National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

October 15, 2010

Reply to Attn of: NE141-10-373

TO: EA321/NASA Project Manager, Alpha Magnetic Spectrometer-02

FROM: NE/Executive Officer, Payload Safety Review Panel

SUBJECT: Alpha Magnetic Spectrometer (AMS)-02 ISS Digital Data Recording System (ISS DDRS) Phase III Safety Assessment, Hazard Report (HR) and Fire Detection and Suppression (FDS) Reporting Form Approval for STS-133/ULF5

The subject payload Phase III safety data contained in your memorandum EA3-10-041, which was provided by your representative on October 1, 2010, and subsequently updated via electronic correspondence on October 7, 2010, was reviewed with Mr. M. R. Surber, Chair, Payload Safety Review Panel, on October 8, 2010, and is considered adequate to satisfy Phase III requirements. The signed HR (STD-ISS-DDRS-01) and FDS Reporting Form (ISS DDRS-FDS-01) are enclosed for your retention.

Please direct any questions to Mr. P. Mensingh, telephone (281) 335-2363, Mail Code NA2450.

Richard W. Guidry

Enclosures

cc:
See List

cc: (*h/c memo and encl.)
CB/J. Rickard
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FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT	A. NUMBER	B. PHASE	C. DATE
	STD- ISS-DDRS-01	I/II/III	

D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*	HAZARD TITLE	E. VEHICLE
ISS Digital Data Recording System (DDRS)	STANDARD HAZARDS	***Shuttle Delivery to ISS ULF5***

F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: *(complies with)*	H. APP.	I. VERIFICATION METHOD, REFERENCE, AND STATUS:
1. Structural Failure	Designed to meet the applicable requirements for standard locker or soft-stowed items for launch/landing as defined in SSP 57008 or equivalent IDD NSTS 21000-IDD-MDK.	☒	1.1.1 SVM: Inspection of As Built Design 1.1.1STATUS: Closed. ESCG Memorandum ESCG-4510-10-SES-MEMO-0026, "AMS-02 ISS DDRS Hazard Controls," dated September 30, 2010
2. Structural Failure of Sealed Containers	Sealed containers must be compliant with a) and b) in <u>all</u> cases: a) Be a single, independent container containing a non-hazardous substance. b) Contain less than 14,240 foot-pounds (19,310 Joules) of stored energy due to pressure. *AND* Additionally, one of either c), d) or e) must be met, depending on the MDP and verification method. c) Have a maximum delta pressure of 1.5 atmospheres (22 psia, 1.5 bars). *OR* d) Have an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) <u>and</u> analysis or test showing minimum safety factor for the design is 2.5 X MDP. *OR* e) Have an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) <u>and</u> each flight unit pass a proof test to 1.5 X MDP.	☐ ☐ ☐ ☐ ☐	N/A

APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I		
PHASE II		
PHASE III	10/1/10	Michael R. Lin 10/8/2010

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D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
3. Structural Failure of Vented Containers	Vented enclosures are not intentionally-sealed and will not create a hazard in the event of depressurization or repressurization of the surrounding volume as verified by at least one of the following: a) Contains less than 3,063 foot-pounds (4,152 J) of stored energy due to pressure in the event of vent(s) failure *Note: Calculation of the stored energy potential can be found in NASA-HDBK-5010, Appendix. G.* b) Vents are sized to maintain a minimum FOS of 1.5 for pressure loads when assessed against depressurization/repressurization rates in SSP 57000, SSP 57008, or the equivalent ICD/IDD_____) c) Provides an internal volume to effective vent area ratio that results in a differential pressure loading of no greater than 0.01 psid. *Note: Maximum Effective Vent Ratio (MEVR) for a 0.01 psid pressure differential is defined as:* $MEVR = \left(\frac{Internal\ volume\ (in^3)}{Effective\ vent\ area\ (in^2)}\right) \leq 2000in$	☒ ☐ ☐	3.a.1 SVM: Analysis of ISS DDRS enclosures for energy storage capability in excess of 3063 ft lbs 3.a.1 STATUS: Closed, Analysis of energy content attached to hazard report *Note: Include a listing of the vented container(s) as an attachment.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		*Shuttle Delivery to ISS ULF5*

F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: *(complies with)*	H. APP.	I. VERIFICATION METHOD, REFERENCE, AND STATUS:
4. Sharp Edges, Corners, and/or Protrusions	Meets the intent of one or more of the following: a) NASA-STD-3000 / SSP 50005. b) NSTS 07700 Volume 14, Appendix 7 (EVA hardware). c) NSTS 07700 Volume 14, Appendix 7(IVA hardware)/ SSP 57000. d) SSP 41163, Paragraph 3.3.6.12.3 (EVA)/ SSP 41163, Paragraph 3.3.6.12.4 (IVA).	☒ ☐ ☐ ☐	4.a.1 SVM: Sharp Edge, Corners and/or Protrusion inspection of as built hardware 4.a.1 STATUS: Closed. Human Factors Implementation Team (HFIT) Hardware Certificate of Compliance for AMS-02 ISS DDRS, 10/6/2010
5. Shatterable Material Release	Meets all that apply: a) All materials are contained. b) Optical glass (i.e. lenses, filters, etc.) components of crew cabin experiment hardware that are non-stressed (no delta pressure) and have passed both a vibration test at flight levels and a post-test visual inspection. c) Shuttle payload bay hardware shatterable material components that weigh less than 0.25 lb (113g) and are non-stressed (no delta pressure) or non-structural.	☒ ☐ ☐	5.a.1 SVM: Inspection, all fiber optic cables and interfaces contained per TPS Build 5.a.1 STATUS: Closed. JSC TPS No 2A1020182, "Fabricate HRDL Cable Assembly P/N SEG39136091-301 S/N 1001 (CI)," 9/20/2010, JSC TPS 2A1020183, "Fabricate HRDL Cable Assembly SEG39136091-301 S/N 1002 (CI)," 9/23/2010, JSC TPS 2A1020148, "Fabricate Extension Cable Assemblies P/N SEG3913800-301 S/N 1001 (CI) and 1002 (CI)," 9/28/10, JSC TPS 2A1020149, "Fabricate Extension Cable Assemblies P/N SEG39138001-302 S/N 1003 (CI) and 1004 (CI)," 10/5/2010 *Note: Include a listing and figure(s) of shatterable material(s) as an attachment.*
6. Flammable Materials	Meets one or more of the following: a) A-rated materials selected from MAPTIS or applicable IP materials process. b) Flammability assessment per NSTS 22648, JSC 29353, or applicable International Partner materials process.	☐ ☒	6.b.1 SVM: JSC/ES4 approval of materials usage 6.b.1 STATUS: Closed. MATL-10-065, "Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated 9/21/2010

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
7. Materials Offgassing	Meets one or more of the following: a) Offgassing tests of assembled article per NASA-STD-6001. b) Offgassing evaluation per: MSFC-HDBK-527/JSC or MAPTIS.	☒ ☒	7.a.1 SVM: Acceptance of offgassing test results for transmitter and receiver adapter boxes. 7.a.1 STATUS: Close to SVTL 7.b.1 SVM: Acceptance of offgassing analysis for hardware other than transmitter and receiver adapter boxes. 7.b.1 STATUS Closed. MATL-10-065, "Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated 9/21/2010	
8. Nonionizing Radiation 8.1 Non-transmitters	Meets all that apply: a) Meets ICD-2-19001, 10.7.3.2.2 EMI compatibility testing. *AND/OR* b) Meets SSP 30238 EMI compatibility testing.	☐ ☒	8.1.b.1 SVM: EMI Testing 8.1.b.1 STATUS: Closed. EV5-10-EMC-019R, "EMI/EMC Test Report Certification of the Alpha Magnetic Spectrometer (AMS) Transmitter and Receiver Adapters," dated August 31, 2010 *Note: Specify all ICD-2-19001, Section 20 and ISS/EMEP approved TIA exceedances in verification section.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
8.2 Lasers	Meets all that apply: a) Classified as as a Class 1 and/or Class 2 laser, as defined in ANSI Z136.1-2007 (as measured at the source). b) The radiant exposure, H, or irradiance, E, at the ISS crewmember's eye or on the crewmember's skin for laser source shall not exceed the maximum permissible exposure (MPE) as defined in ANSI Z136.1-2007. c) Optical magnification equipment on board ISS that could be used to view a laser source or its specular reflection shall be considered in any ocular hazard analysis.	☐ ☐ ☐	N/A *Note: Include the manufacturer laser data sheet(s) as an attachment.* *Note: Lasers operating at class 1M, 2M, 3R, 3B and 4 meeting ANSI Z136.1 -2007 and ANSI Z136.4-2005 shall be documented on a unique hazard report.*	
9. Battery Failure	Meets all that apply:		N/A	
9.1 Alkaline cells and batteries *Notes:* • *Up to 12 V* • *Up to 60 Watt-hours capacity* • *No potential charging source* • *Cells not in gas-tight compartment.*	Cells and batteries pass acceptance tests that include: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Leakage check under vacuum (e.g. 6 hours at 0.1 psia).	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
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D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
9.2 Primary button cells: e.g. - Li-(CF)x, Li-iodine, LiV_2O_5, $LiMnO_2$, Ag-Zn Rechargeable button cells: e.g. - LiV_2O_5, Li-ion, Ni-Cd, Ni-MH, Ag-Zn cells *Notes:* • *Battery capacity ≤ 300 mAh* • *Less than 3 cells per common circuit* • *Cells not in gas-tight compartment.*	Cells and batteries pass acceptance tests that include: a) Loaded and open circuit voltage measurements. b) Visual examination. *c)* Leakage check under vacuum (e.g. 6 hours at 0.1 psia). *Note: For button cells soldered to a circuit board, only a functional check of the battery in the equipment is required.*	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	
9.3 COTS Rechargeable NiMH, NiCd & Ag/Zn batteries *Note:* • *Batteries for IVA use up to 20 V and 60 Wh*	Batteries purchased in one lot and pass flight acceptance tests that include, as a minimum: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Vibration to workmanship levels. d) Leakage check under vacuum. (e.g. 6 hours at 0.1 psia). e) Charge/discharge cycles before and after vibration and vacuum testing.	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
9.4 COTS rechargeable Li-ion batteries *Note:* • *Batteries for IVA use up to 10 V and 60 Wh*	Batteries purchased in one lot and pass flight acceptance tests that include, as a minimum: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Vibration to environment or 2X workmanship level, whichever is higher. d) Leakage check under vacuum (e.g. 6 hours at 0.1 psia). e) Functional check (i.e. charge/discharge cycles) before and after vibration and vacuum.	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	
10. Touch Temperature	Meets all that apply, all payload accessible surfaces: a) Are within IVA touch temperature range of –18 Degrees C. (0 Degrees F) and 49 Degrees C (120 Degrees F). a1) For systems with active thermal management: Design contains a single fault tolerant design to not exceed touch temperature limits. a2) For systems with no active thermal management: Design is incapable of exceeding touch temperature limits. a3) For surfaces exceeding touch temperature limits: Acceptability of those higher temperatures has been determined using the formula within letter MA2-95-048 "Limits for Intravehicular Activity (IVA) Touch Temperatures", which considers thermal properties of the involved materials. b) Meet EVA touch temperature criteria of NSTS 07700 Volume 14, Appendix 7.	☐ ☐ ☒ ☐ ☐	10.a2.1 SVM: Touch Temperature Anaylsis/Testing 10.a2.1 STATUS: Closed. ESCG Memorandum ESCG-4470-10-TEAN-DOC-0130, "Touch Temperature Analysis for Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated September 2, 2010	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
11. Electrical Power Distribution	Meets all that apply: IVA Payloads: a) For Shuttle-powered payloads: Meets all circuit protection requirements of letter TA-92-038 and bonding and grounding requirements in NSTS 37330. b) For ISS-powered payloads: Meets station interface circuit protection requirements of SSP 57000 or applicable module ICD, payload circuit protection requirements of letter TA-92-038, and bonding and grounding requirements per SSP 30240 and SP 30245. EVA Payloads less than 32 volts: c) For Shuttle-powered payloads: Meets all circuit protection and wire sizing requirements of letter TA-92-038. d) For ISS-powered payloads: Meets station interface circuit protection requirements of SSP 57003 or applicable module ICD, payload circuit protection and wire sizing requirements of letter TA-92-038.	☐ ☒ ☐ ☐	11.b.1 SVM: Review of Design 11.b.1 STATUS: Closed. ESCG-4295-10-ADV SY-MEMO-0041, "AMS-02 ISS DDRS Electrical Power Distribution and Mating/Demating of Powered Connectors," dated September 21, 2010 *Note: Include circuit protection wire sizing, bonding and grounding diagrams as an attachment.* *Note: Payloads with voltages above 32 volts shall be documented on a unique hazard report.*	

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F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: *(complies with)*	H. APP.	I. VERIFICATION METHOD, REFERENCE, AND STATUS:	
12. Ignition of Flammable Atmospheres in Payload Bay	Meets the following for Shuttle launch, entry, landing, and post landing mission phases: a) Hardware is unpowered and all payload surfaces are below 352°F. *AND* b) Hardware MLI is grounded per ICD 2-19001.	☐ ☐	N/A	
13. Rotating Equipment	Rotating equipment meets both of the following: a) Enclosure has obvious containment capabilities. b) Rotating part does not exceed 8 inches (200 mm) in diameter and 8000 revolutions per minute (rpm) speed in all conditions. *OR* c) Computer Hard Disk Drive structure/enclosure is unmodified and HDDs are industry/safety certified (Example: UL, IEC, CE ratings).	☐ ☐ ☒	13.c.1 SVM: Inspection of Flight Hardware 13.c.1 STATUS: Closed. ESCG Memorandum ESCG=4530-10-GFESEI-MEMO-0025, "AMS-02 ISS DDRS Safety Data Pack: Hazard Verification 13.c.1 Rotating Equipment," dated September 22, 2010 *Note: Include listing of rotating equipment as an attachment.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS	***Shuttle Delivery to ISS ULF5***	
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
14. Mating/demating powered connectors	Meets all that apply: a) Meets the low power criteria of letter MA2-99-170 (32V or less, and less than or equal to 3A maximum available upstream current) . *AND/OR* b) Meets the paragraph 1 criteria of letter MA2-99-170 (i.e., IVA only, greater than 3A and open circuit voltage no greater than 32 volts). *AND* c) Meets bonding and grounding requirements per NSTS 37330 and/or SSP 30240 & SSP 30245.	☒ ☐ ☐	14.a.1 SVM: Review of Design 14.a.1 STATUS: Closed. ESCG-4295-10-ADV SY-MEMO-0041, "AMS-02 ISS DDRS Electrical Power Distribution and Mating/Demating of Powered Connectors," dated September 21, 2010 Note; Demating and mating operational controls for GFE T61p interface to ExPRESS Rack addressed in hazard reports (ExPRESS) EXPR-11 and (T61p) T61p-0004, Cause 4, Control 5 *Note: Include bonding and grounding diagram for mating/demating connectors as an attachment.*	
15. Contingency Return and Rapid Safing	Meets all that apply: a) If payload is unstowed in Shuttle middeck: Can be stowed within 50 minutes. *Note: See paragraph 3 of letter MA2-96-190.* b) If payload is operated in the ISS: Design does not impede emergency IVA egress to the remaining adjacent pressurized volumes.	☐ ☒	15.b.1 SVM: Review of Design 15.b.1 STATUS: Closed. ISS PIRN 57206-NA-0006A, "ER-6 / MERLIN / PWD / ISSFW / CUCU / PS-28 / Condensate Transfer Pump / AMS Laptop Protrusion Exception for Stage ULF5 and Subsequent," dated 6/22/2010 approved 8/6/2010.	

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F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
16. Unintentional Release of Material	Hardware has been assessed for all planned transportation, stowage, and operation location(s), has a minimum of one (1) level of containment, and meets the following constraints: a) Maximum of Toxic Hazard Level 0 (THL-0) as classified by JSC 27472 *AND/OR* b) Maximum of Biological Safety Level 1 (BSL-1) as classified by JSC 63828 *AND* c) Release will have no impacts to Environmental Control and Life Support (ECLS)	☐ ☐ ☐	N/A *Note: Include Hazardous Material Summary Table (HMST) as an attachment.*	

Fire Detection and Suppression Reporting Form

a. Number: ISS DDRS-FDS-01			b. Mission Phase: On- Orbit ISS Operations	
c. Payload Name: AMS-02 ISS DDRS				
d. Fire Prevention:				
e. Payload Volume	f. Fire Detection Method	g. Verification Method, Reference and Status	h. Suppression Method	i. Verification Method, Reference and Status
Volume 1 - GFE T61p Laptop	Cabin Volume (aisle) Smoke Sensor	None	ISS Portable Fire Extinguisher	None
Volume 2 - HRDL to USB Adaptor Boxes (2)	Cabin Volume (aisle) Smoke Sensor	None	ISS Portable Fire Extinguisher	None
Volume 3				
Volume 4				
Volume 5				
Volume "n"				

j. SIGNATURES:	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I		
PHASE II		
PHASE III	10/1/10	10/8/2010