Jefferson Lab
Thomas Jefferson National Accelerator Facility

Notable Event Report
(See ES&H Manual Chapter 5200 Appendix T1 Event Investigation and Causal Analysis for Instructions)

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Notable Event Report

Title of Event			
Event Title:	Unexpected Energy Discovery		
Date and Time of Occurrence:	15 December 2016; 10am	**Notable Event Number:**	ACC-16-1215
Event Location:	Test Lab – Room 1019/1021 Tech Shop	**Date Notable Event Report is Due*:**	15-JAN-2017

*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.

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

On Thursday, December 15th, 2016 at approximately 10am, two technicians were troubleshooting a control fault issue on the 450 Ton Press when they discovered an unexpected source of energy within the power panel after main power had been secured and locked out.

The technicians were investigating an issue where the starter pump would not turn on rendering the press inoperable. During the troubleshooting process, the technicians entered the electrical power cabinet to investigate a possible blown fuse. However, when they went from the controls cabinet into the electrical cabinet, they did not apply their personal locks to the established administrative lockout. One of the technicians pulled a 120 V fuse from the controls circuit, tested it and found it to be open. When installing the new fuse into the fuse terminal, a discharge spark was seen coming from the left side of the terminal to the fuse. The technician was not exposed to the electrical discharge and had been using a fuse puller to pull and replace the fuses.

The technicians stopped what they were doing and verified zero power at the main 480 V terminals. However, they discovered power on the output (left) side of the 120 V fuse terminal.

After further safing out of the machine, an electrician was brought in to investigate the source of the unexpected power at the fuse terminal and traced wiring back to a light fixture mounted on the machine. This light fixture was found to be fed from an external source with a wall switch not directly associated to the press system. However an additional power feed was found connected through the light, directly feeding the downstream side of the 120 V fuse terminal.

Upon further investigation it was determined the light fixture had always been internally fed from the downstream side of the 120 V fuse terminal which also feeds the controls of the press. In the original electrical scheme, when the machine's 480 V was powered on, a stepdown transformer would provide 120 V power to the controls and the light, while the 480 V powered the press' hardware. The light would provide improved visibility under the press during operation. When the 480 V power was secured to the tool, the press hardware fed from the 480 V and the controls and light fed from the 120 V side of the transformer would become inactive.

During the rewire of the light, the wiring for the light was disconnected from the original 120 V power line from the stepdown transformer and the light was fed from an external power source through an external wall switch. However, during that rewiring, a dedicated power line, not connected to the wall switch, was connected to the original 120 V power feed from the output side of the 120 V fuse terminal. This essentially fed continuous 120 V power to the downstream side of the fuse terminal and into the controls. When 480 V was applied to the 450 Ton Press, power fed through the stepdown transformer to the input side of the 120V fuse and led to the fuse opening due to the dual delivery of power from both input and output sides of the fuse.

After the fuse opened, the controls still had power via the 120 V dedicated electrical feed through the light to the output

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

side of the fuse terminal and the press hardware had power through the 480 V power. The stepdown transformer no longer was acting as originally intended and was not providing useable 120 V power in this scheme.

Historically, the 450 Ton Press was obtained from government surplus for JLab in the late 1990's for cavity production for an Oakridge National Laboratory project. The 450 Ton Press is used to press cavity half cells of a certain size which, after assembly and processing, make up accelerating cavities. Originally, the press was located in a different part of the Test Lab which was cramped and not well lit. In February 2012, the press was relocated to its current location when the Test Lab Addition was built. The new location provides better lighting and the work area is not as cramped.

Sometime after the 450 Ton Press was moved, the light fixture was wired[1] to an external power source with a wall switch control. However, there is no record of when an electrical work request was made, when the work occurred or who performed the work (JLab electricians or a subcontractor) within the Lab's established formal work request system. The established work request system is not utilized during construction projects and Engineering Change Orders (ECO) is utilized for substantive changes. It is assumed that this work took place during the installation of the press by the building contractor or their subcontractor under retainer for punch-out items due to the lack of internal paper trail (ECO, work request, etc.) However, without evidence/documentation, this is a best guess.

In the original design, the 120 V fuse is meant to isolate the controls from the transformer. However, due to the resultant miswire and open fuse configuration, continuous power fed the controls while the press hardware had power only when the 480 V power switch was closed. This configuration did not pose any danger to the press operators when the machine was powered and in operation or to bystanders when the 480 V power was secured. However, this configuration would expose technicians gaining access into the power cabinet to an unexpected 120 V electrical hazard when they believed they had secured the primary source of electrical hazard.

In the four years since the 450 Ton Press was relocated at Jefferson Lab to its current location, it has been used less than a dozen times. After the press was moved and brought on line, it is believed that this was the first time the electrical cabinet had been opened for any reason.

[1] Due to a lack of physical changes within the electrical cabinet prior to this discovery, all wiring changes are assumed to be contained to the light fixture only.

Causal Analysis: (Use attachment as necessary)

Root Cause:	*A3B1C01 – Check of work was LTA* When the wiring was altered, the installation electrician/worker who performed the work failed to recognize introduced hazards associated with the change. Proper review or check out of connections was not performed as the improper wiring would have been discovered during a proper check out.
Contributing Causes: (List as many as apply.)	*A4B5C05 – System interactions not considered* *A4B5C04 – Risks/consequences associated with change not adequately reviewed/assessed* When altering the wiring to accommodate external control of the light fixture in the new facility, the installation electrician connected a dedicated electrical feed to the wire which used to feed the light from the machine's 120 V output. There is no evidence that the connection of the dedicated power to the original feed wire was considered by the electrician or the implications of that connection considered within the new wiring scheme. *A3B2C01 – Strong rule incorrectly chosen over other rules* - Employees incorrectly assumed that the administrative lock that was applied was sufficient. They failed to apply their personal lock out tag out before entering the electrical cabinet.

Causal Analysis: (Use attachment as necessary)

A4B5C09 – Change-related documents not developed or revised
There is no evidence that the established formal work request process (Facilities Work Request or Engineering Change Order for contract work) was used for the wiring change. This may be due to the fact that the machine was moved prior to JLab taking ownership of the new facility and the wiring of the light may have taken place during this transition period by a third party contractor who was on retainer to the Subcontractor in charge of the building addition. No documentation was found which describes the changes made to the 450 Ton Press's electrical scheme.
Acceptance of the 450 Ton Press by JLab in the new location centered on the proper operation of the 450 Ton press, which was tested and accepted by the system owner once ownership of the facility was transferred from the subcontractor in charge of the building addition to JLab. The light would have operated as installed and no second thought would have been given to it. Without proper documentation of the changes, machine acceptance was less than optimal.

A2B2C01 – Preventive maintenance for equipment LTA
There is no evidence that a preventative maintenance schedule has been followed with the 450 Ton Press. Maintenance is only performed after an equipment failure and not regularly as recommended by the manufacturer. This could lead to machine damage and/or operator injury not to mention impact to scheduled work due to outages.
The discovery of the blown fuse would have been found during routine preventative maintenance. During the fuse swap out, it would have been highly likely that the preventative maintenance technician would have discovered this issue, much like the technicians did during their troubleshooting efforts, and the issue would have been corrected before 4 ½ years.

A4B3C11 – Inadequate Work Package Preparation – There is no evidence of a formal work request which captures the request for separate control of the light on the 450 Ton Press or a review of interactions based on those changes. If the work was performed during construction the Lab's formal work request system would not have been utilized, but an Engineering Change Order would have been made. Outside of construction projects, the Lab's formal work request system is used to schedule and track changes to equipment and infrastructure. However, there is no evidence of either being utilized for this work.

Extent of Condition Check	JLab CATS Number	Target Date	Action Owner
1.) Accelerator DSO to evaluate all Accelerator work areas and note tools/resources which have dual power feeds which require labeling.	NE-2016-22-01-07	February 17th 2017	Accelerator DSO
2.) Accelerator DSO to send out message to other DSOs regarding incident and to have them review their areas for possible dual feed tools/resources which require labeling and report back to ESH&Q DSO.			

Extent of Condition Check			JLab CATS Number	Target Date		Action Owner
Does this event involve failed equipment?	Y	N ✓	Is there similar equipment in other areas?	Y ✓	N	** If yes, assign extent of condition check to the appropriate DSO(s).

Corrective Action(s)	JLab CATS Number	Target Date	Action Owner
Pull Lock Out/Tag Out and Try qualifications of technicians. Evidence of completion: E-mail from Training Dept. of pulled qualifications	NE-2016-22-01-02	03/31/2017	H. Fanning
Retrain technicians on proper Lock Out/Tag out and Try procedures to ensure entry into an electrical cabinet is made with personal barriers in place. Evidence of completion: Updated training record	NE-2016-22-01-03	03/31/2017	H. Fanning
Update the facility drawings to reflect the separate lighting and control to the 450 Ton Press from building power within the Test Lab Addition for future reference. Evidence of completion: Updated drawings	NE-2016-22-01-04	03/31/2017	J. Willoughby
Ensure the 450 Ton Press electrical documentation reflects the current lighting and control scheme of the 450 Ton Press for future reference. Evidence of completion: Updated drawings or e-mail description of evidence.	NE-2016-22-01-05	03/31/2017	Phil Denny
Develop and implement a preventative maintenance program for this piece of equipment. The program should be developed in accordance to the manual and tracked via tool of choice. Evidence of completion: Preventative maintenance plan and tracking tool of choice	NE-2016-22-01-06	02/28/2017	Tony Reilly

Lessons Learned (Confer with Lessons Learned Coordinator) (Use attachment as necessary)	Lessons Learned Number
When changes are proposed or made to existing systems, always check work to ensure that unintended hazards are not introduced or system functionality is not lost.	991

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

Technician #1
Accelerator DSO,

Technician #2 and I were asked to troubleshoot an electrical control problem with the 450 ton press. The initial problem was the upper platen locking pins would not retract. A hydraulic service technician was called to repair that issue. He found a locking pin was stuck. A few days later when the machine was activated for our use the locking pins would not release once again and in attempting to make them release we caused another problem with the DM pump. It would no longer run when its start button was initiated.

This DM pump problem prompted Technician #2 and I to be assigned to troubleshoot its 'no start' issue. We opened the power box which consists of two large doors to a box that houses the main switch and all fuses associated with the main power input and the controller power step down transformer. Before we unlocked the main power switch or initiated power, we checked the controller transformer fuse (small 15 amp buss type fuse) by pulling it with a fuse puller tool. The fuse was open so we found another and installed it with the tool. When the fuse was inserted we saw a sizable blue spark which startled us both. With that we closed the doors agreeing with each-other that this machine was incorrectly wired since there are live circuits in the controller box with the main switch in the off position. After the doors were closed I continued to troubleshoot by activating the main switch and pressing the DM pump button - the DM Pump still does not activate. This we considered is all we could do so we switched the machine off, locked it, and placed the key back in the key manager box.

Technician #2 and I reported these findings to the System Owner and also reported that the electrical system appears to be incorrectly wired and that there is no warning on the doors that the system is live with the main switch in the off position.

Thank you,

Technician #1

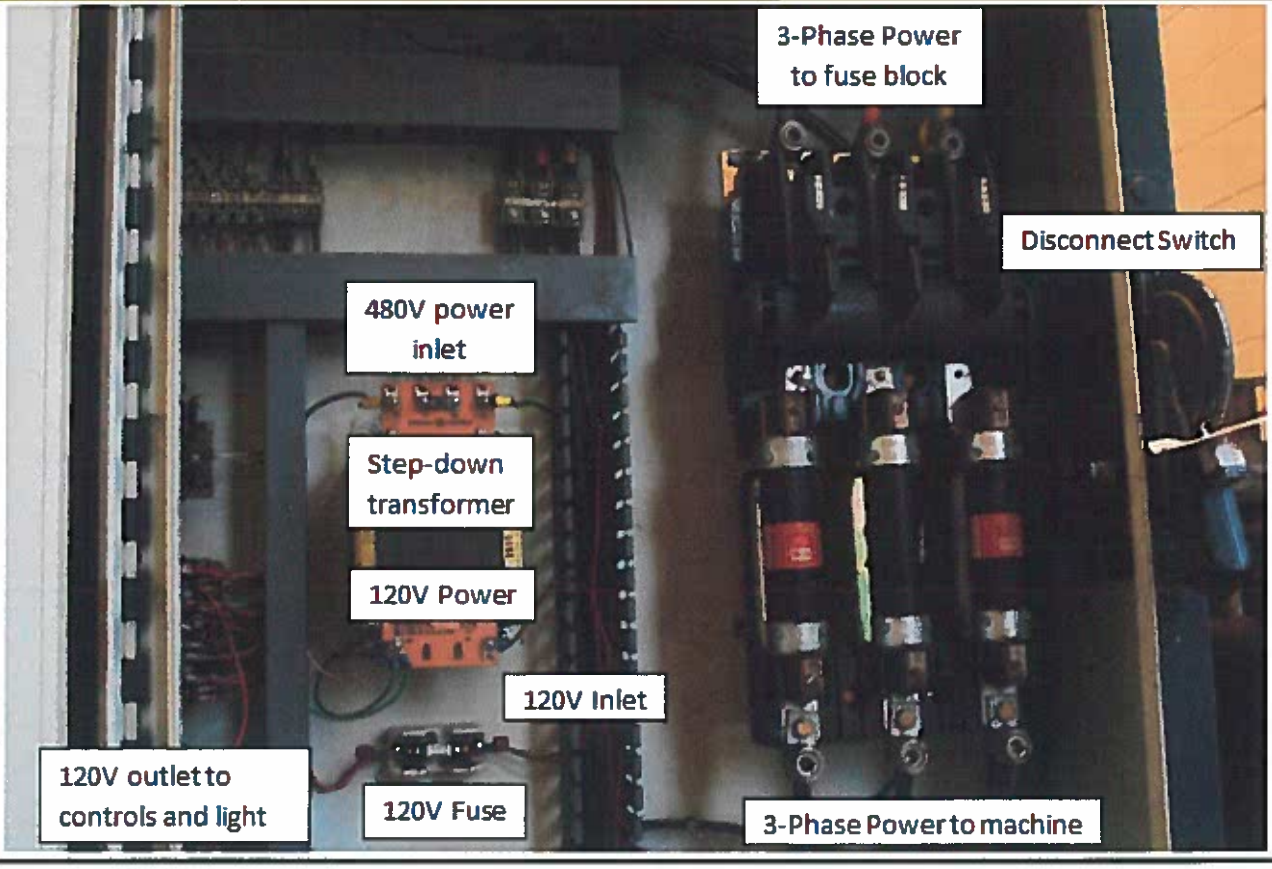
Technician #2
On Friday Dec. 16th I was asked to assist in the troubleshooting of the 450 Ton Press with Technician #1. First off we determined that 440 Volts powered the Press and that by opening the Power cabinet we found the 440 supply to be in the upper most right corner of the right cabinet. We assessed the power path and found a step down transformer with a 15A buss fuse. We determined to test the fuse because it was the source of power to the control panel. Technician #1 pulled the fuse with a fuse puller and we found that the fuse was in fact blown. While replacing the new fuse with the tool, we saw a noticeable spark come from the left side of the fuse. We discovered that there was a second power source feeding the controls. I noticed that there was a conduit coming from the lights in the back of the Press. There were no signs indicating a second source. At that time we closed the cabinet and tried starting the DM pump and it appeared as if the fuse blew again and we decided that no further trouble-shooting be done until the cabinet was properly labeled and all sources removed.

Electrician #1
Upon arriving, I was informed that the press was off but still had voltage inside it at one side of the fuse holder. I checked voltage at the location where I was told it was to find 120v there. I also checked the voltage for the press itself and found no voltage present (the breaker had tripped when a new fuse was installed and the press was turned on). After resetting the breaker for the press and attempting to turn it on I found that the breaker which provided the other power tripped. Seeing that I began to trace all circuits down and found that the 120v power that was in the cabinet was being fed through the light overhead from a receptacle on the wall. With both circuits energized and a good fuse in place that would allow 120v from the rec. to go through the fuse and meet with the incoming 480 causing one of the breakers to trip. I removed the incoming 120v from the wall through the light along with the conduit entering the cabinet. The light now works off the switch on the wall. The press works like it originally did with its 480v feed and controls inside that use 120v are fed from the existing step down transformer inside. The press was tested while I was there and I was informed that it was once again working

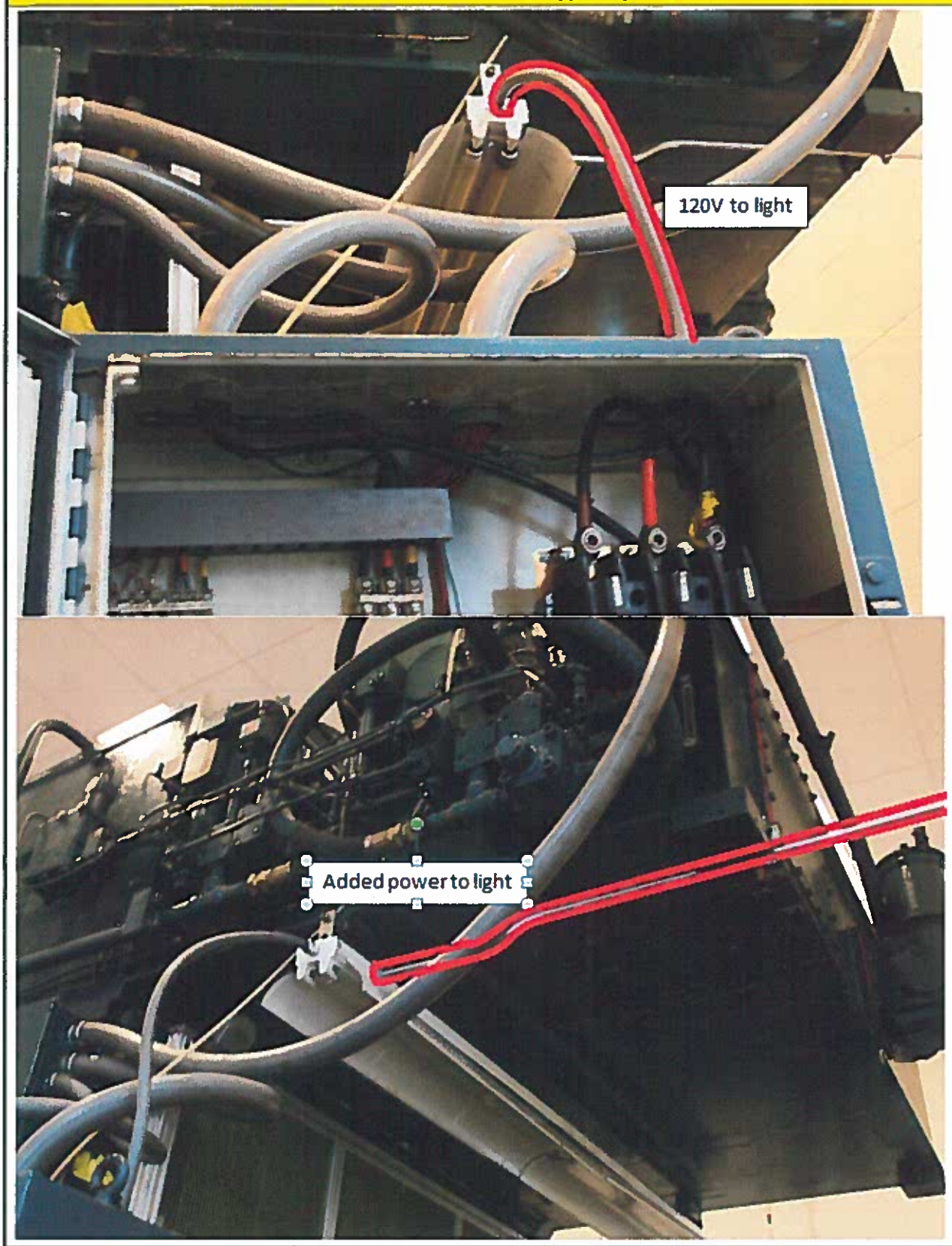
Witness Accounts: (Use attachments as necessary. Box will expand as necessary)

correctly.
If there are any other questions or concerns I will try to clarify more.
Electrician #1

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



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



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Notable Event Report

Emergency Notifications Made (Subsequent to the Event):	Date	Time
Fire, Rescue & Emergency Medical: (9-911)		
Guard Post: x5822; 269-5822		
Occupational Medicine 269-7539		
ESH&Q Reporting Officer: 876-1750	12/16/2016	10:00am
Crew Chief 630-7050		
Industrial Hygiene: 269-7863:		
Other:		

Confirmation Review Distribution: Investigation Team Members Affected Division Managers ESH&Q Reporting Officer	It is asked that you review and provide comments to this document to the Lead Investigator (denoted on Page 1) within ____ days. Your comments will be reviewed and incorporated as appropriate. Thank you for your consideration in this matter.

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	Harry Fanning	Harry W Fanning	8-JAN-2017 FEB th
	Kirk Davis	K Davis	8 Feb PR Jan, 2017
	Jason Willoughby	J Willoughby	8 FEB 17
	Christina Johnson	Christina Johnson	8 FEB 17

Acceptance/Acknowledgement of Facts

	Print	Signature	Date:
Associate Director/ Department Manger	Andrew Hutton	Andrew Hutton	2/10/17

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:	ACC-16-1215
CATS Number:	NE-2016-22-01
Lessons Learned Number:	991
ORPS Number:	SC—TJSO-JSA-TJNAF-2016-0009

NTS Number:	N/A
CAIRS Entry:	N/A
DOE Cause Code:	A3B1C01; A4B5C05, A4B5C04; A3B2C01; A4B5C09; A2B2C01; A4B3C11
ISM Code:	Analyze Hazards, Perform Work within Controls

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Notable Event Worksheet

Unless otherwise specified the following is to be completed by the Lead Investigator.

Step 1 Initial Fact-Finding Meeting (To be held as soon as reasonably possible following event(within 24 hours))					
Date:	19-DEC-2016	**Time:**	13:30	**Location:**	TEDF 2504

Required Attendees: (Print Name)		**Optional Attendees:** (Print Name) **Present**	
Lead Investigator:	Harry Fanning	**Associate Director:**	Andrew Hutton
ESH&Q Representative:	Tina Johnson	**TJSO Observer:**	Patricia Hunt
Supervisor of involved persons(s):	Kirk Davis Ed Daily	**Subject Matter Expert(s), Facility/Equipment Owner as applicable:**	Jason Willoughby
Involved or impacted person(s):	Bill Clemens and Thomas Goodman		Paul Powers (invited)
Witness(es):	Philip Stanley		

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

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Notable Event Worksheet

Step 2 Investigation Team:	**Date Convened:** (Within 24 hours of Fact Finding Meeting.)	20-Dec-2016 / 09:00	
Role	**Name**	**Department/Group**	**Phone**
Lead Investigator	Harry Fanning	ACC/MGT	7619
	Kirk Davis	SRF/OPS	6086
	Jason Willoughby	FML/ENG	5372
	Christina Johnson	ESHDIV	7611
TJSO Observer	Patty Hunt (initial) / Steve Neilson	TJSO	7215

Environmental Aspects	
Type of Material Released:	**Quantity:**
Source:	**Time Flow was Halted or Controlled:**

For Investigation Team (√ All That Apply):

☐ **Reportable Quantity** ☐ **Impact Ground/Soil** ☐ **Storm Water Channel/Drain** ☐ **Sanitary Sewer**

Categorization and Reporting
(To be completed by ESH&Q Reporting Officer within two hours – unless essential information is still pending)

ORPS Determination:	**Date:**	12/20/2016	**Time:**	10:19 am

– See next page –

Categorization and Reporting
(To be completed by ESH&Q Reporting Officer within two hours – unless essential information is still pending)

ORPS Determination:	Date:	12/20/2016	Time:	10:19 am

ORPS/NTS Determination: ACC-16-1215 Unexpected Discovery of Hazardous Energy While troubleshooting a 450 Ton Press 12/20/2016

From: Tina Johnson
To: Patty Hunt
Cc: Mary Logue, Bob May, Harry Fanning

Patty,

On Thursday, December 15, 2016, two qualified technicians were troubleshooting a control panel on the 450 ton press that had been administratively locked out. As they approached the machine, they inspected the lock and visually traced the power supply from the top of the control panel down into the internal control transformer. The circuit was open, and the lock remained intact. They proceeded to remove a 120 volt control power fuse with an approved fuse removing device to check its integrity. Once removed, they saw that it was open. As they proceeded to replace the fuse with a new one, they saw a spark.
Both workers were uninjured and experienced no shock. They ended their trouble shooting activity.

One of the qualified technicians reported this event to their supervisor that afternoon. The Division Safety Officer (DSO) was notified the following day. Follow-up investigation by Facilities Management and Logistics (FM&L) revealed a second power source feeding a light fixture that was attached to the press and back feeding power to the control panel. The lock on the control panel did not isolate the electrical back feed from the light fixture into the control panel.

FM&L removed the second power source on December 19, 2016. The DSO placed their administrative lock on the equipment pending the outcome of follow-up investigations.

This is a discovery of an unknown energy source, and therefore ORPS reportable.

Subgroup E Hazardous Electrical Energy Control.
Significance 3- Any unexpected discovery of an uncontrolled electrical hazardous energy source (e.g., live electrical power circuit, etc.). This criterion does not include discoveries made by zero-energy checks and other precautionary investigations made before work is authorized to begin.

The lab will process this event as a notable event and as ORPS reportable and will meet the appropriate reporting deadlines associated with each.

In the meantime, if you have any questions or concerns feel free to contact me.

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Tina Johnson
Reporting Officer/ Staff Administrator I
Jefferson Lab
12050 Jefferson Ave
Suite 602
Newport News, VA 23606

10 CFR 851 Screen:	Date:	12/20/2016	Time:	10:19am

N/A

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Notable Event Worksheet

Final Distribution:

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

Form Revision Summary

Revision 1.6 – 02/22/16 – Updated form to reflect extent of condition ensuring it covers failed equipment per MOA
Revision 1.5 – 10/04/13 – Changed COE to Lessons Learned; updated links.
Revision 1.4 – 09/06/12 – Qualifying Periodic Review. Clarification of content only.
Revision 1.3 – 01/31/12 – Updated ESH&Q Reporting Officer assignment from S.Smith to C.Johnson per M.Logue
Edited to clarify process steps.
Revision 1.2 – 10/20/11 – Updated ESH&Q Reporting Officer assignment from J.Kelly to S.Smith per M.Logue.
Revision 1.1 – 05/24/11 – Edited to clarify process steps.
Revision 1.0 – 11/23/10 – Updated to reflect current laboratory operations.

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Tina Johnson	02/22/16	02/22/19	1.6

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