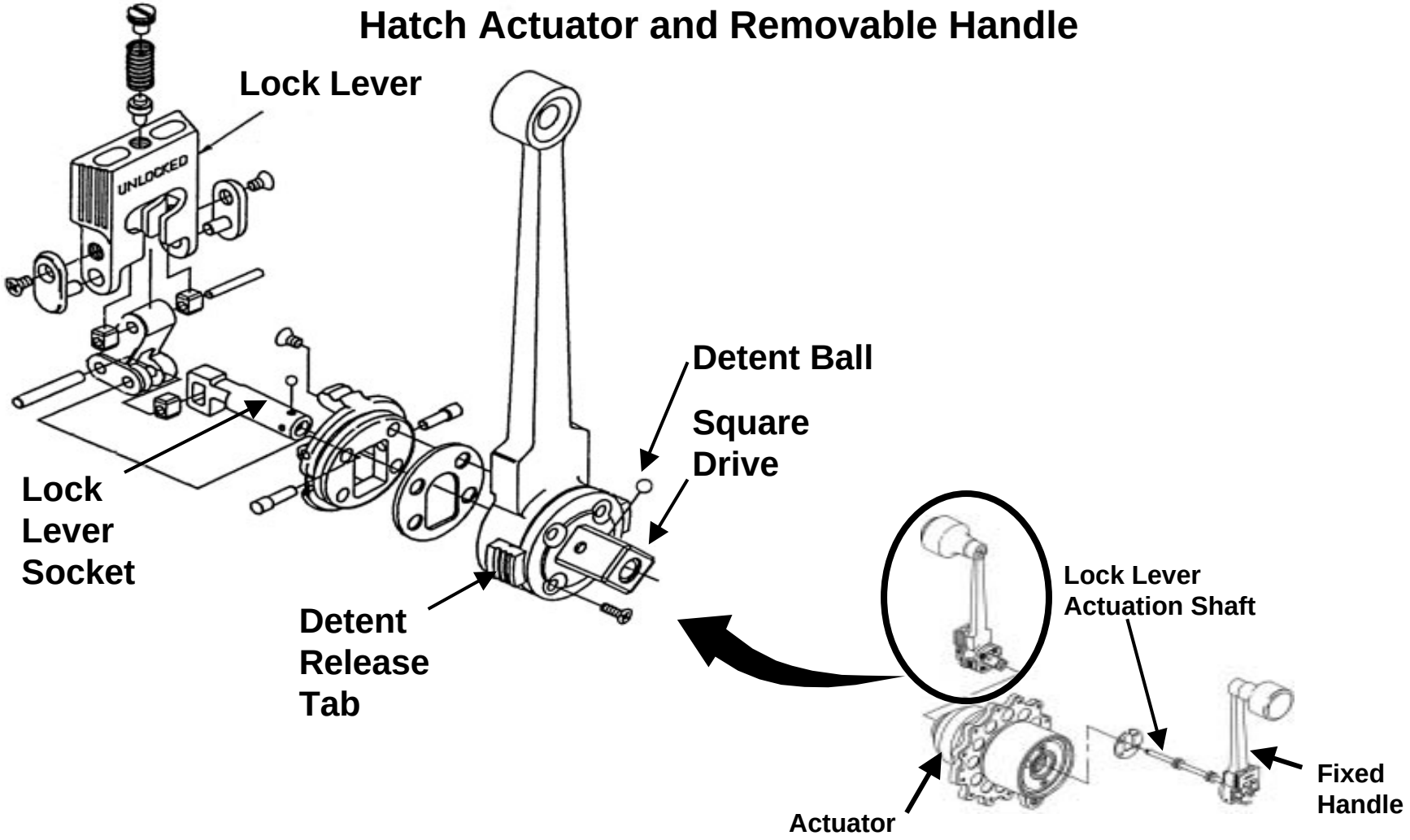
- Inability to unlock the hatch actuator prevents the crew from unlatching the hatch and entering the airlock for EVAs (Crit 1R2)

STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Hatch Actuator and Removable Handle



STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Discussion:

- The handle on the crew module side of this actuator is removable
  - Spring-loaded retention balls on the handle base interface with recesses in the actuator square drive
    - The balls are released from detents when the detent release (tabs on the sides of the handle base) is depressed toward the hatch
  - Lock lever socket interfaces with the pushrod in the center of the actuator
  - Handle must be fully seated for proper lock lever socket engagement
  - With handle unseated, lock lever can move separately from the rest of the lock mechanism leaving the actuator locked

STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Discussion (cont):

- The KSC closeout crew noticed the handle was loose during the STS-109 flow when first opening this hatch in the vertical
  - Lock levers were difficult to move
  - The handle was pushed in to properly seat it into the actuator
  - Locking levers worked properly afterward, and the handle was not loose
- The actuator functioned properly during final hatch closeout for flight

Actions Taken:

- KSC performed troubleshooting of the OV-102 hatch actuator
  - The detent release tabs did not spring back after being depressed
  - The lock lever was rotated with the detent tabs stuck in the depressed position
    - Handle became unseated, and locking levers stopped moving

STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Actions Taken (cont):

- On OV-104 prior to STS-110:
  - The bulkhead hatch actuator has been fully cycled and the locking and detent release mechanisms exercised
  - The external airlock aft hatch detent release tabs have been cycled to verify that they are not binding
  - The ODS upper hatch has been visually inspected to verify the detent release tabs are in the proper position

STS-109-V-02: AIRLOCK A HATCH LOCKING DEVICE DIFFICULT TO ACTUATE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Risk Assessment:

- The problem has been isolated to the removable handle of OV-102's "A" hatch actuator
- Worst case, the inability to unlock the bulkhead hatch actuator is a crit 1R2 failure because it results in losing the capability to perform a contingency EVA, if required
- If unable to unlock the ODS upper hatch, it can be opened by the ISS crew following docking
- For STS-110, the external airlock aft hatch will only be used in the event of a contingency EVA
  - All four planned EVAs will be conducted from the ISS airlock

Acceptable for STS-110 Flight:

- Problem is isolated to the removable handle of OV-102's "A" hatch actuator
- Hatch actuation/locking and handle detent release mechanisms have been verified to the extent possible on OV-104's hatches prior to flight

STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Observation:

- MPS LH_2 4” disconnect (S/N CRP 1003) failed to close pneumatically when commanded at MECO
  - Closed via back-up mechanical mode at ET/Orbiter Umbilical separation

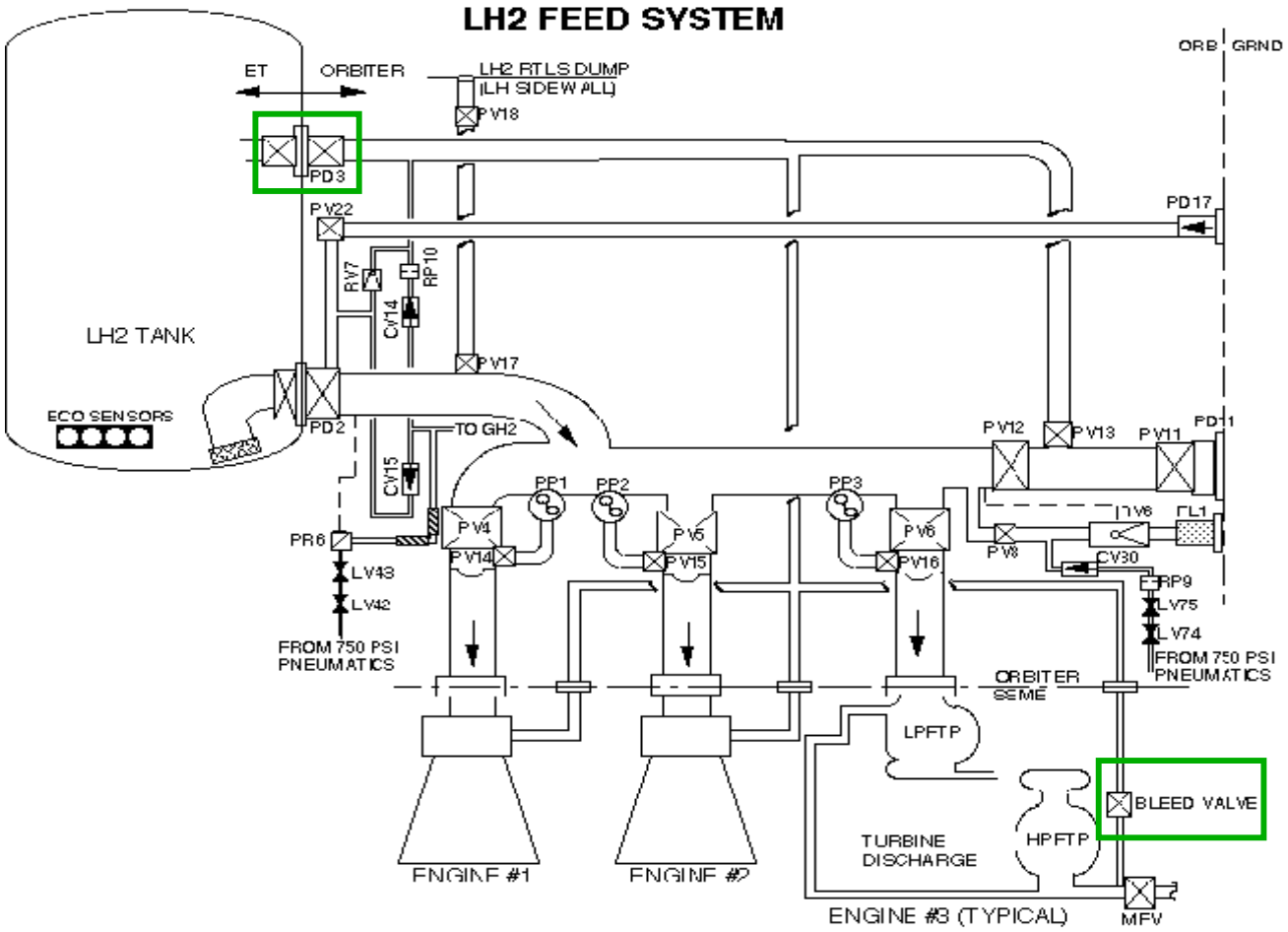
Concern:

- Failure of the 4” disconnect to close pneumatically in the case of a pre-MECO SSME shutdown or pad-abort results in inability to isolate the affected SSME from the ET
  - No concern for nominal mission except for minor helium loss during entry

STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

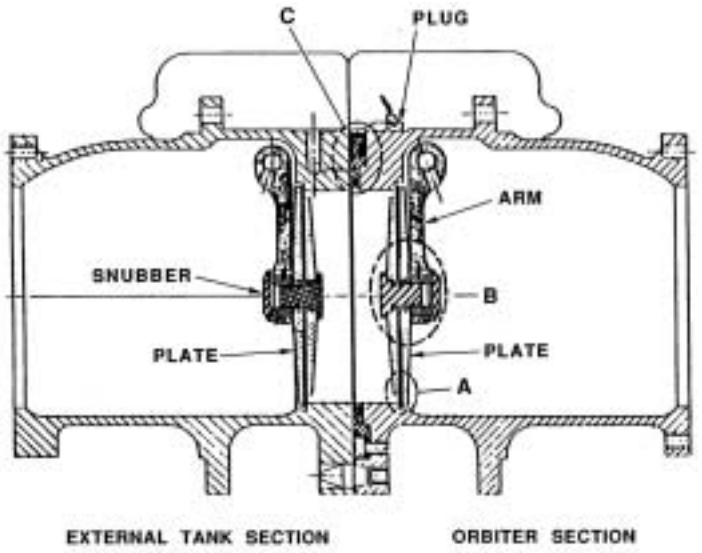


STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE

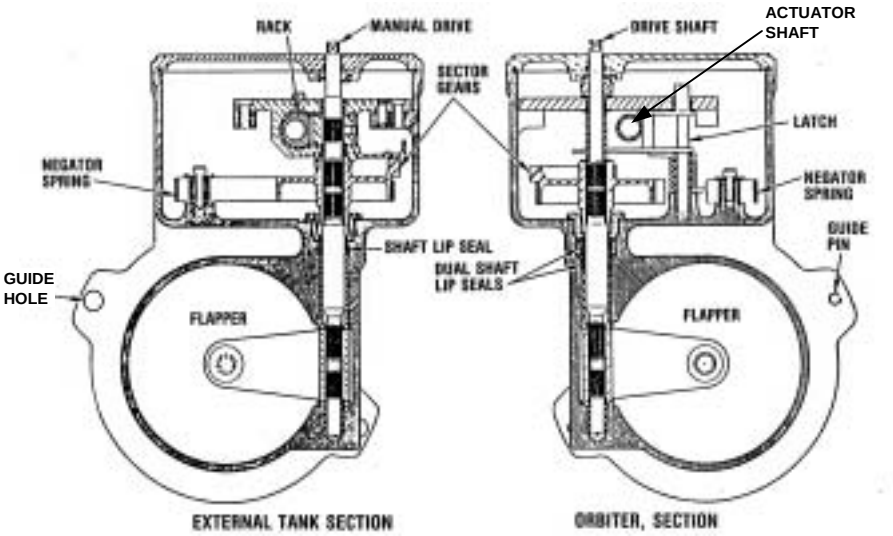
Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Orbiter/ET 4” Disconnect



MATED 4” DISCONNECT



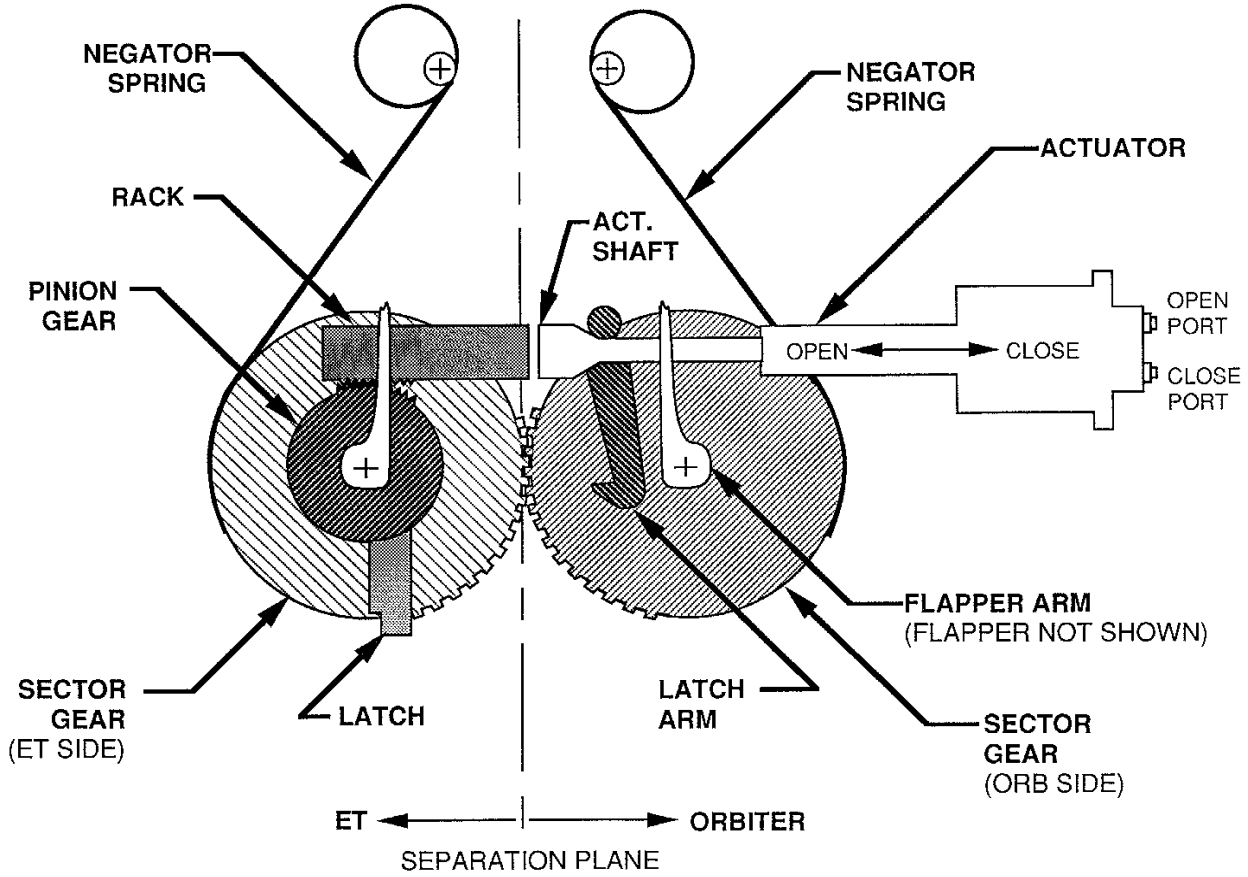
DISCONNECT HALVES SEPARATED

STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Orbiter/ET 4” Disconnect Pneumatic Drive Mechanism



STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Discussion:

- Previous failures of 4” disconnect to close pneumatically:
  - STS-29 (S/N CRP 1004) - Closed at umbilical retract
    - Attributed to icing on ET side rack mechanism
  - STS-55 (S/N CRP 1003) - Failed to close following a pad abort until LH2 topping valve was opened
    - Actuator was replaced in the same disconnect
  - During ascent, disconnect closed at umbilical retract
    - F/A could not repeat failure - closed as UA
  - STS-89 (S/N CRP 1004) - Closed at umbilical retract
    - F/A could not repeat - closed as UA
- Failure history shows that previous 4” disconnect anomalies are associated with S/Ns CRP 1003 and CRP 1004
- OV-104 disconnect (S/N A383011) has no history of failure to close pneumatically and has flown four successful flights since installation

STS-109-V-03: MPS 4-INCH RECIRCULATION DISCONNECT SLOW TO CLOSE

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Actions Taken / In-Work:

- Review of LH_2 Umbilical film did not reveal any anomalous condition of the ET disconnect post-separation
- Orbiter disconnect inspections and actuator / solenoid leak checks will be performed for indications of failure cause
- Review of Orbiter and ET disconnect build paper for similarities among failed units
- If required, disconnect will be removed for more complete failure analysis

Risk Assessment/Acceptable for STS-110 Flight:

- Disconnect failure to close pneumatically is only critical for abort
  - Abort SSME catastrophic shutdown probability is very small
- Low probability that OV-104 disconnect S/N A383011 will fail to close pneumatically
  - All five previous flight failures associated with S/Ns CRP 1003 and CRP 1004
- No history of disconnect failure to close via mechanical back-up separation mode

STS-109-V-04: FORWARD TRANSLATION HAND CONTROL -X CONTACT LOSS ANOMALY

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Observation:

- During an STS-109 -X NC2 burn (MET 00:17:50), channel C output from the forward Translation Hand Control (THC) dropped from logic one to zero three seconds before channels A and B

Concern:

- Loss of redundancy due to failure of one output channel on one axis of THC output

Discussion:

- Based on CDR description of the event and flight data, the THC was not initially positioned to the full -X stop at the start of the planned 20 second burn and it then prematurely migrated back to the null position
  - Three seconds before channel A and B output dropped to zero, channel C dropped to zero
  - Redundancy Management S/W declared channel C failed and deselected it due to disagreement with the other two channels

STS-109-V-04: FORWARD TRANSLATION HAND CONTROL -X CONTACT LOSS ANOMALY

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Discussion: (cont)

- The CDR re-gripped the THC and completed the burn
- Channel C was later manually reselected and the -X channel C output functioned normally during all subsequent applications of -X input to the THC
- Each of the six axis outputs of the THC has three electrically independent channels
- THC switches utilize Hall Effect solid state switches that are not subject to switch “tease” or “bounce”
  - The actuation magnet, which actuates the Hall Effect switching device, is mounted on a pivot which operates in a snap-action manner
  - The actuation magnet subassembly is either magnetically held in detent, or moved by magnetic force against the Hall effect devices
  - One actuation magnet activates all three Hall Effect switches on each axis
- ATP requirement calls for the all three channels of each axis to activate (and deactivate) within 18 millisecs of each other

STS-109-V-04: FORWARD TRANSLATION HAND CONTROL -X CONTACT LOSS ANOMALY	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Actions Taken / Planned:

- Contacted THC vendor who indicated that there are no failures of this nature on record
- Post-flight troubleshooting is on-going
  - On-vehicle testing was able to recreate similar anomaly while manipulating the THC switches
- Review of OV-104 THC SCAN retest data showed no premature dropouts

STS-109-V-04: FORWARD TRANSLATION HAND CONTROL -X CONTACT LOSS ANOMALY	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Risk Assessment:

- For the reported anomaly, the THC is Criticality 1R3
  - Each of the six axis outputs of the THC has three electrically independent and redundant channels
- The THC is Criticality 1R2 only for the ET separation maneuver
  - In the event of the failure of the automatic -Z firing to provide ET separation, a manual command input using the THC would be necessary
  - 1R2 Criticality for a physically jammed THC being unable to provide any -Z firing command channels

STS-109-V-04: FORWARD TRANSLATION HAND CONTROL -X CONTACT LOSS ANOMALY	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Acceptable for STS-110 Flight:

- Given the maturity of the hardware, there is no evidence to indicate that a generic problem exists
  - First occurrence of this anomaly in a flight THC
  - Preliminary troubleshooting indicates the problem is within the THC
- Adequate system redundancy exists
  - THC has three redundant outputs for each axis
- OV-104 THCs have been functionally verified per OMRS requirements
  - Additionally verified during SCAN retest

STS-109-V-05: FES ACCUMULATOR/ HI-LOAD FEEDLINE B HEATER SYSTEM 2 FAILURE

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Observation:

- FES accumulator/hi-load H_2O feedline B (starboard) heater system 2 zone 4 failed off during OV-102 STS-109

Concern:

- Without corrective action, loss of a second heater may result in FES feedline freezing and potential loss of one of the FES water supply systems

Discussion:

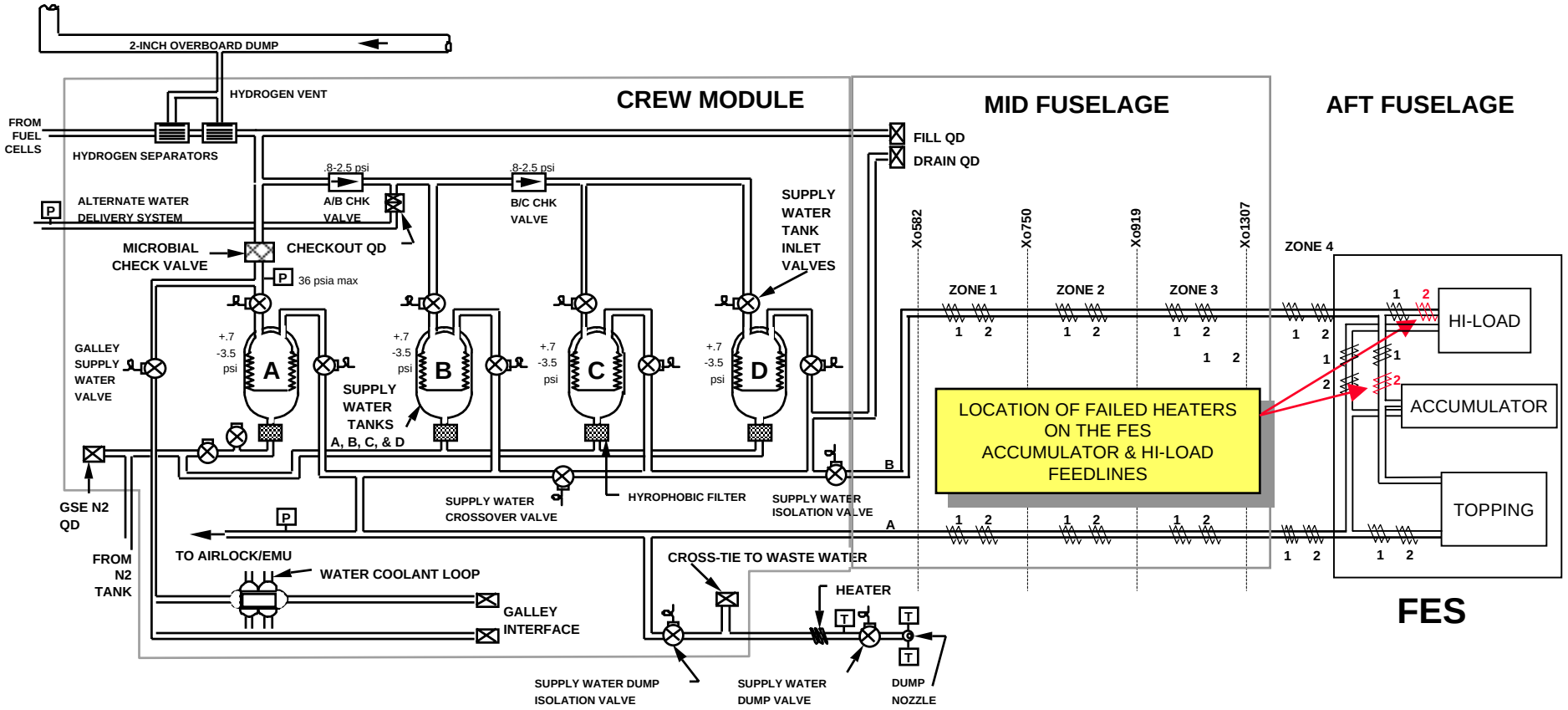
- Accumulator line temperature (V63T1894A) and Hi-load feed line temperature (V63T1896A) dropped to 50°F & 60°F respectively at MET 008:15:15 indicating a heater failure
- The crew switched to heater string 1 and the system performed nominally for the remainder of the mission
- OV-102 post-flight troubleshooting will be performed
  - Suspected cause is a failed thermostat since heater cycle was observed before the failure

STS-109-V-05: FES ACCUMULATOR/ HI-LOAD FEEDLINE B HEATER SYSTEM 2 FAILURE

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

SUPPLY WATER SYSTEM



STS-109-V-05: FES ACCUMULATOR/ HI-LOAD FEEDLINE B HEATER SYSTEM 2 FAILURE

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Risk Assessment:

- Heater is criticality 1R3
  - There are two redundant heater strings per feedline providing temperature control to prevent freezing
  - In the event of a second heater string failure, a contingency line purging procedure is also in place to prevent freezing and recover the line for entry
    - Loss of one water loop results in loss of 4 of 7 FES control modes

Acceptable for STS-110 Flight:

- FES heater string operation was verified as part of OMRSD File IX in-flight checkout requirements during STS-104 and again on the ground prior to aft closeout
- In the event of a heater failure, the redundant heater string is available
- With loss of both heater strings, a contingency procedure to purge the affected line is in place to prevent freezing and allow recovery of the system for entry

STS-109-V-06: RCS THRUSTER R3R FAILED OFF

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Observation:

- Thruster R3R failed off during RCS hotfire

Concern:

- Loss of RCS thruster redundancy

Discussion:

- R3R (S/N 635) failed off during first commanded firing
  - Chamber pressure (Pc) reached max value of 11.2 psia
  - RM deselected thruster due to failure of Pc to reach 26 psia within 320 ms
- Fuel and ox flow was evident by drop in injector temps
- Low Pc and injector temp drop indicate partial flow on one valve and full flow on other valve
- First flight for this thruster since last installation / flushing
- Most likely cause is fuel valve seat extrusion
- Thruster was deselected for remainder of mission

STS-109-V-06: RCS THRUSTER R3R FAILED OFF

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Actions Planned:

- Failed thruster R3R will be removed and replaced - requires entire manifold R&R to prevent sympathetic failures
- Failed thruster will be sent to WSTF for TT&E to determine if the anomaly was caused by a fuel valve or ox valve problem

Risk Assessment:

- Failed off thruster is Crit 1R/3
  - Redundant thrusters exist in all firing directions
  - Extensive flight history of failed off thrusters
    - Well documented and understood failure mode

STS-109-V-06: RCS THRUSTER R3R FAILED OFF

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Risk Assessment: (cont)

- Risk mitigation actions are in place
  - Preventative maintenance flushing performed on all primary thrusters at OMM, as well as those used for in-flow replacements
  - Full manifold R&R required for any thruster removal to preclude collateral damage
  - GN_2 chamber purge implemented during turnaround operations to reduce propellant vapor build-up
  - Molecular sieve of oxidizer implemented at KSC

Acceptable for STS-110 Flight:

- Redundant thrusters exist for each firing direction
- Flight rules exist for failed off thrusters
- Not a safety of flight issue
- Risk mitigation actions in place to reduce failures

STS-109-V-07: EV1 EMU WATER LEAK	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Observation:

- During OV-102's STS-109 mission, the EV1 EMU experienced a water leak of ~ 1 gallon when the feedwater shutoff valve that feeds the sublimator opened inadvertently

Concern:

- Loss of use of an EMU
- Risk associated with free water in the cabin

Discussion:

- The Dual Power Supply & Battery Charger (DPS&BC) is considered to be the most probable cause of the STS-109 EMU EV1 water leak
- EV1 was powered by EMU DPS&BC Side 1 and EV2 was powered by EMU DPS&BC side 2
  - The two sides of the EMU DPS&BC are independent

STS-109-V-07: EV1 EMU WATER LEAK	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Discussion: (cont)

- EMU DPS&BC may have induced a voltage spike which caused the water valve to open
  - Previous occurrence prior to STS-77
    - Troubleshooting showed that the condition could occur with a specific combination of EMU and DPS&BC
    - DPS&BC output voltage transients were caused by greater than ICD load from the EMU fan when in the speed control mode
  - STS-109 data review did not reveal a spike, however voltage is only sampled at 1 sample/second
- EMU DPS&BC was redesigned in 1997 to limit output voltage overshoot, preventing inadvertent energizing of an EMU shutoff solenoid valve
  - Output voltage is limited to 22vDC using a "clamp down" feature
  - Prototype unit has been tested with EMU suits
  - Implementation of new units delayed to resolve a low charge current status discrepancy found in OMRSD test

STS-109-V-07: EV1 EMU WATER LEAK	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Actions Taken:

- EMU checkout has been completed
  - No anomalies identified
- Since the DPS&BC is the most probable cause of this anomaly, the new EMU DPS&BC has been installed in OV-104 for STS-110

Risk Assessment:

- The dumping of water associated with inadvertent energizing of an EMU feedwater shutoff valve presents a water intrusion risk to equipment located in the vicinity of the leak
  - Preliminary engineering assessment indicates that the ~1 gallon that leaked during STS-109 stayed mostly contained within the TMG (thermal & micro-meteoroid garment)
    - Some escaped through the sublimator vent holes
    - Hatch was open at the time
    - Wet/dry DC vac was available for quick clean-up by the crew

STS-109-V-07: EV1 EMU WATER LEAK	Presenter: Doug White Organization/Date: Orbiter/03-26-02

Acceptable for STS-110 Flight:

- Installation of an upgraded DPS&BC eliminates the most probable cause of the STS-109 anomaly
- Replacement unit has been successfully tested per OMRSD requirements

	Presenter:
	Organization/Date: Orbiter/03-26-02

STS-104
IN-FLIGHT ANOMALIES

PREVIOUS IN-FLIGHT ANOMALIES

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

STS-104 In-Flight Anomalies, Previous Mission:

- Four Orbiter problems identified as in-flight anomalies
  - STS-104-V-01: Forward Bulkhead Floodlight Coldplate Return Line Low Temperature
  - STS-104-V-02: FES Hi-Load and Accumulator Feedline A System 1 Heater Failed Off
  - STS-104-V-03: Loss of Ku-Band Forward Link
  - STS-104-V-04: Vent Door 8 & 9 Limit Switch Anomaly

All Anomalies and Funnies Have Been Reviewed and None Constrain STS-110 Flight

	Presenter:
	Organization/Date: Orbiter/03-26-02

CRITICAL PROCESS CHANGES

STS-110 CRITICAL PROCESS CHANGE REVIEW SUMMARY

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Item Reviewed	No. of Items Reviewed	Period or Effectivity Covered	No. Found To Be Critical Process Changes
OMRSD Changes (RCNs)	23	STS-110 Specific & Non-Flight Specific Changes Approved 12/10/01 – 2/18/02	1
OMRSD Waivers & Exceptions	7	STS-110 Specific	0
IDMRD Changes (MCNs)	1	Approved 12/10/01 – 2/18/02	0
IDMRD Waivers & Exceptions	3	Approved 12/10/01 – 2/18/02	0
EDCPs	10	Closed 12/10/01 – 2/18/02	2
Boeing Specifications	43	Released 12/10/01 – 2/18/02	0
Boeing Drawings	351	Released 12/10/01 – 2/18/02	0
Material Review	197	Approved 12/10/01 – 2/18/02	0

- All process changes were reviewed and none constrain STS-110

CRITICAL PROCESS CHANGES

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

EDCPs V0500 and V0501- Vernier RCS O-Ring Material Change

- These EDCPs authorize vendor drawing update to reflect interchangeability of a sub-vendor's o-rings
- A Butyl compound originally used by sub-vendor in production of o-rings is now obsolete and has been replaced by a new compound. The new compound has similar or better thermal/physical properties and performance characteristics than the obsolete product.

CRITICAL PROCESS CHANGES

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

OMRS RCN OV15658R2 – OMS Engine Preventative Maintenance at OMDP

- This RCN establishes requirements for the removal and preparation of shipping of OMS engines for preventative maintenance at OMDP
  - OMS engine preventative maintenance is performed at (WSTF) White Sands Test Facility
- OMS engine preventative maintenance is corrective action for contamination caused by propellant permeation through bipropellant valve shaft seals
  - Preventative maintenance will also address items such as surface corrosion and loose electrical connector backshells which cannot be accessed while the engine is on the vehicle

	Presenter:
	Organization/Date: Orbiter/03-26-02

CONFIGURATION CHANGES AND CERTIFICATION STATUS

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

24 Modifications Were Incorporated During the STS-110 Processing Flow

- Five modifications are flying for the first time
  - MCR 18916 EMU DPS&BC Upgrade
  - MCR 19309 FRSI Plugs for Erosion Prevention
  - MCR 19555 Inboard Elevon Blade Seal
  - MCR 19560 NLG Thermal Barriers
  - MCR 19400 Modular Memory Unit Upgrade

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

First Flight of MCR 18916 Upgraded EMU Dual Power Supply and Battery Charger (DPS&BC):

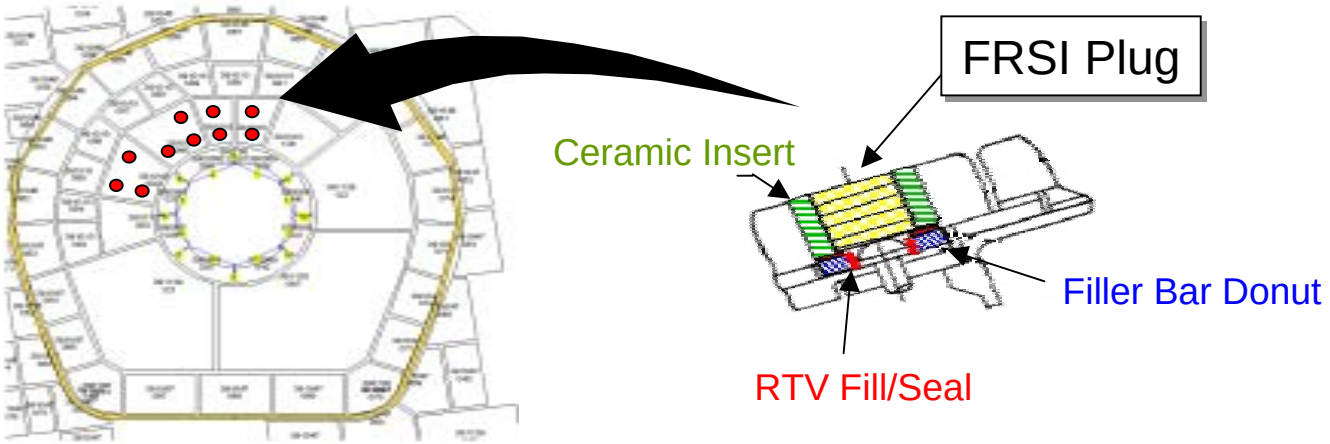
- The old EMU DPS&BC had two known design concerns:
  - Potential to produce output voltage spikes which could inadvertently energize the EMU feedwater shutoff valve and create leakage
  - Operation at an audible frequency which is bothersome to the crew
- The new design resolves the two concerns:
  - Limits voltage overshoot by means of a “clamp down” feature in the output circuit
  - Increases operating frequency to eliminate noise
- In addition, the new design utilizes modern circuit topology (a pulse width modulated power supply) and increases box output from 8.0A to 9.5A in anticipation of future EMU load growth

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

First Flight of MCR 19309 FRSI Plugs for Erosion Prevention:

- Filler Bar donuts experience felt erosion due to air flow
- Installs 10 FRSI plugs to prevent airflow from getting to the sub-insulation

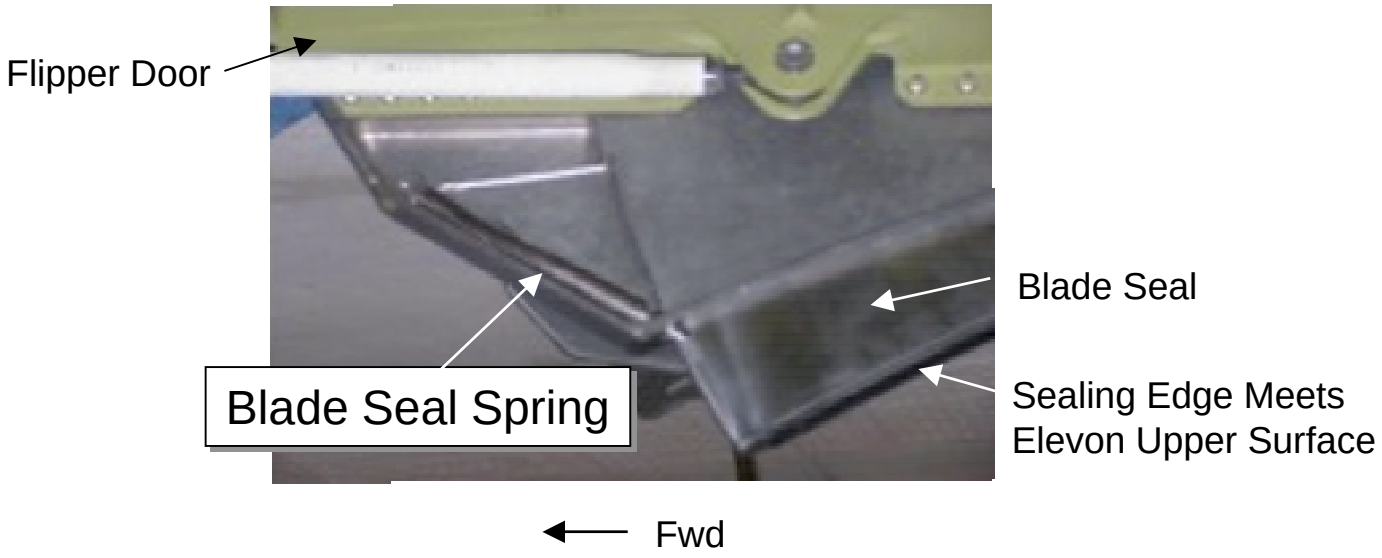


CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

First Flight of MCR 19555 Elevon Blade Seal Modification:

- The inboard elevon blade seals are not remaining seated against the elevon mating surface during the Orbiter/ET mating process
- Design change replaces the old blade seal springs with new, stiffer springs
  - Increases the spring force and allows the blade seal to reseat

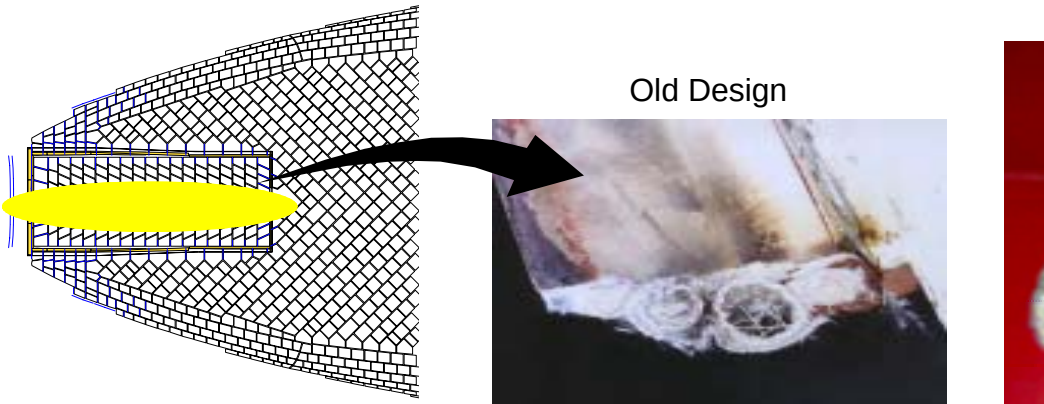


CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

First Flight of MCR 19560 Nose Landing Gear Door Thermal Barriers:

- Ends of NLGD thermal barriers have been found to have missing or compressed inner filler batting during post flight inspection
  - Exposed inner batting at the leading edge of this barrier is subjected to the air impingement upon door opening at landing
  - Improvement closes out the end of the thermal barrier with fabric to prevent the inner batting from being compressed further into the interior of the thermal barrier
  - Optimizes the length of thermal barriers for installation



Old Design

New Design

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Item:

- First flight of the new Modular Memory Unit (MMU) P/N MC409-0241-0003, S/N's 103 & 106 on OV-104

Discussion:

- New MMU is comprised of the Orbiter Solid State Recorder (SSR) and the Solid State Mass Memory Unit (SSMM)
- There are two MMU LRUs per Orbiter
- SSMMs 1 & 2 are functionally transparent replacements for old MMUs 1 & 2
- SSRs 1 & 2 perform all functions of OPS Recorders 1 & 2 and PL Recorders that are currently used

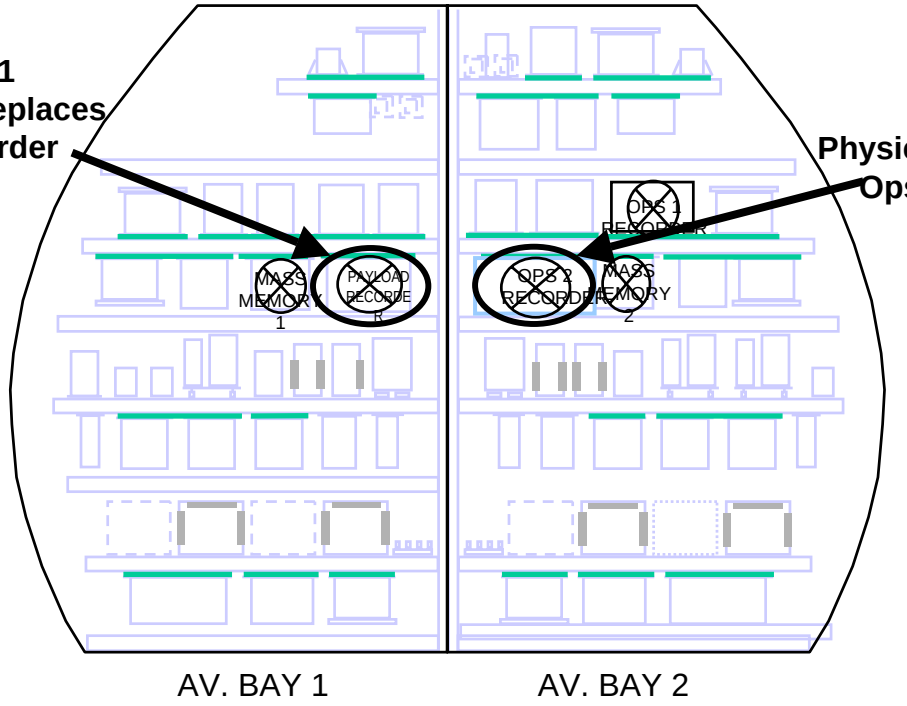
CONFIGURATION CHANGES AND CERTIFICATION STATUS

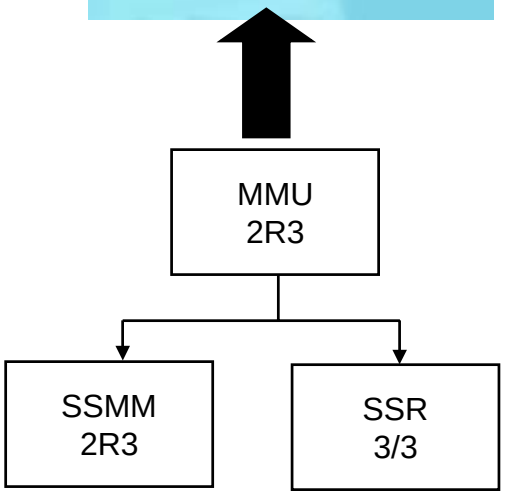
Presenter: Doug White

Organization/Date: Orbiter/03-26-02

MMU 1
Physically replaces
PL Recorder

MMU 2
Physically replaces
Ops Recorder





- SSR & SSMMU share the power supply, backplane, and chassis
- All other hardware is physically separate

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Discussion: (cont)

- Benefits of the new MMU
  - Replaced outdated, unreliable electromechanical tape recorders with flash memory storage
  - Provided open architecture, which allows for growth
  - Reduced LRU count from five to two LRUs
  - Achieved vehicle weight reduction of 165 lbs in the forward
  - Reduced avionics power consumption by 316 watts
  - Provided Simo mode and 2048 bps playback capability

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Actions Taken: (cont)

- All qualification testing was completed in May 2001
  - Three anomalies still under investigation which do not affect STS-110 installed MMUs
- MMU is certified for orbiter flight use in accordance with orbiter requirements for avionics hardware
- OMRS/LCC changes have been approved and FMEA update is complete

Acceptable For STS-110 Flight:

- New MMUs have met all test requirements and provide significant enhancements to the program

	Presenter:
	Organization/Date: Orbiter/03-26-02

STATUS OF INVESTIGATION OF DSC TRANSISTOR FAILURES

INVESTIGATION OF DSC TRANSISTOR FAILURES

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Observation:

- TT&E of a Dedicated Signal Conditioner (DSC) which had failed during the STS-92 mission (Oct. '00) found two defective Raytheon transistors (P/N JANTXV2N3019, Lot Date Code (LDC) 7525)

Concern:

- These transistor failures may be indicative of a problem specific to the 7525 LDC
- Due to their extensive usage throughout the vehicle, these failures could have a significant impact on the fleet if determined to be lot related

Discussion:

- Failure analysis concluded that the DSC transistors failed "open" due to lifted internal bond wires caused by the formation of an intermetallic compound

INVESTIGATION OF DSC TRANSISTOR FAILURES

Presenter: Doug White

Organization/Date: Orbiter/03-26-02

Risk Assessment:

- Failure history and test data show that LDC 7525 has a higher than expected rate of failure due to non-human chlorine contamination
- Failure impact is minimized by subsystem redundancy
- CM has identified all OV-104 LRUs that utilize the suspect 7525 LDC transistors
- SSMs have identified criticality of all circuits and measurements containing 2N3019 LDC 7525 transistors or those with unknown LDCs
  - There are none with criticalities higher than 1R3
  - Twenty (20) measurements are 1 of 2 in the LCC
    - Failure of any one of these and the redundant measurement would cause a launch scrub
    - There are no instances wherein both the primary and secondary measurements are processed by DSCs utilizing 7525 LDC transistors

	Presenter:
	Organization/Date: Orbiter/03-26-02

SPECIAL TOPICS

SPECIAL TOPICS FOR THE STS-110 FLIGHT READINESS REVIEW	Presenter:
	Organization/Date: Orbiter/03-26-02

Topics

AMEC Output Drivers Failure Indication

Connector Saver Concern

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Observation:

- During OV-104 MEC power-up, AMEC S/N U6F0003 provided erroneous Pre-Flight BITE (PFB) indications on four core A Non-Critical (NCR) output drivers
  - Word 10 bit 19 “1” should be “0” – LSRB B/U PWR
  - Word 10 bit 20 “1” should be “0” – RSRB B/U PWR
  - Word 10 bit 21 “1” should be “0” – ATVC 2/1 IVD PWR
  - Word 10 bit 22 “1” should be “0” – ATVC 4/3 IVD PWR

Concern:

- Potential for uncommanded outputs from AMEC

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Discussion:

- The function of the AMEC is to provide for the transfer and signal conditioning of control and measurement data between the GPCs and Orbiter, ET and SRB pyrotechnics and control devices
- PFB provides comprehensive operational status of the AMEC internal logic on each core
- AMEC S/N 3 has successfully completed 2 flights and has operated nominally at SAIL for 564 additional hours
  - Experienced 2 unrelated ATP failures prior to initial delivery

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

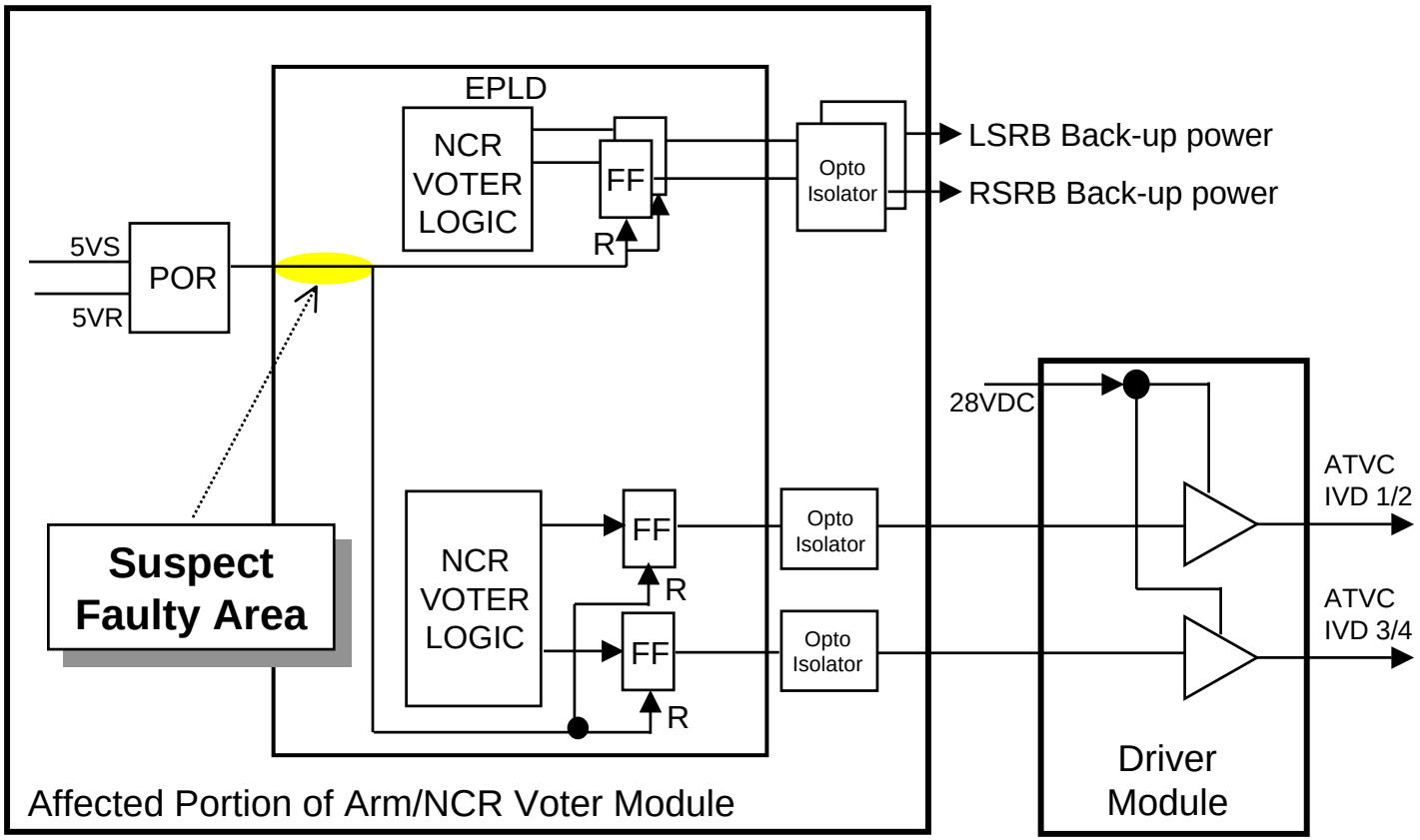
Actions Taken:

- In-vehicle TT&E testing at KSC confirmed the that:
  - Experienced failure is isolated to the core A Arm/NCR Voter module in the AMEC S/N 3
  - All internal core A and core B voltages were within design specification
  - Capability to execute (turn on or off) all MEC functions on both cores remain unaffected by the anomaly
  - Subsequent LRU Power cycles did not repeat the anomaly
- Engineering analysis indicates the anomaly is most likely within the Power-On Reset (POR) logic circuit located on core A Arm/NCR voter module
  - NCR output registers (flip-flops) can initialize to any state, so a reset pulse is issued at power-up
  - POR logic did not generate the reset pulse as required to initialize the registers to the correct state
  - Failure is not in the output registers since it would have required four independent failures

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Simplified Diagram of the POR Logic for Erroneous Outputs



ONLY ONE CORE SHOWN

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Actions Taken: (cont)

- Three separate POR logic circuits exist in each AMEC core
- Design analysis was performed for potential failure of the POR logic circuit for any critical or non-critical driver output from the AMEC
  - Visible when the AMEC is powered-up at T-27 hours
  - No inadvertent PIC firing possible
  - No result which reduces safety of flight
- Review of AMEC failure history indicates that this is the second occurrence of this type of anomaly
  - First anomaly isolated to EPLD in AMEC S/N 6
- AMEC S/N 3 will be replaced with MEC S/N 10
  - MEC S/N 10 will complete OMRS testing prior to flight

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Consequences of Power-on Reset Anomaly

Critical Functions	PIC	SRB Range Safety Safe	ATVC Deadface
	▪ Downstream Fire 2 and Fire 3 interlock logic prevents single failure from causing inadvertent PIC firing	▪ Two independent failures in two separate MECs required	▪ Results in loss of excitation voltage to the pressure transducer for an individual ATVC channel ▪ Loss of capability to detect independent ATVC channel failures ▪ If same channel has another independent failure, 3 on 1 force fight will result ▪ Condition is certified

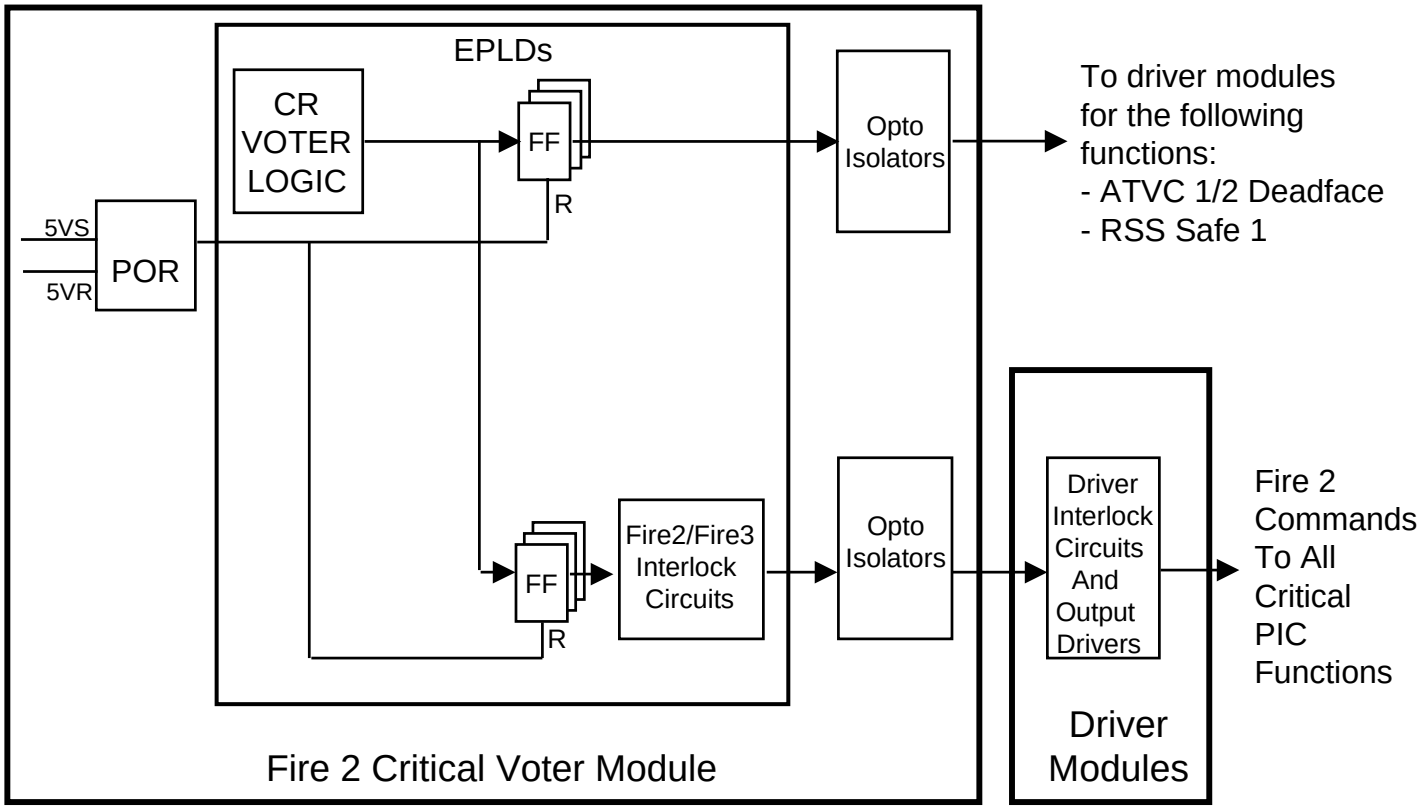
Non-Critical Functions	SRB Power On	SRB B/U Power 1 & 2	Fire 3	SRB Range Safety Power Off	ATVC IVD 1/2 & 3/4	ET DFI
	▪ Timing/reset logic precludes inadvertent reset	▪ Early enable of SRB B/U power (in event of loss of main bus power) ▪ Normally commanded on at SRB power up T-9 hours	▪ Automatically resets after 18ms	▪ Early disable of range safety	▪ Early power on for a function which will be commanded on later	▪ Not used

All POR BITE indications are visible during MEC power-up at T-27 hours

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Simplified Diagram of the POR Logic for Critical Functions

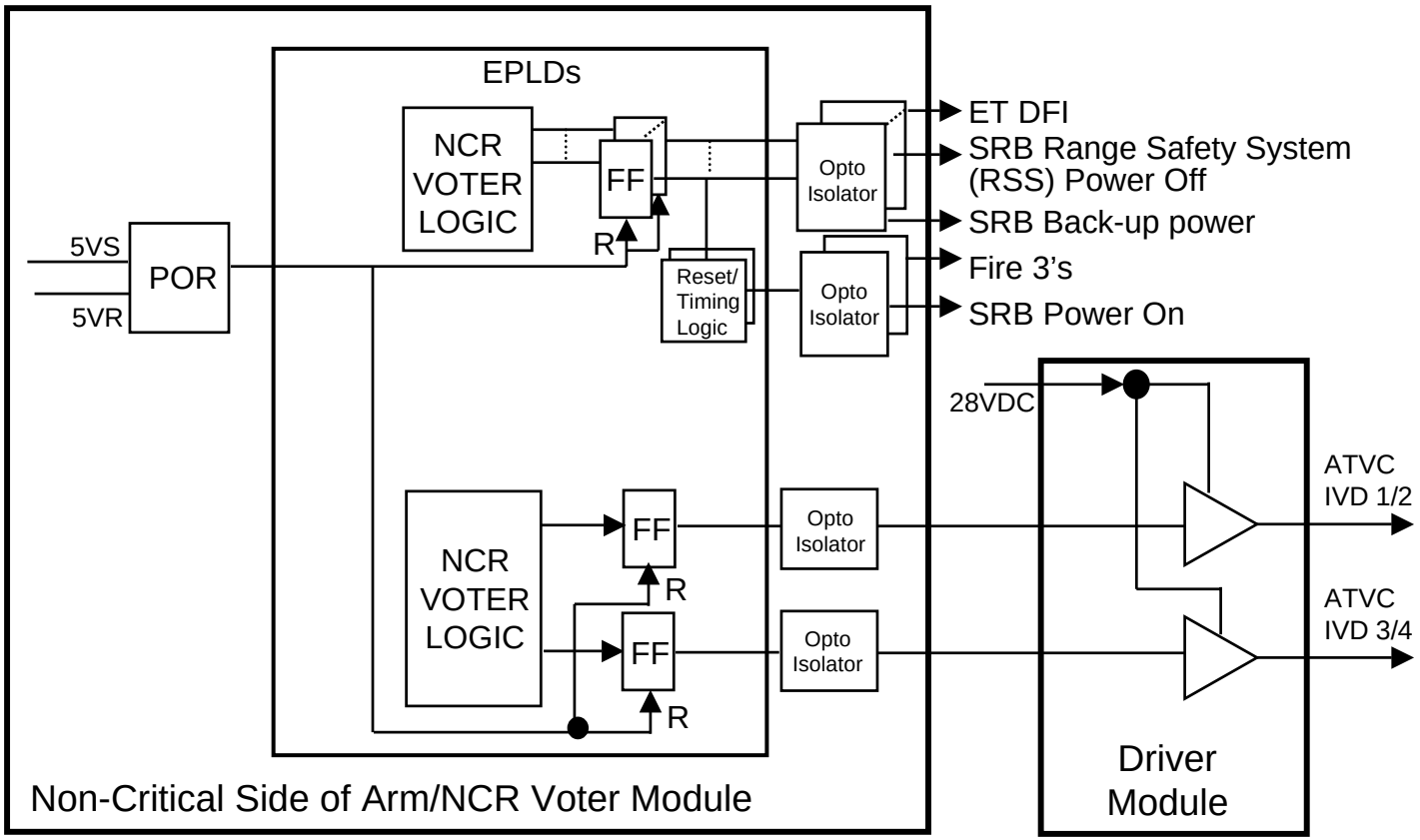


ONLY ONE CORE SHOWN

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Simplified Diagram of the POR Logic for Non-Critical Functions



ONLY ONE CORE SHOWN

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter: Doug White
Organization/Date: Orbiter/03-26-02

Risk Assessment:

- If a POR logic circuit failure occurs, it will be visible through BITE indications upon power-up (~T-27 hours)
  - Ample time to evaluate
- From AMEC power-on until the AMEC LCC becomes active at T-6 hours, various pre-flight BITE commands are transmitted to the AMEC
  - Any BITE failure indications would be evaluated
- AMEC LCC Pre-Flight BITE failure indications require hold for evaluation
  - Some preflight BITE failures allow contingency procedures to be performed
  - Other conditions require case-specific assessments
  - A preflight BITE failure affecting critical AMEC functions would result in a launch scrub

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Risk Assessment: (cont)

- During ascent, Orbiter system and AMEC sub-system architecture provide various levels of redundancy
  - LRU redundancy
  - Core redundancy within each LRU
  - AMEC design precludes failure propagation between cores
  - System design and redundancy prevents adverse effects from any POR circuit failure during ascent
- Design logic implemented on each core to preclude any “premature” or “inadvertent” AMEC critical PIC function execution (1R3)

OV-104 AMEC OUTPUT DRIVERS FAILURE INDICATION

Presenter:
Doug White
Organization/Date:
Orbiter/03-26-02

Acceptable for STS-110 Flight:

- Failure of the POR logic circuit for any AMEC driver output would not result in inadvertent PIC firing or any other event which reduces safety of flight
- The failure can only occur upon AMEC power-on and is immediately detectable
  - The failure can be evaluated and action taken prior to launch
- Failed AMEC S/N 3 is to be replaced with MEC S/N 10
  - MEC S/N 10 will have passed all OMRS testing
  - MEC S/N 10 successfully completed 7 flights
- The OV-104 AMEC (S/N 2 in slot 2) successfully completed over 960 hours of burn-in testing at SAIL, OMRS testing and in-vehicle check-out
  - AMEC S/N 2 has successfully flown three missions on OV-104 (first mission 9/00 STS-106)

CONNECTOR SAVER CONCERN

Presenter:
Doug White

Organization/Date:
Orbiter/03-26-02

Observation:

- Locking feature on the new Monoball Production Break connector savers can become disengaged during the harness connector mate process
  - The locking feature on 4 of the connector savers became disengaged after applying an axial load to the connector saver

Concern:

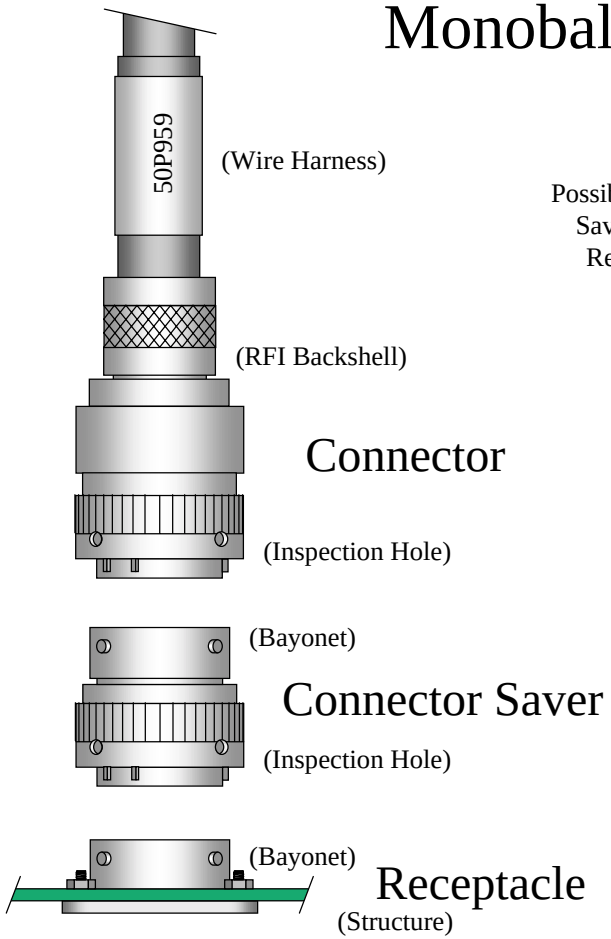
- Launch vibration could theoretically cause rotation of connector saver coupling ring, vibration and dynamic forces could then cause inadvertent demate of connector saver/Monoball harness

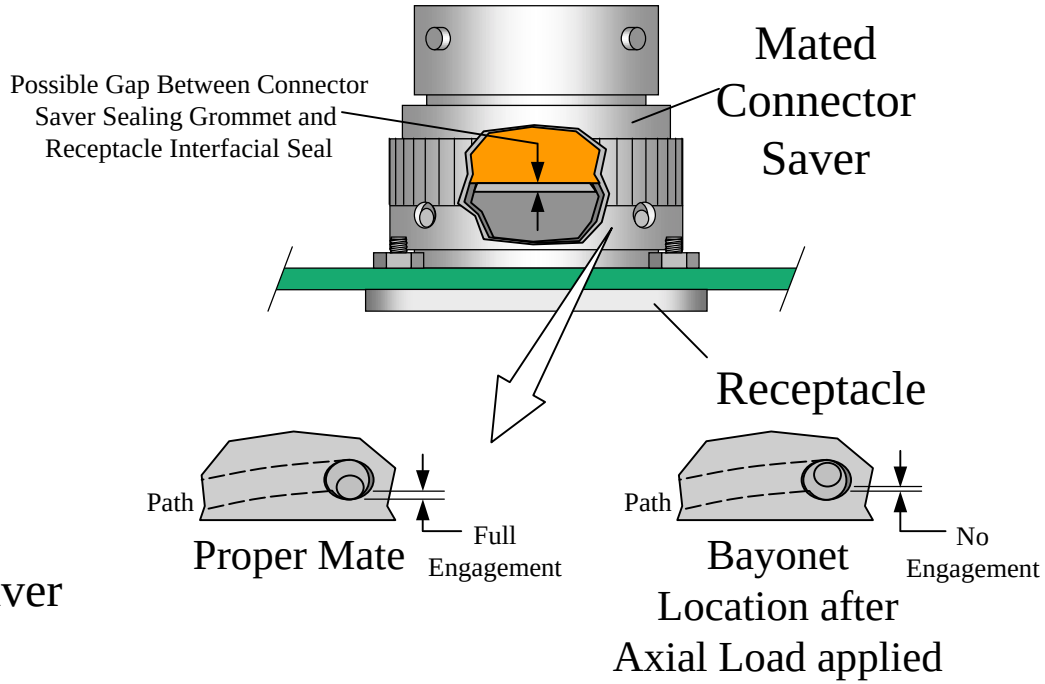
CONNECTOR SAVER CONCERN

Presenter:
Doug White

Organization/Date:
Orbiter/03-26-02

Monoball Harness Connector Saver 50P959





CONNECTOR SAVER CONCERN	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Discussion:

- Connector savers employed in other applications on the vehicle
  - T-0 interface
  - OMS pod interface
  - Ku-Band EA-1 (Bay 3A, Shelf 1)
  - D&C panel (O5)
  - Coax cable (Inst. & Payload data, Aft Fuselage)
  - ODS Upper Bulkhead Interface Connector
  - ODS Payload Wire Tray Interface
  - 1307 Bulkhead Connector (J1404)
- The suspect connector savers (manufactured by Glenair) are used to protect the receptacles on interface panels from excessive wear during Orbiter processing

CONNECTOR SAVER CONCERN	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Discussion: (cont)

- Although these connector savers are installed by design, they could be removed for flight without affecting form, fit or function of the harnesses
- All 15 connector savers installed on the Monoball production breaks were inspected by Engineering on OV-104
  - The locking feature on 4 of the connector savers became disengaged after applying an axial load to the connector saver
  - The locking feature on 2 of the connector savers became loose, reducing the force required to demate the connector saver, after applying an axial load to the connector saver
  - The locking feature on the remaining 9 connector savers remained engaged after applying an axial load to the connector saver

CONNECTOR SAVER CONCERN	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Discussion: (cont)

- OV-103's left hand OMS Pod interface connector savers were inspected
  - Similar to the monoball, 1 became disengaged and 3 of the connector savers became loose
- OV-105's monoball connectors were inspected
  - The same 4 connector savers became disengaged as on OV-104

CONNECTOR SAVER CONCERN	Presenter: Doug White
	Organization/Date: Orbiter/03-26-02

Actions Planned:

- Complete failure history search
- Route suspect hardware to vendor for analysis
  - OV-104 monoball
  - OV-103 OMS pods
- Develop fault tree/root cause logic diagram
- Evaluate criticality of LRUs which use connector savers
- Develop rationale for flight
  - Although these connector savers are installed by design, they could be removed for flight without affecting form, fit or function of the harnesses

CONNECTOR SAVER CONCERN

Presenter:
Doug White

Organization/Date:
Orbiter/03-26-02

This issue is presently considered a constraint to flight for STS-110

- Determine acceptability for flight of each connector saver application
  - Each installed connector saver will either be cleared for flight or removed from the vehicle
- Technical community is meeting daily to develop flight rationale

DTV Configuration 1
System Description

General System Characteristics and Advantages

- Satisfies intent of NASA HQ direction to begin conversion to new US DTV Standards
- Provides for digital recording and downlink of crew cabin video and all CCTV video sources (including CCTV vertical interval telemetry and audio).
- Functionally replaces existing analog camcorders and VTR with improved video quality and editing capabilities.
- Provides simultaneous multiplexed multiple channel access to the Payload Max high data rate downlink, including future HDTV and current OCA.
- AFD equipment mounting for enhanced operability.
- Operation of CCTV system as used today is not precluded.

DTV Configuration 1 System Description

DTV Configuration 1
Flight Side Components

	Presenter: Patti Thornton
	Organization/Date: Flight Software/03-26-02

SOFTWARE

STS-110 SOFTWARE SUMMARY

Presenter:
Patti Thornton
Organization/Date:
Flight Software/03-26-02

First Flight of OI-29 Software

- OI-29 includes capabilities for increased manifest flexibility, support for continuing ISS assembly missions and other enhancements for ground and flight operations and safety
- Two sets of I-Load patches for STS-110
- Two new data patches for STS-110
- One new code patch for STS-110

First Flight of MEDS IDP/MDUF VI 3.0/4.0 Software

- Includes updates for improved crew situational awareness and flight support

Third Flight of GPS Link 167-1133-002 Firmware

- No changes for STS-110

MAJOR NEW CAPABILITIES PASS, BFS and MEDS

Presenter: Patti Thornton
Organization/Date: Flight Software/03-26-02

On-Board Calculation of Navigation Parameters

- Provides a new simplified algorithm to compute the RNP matrix on-board
- Eliminates the I-Load definition and patches currently required for many launch date moves

Expanded Day-of-Launch I-Load Uplink Capability

- Expands existing capabilities to uplink mission configurable I-Loads pre-launch as part of the Day-of-Launch uplink process
  - Supports “Just In Time Flight Design” SSP Reinvention initiative

Operational Enhancements for GPS

- Provides several enhancements to the GPS system to increase system performance and decrease crew work load

MAJOR NEW CAPABILITIES PASS, BFS and MEDS

Presenter: Patti Thornton
Organization/Date: Flight Software/03-26-02

Automated Alpha/Beta Maneuver to Improve TAL Safety

- Adds a mated coast maneuver & automates a Post-ET SEP manual crew procedure for TAL requiring the management of angle of attack (Alpha) and side slip angle (Beta)

Enhancements to Automatic Reboost Capability

- Upgrades the Automatic Reboost capability, added on OI-28, to increase operational flexibility and improve performance

Maintain Target Track Attitude During Rendezvous Burns

- Allows rendezvous burns to be executed while automatically maintaining target track attitude, simplifying crew procedures and conserving propellant

Eliminate 2 SPEC Limit in PASS

- Enables the user to run up to three active SPECs per Major Function, simplifying crew procedures

MAJOR NEW CAPABILITIES PASS, BFS and MEDS

Presenter: Patti Thornton
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Changed On-Orbit Digital Autopilot Drift Channel Constants to I-Loads

- Allows tailoring of Drift Channel width to optimize stability margins for ISS missions

Addition of Cargo PC Support via GPC Command Filter

- Provides the reconfigurable capability for commanding and monitoring payloads from PGSCs attached to the GPC via a serial interface
  - Provides for all hazardous commanding and backup capability for GPC issuance of time-critical mission success commands
- System not yet certified - not currently manifested for OI-29

Allow RMS ID Selection During Ground Checkout Operations (Dial-An-Arm)

- Eliminates the need for code changes/patches when RMS biases change due to hardware change-out

MAJOR NEW CAPABILITIES PASS, BFS and MEDS

Presenter: Patti Thornton
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Expanded TDRS Satellite Tracking Capability

- Increases number of TDRS satellites managed by the FSW from four to six

Automatic Switch of EIU Downlink Source

- Ensures continued insight into engine health in the presence of primary channel failures

Addition of a GPC-to-MEDS Data Transfer

- Provides for addition and customization of MEDS display formats based on data sent to MEDS by PASS and BFS
  - Allowed for changes to unit labels on MEDS HSI digital readout to match units sent by GPCs in various software major modes
- Provides a MEDS Edgekey command interface via the Launch Data Bus allowing ground call-up of MEDS displays
  - Simplifies orbiter ground processing and MEDS system check-out

MAJOR NEW CAPABILITIES PASS, BFS and MEDS

Presenter: Patti Thornton
Organization/Date: Flight Software/03-26-02

Enhanced MEDS Displays

- Rearranges altitude data on ADI/AVVI and Composite Displays for easier readability
- Adds 5 degree tick mark and changes color/position of data on the HSI display for easier visibility/use

MEDS Error Filtering and BITE Error Downlist

- Adds filtering of specific IDP Operational Self Test errors to preclude flooding of the downlist and IDP error logs
- Adds detailed MEDS BITE error data to downlisted status words
  - Provides real-time error information previously not available until post-flight error log dump analysis

STS-110 I-LOAD PATCHES

Presenter:
Patti Thornton
Organization/Date:
Flight Software/03-26-02

Two Sets of I-Load Patches were Approved for STS-110

- Supports Program approved changes since Base I-Loads were defined
  - Mass property and OMS load updates, addition of OMS assist, MPS LH2 manifold over-pressure mitigation and definition of SSRMS operations to support S0 truss installation
  - Additional ISS/Orbiter mass properties changes associated with Soyuz docked node change
- All patches were generated using standard automated processes and released to the field for use in crew training and SAIL verification
- All patches have been authorized for flight by the PRCB

STS-110 DATA PATCHES

Presenter:
Patti Thornton
Organization/Date:
Flight Software/03-26-02

Two Non I-Load Data Patches were Approved for STS-110

- Data-only patches preclude KSC and crew impacts due to discrepancies introduced on OI-29
  - Provides for KSC's continued ability to inhibit normal GPC hardware output commanding during Ground Check-Out (GCO) mode payload processing
  - Corrects an on-orbit flight control display anomaly to preclude the need for crew workarounds to avoid confusion
- Patches were developed and verified using full standard processes and released to the field for use in crew training and SAIL verification
  - Applicable patch was also installed at KSC for use in all GCO mode processing
- Patches have been authorized for flight by the PRCB
- Process improvements to preclude introduction of similar problems in the future have been identified and are in work

STS-110 CODE PATCH

Presenter:
Patti Thornton
Organization/Date:
Flight Software/03-26-02

One Code Patch was Approved for STS-110

- Latent issue identified prior to STS-109 and waived for flight
  - Additional exposure exists on OI-29 due to new capabilities
- Patch precludes any downstream effects if a Fail-to-Sync occurs in a specific timing line-up with active I/O
  - Ensures any inconsistent input data is marked in error prior to use by applications code
  - Eliminates exposure to an additional sync failure during critical flight phases
- Patch was developed and verified using full standard processes and released to the field for use in crew training and SAIL verification
- Patch has been authorized for flight by the PRCB

SOFTWARE READINESS

Presenter:
Patti Thornton
Organization/Date:
Flight Software/03-26-02

SAIL Integrated Avionics Verification

- A total of 130 OI-29/STS-110 Base Cycle SAIL test cases were performed and analyzed
- 15 test cases were performed and analyzed for STS-110 patches

Software Readiness Review (SRR) Conducted 03/07/02

- No open exceptions

With the Completion of Standard Open Work, Flight Software Is Ready to Fly

	Presenter:
	Organization/Date: Orbiter/03-26-02

FLIGHT READINESS STATEMENT

PENDING RESOLUTION OF THE CONNECTOR SAVER CONCERN, SSVEO IS READY TO FLY STS-110

ORBITER
FLIGHT SOFTWARE
FLIGHT CREW
EQUIPMENT

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Shuttle Engineering Office

D. E. Stamper, TMR
Software

F. A. Ouellette, Manager
Flight Crew Equipment Management Office

P. A. Petete, Acting TMR
Orbiter and Flight Crew Equipment

ORBITER/FLIGHT SOFTWARE

/s/ B. I. Bejmuk
B. I. Bejmuk, Program Director, Orbiter
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J. Wilder, Associate Program Manager
Orbiter Element
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FLIGHT CREW EQUIPMENT

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Advanced Robotics Limited

/s/ R. Allison
R. Allison, RMS Project Manager

SVS

/s/ L. Beach
L. Beach, Program Manager, SVS
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D. S. Moyer, SVS Integration Office

FERRY FLIGHT PLANNING

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