

**MINUTES FOR THE PHASE II
GROUND SAFETY REVIEW
FOR THE
ALPHA MAGNETIC SPECTROMETER-02
(AMS-02)**

October 1 – 3, 2008

Kennedy Space Center

Phase II Ground Safety Review for the Alpha Magnetic Spectrometer-02 (AMS-02) October 1 – 3, 2008

The Phase II Ground Safety Review for the AMS-02 was held at the Kennedy Space Center (KSC). A list of the meeting attendees is attached following these minutes (Attachment 2).

Mr. Paul Kirkpatrick, Chairman, Ground Safety Review Panel, welcomed the meeting attendees and had the members of the GSRP introduce themselves.

Mr. Trent Martin, JSC/AMS-02 Project Manager presented an introduction and overview of the AMS-02.

Prof. Sam Ting, Principal Investigator presented an overview of the AMS-02 Science.

Mr. Timothy Urban, JSC/Jacobs ESCG presented an overview of the Ground Operations and KSC Ground Support Equipment and Tools.

Mr. Phil Mott, JSC/Jacobs ESCG, presented an overview of the Vacuum Case, Ground Handling Equipment (GHE) and Assembly Operations for the GHE.

Mr. Steve Harrison, Scientific Magnetics, presented an overview of the Cryogenic System, Cryogenic Ground System Equipment and the Superconducting Magnets.

Mr. Chris Tutt, JSC/Jacobs ESCG/AMS-02 Project Manager, presented an overview of the Helium Venting Analyses, Laser Alignment System, and the Composite Overwrapped Pressure Vessels.

Mr. Thorsten Siendenburg, MIT, presented an overview of the AMS Transition Radiation Detector (TRD) Flight Hardware and GSE Systems.

Mr. Marco Molina, Carlo Gavazzi Space SpA, presented an overview of the Thermal Control System and Thermal Control GSE at Kennedy Space Center.

Mr. Mike Capell, MIT, presented an overview of the Avionics and EGSE.

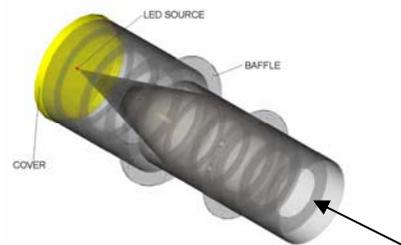
GENERAL COMMENTS

For Phase III, determine if there will be power required during pad clears.

The sharp edges are interior to the AST Star Tracker and do not pose a hazardous threat.

For Phase III, include a safety assessment of the ground operations and GSE (if applicable) for installation of AMS-02 payload hardware into the Orbiter crew compartment.

All AMS-02 responses to the GSRP comments on the Phase II Ground Safety Data Package were accepted by the GSRP Chairman. (Attachment 1)



Based on the minutes, Action Item (AMS-01/1) from the Phase I GSR was closed by the GSRP Chairman.

HAZARD REPORTS

Mr. Eric Harvey, JSC/Jacobs ESCG, presented the Hazard Reports.

GHR-AMS02-001 - Fire Hazard Due to Flammable Materials and/or Equipment Failure
Hazard Report was accepted with modifications.

GHR-AMS02-002 - Toxic Materials in Flight Hardware
Hazard Report was accepted with modifications.

GHR-AMS02-003 - Liquefaction of Atmospheric Gases
Hazard Report was accepted as written.

GHR-AMS02-004 - Rupture of the AMS-02 Pressurized Components
The AMS Project will work through the PSRP to ensure compliance with current COPV requirements concerning COPV design, and in particular stress rupture as it applies to ground processing. AMS will provide a specific briefing to the GSRP on this subject at Phase III.

Hazard Report was accepted with modifications.

GHR-AMS02-005 - Exposure to High-Pressure Gas Plume Effects
Hazard Report was accepted with modifications.

GHR-AMS02-006 - Injury to Personnel due to Excessive Low Temperatures
Hazard Report was accepted with modifications.

GHR-AMS02-007 - Loss of Breathable Atmosphere in KSC Facilities.

The oxygen deficiency detectors will be provided by KSC through the Program Requirement Document (PRD).

The number, location, and usage of the meters will be determined by the payload organization in conjunction with KSC Environmental. They will be called out in the procedures.

Hazard Report was accepted with modifications.

GHR-AMS-02-008 – Excessive Ionizing Radiation
Hazard Report was deleted. Ionizing radiation source was deleted from the AMS02 design.

GHR-AMS02-009 - Structure Failure of Hardware During Ground Handling / Moving / Operations
Hazard Report was accepted with modifications.

GHR-AMS02-010 - Structural Failure of the AMS-02 Primary Support Stand (PSS) During Static Operations

A proofload of the PSS will not be required due to the PSS being in use and has experienced no structural anomalies.

AMS will address access control around cryogenic support stands at Phase III.

Add GSE casters to the Lifting and Handling Matrix for Phase III.

Hazard Report was accepted with modifications.

GHR-AMS02-011 - Electric Discharge/Shock
Hazard Report was accepted with modifications.

GHR-AMS03-012 – Excessive Noise Levels
Hazard Report was accepted with modifications.

AMS will take noise level into consideration when buying the TCS GSE fans. The safety impact will be assessed in the Phase III GSDP.

GHR-AMS02-013 – Magnetic Fields
Hazard Report was accepted as written.

GHR-AMS02-014 – Sharp Edges
Hazard Report was accepted with modifications.

GHR-AMS02-015 – Touch Temperatures-Hot
Hazard Report was accepted with modifications.

GHR-AMS02-016 – Exposure to Lasers
Hazard Report was accepted as written.

GHR-AMS02-017 – Injury/Damage from Hand Tools or Loose Hardware
Hazard Report will be updated at Phase III to include the Tool Control Plan.
Hazard Report was accepted with modifications.

AMS can add parts/components to hazard cause 2 and eliminate cause 3, because control of loose tools and parts/components will be addressed in the AMS-02 Tool Control Plan.

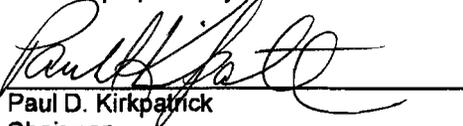
PHASE II ACTION ITEM

Action #	Action	Due Date / Actionee
AMS02/01	Determine which COPV requirements of KNPR 8715.3 are applicable to AMS-02.	AMS/NASA KSC SA-C December 1, 2008

SUMMARY

The Phase II Ground Safety Review was completed with all hazard reports being accepted. The Chairman thanked everyone for their participation.

Minutes prepared by Maxine Daniels.


Paul D. Kirkpatrick
Chairman
ISSP / SSP Ground Safety Review Panel


Mr. Trent Martin
JSC/AMS-02 Project Manager

ATTACHMENT 1

September 24, 2008

COMMENTS ON THE PHASE II GROUND SAFETY DATA PACKAGE FOR THE ALPHA MAGNETIC SPECTROMETER-02 (AMS-02) AND GROUND SUPPORT EQUIPMENT DOCUMENT# JSC 64275, DATED MAY 1, 2008

1. Page 21 – Can we get a real world perspective of how strong the magnetic field is?
Covered in Steve Harrison’s presentation.
2. Page 22, Figure 4.1.1-2 – Add the 2000G area(s) to the figure.
Can’t—too close to the outer vacuum case to show in the diagram. Put footnote in diagram that states that the magnetic field is 2000 G at outer skin of vacuum case. Update in phase II package.
3. Page 23, Section 4.1.3 – Describe a Cryomagnet quench, and is it a concern at KSC? If so, what are there ground safety implications?
Will be covered in presentation. Will address in phase III package.
4. Page 27 – Discuss the cryo effects on selected materials; does it become brittle and susceptible to impact?
Taken into account during design. Insert “Cryo effects on materials were taken into account during design.” For phase II
5. Page 33, paragraph 4 – What material is the small mixing tank made of?
Stainless steel. Corrected in phase II package.
6. Page 38, Section 4.4.2.2, third paragraph – Is the canister in Box C pressurized?
Yes, pressurized to 2 bar. Corrected in phase II package
7. Page 58 – Didn’t see the cryostats discussed in the HRs from a mechanical perspective; e.g. hoisting points and casters.
The hoisting points are discussed in the HR (GHR-AMS02-009) that they will comply with the 5:1 safety factor. The GHE Lifting/Handling matrix will be updated to include all lifting points. (phase II)
8. Page 58, Section 5.1.1.1, second paragraph – It is stated: “The Cryostat is 2.2 m in height and 1.36 m in outer diameter...” The next sentence states: “The Cryostat ... is 1.4 m x 1.4 m x 2.2 m ...” Please clarify.
Corrected in phase II package.
9. Pages 58, 61, 64, 65 & 71/72, Sections 5.1.1.1, 5.1.2, 5.1.3 & 5.1.8 – It is stated that these items (Cryostat, LHe Master & Transfer Dewars, Liquid Valve Box, Gas Valve Box, VH1 Heat Exchanger) are capable of being hoisted. Will any of these items be hoisted at KSC? For these or any other GSE items that will be hoisted, provide maximum weight data (GSE item

full, empty or in between), identify whether lifting points are removable or permanently attached, state rated load/factor of safety of lifting points, and they must comply with Section 4.5.1 “Hoisting and Handling”, of KHB 1700.7C.

See comment 7 above. Also, matrix and text will indicate whether attach points are permanent or removable. Update for phase II.

10. Page 61 Section 5.1.2 – Reference to figures 5.1.3-1 and 5.1.3-2 should be 5.1.2-1 and 5.1.2-2. Corrected in phase II package.

11. Page 64 Section 5.1.3 – Reference to figures 5.1.4-1, 5.1.4-2 and 5.1.4-3 should be 5.1.3-1, 5.1.3-2 and 5.1.3-3.

Corrected in phase II package.

12. Page 70 – The last bullet states the burst disks are 7 bar. The figure shows 8 bar(a). Is that the same?

No issue. The difference is one takes into account atmosphere and the other does not.

13. Page 71, Section 5.1.8, sentence 6 – Are the VH1 Heat Exchanger wheels lockable?

Need to find out for phase III.

14. Page 72, Section 5.1.8, second to last sentence – It is stated that the lifting points have been designed with a safety factor no less than four; however, Section 7.10 states that permanent lifting points on GSE will have an ultimate factor of safety of 5. Please clarify.

Will clarify for phase III. All CGSE hardware will need to be analyzed. GHE is OK.

15. Page 75, Section 5.1.11 – It is stated that the maximum load capacity of the Support Stands for CGSE Cryogenic and Vent Lines is 150 kg. What is the maximum load that these stands will be required to support?

Will address for phase III. Will have to add to GHE Lifting/Handling matrix.

16. Page 77, Section 5.1.12 – How will the electrical GSE racks be transported/moved at KSC?

Supposedly by wheels—will check to see if they are lockable. Will address for phase III.

17. Page 79 – First bullet – What is the construction of “commercial bottle” and is it covered by the HR?

Yes, it is covered by HR 004. Information we have in the table is the best we have at present. Will address at phase III.

18. Page 79 – 2nd Paragraph/2nd Sentence – When will AMS be without power and no personnel access, so as to need the GSE?

Corrected in phase II package. Inserted “It will be connected to the TRD system before arriving at KSC and remain on during ground processing”.

19. Page 81 – The TBD for the Warm Helium Gas System GSE will be a Phase II Action Item.
OK.

20. Page 84, Section 5.6 – The TBD details for the Star Tracker GSE (including identification of the illumination source that will be used to check the tracker cameras) will be a Phase II Action Item.

OK.

21. Page 84, Section 5.7.1 – 1st Paragraph, Last Sentence – Quantify “most lifting operations”.

Corrected in phase II package.

22. Pages 84 & 95, Section 5.7.1 & Section 5.7.3 – Section 5.7.1 states that the PSS has *two* different configurations while at KSC (low and high); however, Section 5.7.3 states that the PLF will lift the PSS into *three* different heights. Please clarify.

Corrected in phase II package.

23. Pages 84 & 96, Section 5.7.1 & Section 5.7.4 – Section 5.7.4 states that the MPLF will lift the PSS top frame. Please add a description of the PSS top frame to Section 5.7.1.

Add to phase III package.

24. Page 90, Figure 5.7.1-5 – This figure appears to be the same as figure 5.7.1-4.

Corrected in phase II package. A previously deleted picture was inserted and the numbering was corrected.

25. Page 95, Section 5.7.3 – Will the PSS ever be lifted at KSC with the entire AMS-02 payload in it? If so, will the PLF, MPLF or something else be used to lift it? Will the PSS with the entire AMS-02 payload in it ever be moved as one assembly by any other means at KSC?

We will add this to the phase III package.

26. Page 99 – Section 5.9, Last Sentence – Explain what is being sought and from what systems.

Corrected in phase II package.

27. Page 99 – Section 6.1 – What GSE and how will it arrive? Include a description of the shipping containers.

Will address in phase III package.

28. Page 100 – Section 6.3, 11th Bullet – Define charging.

Will address in phase III package. I believe Steve Harrison will cover this in his presentation.

29. Page 101 – We think the Pad Clear @ L-80 comes after PLB doors are closed.

Timeline will be more detailed for phase III. Tim Urban will address this in his presentation.

30. Page 101 – Contingency return (RLS, TAL, contingency return from orbit) will be discussed at the review.

OK.

31. Page 102, Section 7.1 – It is stated that all non-COTS mating will be done dead-faced. What about COTS?

Corrected in phase II package-comment was deleted. Address payload to payload powered mating-demating at phase III.

32. Page 102, Section 7.1 – Identify in this section and the electrical HRs, whether the COTS meets UL/an Electric Code, whether it has been modified, and whether it is being used for the purpose it was designed.

I have included a matrix in the “electric shock” HR.

33. Page 103 – The requirements for the COPVs, KNPR 8715.3, will be discussed at the review.

OK.

34. Page 105, Section 7.6, last paragraph – Explain the purpose of the dump diodes and why they could be a hot touch temperature hazard.

Corrected in phase II package. I changed the wording to more clearly indicate the function of the dump diodes described in section 7.6. Will modify flight hardware section for phase III.

35. Page 105, Section 7.7 – Who will provide the oxygen sensors/monitors?

Will discuss at the review.

36. Page 105, Section 7.7, third paragraph – Clarify: “Injury due to prolonged activity close to venting gases may vent will be controlled by requiring...”

Corrected in phase II package.

37. Page 106 – The 2nd Bullet seems to contradict the sentence further down the page about personnel working in the upper bay of the SSPF. Also, second paragraph on page 107 states caution should be taken in upper levels of the CRF.

The bullet addresses an assumption KSC wanted us to make—that for conservatism we were to assume instantaneous mixing of He with the atmosphere. The second occurrence deals with reality in that He rises, constituting a hazard for personnel working near the top of the SSPF.

38. Page 106, last paragraph – It is stated: “While being transported in the canister, flight hardware will be in the transport configuration and will not require nominal venting/evacuation of the helium tank.” On page 107, it is stated: “The evolution of helium gas from either nominal release or by fault conditions...could in theory displace the breathable atmosphere within the canister.” What nominal release will there be in the canister?

A burp in the system can easily be handled by the canister’s ventilation system. The wording on page 107 was re-worded to make it clearer.

39. Page 107 – Explain the sentence at the top of the page “It also stops the vehicle should it be required.”

Corrected in phase II package.

40. Page 108, Section 7.10 – Add the Support Stands for CGSE Cryogenic and Vent Lines to this section.

Corrected in phase II package.

41. Page 111 – Section 7.2.2 – When will the list be provided?

There are currently no GSE anomalies to report. There are no current flight anomalies that impact ground safety. We will send reports if either of these two conditions change.

42. HR 001 – Delete hazard control 1.1. Use of flammable materials will not be allowed.

Will discuss at phase II review.

43. HR 001/Control 1.2 – Delete “with concurrence from KSC” from the control. Needs to address payload organization assessment of materials used compared to KSC approved lists.

Changed.

44. HR 001/Control 1.3 – Change GSRP to KSC.

Changed.

45. HR 001/Control 1.5 – Change “KSC health and safety protocols” to “the Process Waste Questionnaire”.

Changed.

46. HR 001/Verification 1.2.1 – Add “against KSC-approved lists” to the end of the statement.

Changed.

47. HR 001/Verification 1.2.2 – Change to “Material Usage Agreements, if necessary”.

Changed.

48. HR 001/Verifications 1.3.1 & 1.3.2 – Delete these verifications and replace with: “Material Usage Agreement from KSC for all solvents not provided by KSC.”

Changed 1.3.1. Kept 1.3.2 the same.

49. HR 001/Verification 1.5.1 – Change it to “Submission of Process Waste Questionnaire”.

Wrote in “Approval of Process Waste Questionnaire”.

50. HR 001/Control 3.1 – It is stated that AMS-02 GSE electrical circuits are being designed; however, Section 5.8 states that the EGSE for AMS-02 is COTS. Please clarify.

Cables are being designed. All other EGSE is COTS.

51. HR 001/Control 4.1 – If true, why do we need HR 011/Cause 3 about hot mates?

HR 011 is dealing with shock hazard, not fire hazard.

52. HR 001/Control 5.1 – Does this only apply to electrical connectors?

Yes.

53. HR 001/Control 6.1 – Are these heaters Flight Hardware or GSE?

Both.

54. HR 001/Control 6.1 – What type of monitoring will be used?

Computers.

55. HR 001/Verification 8.3.1 – How will this be monitored?

Changed verification.

56. HR 002/Control 1.3 – Is it meant that non-toxic alternatives will be substituted for toxic materials when possible?

Changed.

57. HR 002/The TBD GSE Materials List will be a Phase II Action Item. When it is added, reference it on the HR.

Will update for phase III.

58. HR 003/Control 1.1 – Control should also address improper/inadequate insulation design and installation; not just that it is there or not.

Changed.

59. HR 003/Control 2.1 – Are warnings covered in another HR?

Added controls and verifications.

60. HR 004/Verification 1.1.1 – Specify demonstration method.

Added “Review of manufacturer’s data”.

61. HR 004/Control 2.2 – Specify how the design and operation preclude introduction of overpressure.

Add to control for phase III.

62. HR 004/Control 3.2 – We will discuss, in the review, how you can work with Boeing CAPPS & KSC to control KSC hardware.

63. HR 004/Verification 4.1.1 – Add analysis to the verification.

Added words to the effect “compare to flight hardware”.

64. HR 004/Verifications 6.2.1, 6.4.1 & 6.5.1 – Add QA verification that pressure relief devices are installed per drawings.

Added “Review of as-built hardware to ensure pressure relief devices built as per design drawings”.

65. HR 004 – Reference the GSE Pressure Systems Components Tables on the HR

Wrote this in “Description of Hazard”.

66. HR 005/Verification 1.3.1 – Review and approval is by the Project not KSC (GLOBAL – Keep us out of the approval loop)

Said “with concurrence of KSC”.

67. HR 005/Cause 3 Note – Is this a problem?

No, just there for information.

68. HR 006/Control 2.2 – How will the cryogenic systems be monitored and when?

Work on wording. Expand for phase III.

69. HR 007/Control 2.3 – State how the “Buddy System” will work so that both operators will not suffer from reduced oxygen availability.

Deleted control.

70. HR 007/Cause 3 – Will nominal venting occur while in the canister? (See comment# 38)

Possibly, but it will be only a small amount. Canister vent system should take care of this.

71. HR 007/Control 3.2 – Should “inspection of atmosphere” be changed to “measurement of atmosphere”?

Changed.

72. HR 009 – As stated in Section 7.10, address GSE lifting points on this HR. Are all of the lifting points permanently attached?

I believe this is addressed in control 1.1.

73. HR 009/Control 2.1 – Add eyebolts that are not permanently attached.

Changed.

74. HR 010/Verification 1.2.1 – How do DRs prevent incorrect assembly?

Delete last part of statement.

75. HR 010/Cause 2 – Add improper installation of PSS top frame.

Talking about the corner supports. Top frame will not be installed at KSC.

76. HR 010 – Add the Support Stands for CGSE Cryogenic and Vent Lines to this HR.

Changed.

77. HR 011/Causes – If three-phase power is used, add mismatch of three-phase power sequencing between AMS-02 electrical equipment and KSC facilities.

Added a cause with associated controls and verifications.

78. HR 011/Control 2.3 – Does this include the electrical path from the Cryomagnet to the CAB?
(See page 51, section 4.12)

See change in hardcopy of package. Will update for phase III.

79. HR011/Contol 3.1 – See #51 above.

Resolved at telecon.

80. HR 011/Controls 3.1 & 6.2 – Mating of powered connectors requires “scoop-proof” connector design, not just keying.

Deleted.

81. HR 011/Verification 6.2.1 – Will COTS connectors be mated/demated while energized?

Yes, when connecting from payload to KSC power supply.

82. HR 013/Description – Does the magnetic field pose a hazard to personnel? Will warning signs be required?

Added cause and associated controls and verifications.

83. HR 015/Verification 3.2.1 – Will functional testing of the temperature sensor be performed?

Added “operational testing at CERN”.

84. HR016/Controls – Move the Use Authorization Approval reference to the safety verification methods section.

Added new verification with above-mentioned wording.

85. HR 017/Controls & Verifications for cause 1 – Add personnel training.

Changed.

86. HR 017/Controls & Verifications for cause 2 – Add tool control plan.

Changed.

87. HR 017/Add tip-over of electrical GSE racks, and provide tip-over analyses on the racks.

Added additional cause with associated controls and verifications.

GENERAL

88. Add discussion of Phase III requirements to end of Agenda.

Not needed.

89. Add a Table which identifies the electrical GSE, whether it is COTS, what electric code it meets, whether it requires 3-phase power, and the KSC facilities where it will be used.

Added a chart to HR 11 “Electric Shock”. Will know KSC facilities at phase III.

90. Will there be a need for scaffolding/access stands/access stairs/ladders? If so, will AMS-02 payload organization provide them or will the use of KSC-provided ones be required?

Hopefully, KSC-provided.

91. General – When ground processing is performed in the SSPF, personnel must be notified of potential hazards.

- a. In order to notify personnel Boeing CAPPS SHEA will be required to post signs and possibly issue Safety Bulletins to all employees.
- b. Boeing CAPPS SHEA would like the payload provider to provide some discussion in the ground safety data package as to the types of signs and the specific wording for these signs that will be posted by Boeing CAPPS SHEA.

We can provide information.

- c. This same information should be incorporated into any procedures developed by the payload developer and/or Boeing CAPPS.
- d. For example –
 - i. What potential hazards does the magnet impose on personnel when it is activated?
 - ii. What is the maximum distance that essential and/or non-essential personnel are to be from the magnet when they are performing other tasks in the high bay?
 - iii. What is the maximum distance that personnel will be required to be from the vacuum pumps?

Can probably address these during presentations. Will address more fully in phase III package.

- e. **NOTE:** This issue arose during processing of AMS-01. It is presented now in order to alleviate any issues in the future.

MEETING ATTENDANCE ROSTER

MEETING TITLE:

Alpha Magnetic Spectrometer-02 (AMS-02)

October 1-3, 2008

No.	NAME COMPANY/MAIL STOP	FUNCTION	FULL MAIL ADDRESS	E-MAIL ADDRESS	TELEPHONE/ FAX NUMBER
1	Paul Kirkpatrick SA-C	GSRP Chairman	Safety & Mission Assurance	Paul.D.Kirkpatrick@nasa.gov	(321) 867-6568
			KSC, FL 32899		(321) 867-9253
2	Tom Tinsler SA-C3	Safety Engr	Safety & Mission Assurance	Thomas.R.Tinsler@nasa.gov	321-867-3644
			KSC, FL 32899		(321) 867-9253
3	Maxine Daniels SA-C3	Recorder	Safety & Mission Assurance	maxine.daniels@boeing.com	(321) 867-5976
			KSC, FL 32815		(321) 867-9253
4	Gary Hendricks SA-C3	GSRP Exec Chairman	Safety & Mission Assurance	Gary.D.Hendricks@nasa.gov	(321) 867-8738
			KSC, FL 32815		(321) 867-9253
5	Gilbert White	HQ USMA	HQ USMA Gilbert.White@nasa.gov →		202-358-0542
6	MIKE CARDINALE	KSC/OWETH		MICHAEL R. CARDINALE @NASA.GOV	321 867-6342
7	Dennis R. Morley	KSC/Safety	" SSPF "	Dennis R. Morley @NASA.GOV	321-867-6572
8	Mark Sistilli	NASA AMS Program Manager	SOMD, NASA HQs	mark.j.sistilli@nasa.gov	(202) 358-2242
9	ERIC HARVEY	BARROS/ AMS-02 Ground SAFETY ENGINEER	eric.harvey@escg.jacobs.com	eric.harvey@ jacobs.escg.com	281-461-5509
10	Chris Tutt	ESCG AMS Project Manager	2224 Bay Area Blvd Houston, TX 77058	john.tutt@escg.jacobs.com	281-461-5703
11	Leland D. Hill	ESCG AMS SAFETY LEAD	2224 BAY AREA BLVD Houston TX 77058	leland.hill@escg.jacobs.com	281 461 5701
12	Bruno Borzic Univ Roma	Rome group leader	Piazzza A. Moro 5 Roma Italy	bruno.borzic@ roma1.infn.it	+39.06.49914330
	CORRADO GARGIULO INFU ROMA	AMS MECHANICAL INTEGRATION	CERN, GENEVA	CORRADO GARGIULO @CERN.CH	0041766870322

MEETING ATTENDANCE ROSTER

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Alpha Magnetic Spectrometer-02 (AMS-02)

October 1-3, 2008

No.	NAME COMPANY/MAIL STOP	FUNCTION	FULL MAIL ADDRESS	E-MAIL ADDRESS	TELEPHONE/ FAX NUMBER
13	Robert Becker M.I.T.	AMS mechanical Integration	CERN Geneva Switzerland	robert.becker@cern.ch	+41 22 767 9656
14	Steve Harrison Scientific Magnetics	AMS superconducting magnet lead	El Culham Science Centre, Abingdon, UK	stephenharrison@ scientificmagnetics.co.uk	+44 1865 409200
15	JOSEPH KASTLICH JSC	AMS02 MECHANICAL	2224 Bay Area Blvd Houston, TX 77058	JOSEPH.KASTLICH@ ESCG.JACOBS.COM	281-461-5705
16	PETER DENNETT PADSOFT, INC	SOFTWARE	61 HAZBOL LN, KEMAH TX 77565	pdenmett@padssoft.com	281 334 3800 713 899 6100
17	Tim URBAN BARRIOS / JSC ESCG	AMS AVIONICS & OPERATIONS	2224 BAY AREA BLVD HOUSTON, TX 77058	timothy.urban@escg- jacobs.com	281-461-5702 713-213-8486
18	MORGAN SIMPSON NASA KSC / NE-F3	KSC NASA FLUIDS	NE-F3 KENNEDY SPACE CENTER FL 32899	morgans.simpson@nasa.gov	321-867-5857
19	PHIL MOTT JSC / JACOBS ESCG	AMS02 MECHANICAL + TESTING	2224 BAY AREA BLVD HOUSTON, TX 77058	phillip.mott@escg.jacobs. com	281-461-5712
20	Stefan Schael RWTH Aachen	AMS TRD lead	Sommerfeldstr. 14 52074 Aachen	Schael@physik.rwth-aachen.de	+49 241 8027159
21	MARCO MOLINA CARLO GAVAZZI SPACE	AMS02 THERMAL	Via Gallarate, 150 20151 MILANO ITALY	mmolina@cgspace.it	+390238048259 +39023086458
22	JAUIER BERDUGO CIEMAT-MADRID	AMS Collokat	A. COMPLUTENSE, 22 28040 MADRID-SPAIN	javier.berdugo@ciemat.es	+34 91 3466513
23	Thorsten SIEDENBURG M.I.T.	AMS TRD	Sommerfeldstr. 14 52074 Aachen, Germany	thorsten.siedenbourg@ cern.ch	+49 241 80 27186
24	Raymond Rehm GHG Corp	S&MA Payload Safety	2450 NASA Parkway Houston, TX 77058	raymond.b.rehm@ nasa.gov	281-336-2374
25	Richard Gidny NASA JSC	PRP Executive officer	2101 NASA Parkway - NE141 Houston, TX 77058	richard.w.gidny@ nasa.gov	281-244-5310

MEETING ATTENDANCE ROSTER

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Alpha Magnetic Spectrometer-02 (AMS-02)

October 1-3, 2008

No.	NAME COMPANY/MAIL STOP	FUNCTION	FULL MAIL ADDRESS	E-MAIL ADDRESS	TELEPHONE/ FAX NUMBER
26	Michael R. Surber NASA / JSC / OE	Chairman PSRP	Michael.r.Surber@nasa.gov	←	291-493-4626
27	Michael H. CAPELL M.I.T	AMS Avionics & Ops Lead	CERN, Geneva, Switzerland	Capell@mit.edu	617 253 8326
28	Peter Kittel NASA/ARC 244-10	cryogenics Consultant	NASA Ames 244-10 Moffett Field CA 94035	pkittel@cal-berkeley.edu	650-493-2792
29	Jack Keifenheim NASA/KSC UB-R	Mission Project Engineer	Jack Keifenheim UB-R Kennedy Space Center FL 32899	Jack.P.Keifenheim@nasa.gov	321-867-6028
30	GIULIANO LAURENTI	Project Engineer	Laurenti@bo.infn.it		4390581095263
31	Richard Kuhn NASA/KSC/UB-G	Integration Engineering	UB-G NASA Kennedy Space Center FL 32899	Richard.Kuhns-1@nasa.gov	321.867.6061
32	Robert Franco NASA/KSC/UB-G	Integration Engr	UB-G NASA KSC, FL 32899	robert.franco-1@nasa.gov	321 867 6401
33	Michael Gardner NASA / NE-O-C	chief Eng office	NE-O-C KSC, FL 32899	Michael.s.gardner@nasa.gov	321-867-6586
34	DARREN BURKETT IHA /	ENVIRONMENTAL HEALTH/IEH		DARREN.BURKETT@NASA.GOV	321-867-9016
35	Joe Hamilton SAC3/MEI	Safety	SAC3/MEI KSC	Joseph.b.hamilton@nasa.gov	321-861-1809
36					
37					
38					

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