Alpha Magnetic Spectrometer - 02
(AMS-02)
Critical Design Review

Operations Overview
Prepared By: P. Nemeth
Contents

• Prelaunch
• Ascent
• On-Orbit
  – Space transportation System (STS)
  – International Space Station (ISS)
• AMS Crew Operations Post (ACOP)
• EVA Interface
Kennedy Space Center Flow

- Arrive at Multi-Purpose Payload Facility (MPPF)
- Integrate AMS
- Top-off Cryo
- Power up/checkout Avionics and Charge Magnet
- Discharge Magnet and Power off all systems
- Package and transport to Space Station Processing Facility (SSPF)
- Integrated Verification Test in LPIS and PRCU
- Power up/checkout avionics, No Magnet Charge planned at this time
- End to End Test in STS
Prelaunch Operations Profile

• **T₀ Umbilical requirements**
  - Vent Pump, Cryocoolers, Cryo valves, Main Control Computer (MCC)
    - 120Vdc Power, command, and telemetry
      - Commanding includes vacuum pump and cryocoolers on/off and momentary power for cryo valves open/closed
      - Telemetry includes temperature/pressure measurements and system operating characteristics).
    - 1553 for command/telemetry requirements
    - All Power routed through the Power Distribution Box (PDB) except for Vent Pump
    - Required continuously until T-9 min to monitor health status of Cryo systems (Vacuum case pressure and SFHe pressure/temp)
  - Remainder of experiment avionics
    - High Rate Data via RS422
    - Required only for calibration and contingency troubleshooting operations
Prelaunch Operations Timeline

• Installation through L-30 min nominal ops
  – 650 W for MCC, Cryo valves, Cryo coolers, SFHe Tank vent pump
  – Maximum of 2 kW for calibration and contingency should be completed prior to L-TBD days

• At L-30 minutes
  – Close SFHe Tank Vent and deactivate pump
  – Deactivate Cryo coolers
  – Power down all equipment with the exception of MCC and necessary CAB functions to monitor of cryo system health (limited to 120W)

• Monitor health status of cryo systems till T-9 min

• Launch, T0 disconnect (loss of 1553/power)
Ascent Operations Requirements

- SFHe Tank Nominal Vent Valve operation
  - Barometric switch to open valve when PLB pressure is less than the SFHe
  - Time-tagged command via Backup Flight System (BFS) General Purpose Computer (GPC) to open as backup @ L+ TBD min
  - 28Vdc momentary power for valve opening and 5Vdc discrete for command
  - In the event of an abort must close vent valve when descending through 100,000 ft (+20,000 ft)
  - Any potential ignition sources will be compliant with NS2/81-M082
On-Orbit STS Operations Profile

- Activate Assembly Power Converter Unit (APCU)s, Cryocoolers, and Housekeeping data at approximately Mission Elapsed Time (MET) 2 hr 30 min
- Activate/checkout AMS avionics subsystems and thermally condition payload
- Maximum power draw on shuttle 2 kW @ 120Vdc
- No magnet charging on STS
- Dock with ISS (MET Day 3)
- Power down AMS prior to transfer operations, transfer to ISS by MET day 4.
- Grapple Flight Releasable Grapple Fixture (FRGF) with Shuttle Remote Manipulator System (SRMS)
- Disconnect Remotely Operated Electrical Umbilical (ROEU)
- AMS removed from PLB by SRMS
On-Orbit ISS Operations Profile

• Power up ACOP
  – Note: ACOP must be checked-out and active prior to AMS installation on ISS. (Transferred to ISS on previous flight.)

• Grapple Power and Video Grapple Fixture (PVGF) with Space Station RMS
  – Note: Supplies power to and video signal from Berthing Cues System located on AMS

• SRMS release of AMS

• Transfer to S3 attach site
  – Berthing Cues System (BCS) utilized to verify final approach to Attach Site

• Attach AMS to S3 upper inboard site mechanical/electrical (via PAS & UMA)
On-Orbit ISS Operations Profile (Cont.)

- SSRMS Ungrapple
- Power up Avionics
- Perform abbreviated avionics checkout
- Begin magnet charging operations (w/ crew monitoring)
- Once Magnet charging operation complete, begin 3 years of science data acquisition.
- Primary control of AMS is from ground.
- Crew interfaces to AMS include ACOP and Portable Computer System (PCS).
EVA Interface

• Allows for redundant avionics interfaces in contingency scenario
• First access test in NBL completed in March 2002, no mission specific NBL testing required
• Second NBL access test (with higher fidelity mockup) performed in November 2002
• Connectors will meet the mating/demating requirements identified in letter MA2-99-170
• No specific EVA training requirements
Passive UMA EVA Connector Layout
EVA Connector Panel
Mission Abort

• In the event of an abort (e.g. RTLS, TAL, or any other return with AMS still in STS), power needs to be applied after landing to:
  – Monitor He tank pressure
  – Open Vent valve when He pressure exceeds 1 atm
  – Present calculations estimate the vent valve opening to be between 10 hours and 2 days, so power should be supplied approximately by Landing plus 5 hours
  – Not a safety concern, but rather a refurbishment concern (don’t want to operate burst valves)
NBL Testing

• Testing to evaluate AMS Contingency EVA interfaces was performed November 12th thru 15th, 2002 (five crewmembers performed tasks)

• Testing included:
  – PVGF Contingency Release
    • PVGF Grapple Release
    • LEE Release
  – Capture Bar Contingency Release
  – Connector Panel Access/Evaluation
  – Passive Umbilical Mating Assembly (UMA) bolt access
  – And, crew translation path evaluation
NBL Test Results

• All tested tasks were deemed “acceptable” as documented in Crew Consensus Report (reference letter CB-02-129)

• Only minor issues identified with
  – Labeling (to be validated from drawings)
  – Fit-checks (to be verified with flight hardware)
  – Connector clocking (verified by drawings)

• All issues resolved in the data-package (except fit-check verification)