6A Flight Readiness Review
(FRR)

International Space Station Program

Agenda

Mission Overview	**Floyd Booker**
Vehicle Readiness	**Steve Porter**
Program Integration Readiness	**Caris Hatfield**
GFE Flight Projects Readiness	**Cathy Dempsey**
Avionics/Software Readiness	**Peggy Thomas**
Payloads Readiness	**Rick Nygren**

6A Flight Readiness Review (FRR)
Mission Overview
International Space Station Program
April 05, 2001

OC/F. Booker

Agenda

- ISSP 6A Program Reviews
- Stage Overview
- Stage Mission Priority Summary
- Soyuz Relocation Plans
- Spacelab Pallet Manifest
- Payload Bay Sidewall Carriers
- Multipurpose Logistic Module (MPLM) Manifest
- ISS Stage 6A Consumable Status
- Configuration Status

ISSP 6A Program Reviews

Station Cargo Readiness Review (SCRR), October 20, 2000

- Provided confirmation and forward plans to ensure that cargo integration plans were defined and ready for implementation and manifested hardware and software items were ready to begin cargo integration process for flight.
- No exceptions to proceed

Launch Package Readiness Review (LPRR), March 13, 2001

- Addressed the CoFR-1 requirements for cargo elements and middeck stowed hardware and readiness for integration in the Orbiter.
- Completed successfully and authorized to complete payload processes

Stage Operations Readiness Review (SORR), March 27, 2001

- Addressed CoFR 2 requirements for the launch package, personnel, facilities, and operations and their readiness to proceed to launch 6A on 4-19-01.
- Authorized to proceed to launch 6A on 4-19-01.

Increment Overview

Increment Start: Flt 5A.1 launch (8 March 01)

Increment End: Flt 7A.1 undock (22 Jul 01)

Increment Duration: 136 days

6A Stage Duration: 42 days

Crew:

- **ISS2-1: Rosaviakosmos/Yury Usachev**
- **ISS2-2: NASA/James Voss**
- **ISS2-3: NASA/Susan Helms**

6A Stage Mission Priorities

1. Final Stow of 6A cargo
2. Perform SSRMS checkout
3. Dock 2 Soyuz TM to SM aft port
4. Reassign ISS 2 crew to 2 Soyuz TM as emergency crew return vehicle
5. Undock 1 Soyuz TM from FGB nadir port
6. Dock 4 Progress M1 to the SM aft port
7. Perform cargo and propellant transfer
8. Connect N2/O2 lines between Node 1 and the US Lab
9. Perform US/RS maintenance
10. Perform US/RS medical operations
11. Install the audio-video complex (Agat-2)
12. Perform reboost if required
13. Install 17 acoustic mats behind SM panels
14. Install sound insulating cover on Vozdukh system
15. Perform US/RS Payload operations
16. Install seat for 2nd TORU operator
17. Outfit SM TV system, onboard time-division multiplexer, onboard time division demultiplexer
18. Outfit SM onboard equipment control system
19. Install SM lights

6A Stage Mission Priorities

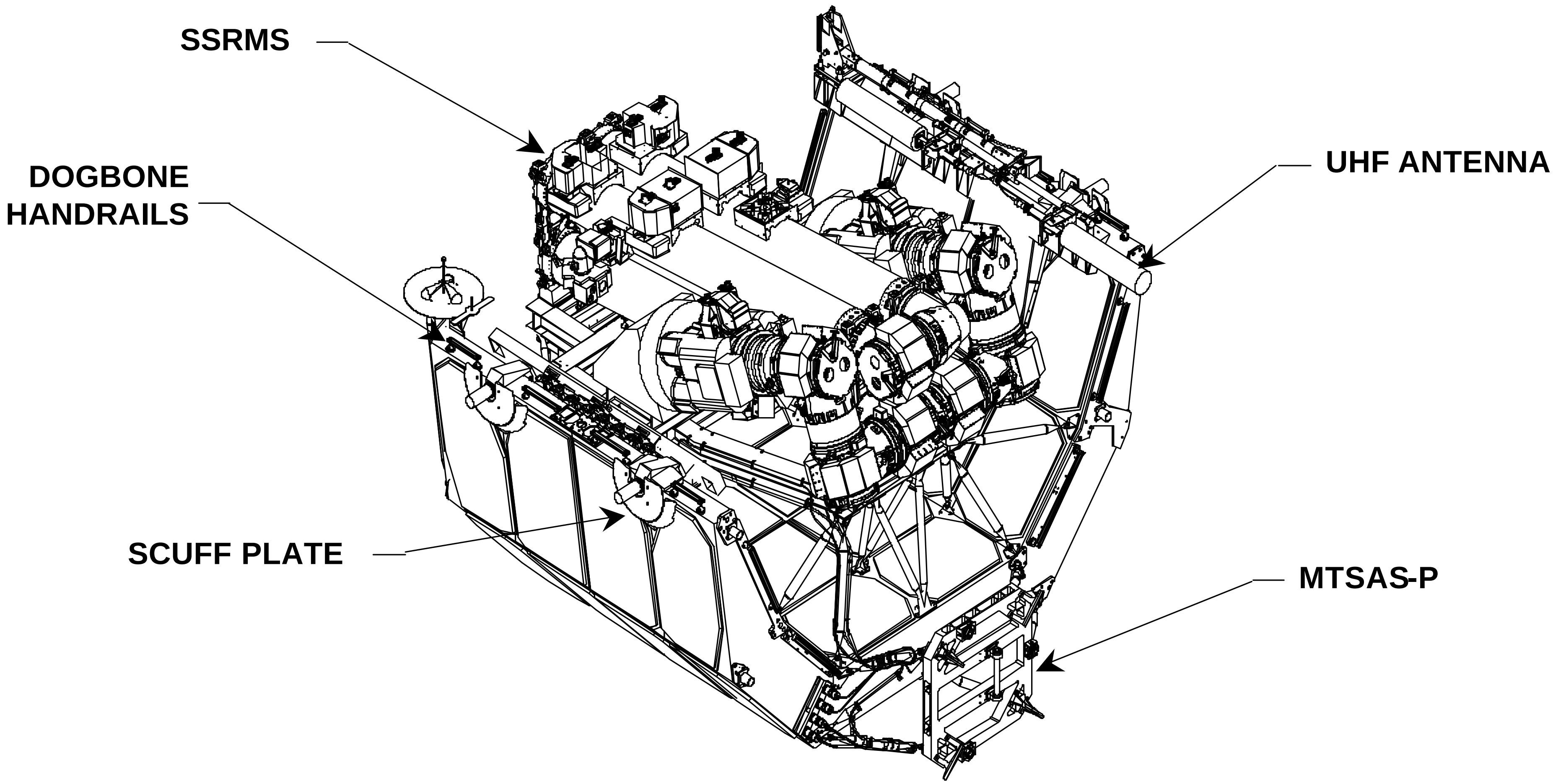
20. Install the experimental video complex (LIV)
21. Outfit SM Kriogem refrigerator
22. Install k-bar adapters in Node
23. Move LAB1O2 ZSR to Node
24. Perform prepack for 7A
25. Perform hardware staging for 7A
26. Setup SM radiation monitoring
27. Install SM air decontamination assembly, install revitalization subsystem
28. Set up SM TV system video monitor
29. Install SM work table
30. Install Global Timing System
31. Disassemble and dispose of following SM hardware:
    - A. Solar array deployment control unit
    - B. Remote switching unit
    - C. Matrix commutator
    - D. Pyrocartridge firing unit and installation brackets
    - E. Fairing separation unit switching unit
    - F. Common relay channel switch
32. Set up Glisser video complex
33. Perform RS Orlan EVA to transfer the docking cone to the SM nadir port
34. Perform TOCA tasks

Soyuz Relocation Plans

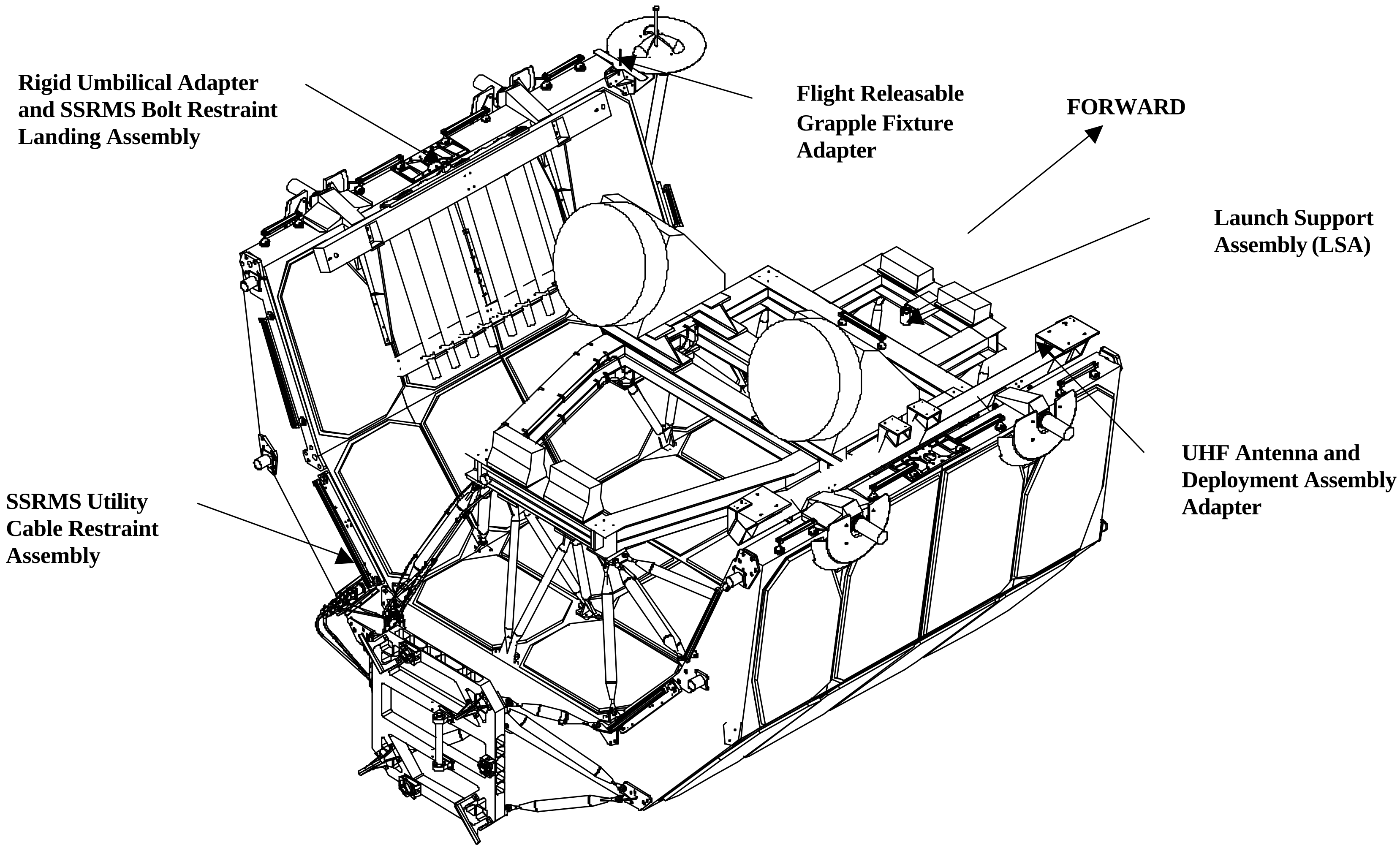
Russians have requested 1S relocation from FGB nadir to SM aft occur prior to 6A rather than with 2S after the Soyuz transfer

- **Rationale is not enough fuel in 2S to support relocation**
- **This is a 2+ day impact to Stage 5A.1 timeline, improves Stage 6A timeline**
- **U.S. side agrees**

Spacelab Pallet Ascent Manifest



Spacelab Pallet Return Manifest

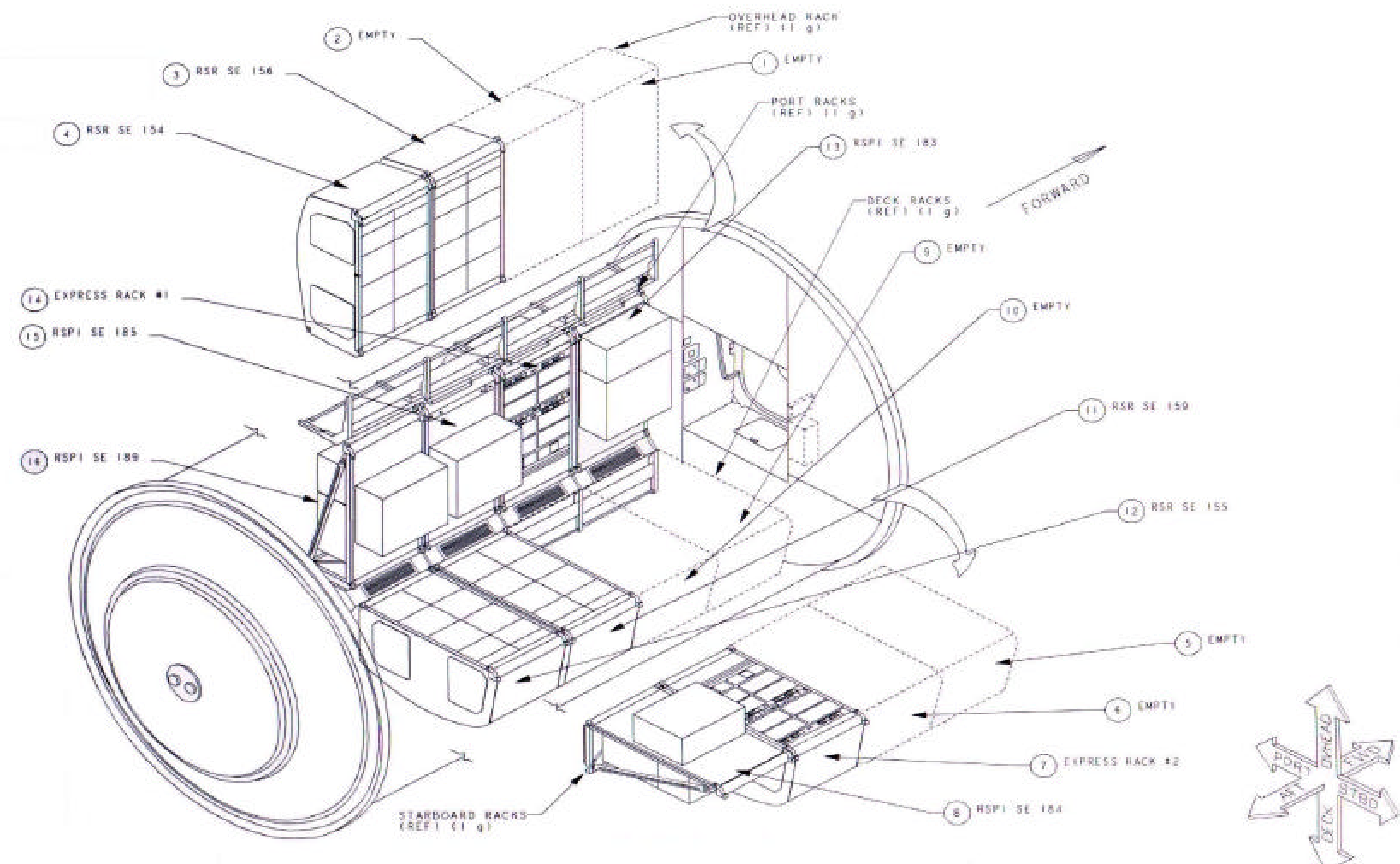


Payload Bay Sidewall Carrier

Sidewall Payloads

- Direct Current Switching Unit (DCSU) with Flight Releasable Attachment Mechanism (FRAM)
- IMAX3D Cargo Bay Camera (ICBC3D)

MPLM Ascent Configuration



Flight Module 2
Raffaello

MPLM & Orbiter Middeck Hardware Summary

Consumables

60 Food Containers
10 CWCs full of water
10 Half Bags of crew provisions (towels, napkins, wipes, etc.)
1 Half bag – Printer Supplies (Paper, batteries, ink cartridges, etc.)
4 Half bags of clothing each, for Susan and Jim, 3 Half bags of clothing for Yuri
Photo/TV Resupply Bag
IMAX Flim

Payloads

2 EXPRESS Racks with payloads ARIS Hardware
4 Active experiments from middeck to EXPRESS-1: CGBA, CPCG-H, two STES units
2 separately transferred payloads to EXPRESS racks: ADVASC and EXPPCS
Phantom Torso

Operations Support Equipment

Tools
Utility Outlet Bypass Cables
Common Berthing Camera System cables
Internal lab window cover

MPLM & Orbiter Middeck Hardware Summary

<u>Pre-positioned airlock Items</u>

Oxygen Recharge Compressor Assembly (ORCA),
METOX canisters,
One Additional Extravehicular Mobility Unit (EMU)
Replacement Simplified Aid for EVA Rescue (SAFER)
EMU Umbilicals

<u>Spares</u>

SSRMS Computer Unit
SSRMS Camera Assembly Spares
Electronics Control Unit (ECU)
Multiplexer/Demultiplexers (MDMs)
Remote Power Controller Modules (RPCMs)
Direct Current Switching Unit (DDCU)
Umbilical Interface Assembly
LiOH Canisters

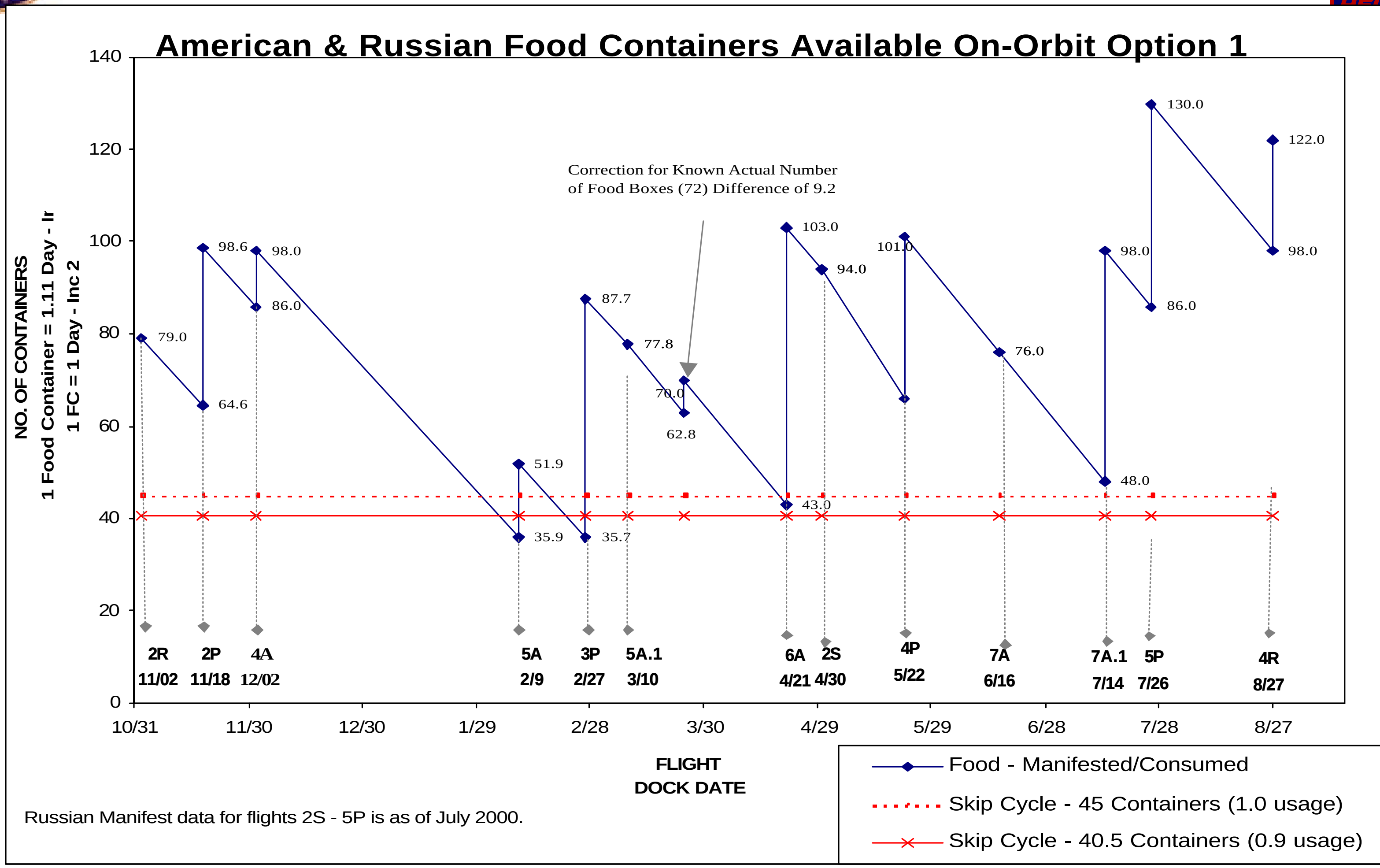
<u>Crew Health Care Equipment</u>

Interim Resistive Exercise Device (IRED) Canisters
Extra Treadmill Slats
Total Organic Carbon Analyzer (TOCA)

ISS Stage 6A Consumable Status

- **All consumables have been reviewed and are healthy for the 5A.1 Stage**
  - ISS propellant reserve requirement is met
  - Food reserve projected to dip below 45 day reserve to 36 days just before 6A arrival
  - EDV, KTO, KBO requirements are met, SWC's fall slightly below skip cycle
  - Oxygen cassettes are maintained at above the skip cycle throughout the stage for maintenance protection (assumes working electron)
  - LIOH is at the skip cycle requirement
  - Crew provisioning requirements are met
  - Water is maintained at well above the skip cycle throughout the stage
  - Details are found in backup charts.

Food Containers Available On-Orbit Traffic Model



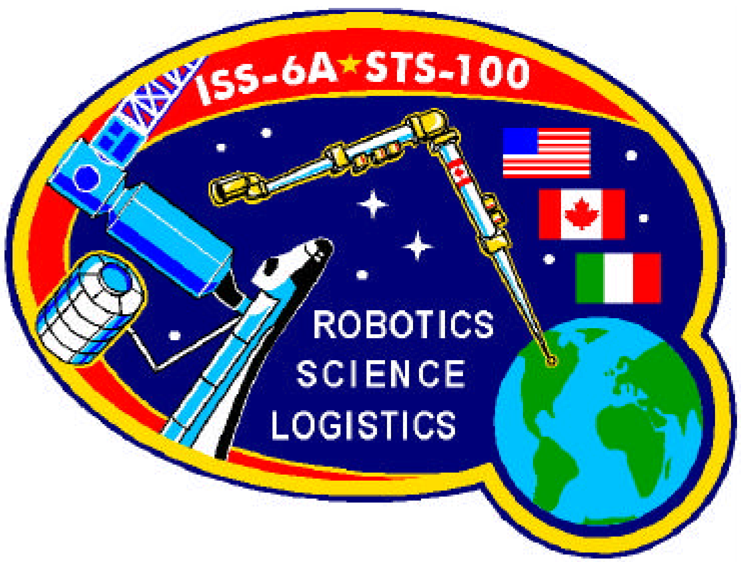
6A Configuration Status

- All 6A approved changes including waivers, deviations, and exceptions, have been identified and incorporated. (except as noted in backup charts).
- The 6A as-built configuration has been reconciled with the as-designed baseline (except as noted in backup charts).
- 6A open work has been identified and will be tracked to closure.

Launch Commit Criteria Statement

- **All Stage Readiness Requirements and Stage Launch Commit Criteria have been verified GO.**
- **Applicable Flight Rules are in compliance with the Stage.**
- **There are no 6A Cargo Element Launch Commit Criteria.**

ISS
Vehicle Office
Flight Readiness Review



04/05/01

AGENDA

•6A On-Orbit Status	Walker

SPECIAL TOPICS

•PCU Plan	Eliason
•RWS UOP Plan	Gholdston
•BGA Locking For Docking/Undocking	West

On-Orbit Status

Shannon Walker

On-Orbit 5A.1 Fly Around

On-Orbit Configuration ready for 6A Flight

On-Orbit Hardware Status

Failure	New Since 5A.1 FRR	Impact to 6A Operations	Topic to be Presented	Additional Ground Testing or open work	On-Orbit Repair scheduled or required
FPP Failure to acquire data	No	Yes	Yes (Vehicle)	Yes	Yes
RWS UOP Trip	Yes	No	Yes (Vehicle)	Yes	Yes
TVIS	No	Yes	Yes (GFE)	Yes	Yes
BGA Latch Failed	Yes	No	Yes (Vehicle)	Yes	Yes
Ku Band Acquisition Issue	Yes	TBD	Yes (Avionics)	Ground OPS Only	Yes
Water Vent Problems	Yes	Yes	Yes (On-Orbit)	Yes	Yes
CBCS Video Failure	Yes	Yes	Yes (Avionics)	Yes	Yes
CDRA	Yes	No	Yes (On-Orbit)	No	Yes
RPCM Health Flags	Yes	No	No	Yes	Yes
SM Battery #8 Failed	Yes	No	No	Yes	No
SM Air Conditioner # 2 (SKC-2) Failed	Yes	No	No	Under evaluation	No
SM Rapid Depress Algorithm Disabled	No	No	No	No	Yes (on Ground in Russia)
Vozdukh Operating on 2 of 3 CO2 Beds	No	No	No	Under evaluation	No
CMG	No	No	Yes (Avionics)	Under evaluation	No

Water Vent Plan

- Attempts to vent on 5A.1 showed flow was significantly below expected value
- Suspect vent is clogged and requires R&R of vent filter
  - Replace with Orbiter Contingency waste water dump filter and associated fittings
  - Proven Hardware used with waste water(urine and condensation) vent on Orbiter
- Provides filter depth to increase lifetime
- R&R hardware being manifested on 6A
- Condensate can be drained to CWC's if functionality is not restored
  - Requires coordination of on-orbit stowage and down manifesting/venting from Orbiter
  - Can be accommodated Indefinitely

- **Resolution is not a Constraint to LP 6A**

CDRA Issues

- CDRA two stage pump failed to start during AR rack activation on 5A
- Pump, pump controller, and controller cable R&R'd on March 29
  - R&R'd pump on down manifest
- Subsequent start up attempts showed
  - Pump operational
  - Pump could not pull a vacuum on CO2 bed #1
- Troubleshooting has led to belief that the check valve between the CO2 bed and its desiccant bed is not seated
    - Have seen similar problem on the ground
    - Ground problem solved by pulling a vacuum on the vent line and reseating check valve
    - On-orbit vacuum on vent line failed to reseat valve
- Further troubleshooting planned for week of April 2
- Russian Vozdukh is Primary System and CDRA is Secondary
  - No immediate impacts to on-orbit operations
  - LiOH for 15 Days
  - Russian Vozdukh has 2nd CO2 bed and other spares on-orbit

- **Resolution is not a constraint to LP 6A**

EEPROM Refresh Plan

- Prior to 5A.1, 7 bit flips have occurred in 6 different ORUs
  - 2 more bit flips have occurred since 5A.1 launch
  - 7 of 9 bit flips have been cleared by refresh or R&R (1 R&R, 6 refresh procedures successfully run).
    - N14B-B - To be refreshed the week of 4/2/01
    - N13B-A - Working on a procedure to write a single bit to SRAM so that the refresh procedure will successfully clear bit flip. -ECD 4/20/01

- Short and long term solutions being addressed
  - Operate with existing EEPROM
    - Refresh from SRAM when bit flips occur - Current short term solution
    - Periodic Refresh as Maintenance
  - Operate out of SRAM backup memory
  - Upgraded EEPROM Replacement options
  - Develop on-orbit firmware download capability for all EPS ORUs
  - ART formed to discuss issues with each option

•EEPROM can continue to be refreshed as required-Not a constraint to LP 6A

PCU Plan

Brenda Eliason

PCU Background

- PCUs FM-01 and FM-02 launched on 3A
  - Active since 4A to control electrical potential of ISS relative to plasma
  - Performance has been excellent
    - Heater issue requiring dual-PCU operation at times to keep lines warm
- PCU FM-03 contamination issue being worked at GRC
- Floating Potential Probe installed on 4A <u>confirmed</u> PCU function to control ISS potential
  - FPP provides direct measurement of ISS FP
  - FPP currently non-op – 6A troubleshooting planned
- Two remaining hazards associated with ISS potential
  - Passive Thermal Control surface degradation (ISS FP >74V)
  - EMU arc (ISS FP >40V)
    - EVA office has action to review 40V limit
- Testing (SDTO) continues to be executed to refine model of ISS/plasma interaction
  - Worst-case predicted ISS FP is 100V (was 160V)
  - Shunting confirmed as hazard control
  - Arrays-to-wake better hazard control than expected
    - Allows more flexibility with pointing (increased safe range for arrays to wake)
  - Passive plate to control hazard now potentially feasible

PCU - EVA plan for 6A

- PCU - EVA plan for 6A
  - Operate with both PCUs and solar arrays to wake position
    - Provides required redundancy for arc hazard
    - Energy balance analysis shows margin
  - Same plan used on flights 4A – 5A.1
  - Requires that all PCU failures are detectable on ground within minutes
    - Recent PCU FMEA TIM :
      - <u>confirms</u> that all PCU failures detectable on ground
      - <u>confirms</u> no credible single-point failure scenario which causes both PCUs to fail
    - If loss-of-signal, on-board C&W detects some PCU failures
- Additional PCU DTOs continue to characterize the environment and risk
  - Scale the hazard with possible alternative approaches to control
  - Verify and refine model
- Options for future flights in work
  - Additional hardware to allow full SAW Tracking and required fault tolerance
  - Operational workarounds to ensure safety of EVA
  - Options for R&R of FPP in work
- **<u>PCU Configuration and EVA Plan is acceptable for Flight 6A</u>**

RWS UOP Plan

Ed Gholdston

RWS UOP Trip Mitigation Plan

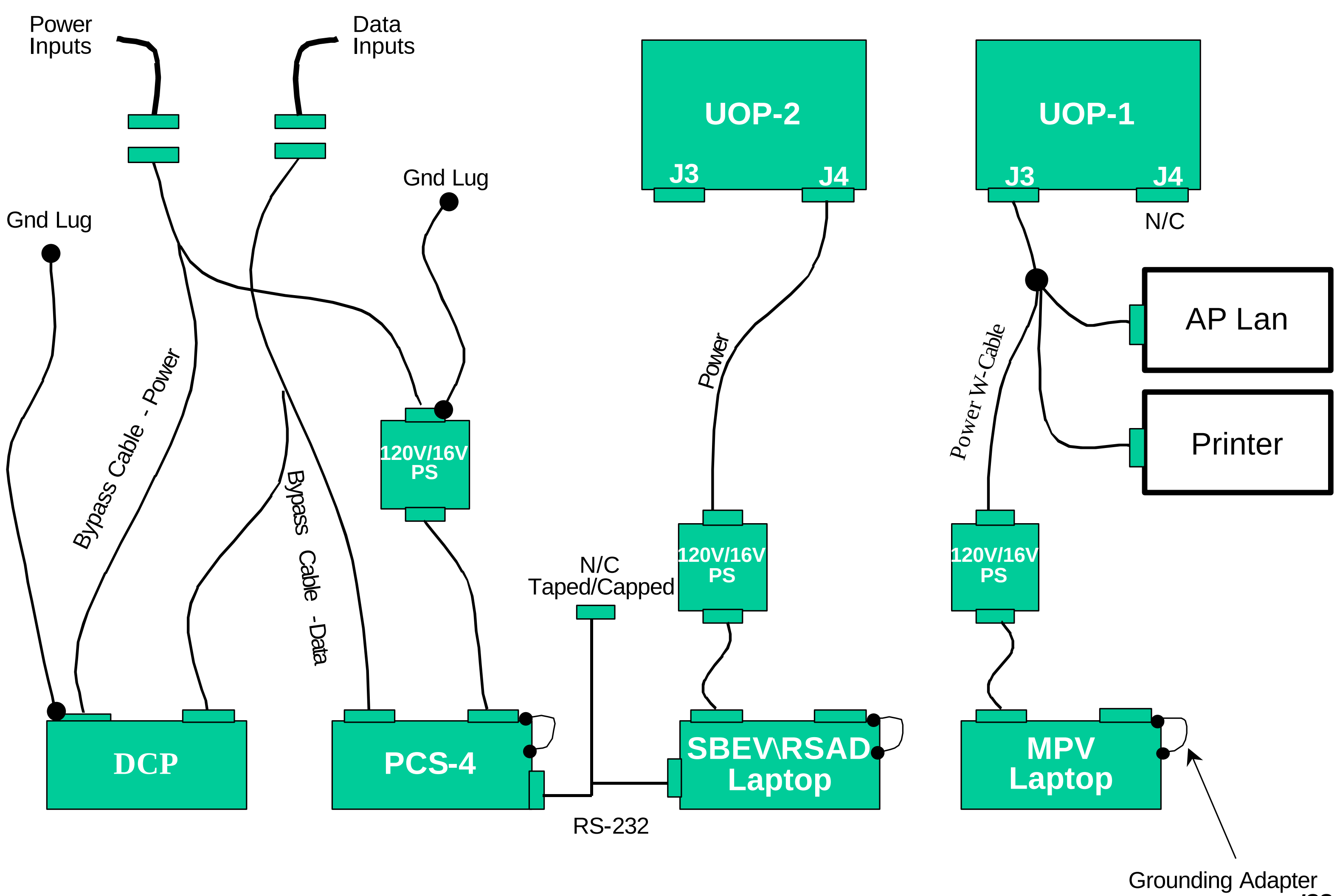
- As a result of the UOP GFCI trips observed on-orbit during the 5A.1 flight, options to bypass the GFCI have been developed
  - RWS operation demonstrated using two DCP cables during the 5A.1 stage
    - One DCP cable used for providing data from MSS rack UOP and the other DCP cable used for providing power from the CHECs defibrillator outlet which has no GFCI
    - Since both DCP cables are used, only one RWS can be powered at a time
    - On-orbit ground strap fabricated by crew to maintain 3 hazard controls
  - Bypass cables for both MSS rack UOPs have been manufactured and are manifested on 6A
    - UOPs in MSS rack are removed which eliminates GFCI tripping
    - Allows both Lab and Cupola RWS' to be powered at same time
    - Bypass cables add additional ground straps to maintain 3 hazard controls
    - Testing at KSC on 4/4-5 will verify bypass cables

Plan for 6A Flight and Stage Operations

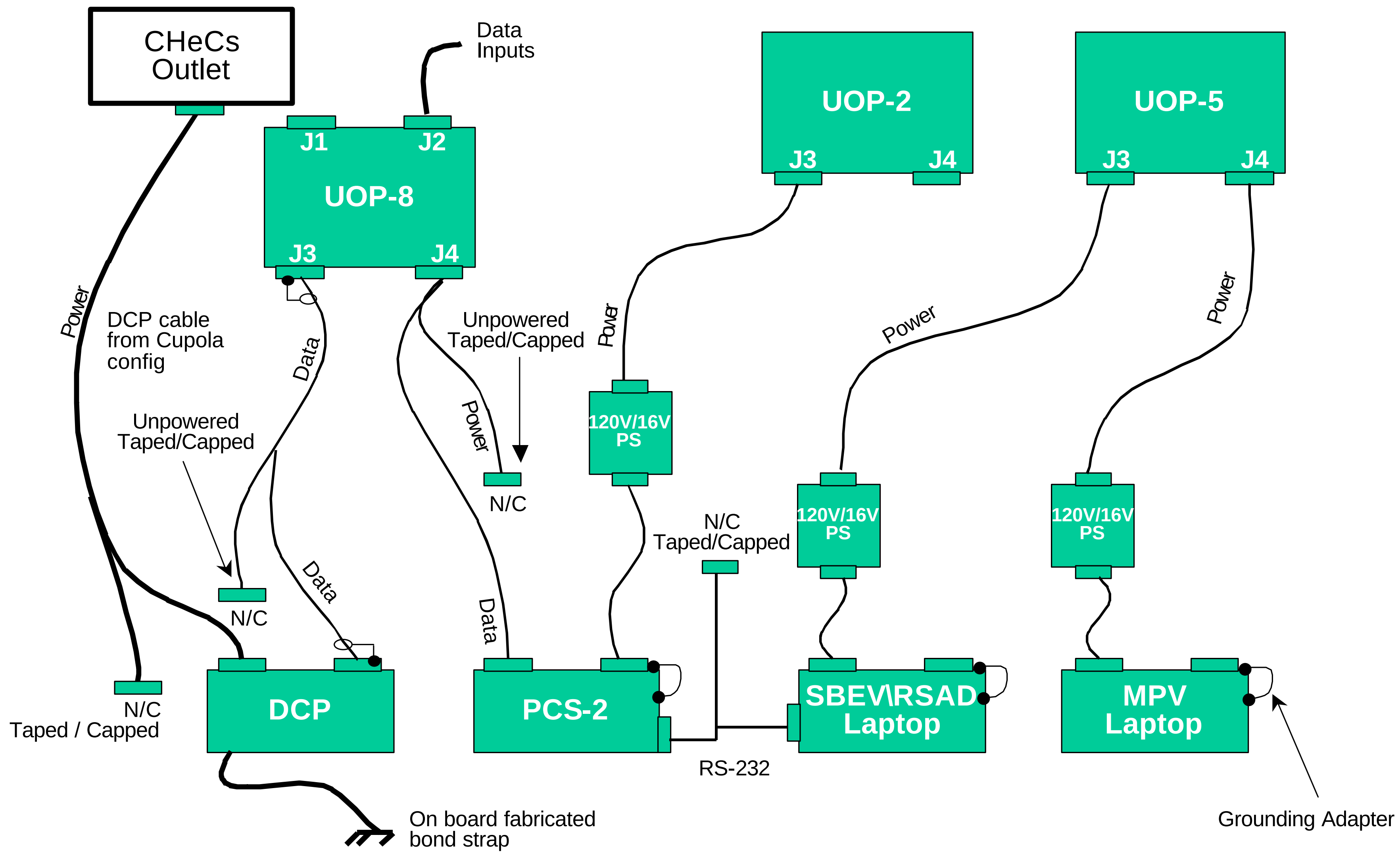
- Before 6A docking
  - Cupola RWS will be configured using both DCP (Display and Control Panel) cables
  - UOP from Lab MSS rack will be removed
- After 6A docking, before SSRMS walkoff
  - Bypass cables will be transferred from Shuttle to Station
  - Crew will perform IFM to install bypass cables on Lab RWS
  - Lab RWS will be used as primary for walkoff operations with Cupola RWS as hot backup
- After SSRMS walkoff
  - Bypass cables will be installed on Cupola RWS

- The above approach reduces the IFM time prior to SSRMS walkoff and provides 2 functional RWS'
- Once both bypass cables are installed, they will remain in place until long term UOP GFCI resolution is put in place

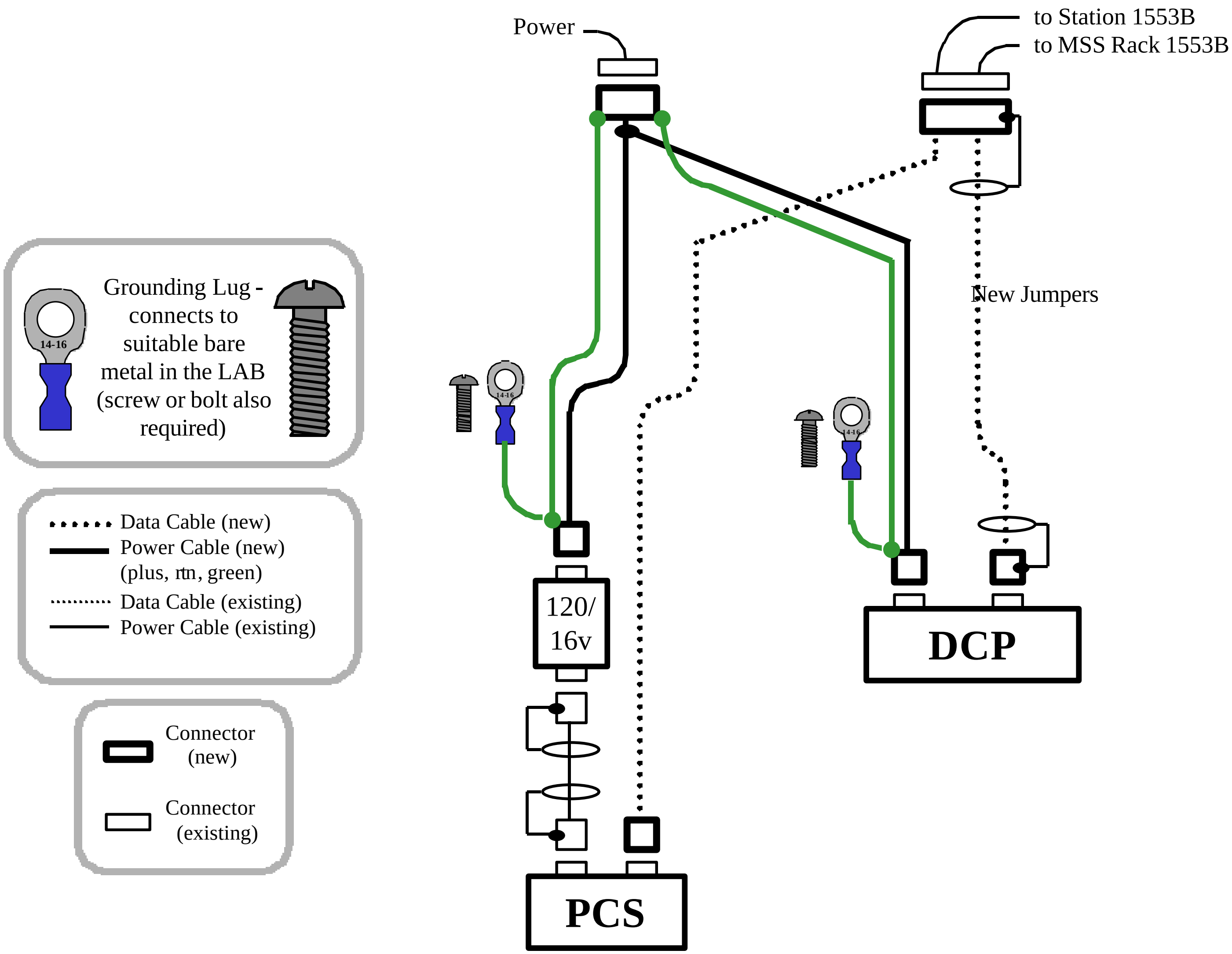
6A Lab RWS Configuration
Using bypass cable



6A Cupola RWS Configuration Using 2 DCP cables



UOP Bypass Cable Detailed Design



BGA Locking For Docking/Undocking

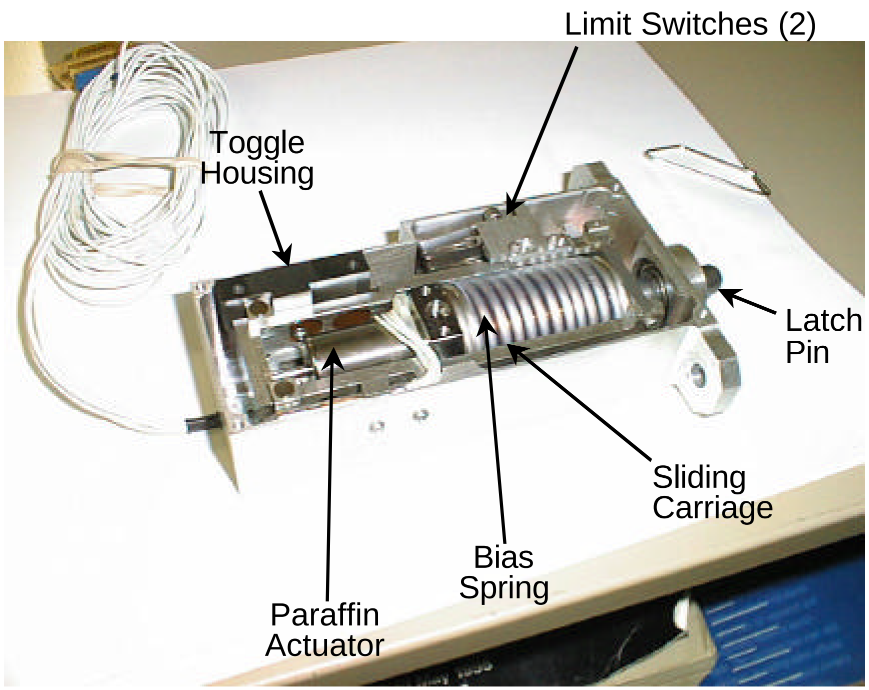
Scott West

BGA Latch Requirements for 6A Orbiter Approach and Separation

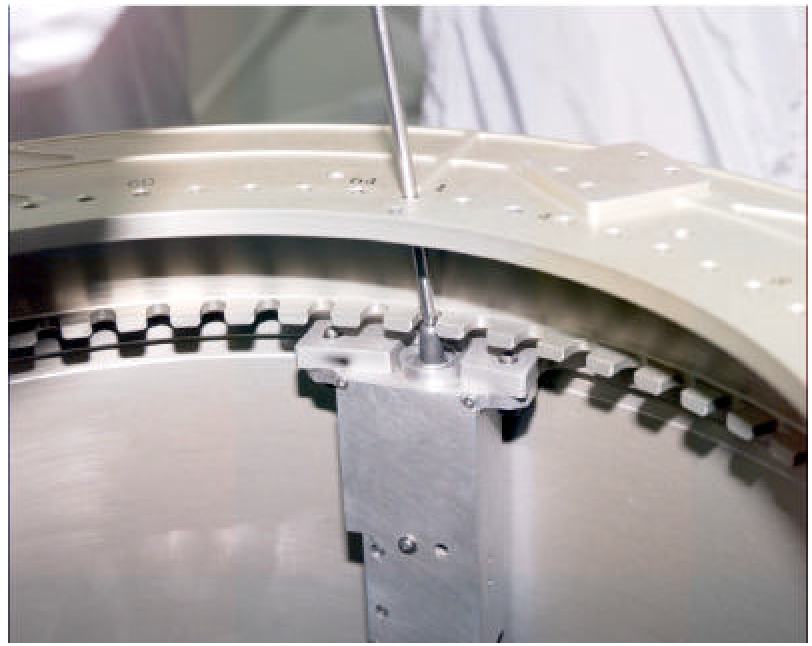
- During Flight 5A.1 Orbiter rendezvous, 4B BGA Latch 2 failed to engage to lock the SAW in a feathered orientation for approach
  - 4B BGA Latch 1 was subsequently commanded and engaged successfully
- The root cause investigation initially was inconclusive, however an apparent latch drag signature was observed starting 3/30/01
  - Closer inspection of data previous to 3/30/01 revealed the same signature with much lesser magnitude ever since the failure to engage
  - Signature continued to grow until 4/1/01 and has leveled off
- Current plan is to cycle 4B BGA latch 2 to engaged, then disengaged just prior to Flight 6A EVA 2
  - Mitigates potential for latch failed engaged, which would lock the SAW and impact power and CMG momentum management
- Telemetry will be monitored continuously to ensure drag signature does not become worse and cause hardware damage
  - EVA backup for latch engagement
  - EVA backup for latch release

BGA Latch Requirements for 6A Orbiter Approach and Separation

BGA Anti-rotation Latch

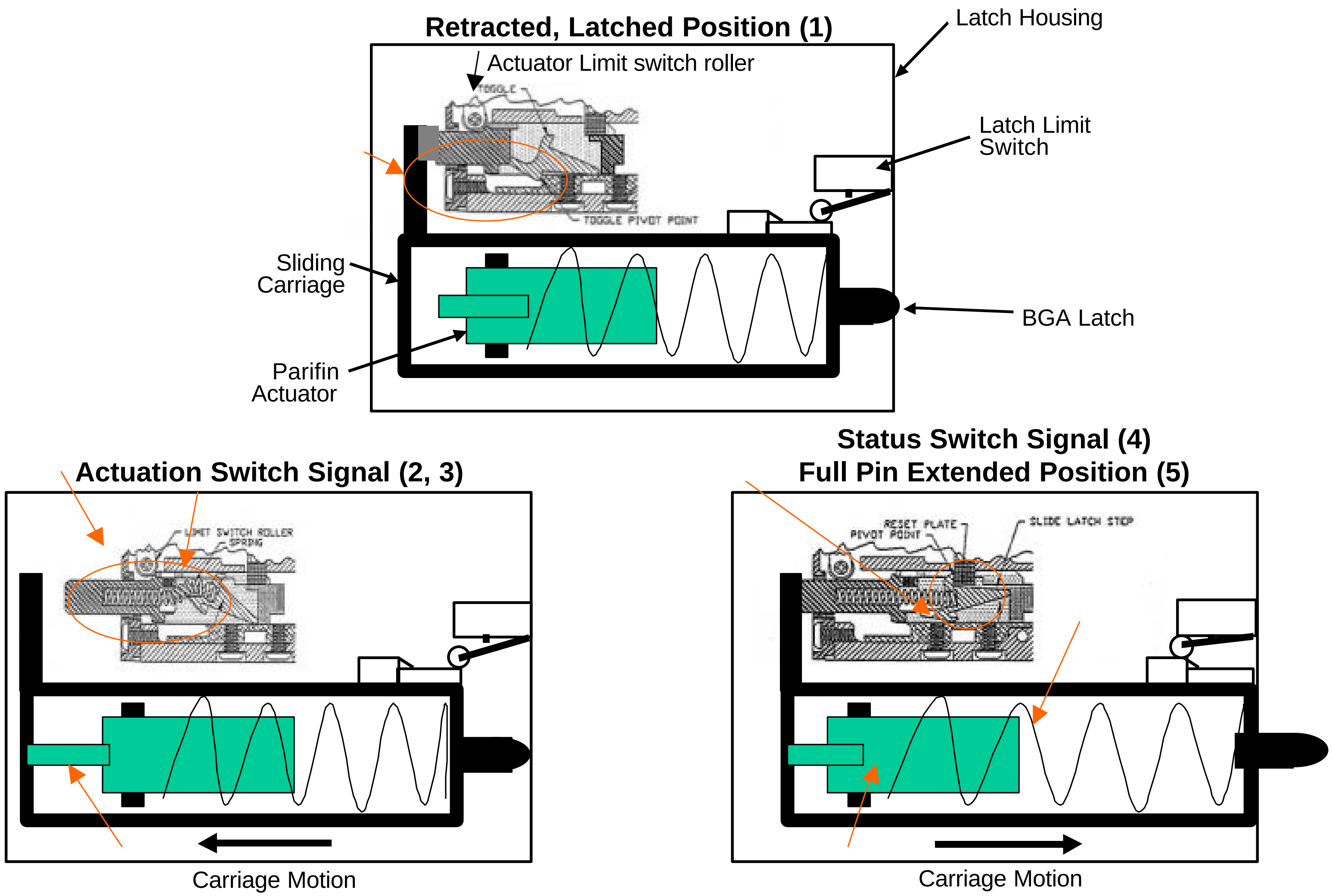


Latch Pin Engagement with Inboard Bearing Support



BGA Latch Requirements for 6A Orbiter Approach and Separation

Latch Actuation Cartoon - BGA Latching



BGA Latch Requirements for 6A Orbiter Approach and Separation

- Because of the zero fault tolerance (remotely commanded) of the BGA latches, analysis has been conducted to investigate relaxation of locking requirements during Orbiter approach and separation
  - BGA latches are mechanically redundant for latching but are electrically zero fault tolerant
  - BGA latches are zero fault tolerant for unlocking

BGA Latch Requirements for 6A Orbiter Approach and Separation

- A rigorous analysis process has been followed to address Orbiter approach and separation for ISS configurations up to 11A (point in current assembly sequence where SAW configuration changes)
  - Orbiter approach and separation firing histories defined by databases of pilot-in-the-loop simulations
  - BGA control system analysis with feathered SAWs
    - Ensures controllability and maintains structural loads within certification limits
  - Structural analysis of unfeathered SAWs
    - Ensures margin against structural limits in the event of BGA controller failure
  - Thermal analysis of unfeathered SAWs
    - Ensures margin against thermal limits in the event of BGA controller failure

BGA Latch Requirements for 6A Orbiter Approach and Separation

Flight 6A Orbiter Approach Preliminary Results

- Results to date show that a small risk of motor stall exists for operation of the BGAs in directed position mode (unlocked) during Orbiter approach
  - Continuing analysis of additional approach firing histories to better quantify risk
- Recommend maintaining baseline of feathered/locked SAWs for Orbiter approach until further analysis is conducted

Analysis Parameter	Predicted Result	Limit
SAW angle error (deg)	1.13	+/-1 (+/-6)
SAW angular veloctiy (deg/sec)	0.59	+/-2
BGA motor current (amps)	0.16	1.4
BGA motor torque (in-lbs)	45.28	320
Peak % of structural limit load (%)	75 (blanket membrane stress)	100
SAW blanket temperature (deg F)	TBD	212

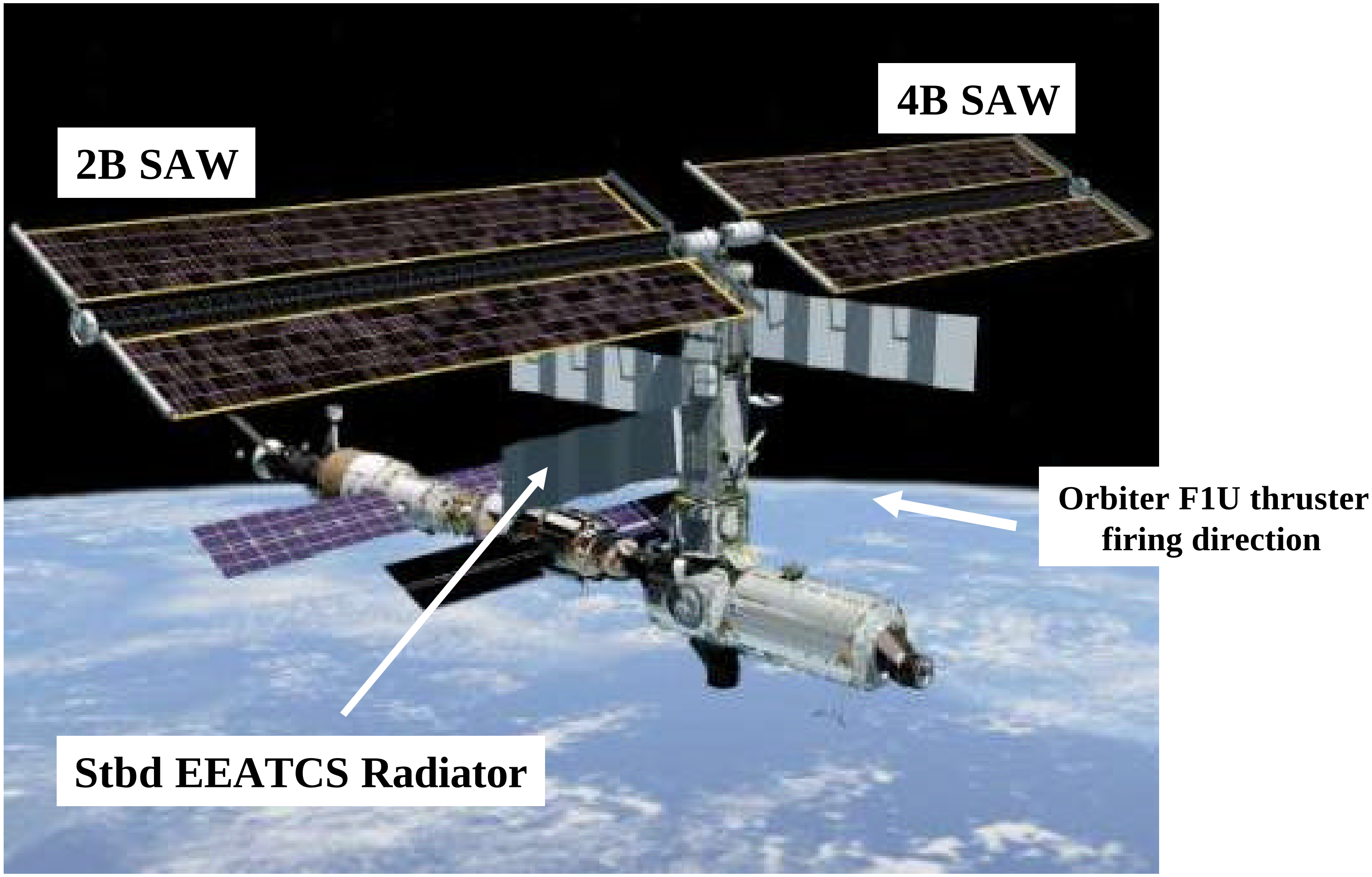
BGA Latch Requirements for 6A Orbiter Approach and Separation

Flight 6A Orbiter Separation Results

- Results of these analyses show that adequate margin exists to allow operation of the BGAs in directed position mode (unlocked) during Orbiter separation

Analysis Parameter	Predicted Result	Actual Result (2B/4B)	Limit
SAW angle error (deg)	0.31	0.23/0.06	+/-1 (+/-6)
SAW angular veloctiy (deg/sec)	0.17	0.10/0.04	+/-2
BGA motor current (amps)	0.05	0.06/0.01	1.4
BGA motor torque (in-lbs)	14.15	16.98/2.83	320
Peak % of structural limit load (%)	64 (blanket membrane stress)	N/A	100
SAW blanket temperature (deg F)	190	N/A	212

BGA Latch Requirements for 6A Orbiter Approach and Separation



Program Integration

April 5, 2001

Program Integration

• Robotics	Skip Hatfield
• CSA	Benoit Marcotte
• Russian Elements	Jeff Arend
• MPLM Return Certification Plan	Jeff Arend

MSS Robotics Initial Capability

6A Flight Readiness Review

April 5, 2001

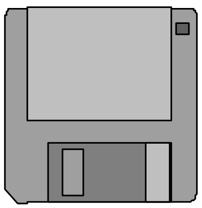
Caris A. (Skip) Hatfield

CSA & Robotics Integration Office

ISS-C- 3

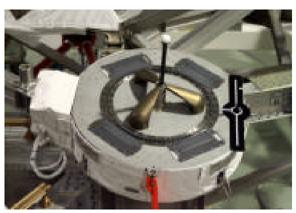
MSS Robotics Initial Capability

5A



Software

PDGF

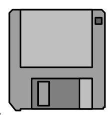


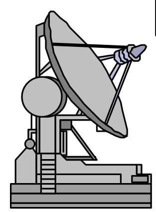
VSC

5A.1

RWS (GFE)

AVU (GFE)

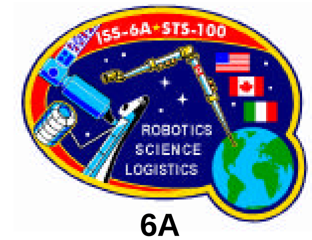




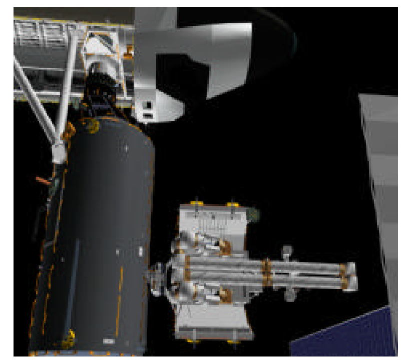
Software Upgrades (CSA)

Rigid Umbilical (Boeing)

LCA (Boeing)



6A



Canadarm 2

6A is a major step in achieving initial station-based robotics capability

Jeff Arend/281-244-7038

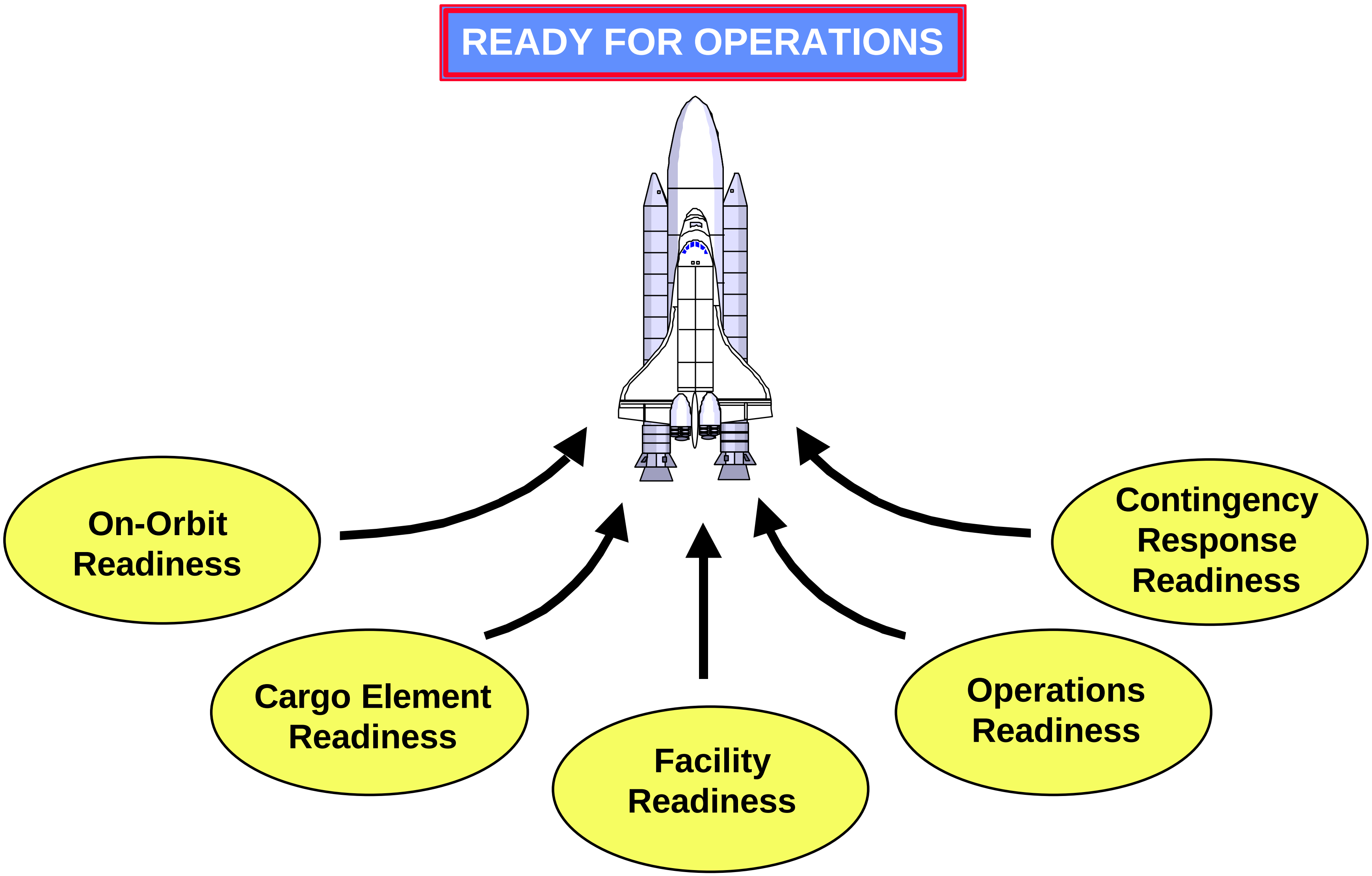
MSS Robotics Initial Capability
Robotics Readiness

	5A.1	5A.1 Stage	6A
Robotic Work Station (RWS)	**COMPLETE**	**COMPLETE**	
RWS Video		**COMPLETE**	
Portable Computer System (PCS)		*** 4/6/2001**	
Robotics Birds Eye View (RBEV)		*** 4/6/2001**	
Robotics Situation Awareness Display		*** 4/6/2001**	
Manual Procedure Viewer (MPV)	**COMPLETE**	**COMPLETE**	
Utility Outlet Panel (UOP) Bypass (5A.1)		**COMPLETE**	
Bypass 6A Ground Test		**4/5/01**	
6A UOP Fix			**X**
Artificial Vision Unit (AVU)		**COMPLETE**	
Software Update		**4/16/01**	

*** Lab RWS configuration completed 3/30/01**

Jeff Arend/281-244-7038

MSS Robotics Initial Capability Operational Readiness



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MSS Robotics Initial Capability On-Orbit Readiness

- RWS/Control Equipment On-Orbit Checkout
  - UOP anomaly covered on following chart
  - Lab RWS commissioning – COMPLETE
  - Will complete Cupola RWS configuration commissioning 4/6/01

- Software Update
  - Complete validation of 6A Graphical User Interface (GUI) configuration files 4/5/01
  - Uplink software update NLT 4/16/01

NO CONSTRAINTS TO LAUNCH AND ON-ORBIT OPERATIONS

Jeff Arend/281-244-7038

MSS Robotics Initial Capability
UOP Strategic Plan

- There are two major constituents to a successful resolution of MSS control equipment.
  - On-orbit checkout
  - Bypass cable manufacture/test
- On-Orbit
  - Configure Lab and Cupola RWS with bypass power from CHeCS rack
  - Successful power-up and activation completed
- Bypass Cable Manufacture
  - Manufacture complete - 4/4/01
  - Integrated checkout with RWS – 4/5/01

NO CONSTRAINTS TO LAUNCH AND ON-ORBIT OPERATIONS

MSS Robotics Anomaly Resolution Facility Readiness

- Two Facilities are Configured to Provide Ground-Based Replication of On-Orbit Systems
- MSS Avionics Integration Facility – Brampton, Canada (CSA)
  - Configured for flight-following mode for Canadarm 2 and control equipment anomaly resolution
  - RWS projected delivery is 4/7/01 for integration
  - Completion of upgrades - ECD 4/5/01
    - » Operations Readiness Review (ORR) – 4/6/01
  - Full flight-following mode configuration integration - ECD 4/19/01
- ISS Software Integration Lab (ISIL) – Houston, Texas USA (NASA)
  - Configured for 6A video architecture for flight-following mode
  - Hardware in place

FACILITIES ARE READY TO SUPPORT

Jeff Arend/281-244-7038

MSS Robotics Initial Capability
CSA Facility Readiness

- MOTS – MSS Operations Training System
- ESC – Engineering Support Center
  - Support CHITs, real-time monitoring and anomoly resolution
- MSEF – MSS Sustaining Engineering Facility
  - Support anomaly resolution, ESR processing, and software patch generation/test/verification
- R-MPSR – Remote Mission Planning Support Room
  - Multi-purpose support room that supports front room consoles
- OPR – Operations Planning Room
  - generate reconfiguration files as required and to deliver files to MBF using a VPN link from CSA to MBF

FACILITIES ARE READY TO SUPPORT

Jeff Arend/281-244-7038

MSS Robotics Initial Capability Operations Readiness

- Integrated Flight Control Team in Place and Ready for Flight
  - CSA flight control & support team will be in the Mission Control Center (MCC-H) in Houston
  - CSA flight controllers in St-Hubert in flight following mode
  - Mission Evaluation Room (MER)/Engineering Support Center (ESC) Team certified and in place
  - Increment Management Center Team certified and in place
- Integrated Management Team in Place Using Same Management Processes Used During Development Phase

Jeff Arend/281-244-7038

Flight 6A Forward Work

- Required MSS IFL uplinks prior to Flight 6A (NASA Action)
  - LEE Control Software CSCI Revision G (from Rev. F)
  - 6A PCS GUI Configuration file update

    Note: MSS IFL SW is fully certified and delivered to the NASA MBF
- UOP Plan

Jeff Arend/281-244-7038

Force Moment Accommodation (FMA) On-Orbit Verification

- Description
  - The specified performance of the FMS cannot be demonstrated by test on the ground in a 1-g environment.
  - The FMS will be characterized on orbit during flights 6A through 11A and that characterization data will be used to show compliance to the FMA requirement.
  - The SSRMS Force Moment Accommodation (FMA) specified capability cannot be verified until the Force Moment Sensor (FMS) performance is characterized on-orbit.
  - FMA is not required until Flight 1J/A.

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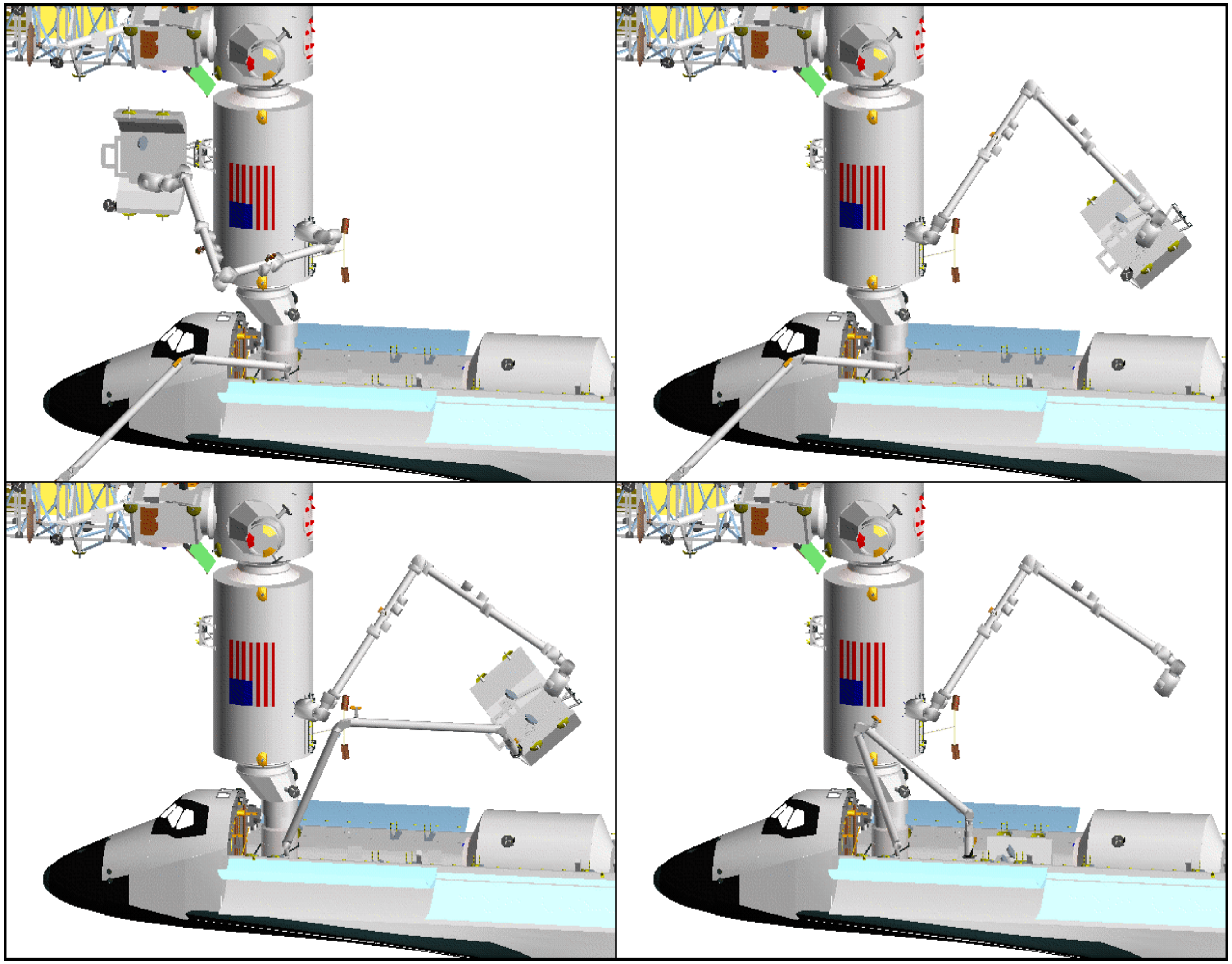
Special Topic
Canadarm 2 Hand-off

- Issue: Will residual loads induced in the hand off operation from SSRMS to SRMS cause damage, thereby prohibiting this operation
  - Loads induced during SRMS rigidization will likely cause movement of the SSRMS Latching End Effecter (LEE) on release from the FSEGF.
- On further investigation, the issue applies any time the LEE is released from FSEGF
  - Issue exists regardless of when the FSEGF is released
  - This is acceptable ***provided*** no hardware damage results from LEE contact with structure
- Therefore, there is no issue preventing SLP handoff.
  - Conclusions reached following investigation of residual loads on all FSEGF release cases are documented on the following charts.

SLP Handoff Operation



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Conclusion

- CSA/MDR conducted analysis of worst case load conditions for FSEGF release.
- Analysis concluded there is low probability of damage to SSRMS during the release.
- No further action required, FSEGF to LEE release cleared for all planned operations.

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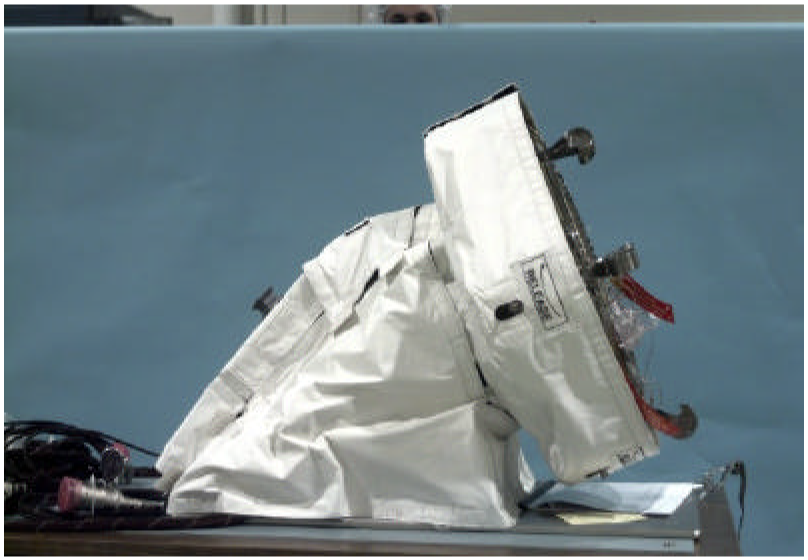
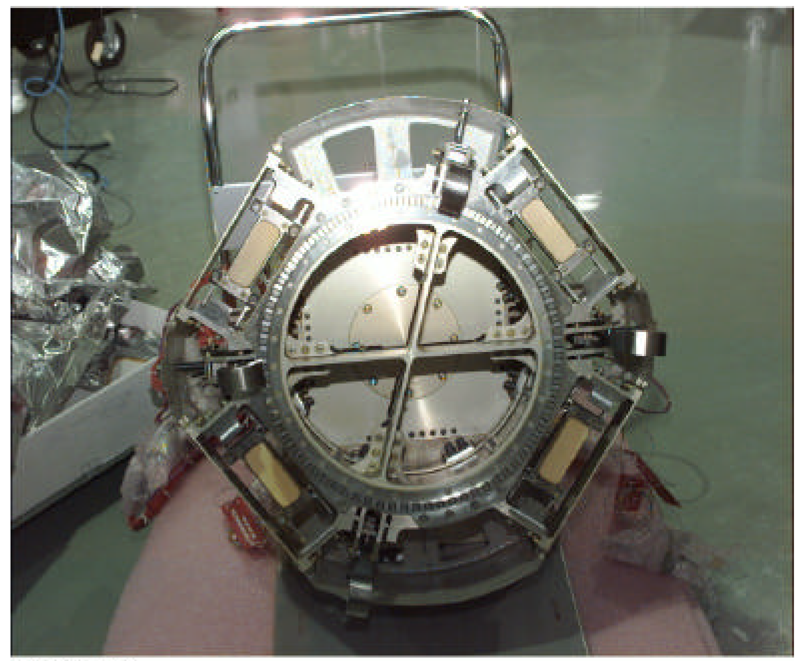
FSEGF





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SSRMS with FSEGF

97E02514 1997:07:08 00:56:25
Serial : 4151195 Firmware : 031696
Frame : 22 Shtr : 160 Exp : P Exp Comp : -1.3 Dist :
ISO : 200 Lens : 24 Prog : SP Mtr Area : Mtrx
Drv Mode : S F Sync : Norm F Mode : S F Area : Wide

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MSS Robotics Cargo Element Certification
SUMMARY

- NASA and CSA have completed an integrated plan for flight certification.
  - Including hardware, avionics and software, cargo element, ground facilities, and flight support team.
- On-orbit hardware and software is operational, with new power cables arriving on flight 6A.
- The one significant piece of open work is the uplink of the MSS SW upgrade

THE MSS SYSTEM IS READY FOR ITS INITIAL OPERATIONAL CAPABILITY ON FLIGHT 6A.

Jeff Arend/281-244-7038

Canadian Space Agency Agence spatiale canadienne

CSA ASC

Mobile Servicing System Flight 6A FRR

Benoit Marcotte

April 5, 2001 01

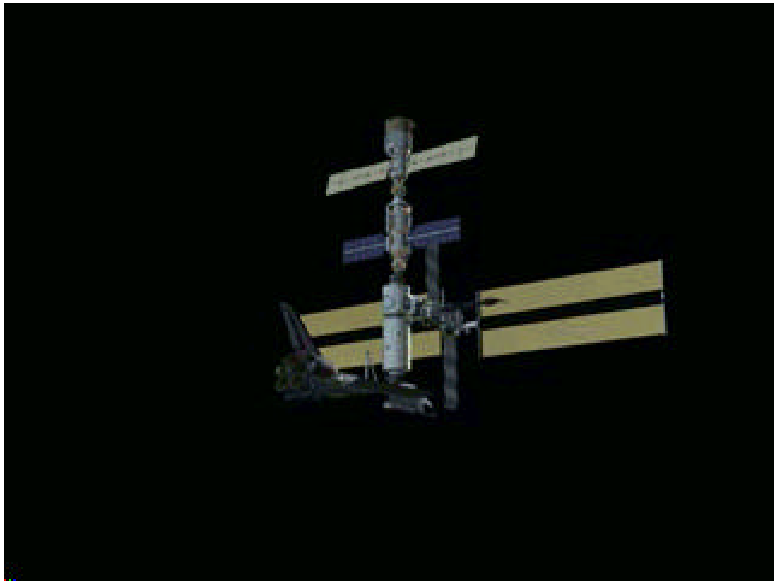
Canada

6A Flight Highlights

- FD1 – Launch
- FD3 – Rendezvous and docking
- FD4 – EVA 1: Canadarm 2 Deployment
- FD5 – Canadarm 2 Lab Grapple
- FD6 – EVA 2: Canadarm 2 Powered from the Lab PDGF
- FD7 – Space Lab Pallet Handoff
- FD8 – EVA 3: Unscheduled, Airlock Dry Run
- FD9 – Unloaded checkout
- FD10 – Undocking
- FD12 – Landing

* RWS and AVU successfully checked out on Flight 5A.1 Stage

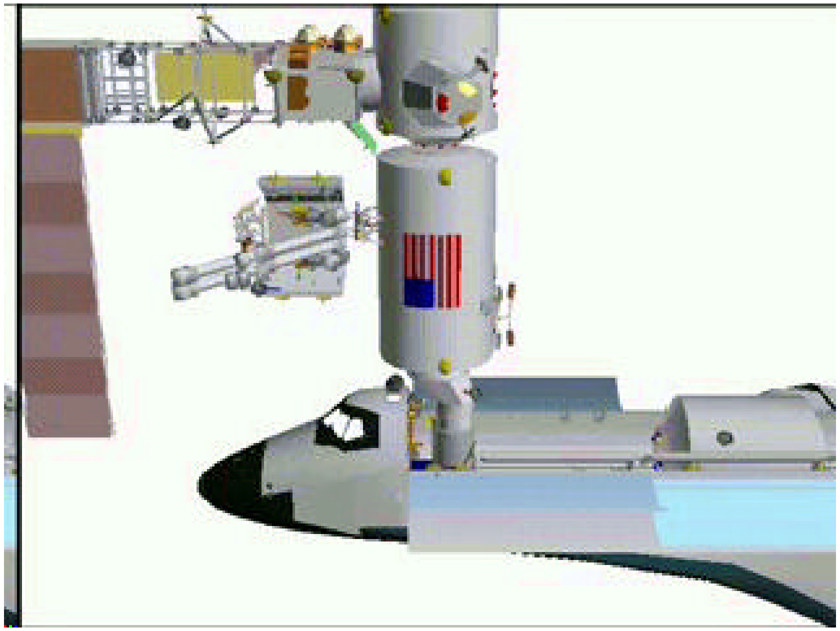
FD4 - EVA 1: Canadarm 2 Deployment



- Wiring is reconfigured to power the Space Lab Pallet
- Keep alive power is applied
- Canadarm 2 deployment, power up and boom raise
- First ever EVA by a Canadian - Chris Hadfield

- Space Lab Pallet is removed from the Payload Bay by the Canadarm and installed on Lab Cradle Assembly for EVA-1

FD5 - Canadarm 2 Lab Grapple

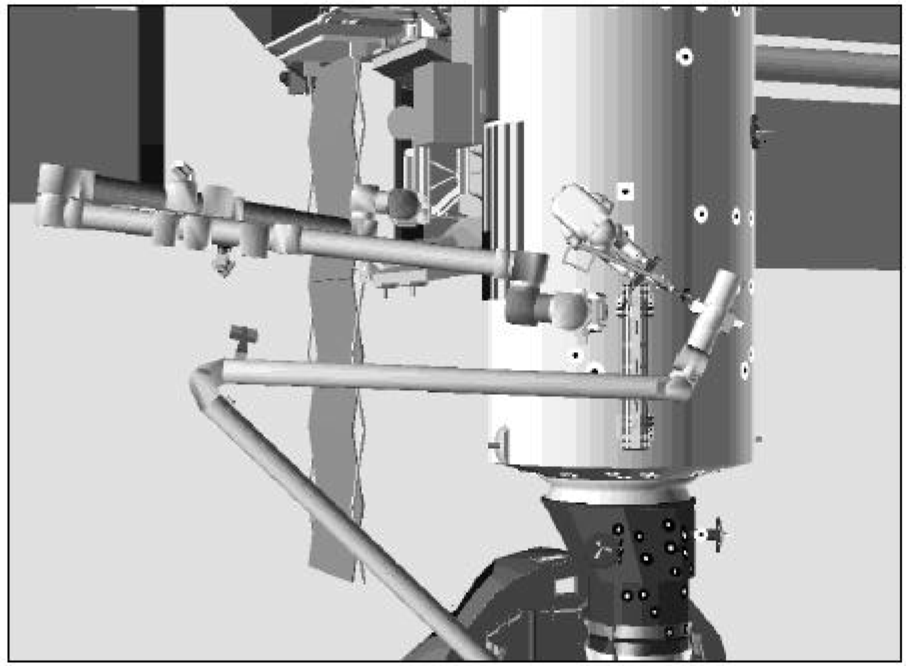


- Canadarm 2 grapples and latches the Lab PDGF
- Canadarm 2 now ready for power reconfiguration during EVA-2 on FD6

- Canadarm 2 steps off to the Lab PDGF while performing checkout manoeuvers

FD6 - EVA 2: Canadarm 2 Powered from the Lab PDGF

- EVA 2 reconfigures power to the Lab PDGF
- Canadarm 2 powered from the Lab
- Space Lab Pallet manoeuvered to overnight park position



FD7 - Space Lab Pallet Handoff

- Space Lab Pallet is handed off from the Canadarm 2 to the Canadarm
- Space Lab Pallet is berthed in the Shuttle Payload Bay

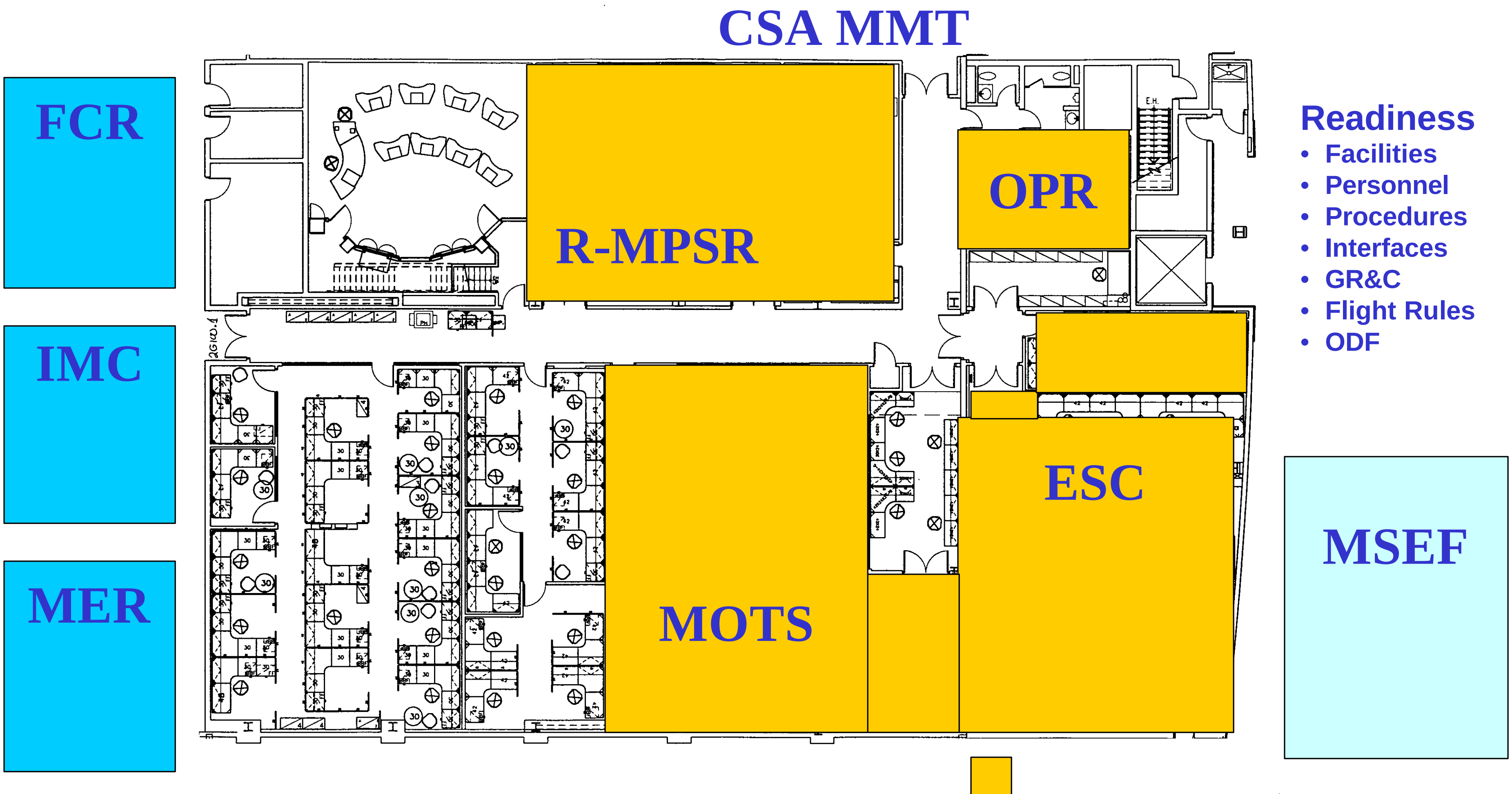
FD8 - EVA 3: Unscheduled, Airlock Dry Run

- EVA 3 is reserved for tasks deferred from EVAs 1 and 2
- Airlock dry run will be performed in preparation for 7A

Hardware / Software

- SSRMS or Canadarm 2
- IFL
- Patches
- Spares
- Procedures

MSS Operations Centre
Facility Layout



Readiness

- Facilities
- Personnel
- Procedures
- Interfaces
- GR&C
- Flight Rules
- ODF

MSS Operation Training System

Advanced Training

- Exp 2
- Exp 4
- Msn Controllers
- CapCom
- CB Robot

- On-Orbit Trg

MOTS Ready for Msn 6A RT Support

Engineering Support Centre

Remote MPSR


CENTRE D 'APPUI AUX
OPÉRATIONS SPACIALES
SAINT-HUBERT


SSRMS OPS
SSRMS OPS

READINESS STATEMENT

Pending completion of the identified open work, CSA is ready to support Flight 6A mission and stage operations.

/s/ E. White	/s/ I. Foster	/s/ P. Jean
Eric White Director, System Engineering (Acting)	Ian Foster Configuration Management	Pierre Jean Manager, Safety & Mission Assurance
/s/ B. Marcotte	/s/ A. Dubeau	/s/ D. Bassett
Benoît Marcotte Deputy Program Manager, Operations	Alain Dubeau Program Manager	Doug A. Bassett Deputy Program Manager, Development

Russian Elements

March 29, 2001

Jeff Arend
(281)-244-038

ISS-C- 36

Soyuz Launch Vehicle Upgrade

- Upgrading Soyuz launch vehicle to accommodate heavier Soyuz TMA vehicle, increase Progress payload capability, and increase vehicle altitude capability

- Upgrades to booster and second stage engines have completed development tests
  – Specifics of these upgrades have not been shared with NASA at this time
  – Will be a topic of discussion at TIM 26

- Two launches of upgraded booster on unmanned Progress vehicle to be performed prior to use on manned Soyuz vehicle

- First launch using upgraded booster to occur on Progress 4P mission (5/20)

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Soyuz cooler/dryer Modification

- Upgrade to Soyuz TMA cooler/dryer unit in Soyuz descent module required to accommodate increased crew size (height).
  - First Soyuz TMA will fly in 2002
- Upgrades include reducing cooler dryer unit size, adding redundant fan and air flow diverter valve, and modifying fan control logic and circuitry
- For commonality cooler/dryer unit in Soyuz habitation module is also being upgraded
- All component certification and integrated testing has been successfully performed
  - NASA Subsystems have agreed with implementation based on successful certification and integration
- Soyuz flight 2S TM (4/28) will be the first flight of this redesigned system and will be installed only in the habitation module to gain flight experience

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Soyuz TCS Leak

- Leak discovered during helium testing of the Thermal Control Loop (TCS) of the Soyuz 2S descent module
- Locating leak would require partial disassembly of vehicle and regression testing and re-certification
- Russian Panel review of the leakage determined that the leak was not significant and would not affect system performance
  - Leakage occurred at 2 atm pressure level
  - Leakage was within spec levels at nominal system pressure
  - NASA experience indicates that liquid leakage not likely based on measured Helium leak rate
- NASA/JSC specialist (Nagy/Rotter) concur with RSC-E acceptance decision
- NASA/Medical (Dr. John James) indicates that if loop coolant did leak that it is not a medical hazard Coolant is Triol

Jeff Arend/281-244-7038

6A Return MPLM Certification Plan

Systems Integration & Analysis Office

March 29, 2001

Jeff Arend
(281)-244-038

ISS-C-40

Introduction / Background

- What were some of the difficulties which occurred on flight 5A.1
  - Only a single VLA return configuration was performed
    - » Focused on the heaviest of the potential return configurations
  - 1000 lbs decrease (RS trash deleted) in MPLM manifest 1 week prior to launch drove the MPLM integration teams to continually *react* to manifest changes instead of providing flexibility
    - » Caused stowage plan to change rapidly which caused minor disconnects between manifest and mass properties
    - » Late stowage plan caused transfer list to be re-assessed and developed
    - » Improved transfer plan wasn't adequately provided to the crew
    - » Caused physical integration of stowage to older plan, which in turn caused structural re-analysis of current configuration

Jeff Arend/281-244-7038

Process Improvements Since 5A.1

- Two VLA return configurations were analyzed for 6A
  - Heavy case integrated MPLM at 15,401 lbs.
  - Light case integrated MPLM at 13,947 lbs.
    - » Protects for hardware identified to return - no trash
  - With recognized 200 lbs tolerance of VLA cases, ~1450 lbs. variance is established.
- MPLM Return Manifest will be baselined by ~L-2 weeks = ECD 4/06/01
- Stowage plan will be baselined by ~L-2.5 weeks = ECD 4/04/01
- LPM / IM / MPLM integration teams will conduct a line-by-line review of the manifest to ensure the return manifest is accurately reflected in the return stowage configuration by ~L-1.5 weeks = ECD 4/09/01
- Additional changes to the manifest will be tracked by the CHIT process
- Real-time process will be documented in JOIP
- General stowage packing guidelines will be developed for the crew in case of shortened mission duration events to protect for safe return
- Mission unique CoFR'able guidelines will be developed for the nominal mission duration to minimize iterations between the ground and the crew and to avoid real-time structural analysis = ECD 4/15/01

Jeff Arend/281-244-7038

Flight 6A
Flight Readiness Review

Special Topic

Treadmill w/ Vibration Isolation System (TVIS)
Flight 6A
Status

Cathy Dempsey
ISS GFE Flight Projects Office
CHeCS Project Manager
April 5, 2001

TVIS On-orbit Status

- TVIS operations have been prohibited since 3/18/01
  - Russian Cycle Ergometer, U.S. Cycle Ergometer, and the Interim Resistive Exercise Device are all operational and being used by the crew

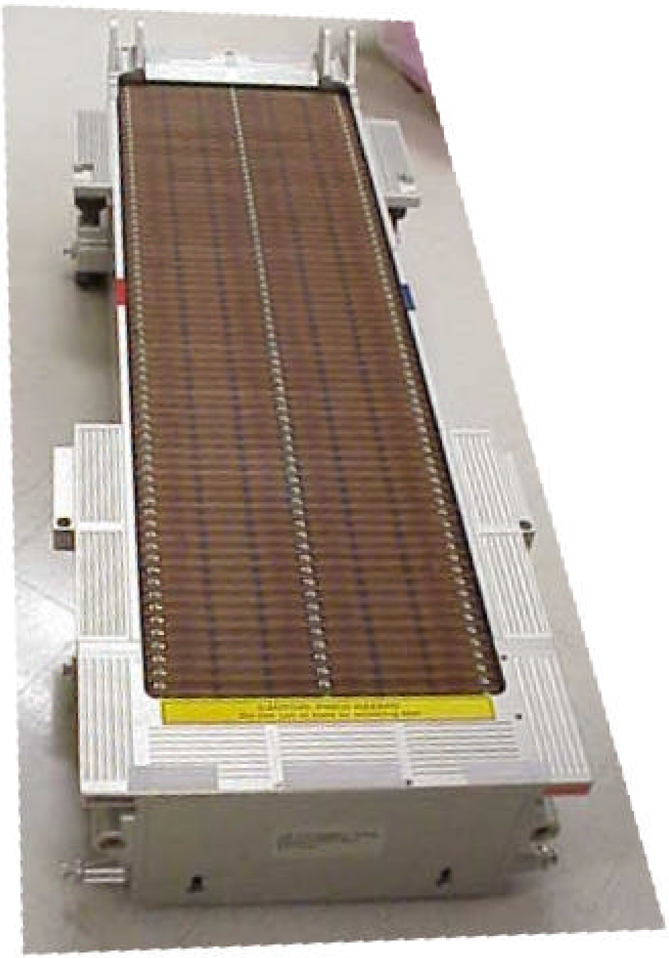
- TVIS belt slats have continued to crack and break intermittently since 2/20/01

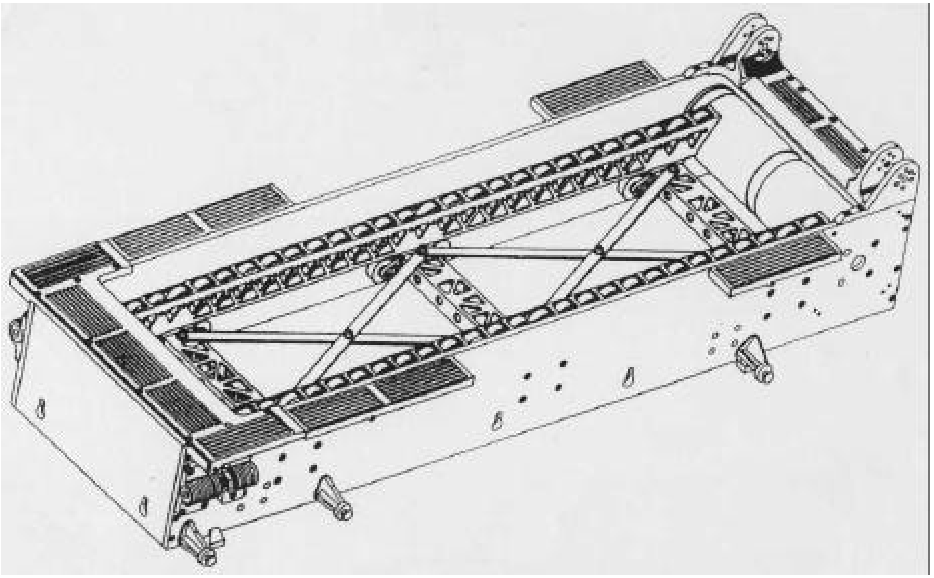
- On 3/18/01 eight additional slats confirmed broken with one more suspect during 5A.1 docked operations

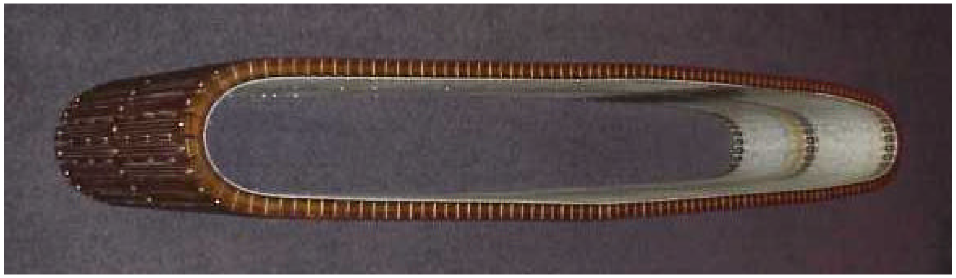
- Crew performed on-orbit IFM to inspect all TVIS belt slats on 3/24/01 and found a total of 40 belt slats cracked or broken
  - Currently 27 spare TVIS belt slats are on-orbit
  - Instead of continuing IFM to replace slats, TVIS was partially re-assembled and stowed in a safe configuration back in SM pit

- Crew is removing damaged belt slats from the TVIS belt as time permits on-orbit & preparing them for return on Flight 6A as stowage volume permits

TVIS Chassis and Belt







Flight 6A Recovery Plan

Engineering testing and analysis has demonstrated that the original belt slats were under-designed for this application and will continue to fail on-orbit as they are used

- Replacement of all TVIS belt slats (159) being implemented to ensure TVIS Ops

Flying additional belt slats up on Flight 6A:

- 27 belt slats of original design delivered 3/23/01 to KSC for stow in MPLM
- 120 belt slats of original design delivered 3/30/01 to USA/FEPC for stow in middeck
- JSC Engineering currently fabricating new slats of a more robust design to fly in 6A middeck in place of the original slats
  - Fabrication effort initiated on 3/29/01 with ECD for delivery 4/13/01
  - New slat design currently being evaluated wrt TVIS integrated system
  - Decision to fly new slats to be made by 4/13/01

TVIS Contingency Exercise Surface:

- Evaluating on-orbit cargo to find slick, flat material to mount to TVIS surface that would allow the crew to perform alternative exercises
- JSC Engineering fabricating a flat, slick aluminum plate to mount to TVIS

Flight 6A Launch Slip Option (~5/6/01):

- Evaluating launch of TVIS Chassis in 6A middeck to alleviate operational impacts associated with replacement of all TVIS belt slats

Conclusion

- TVIS anomaly resolution plans are in place and are being implemented
  - Additional belt slats being flown up on Flight 6A
  - SLSD medical community and Exercise Physiologists evaluating alternative TVIS exercises prescriptions to reduce TVIS loading throughout increment to ensure nominal TVIS ops during last 30 days of increment
- Forward work plans are in place to recommend design modifications for current anomalies and investigating manifest opportunities (7A.1, UF-1)
- Contingency exercise options are in work if TVIS operation is lost
- JSC Engineering Directorate and ISS GFE Flight Projects Office have no constraints for launch of Flight 6A given known TVIS anomalies

Avionics & Software Office
NASA and Boeing

6A Flight Readiness Review

Peggy Thomas - Boeing

Avionics and Software
6A Flight Readiness Review

- Ku Band Pointing Anomaly
- Control Moment Gyro 2 (CMG 2) Spin Motor Current Transients
- Video Connectivity Jumper Cable
- On-Orbit Fault Detection Fiber Optic Tool Kit

Ku-Band Pointing Anomaly

- The Ku-Band system is not locking on the signal from the Tracking and Data Relay Satellite (TDRS) caused by a pointing error of Ku-Band antenna (SGANT)
  - Static offset between the direction to TDRS and the direction predicted by GN&C software from Russian State Vector
  - Most likely explanation of offset: mechanical misalignments at one or more interfaces between Russian Navigation Base and the antenna
  - Ku-Band locks on the signal and auto tracks TDRS properly when the antenna is manually pointed close to the signal
- Program Impact
  - Inhibits ability to checkout the Ku-Band system
  - Prevents downlink of data to support
    - Activation and checkout of Human Research Facility (5A.1)
    - Activation and checkout of 2 EXPRESS Racks and 9 payloads data support (6A)
    - Payload MDM file comparisons
    - MACE experiment data retrieval
    - Public Affairs Office Video when Orbiter is not present
  - Prevents Forward Link Ops LAN including videoconferencing and procedure uplink
  - No formal constraint or Safety Risk to Flight 6A

Ku-Band Pointing Anomaly

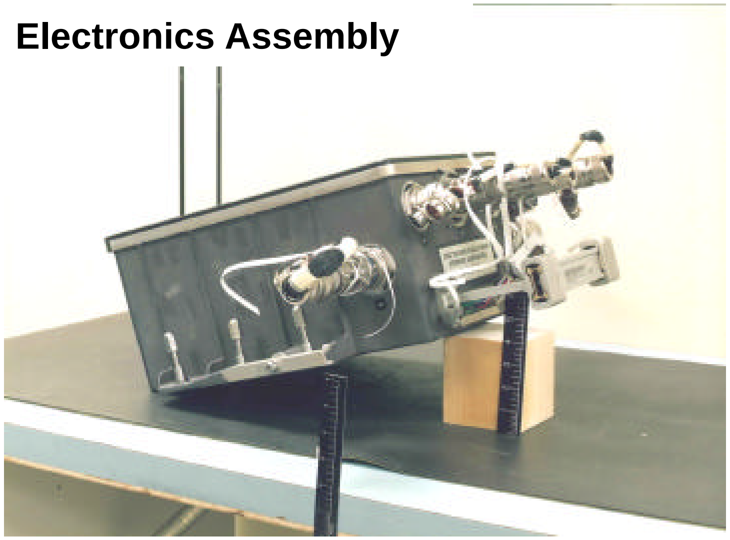
- **An interim fix is in work while the source of the error / misalignment is investigated further**
  - **Angular bias matrix to be inserted in Command Control Software (CCS)**
    - **Matrix values determined by comparing predicted TDRS position from the measured position obtained while the Ku-Band system is auto tracking TDRS after manually acquiring satellite**
    - **Matrix parameter values were analyzed and calculated by Boeing and MOD independently**
    - **Analysis used data values from 5 passes using two different TDRS, covering a full range of SGANT gimbal angles**

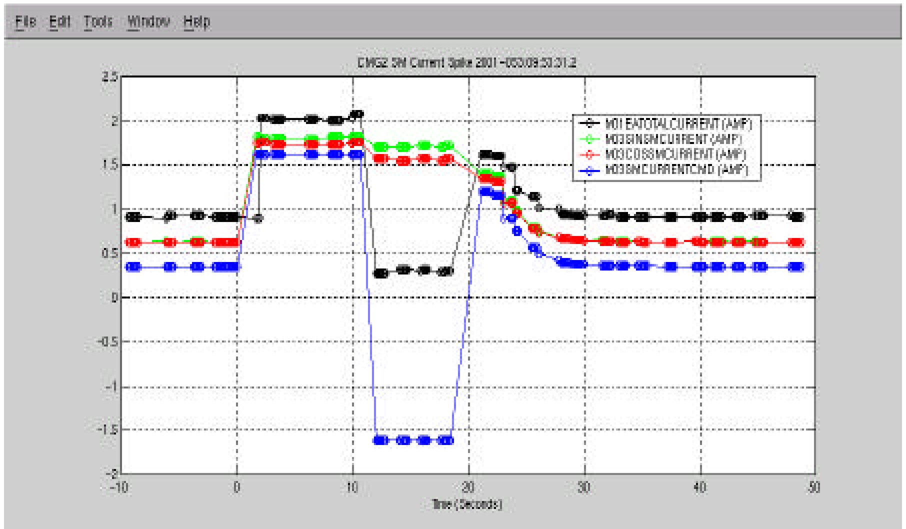
- **Pre-positioned Software Load (PPL) is in development and testing with an up-link scheduled for 4/6/01**

Control Moment Gyroscope 2 (CMG 2) Spin Motor Transients

- The spin motor of CMG 2 (one of four CMG's) has had 24 occurrences of an increase in current to the motor that spins the rotor
  - Motor current increase is the same as the current necessary to provide full torque
  - Motor current increase is within spec and lasts for ~10 seconds (consistent with controller design)
  - No pattern has yet emerged from the occurrences
    - Transients have occurred between 47 minutes and 123 hrs of each other
    - No evidence that the frequency of occurrence is increasing
  - Any correlation to mechanical problems have been dismissed
  - No safety issues with continued operation of CMG – spin motors too small to accelerate rotor to rupture rotation speed

Electronics Assembly



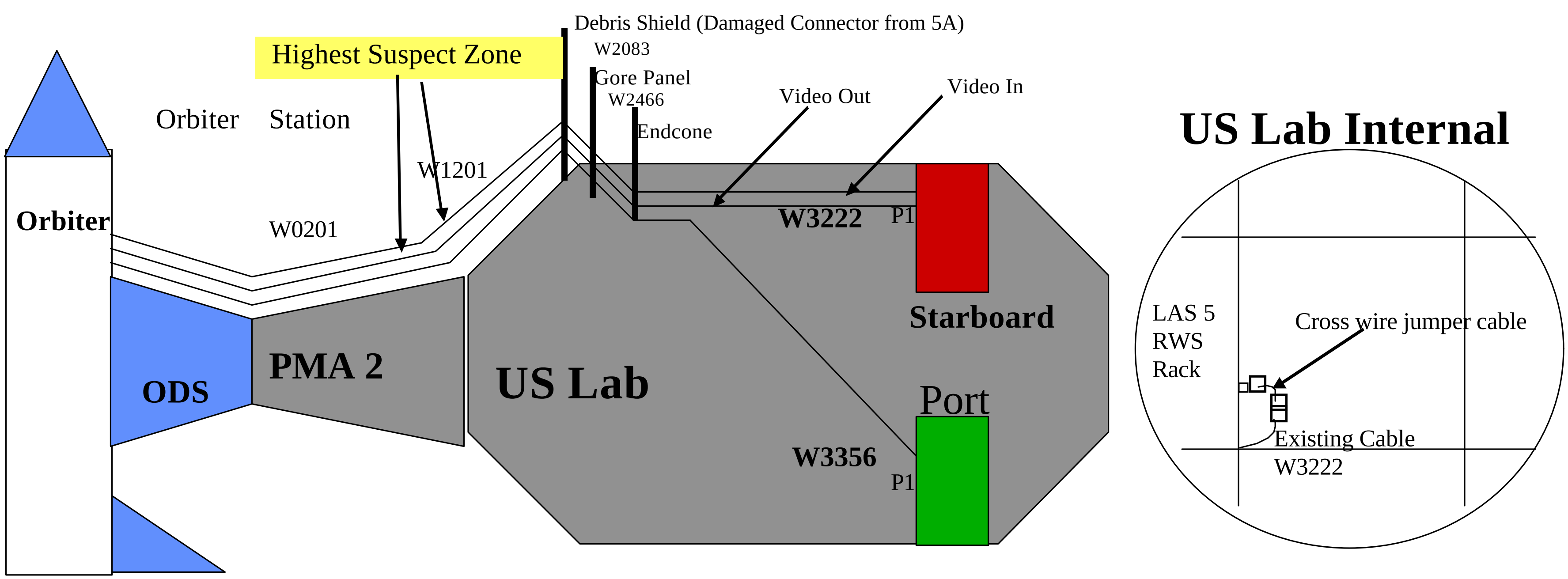


CMG 2 Spin Motor Current Transient

- Problem isolated to a signal transient in the spin motor phase lock loop controller circuit
  - Suspect circuit components reside in the Electronics Assembly (EA), only part of larger CMG assembly
  - No evidence that a circuit component is failing
  - There is insufficient data at this point to determine if there is a longevity issue for the CMG
- Performance / Program impact
  - Anomaly observed in one of four CMGs; CMG 2
  - CMG 2 performance (attitude control capability) is unaffected by transients
  - Anomaly isolated to Electronics Assembly (EA) which is an EVA replaceable ORU
  - ISS is controllable on 3 CMGs through stage 11A
- Recommendation
  - Continue to use; the current transient is within spec and is NOT causing harm to the spin motor or associated circuitry
  - Monitor and analyze new data as it becomes available

Video Connectivity Jumper Cable

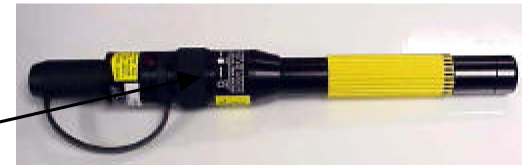
- A video cross wiring problem was found during the 5A.1 mission and localized to the W1201 cable
- Anomaly Resolution Team and ASCB recommended building a 6A crosswire jumper to interface with the internal cable connection
- Forward work for cable fabrication
  - Cable Manufacturing ECD 4/10/01
  - Fit Check and Test ECD 4/11/01
  - Acceptance Review and Delivery ECD 4/14/01



On-Orbit Fault Detection
Fiber Optic Tool Kit

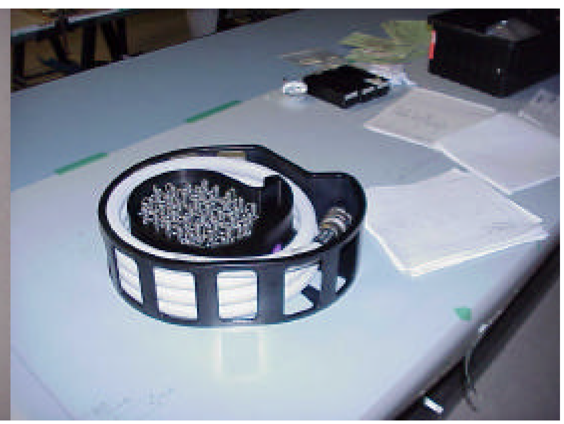
Primary Fault Isolation Tools – First Deployed on 6A

Where cables can be viewed directly
Visual Fault Finder (VFF)



Where Cables can not be viewed along length
Optical Time Domain Reflectometer
(OTDR)

OTDR/Reel Patch Cable (QTY 3)



Reel Assembly acts as breakout box with 37 termini test capability

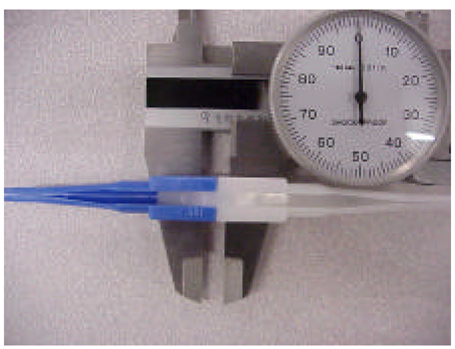
Flight Test Adapters
(15 different in 8 different Softpack Assemblies)

Fiber Optic Tool Kit

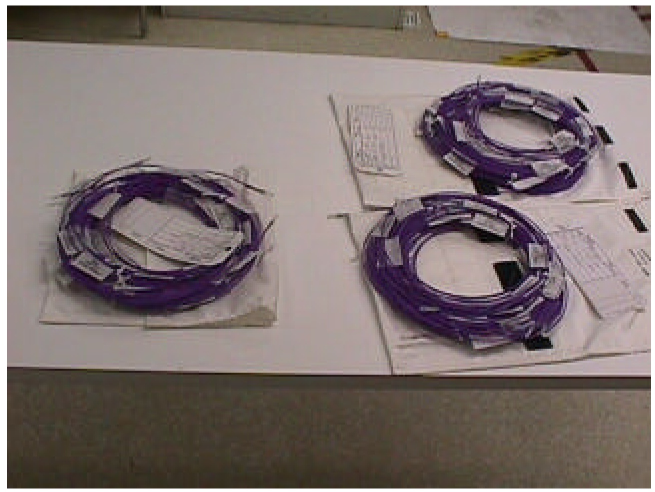
Primary Contingency Tools – First Deployed on 6A

Backshell Holding Tool 2

Backshell Holding Tool 1



Insertion/Extraction Tools (QTY 10)



Terminated Flight Links
(QTY 36 in 12 Configurations stored
In four different low level softpacks)

Multi-purpose EVA PDGF Contingency Cable

Certification Results
Fiber Optic Tool Kit

- **Tests Performed**

11/00	OTDR Outgas
10/00	OTDR Radiation Testing
12/00	PDGF Crew Walkdown with installation scenarios
12/00	OTDR Burn-in Testing
01-01	OTDR Vibration Testing
01/01	OTDR Thermal Cycling Testing
12/00 – 3/01	FO Cable Functional ATPs
3/01	Electrical Cable (28VDC) Functional ATP
1/01 - 3/01	Other COTS tools and miscellaneous Outgassed
3/16/01	Kit Sharp Edge Inspection
3/16/01	Kit Connector Fit Checks (IVA OTDR, Patch Cables, Reel, and all test adapters
3/20/01	Crew Walkdown and Bench Review

- **Forward Work**
  - Verify one last requirement and complete Safety Assessment Form 1230 ECD 4/4/01

Space Station Payloads Office/OZ

Richard W. Nygren

6A Flight Readiness Review

Prepared by:

Welby Redwine

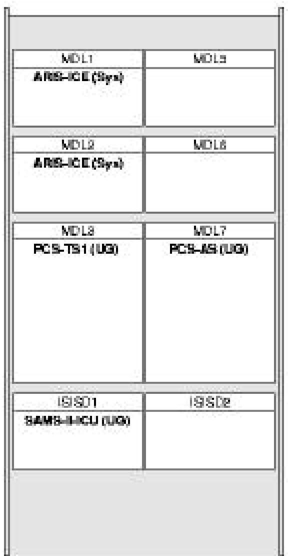
Andrew Menges

Ven Feng

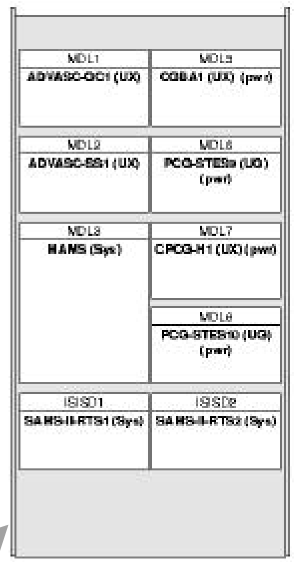
April 5, 2001

STS-100/ISS-6A Payload Overview

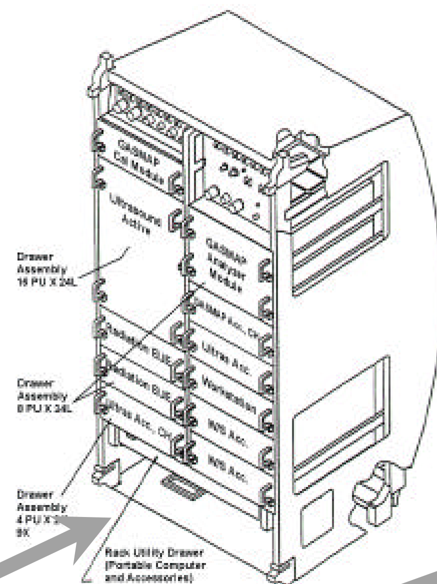
EXPRESS Rack 2
(LAB1O1)



EXPRESS Rack 1
(LAB1O2)

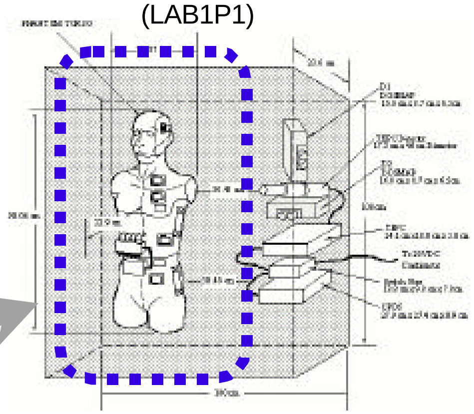


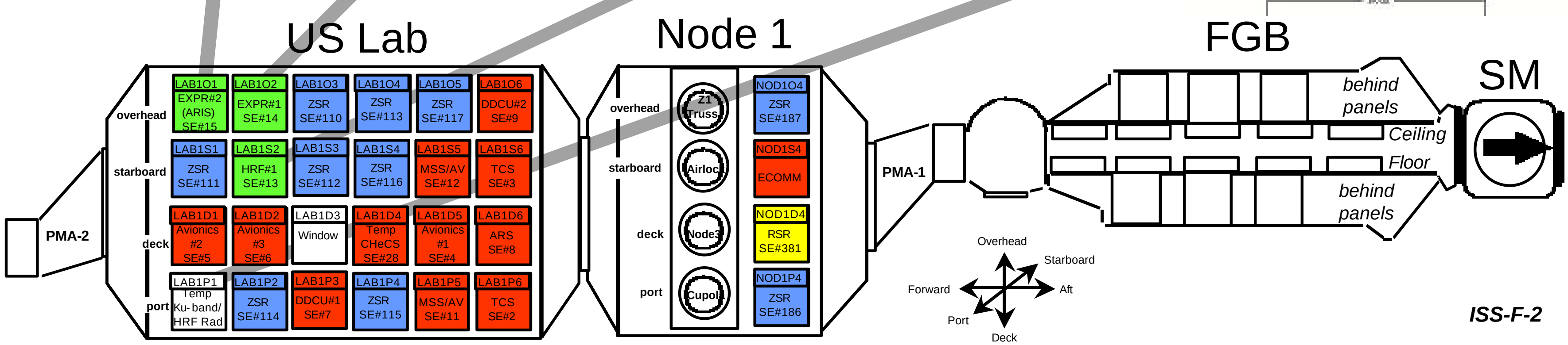
Human Research Facility
(LAB1S2)



Stowed and Deployed Payloads
- Crew Earth Observations
- H-Reflex
- Interactions
- NASA EarthKAM

HRF Radiation Suite
(LAB1P1)





ISS-F-2

Ascent and Descent Manifest

- **Ascent manifest requirements for transfer from Orbiter to ISS**
  - MPLM - Rack Facility Payloads
    - Expedite the Processing of Experiments to Space Station (EXPRESS) Rack 1: Advanced Astroculture Support System, Microgravity Acceleration Measurement System, Space Acceleration Measurement System
    - EXPRESS Rack 2 (with Active Rack Isolation System (ARIS)): Physics of Colloids in Space Avionics Section, Station Acceleration Measurement System, ARIS-ISS Characterization Experiment (ARIS-ICE)
  - MPLM - Passive Stowage (23 Bags)
    - HRF Phantom Torso, Electronic Media Kit
    - Passive Dosimeter System
    - Payload Equipment Restraint System (PERS)
    - Earth Knowledge Acquired by Middle Schools (EarthKAM) Jaz Drives (2)
    - EXPRESS Rack support hardware and spares
    - ARIS support hardware and spares
  - MDK - Powered (4 MLE)
    - Commercial Generic Bioprocessing Apparatus, Commercial Protein Crystal Growth, Protein Crystal Growth - Single Thermal Enclosure (2)
  - MDK - Passive (3 MLE)
    - Physics of Colloids in Space Test Section, Advanced Astroculture Growth Chamber
- **Descent manifest return requirements for transfer from ISS to Orbiter**
  - MDK - Passive Stowage
    - EarthKAM Jaz Drives (2)
    - Human Research Facility launch restraints and bracket

Payload Operations Integration Status

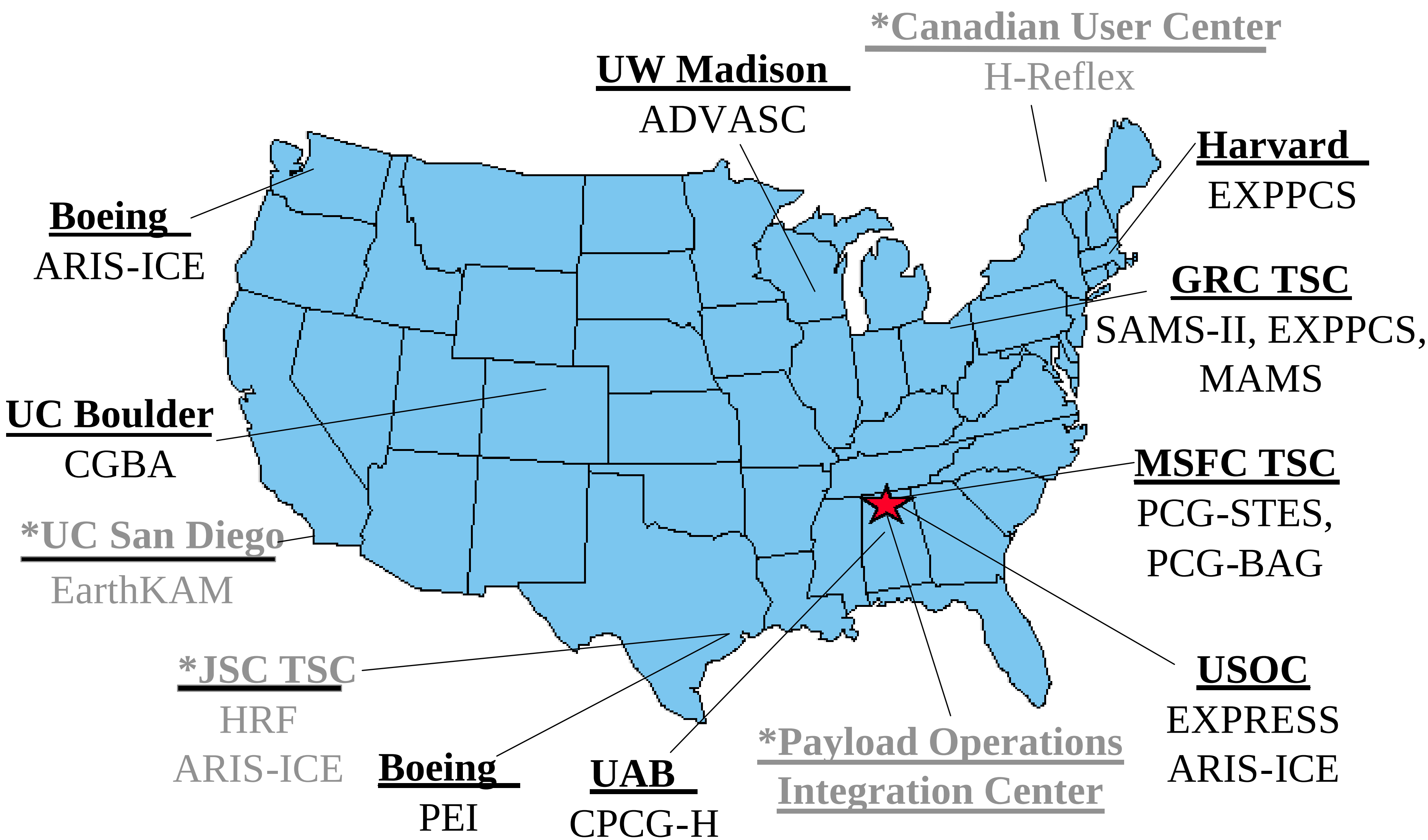
- **Expedition 2 and STS-100/6A crew training complete**

- **Five Payload Operations Integration Center (POIC) control teams online and providing continuous support.**

- **MSFC POIC core functions are in place. Incomplete capabilities have operational workarounds. Work continues to install capabilities for follow-on flights.**

- **Nine Telescience Support Centers and remote sites coming online**
  - MSFC and GRC Telescience Support Centers
  - MSFC US Operation Center
  - Boeing-Houston & Boeing-Seattle
  - Harvard University, University of Colorado-Boulder, University of Wisconsin and University of Alabama-Birmingham

Increment 2 TSCs and Remote Sites



* Support began with STS-102/ISS-5A.1

ISS-F-5

Exception (in work):

EXPRESS Rack 2 (ARIS) Viton Hoses

- **Initial EXPRESS Rack 2 (ARIS) Viton umbilicals failed qualification testing.**
  - Flexible hoses required to minimize transmission of loads and vibrations between ISS and EXPRESS Rack
- **Umbilicals re-designed and tested. Flight umbilicals are loaded in the MPLM and yellow-tagged pending results of qualification testing.**
- **Rigid umbilicals have been manifested as a backup.**
  - Significantly degrade ARIS isolation performance
- **Viton qualification test results:**
  - Vacuum Vent: passed qualification test
  - High Pressure Nitrogen (GN2): failed qual test (not used until UF-3); will not be installed
  - Moderate Temperature Loop Feed: failed at 415 psia; requirement is (4 x 115 psia)
  - Moderate Temperature Loop Return: failed at 415 psia; requirement is (4 x 115 psia)
- **Boeing proceeding with waiver for MTL feed and return lines. Pending approval, Viton hoses will remain yellow-tagged and rigid umbilicals will be used.**
  - Preferred characterization configuration is 3 Viton hoses with GN2 capped
  - Task list activity to characterize ARIS performance with 3 Viton and 1 rigid umbilical (GN2)

Statement of Readiness

Pending completion of the identified standard open work and resolution of issues and forward work, the Payloads Office is ready to proceed with STS-100/ISS-6A.

Richard Nygren,
Manager,
Space Station Payloads Office

Summary

- Flight objectives and priorities are defined
- Flight manifest has been defined
- All hardware and software certification is completed or planned to be complete before L-2
- Personnel and facilities are ready to support
- Hardware delivery and processing schedule support launch date
- US and Russian certification schedule support launch date
- Special topics have been resolved or have acceptable operational workarounds

The ISS Program is Ready to Proceed with the Launch of ISS 6A/STS-100