

Notable Event Worksheet

(See [ES&H Manual Chapter 5200 Appendix T1 Event Investigation and Causal Analysis for Instructions](#))

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For Word Doc

Title of Event			
Event Title:	Hall A Right Septum Electrical Short		
Date and Time of Occurrence:	Saturday, March 17, 2012 9:16 AM	Notable Event Number:	PHY-12-0317
Event Location:	Building 101 - Hall A	Date Notable Event Report is Due*:	04-17-2012

*The Notable Event Report is due to the ESH&Q Reporting Officer with 30 days of the Initial Fact Finding Meeting unless an extension is requested.

Categorization and Reporting (To be completed by ESH&Q Reporting Officer within two hours – unless essential information is still pending)			
ORPS Determination:	Date: March 22, 2012	Time: 3:00 PM	
This event does not meet occurrence reporting and processing system (ORPS) reporting criteria per DOE O 232.2			
10 CFR 851 Screen:	Date: March 22, 2012	Time: 3:00 PM	
This event does not meet the voluntary reporting criteria either as a discreet event or as a programmatic weakness.			

Unless otherwise specified the following is to be completed by the [Lead Investigator](#).

Step 1 Initial Fact-Finding Meeting			
Date:	3-22-12	Time:	3:00 PM
Location:	Building 12, CEBAF Center, Room A110		
Required Attendees:	Optional Attendees:	√ if Present	
Lead Investigator:	Associate Director Physics Division :	X	
Albert Manzlak / EH&S physics division liaison	Rolf Ent		
ESH&Q Representative:	TJSO Observer:	X	
Albert Manzlak / EH&S physics division liaison	Patricia Hunt		
Supervisor of involved persons(s):	Subject Matter Expert(s), Facility/Equipment Owner as applicable:		
Robert Michaels / physics division acting hall leader //	David Kausch / facilities and logistics division fire	X	

Javier Gomez / physics division acting division safety officer	Protection Group engineer	
Involved or impacted person(s):	Timothy Minga / facilities and logistics division fire protection group engineer	X
Edward Folts / physics division hall work coordinator	David Hamlette / ESH&Q division radiation control group field supervisor	X
John Segal / physics division hall technician	John LeRose / physics division Hall A scientist	X
Witness(es): At the time of the event, the hall was in beam permit status. However, there were researchers in the Hall A counting room of the Counting House, Bldg. 97, and the Jefferson Lab Operations Group machine operators were located in the Machine Control Center, Bldg. 87.	Karl Slifer / User physics division Hall A researcher	X
	Bradley Sawatzky / physics division Hall C scientist	X
	Kalyan Allada / physics division Hall A post doctoral scientist	X
	Mary Logue / ESH&Q division associate director	X
	Christina Johnson / ESH&Q division/reporting manager	X
	Robin Wines / physics division Hall A lead engineer	X
	Arne Freyberger / accelerator division operations group manager	X
	Jay Benesch / accelerator division operations group scientist	X

	Yves Roblin / accelerator division operations group scientist	X
	Harry Fanning / accelerator division safety officer	X
	David Mack / physics division Hall C scientist	X
	Paul Brindza / physics division Hall C lead engineer	X
	William Merz / engineering division electrical engineering systems manager	X
	Charles Hightower / physics division coordinator	X

Agenda <i>(Ensure the pace of the meeting allows time for accurate note taking.)</i>	√ if Complete
1. Introduction – Provide Event Title, Date and Time of Occurrence, and Location:	X
2. Attendance - Are Required Attendees present.	X
3. Purpose of Initial Fact-Finding meeting.	X
4. Event Reconstruction – Use information to complete Section 3. Summary of Event and/or Injuries below.	X
a. Personnel and organizations involved in the event.	X
b. Conditions and actions preceding the event.	X
c. Chronology (timeline) of the event; and	X
d. Immediate actions taken in response to the event.	X
5. Clarify information – Subject-Matter Expert (SME) confirms work conditions.	X
6. Stop Work or the Tag Out Required? If “Yes” – establish the restart criteria and inform the affected Management chain.	X
7. Compensatory Actions Required? If “Yes” determine responsibility and include confirmation documentation.	X
8. Records or documentation required to confirm, clarify, or complete information (i.e., work plans, work control documents, photos, etc).	X
9. Other Questions or Concerns: Ask attendees if there are any other questions, concerns, or information that they wish to provide.	X
10. Obtain TJSO Observer feedback on conduct of fact finding meeting and potential improvements.	X

Step 2 Investigation Team:		Date Convened: (Within 24 hours of Fact Finding Meeting.)		Tuesday, March 20, 2012
Role	Name	Department/Group	Phone	
Lead Investigator	Albert Manzlak	ESH&Q physics division liaison	757 269 Ext. 7556	
Research Physicist	David Mack	Physics division Hall C group	Ext. 7442	
Magnet Engineer	Paul Brindza	Physics division Hall C group	Ext. 7588	
Electrical Engineer	William Merz	Engineering division electrical engineering group	Ext. 5836	
<u>TJSO Observer</u>	Patricia Hunt	TJSO	Ext. 7039	

Step 3 Summary of Event and / or Injuries, including Initial Fact Finding Meeting information: determine the chain of events and timeline. Use attachment as necessary.

On Saturday, March 17, 2012 at 9:16 AM, an unwanted event occurred in Experimental Hall A, Building 101, related to experiment apparatus for Experiments E08-027(g2p) and E08-007 (Gep), specifically the experiment's septum magnet. There was a meltdown of a loose electrical direct current buss connection in the magnet, followed by an electrical arc, then a flashover (disrupting discharge) involving a wiring connection known as a double pancake in two of the three upper right coils. These events probably did not occur instantaneously but most likely over days.

The g2p experiment had begun the most recent production run a month earlier, on February 16th and from then on there were several notable precursors to the magnet event: however none was recognized individually as a serious problem. Consequently, there was no mitigating action taken before the disruptive event. One of the precursors was intermittent problems with the spectrometer resolution. Attempts to characterize the problems with the resolution were being conducted up until the time of the ultimate failure. Then on Wednesday, March 14th the magnet power supply tripped off and was reset, twice. This was attributed to beam tuning activity. The experimental run plan continued. Also, later the same day the hall fire detection system, Very Early Smoke Detection Apparatus (VESDA), went into a warning status. At that time the hall ceased beam delivery and the hall status was dropped from beam permit to controlled access. An investigation by technical staff was conducted. However, no cause was observed or determined and the experimental program was restarted. Friday, March 16th the spectrometer resolution improved without intervention by technical or research personnel. The experimental run plan continued. During these continuing problems, careful inspection of the data archiver would have revealed a discrepancy between a hall probe value and the power supply setting. The inspections done were cursory. On Saturday the breaker for the right septa power supply tripped and the VESDA went into warning status, nearly simultaneously. The VESDA went from warning status to alarm within a few minutes.

Once the magnet power supply tripped and VESDA went into alarm, beam delivery to the experiment stopped and procedures to enter the hall for investigation began. The hall status was dropped from beam permit to controlled access, then afterward to restricted access. All this was accomplished according to hall technical and accelerator operations guidance, with one exception: the local municipal fire

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department was not contacted. This exception will be further evaluated in the lessons learned section of this report.

Shortly after the event the Jefferson Lab Environment, Health and Safety (EH&S) reporting manager was notified as were acting physics division safety officer, physics division liaison, acting hall leader, and Associate Directors of Physics and ESH&Q. As required, the Department of Energy Jefferson Lab Site Office reporting manager was also notified.

Once the hall was made accessible and guidance was given to the Hall work coordinator by a radiation control group supervisor a technical support team entered the hall to investigate, followed by addition technical support workers from outside the physics division.

After the event and initial investigation and discovery of the damaged equipment, it became obvious that the experimental program should be suspended for further investigation and damage assessment, equipment repairs, and experimental program modifications. Also the cause of the event must be determined, and a viable restart plan implemented.

The following is a list of equipment damaged due to this event.

1. Three layers out of 28 layers were disabled on the right septum coil
2. One aluminum block cable connection was damaged
3. Approximately ten feet (4 cables x ~2.5') 535.3 MCM, 1313 strands, extra flexible copper cable were damaged

On Tuesday, March 20th the acting division safety officer requested additional subject matter experts make an assessment of the event and provide recommendations to assist in recovery. The recommendations included the following:

1. Install ground fault interrupter on septum (Big Bite) power supply, and also on the FZ magnets, and verify proper operations.
2. Install additional thermo limit switches (Klixons) on cable connectors.
3. Replace the damaged aluminum block connections, and at the cable connections use no oxide (No-Ox) electrical grease, and torque all connections to manufacturer's specification, and develop a procedure to re-torque periodically.
4. Add voltages monitoring at several locations, specifically on the weak coils.
5. After repair of the septa magnet, high potential test (Hi pot) to 400 volts, and run the magnet for at least an hour to verify that all is in proper working order.

On Thursday, March 22nd a well attended Lessons Learned Meeting was held.

On Tuesday, March 27th

1. The additional subject matter experts reported to the acting physics division safety officer / acting deputy associate

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director of physics and verified that all the recommendations were successfully completed.

On Tuesday, March 27th

2. The associate director of physics gave the experiment spokesperson authorization to re-start the experimental program.
3. During the swing shift beam was delivered and the experimental program with its new run plan was re-established.

Notable Event Report

Emergency Notifications Made (Subsequent to the Event):	Date	Time
Fire, Rescue & Emergency Medical: (9-911)	Not Applicable	
Guard Post: x4444; 269-5822	Not Applicable	
Occupational Medicine 269-7539	Not Applicable	
ESH&Q Reporting Officer: 876-1750	03-17-12	~ 9:35 AM
Crew Chief 630-7050	03-17-12	9:16 AM
Industrial Hygiene: 269-7863:	Not Applicable	
Other: Radiation Control Group 876-1743	03-17-12	~ 10:00 AM

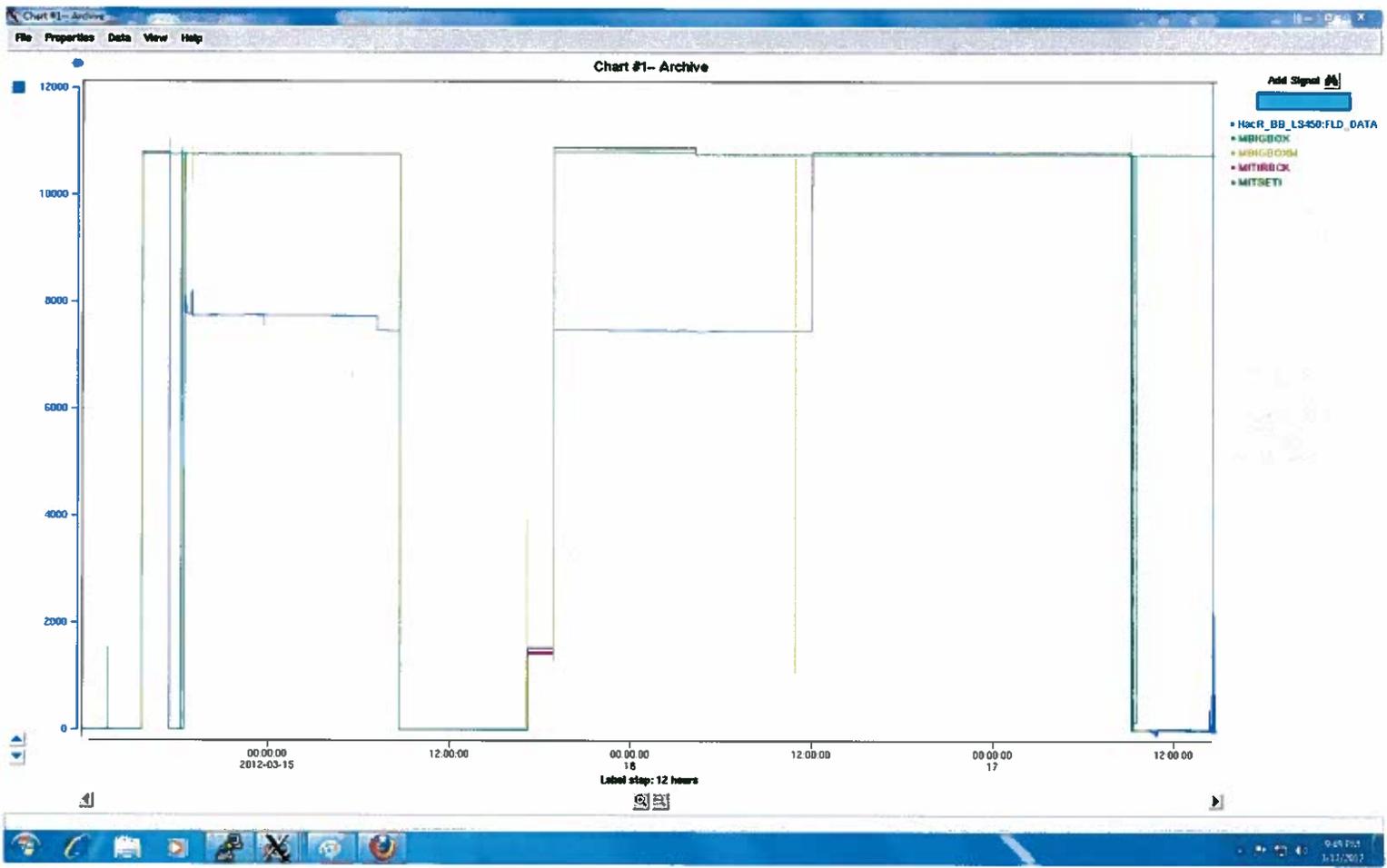
Witness Accounts: (Use attachments as necessary. Box will expand as necessary)

The initial indication of a problem is noted in the Hall A online logbook as 9:16AM. The power supply for the Right Septum magnet tripped off. 10 minutes later the fire alarm went off and the shift called the Tech-On-Call, Ed Folts. Ed instructed the shift to call MCC and go to controlled access. MCC did a full sweep and then let Ed enter the hall. Ed called Jack Segal for support on the power supplies. Dave Kausch and Tim Minga showed up at Hall A. All four were now in Hall A on a Controlled Access and found a light smoke haze, but no readily visible source. The breaker for the BigBox power supply had tripped. A brief visual inspection showed nothing burnt inside the BigBox supply. This was the second time the VESDA had alarmed in Hall A, previously on Wednesday. With the second VESDA alert and the tripped breaker, we decided to continue with the search in the hall for however long it would take till we found the cause. Dave Kausch called Bob Rice in to look at the tripped breaker. While looking around the hall, Tim Minga noticed soot on the downstream side of the Septum magnets, on the platform above them. After we got a verbal ok from Radcon, to go up by the pivot to do visual checks, we proceeded to look at the Septa magnets. The damage to the cabling on the top of the Right Septum was readily apparent on closer inspection. At this point it was decided to go to Restricted Access. We exited the hall and called MCC. The hall was dropped to Restricted Access and we re-entered the hall to continue with the inspections. The hall exhaust fans were turned on to clear the smoke out of the hall. Some more damage was noted to the coils of the Right Septum magnet. It was decided to leave further work till Monday when we could get clearance from Radcon about where we could work and what precautions we would need to take.

Environmental Aspects			
Type of Material Released:		Quantity:	
Not Applicable		Not Applicable	
Source:		Time Flow was Halted or Controlled:	
Not Applicable		Not Applicable	
For Investigation Team (√ All That Apply):			
<input type="checkbox"/> Reportable Quantity	<input type="checkbox"/> Impact Ground/Soil	<input type="checkbox"/> Storm Water Channel/Drain	<input type="checkbox"/> Sanitary Sewer

Records, Documents, Pictures, and Other References: (Copy and paste, use attachments or document links as necessary)

Below is an EPICS Archiver plot of the Right Septum magnet current (green) vs the hall probe readout at the rear of the magnet (blue). While the current stays at roughly 750 amps, the field reading drops and remains low for quite a while. This is an indication the current was not following the correct path. This is included to give a general idea of how long the problem was developing.

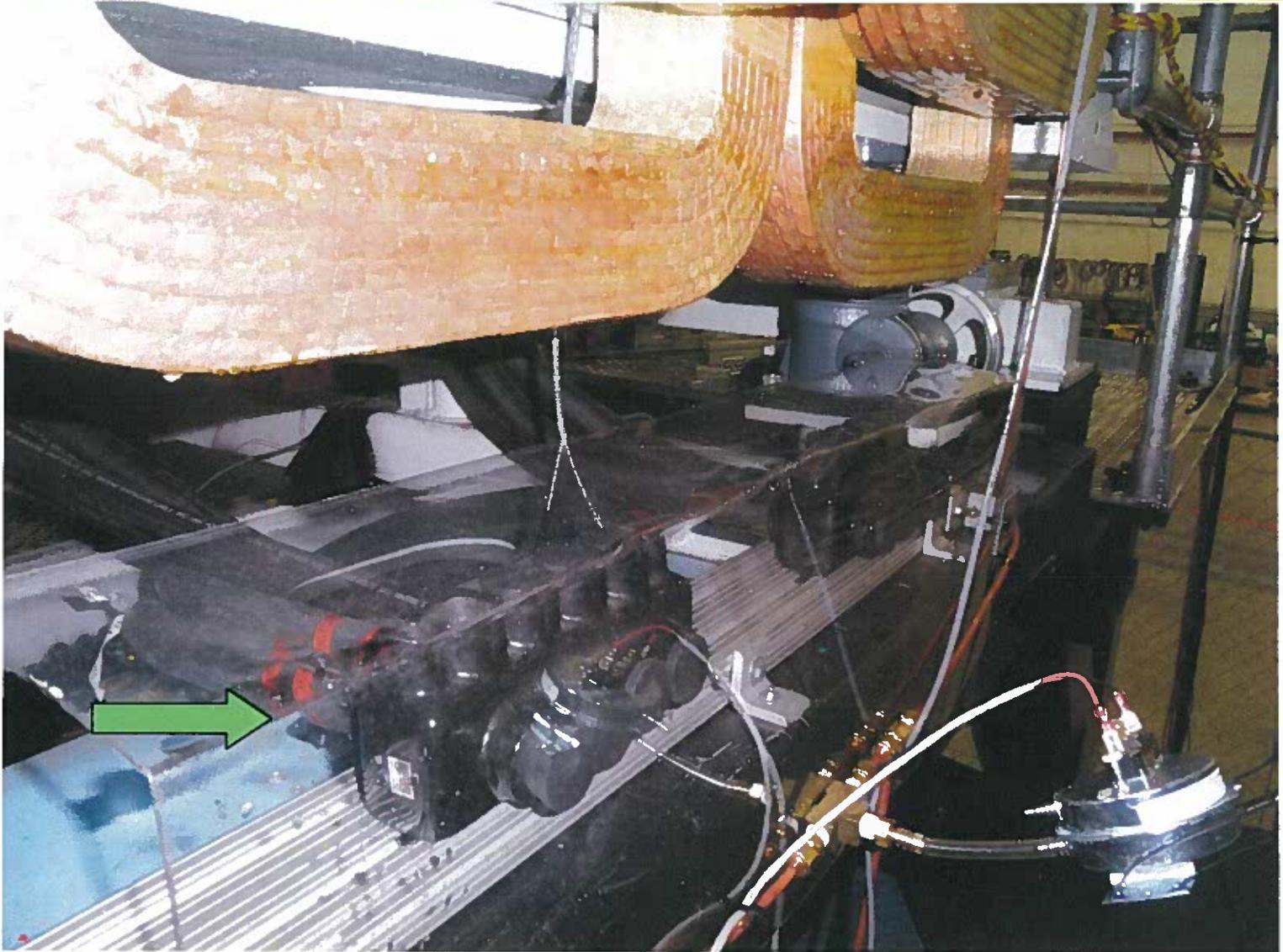


Records, Documents, Pictures, and Other References: (Copy and paste, use attachments or document links as necessary)



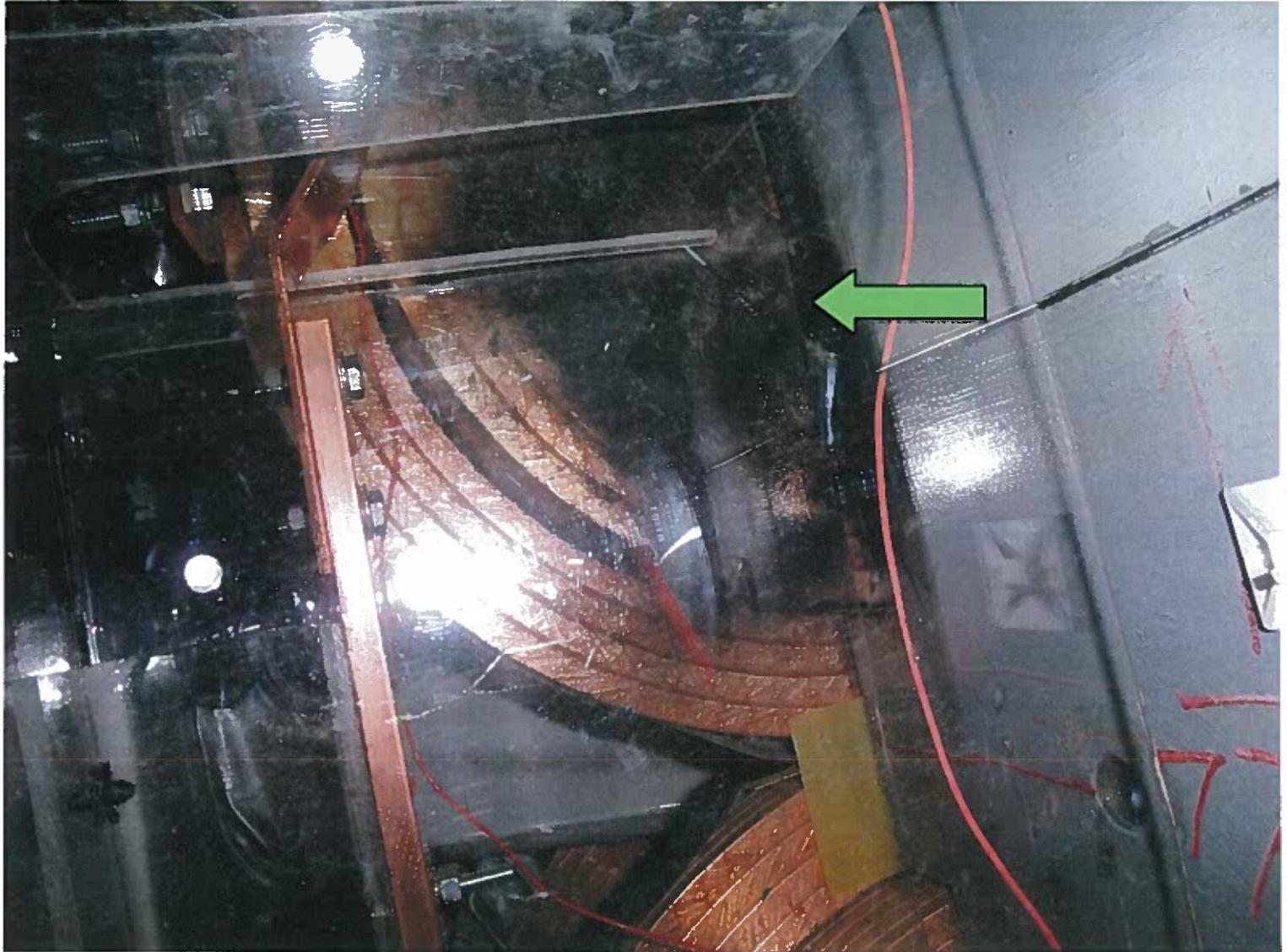
A picture is of the damaged 535.3 MCM copper cable and aluminum splice box as was found after the event.

Records, Documents, Pictures, and Other References: (Copy and paste, use attachments or document links as necessary)



A picture of an undamaged copper cable and an aluminum splice box.

Records, Documents, Pictures, and Other References: (Copy and paste, use attachments or document links as necessary)



A picture is of the damage to the septum magnet coil as first found.

Causal Analysis: (Use attachment as necessary)

Root Causes:	<p>1. Less than adequate connection in the electrical cable splice box</p> <p>Integrated Safety Management Core Function 2 - Analyze the Hazard and Core Function 3 - Develop and Implement Hazard Controls</p> <p>2. Ground fault (at some point) and no ground fault detection interlock.</p> <p>The damage that resulted from the overheated connection and very likely the damage to the coils (melting and leaking water), would have been much less if the GFI had been installed. It is highly probable that the fault would have showed up early (when the coil field and current discrepancy showed up) had the GFI been operational. Very likely that the magnet current was bypassing the coils through the dual faults (Coil GF and melted terminal block GF) for some time. Whichever ground fault occurred first would have shut the supply off. The melted cable connection may still have occurred however the rest of the magnet damage may have been much less dramatic.</p> <p>Integrated Safety Management Core Function 2 - Analyze the Hazard and Core Function 3 - Develop and Implement Hazard Controls</p>
Contributing Causes: (List as many as apply.)	<p>1. A copper electrical cable used in an aluminum splice block</p> <p>Integrated Safety Management Core Function 2 - Analyze the Hazard and Core Function 3 - Develop and Implement Hazard Controls</p>

Extent of Condition Check	Responsible Person(s)	<u>JLab CATS Number</u>	Target Date
Hall B, Bldg. 94	Doug Tilles	Not applicable	March 27, 2012
Hall C, Bldg. 96	Joseph Beaufait	Not applicable	March 27, 2012

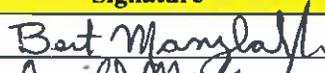
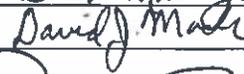
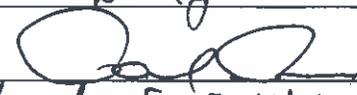
Corrective Action(s)	<u>JLab CATS Number</u>	Target Date
Install ground fault interrupter on septum power supply. Also on the FZ magnets.	Not applicable	March 27, 2012
Install Klaxons on cable connectors	Not applicable	March 27, 2012
Replace the damaged aluminum block connections, to include use of no oxide electrical grease, torque the connections to manufacturer's specification, and develop a procedure to re	Not applicable	March 27, 2012

Corrective Action(s)	JLab CATS Number	Target Date
torque periodically.		
Measure voltages at several locations, specifically on the weak coils	Not applicable	March 27, 2012
After repair of the septa magnet, high potential test (Hi pot) to 400 volts, and run the magnet for at least an hour to verify all is in proper working order.	Not applicable	March 27, 2012

Lessons Learned (Confer with Division/Department Lessons-Learned Coordinator) (Use attachment as necessary)	JLab COE Number
An electrical splice box connection using copper wire cable to aluminum, use no oxide electrical grease, and torque the connections to manufacturer's specifications and re torque periodically.	Not applicable
Follow as written the Jefferson lab emergency procedure for contacting the municipal fire department. Modification can be considered after the event not while in progress.	Not applicable

Investigation Team Confirmation:

The below signees, confirm to the best of their knowledge, that the information presented in this document is accurate and complete.

Role	Print	Signature	Date
Lead investigator	Albert Manzlak		5/9/12
Nuclear physicist	David Mack		5/22/12
Lead mechanical / magnet engineer	Paul Brindza		5/23/12
Electrical engineer	William Merz	 Curt Howerton for B.I.M	5/23/12

Upon confirmation submit document to the **ES&H Reporting Officer** for completion and distribution.

Documentation of Findings: (To be Completed by ESH&Q Reporting Officer)

Notable Event Number:	PH4-12-0317
CATS Number:	N/A
JLab COE Number:	N/A.
ORPS Number:	N/A.
NTS Number:	N/A.
CAIRS Entry:	N/A.
DOE Cause Code:	A3 Human Perf. LTA, Skill Based, Col Check of work LTA
ISM Code:	Analyze the hazards, Develop and implement Hazard Controls.

Acceptance/Acknowledgement of Facts

Print	Signature	Date:
Associate Director/ Department Manger Rolf Ent	<i>Patricia Ross</i>	5/23/2012

Distribution:

- ES&H Reporting Officer (Original)
- Associate Director/Department Manager
- Division Safety Officer
- Investigation Team Members

Form Revision Summary

Revision 1.3 – 01/31/12 – Updated ESH&Q Reporting Officer assignment from SSmith to CJohnson per MLogue Edited to clarify process steps.

Revision 1.2 – 10/20/11 – Updated ESH&Q Reporting Officer assignment from JKelly to SSmith per MLogue.

Revision 1.1 – 05/24/11 - Edited to clarify process steps.

Revision 1 – 11/23/10 – Updated to reflect current laboratory operations.

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	EXPIRATION DATE	REV.
ESH&Q Division	<u>Tina Johnson</u>	10/19/09	10/09/12	1.3

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