

Notable Event Report

Title of Event			
Event Title:	Radiation Area not identified or posted during survey		
Date and Time of Occurrence:	3/11/2016 ~ 0900	Notable Event Number:	ESH&Q-16-0311
Event Location:	South LINAC tunnel zone 2L24	Date Notable Event Report is Due*:	4/17/2016

*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.	
<p>Brief summary (see full summary statement by D. Hamlette in witness accounts section): On 3/11/16 the RadCon Field Operations Group Leader (FOGL) surveyed and re-posted an existing radiation area at the warm region girder between SL23 and 24 to a smaller area. The survey conducted to shrink the size of the area did not identify the true extent of the radiation area. An area beneath the SL24 cryomodule extending about six feet downstream from the girder had whole body dose rate above 5 mrem/hr, but the survey did not reveal this portion of the radiation area. The area beneath the cryomodule was not posted as a radiation area until another survey was performed on 3/16/16, when the condition was discovered.</p>	

Causal Analysis: (Use attachment as necessary)	
Root Cause:	A3B3C01: Attention was given to wrong issues (in this case, more focus on historically known activation patterns)
Contributing Causes: (List as many as apply.)	A4B4C07: Too many concurrent tasks assigned to worker A3B2C03: Too much activity was occurring and error made in problem solving A3B2C01: Strong rule incorrectly chosen over other rules A4B3C08: Job scoping did not identify special circumstances and/or conditions

Extent of Condition Check		<u>JLab CATS Number</u>	Target Date	Action Owner
Survey of both linacs completed as part of the initial finding. Evidence of completion: Survey Maps		NE-2016	Complete	D. Hamlette
Does this event involve failed equipment?	No	Is there similar equipment in other areas?	N/A	** If yes, assign extent of condition check to the appropriate DSO(s).

Corrective Action(s)	JLab CATS Number	Target Date	Action Owner
See attached "causal analysis and corrective actions" for full description of corrective actions.			
Communicate new activation phenomenon to all ARMs and RCTs. Evidence of completion: Sign in / OPS Standing Orders	NE-2016-01-01	Complete	D. Hamlette
Incorporate the new activation patterns into standard ARM/RCT training materials. Evidence of completion: Training slides or link to new training	NE-2016-01-01	6/30/16	D. Hamlette/K. Welch
Investigate training exercises which strengthen problem-solving techniques for novel or unfamiliar situations. Include in RCT continuing training. Evidence of completion: Memo stating results of investigation of various training exercises	NE-2016-01-01	10/31/16	K. Welch
Enhance procedures for de-posting radiological areas. Posting and surveys are covered by two procedures within RadCon, but neither specifically speaks to de-posting a radiation area. Consider whether radiation area de-posting should be restricted only to RCTs. Train RCTs and ARMs on revised procedures. Evidence of completion: Updated procedure	NE-2016-01-01	6/30/16	D. Hamlette
Evaluate workload of Field Operations Group Lead (FOGL), consider redistribution of tasks or scheduling practices that reduce multitasking at peak work times. Evidence of completion: Memo of evaluation results that answers the action.	NE-2016-01-01	5/31/16	K. Welch
Conduct a workload/resource analysis of the Field Operations Group. Make recommendations to management based on results. Evidence of completion: Analysis results	NE-2016-01-01	10/31/16	K. Welch

Lessons Learned (Confer with Lessons Learned Coordinator) (Use attachment as necessary)	Lessons Learned Number
When performing routine work, it is always best to revert back to the procedure to ensure that you are following every step as if you were a new employee.	947

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

Description of events as recalled by the RadCon Field Operations Group Leader

South Linac C100 Unposted Radiation Area

On March 11, 2016, during the 8:00 am morning planning meeting, it was decided that there was a need to perform CHL leak test troubleshooting in the South linac, as well as vacuum repairs in the North linac. After some discussion, I informed the operations group that I would escort members of the Installation Group down to the SL C100 area where they could explain the nature and location of the work they needed to perform, and I could assess the radiological conditions. After performing a survey of the elevated areas within the posted "Radiation area- Walk thru permitted", I determined that I could shrink the large area down to two smaller radiation areas (RA). The first RA was posted around QB2L23. This area had a contact dose rate of 100mr/hr and whole body dose rate of 5.7mr/hr. The boundary was posted with dose rate at 3mr/hr. The second RA was posted around QB2L24. This area had a contact dose rate of 200mr/hr and whole body dose rate of 17mr/hr. The boundary was also posted with dose rate at 3mr/hr. I informed the Installation group members of the RAs, and let them explain the scope of their work. None of the work entailed portions of their whole body in the RAs. I then left them, and exited the SL portion of the tunnel. At ~9:30, I stopped by the MCC to convey the survey results and reduced posting area in the South. Greg Marble was to accompany me down in the North linac, but they were having problems with the PSS. I had a previously scheduled meeting for 10:00 in the MCC, so we agreed I would call him right after my meeting. At 11:30 Greg and I went down into the North Linac. He showed me where he needed to perform the vacuum repairs and I assessed the radiological conditions there. I noticed elevated levels underneath the cryomodule. This raised a flag because we typically do not see radiation area levels under the cryomodules away from the warm region girders. My initial plans were to survey, and if possible, de-post the large "Radiation area- Walk thru permitted", down to smaller RAs, similar to what I did in the South. However, after further surveying under the rest of the C100 cryomodules, it was clear reducing the RA was not an option. I covered Greg until he had completed his repairs. This took only a few minutes, and we both left out together. It did not register with me at the time that there might be similar conditions in the South linac, because after de-posting to smaller radiation areas, I walked through and re-checked the whole body dose rates. In addition, my understanding was once the Installation Group was finished, they would be locking the tunnel back up and keeping it in "Power Permit". After exiting the tunnel, I did however, speak with Paul Vasilauskis about the elevated dose rates under the cryomodules so that he could convey the information to the ARMs. Also, upon returning to the ARC building, I gathered the RCTs together and informed them of the new conditions so they would be aware to look underneath the cryomodules while performing surveys in the C100 areas. I subsequently mentioned this to Keith Welch, as we are in the process of trying to propose a shielding method for these areas that would mitigate elevated dose rates for the Open House, and this information could certainly affect our approach.

On March 16th, I requested the FOPs Group RCTs to go back down to perform surveys in the North and South once again. It was at this time that Aaron Robinson and Adam Hartberger, discovered an unposted radiation area underneath 2L24 (~7.4 mr/hr whole body). They reposted the entire area as a "Radiation area- Walk thru permitted", and called me to inform me of the condition.

Since the 11th of March there have been 14 entries into the South linac as follows:

NAME	TIME	DATE	WORK AREA
Larry King	9:40-10:09 (29min)	3/11/16	***
David Schleeper	10:21	3/11/16	Non-C100
Chris Kerns	11:13-11:42 (29min)	3/11/16	2L24
Delisa Smith	11:13-11:42 (29min)	3/11/16	2L24

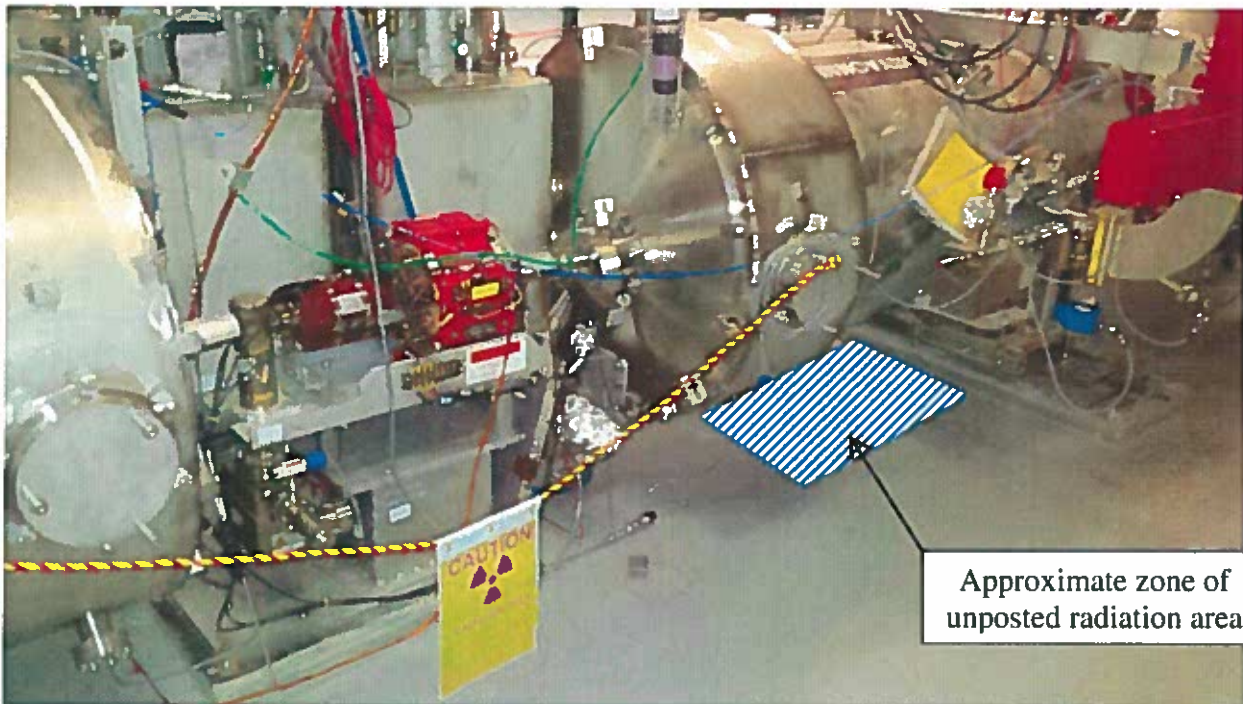
Witness Accounts: (Use attachments as necessary. Box will expand as necessary)

Tommy Michaelides	11:35	3/11/16	Non-C100
Greg Marble	11:04	3/14/16	Non-C100
George Greenfield	11:04	3/14/16	Non-C100
Elliott Smythe	11:04	3/14/16	Non-C100
David Schleeper	11:15	3/14/16	Non-C100
Scott Thompson	11:15	3/14/16	Non-C100
Greg Marble	12:58	3/14/16	Non-C100
Greg Marble	13:38	3/14/16	Non-C100
Greg Marble	14:28	3/14/16	Non-C100
Scott Thompson	16:01	3/14/16	Non-C100

At this time I have not determined all of the areas these individuals performed their work. It is rather difficult to have portions of your whole body in this area.

-The instrument used was a teleprobe model FH40G, calibration due date: 4/2/16. I source checked this instrument on 3/11 prior to performing the survey.

The following are picture associated with the posting



Approximate zone of unposted radiation area

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



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

Excerpts from Operations Supervisor email regarding conditions in the Linacs for the time period.

A full survey is required whenever beam is run into a area. Only the area where beam was would need to be surveyed so in the North Linac if beam was only run to the inline dump which is at the beginning of the linac and not past it into the rest of the linac, then we only need to survey up to the inline dump. However, because the C100s are field emitters, if any C100 was run (had an accelerating gradient in it) then the area around that C100 must be surveyed. The Injector is an exception since its energy is so low it has a system of installed radiation monitors that if that system shows the levels are low enough, we don't need to do a survey in the Injector.

When the CHL went down on the afternoon of Wednesday March 9th a full survey was performed on all areas of the accelerator and the operating halls because we had been running beam through all those areas. Since that day, no beam has been run outside of the Injector and the C100s were not run so another full survey has not been required. (but... see below)

Links to full surveys from 9 March:

[North Linac](#)

[South Linac](#)

[BSY](#)

[Hall A](#)

[Hall D](#)

[Hall D Tagger](#)

In the South linac there was a radiation area posted around the C100s (>5mrem/hr) but it was be low enough (<25mrem/hr) that walk-thru was permitted. In the North it was not low enough and thus walk-thru was not permitted. The next day [another survey was done in the NL](#) and the levels had dropped enough that walk-thru was permitted in the North. However, (this is where the "but..." above comes in) if any work is being done in any of these radiation areas whether walk-thru is permitted or not, RadCon must be involved to determine if an RWP is required. They will come down and do a survey of the area where the work is being done. Generally we don't

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

get those surveys (there are none in the logbook for me to link to) as it is just for that particular job, use of the survey for anything else would be RadCons call but I would expect them to go down and resurvey for a new or different job.

So for the workers entering the SL on 3/14. If they were not working in the radiation area another survey would not be needed. If they were working in the radiation area, they should have contacted RadCon to get their permission to do so. RadCon would make the call whether to resurvey or use prior knowledge from an earlier survey knowing that the levels would have been less due to decay. Below are screen shots of the logs for the North and South Linac state changes from 5 March to current. There are a few "Unknown" states, those are usually when the state is being changed and only one of the two channels changes. The operator usually just turns the key back and tries again.

SL

- 3/05/16 15:39 SL to Beam Permit (for operations)
- 3/09/16 15:35 SL to Controlled Access (CHL down)
- 3/09/16 16:52 SL to Power Permit (to turn on magnets to maintain tunnel temperatures)
- 3/10/16 08:53 SL to Controlled Access
- 3/10/16 20:51 SL to Power Permit
- 3/11/16 08:38 SL to Controlled Access
- 3/11/16 12:03 SL to Power Permit
- 3/14/16 09:58 SL to Controlled Access
- 3/14/16 16:31 SL to Power Permit
- 3/15/16 07:42 SL to Restricted
- 3/16/16 14:40 SL Sweep Completed
- 3/16/16 14:47 SL to Controlled Access (Following being swept)
- 3/16/16 14:47 SL to Power Permit
- 3/16/16 15:28 SL to Controlled Access
- 3/16/16 15:49 SL to Power Permit
- 3/17/16 09:51 SL to Controlled Access
- 3/17/16 10:27 SL to Power Permit

SL

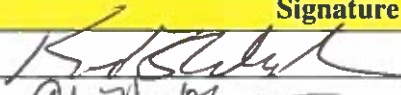
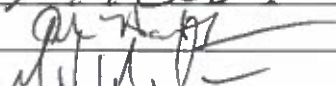

PSSLogID	Time	Area	Type	User	Title
144426	03-17-16 10:27	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144421	03-17-16 09:51	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144409	03-16-16 15:49	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144406	03-16-16 15:28	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144391	03-16-16 15:12	SL	AUTO	--	SOUTH LINAC 5 => Power Permit
144381	03-16-16 15:10	SL	AUTO	--	SOUTH LINAC Power Permit => 5
144374	03-16-16 14:47	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144373	03-16-16 14:47	SL	AUTO	--	SOUTH LINAC Sweep Complete => Controlled
144370	03-16-16 14:40	SL	AUTO	--	SOUTH LINAC Sweep Progress => Sweep Complete
144369	03-16-16 14:03	SL	AUTO	--	SOUTH LINAC Restricted => Sweep Progress
144346	03-16-16 13:09	SL	AUTO	--	SOUTH LINAC UNKNOWN => Restricted
144345	03-16-16 13:07	SL	AUTO	--	SOUTH LINAC Restricted => UNKNOWN
144246	03-15-16 07:42	SL	AUTO	--	SOUTH LINAC Sweep Complete => Restricted
144245	03-15-16 07:42	SL	AUTO	--	SOUTH LINAC Controlled => Sweep Complete
144244	03-15-16 07:41	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144234	03-14-16 16:31	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144198	03-14-16 09:58	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144152	03-11-16 12:03	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144124	03-11-16 08:38	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144119	03-10-16 20:51	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
144032	03-10-16 08:53	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
144016	03-09-16 16:52	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
143995	03-09-16 15:35	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
143981	03-09-16 15:19	SL	AUTO	--	SOUTH LINAC Beam Permit => Power Permit
143823	03-05-16 15:39	SL	AUTO	--	SOUTH LINAC Power Permit => Beam Permit
143822	03-05-16 15:36	SL	AUTO	--	SOUTH LINAC Controlled => Power Permit
143812	03-05-16 13:29	SL	AUTO	--	SOUTH LINAC Power Permit => Controlled
143806	03-05-16 13:25	SL	AUTO	--	SOUTH LINAC Beam Permit => Power Permit

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	03/16/2016	~1600
Crew Chief 630-7050		
Industrial Hygiene: 269-7863:		
Other: TJSO	03/16/2016	~1700


<p>Confirmation Review Distribution: Investigation Team Members Affected Division Managers ESH&Q Reporting Officer</p>	<p>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.</p>
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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	Keith Welch		5/5/16
RadCon SME	Adam Hartberger		5/5/16
Operations SME	Mike Aiken		5/5/16

Acceptance/Acknowledgement of Facts

	Print	Signature	Date:
Associate Director/ Department Manger			5/5/16

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:	ESH&Q-16-0311
CATS Number:	NE-2016-07-01

<u>Lessons Learned Number:</u>	947
<u>ORPS Number:</u>	N/A
<u>NTS Number:</u>	N/A
<u>CAIRS Entry:</u>	N/A
<u>DOE Cause Code:</u>	A3B3C01: Attention was given to wrong issues (in this case, more focus on historically known activation patterns)
ISM Code:	Perform Work Within Controls, Provide Feedback and Continuous Improvement

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:	3/17/16	Time:	1500
Location:	ARC Rm 661		
Required Attendees: (Print Name)		Optional Attendees: (Print Name) Present	
Lead Investigator:	Keith Welch	Associate Director:	Mary Logue
ESH&Q Representative:	Tina Johnson	TJSO Observer:	Patty Hunt
Supervisor of involved persons(s):	Keith Welch	Subject Matter Expert(s), Facility/Equipment Owner as applicable:	
Involved or impacted person(s):	David Hamlette	Adam Hartberger	
		Harry Fanning	
		Aaron Robinson	
Witness(es):			

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. <u>Summary of Event and/or Injuries</u> 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 – <u>Subject-Matter Expert</u> (SME) confirms work conditions.	√
6. <u>Stop Work</u> or the <u>Tag Out</u> Required? If “Yes” – establish the restart criteria and inform the affected Management chain.	No
7. Compensatory Actions Required? If “Yes” determine responsibility and include confirmation documentation.	No
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.	√

Step 2 Investigation Team:		Date Convened: 3/22/16 (Within 24 hours of Fact Finding Meeting.)	
Role	Name	Department/Group	Phone
Lead Investigator	Keith Welch	RadCon	7212
Radiation Safety SME	Adam Hartberger*	RadCon	7463
Acc Operations Liaison	Michael Aiken	Acc Ops	7745
	*unable to attend due to other emergent issues		
<u>TJSO Observer</u>		TJSO	

Environmental Aspects	
Type of Material Released:	Quantity:
N/A	
Source:	Time Flow was Halted or Controlled:
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

Categorization and Reporting (To be completed by ESH&Q Reporting Officer within two hours – unless essential information is still pending)			
ORPS Determination:	Date: 3/18/16	Time: 1350	
Email from reporting officer on 3/18/16: ----- Patty,			
<p>As you know on March 11, 2016, RadCon was requested to support the Installation Group as they performed CHL leak test troubleshooting in the South Linac. Surveys were performed and after surveying the elevated areas within the posted Radiation Area, that area was shrunk to smaller Radiation Areas. Later that morning RadCon accompanied a member of the Vacuum Group down to the North Linac. At that time elevated radiation areas were discovered underneath the cryomodule (~7.4 mR/hr whole body at 30 cm). This is not typical, because normally there are no radiation areas under the cryomodules away from the warm girders. This information was supplied to Paul Vasilauskis; however RadCon made the decision not to return to the South Linac, survey underneath those cryomodules (and possibly re-post the area), because they were under the impression that the South Linac would be placed back into Power Permit after the Installation Group had completed their task.</p> <p>On March 16, 2016, RadCon surveyed under the South Linac cryomodules. At that time, it was determined that there was an unposted Radiation Area under 2L24, which is in violation of 10 CFR 835. Based upon what we know about where people may have worked, there were no exposures.</p>			

Categorization and Reporting

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

ORPS Determination:	Date: 3/18/16	Time: 1350
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At this time, we have classified this as a Notable Event. If you have any questions or concerns.

Regards,
 Tina Johnson
 Reporting Officer/ Staff Administrator
 Jefferson Lab
 12050 Jefferson Ave
 Suite 602
 Newport News, VA 23606
 757-269-7611 (office)
 757-876-1750 (cell)

Based on screening by the Reporting Officer and RadCon Manager, the event is an infraction of 10 CFR 835: failure to post a radiation area. From initial conditions, potential for actual unexpected dose to personnel is very low and there is no potential for unmonitored exposure. Therefore no ORPS criteria have been or are likely to be met. This report will include additional investigation to verify absence of exposure issues.

10 CFR 851 Screen:	Date: N/A	Time:
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N/A

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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