DISTRIBUTION OF MINUTES FOR ALPHA MAGNETIC SPECTROMETER PHASE 0/I FLIGHT SAFETY REVIEW ON JANUARY 16, 2001.

CB/M. E. Kelly
DO12/J. M. Childress
DO6/Payload Operations Branch
EA4/L. C. Benal
EA4/D. E. Tadlock
EM2/G. M. Ecord
ES2/V. A. Fogt+
EV15/D. C. Sykes
KN/NASDA/K. Narita
MA2/V. S. Ellerbe
MA2/S. N. Hardee
MA2/J. D. Holt
MA2/A. M. Larsen
MA2/D. E. O'Brien
MA2/J. Williams
MS2/C. R. Miller
MS3/K. Packard
MT/M. Brekke
MT2/J. J. Conwell
NC4/M. L. Ciancone
NC44/SAIC/M. A. Fox
NC44/SAIC/P. J. Gothreaux
NC44/SAIC/P. L. Mitchell
NC55/SAIC/S. E. Loyd
NE2/G. L. Priest
OE/L. W. Gana
OR/CSA/H. L. Williams
OT/ESA/U. Thomas
OZ/M. A. Culp
OZ/G. W. McCollum
OZ/R. R. Miley
OZ3/D. W. Hartman
SD2/M. E. Coleman
SF2/D. J. Grounds
KSC/UB-F3/J. C. Dollberg
KSC/UB-F3/P. D. Kirkpatrick
MSFC/CR90/V. P. Kulpa
LMSO/B25/P. D. McDonald
LMSO/C20/D. G. Russell
LMSO/C80/H. G. Beaird
BNA-Houston/ZC01/A. B. Green
BNA-Houston/ZC01/V. H. Ruhe
Boeing/HS-12/M. P. Hudson
Boeing/HS-44/J. D. Blalock
Boeing/HS-44/R. DuBose
USH/700D/L. Lo
USH/700D/H. A. Maltby

Canadian Space Agency
John H. Chapman Space Center
Attn: V. Chang*
6767 route de l'Aeroport
Saint-Hubert, Quebec
Canada J3Y 8Y9

ESTEC/GP
Attn: T. Sgobba
T. Heimann
P. O. Box 299 NL
2200 AG, Noordwijk
The Netherlands

NASDA
Tsukuba Space Center
Attn: H. Hasegawa
Space Station Safety and Product Assurance Office
2-1-1 Sengen
Tsukuba-shi, Ibaraki
Japan 305

See Attachment 1 for a list of meeting attendees/ additional minutes recipients.

For nondeliverable mail, please return to JSC/NC4/Brenda L. Smith.

NASA JSC
Payload Safety Review Panel
Alpha Magnetic Spectrometer - 02
Phase 0/I Flight Safety Review

Minutes of Meeting
January 16, 2001

1.0 INTRODUCTION

1.1 **General:** The Payload Safety Review Panel (PSRP), chaired by JSC/MA2/A. M. Larsen, met on January 16, 2001, with representatives of the Alpha Magnetic Spectrometer-02 (AMS-02), the Payload Organization (PO), at the Regents Park III Conference Facility for a AMS-02 Phase 0/I Flight Safety Review (FSR). JSC/NC44/A. N. Nelson, Jr., the supporting Payload Safety Engineer (PSE), introduced the meeting and attendees (see Attachment 1).

1.2 **Background:** The AMS is a Department Of Energy, NASA, and various high-energy physics institutes-funded state-of-the-art cryogenic superconductive magnet that is designed to search for anti-matter and dark matter. The AMS-02 experiment is a particle physics detector. The science objectives of the AMS-02 experiment are to search for anti-matter (anti-helium and anti-carbon) in space, to search for dark matter (90% of the missing matter in the universe) and to study astrophysics (to understand the Cosmic Ray propagation and confinement time in the galaxy). The AMS-02 experiment will utilize a Cryogenic Superconducting Magnet (Cryomag) with planes of detectors on top, inside, and below the magnet. The precursor Space Shuttle flight of AMS-01 used a permanent magnet in place of a cryomagnet. LMSO will provide analysis and design for the Cryomag Vacuum Case hardware. The superfluid helium tank has a capacity of about 2500 liters, and the cryogenic insulation system includes 160 layers of MLI superinsulation.

1.2.1 **Hardware Overview:** The AMS-02 hardware is made up of several subsystems, including: the Cryogenic Superconducting Magnet (Cryomag), Unique Support Sutructure-02 (USS-02), Synchrotron Radiation Detector (SRD), Transition Radiation Detector (TRD), Time-Of-Flight (TOF) Scintillator Assemblies, Ring Imaging Cherenkov Counter (RICH), Electromagnetic Calorimeter (ECAL), data and interface electronics, electrical cables, two Monitoring and Control computers (MCCs), Power Distribution Box (PDB), AMS Crew Operations Post (ACOP), Thermal Control System (TCS), Micro Meteoroid and Orbital Debris (MM&OD) shields and a passive Payload Attach System (PAS).

1.2.2 **Cryomagnet:** The Cryogenic Superconducting Magnet (Cryomagnet) system consists of a superconducting magnet and a Superfluid Helium (SFHe) dewar enclosed in a Vacuum Case. The total magnet system including the Vacuum Case (VC) is estimated to weigh ~ 6508 lbs. (2952 Kg). The VC serves a dual purpose as a primary structural support and as a vacuum vessel for the cryosystem and magnet. They are suspended inside the VC by sixteen support straps. The main structural components of the VC are: upper conical flange, lower conical flange, upper support ring, lower support ring, inner cylinder and outer cylinder. On the VC inner joints, the upper and lower flanges will be butt welded to the inner cylinder. On the VC outer joints, the upper and lower flanges will be attached to the outer cylinder with 192 fasteners at each interface. Double O-rings will be used at each outer joint interface. There will be test ports between the O-rings to test them. There will be 41 ports in the VC. Sixteen ports will be for the cryosystem support straps and 25 ports will be for plumbing lines, burst disks, electrical connections, etc. Double O-rings will be used at each of the ports. All pump-out ports will also have redundant seals. The VC will also have three burst disks in series for emergency venting.

1.2.3 **Unique Support Structure-02 (USS-02):** The USS-02 is used to support the AMS-02 cryomagnet and detectors and to interface the entire AMS-02 Experiment with the Shuttle and International Space Station. The VC is also an integral part of the USS-02. The USS-02 is comprised of the following subassemblies: Upper USS-02 Assembly, Vacuum Case Assembly, Lower USS-02 Assembly, Keel Assembly, and the Payload Attach System (PAS)/Umbilical Mechanism Assembly (UMA) Assemblies. The USS-02 primary members consist of layered tubing with aluminum walls. They are fastened with rivets and bolts. The USS-02 attaches to the Shuttle with four longeron trunnions and one keel trunnion. Several AMS-02 components are mounted to the USS-02. These include: the SRD, TRD, TRD gas supply system, TOF, RICH, ECAL, electronics crates, RICH electronics, ECAL electronics, Cryo Avionics Box, cryomag rectifiers, electrical cables and components of the Thermal control System. The AMS-02 payload will be attached to the ISS using the Payload Attach System (PAS). The PAS hardware on the AMS-02 is the passive half and consists of three guide pins and a capture bar.

1.2.4 **Synchrotron Radiation Detector (SRD):** The SRD is located on the top of the experiment stack and attaches to the top of the TRD support at four locations. A large honeycomb panel supports the SRD detector. The SRD is a particle physics experiment with different detector materials configurations to measure photons, X-rays and low energy charged particles.

1.2.5 **Transition Radiation Detector (TRD):** The TRD's role is to discriminate between e^-/p^- and e^+/p over the range E = 3 – 300 GeV. This is accomplished by detecting the presence of X-ray photons emitted by electrons and positrons when they pass through a radiator. p, p- and nuclei do not emit such radiation. The radiation is detected in 5248 proportional tubes filled preferentially with $Xe:CO_2$, since Xenon gives a very high efficiency for photon detection. By proportional multiplications, the ionization electrons are converted into a measurable signal.

The proportional tubes are made from a multi-layer composite structure comprised of layers of poluyurethane, conductive carbon-polyamide, aluminum, and kapton that are grouped into 44 separate segments connected through gas manifolds. A straw module consists of 16 straws glued together with 6 CFC stiffeners running alongside the straws and polycarbonate end pieces that contain the wire fixation pieces, the gas distributor, and the gas seal. The TRD is built from 20 layers of the straw modules with a radiator material in the gaps between the layers. The upper 4 layers and the lower 4 layers are oriented in the X-direction and the 12 middle layers are oriented in the Y-direction.

1.2.6 **Time Of Flight (TOF):** The four layers of TOF Scintillator Counters are located across the top and bottom of the cylindrical magnet, with two layers on the top and two layers on the bottom. The scintillators provide the trigger function for selection of a single particle or nucleus cleanly traversing the magnet bore. The counters are made of polyvinyl toluene enclosed in a cover made of carbon fiber with an aluminum foil surface on the inside and outside. At the ends of each panel are light guides which direct the light of scintillation to photomultipliers. Two large flat aluminum honeycomb panels are used to support the scintillator counters. The upper TOF honeycomb is attached to the TRD, which is then attached to the USS-02 just above the USS-02-to-VC interface. The lower TOF honeycomb is supported to the lower USS-02.

1.2.7 **Ring Imaging Cherenkov Counter (RICH):** The RICH is located near the bottom of the experiment stack and is composed of one section containing all the Photomultiplier Tubes (PMTs) and one section that is the reflector. The first section is made of aluminum cross braces that attach to the USS-02 at eight locations that are made with pins/bolts and isolated with Bellville washers. The PMT units are screwed in place in between the welded cross bracing. The reflector section is extremely light and is made of a composite material that is spray coated with reflective aluminum that must be light tight.

1.2.8 **Electromagnetic Calorimeter (ECAL):** The ECAL functions to attain the main physics goals of the payload. These physics goals include: measuring the energy of electrons, positrons, and gammas up to 1 TeV and ensuring the identification of electromagnetic (e.m.) and hadronic cascades with a discrimination capability better that 10^{-4}. ECAL must be able to reconstruct the electromagnetic showers development with high accuracy in order to attain these goals.

ECAL is located at the bottom of the experiment stack and is mounted to the USS-02 at four attach locations via radially slotted holes. The active part is subdivided into nine sub-samples, called "superlayers". Each superlayer consists of eleven layers of the glued lead foils, with the fibers running in the same direction. The superlayers are assembled so that the fibers are running in orthogonal directions on the X and Y directions, alternatively. This kind of structure enables the study of electromagnetic showers development with the required accuracy. The primary materials for ECAL include the following: aluminum housing and brackets, aluminum honeycomb top and bottom plates, lead foil 'pancake' superlayers, and scintillating fibers.

1.2.9 **Data and Interface Electronics:** The data and interface electronics for the AMS-02 experiment will be housed in electronics crates with aluminum covers on the outside of the USS-02. The data and interface electronics will enable the connection of the AMS-02 experiment to the ISS data system.

1.2.10 **Electrical Cables:** AMS-02 will be equipped with an ISS provided passive Umbilical Mechanism Assembly (UMA), which will be mated to the ISS active UMA when the AMS is installed on the ISS. Mission Integration provided cables will run from the umbilical connector on the ISS to an input connector on the Ams-02 instrument for both data and power cables. This will be to provide the interfacing between the AMS-02 data/interface electronics and the ISS data systems, and the AMS-02 experiment and the ISS electrical power system via the ISS umbilical connector.

1.2.11 **Monitoring and Control Computers (MCCs):** Two MCCs are mounted on the USS-02 or the electronics racks. The MCCs provide the primary data interface between the AMS-02 Experiment low rate data system and the ISS 1553 data bus. The ISS 1553 data bus provides the housekeeping data from the AMS-02 Experiment and command capability to the AMS-02 Experiment through the ISS for transmission to the ground.

1.2.13 **Power Distribution Box (PDB):** The AMS-02 PDB is mounted on the USS-02 near the passive UMA. The purpose of the PDB is to provide the power interface circuitry between the ISS and AMS-02. The PDB receives power from either or both of the ISS power buses and converts this voltage to 28v dc for distribution to the various AMS-02 subsystems. The PDB also distributes power to the AMS-02 Magnet Cryo Avionics Box. In addition, the PDB provides unswitched power for the AMS-02 mission critical systems, controllers, computers, monitoring circuits, etc.

1.2.14 **Cryomagnet Avionics Box (CAB):** The CAB is mounted between the horizontal and diagonal members of the USS-02 near the sill trunnion. The purpose of the CAG is to provide power to the Charging Circuitry in the Magnet as well as to provide control and monitoring circuitry for charging/discharging operations. The CAB receives unswitched power directly from ISS Bus A via the PDB. Magnet charging operations depend upon the operation of Bus A from the ISS. A transformer contained within the Cryo Magnet Current Source, which is contained within the CAB, performs isolation from the magnet.

The CAB also controls the discharge circuitry for the magnet. Controlled discharges are commanded either by automatic control circuitry or crew/ground commanding. The commanding causes opening of the magnet persistent switch, which then routes the current to a set of eighteen rectifiers. These rectifiers cause the discharge of the magnet and convert the energy into heat. Each rectifier is capable of dissipating 200 Watts. The magnet discharges in approximately 90 minutes and each rectifier will remain below 212 F (100 degrees C).

The control system for the discharge circuitry will require an Un-interruptable Power Source that will allow AMS to perform a quench or a controlled run-down of the magnetic field in the event of loss of power for an extended (unplanned) period.

1.2.15 **AMS Crew Operations Post (ACOP):** The AMS Crew Operations Post (ACOP) system consists of a 4PU EXPRESS rack payload drawer assembly and one middeck locker of hard drive media, payload provided external cables, and spares. ACOP serves as a management system for the AMS-02 science data as well as a crew operations post. ACOP is capable of simultaneously receiving, processing, and downlinking the AMS-02 science data stream as provided on the High Data Link. Crew control is provided at a low level via the front panel interface. Payload Support Computer based applications software will provide robust operations and monitoring ability via network sessions with ACOP. Mounted within the payload drawer are six hot swap hard drive bays, a power supply, and operations interface consisting of a graphic LCD display and push buttons, a drawer cooling fan, and a Compact PCI card cage assembly. The stowage volume will contain twenty hard drives, payload provided data cables, and spares.

1.2.16 **Thermal Control System (TCS):** The AMS-02 Thermal Control System (TCS) design is currently being developed by the AMS experiment team. Preliminary indications are that this system will consist of radiators mounted either directly to the AMS-02 electronics or mounted on the USS-02. One or more cooling loops will be used to transport heat from various electronic boxes to the radiators. These loops will probably be driven by a pump and controlled with valves. Working fluids being considered are carbon dioxide (CO_2) and ammonia (NH_3). Required heaters for various experiment components are yet to be defined. Standard NASA Multilayer Insulation (MLI) thermal blankets will also be used.

1.2.17 **Meteroid and Orbital Debris Shielding (MOD):** The MOD shielding is designed to protect the pressure systems on the AMS-02 experiment. These systems include the Cryomagnet system including the warm helium tank, the TRD Gas System, and possibly the TCS. Much of the shielding will be thin aluminum plates with small standoffs from other AMS-02 experiment hardware.

1.2.16 **Reflight/Series Hardware:** The AMS-02 Silicon Tracker Assemblies, Tracker Alignment System (TAS), Anti-Coincidence Counter (ACC) and Digital Data Recording System (DDRS) are reflown/series elements from AMS-01. The reflown/series safety assessments for these elements will be included in the AMS-02 Phase III Flight Safety Data Package. AMS-02 is scheduled for launch in October 2003.

1.2.17 **AMS-02 Science:** MIT/S. Ting presented an overview of the science associated with the AMS-02 payload. He outlined the purpose of the payload as performing an accurate, high-statistics long-duration measurement of energetically charged cosmic ray spectra in space. This will include studying the origin of cosmic rays, and the search for anti-matter and dark matter. He stated that all particles in physics have correlating anti-particles. He linked the AMS-02 science to the Big Bang Theory of creation of our universe and offered that an anti-matter, or a universe made of dark, unobservable matter, would be required prior to the big bang explosion. He stated that 90% of our universe is dark matter composed of Super Symmetry (SUSY) particles that are not observable, and that a magnet is required to measure matter and anti-matter. When magnetized, matter and anti-matter bend in opposite directions, which distinguishes them from each other. He offered that the measurements must take place in the vacuum of space because the matter and anti-matter would annihilate each other on Earth.

1.3 **Scope:** This meeting focused on proving that AMS-02 is safe without services.

1.4 **Conclusion:** Nine agreements and three action items resulted from this meeting (see Attachment 2.) JSC Form 1230 and eleven unique Hazard Reports (HRs) were signed and approved for Phase 0/I, no HRs were deleted prior to or during the review, and no HRs remain open pending correction and updates. This meeting completed the Phase 0/I FSR.

2.0 **SIGNIFICANT SAFETY DISCUSSION**

2.1 **Cryomagnet Magnetic Field**: The PO stated that the AMS-02 magnetic field plots create a spherical dipole magnetic field. The PO further offered that the effects on the International Space Station (ISS) with the AMS-02 in alignment along the ISS y-axis would not exceed the Magnetic Dipole Moment of the maximum allowable 40,000 amp-$m^{2.}$ Estimates based on the ISS Control Moment Gyro Momemtum Manager Interaction Assessment project the effects to be about 27, 300 amp-m^2. The magnetic field had affected the Extravehicular Mobility Unit (EMU) while in close proximity, but no permanent affects on any of the equipment were manifested when removed from the magnet. Testing was conducted on the EMU to determine its tolerance to magnetic fields. Results indicated that the EMU and all related hardware (cameras, communication, etc.) could function normally at approximately 600 gauss. The PO is working with JSC EVA Project Office/NC55 to raise the EMU's maximum allowable limit to 300 gauss, which would provide a significant margin of safety.

2.2 **Cryosystem Venting and Certification:** The main topics presented regarding venting and certification of the Cryosystem including the Certification Plan for AMS-02 Vacuum Seals, the Certification plan for AMS-02 Mechanical Fittings for Pressure Systems, the various scenarios related to Puncture of the Vacuum Case, and the AMS-02 Nominal Vent into the Payload Bay.

2.2.1 The PO stated that the Certification Plan for AMS-02 Vacuum Seals calls for double o-rings for all o-ring seals, and that there is inadequate room for triple o-rings. The PSRP referred the PO to data from another payload detailing the required time for safing if one or two o-ring seals were lost, and suggested that the PO use the data as a guideline for their data preparation regarding this issue. The PO noted that they already have data providing information relating to instantaneous loss of all vacuums.

2.2.2 The PO presented the Certification Plan for Mechanical Fittings for pressure Systems, in which all fittings are designed to be cryogenic welded. The payload will use commercial off-the-shelf fittings for low-pressure fittings.

2.2.3 Three possible scenarios for puncturing the Vacuum Case were discussed, including puncture with the Payload Bay Doors open, puncture with the Payload Bay Doors closed, and Micro-Meteoroid and Orbital Debris (MMOD) penetrations.

In the event of a puncture with the Payload Bay Doors open, burst disks were incorporated into the pressure system to avoid exceedance of Maximum Design Pressure. The PO addressed the four criteria for the burst disks. These include the following: the burst disks must have no sliding parts; they must be design qualified to the intended application by test data applicable to the intended use, including flow rate and temperature; the burst disks must meet the qualifications for the specific part number used; and it must be verified that no design or material changes exist between flight assemblies and assemblies making up the data; and each flight assemble must be verified for membrane actuation. The PO further recommended testing large batches of disks, about every eight out of ten, and using the remaining disks. The PO will apply statistical analysis to demonstrate that there is certainty to an acceptable level that the disks will operate within the Maximum Design Pressure for the Helium tank.

The PO delivered the analysis of the effect of a ¼-pound sharp, pointed object falling the length of the Payload Bay in the vertical position and hitting the bare Vacuum Case at its thinnest section while the Payload Bay Doors were closed. This analysis reflected positive margins of safety even when the VC was hit at its thinnest section.

Meteroid and orbital debris are not expected to be able to reach the VC due to the shields and outer sections of the payload hardware.

2.2.4 Nominal Vent into Payload Bay: The PO stated that the vent rate is acceptable in any direction and the vent will be zero thrust.

2.2.5 Emergency Venting into Payload Bay: The PO cannot find a credible scenario for this to happen; and maintain that it is only an issue if all three burst disks rupture between T+30 and T+60 seconds. The thermal issue due to helium venting is still open and in work. The PO requested advice about whether the scenario is credible enough to analyze. PSRP questioned the reliability of the PO's source data for time from launch vent profile curve and requested that MS3/S. Kunkel research the source data vent profile curve to ensure that the PO is not required to meet constraints that are not necessary. The PSRP was concerned that the PO may have been too conservative. A representative from USA verified that the data is current. The PSRP challenged the PO to avoid making assumptions that are not realistic, and which may lead them to perform an analysis that is not necessary or wrong. The PSRP reminded the PO that they want to avoid launch commit criteria beyond 9 minutes, and they especially want to avoid the T-31 seconds window with a payload capable of stopping the launch. The PO will work with cargo integration after they get actual test data. (Agreement 3.10)

2.2.6 The PSRP chairman suggested that the PO consult with JSC experts to investigate the potential for a corona discharge due to Xe venting from AMS-02.

2.3 MM&OD Testing and Analysis: The PO summarized the results of risk assessments and variations for ballistics limit curves relating to different areas on AMS, noting that they still need to reduce penetration sites by 40%. The PSRP addressed concerns about the disparity between ISS requirements and the requirements per HQ. The PO stated that the use of different models, one from 1991 and one from 1996 might cause the disparity. The PSRP requested that the PO know why the requirements numbers are different. The PO offered to research the issue to acquire HQ's understanding of the requirements. The PSRP directed NC44/A. Nelson, Jr. to also research HQ's numbers to provide the rationale for them. (Agreement 3.3)

2.4 Avionics: After the PO delivered the Avionics Ascent Operations Profile, the PSRP ascertained that the power to open the SFHe valve when Payload Bay pressure drops below the SFHe tank pressure and to close the vent valve in case of a possible abort are only Mission Success issues, not safety issues. The PSRP directed the PO to include a highlight of this information as mission success only, not safety, for Phase II. (Agreement 3.2)

The PO clarified that they want AMS-02 checked out while the Shuttle is still docked to ISS, so if major mission success problems exist, not safety issues, the option to return AMS-02 to the Orbiter and bring the payload back is available. The PO wants to be able to decide whether to stay while the Shuttle is still docked.

2.5 Hazard Reports

2.5.1 JSC Form 1230: Approved with modifications.
The PSRP reminded the PO that NSTS 13830 requires the inclusion of the battery manufacturer and battery specifications at Phase II. The PO agreed to provide that information when the battery is chosen,

either by the Delta Phase I review or as a highlighted section of Phase II SDP as new information. (Agreement 3.2)
Ignition of Flammable Atmospheres in Payload Bay: The PSRP verified that He Nominal Vent Valve solenoid will be operated via an automatic on-board command via the Barometric Switch.
The payload will depend on the ISIS/EXPRESS rack to provide FDS inside the rack.
The PO will provide information regarding the hard drives when they are chosen.
The PSRP cautioned the PO to maintain the promise of clean air inside the cabin.
Mating/Demating power connectors: The PSRP advised the PO to add a procedure verifying that ACOP is depowered via circuit breaker when the ISIS/EXPRESS rack is opened.

2.5.2 AMS-02-1 Structural: The PO met OOB with the JSC Structures Working Group to modify this HR for signature.

2.5.3 AMS-02-2: Materials Offgassing: Approved. A unique HR was required because some verifications were done by analysis instead of testing.

2.5.4 AMS-02-3: Approved with modifications. Rupture of Vacuum Case and/or SFHe Tank/Lines/Fitting/Pressurized Components: The PO will add a crew procedure to the controls section directing the crew to open the DV02 valve to meet fault tolerance requirements. The PO also agreed to add information to part “d” of Letter TAA-88-074, “Burst Disk Certification Approach,” regarding materials and process control.

2.5.5 AMS-02-4: Approved with modifications. Venting of Helium Gas: 1.b Control: The PO will clarify the redundancy for Pressures and Temperatures in the SFHe tank and the VC for Phase II. The PO will also delete verification 2a and replace it with a statement saying that the cryosystem is designed to minimum risk per NSTS 1700b, paragraph 202.6 and attach the presentation package pages regarding this area to the HR.

2.5.6 AMS-02-5: Approved with modifications. Rupture of the Following AMS-02 Pressure Systems: TRD Xe & CH_4 (or CO_2) Gas Supplies, Warm He Supply or the Thermal control System (TCS): The PSRP reminded the PO that they may need to update the schematics for the AMS-02 TRD gas system for Phase II to provide greater detail for the controls being utilized. The relevant matrix will also be updated for Phase II.

2.5.7 AMS-02-6: Approved with modifications. Venting of Xenon (Xe), Carbon Dioxide (CO_2) or Freon (CF_4) Gas from the TRD; Venting from the Warm Helium Supply and/or Venting from the Thermal Control System (TCS): Vent test data will be presubmitted to EP4/Howard Flynn, then submitted to USA in April 2001 for analysis prior to Phase II. Paragraph 202.6 will be added to Applicable Safety Requirements section of HR for Phase II. Both the data inclusion and referencing paragraph 202 are AI 2 to the PO. The PSRP addressed the need to define a process for data submittal to USA to ensure compliance with ISO 9000. MT2/J. J. Conwell is working this issue.

2.5.8 AMS-02-7: Electromagnetic Interference (EMI) from AMS-02 Magnetic Field: Approved. Questions regarding EMU testing and the amount of gauss that the crew could be exposed to were addressed. The PO assured the PSRP that testing had proven the suit safely withstood testing. NC55/S. Loyd received an action to provide updates regarding changes to the magnetic requirements for the EMU and peripheral equipment and status the relevant communication between the PO, EVA Project Office, and XA. (AI 3)

2.5.9 AMS-02-8: Electrical Shock: Approved with modifications.

2.5.10 AMS-02-9: Excessive Ionizing Radiation: Approved with modifications. Updated Form 44.

2.5.11 AMS-02-10: Fire Protection: Approved as written.

2.5.12 AMS-02-11: Inability to completely install/remove the AMS-02 in/from the active Payload Attach System (PAS): The PO will add a crew procedure to the control section. The PSRP requested that the PO provide more definition regarding EVA procedures, including contingency EVAs, related to this hazard for Phase II.

3.0 AGREEMENTS

3.1 The PO agreed to accurately define the weight of the Xe transported in the Xe tanks in the TRD.

3.2 The PO agreed to highlight or differentiate any new material in the Phase II SDP.

3.3 The PO agreed to research the rationale for the different requirements numbers from HQ, ISS, and AMS-02 personnel regarding MM&OD and coordinate the findings with the PSEs assigned to AMS-02.

3.4 The PO agreed to highlight the Avionics Operations Profile for Phase II to designate that the information regarding the SFHe Tank Nominal Vent Valve opening during ascent and closing during a possible abort are only goals for mission success, not safety issues.

3.5 The PO agreed to present information related to the ACOP drawer assembly Hard Drives when available, and to ensure that fans/filters are kept cleaned to provide clean cabin air.

3.6 The PO agreed to define all TBDs in JSC Form 1230 for Standardized Hazards for Phase II.

3.7 The PO agreed to add information to part "d" of Letter TAA-88-074, "Burst Disk Certification Approach," regarding materials and process control.

3.8 The PO agreed to add information to HR AMS-02-3 AMS-02 Pressure System-Cryomagnet table for Phase II.

3.9 NC44/A. Nelson will verify that M. Golightly has a copy of the updated version of Form 44.

3.10 The PO agreed to coordinate with Cargo Integration after the research on the source data profile for time from launch vent profile is completed.

JSC/NC44/A. N. Nelson, Jr.
Payload Safety Engineer

JSC/NC44/S. J. Taylor
Technical Writer

JSC/NC44/S. J. Daniel.
Payload Safety Engineer

Status of Hazard Reports Presented

(Note: See the text of the minutes for more details.)

Number	Title	Status	Comments
JSC Form	Standard Hazards	Approved	2.5.1

1230		w/Mods	
AMS-02-1	Structural Failure of Hardware	Approved w/Mods	2.5.2
AMS-02-2	Materials Offgassing	Approved	2.5.3
AMS-02-3	Rupture of Vacuum Case and/or SFHe Tank/Lines/Fittings/Pressurized Components	Approved w/Mods	2.5.4
AMS-02-4	Venting Helium Gas	Approved w/Mods	2.5.5
AMS-02-5	Rupture of the Following AMS-02 Pressure Systems: TRD Xe & CH_4 (or CO_2) Gas Supplies, Warm He Supply or the Thermal co0ntrol System (TCS)	Approved w/Mods	2.5.6
AMS-02-6	Venting of Xenon (Xe), Carbon Dioxide (CO_2) or Freon (CF_4) Gas from the TRD; Venting from the Warm Helium Supply and/or Venting from the Thermal Control System (TCS)	Approved w/Mods	2.5.7
AMS-02-7	Electromagnetic Interference (EMI) from AMS-02 Magnetic Field	Approved w/Mods	2.5.8
AMS-02-8	Electrical Shock	Approved w/Mods	2.5.9
AMS-02-9	Excessive Ionizing Radiation	Approved w/Mods	2.5.10
AMS-02-10	Fire Protection	Approved	2.5.11
AMS-02-11	Inability to completely install/remove the AMS-02 in/from the active Payload Attach System (PAS)	Approved w/Mods	2.5.12

AI 1: The PSRP assigned SF3/J. Bates an action to continue to assess the helium venting analysis with Shuttle Integration and EP4 and develop a history of cryostat operations to determine the necessity of a Launch Commit Criteria (LCC) inside T-9 minutes to launch and report findings at Phase II.

AI 2: The PSRP assigned SF3/J. Bates an action to pre-submit AMS-02 vent test data regarding TCS, warm helium supply, TRD, and the cryosystem to EP4/H. Flynn for approval; submit data to USA in April 2001 for analysis; and add results to HR AMS-02-6 for presentation at Phase II FSR.

AI 3: The PSRP assigned NC55/S. Loyd an action to provide updates regarding changes to the magnetic requirements for the EMU and peripheral equipment, and status the relevant communication between the PO and EVA Project Office/XA. (PSRP may schedule a meeting with XA and AMS following review of the AI, if necessary.)

ATTACHMENT 1

Payload Safety Review Attendance Log

Payload: Alpha Magnetic Spectrometer-02 Phase 0/I Flight Safety Review
Meeting Date: January 16, 2001

Mail Code	Name	Phone 281	X
CHAIRMAN			
MA2	Larsen, A. M.	483-1207	
MA2	O'Brien, D. E.	483-1396	
SUPPORT PERSONNEL			
CB	Bonse, G.	244-8542	
DO12/USA	Knutson, D.	483-4405	
EA4	Tadlock, D.	483-3783	
MS3/USA	Kunkel, S.	280-6844	
NC55	Loyd, S.E.	244-1964	
NE2	Priest, G.	483-6219	
Boe/HS44	Blalock, J.	336-4743	
NC4	Grant, R. J.	483-9494	
NC4	Moreland, D. W.	483-5549	
NC44/SAIC	Daniel, S.	483-3294	
NC44/SAIC	Nelson, Jr., A. N.	483-9661	
NC44/SAIC	Taylor, S.J.	483-9551	
LMES/C36	Martinez, N.	483-8933	
LMES/B25	McDonald, P. D.	333-7309	
LMES/C20	Russell, D.	333-6892	
LMES/C80	Beaird, H.G.	333-6957	

Mail Code	Name	Employer	Phone Number	INTERNET ADDRESS
SF3	Jim Bates	NASA/JSC	281-483-0657	jbates@ems.jsc.nasa.gov
C42	Ken Bollweg	LMSO	281-335-2714	Ken.bollweg@lmco.com
C42	Trent Martin	LMSO	281-335-2139	Trent.martin@lmco.com
OZ2	Robert Miley	USA	281-244-8261	Robert.r.miley@usahq.unitedspace alliance.com
SF3	Rick Sanchez	NASA/JSC	281-483-3576	Ricardo.sanchez1@jsc.nasa.gov
MT3	Gail Clark	NASA/JSC	281-483-0669	gclark@ems.jsc.nasa.gov
XA	Ed Svrcek	NASA/JSC	281-483-4866	esvrcek@ems.jsc.nasa.gov
AP	Doug Blanchard	NASA/JSC	281-483-5151	Douglas.p.blanchard@jsc.nasa.gov
OZ4	Stephen A. Voels	NASA/JSC	281-244-8111	Stephen.a.voels@jsc.nasa.gov
NE2	Dan Londa	NASA/JSC	281-483-6988	dlonda@ems.jsc.nasa.gov
	S. Ting	MIT	617-253-5065	
C20	Tom Tinsler	LMSO/JSC	281-333-6946	Tom.tinsler@lmco.com
	X2 Wang	MIT	41-22-767-1868	X2.wang@cern.ch
	Manfred Steuer	MIT	41-22-767-6553	m.steuer@cern.ch

C42	Paul Nemeth	LMSO/JSC	281-335-6706	Paul.nemeth@lmco.com
C42	Lollie Lopez	LMSO/JSC	281-335-6148	Lollie.lopez@lmco.com
B22	Ross A. Harold	LMSO/AMS	281-333-6134	Ross.Harold@lmco.com
DT42	J. Travis Fitzgerald	USA	281-244-8219	Travis.j.Fitzgerald1@jsc.nasa.gov
	Robert Becker	MIT	41-22-767-9656	Robert.becker@cern.ch
C42	Stan Blackmer	LMSO	281-335-2711	Stanley.blackmer@lmco.com
C42	George R. Smith, Jr.	LMSO	281-335-2871	George.r.smith@lmco.com
	Mike Capell	MIT		Michael.capell@cern.ch
	J. Ulbricht	ETHZ	4113662028	Ulbricht@particle.phys.ethz.ch
	Steve Harrison	Space Cryomagnets, Ltd.	441235464069	stephenharrison@spacecryo.co.uk
C42	Robert Mohler	LMSO	281-335-6154	Robert.mohler@lmco.com
NT52	Juan Traslavina	SAIC	281-483-0531	Jtraslav@jsc.nasa.gov
	Dean Read	LM/ATC	650-424-2385	Dean.read@lmco.com
	Kathleen Johnston	Aerospace		kjohnsto@ems.jsc.nasa.gov
C70	Craig Clark	LMSO	281-333-6779	Craig.clark@lmco.com
HS-44	Phillip Mak	Teledyne		Ext.phillip.mak@boeing.com
C70	David Farner	LMSO	281-333-6481	David.farner@lmco.com
HS-44	Bill Corley	Teledyne Brown	281-336-4280	William.corley@sw.boeing.com
OZ2/USA	Milton Ferreri	USA	281-244-8944	Milton.a.ferrari1@jsc.nasa.gov
B22	Phil Mott	LMSO	281-333-6451	Phil.mott@lmco.com
B25	Bruce Sommer	LMSO	281-333-6243	Bruce.sommer@lmco.com
	Joe Uceda	HEI	281-333-7862	
B25	Ryan Lawrence	LMSO	281-333-7314	Ryan.m.Lawrence@lmco.com
B25	C. Balasubramanian	LMSO	281-333-7518	Chittur.balas@lmco.com
B14	Derek E. Rochelle	LMSO	281-333-6978	Derek.Rochelle@lmco.com
B22	Morgan Garner	LMSO	281-333-7487	Morgan.d.garner@lmco.com
EP4	Howard Flynn	NASA	281-483-1198	Global
	Gerald Kenney	ETH-Zurich	41227679924	gkenney@cern.ch
	Bill Hungerford	LMSO	281-474-2460	Bill.hungerford@cern.ch
	Joseph Burger	MIT	41792010241	Joseph.burger@cern.ch
	Kristi Ramage	TBE		Kristi.ramage@tbe.com
OZ	Gene Cook	NASA	281-244-8467	gcook@ems.jsc.nasa.gov

ATTACHMENT 2

NASA JSC
Payload Safety Review Panel
Alpha Spectrometer-02
Phase 0/I Flight Safety Review

Summary of Action Items
January 18, 2001

AI	Action	Date Due
1 Assigned to: SF3/J. Bates	Continue to assess the helium venting analysis with Shuttle Integration and EP4 and develop a history of cryostat operations to determine the necessity of a Launch Commit Criteria (LCC) inside T-9 minutes to launch.	Date: Phase II Mandatory Reviewers: PSRP
2 Assigned to: SF3/J. Bates HR: AMS-02-6	Pre-submit AMS-02 vent test data regarding TCS, warm helium supply, TRD, and the cryosystem to EP4/H. Flynn for approval; submit data to USA in April 2001 for analysis; and add results to HR AMS-02-6 for presentation at Phase II FSR.	Date: Phase II Mandatory Reviewers: PSRP
3 Assigned to: NC55/S. Loyd HR: AMS-02-7	Provide updates regarding changes to the magnetic requirements for the EMU and peripheral equipment, and status the relevant communication between the PO and EVA Project Office/XA. (PSRP may schedule a meeting with XA and AMS following review of the AI, if necessary.)	Date: February 18, 2001 Mandatory Reviewers:

Original signed by:

_________________________ January 18, 2001
JSC/MA2/A. M. Larsen Date
PSRP Chairman

_________________________ January 18, 2001
AMS-02/J. Bates Date
Payload Organization