

Notable Event Report

Title of Event			
Event Title:	Less than Adequate posting of a Radiation Area upon Completion of a Full Survey		
Date and Time of Occurrence:	08-MAR-2016 06:45am	Notable Event Number:	ACC-16-0308
Event Location:	Hall A	Date Notable Event Report is Due*:	09-APR-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.

On the morning of March 8th, 2016 at around 6:45 am, an Operator acting as an Assigned Radiation Monitor (ARM) conducted a full radiation survey in Experimental Endstation (Hall) A. However, at the conclusion of the survey, not all Radiation Areas were properly posted (as per 10 CFR 835 Subpart G – Posting and Labeling), which could have led to an unintended access by Lab personnel into a Radiation Area.

Due to a recent increase of beam energy configuration to Hall A (from 1 Pass at 2.2 GeV to 4 Pass at 8.8 GeV), the ARM encountered multiple radiological areas within the survey area which had not existed prior to the energy reconfiguration. The increased radiological areas required the ARM to gather more supplies from the Radiation Control Division (or RadCon) supply cabinet located within the hall for the additional postings. Because of the additional postings, the survey took approximately 1.5 hours to conduct where the “normal” duration of surveys for the Hall would take 45 minutes to an hour.

During this survey, the Machine Control Center (MCC) called to check on the ARM approximately one hour into the survey and informed the ARM that Hall A personnel were urgently awaiting the completion of the survey to gain access into the area. This added a perceived pressure on the ARM to finish their survey tasks so they returned to their survey. The last remaining area to be surveyed was located at the Calorimeter which is behind the target chamber and between the two High Resolution Spectrometers. This area was revealed to be another Radiation Area and required posting. The main access to this area (a stairway) was posted with appropriate notifications. However, the ARM failed to recognize and post all access points around the spectrometer which could lead to the Radiation Area around the Calorimeter.

After the ARM completed their survey and postings, the ARM proceeded to exit the Hall. Upon exiting they were met by three Physics personnel who were waiting to enter. The ARM briefed the employees/users about the Radiation Areas, specifically around the Calorimeter and explained that they were not to enter without a Radiation Control Technician (RCT) escort. After the radiation survey was reviewed by the Crew Chief and posted to the log, the ARM went home as it was past the end of their shift.

Later the same morning (~08:30am), Physics personnel wanted to gain access to the Calorimeter area and contacted RadCon on-call to gain access as per the ARM’s instructions. The on-call RCT made entry into the Hall with the Physics personnel for an escorted access. The RCT surveyed the Calorimeter area and noted that there were 3 potential access points to the Calorimeter area which had not been posted by the previous surveyor. Upon discovery, the RCT completed the posting and questioned all personnel who were in the hall after the previous survey to discern if anyone went into the unposted areas. *The RCT found that no one had entered the area.* The RCT also conducted a full survey to ensure all areas had been adequately posted. *No other areas were found to be inadequately posted.*

Due to the potential for a 10 CFR 835 violation, RadCon raised the level of awareness with the on-duty MCC staff and RadCon management that there had been a discovered Radiation Area which had not been fully posted by an ARM. A Fact

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

Finding meeting was convened the following day at 08:30 and it was determined that 10 CFR 835 Subpart G – Posting and Labeling had been violated.

Timeline:

- Friday 26-FEB-2016 – Hall A Energy Changes from 1 Pass (2.2 GeV) to 4 Pass (8.8 GeV)
- Tuesday 08-MAR-2016 – 06:30 Hall A contacts MCC for full survey of hall enclosure following 15-30uA CW operations to the hall since last access
- Tuesday 08-MAR-2016 – 06:45 ARM #1 goes to Hall A and commences full survey
- ~07:45 MCC makes an All-Call over the public address system to have ARM call MCC
 - ~07:45 ARM #1 stops survey and contacts MCC, being asked current status and relayed that Hall A personnel are waiting to gain access into the hall when survey is complete
 - ~7:45 ARM #1 resumes survey of hall, going from Dump area to Target area, the last portion of the hall to be surveyed.
 - ARM #1 finds Radiation Area at the Target chamber extending back towards the Calorimeter and Calorimeter platform
 - ARM #1 posts area around Target Chamber and posts the staircase to the Calorimeter platform
 - ARM #1 leaves Hall A enclosure
 - ARM #1 encounters Hall A staff wanting to go inside, briefs individuals on radiological status in hall and keep out zones
 - ~08:10 ARM #1 departs area, posts survey after Crew Chief Review and goes home
 - Hall personnel contact RadCon on-call for instruction to gain access to Calorimeter via the posted platform
 - ~8:30 RCT enters Hall A enclosure to survey the area and assess Calorimeter radiological status
 - RCT finds only stairway to Calorimeter is posted, but other avenues to radiation area are not posted
 - RCT performs a full survey to assess posted conditions but finds all other areas within the hall enclosure are adequately posted
 - RCT notifies OPS and RadCon Management of possible 835 violation
- Wednesday 09-MAR-2016 – 08:30 Fact Finding convened

Fact Finding Meeting – 09 March 2016 08:30am

Items of discussion during the Fact Finding Meeting:

- 1.) This was one of the first surveys of the hall enclosure since the pass change from 1st pass to 4th pass (2.2 GeV to 8.8 GeV) and the first ever performed of any appreciable beam delivery (15 – 30uA CW) above 6 GeV energy into the hall
- 2.) Though ARM #1 had surveyed other portions of the Accelerator, this was the first survey ARM #1 performed in Hall A enclosure in 1 – 2 years
- 3.) ARM #1 found several additional areas within the hall which had become activated and needed posting since the last survey at lower energy. ARM #1 needed to go back and forth to RADCON supply cabinet (located within the

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

hall) for more posting material increasing duration of the survey. "Normal survey" usually takes 45 minutes to 1 hour.

- 4.) ARM #1 was interrupted by an "All Call" over the PA by MCC staff. ARM #1 stopped what they were doing to call the MCC and was informed that MCC wanted to check on progress of survey and to inform ARM #1 that Physics personnel were waiting for entry.
- 5.) Target area was the last area needing to be surveyed and was next before the phone call
- 6.) Calorimeter was surveyed and primary access (staircase to the platform which had access to the Calorimeter) was posted with the appropriate radiological information. Other potential avenues of access into the radiation area (identified by RadCon) had not been initially considered by ARM #1 and so were not posted. Only after the later identification did ARM #1 understand those potential access points, though not common areas of entry, were still access points and needed to be properly posted.
- 7.) ARM #1 was beginning last hour of their eight hour shift when the radiation survey was initiated. (ARM presumed the normal time for survey would be needed and did not expect extended duration.)
- 8.) It was discovered during the 3rd entry by RadCon that this was a succession of six planned accesses into the hall enclosure for that day by Hall A personnel. However, the plan for multiple accesses (regardless of frequency or duration) was not communicated ahead of time (to the Program Deputy, via Program Deputy Shift Plan of the day, during the Program Deputy 7:45am meeting, during the 8am Daily Summary Meeting or via a phone call to MCC or RadCon). Both RadCon and ARM #1 stated that if they had understood these accesses were planned and needed multiple surveys, they would have been able to plan their activities leading up to the surveys with better coordination and/or preparation. As it was, communication was Less Than Adequate (LTA) between work groups and planned work from RadCon was interrupted.

NOTE: Delays in publishing report were due to multiple factors including, but not limited to, team member availability for Lead Assessor and causal factor training and original investigation overtaken by events when multiple tandem event investigations occurred.

Causal Analysis: (Use attachment as necessary)

<p>Root Cause:</p>	<p>The Assigned Radiation Monitor (ARM) neglected to post all access points to a radiation area due to attention given to wrong issue during a performed task.</p> <p>The ARM gave their attention to the wrong issue by focusing on the platform as the only means of access to an identified radiation area. In what they considered to be a conservative method of posting the area, the ARM posted the stairway leading up to the platform. Unfortunately, the stairway was not the only means of access to the platform, and the ARM did not consider these alternate access points at that time. Due to an apparent focus on psychologically important information over logically important information, the alternate access points were not posted as a consequence.</p> <p>DOE Cause Codes: A3B3C01 – Attention was given to wrong issue</p>
<p>Contributing Causes: (List as many as apply.)</p>	<p>When the ARM was in the middle of a survey of Endstation (Hall) A, they were contacted by their shift supervisor for a status update of their survey progress and to inform the ARM that personnel were waiting to gain access to the hall. This added a sense of time pressure to the ARM's task as their survey had already taken longer than initially expected due to increased number/size of radiological areas throughout the hall after a recent increase in delivered energy. The call interrupted the ARM's progress and with the additional sense of time pressure, contributed to the ARM's failure to conspicuously post all</p>

Causal Analysis: (Use attachment as necessary)

access points to the radiation area.

A contributing cause was the Hall workers perceived they had a tight schedule they needed to keep to in order to perform their measurements. Because of this, they planned to have periodic accesses into the hall to adjust their apparatus so they could complete all their tasks. In order to do this, they wanted these accesses as short as possible so that they could quickly resume taking beam data. Attempting to keep to the tight schedule, this added perceived pressure to the affected hall workers. However, neither the hall workers nor the Hall Run Coordinator (who interfaces with the Program Deputy) communicated this need to the Operations staff. Since it was understood ahead of time, the plan to make periodic accesses for as short of duration as possible could have been communicated up front and all effected workers (Program Deputy, Operations staff, RadCon Techs, other Hall staff, etc.) could have coordinated and carried out these accesses in a more efficient manner.

Another contributing cause was that the ARM initiated the survey at the end of their shift, specifically night shift. It is a well-known human-factor issue with people on rotating shifts that people are not working at their peak on night shift. Previous incidents where similar human factor mistakes played a roll, established an "in house understanding" between the OPS and RadCon groups. This understanding was if an ARM was in their last hour of their shift and was asked to perform a radiation survey that could take them beyond the end of their shift, the ARM can call upon RadCon to assist. This understanding is not written down and the ARM did not know the option was available to them.

DOE Cause Codes:

A3B1C02 – Step was omitted due to distraction

A4B3C09 – Work planning not coordinated with all departments involved in task

A4B4C05 – Emphasis on schedule exceeded emphasis on methods/doing a good job

Extent of Condition Check		JLab CATS Number	Target Date	Action Owner
RADCON investigated entire Hall for other areas which might have been missed or improperly posted. No other areas were found improperly posted.		n/a	08Mar2016	RADCON
Does this event involve failed equipment?	Y N <input type="checkbox"/> <input checked="" type="checkbox"/>	Is there similar equipment in other areas?	Y N <input type="checkbox"/> <input checked="" type="checkbox"/>	** If yes, assign extent of condition check to the appropriate DSO(s).

Corrective Action(s)	JLab CATS Number	Target Date	Action Owner
RadCon practical trainer should consider incorporating a regular reminder to ARMs during ARM qualification training for ARMs to investigate all avenues of access into a Radiation Area and to ensure it is appropriately posted before leaving area.	NE-2016-23-01-01	12/01/2017	Keith Welch
Evidence of completion: Meeting notes and if			

Corrective Action(s)	JLab CATS Number	Target Date	Action Owner
adopted, attach text file of written guidance to ARMs.			
<p>Physics Management should consider reminding the Experiment's Spokespersons, Physics Liaisons and Run Coordinators that multi-hall running requires a tight coordination among the halls as well as Accelerator OPS and the Program Deputy. Desired program plans should be communicated with the Program Deputy in order for them to effectively coordinate these requests in the overall program.</p> <p>Evidence of completion: E-mail or excerpt from Conduct of Operations or other shift related guidance documentation to shift workers.</p>	NE-2016-23-01-02	9/29/2017	Javier Gomez
<p>Opportunity for Improvement: A previous "in-house understanding" was that if an ARM was in their last hour of shift and was asked to perform a radiation survey that could take them beyond the end of their shift, the ARM can call upon RadCon to assist. This was not written down and could be missed. OPS Management with RCG Management should consider formalizing this understanding within written OPS procedures and OPS Management should remind shift workers of this available option.</p> <p>Evidence of completion: Meeting notes and if adopted, attach text file of written guidance to be added to OPS documentation.</p>	NE-2016-23-01-03	12/29/2017	Paul Vasilauskis/Keith Welch

Lessons Learned (Confer with Lessons Learned Coordinator) (Use attachment as necessary)	Lessons Learned Number
When performing a task and are interrupted, it is best to reassess the task before continuing to ensure all aspects will be completed properly.	1002

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

To whom it may concern,

On Tuesday, March 8th, 2016, I served as the Assigned Radiation Monitor (ARM) for Owl shift, midnight to 8 am. At approximately 6:30 am Hall A called the control room, asking to set them up for an extended Controlled Access. They asked that a full radiation survey be performed so that they could have unescorted access in and out of the Hall. The Program Deputy (PD) had called at approximately 5:00 am to tell the Crew Chief that Hall A was going to perform a spectrometer configuration change in the morning. No exact time was given. Other than this call, there was no information that this access was to occur relayed to our shift, and no time given.

Hall A, at this time, was taking the highest energy beam the Hall has ever had – 8843 MeV, 4th pass beam – with currents up to 20 uA. Up to this point during the run, no additional Radiation Areas, other than the normally posted permanent High Radiation Area gate at the high power dump and the Contamination Area around the water filtration

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

system were, had been generated.

I entered the Hall, alone, under controlled access at 6:42 am with survey sheet and instrument and began the full survey. I began with surveying the portion of the beam pipe from the Beam Switchyard to the end of the elevated stand several meters from the target chamber. I then proceeded to survey the shielded equipment racks and North half of the Hall. Up around the target I found elevated radiation levels near the target approaching from the North, but not high enough on this side to trigger a Radiation Area. I then passed under the right spectrometer arm, and found a large Radiation Area emanating from the high power dump out into the Hall. I proceeded to survey the South half of the Hall, proceeding under the left spectrometer arm, making my way to the RADCON locker containing ropes and signs to cordon off Radiation Areas with. Again, the target chamber, when approached from the South, had elevated radiation levels, but not enough to trigger a Radiation Area. I returned to the area around the dump and began roping it off. Upon finishing, I surveyed the boundary that I roped off and found that the rope did not extend far enough to fully encompass the Radiation Area. I returned to the locker, got more rope, and posted the boundary emanating from the high power dump even further. This time, it was sufficiently far back enough. I then approached the target chamber from the high powered dump, in between the two spectrometer arms. On a platform from which the calorimeter could be accessed I measured the exit of the target chamber and found it to be generating a Radiation Area. I returned to the locker to get more rope and signage to post the area. I conservatively posted the whole platform as a Radiation Area.

At this point, it was approximately 7:30 am, and I received a page over the intercom system asking me to call the control room. I went to the nearest phone and called the control room. They asked if everything was alright, what was taking so long, and informed me that Hall A personnel were eager to enter the Hall. I replied that I still had some areas left to survey and it was taking some time because new Radiation Areas had to be posted. I then finished up my survey, surveying the platforms of the two spectrometer arms.

I went to exit the Hall at 7:57 am. As I called the Safety Systems Officer to process me out of the Hall he informed me that Hall A personnel wanted me to stop by their Counting House office and let them know I had finished. Immediately after being processed out, downstairs from the Hall A Counting House office, Hall A personnel intercepted me. I showed them my survey and asked if they were doing work near the calorimeter. They said they were, and I informed them that they would need to contact RADCON before any work in that area could take place, as it was a Radiation Area. They acknowledged and went to be processed into the Hall.

The target chamber, when approached from other angles, that is not from the dump, did not generate a Radiation Area. When approaching from other angles, however, one could maneuver around the target chamber such that one would be behind it, directly in the Radiation Area. The whole area is tight, and the other points-of-access to behind the target chamber where the Radiation Area was are narrow, but they could be climbed or crawled through. As such, I should have roped off these points-of access, however tight, preventing unwanted access to a Radiation Area.

Signed ARM #1

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

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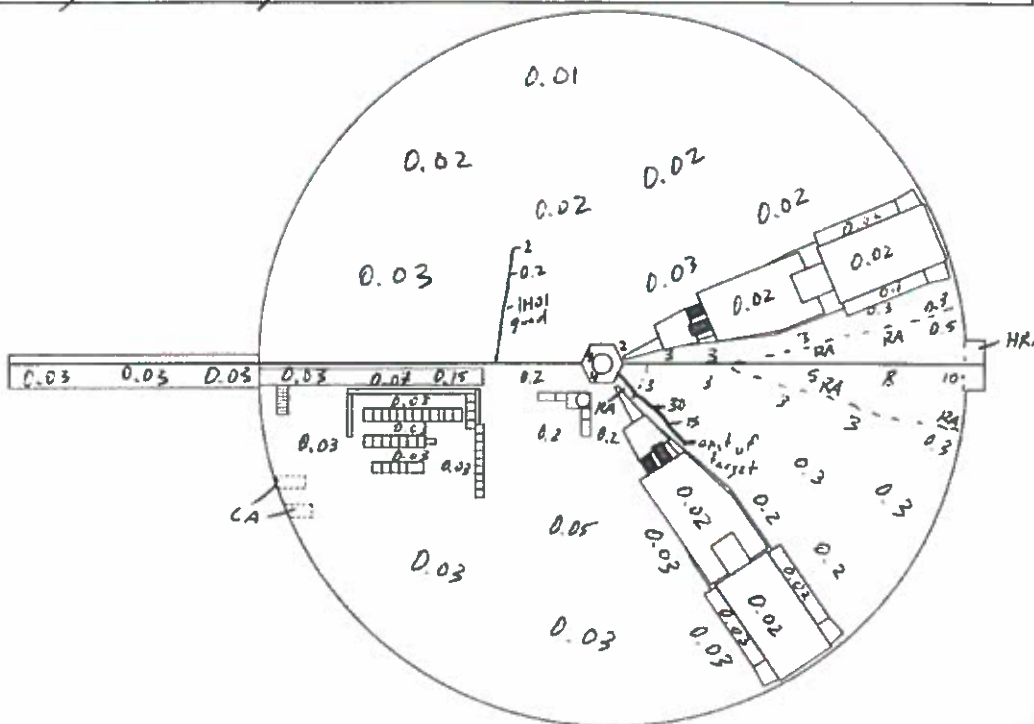
HPF-SUR-001	Rev: 4	07/16/2012	RADIATION CONTROL DEPARTMENT RADIOLOGICAL SURVEY FORM		Page 1 of 1
Location HALL A	Accelerator Operating Conditions 8843 AMU, 15 μA CW	Instrument: FH406 Serial #: 10585 Calibration Due: 4/2/16	Survey Number N/A	RWP 2016-5001	
Reason for Survey: <i>HRS Configuration Change</i>					

LEGEND
All readings in mR/hr whole body (unless annotated otherwise)
--- Denotes posted area
⊙ Denotes smear location (refer to page 2 for results)
--- Contact dose rate
--- Whole Body dose rate
--- Item description
▨ Denotes area not surveyed

Approved Abbreviations
RA - Radiation Area
HRA - High Radiation Area
CA - Contamination Area

- For Beam Enclosure Entry Surveys**
- Full survey, all areas posted
 - Partial survey with continuous surveillance
 - Partial survey with exclusion zone(s) posted

Comments:
- big radiation area emanating from dump



Performed By (Print):	Date: 3/8/16	Crew Chief Review (Print):	Date: 2016-07-04	RCD Review (Print):	Date:
Sign:	Time: 0800	Sign:	Time: 0921	Sign:	


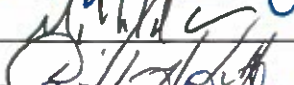

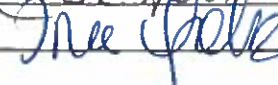
Emergency Notifications Made (Subsequent to the Event):	Date	Time
Fire, Rescue & Emergency Medical: (9-911)		
Guard Post: x5822; 269-5822		
Occupational Medicine 269-7539		
ESH&Q Reporting Officer: 876-1750	8-Mar-2016	13:00
Crew Chief 630-7050	8-Mar-2016	09:30
Industrial Hygiene: 269-7863:		
Other:		

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		2-MAY-2017
	Mike Aiken		5/2/17
	Dave Hamlette		5/3/17
	Tina Johnson		may 2, 2017

Acceptance/Acknowledgement of Facts

	Print	Signature	Date:
Associate Director/ Department Manger	Andrew Hutton		5/4/17

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-16-0308
CATS Number:	NE-2016-23
Lessons Learned Number:	1002
ORPS Number:	N/A
NTS Number:	N/A
CAIRS Entry:	N/A
DOE Cause Code:	A3B3C01, A3B1C02, A4B3C09, A4B4C05
ISM Code:	Define the Scope of Work, Perform Work Within Controls

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:	09Mar2016	Time:	08:30
Location:	MCC Conference Room		
Required Attendees: (Print Name)		Optional Attendees: (Print Name) Present	
Lead Investigator:	Harry Fanning	Associate Director:	Andrew Hutton (invited)
ESH&Q Representative:	Tina Johnson	TJSO Observer:	Patty Hunt (Steve Neilson) Notified
Supervisor of involved persons(s):	Paul Vasilauskis (for Brian Freeman)	Subject Matter Expert(s), Facility/Equipment Owner as applicable:	
Involved or impacted person(s):		Dave Hamlette	
	Daniel Moser		
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.	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.	✓

Step 2 Investigation Team:		Date Convened: (Within 24 hours of Fact Finding Meeting.)	11-Mar-2016 – 10:00
Role	Name	Department/Group	Phone
Lead Investigator	Harry Fanning	Accel/ACCMGT	7619
Co-Lead	Mike Aiken	Accel/OPSMCC	7745
SME	Dave Hamlette	ESH/ESHDIV	7219
ESH&Q Reporting Officer	Tina Johnson	ESH/ESHDIV	7611
<u>TJSO Observer</u>	Patty Hunt (invited)	TJSO	7039

Environmental Aspects	
Type of Material Released: n/a	Quantity: n/a
Source: n/a	Time Flow was Halted or Controlled: n/a
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: 03/09/2016	Time: ~10:00	
This event does not rise to the level of an ORPS reportable event. The Lab will handle this as a notable event only.			
10 CFR 851 Screen:	Date: 03/09/2016	Time: ~10:00	
Negative: This event does not meet the voluntary criteria as a discreet programmatic weakness.			

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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