INTERNATIONAL SPACE STATION PROGRAM

9A/STS-112 Flight Readiness Review

September 17, 2002

Agenda

- ✓ **Mission Overview** — **Ron Torcivia**
- ✓ **On-Orbit Vehicle Status** — **Anthony Sang**
- ✓ **<u>Special Topics</u>:**
  - ✓ **Treadmill with Vibration Isolation System (TVIS)** — **George Parma**
  - ✓ **Ammonia QD Hydraulic Lock-up/ Spool Positioning Devices (SPDs)** — **Tim Bond**
  - ✓ **CMG Operations** — **Thomas Russell**
  - ✓ **Wrist Roll Joint Anomaly Resolution** — **William Mackey (CSA)**
- ✓ **9A Flight Summary** — **Ron Torcivia**

9A Mission Overview

9A Flight Readiness Review
(FRR)
September 17, 2002

Mission Summary

Mission Duration: 11+1+2

Crew Size: 6 on Orbiter
3 on ISS

EVAs: 38.5 man-hours (Orbiter crew EVAs)

EVA 1: 6:15

EVA 2: 6:30

EVA 3: 6:30

Crew

- **CDR – Jeff Ashby**
- **PLT – Pam Melroy**
- **MS1 – David Wolf (EV1)**
- **MS2 – Sandra Magnus**
- **MS3 – Piers Sellers (EV2)**
- **MS4 – Fyodor Yurchikhin**

Rendezvous Altitude: 210 nmi.

Station Attitude:

Initial Flight:	**+XVV, Z Nadir**
Rendezvous:	**+XVV, Z Nadir**
Mated:	**XVV, Z Nadir TEA (Roll Bias)**
Departure:	**XVV, Z Nadir**

DTOs

- **264 Validation of SSRMS Dynamic Attitude Control System**
- **13005-U ISS Structural Life Validation and Extension (SSRMS Operations, S1 Installation, Reboost, Undock)**
- **15003-U Microgravity Environment Definition (TRRJ rotation)**

ISSP 9A Program Reviews

Launch Package Assessments (LPA), July 2 2002

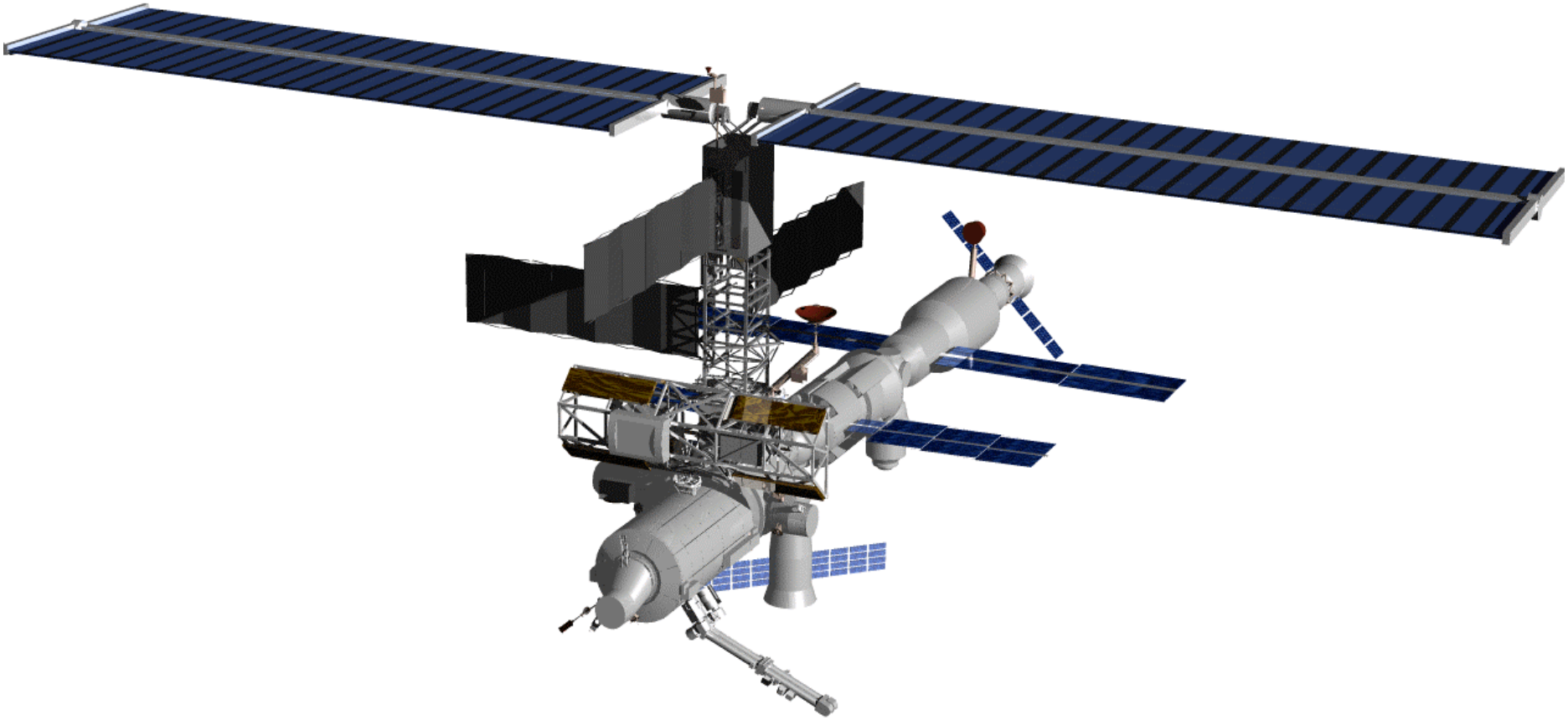
Addressed the launch package readiness for integration into the Orbiter.

- Successfully completed and authorized to proceed with payload processing

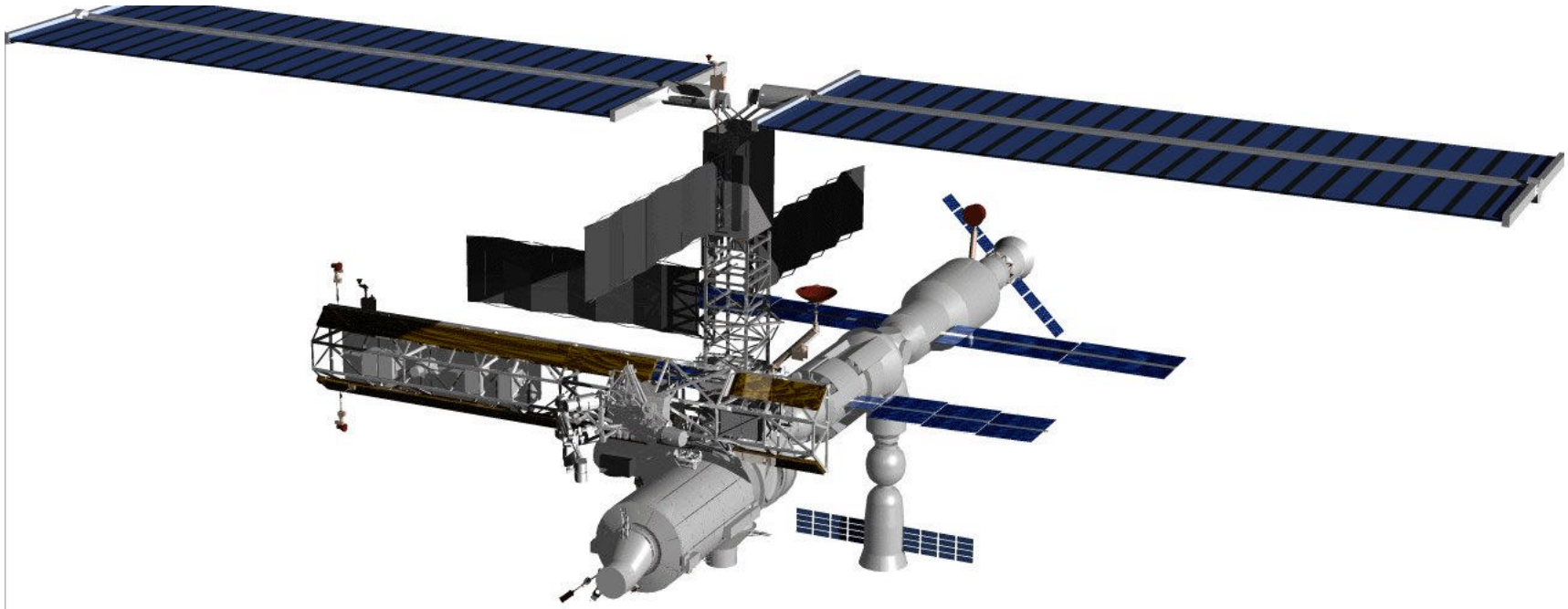
Stage Operations Readiness Review, August 29, 2002

- Addressed CoFR requirements for cargo elements, middeck stowed hardware, launch package, personnel, facilities, and operations and their readiness to proceed to launch 9A on 10/2/02.
- Authorized to proceed to launch 9A with 1 exception:
  - Pistol Grip Tool Torque Specification
    - ECD – 9/26/02

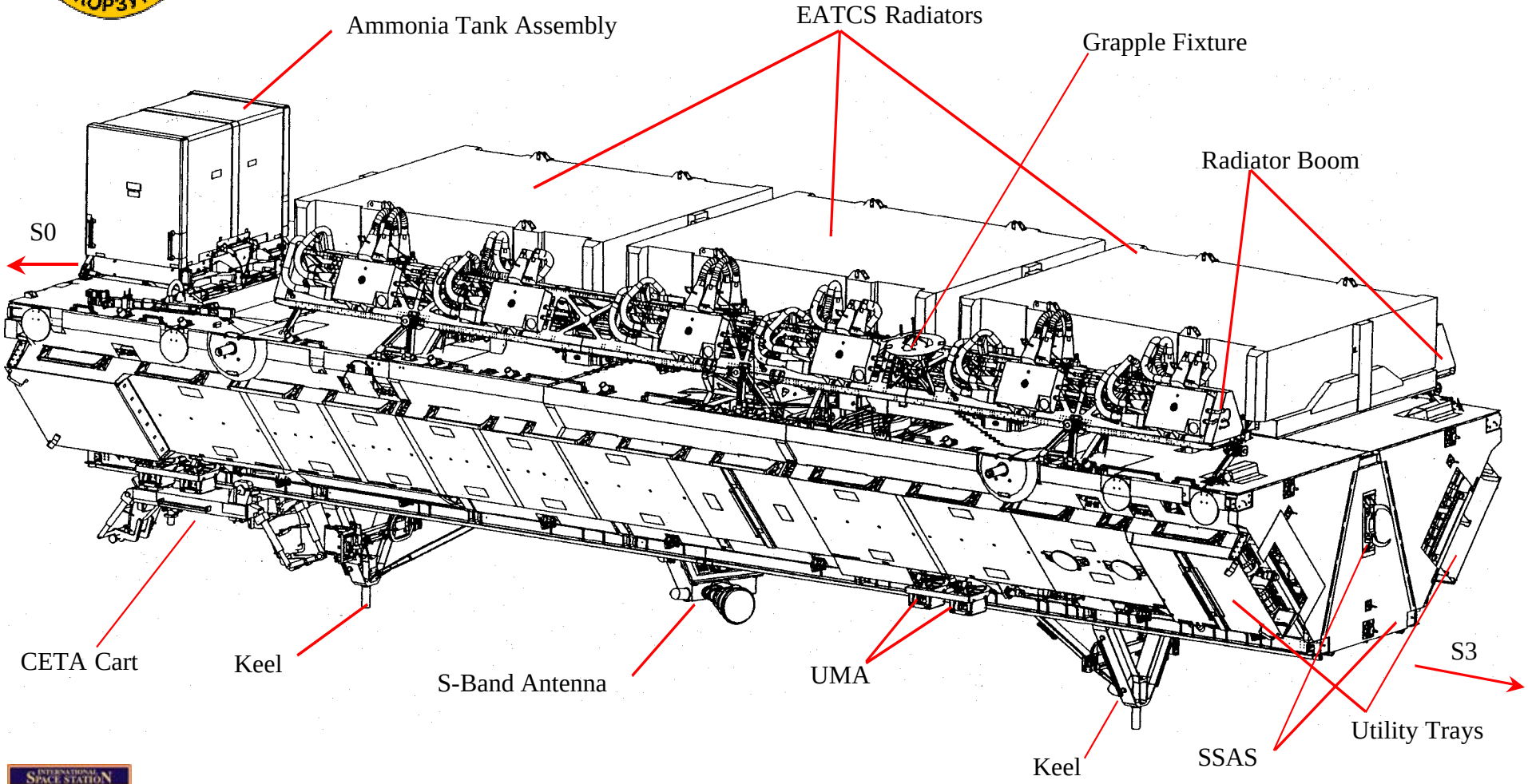
Flight 9A Upon Arrival



9A Post Undocking



S1 Integrated Truss



9A Significant Hardware

- **Electrical**
  - **DDCU-E (1)**
  - **SPDA (2)**
  - **MDM (3)**
- **Mechanical**
  - **Passive SSAS (1)**
  - **Active SSAS including two Bolt Bus Controllers (1)**
- **Mobile Transporter**
  - **CETA Cart (1)**
- **Thermal**
  - **TRRJ (1)**
  - **RJMC (2)**
  - **ATA (1)**
  - **NTA (1)**
  - **Pump Module Assembly (1)**
  - **Radiator Assembly (3 panels)**
- **Communication**
  - **S Band System including SASA, TDRSS Transponder, BSP (1)**
- **Miscellaneous**
  - **Accelerometers (4)**
  - **Video Camera Stanchions (2)**

9A Mission Priorities Overview

- IDRD, MIP and Flight Rules are in agreement
- Priorities
  - –Rendezvous and dock
  - –Berth S1 and connect umbilicals to achieve “Safe” configuration
  - –Deploy SASA and activate heaters to achieve “Safe” configuration
  - –Transfer critical equipment
  - –TVIS chassis R&R

Primary Mission Objectives achieved

  - –Perform mandatory daily maintenance for powered Middeck and Lab payloads
  - –Perform remaining transfers
  - –Install critical Spool Positioning Devices
  - –Complete remaining S1 umbilical connections
  - –Perform TRRJ checkout
  - –Deploy S1 central radiator
  - –Disconnect Squib Firing Units to redundant radiator beam line heaters
  - –IUA R&R

Secondary Mission Objectives achieved, STS can depart with no or minimal impact to future assembly missions

  - –Connect S0 / S1 fluid jumpers
  - –Connect ATA / NTA lines
  - –Install second set of Spool Positioning Devices

9A Mission Priorities

- **Priorities (cont.)**
  - Configure inboard section of MT translation path
  - Release CETA Cart
  - Install 2 ETVCGs
  - Complete additional ISS consumables transfer
  - Configure outboard section of MT translation path
  - Release S1 / S3 line clamps
  - Remove Fluid Hose Rotary Coupler launch restraint bolts
  - Open Radiator Beam Valve Module MLI flaps
  - Install ZCG Utilization Rack Ground Straps
  - Perform ZCG activation
  - CCAA Water Separator R&R
  - Perform TVIS SLD R&R
  - Perform Defibrillator checkout
  - Complete S1 activation and checkout

  - Reboost
  - Imagery survey during fly around
  - Install third group of Spool Positioning Devices
  - CBM Seal Wipe-down
  - Perform Respiratory Support Rack Check-out
  - EVARM
  - DSOs, DTOs, SDTOs

ISS 9A Consumables Status

- ✓ **ISS N2 Supply remains above redline with margin even if transfer does not take place**

- ✓ **Should STS O2 be available during the flight, an O2 transfer will replenish the ISS O2 Tanks to just under full (full = 440 lbm, 2400 psia)**
  - ✓ O2 Tanks will have sufficient quantities should transfer not take place

- ✓ **LiOH plan covers dual-bed or single-bed CDRA configurations**
  - ✓ Dual-bed and Single-bed CDRA configurations do not require use of ISS Stockpile reserve
  - ✓ Assumes protection for EOM+3
  - ✓ Should CDRA completely fail prior to 9A launch, LiOH requirement will be supported by combination of STS manifest (31) plus ISS Stockpile reserve (14)
  - ✓ Downstream effect on 11A is supportable, independent of CDRA functionality on 9A

- ✓ **All Water requirements have been met**

Launch Commit Criteria

- **MER has verified that all Launch Commit Criteria are GO**

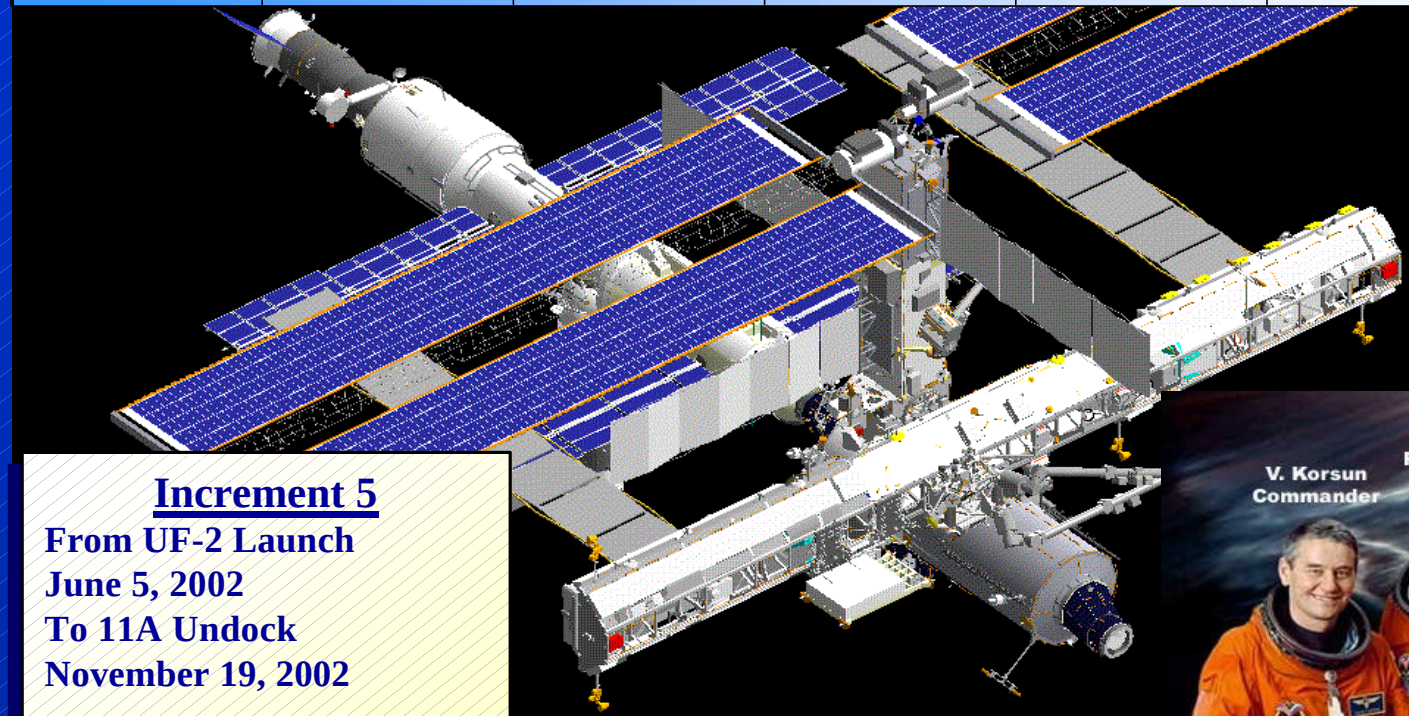
- **Launch Day Scrub Turnaround**
  - **CBOSS Cryo-dewars**
    - **> 24 hrs**
    - **> LN2 limitations**

INCREMENT 5

June	July	August	September	October	November	December

05 JUN — 19 NOV

05 JUN	26 JUN	16 AUG	26 AUG	25 SEP	02 OCT	28 OCT	10 NOV
UF-2 (MPLM)	8P			9P	9A (S1)	5S (Taxi)	11A (P1)



Increment 5

From UF-2 Launch
June 5, 2002
To 11A Undock
November 19, 2002

Duration – 176 Days
On-board ISS – 174 Days

Denotes EVA

Increment 5 Accomplishments

Accomplishments during Expedition 5 include:

- Use of the Space Station Remote Manipulator System (SSRMS) Canadarm 2 to install the Mobile Remote Servicer (MRS) Base System (MBS) onto the Mobile Transporter (MT).
- Walkover of the SSRMS Canadarm 2 from the Lab to the MBS and successful change to new base Latching End Effector (LEE)
- 7 Progress undocking, 8 Progress docking, Kurs antenna test
- Successful software upgrade for the External R2 Multiplexer/ Demultiplexer and successful uplink and checkout of the SSRMS software patch for Flight 9A

- **During Expedition 5, additional hardware installations onboard include:**
  - EVA #7 and #8 from Russian Docking Compartment (DC) to install six Service Module Debris Panels (SMDPs); 4 fairleads; the last 2 Ham antennae; orbital replacement unit (ORU) platform on the Functional Cargo Block (FGB)
  - Successful Removal and Replacement (R&R) of SSRMS Wrist Roll Joint
  - R&R of Carbon Dioxide Removal Assembly (CDRA) filter kit and sorbent bed (R&R complete, activation and troubleshooting in work)
  - R&R of two Remote Power Control Modules (RPCMs)
  - Installation of six FGB Zone Stowage Enclosures
  - R&R of three Utility Outlet Panels (UOPs) – completes the planned UOP changeouts
  - Installation of the P6 Power and Data Grapple Fixture (PDGF)
  - R&R of the Major Constituent Analyzer Assembly (MCA)

Remaining Increment 5 Overview

Remaining Stage UF-2 Objectives

•Prepare for 9A arrival
•Perform remaining 8 Progress-M cargo transfer
•Undock 8Progress and Dock 9 Progress-M1
•Perform remaining mandatory science and utilization

Stage 9A Data

9A Undock Date:
11 October, 2002

Flight 11A Dock Date:
12 November, 2002

9A Stage Duration:
32 days

Stage Objectives

•Prepare for 11A arrival
  –Checkout S0 to P1 SSAS capture latch.
  –Checkout S0 to P1 bus bolt controllers, Motorized Bolt Assembly (MBA), and Ready to Latch (RTL) sensors.
  –Prelaunch SSRMS checkout prior to 11A launch (max of 4 hours each for 2 crewmembers).
  –Relocate SSRMS to PDGF 3 on MBS at S0-4 to support 11A assembly operations.
  –Perform one P1 robotics dry run
  –Perform SAFER checkout and EMU reconfiguration
  –Prepack for Expedition 5 crew return
•Dock 5Soyuz and Soyuz crew to perform mission objectives
•Undock 4Soyuz
•Perform remaining 9 Progress-M1 cargo transfer
•Perform mandatory science and utilization

Payload Status

- **Active US Science Facilities**
  - EXPRESS #1, EXPRESS #2, EXPRESS #4, HRF Rack (as scheduled), MSG Rack (as scheduled), ARCTIC 1, ARCTIC 2
- **Completed UF2 Stage US Payload Investigations**
  - Code M: EPO-5
  - SPD: STELSYS, ZCG, MEPS
  - MRPO: SUBSA
- **Ongoing UF2 Stage US Payload Investigations**
  - Code M: CEO, MISSE, EARTHKAM
  - HLS: Interactions, EVARM, PuFF, Renal Stone
  - MRPO: SAMS, MAMS, PCG-STES #8, PFMI
  - SPD: ADVASC

Payload Status – Cont'd

- **UF2 Stage Payloads Affecting 9A**
  - EVARM badge readings performed in preparation for 9A joint operations
  - Return hardware and samples include: ADVASC, STELSYS, MEPS, ZCG, PCG-STES #8, HLS return, SAMS HD and battery

- **9A Stage New Investigations**
  - SPD: PGBA, CGBA, ZCG - new samples delivered on 9A
  - MRPO: PCG-STES #7 - new samples delivered on 9A

- **Late Payload Manifest Changes to 9A Ascent**
  - MSG Clean-up Kit Consumables Re-supply
    - Clean-up kit items used on-orbit for SUBSA and MSG work volume clean-up
  - Third BCSS-CS2 Cryodewar
    - Nominal plan did not include returning StelSys used syringes
    - Late request received to return the syringes frozen to assist with science data analysis
  - EXPRESS Rack ARIS Ground Strap
    - On-orbit Ground Strap was damaged during the ER#2 smoke detector change-out procedure
    - Ground Strap Replacements added for both ER#2 and ER#3

The 9A Launch Package Manager and the Increment 5 Manager are ready to proceed with the launch of ISS 9A/STS-112

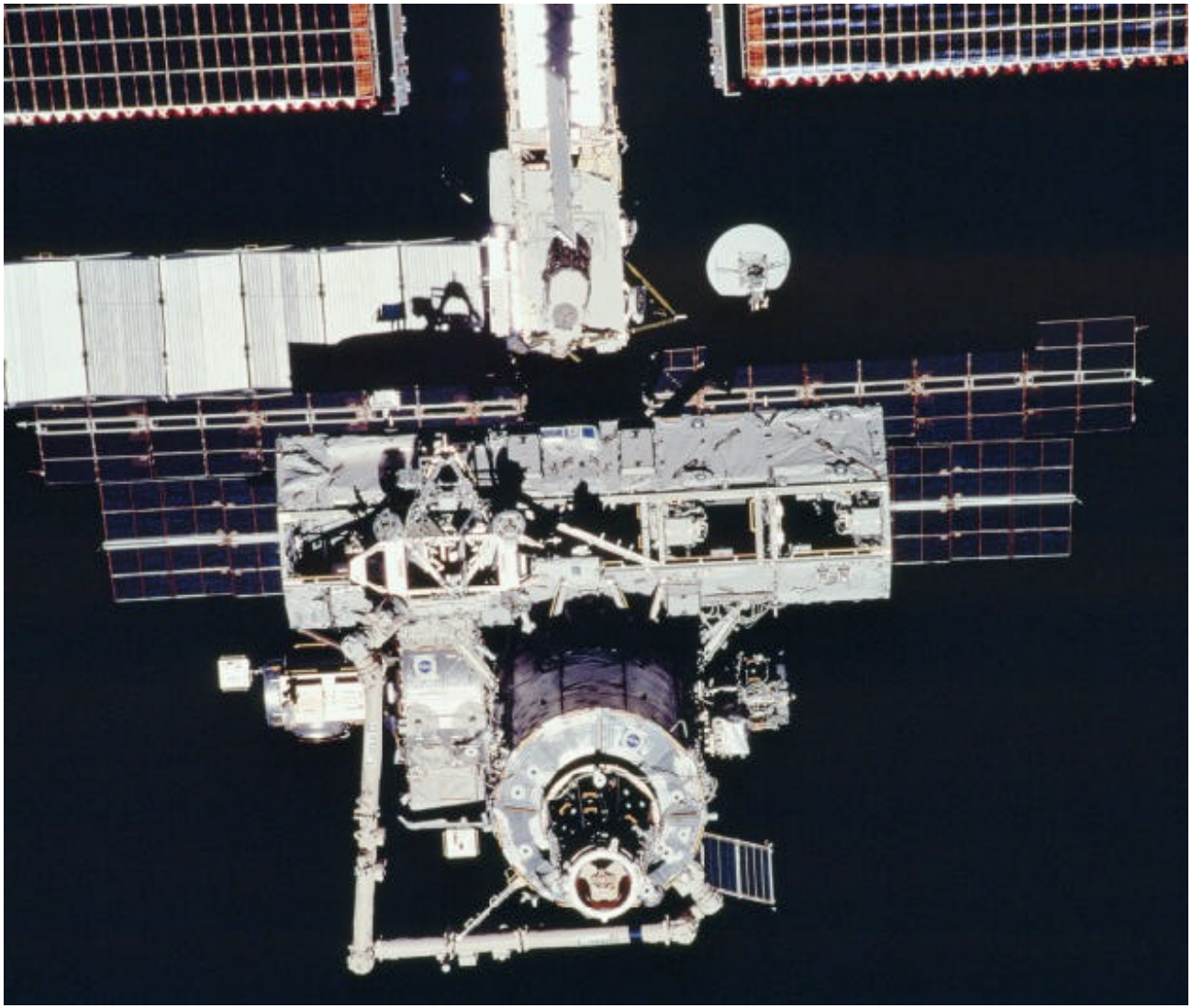
On-Orbit Vehicle Status

Tony Sang/JSC OB

AGENDA

- **On-Orbit Vehicle Readiness** — **A. Sang**
  - **Flight UF-2 Configuration**
  - **Hardware Status**
  - **CDRA Repairs/MCA Operations**
  - **Airlock CCAA Anomaly**
  - **Current On-Orbit System Status**
  - **On-Orbit Summary**
  - **Backup**

Flight UF2 Configuration



Hardware Status

Issues	New Since UF2 FRR	Impact to 9A Operations	Topic to be Presented	On-Orbit Repair scheduled or required
CMG #1 Failure	Yes	No	Yes (Avionics)	Yes
Treadmill Vibration Isolation System (TVIS) Anomaly	Yes	Yes	Yes (Vehicle)	Yes
PGT Out of Cal Impacts	Yes	Yes	Yes (EVA)	TBR
EMU Battery Anomaly	Yes	No	Yes (EVA)	No
BGA Shoulder Bolt	Yes	No	No	TBD
CDRA Repair/ MCA Operations	Yes	No	Yes (ISS MER)	Potential
Airlock CCAA Hum Sep Water Carryover	Yes	Yes	Yes (ISS MER)	Yes
Express Rack 2 ARIS RF Bonding Strap Damage	Yes	Yes	No	Yes

Hardware Status

Issues	New Since UF2 FRR	Impact to 9A Operations	Topic to be Presented	On-Orbit Repair scheduled or required
Ammonia QD Lock-up/Spool Positioning Devices (SPD)	No	Yes	Yes (Vehicle)	Yes
TUS IUA Safing Bolt	No	Yes	No	Yes
USOS Battery Pressures	No	No	No	TBR
ITCS Coolant Quality	No	No	No	No
BGA High Motor Current	No	No	No	TBR
RPCMs	No	No	No	Yes
SM Kurs Intermittent Failure	No	No	No	TBR

CDRA/MCA Repairs

- **Both the CDRA and the MCA had hardware replaced during the UF2 Stage**
  - **CDRA Sorbent Bed ORU 1 removed and replaced**
    - **Startup was unsuccessful**
    - **Still operable for single bed operations**
    - **No impact to 9A - Shuttle's 31 LiOH sufficient for 9A docked phase**
    - **Troubleshooting successfully pinpointed leaky connector.**
      - **Corrective action scheduled for Monday, 09/16/02**
  - **MCA Mass Spectrometer and Verification Bed ORU removed and replaced**
    - **Startup was unsuccessful**
      - **Isolated to a valve position sensor problem**
    - **Work around in place**
      - **MCA operational for ppO2, ppCO2. ppH2, ppN2, and ppCH4**
    - **Available for 9A operations**
      - **Utilized existing procedure for 10.2 psia management without MCA as used during UF2**
        - **Utilizes CSA-CP hardware**
      - **On non-interference basis considering MCA ops during 10.2 psia ops to verify software operational readiness.**

No constraints to 9A launch and on-orbit operations

Airlock CCAA Anomaly

- Airlock CCAA is “spitting” water during certain conditions
  - Fault is isolated to the water separator ORU
    - Suspect that filter within the water separator ORU is clogged
  - Need to changeout ORU at next opportunity
    - Replacement ORU has been manifested on STS-112/9A
    - R&R will be during 9A docked phase.
  - 9A Operations Impacts (EVA operations)
    - Engineering analysis revealed that if nominal 4 crew present in the airlock at 10.2 psia the system should accommodate humidity removal
    - MOD and Crew Office wants to preserve ability to have 5 people in crewlock during 10.2 psia ops
      - Increase risk to spitting water, but not safety hazard.
      - No constraints to Oxygen Recharge Compressor Assy (ORCA) operations
      - Developed and documented ops constraints for MOD
      - Agreement: For EVA 1, nominal 4 crew will be in crewlock. ISS MER will perform realtime analysis of 4 crew case to determine if the 5 crew is acceptable

No constraints to 9A launch and on-orbit operations

Current On-Orbit Status

- C&DH
  - All Station MDMs operational
    - Node - N1-2 primary, N1-1 secondary
    - Lab
      - C&C MDMs: C&C 1 standby, C&C 2 backup, C&C 3 primary
      - INT MDMs: INT systems 1 off, INT systems 2 operating
      - Lab MDMs – LA-1, LA-2, LA-3 are operating
      - Power Management Controller Units: (PMCU) 1 off, PMCU 2 operating
      - GNC MDM: GNC 1 backup, GNC 2 primary
      - Payload MDM: PL-1 off, PL-2 primary
    - Airlock MDM - operating
    - Photovoltaic Control Unit (PVCU) - 2B backup, 4B primary
    - S0
      - EXT MDMs: EXT 1 – operating, EXT 2 – off
      - S0 MDMs: S0-1 and S0-2 are operating
    - FGB - 1 operating, FGB - 2 off
    - SM - Loaded with version 5.0 software
      - SMTCs - all in redundant set
      - SMCCs – SMCC-1 and –2 are operating. SMCC-3 out of redundant set.

Current On-Orbit Status
(continued)

- C&T
  - S-band high/low data rate operating nominally
  - Ku band operating nominally
  - MCOR operational
  - SM Regul System - 2 of 3 strings operational
  - Audio system
    - Internal Audio Controller (IAC) 1 active, IAC-2 off
    - Have occasional P-bits on audio equipment
  - SM Kurs: Set #1 is fully operational. Set #2 has intermittent failures - no impact

Current On-Orbit Status
(continued)

- ECLSS
  - Lab ECLS systems operating as required
    - CDRA has single bed capacity
    - MCA operational.
  - Node smoke detector #2 operational, but off due to dirty indication –
    - Still awaiting on-orbit troubleshooting
    - Cleaning procedure in work.
  - Airlock CCAA water separator performance has degraded.
    - LTL flow in Airlock CCAA currently off.
  - SM Vozdukh operating on 2 of 3 CO2 removal beds
    - CO2 removal capability nominal
      - Spare CO2 removal bed available on orbit.
  - SM Air conditioners (SKV) #1 and #2 operational.
  - SM rapid depress response now enabled all the time
    - The Russians had been enabling the algorithm during the crew day
    - They have installed filters, both physical and software, to remedy the false indication problems.
    - The sensors operating nominally now.

Current On-Orbit Status
(continued)

- EPS
  - FGB EPS working nominally
    - 5 of 6 batteries on-line
  - SM EPS working nominally
    - 7 of 8 batteries on-line
  - P6 power channels 2B and 4B operating nominally
  - RPCMs
    - RPCMs LAD22B-A, LAFWD-1B-A, LAFWD-1B-C, and LAD62B-A have bit flips on SRAM and cannot be refreshed
      - No short term impact
      - Spares available, if required
    - Overall R&R plan being implemented to return suspect RPCMs to the ground
    - P6 Battery 4B21 vs 4B22 Average Pressure Delta: ~ 7232 mmHg (~ 140 PSI)
      - Currently, no impact to nominal operations
      - Anomaly impact being investigated.

Current On-Orbit Status
(continued)

- S&M
  - 2B and 4B BGA showing high currents sporadically
    - 2B and 4B rotated as required for power
    - Dual angle mode and XPOP flown when possible
    - Low beta X-POP being pursued to limit BGA rotations, when possible.
  - Impact mark on SM window #7
  - 3 of 4 Beta Gimbal Assembly (BGA) latching mechanisms locked on starboard 4 Bar assembly
    - Strength analysis shows 3 of 4 acceptable for life.

Current On-Orbit Status
(continued)

- TCS
  - Early external active thermal control system operating within specification
    - Starboard radiator has one loop plumbed incorrectly
      - Heat rejection capability impacted - still meets heat rejection needs
  - ITCS operating nominally
    - ITCS fluid forward plan still in work

- EVR
  - CanadArm2 operating nominally
    - WR Joint R&R'd on UF2
  - RWS had one monitor failed
    - Replacement flown on UF2
    - R&R completed

Current On-Orbit Status
(continued)

- GN&C
  - CMG #1 failed
  - All remaining CMGs have experienced occasional loss of comm
  - GPS system active

- Propulsion systems nominal and ready for 9A operations

Current On-Orbit Status
(continued)

- EV&CS/GFE hardware
  - VOA (air sample analyzer) - sporadically operational
    - 3-4 month system validation process in work
    - New software to be delivered on 9A
  - TOCA (water sample analyzer) - operational
  - TEPC (radiation monitor) - returned to ground on UF2, return on 9A
  - Defibrillator - working
  - IRED, CEVIS - working
  - TVIS - operating restrictions in place
    - Replacement hardware being flown and R&R on 9A
  - IV-CPDS - experiences occasional downlink of data problems
  - EV-CPDS - working
  - Water Maintenance Kit (WMK) - kits useable

On-Orbit Summary

- None of the identified items for investigation regarding the on-orbit configuration represent a constraint to the flight of 9A
- The MER personnel and facilities will be ready to support

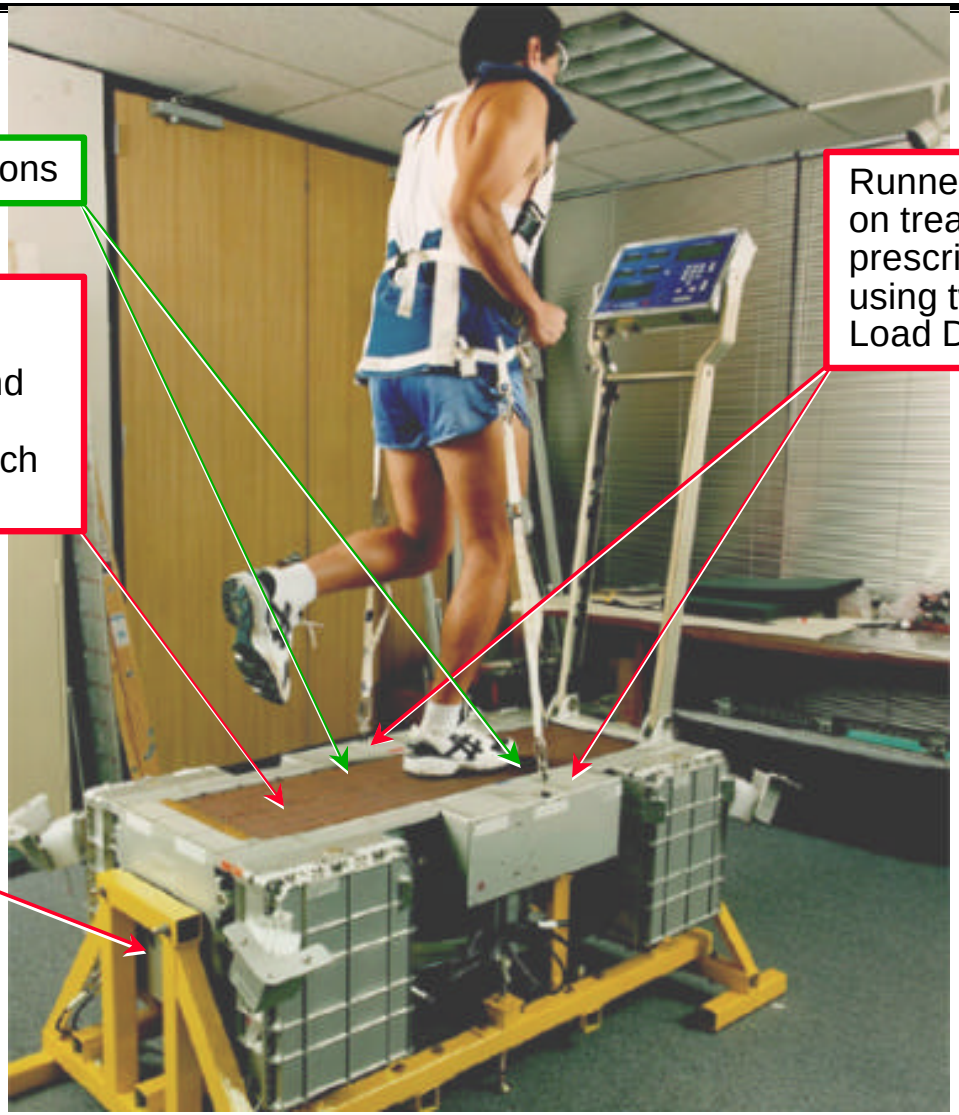
SPECIAL TOPICS

9A FRR Special Topic

Treadmill with Vibration Isolation System (TVIS) Repair Hardware

George Parma-JSC EB

9A FRR Special Topic
TVIS Repair Hardware



Failed truss roller locations

Chassis is treadmill's structural backbone
- Contains the belt and support roller truss
- All components attach to it

Runner is held down on treadmill at a prescribed load using two Subject Load Devices (SLD's)

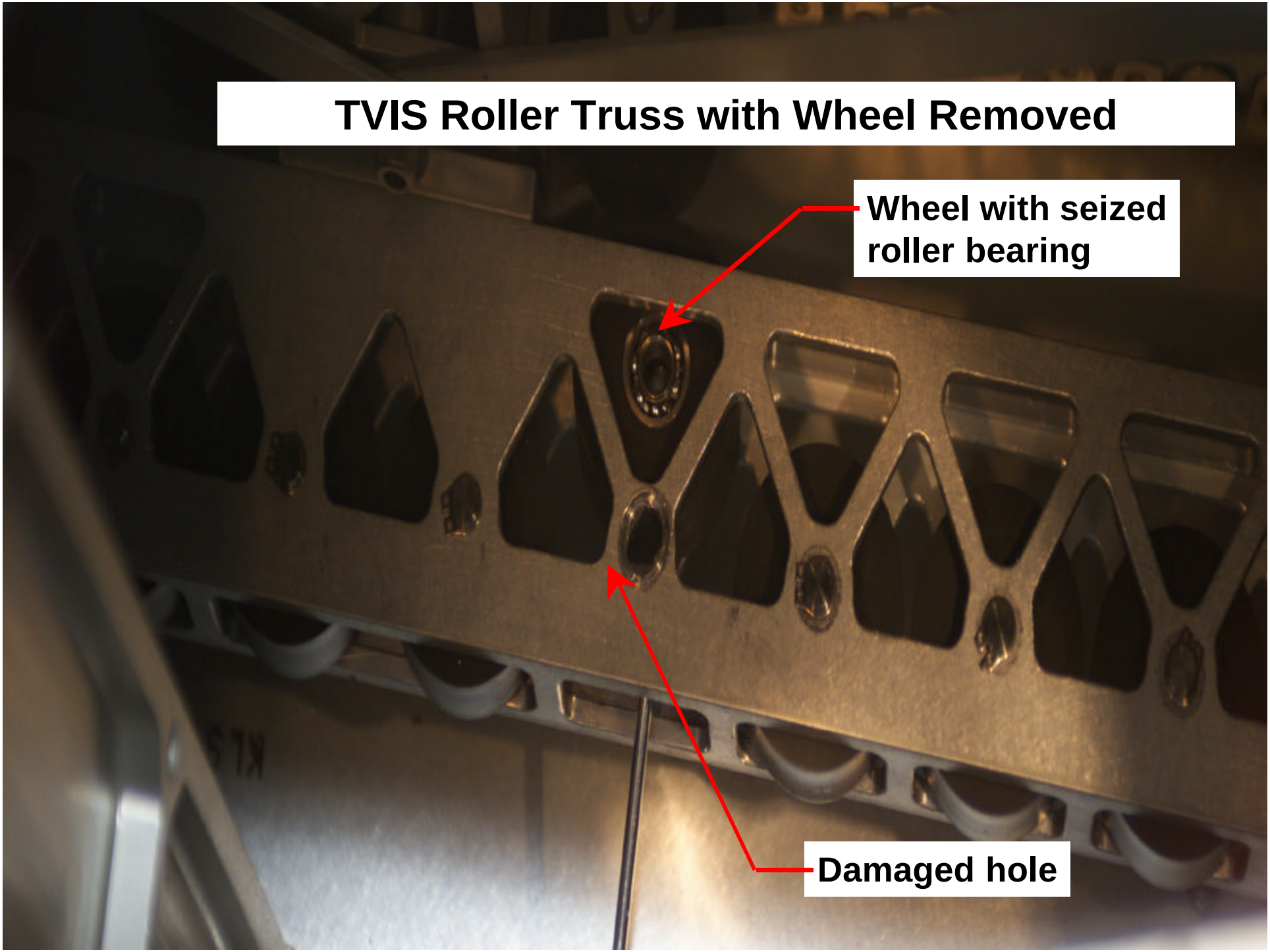
Electronics Box

Some components not shown. Hand rail not part of nominal on-orbit configuration.

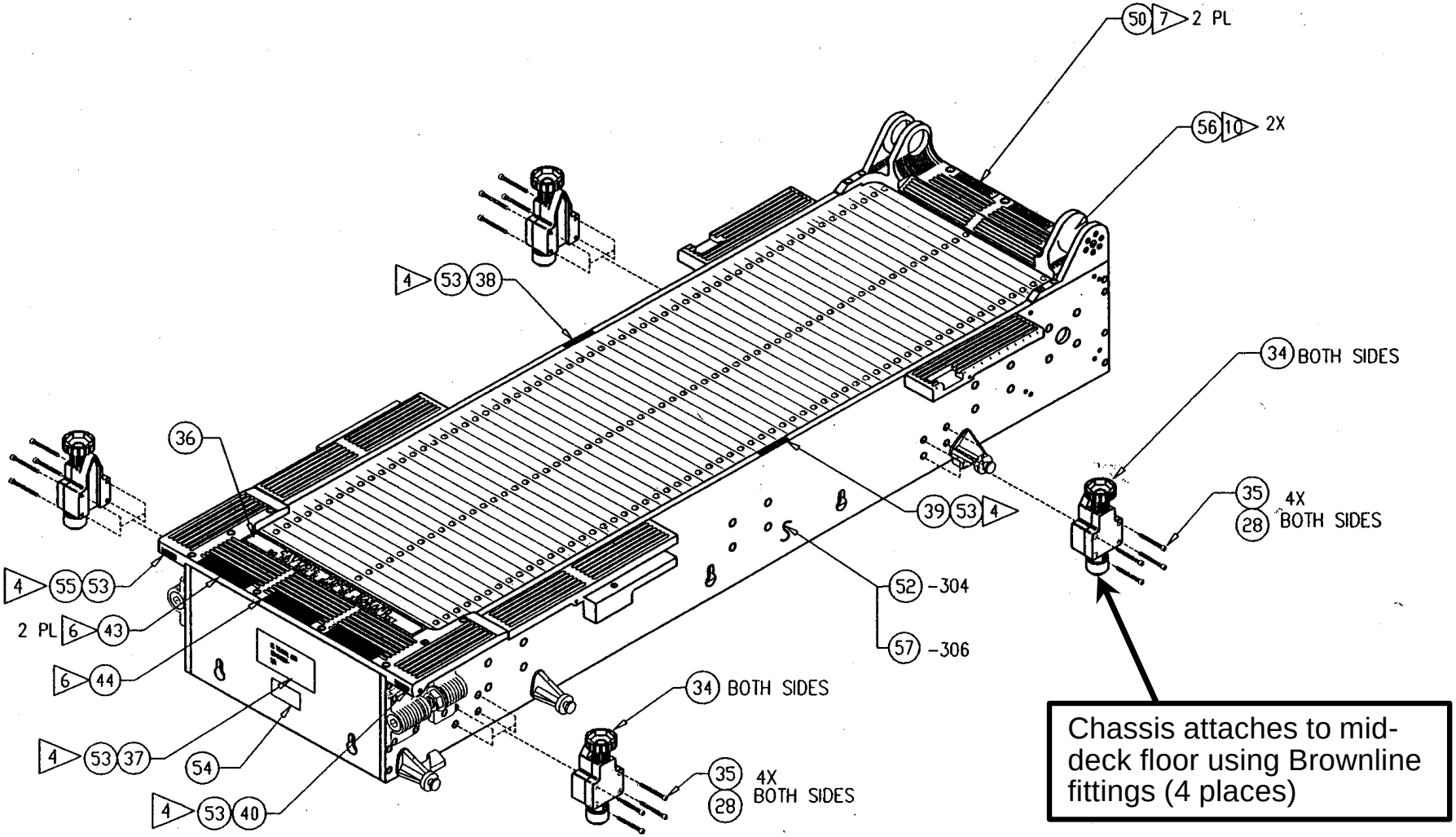
9A FRR Special Topic
TVIS Repair Hardware

Treadmill with Vibration Isolation System (TVIS) Chassis failures

- **On 7/24/02, the Crew reported that the TVIS was making a "ticking" noise as they ran on it (IFI # MER-00852)**
  - **A detailed inspection revealed that the noise was most likely coming from two set screws on the front roller drum which had backed out (these were later tightened and locked with dental adhesive). Belt slat screws were also found to be loose.**
  - **Most significantly, the inspection also revealed that the bearings on one of the rollers that supports the running surface had seized and caused structural damage to the left side roller truss. A second bearing was found seized during inspection on 8/20/02**
    - **Structural analysis has shown that with the roller shafts of the seized bearings removed, the crew can continue to run on TVIS with reduced crewmember loading and running speed**
  - **Two pieces of TVIS repair hardware are being flown on 9P as a stop-gap in case chassis fails before 9A**
    - **Clamshell truss stiffener**
    - **Internal Chassis Support Assy (ICSA)**
  - **Plan is to try to avoid the time-consuming IFM which would be required to install any of the 9P repair hardware and wait for a full chassis to arrive on 9A**
    - **If not required prior to 9A, Clamshell and ICSA delivered on 9P will remain on orbit as spare parts**
- **9A TVIS chassis includes smart modifications to preempt recurrence of the above failures**
- **Chassis, SLD's, and Electronics Box will be swapped on-orbit during docked ops (FD 7), so returned chassis and SLD's are available for repair/upgrade**


TVIS Roller Truss with Wheel Removed
Wheel with seized roller bearing
Damaged hole

9A FRR Special Topic
TVIS Repair Hardware
TVIS Chassis Assembly



9A FRR Special Topic
TVIS Repair Hardware

- TVIS repair hardware on 9A
  - One (1) Chassis (Mid deck floor ICD load waiver approved – Orbiter CR # S016859B, O/D @ KSC 9/25, Cert. Closure 9/23)
  - Two (2) Subject Load Devices (SLD's) (O/D @ JSC/FCE 9/23, Cert. Complete, Open DRs and TPSs completed 9/24)
  - One (1) Electronics Box (O/D @ JSC/FCE 9/23, Cert. Closure 9/24)
  - One (1) Roller and Tread Belt, Spare Parts Kit (O/D @ JSC/FCE 9/19, Cert. Complete 9/19)
- 3 TVIS issues will be addressed with 9A TVIS hardware
  - TVIS Chassis failures:
    - Roller truss bearing failures, drum set screw back-out, belt slat screw back out
  - SLD failure
    - Seized exit pulley bearing
  - Electronics Box design deficiency
    - Wiring/contact harness design issue
- After flight 9A, TVIS will be operating nominally with the following exceptions:
    - The SBS (bungees) will be used for subject loading until the last 30 days of each increment
    - Speed and load restrictions will remain in place for motorized running at the beginning of each increment until each crewmember's power draw is characterized
- Pending completion of the open work identified above, the TVIS repair hardware is ready for flight on STS-112

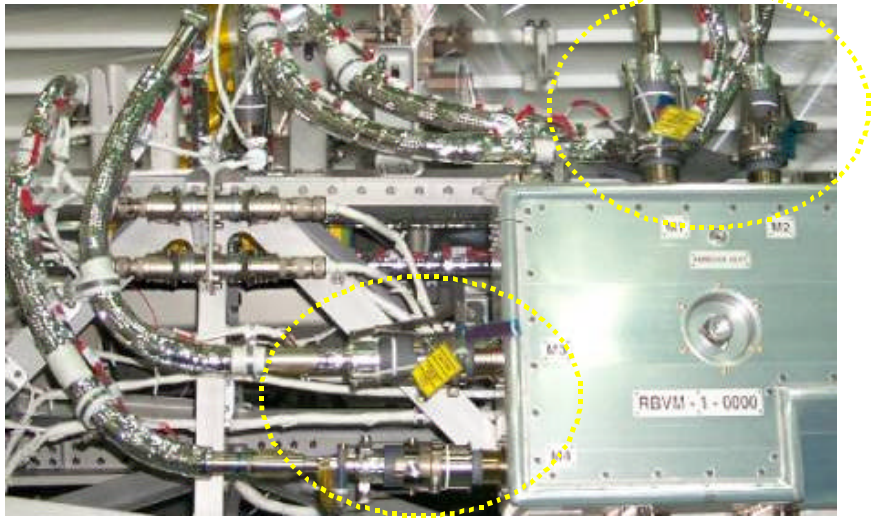
9A FRR Special Topic on QD Hydraulic Lockup

Tim Bond / NASA JSC EC6

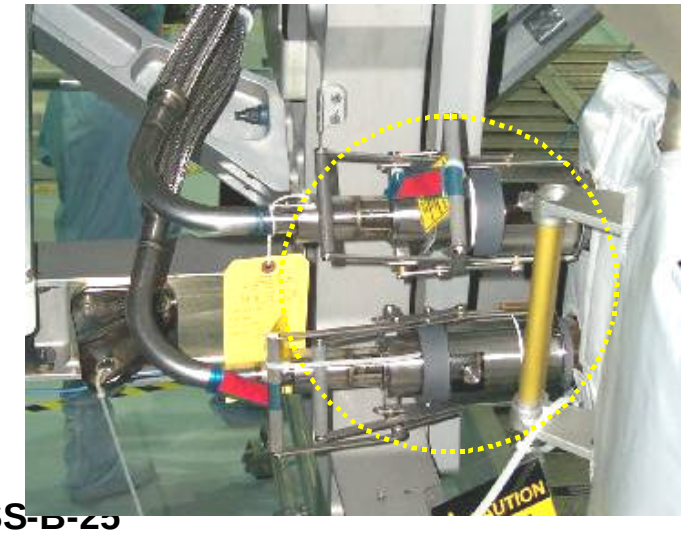
NH3 QD Hydraulic Lockup

- **Issue:**
  - **Any normal, mated and open NH3 Parker Stratoflex Quick Disconnect (QD) pair may experience hydraulic lock-up**
    - **subsequent pressure buildup in the male spring cavity during temperature transients can result in permanent damage to the QD**
  - **This concern affects all QDs on both Early and Permanent External Ammonia Systems (EEATCS and EATCS)**
    - **QDs that are continually exposed to NH3 can experience this condition (~50 on S1)**
  - **Surfaced as part of 5A on-orbit NH3 QD leak failure investigation activities**

S1 RBVM QDs

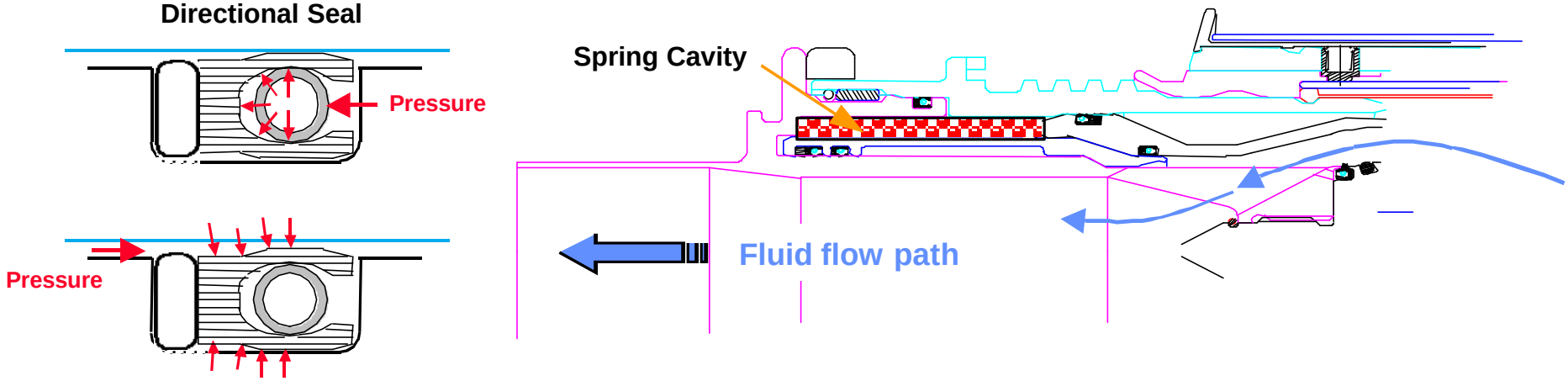


S1 TRRJ FHRC QDs



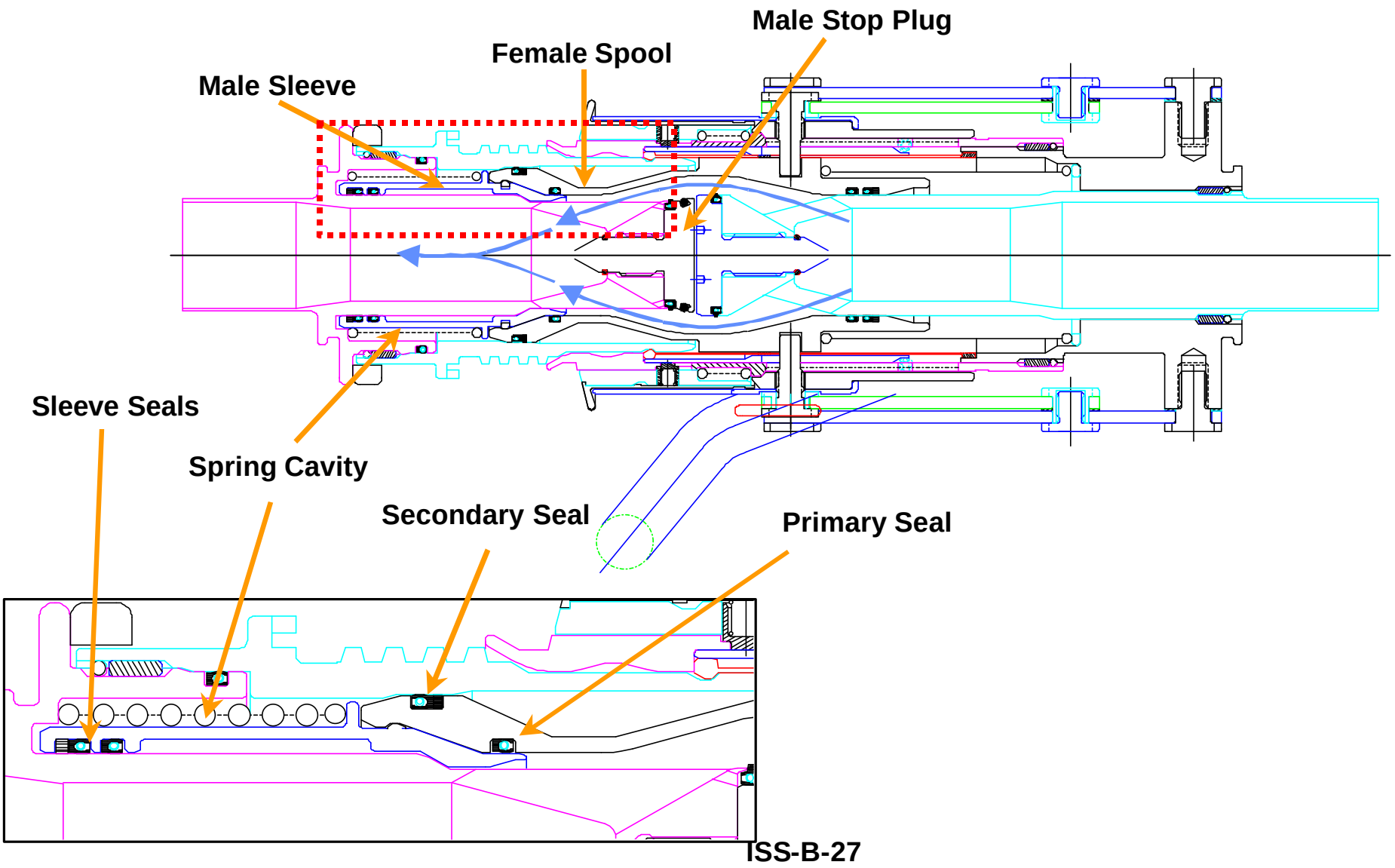
NH3 QD Hydraulic Lockup

- **Background:**
  - Analysis suggests complete filling of the spring cavities likely with time
    - As short as one year
  - Design of directional seals intended to relieve pressure buildup back into flow-path



  - Testing has shown that consequence of hydraulic lockup varies with QD size
    - Jamming/erratic behavior on 1.0, 1.5 and 1/2 -inch QDs – *unacceptable condition*
    - Pressure relief on 3/4 and 1/4-inch QDs – *acceptable condition*
    - Spring cavity pressure also can make operation of QD more difficult

Ammonia QD Detailed Cross-Section

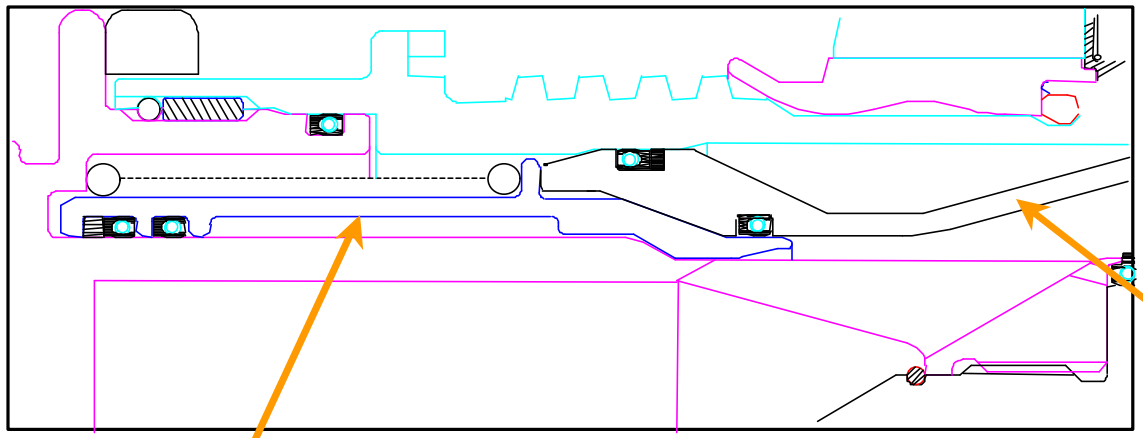


ISS-B-27

NH3 QD Hydraulic Lockup

- Extensive testing and analysis has been conducted to characterize the concern
- Testing summary by QD size:
  - ¼" QDs - risk of high button depress forces only
  - ½" QDs - risk of high button depress forces and permanent QD deformation
  - ¾" QDs – risk of high button depress forces only
  - 1" QDs – risk of high button depress forces and permanent QD deformation
  - 1.5" QDs - risk of high button depress forces and permanent QD deformation
- Overall QD solution consists of:
  - EVA Installed Spool Positioning Devices (SPDs) for ½", 1", and 1.5" ISS QDs
    - SPDs unseat only the secondary seal of the QD and prevent lock-up
    - Installation is planned during EVAs on 9A, 11A, ULF-1, 10A, and Stage 10A
  - New tools to address QD detent button loads:
    - 1" Button Depress Tool (BDT) will be available by 11A
    - ¼" and ¾" Button Depress Tools (BDT) will be available prior to maintenance (post 12A.1)
  - Additional crew training
    - Familiarization with consequences and effects of pressure in spring cavity
    - New detailed ops procedures to operate QDs both normally and contingency

NH3 QD Hydraulic Lockup

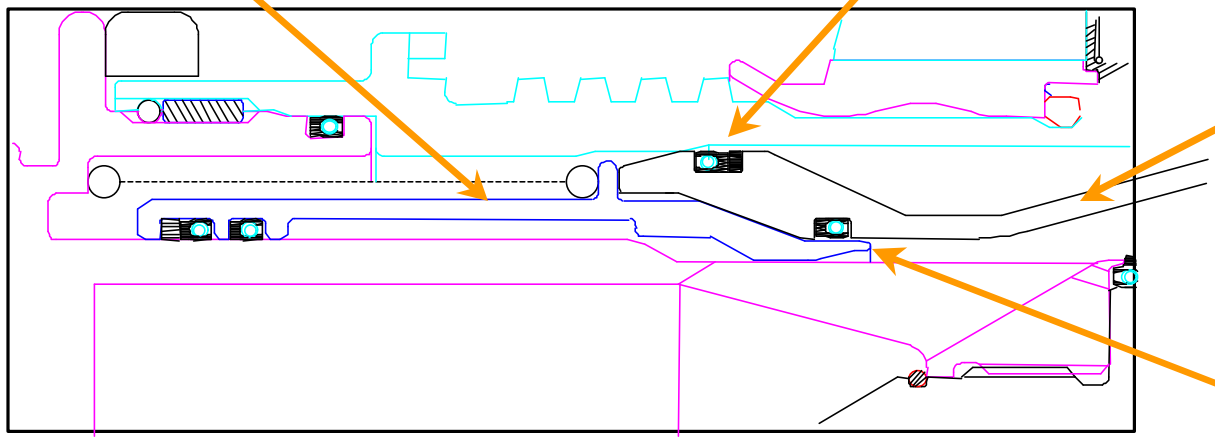


Without SPD

Male Sleeve Follows
Female Spool

Secondary Seal Unseated

Female Spool



With SPD

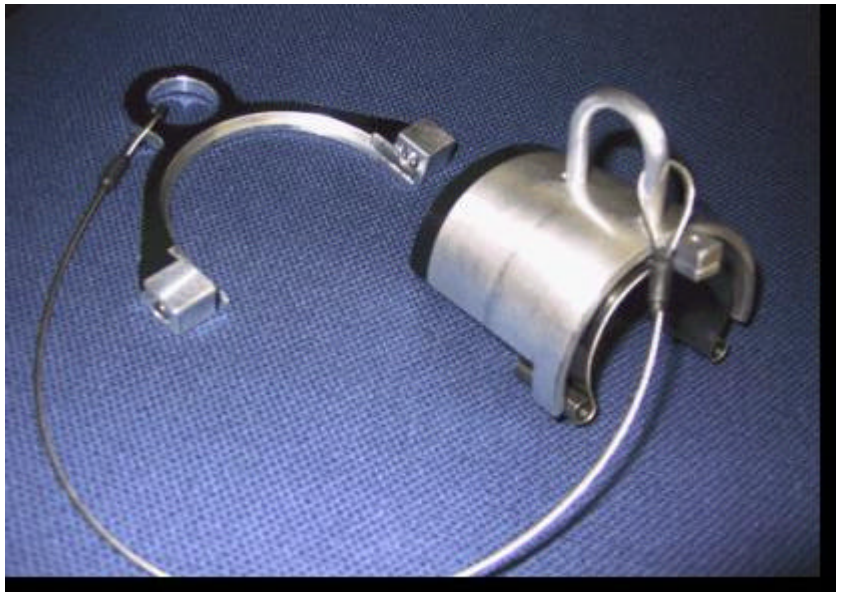
Primary Seal Fully Engaged

ISS-B-29

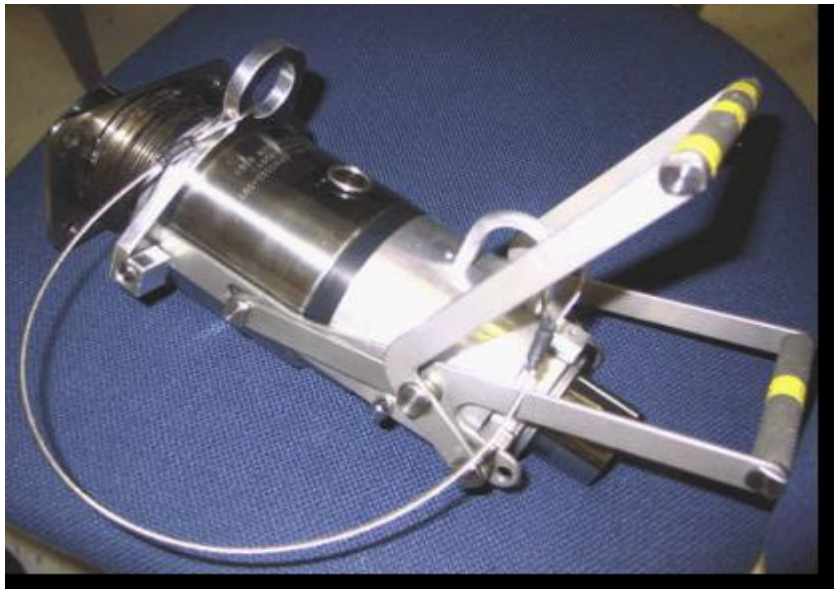
1.5 Inch SPD

- **1.5” SPD**
  - **Front clip places the spool in single seal position to prevent spring cavity pressurization**
  - **Rear clip locks QD open**

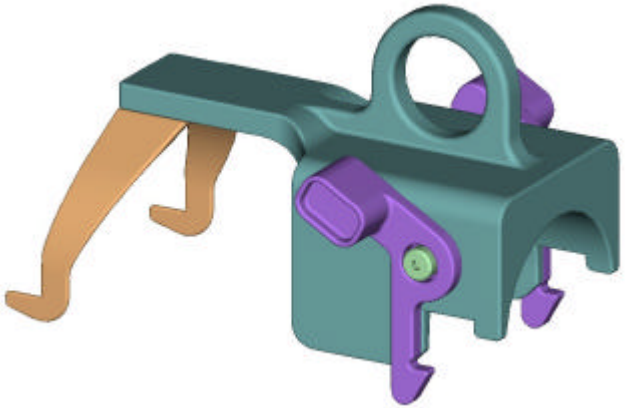
1.5-Inch SPD Prototype



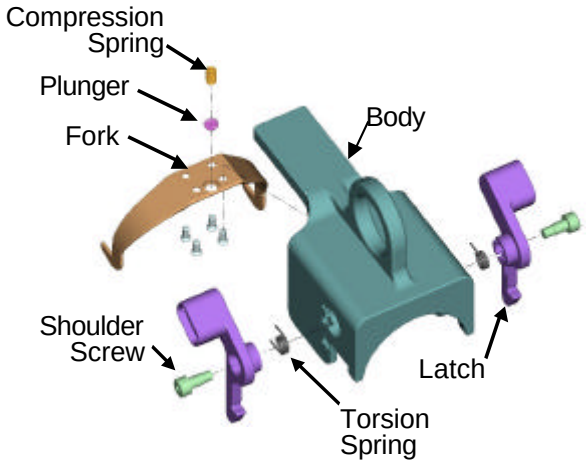
1.5-Inch SPD Prototype Fit Check on QD



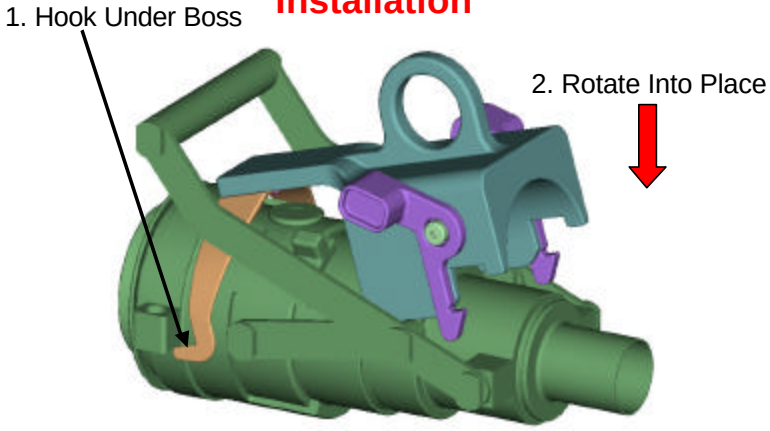
1 Inch SPD

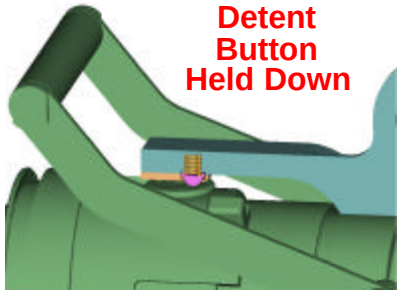


- **1” SPD clips under locking collar in front of QD, and engages boss in back**
- **Design permits QD to be fully open with secondary seals engaged initially, and vent spring cavity as required**

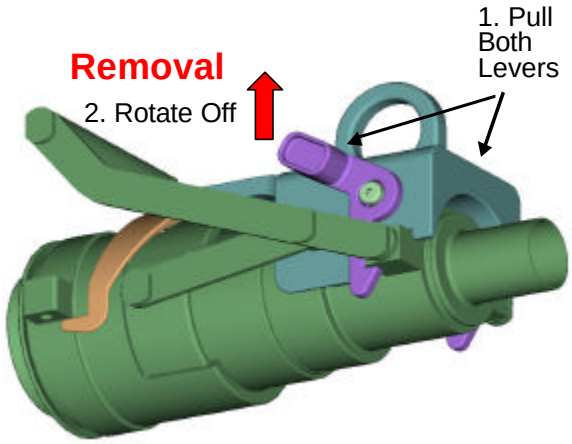


Installation





Removal

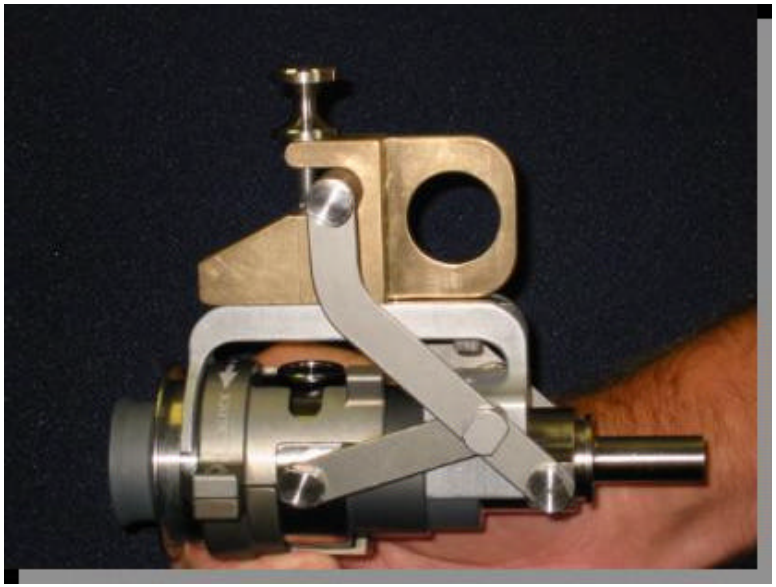


0.5 Inch SPD

- ½” SPD
  - Positions spool in fully open single seal position (secondary seal unseated)
  - Different from 1” SPD design due change in relative position of handle and button
  - Requires EVA installation of MLI bootie extender at ATA QDs to enable SPD fit (designed and manifested on 9A)

0.5 inch prototype installation

0.5 inch SPD prototype installed



QD Hydraulic Lockup EVA Solution

SPD Installation Plan

Flight	EVA	Location	1.5”	1”	½”
9A (31 SPDs)	**EVA 2**	**Z1-P6 Loop A***		**2**	
		Z1-Lab Loop A*		**2**	
		P6 PVR*		**2**	
		S1 ATA			**1**
		S1 RBVM		**18**	
	EVA 3	**S1 TRRJ Stinger**	**2**		
		S0-S1 Jumpers	**4**		
11A (51 SPDs)	**EVA 1**	**P1 FHRC**	**4**		
		P1 TRRJ Stinger	**2**		
	EVA 2	**P1-S0 Jumpers**	**4**		
	EVA 3	**Z1-P6 Loop B***		**2**	
		Z1-Lab Loop B*		**2**	
		P1 ATA			**1**
		Lab Heat Exchanger Loop B*		**2**	
		S1 and P1 Pump Modules	**6**		**2**
		P1 RBVMs		**18**	
		S1 FHRC	**4**		
		S0 Shunt Jumpers		**4**	
ULF-1 (2 SPDs)	**EVA 3**	**Lab Heat Exchanger Loop A***		**2**	
12A.1 (4 SPDs)	**EVA 4**	**S0-Lab**		**4**	
Stage 10A (12 SPDs)	**EVA 1**	**S0-Node2 Jumpers**		**12**	
Total –100 SPDs	**-**	**-**	**26**	**70**	**4**
		* = wet QDs (14 total)			

QD Hydraulic Lockup EVA Solution

- 9A EVA Risks
  - SPD fit:
    - Due to schedule constraints and hardware availability, flight SPDs and tools were not fit checked against matching S1 flight QDs
    - No specific engineering was released addressing the installation envelope
    - Risk mitigated through several approaches
      - ATP fit check of each SPD on qual QDs
      - Visual inspections were performed on flight QDs, worksites, and worksite photos
      - Best effort prototype fit check on alternate flight QDs (P1 in lieu of S1)
      - Crew and EVA worksite evaluations with prototype SPDs
    - Risk accepted by VCB and SSPCB
  - QDs currently exposed to NH3 already jammed or experiencing high detent button loads:
    - Risk is low since most QDs were inspected on-orbit for jamming and ops procedures during 9A will reduce pressure in the cavity
    - Risk mitigated by button depress tools beginning with flight 11A
    - Any QDs planned for SPD install on 9A that cannot be operated will be revisited next flight with BDT
  - QD operation loads
    - High bail loads could drive the need for foot restraints and extend time required

NH3 QD Hydraulic Lockup

- Re-verification test and analysis complete
  - Qualification Site Approval (QSA) completed
  - All cavity cycle, compliance & button depress load testing completed
  - Pressure drop testing completed
  - Structural analysis completed
  - Passive and active thermal analysis completed

- EVA and Ops readiness
  - All SPD hardware delivered for 9A
    - Only open paper is ½" SPD cert due 9/19
  - Implementing NH3 loop cool-down procedures on 9A prior to installation of SPD's on Z1/P6 to bias down spring cavity temperatures/pressures
    - PPL required for loop cool-down, will be up-linked on 9/20

- All hardware and procedures in place – Team is ready for 9A !!

Pending completion of the identified open and forward work, the Vehicle Office is ready to proceed with the STS-112/9A Launch and Stage On-Orbit Operations.

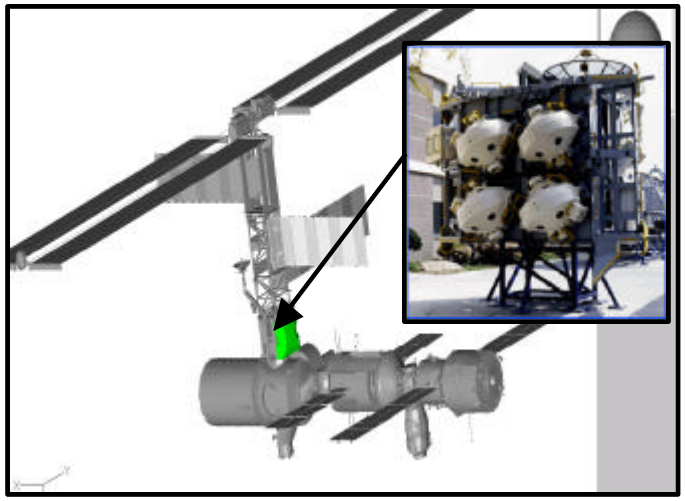
Avionics and Software
9A Flight Readiness Review
Control Moment Gyroscope Operations

September 17, 2002

Thomas Russell

BOEING

Avionics Hardware
Guidance Navigation and Control
Control Moment Gyroscope Operations



- On-Orbit CMG #1 failed
- Bearing failure root cause investigation continues
- GN&C Certified for 3 of 4 and 2 of 4 CMG operations for 9A Activation and Stage
  - 3 of 4 CMG operations without desaturation jet firings
    - -8/+3 degree maximum roll bias
      - Used at high solar beta angles to improve power generation margins
      - No constraints for current flight dates.
  - 2 of 4 CMG operations are acceptable with the following caveat:
    - Stage 9A mated LVLH with roll bias will require desaturation jet firings for some roll biases and atmospheric conditions
      - Will use LVLH Torque Equilibrium Attitude momentum management for 9 hour S1 installation where jet firings are prohibited

Avionics Hardware
Guidance Navigation and Control
Control Moment Gyroscope Operations (Cont.)

- **Current CMG Operating plan:**
  - **Maneuvers from XPOP (warm attitude) to LVLH (cold attitude) will be performed only when CMG spin bearing temperatures have been under 85°F for 12 hours**
    - **Prior to reaching the 85°F limit, short duration maneuvers from XPOP can occur for up to 12 hours.**
  - **Minimize CMG desaturations by using Russian control for maneuvers when necessary.**
  - **Spin motor current monitoring and action plans are in place for active CMGs**
- **No CMG constraints identified for orbiter docking and undocking**

The Avionics and Software community endorses the readiness for 9A with the current operational plan

Flight 9A FRR Special Topic

Canadian Space Agency (CSA) Wrist Roll Joint Anomaly Resolution

CSA/William Mackey

September 17, 2002

Canadarm2 WR Joint Anomaly

- **Anomaly:**
  - On Day 064 GMT (UF-1 Stage - 03/05/02), Canadarm2 Prime String Wrist Roll (WR) joint failed in a persistent manner, preventing release of brakes.

- **Troubleshooting:**
  - On-orbit diagnostic testing isolated the most likely cause to a hard short in the WRJ motor module or JEU-MM harness

- **Workaround:**
  - Software patch to override failed WR joint and function in 6-DOF mode was made available for Flights 8A, UF-2 and stage contingency ops, but was not required. Generic DJOPs software subsequently generated.

Canadarm2 WR Joint Anomaly

- **On-orbit Failure Resolution:**
  - Wrist Roll (WR) Joint R&R was completed successfully on UF-2.

- **Investigation Results:**
  - Short was present when electrically connected at start of investigation and disappeared during removal of the solithane seal over the connector.
  - Ground-based inspection detected a 3.5 mm piece of 38 gauge wire strand shorting Pin 1 (+V) and Pin 6 (GND) within the MM connector.
  - Wire strand most likely came from the MM cable harness protective sheath.
  - Proper inspection and QA processes were followed during assembly.
  - **Root cause of failure:** The presence of a strand of wire was not detected before the mating of the connectors.

Canadarm2 WR Joint Anomaly

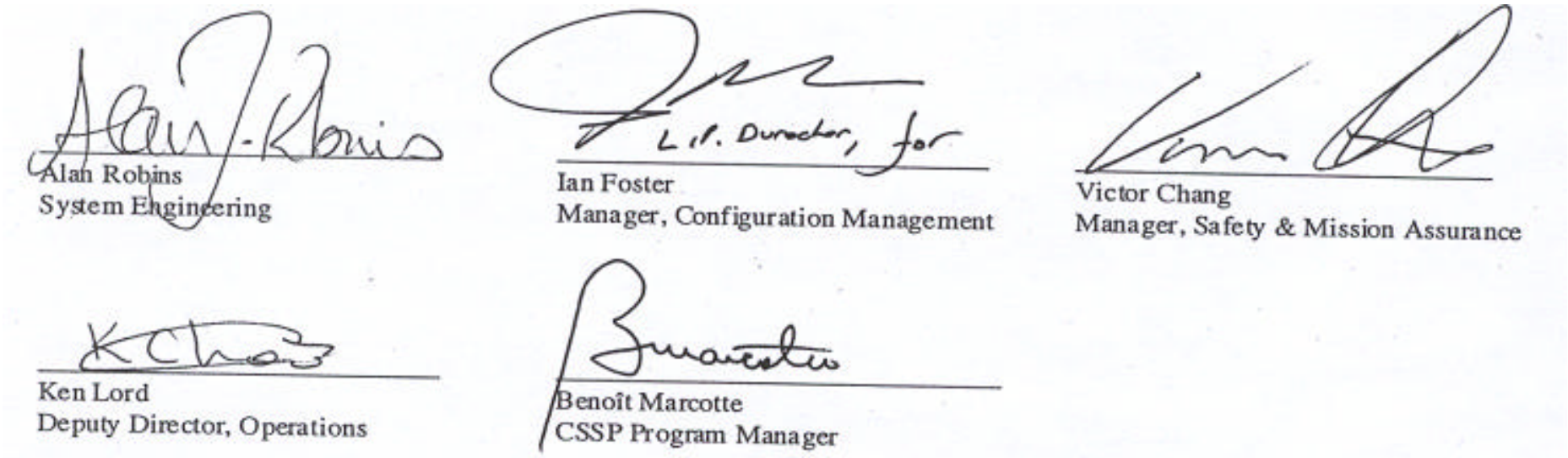
- **Other findings:**
  - Motor Module windings and remaining joint electronics were found nominal.
  - Circuit analysis of SSRMS avionics concluded that components were not stressed.
  - All SSRMS components operated within design limits
- **Conclusion:**
  - Wire strand caused the WRJ anomaly.
  - This is not a systemic problem.
- **Prevention:**
  - Strict manufacturing, inspection & testing practices were/are in place.
  - DJOP Software patch available if required.

Degraded Joint Operations

- Generic Degraded Joints Operations (DJOPs) is a software enhancement that is embedded in the Operations Control Software (OCS).
- Provides the capability to perform Manual (MAM and Single) or Automatic Mode (FOR & Joint) operations with any number of joints powered-on.
- Tested with 9A Recon Products (Payload Parameter and GUI Config Files).
- Certified for use if required.
- DJOPs ground-ops familiarization planned for 09/18/02 and 09/24/02.
- 9A Pre-launch checkout and robotics dry-run operations planned for 09/26/02.
- **Constraints to Launch:** None

Readiness Statement

Pending completion of the identified open work, the Canadian Space Agency is prepared to support Flight 9A and 9A stage operations.



Alan Robins
System Engineering

L/D. Director, for
Ian Foster
Manager, Configuration Management

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Manager, Safety & Mission Assurance

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Deputy Director, Operations

Benoît Marcotte
CSSP Program Manager

9A Flight Summary

9A/STS-112 Flight Readiness Review

September 17, 2002

OPEN PAPER

- **Forward Work:**
  - (3) Open Planning
    - Held for pad work - ECD 9/20/02
      - S1-ELE-T139, S1-MECH-T285, S1-MECH-T321
  - (1) Payload item at L-9 days (late load Video) – ECD 9/23/02
  - (1) VTL
    - STO-801-01-01.a-9A - ECD 9/26/02
      - Stowage compliance assessment (L -2 days)

- **Open Certifications:**
  - TVIS Chassis – ECD 9/25
  - TVIS Electronics Box – ECD 9/24
  - TVIS Spare Parts Kit – ECD 9/19
  - TVIS SLDs – Open DRs and TPSs - ECD 9/19
  - Tourniquets for the Advance Life Support Pack – ECD 9/20

- **SORR Exception:**
  - Pistol Grip Tool Torque Specification – ECD 9/26/02

9A FLIGHT SUMMARY

- Flight objectives and priorities are defined.
- Flight manifest has been defined.
- Hardware delivery and processing schedule supports launch date.
- All hardware and software certifications are complete or will be complete prior to launch
- Personnel and facilities are ready to support the mission.
- Special topics have been resolved.

The ISS Program is ready to proceed with the launch of ISS 9A/STS-112

9A Flight Readiness Review

Back-up Charts

Interdependencies

Previous Flights

8A

- Install S0 Truss (complete)
- S0/S1 SSAS Checkout (complete)
- R2 software upload (complete)
- SSRMS power/video reconfiguration (complete)

UF2

- Install MBS onto MT
- Assemble 2 ETVCGs
- SSRMS Joint Replacement

Future Flights

11A

- Outfit CETA Cart

ULF1

- Return 2 ETVCG stanchion dummy boxes for re-launch

12A.1

- EATCS configuration
- TRRJ checkout
- Release CETA Cart from launch position

13A

- Install S1 Truss
- Release S1/S3 line clamps
- S1/S3 SSAS Checkout
- MT translation path configuration

10A

- Install ETVCG to support Node 2 berthing

9A / STS-112 Flight Plan

FD1

- Launch

FD2

- SRMS and OSVS Checkout
- EMU & SAFER Checkout

FD3

- Rendezvous with ISS
- Dock Orbiter to PMA2
- Transfer operations

FD4

- Unberth S1 from PLB using SSRMS
- Maneuver S1 to preinstall position near S0 and perform DTO 264
- Complete berthing to S0 and activate SSAS
- EVA 1:
  - Connect zenith tray umbilicals and begin activation

S1 in "SAFE" mode (90%)

  - SASA deploy and activate heaters

SASA in "SAFE" mode

  - Begin removal of CETA Cart Launch Locks
  - Install S1 outboard nadir ETVCG
  - Begin release of Radiator Beam Launch Locks
  - Engage TRRJ DLA
  - Connect nadir tray umbilicals and begin activation

S1 in "SAFE" mode (100%)

FD5

- Transfer operations
- PAO event

FD6

- Reboost
- EVA 2:
  - Install Spool Positioning Devices
  - Install Lab ETVCG
  - Complete removal of CETA Cart Launch Locks
  - Connect S1 fluid umbilicals

FD7

- Transfer operations
- TRRJ Checkout
- EATCS Radiator Deploy (Center Panel)
- TVIS R&R

FD8

- Reboost
- EVA 3:
  - Connect S1/S0 fluid umbilicals
  - IUA R&R
  - Remove drag links and keel pins
  - Install Spool Positioning Devices
  - Reconfigure Squb Firing Units
  - Remove S1/S3 Line Clamps

FD9

- Transfer operations

FD10

- Undock
- ISS Fly around (minimal)

FD11

- SHIMMER operations
- PAO Event

FD12

- Deorbit prep and landing

ISS-9A/STS-112
Manifest Overview
(Ascent/Descent)

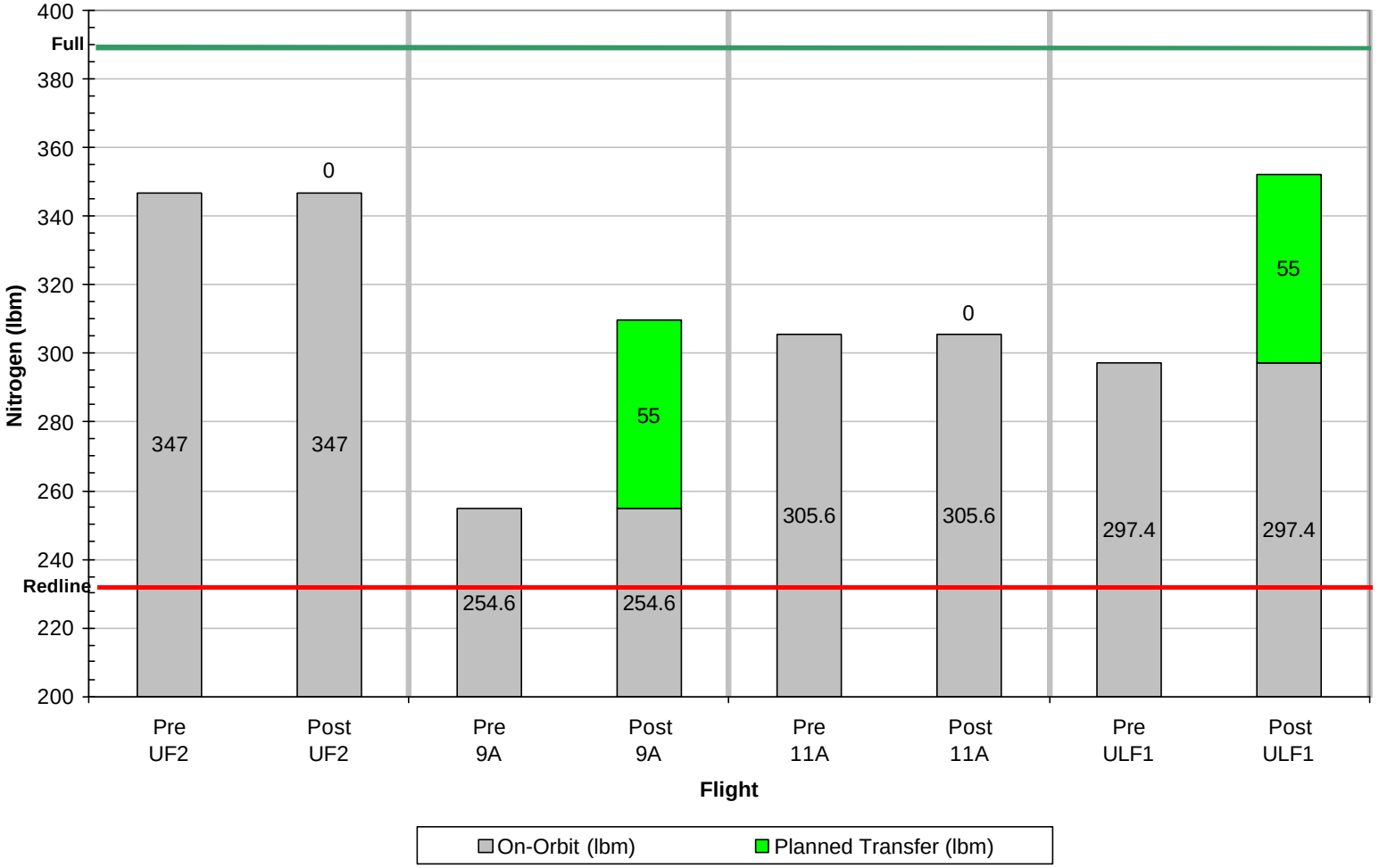
Ascent

Ingress Equipment	12 lbs
Water Equipment	30 lbs
Crew Care	34 lbs
Middeck SI Items	13 lbs
ESEL EMU	189 lbs
ESEL Tools	300 lbs
PCS/COSS	25 lbs
ODF	79 lbs
UTILIZATION	425 lbs
Cryodewars	
CHECS	200 lbs
TVIS Equipment	119 lbs
TEPC	23 lbs
PHOTO/TV	82 lbs
MAINTENANCE	22 lbs
Water separator	30 lbs
RPCM	30 lbs
HCOR	60 lbs
ETVCG	132 lbs
Other	142 lbs

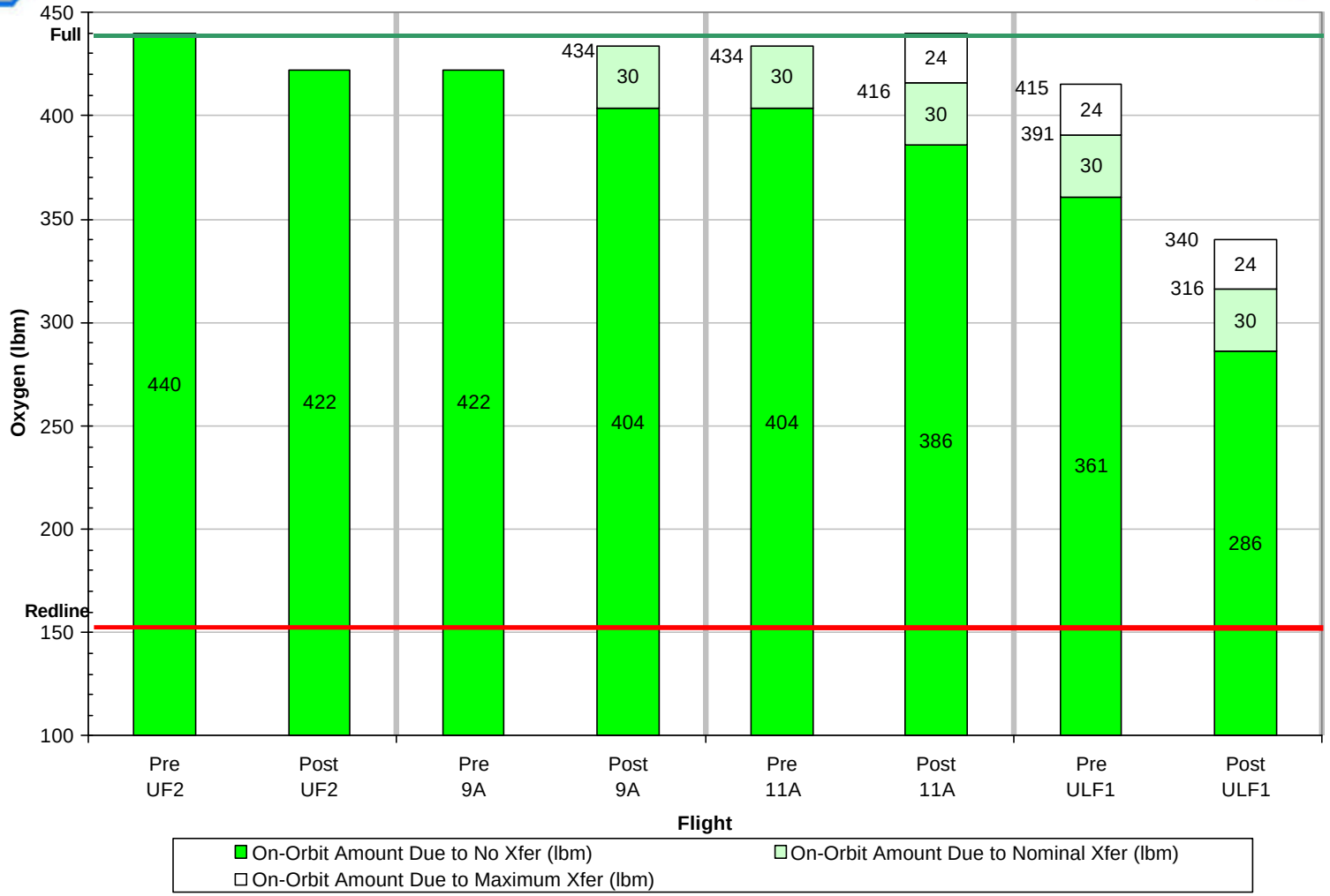
Descent

Ingress Equipment	12 lbs
Water Equipment	138 lbs
Middeck SI Items	29 lbs
ESEL EMU	122 lbs
ESEL Tools	320 lbs
PCS/COSS	25 lbs
ODF	52 lbs
UTILIZATION	364 lbs
CHECS	198 lbs
TVIS Equipment	172 lbs
TEPC	23 lbs
PHOTO/TV	104 lbs
C&T	82 lbs
MAINTENANCE	45 lbs
Bacteria Filters	13 lbs
RPCM	30 lbs
MCOR	16 lbs
CDRA	95 lbs
Water Separator	26 lbs
TRASH	20 lbs
ITCS	25 lbs
IUA	40 lbs

Nitrogen Profile



Oxygen Profile



LiOH Assessment for 9A

- LiOH Cans required for use by 9A are contingent upon CDRA operation:
  - "Best Case": dual-bed CDRA operational; EOM+3 duration
  - "Nominal Case": single-bed CDRA operational; EOM+3 duration
  - "Worst Case": CDRA not functional; EOM+3 duration

# LiOH Cans	Best Case	Nominal Case	Worst Case
Required	21	29	45
Manifested	31	31	31
Available for ISS Reserve	9*	1*	-15*
Resulting Stockpile	25 + 9 = 34	25 + 1 = 26	25 – 15 = 10

- * denotes that ISS Stockpile holds 1 can already expired that must be swapped out {Full Stockpile = 25 cans; currently 24 usable}
- Assumes ISS Stockpile can that expires 10/23/02 will be used during 9A docked time frame (based on 10/2/02 launch date)