

EA Operational Awareness Record		Report Number: OAR-EA-LLNL-2016-08-15	
Site: Lawrence Livermore National Laboratory (LLNL)		Subject:	Follow-up Assessment of the LLNL Fire Protection Program as Implemented for the Plutonium Facility and the High Explosives Applications Facility
Dates of Activity: 8/15/2016 – 9/15/2016		Report Preparer: Ron Bostic and Barry Snook	
<p>Activity Description/Purpose: The Office of Environment, Safety and Health Assessments, within the Office of Enterprise Assessments (EA), performed a follow-up assessment to evaluate the completion of corrective actions taken to address the findings that EA identified in the <i>Independent Oversight Review of the Fire Protection Program at Lawrence Livermore National Laboratory</i> report, September 2013. This assessment evaluated the effectiveness of Lawrence Livermore National Security (LLNS), the management and operating contractor for LLNL, in managing the findings and subsequent corrective actions associated with fire protection at certain LLNL facilities.</p> <p>Fire protection was identified as an independent oversight targeted review area for 2013. At LLNL, EA completed targeted fire protection reviews at the Plutonium Facility and the High Explosives Applications Facility (HEAF) from June 11-20, 2013. The findings from the September 2013 report were the focus of the follow-up review documented by this operational awareness record.</p> <p>The Livermore Field Office (LFO) oversees the management and operation of LLNL and is responsible for administrating the performance-based contract, executing assigned National Nuclear Safety Administration (NNSA) and U.S. Department of Energy (DOE) programs, and conducting oversight of work performed at LLNL in support of NNSA requirements and priorities. During the 2013 fire protection program review, the LLNL Plutonium Facility (B332) was undergoing a transition to complete the removal of special nuclear category 1 and 2 materials. At the time of this follow-up review, these materials had been removed from Building B332 and the facility continues to conduct plutonium/special nuclear materials (SNM) operations involving category 3 and 4 materials. The current mission of Building B332 is to support weapons research and development (R&D), weapons certification, and plutonium process R&D. The HEAF is a DOE and NNSA complex-wide center for high-explosives research and development in support of the NNSA stockpile stewardship program.</p>			
Attachments: None.			
<p>Result: EA confirmed that LLNS is tracking each finding and that the proposed actions are appropriate for resolving the issues. EA observed the following results during this follow-up review.</p> <p>Previous Finding F-1: The LLNL pre-fire plan (i.e., RunCard) for the HEAF is inconsistent with the Facility Safety Plan (FSP) and does not reflect the physical conditions observed in the facility. The RunCard had not been updated to incorporate facility changes since the last revision in 2004. Examples included:</p> <ul style="list-style-type: none"> • <i>Sprinkler System Modifications: The deluge sprinkler system has been converted to a wet pipe system;</i> • <i>Gunpowder storage was not identified on the RunCard; and,</i> • <i>Chemical storage rooms were not identified or consistent with the FSP. The FSP indicated the largest number and variety of chemicals and explosives to be in the synthesis laboratories.</i> <p>(Note: Information in italics is additional details from the September 2013 report concerning the finding.)</p> <p>LLNS appropriately tracked this finding in the Integrated Tracking System (ITS) under ID 36213.3, which includes one action item: “Ensure the HEAF RunCard is modified to reflect current facility conditions.” EA verified that the proposed action was appropriate and that LLNS has completed the action to resolve the finding:</p> <ul style="list-style-type: none"> • EA reviewed the January 4, 2016, revised RunCard for Building 191 and verified that the deluge system was changed to a wet pipe sprinkler operation; Room 1450 was identified as a High Explosives Storage Magazine 			

with a High Severity of “Extreme B;” and Rooms 1308 and 1313 were identified as chemical storage rooms consistent with the FSP.

Previous Finding F-2: Several non-compliant fire safety conditions were identified during the HEAF walkdown/tour, including restricted egress, obstructed fire extinguishers, improperly stored flammable liquids, and an outdated placard. *A wood pallet had been left on the floor of the high bay area, restricting the route to an emergency exit. A fire extinguisher was obstructed in the high bay area. A hydrogen gas bottle was left unsecured in the high bay area. Flammable liquids including small quantities of acetone, ethyl alcohol, and other solvents were not properly stored. In addition, a sprinkler riser placard was not updated to reflect the actual sprinkler systems supplied by the riser.*

LLNS tracked Finding F-2 in ITS under ID 36213.4.1, which has one corrective action item: “Walkdown the HEAF to ensure noncompliant fire safety conditions have been resolved.” During this follow-up review, EA conducted a facility walk down to verify that LLNS took action to resolve the specific deficiencies included in Finding F-2. The proposed action and the action taken were appropriate for resolving issues related to the restricted egress, obstructed fire extinguisher, and unsecured compressed gas cylinder. Although LLNS has acted to address the storage of flammable liquids in the high bay, the action taken does not adequately address the requirements for proper storage of flammable liquids. Furthermore, LLNS has not addressed the riser placard deficiency and the sprinkler system control valve identification requirements. EA observed the following during the walk down of HEAF:

- There were no emergency egress routes or exits restricted. However, combustible materials were stored under the stairs in the Gun Bay, including a shop vacuum, which was also wedged against a sprinkler head. The vacuum was moved during the walkthrough. The facility fire protection engineer indicated that the combustible materials would be removed from under the stairs and the area posted as no storage permitted.
- There were no fire extinguishers obstructed in the high bay. However, an unsecured 2.5-gallon pressurized fire extinguisher was sitting on the floor of the Gun Bay. National Fire Protection Association (NFPA) 10, section 6.1.3.4, requires portable fire extinguishers to be installed using any of the following means: (1) securely on a hanger intended for the extinguisher; (2) in the bracket supplied by the extinguisher manufacturer; (3) in a listed bracket approved for such purpose; or (4) in cabinets or wall recesses. Additionally, section 6.1.3.8.3 specifies that the clearance between the bottom of the hand portable fire extinguisher and the floor shall be no less than 4 inches.
- LLNS installed two compressed gas cylinder storage racks in the high bay. All compressed gas cylinders not in use were appropriately secured in the compressed gas cylinder storage racks.
- LLNS procured three storage cabinets for flammable liquids and installed them in the high bay. However, the cabinets do not meet the specific design criteria required by NFPA 30, section 9.5. For example, there are no design specifications on the cabinets (nor is there an Underwriters Laboratory (UL) Listed or Factory Mutual (FM) approved label attached) and the cabinets are not marked with the maximum volume of Class I, Class II, and Class IIIA liquids that are permitted to be stored.
- EA evaluated two sprinkler risers. One riser did not have a placard and the other riser placard had not been updated to reflect the actual sprinkler systems that the riser supplied. Additionally, the sprinkler system control valves were not identified with a sign indicating the system or portion of the system they control. NFPA 13.3.3 states that each control valve shall be identified and have a sign indicating the system or portion of the system it controls.

Although LLNS has closed ITS ID 36213.4.1, actions taken to resolve the proper storage of flammable/combustible liquids and the installation of NFPA compliant riser placards and control valve signage are inadequate and/or incomplete. EA identified Finding F-2 as an item for further follow-up.

Previous Finding F-3: Inspection, Maintenance, and Testing (ITM) of the fire water supply components are not in accordance with NFPA standards. *Auxiliary valves for fire hydrants were not being inspected or tested, and the frequencies for flushing hydrants had been extended beyond the NFPA required frequencies. Furthermore, based on the findings documented in the subcontractor report (V&A - see Reference 16), the recent reduction and/or elimination of ITM on fire water components such as sectional control valves and hydrants, and the extension of pump test frequencies, EA is concerned that the actions taken by the Maintenance and Utilities Service Department (MUSD)*

have not been sufficiently coordinated and/or evaluated from a fire protection program perspective to ensure that a reliable supply of water for fire protection is maintained.

LLNS tracked this finding in ITS under ID 36213.5, which has one corrective action: “Develop a plan for maintenance of the LLNL Water Supply System that is consistent with the requirements for a water supply utility that serves fire protection systems.” EA evaluated the proposed action and determined it was appropriate for resolving the finding. However, LLNS has not adequately implemented the maintenance plan for fire water components and LLNL and LFO have not approved in writing where the fire system begins and ends at both Sites 200 and 300. For example, boundaries of the fire suppression systems and water distribution systems are not clearly defined to indicate which portions of the systems are managed under NFPA vs. AWWA requirements. EA reviewed LLNL procedures/policies, ITM records, LFO follow-up reports, and ITS reports:

Fire Hydrant Auxiliary Valves and Flushing

Lawrence Livermore Fire Department Policies and Procedures 1412, March 30, 2005, *Hydrant Flow Testing and Inspections, Procedure for Inspection and Maintenance of Hydrants, Procedure – Fire Protection System Design Testing*, specifies that the Emergency Management Division will inspect, test, and maintain all fire hydrants on LLNL property annually per NFPA standards. Additionally, an interdepartmental letter from the LLNL Fire Marshall/Authority Having Jurisdiction to the LLNL MUSD, *Standards for Water Utilities ITS ID 36213.5.1*, July 31, 2014, states, “Fire hydrants are considered part of the water utility. As you know, the fire department has performed and will continue to perform annual flow tests and lubrication.” EA reviewed the Hydrant Information Spreadsheet, which indicates the Emergency Management Division is not testing all fire hydrants annually in accordance with Lawrence Livermore Fire Department Policies and Procedures 1412, the interdepartmental letter, and NFPA frequencies. For example, hydrants 331, 332 and 333, which support the Plutonium Facility, were last tested and their associated auxiliary valves operated in January 2012. Furthermore, Emergency Management did not request formal concurrence from LFO to extend established frequencies when hydrant tests became considerably delinquent.

Reduction of ITM on Fire Water Components

In May 2015, LFO reviewed the LLNS water utility system distribution piping main isolation valves inspection and test program for Sites 200 and 300. The conclusions of that review resulted in LFO appropriately communicating a deficiency to LLNS, using the ePegasus tracking system, for reducing the ITM on fire water components (see ISS-SI-5.27.2015-627454). EA observations include:

- The last time MUSD had operated any large group of valves was in November 2013, in response to EA’s September 2013 LLNL fire protection program report. Since then, LLNS has not completed its annual preventive maintenance (PM) Task Codes for each water utility system main isolation valve. PM for these valves is overdue, with no justification other than “lack of resources,” and there has been no formal request to LFO for concurrence.
- An interdepartmental letter from the LLNL Fire Marshall/Authority Having Jurisdiction to the LLNL MUSD, *Standards for Water Utilities ITS ID 36213.5.1*, July 31, 2014, indicates that the LLNL water system is considered a water utility and that pumps, tanks, and other elements of the water utility would follow the standards established by the American Water Works Association (AWWA). The letter further implies that NFPA codes and standards only apply to fire protection systems from the isolation valve into the building. Furthermore, closure documentation for ITS ID 36213.5.1 states, “NNSA LFO and LLNL have agreed that the water supply serving LLNL is a water utility and not a dedicated fire protection water supply.” However, LLNS could not produce any formal documentation from LFO to LLNS validating this decision.
- LLNS postponed PMs without performing an “engineering analysis” to determine the rigor and periodicity for completing the maintenance as required by AWWA. Additionally, LLNS has not provided a formal notification or requests to LFO for concurrence of the postponed PMs.
- AWWA Manual M44, Chapter 5, states “It is important to identify the critical valves necessary to maintain the effective provision of service in an emergency or during a crisis. Once selected, it should be the intent of the agency to schedule maintenance and operation on these valves in a manner that can be achieved within a reasonable timeframe.” LLNS has not identified the critical valves necessary to maintain fire water service in

the event of an emergency or crisis, and a justification for changing the annual PM to a lower periodicity has not been provided. Furthermore, LLNS has not formally requested LFO's concurrence for reducing the PM periodicity.

Although LLNS closed ITS ID 36213.5.1, EA concluded that actions taken to resolve Finding F-3 are inadequate or incomplete. LLNS has not implemented actions to resolve EA's 2013 finding, recommendations from the V&A report, and/or issues published in LFO's follow-up reports. The LLNL water systems that supplement building fire suppression systems and fire hydrants are inspected, tested, and maintained by MUSD. The MUSD implemented ITM program does not comply with NFPA 25, but does appear to meet AWWA Manual M31 recommended practices. Although discussions with LLNL fire protection and LFO indicated the MUSD ITM program is an acceptable approach, no formal approval of the program could be provided. MUSD continues to operate and complete ITM on the water distribution system that supports the fire protection systems (i.e., fire hydrants, control valves, pumps, etc.) without providing adequate priority or attention to the underground distribution infrastructure, which is more than 40 years old. Furthermore, Emergency Management and MUSD implemented a reduced periodicity of testing and maintenance on fire hydrants, control valves, and pumps without formal approval from LFO. And finally, LLNL and LFO have not approved in writing where the fire system begins and ends at both Sites 200 and 300 to clearly define which portions of the systems are managed under NFPA vs. AWWA requirements. Thus, EA continues to have concerns that LLNS has not demonstrated that a reliable and adequate water supply for fire protection is provided to LLNL as required by DOE Order 420.1, *Facility Safety*. EA identified Finding F-3 as an item for further follow-up.

Previous Finding F-4: Interim compensatory measures are insufficient at the facility level to ensure that the building occupants are aware of life safety deficiencies. *Facility managers have not been directed to raise occupants' awareness of the risk associated with the lack of operable emergency lights in case of a loss of power. An action or response plan has not been prepared to describe how each facility would respond. These controls have not been implemented until the emergency lighting systems were adequately tested and validated to be functional as required by LLNL Fire Protection Engineering Standard, Policy 4.3, Emergency Lighting, Revision 3.*

LLNS appropriately tracked this finding in ITS under ID 36213.6, which included three actions:

- Subsequent testing of all generators that power emergency egress lighting has been performed on a monthly PM schedule.
- Emergency egress lighting batteries have subsequently been tested and/or replaced.
- The emergency egress lighting issue was communicated to the workforce in the Newsline publication, *Status of LLNL's Emergency Egress Lighting*, July, 17, 2014.

EA evaluated the proposed actions for ITS ID 36213.6.1, 36213.6.2, and 36213.6.3 and concluded that these responses do not identify the correct actions for adequately resolving the finding. The proposed actions did not address developing a response plan that ensures building occupants are aware of a life safety deficiency or establish compensatory measures at the facility level to be taken during the interim to ensure their safety. Response plans and/or compensatory measures for emergency lighting systems commonly found within the DOE complex include such actions as notifying building occupants via the facility public address system, posting the affected area with specific instructions for entry or no entry, contacting the facility manager prior to access into an affected space, and/or requiring an operable flashlight when entering the affected area. Although LLNS has closed ITS actions 36213.6.1, 36213.6.2, and 36213.6.3, the proposed actions identified to resolve Finding F-4 are inadequate or incomplete. EA identified Finding F-4 as an item for further follow-up.

Conclusion:

LFO appropriately communicated the four findings to LLNL via letter COR-ESH-10/17/2013-542797 on November 20, 2013. LLNS has conducted follow up reviews for the findings that were appropriately entered in ITS and has declared the four findings closed. LFO has monitored and facilitated LLNS's closure of Findings F-1 and F-2, but has not concurred with the closure of Findings F-3 and F-4. LFO conducted follow-up reviews for Findings F-3 and F-4 and entered these reports and the associated open issues into the DOE ePegasus tracking system. EA has concluded

that LLNS has adequately developed and effectively implemented corrective actions resulting from Finding F-1. However, management attention is necessary to ensure:

- Corrective actions for Finding F-2 adequately implement the proper storage of flammable/combustible liquids and NFPA compliant riser placards and sprinkler control valve signage.
- Corrective actions for Finding F-3 address LLNS actions to resolve issues from the EA, VA, and LFO reports, formal concurrence is obtained on the maintenance programs and reduced periodicity of ITM on the fire water supplies and system components, and LLNL and LFO approved in writing where fire systems begin and end at both Sites 200 and 300 to indicate which portions of the systems are managed under NFPA vs. AWWA requirements.
- Finding F-4 is reevaluated to address the corrective action for interim compensatory measures of life safety deficiencies.

EA Participants:

1. Ronald Bostic (lead)
2. Barry Snook

References (Key Documents, Interviews, and Observations)

Key Documents:

1. EA Independent Review Report, *Independent Oversight Review of the Fire Protection Program at Lawrence Livermore National Laboratory*, September 2013
2. COR-ESH-10/17/2013-542797, *Transmittal of Final Report – Independent Oversight Review of the Fire Protection Program at Lawrence Livermore National Laboratory*, September 2013, November 20, 2013
3. LLNL-AM-658521, *Fire Protection Program Manual*, Revision 4.0, July 2014
4. LLNL-MI-637893, *Fire Protection and Life Safety Equipment Inspection Program*
5. Policy 1.2, *LLNL Fire Protection Program Criteria*, Rev. 4, January 2, 2014
6. Policy 1.6, *Interim Fire Protection of Life Safety Measures*, Rev. 0, September 15, 2011
7. Policy 1.7, *Fire Protection Program Administration*, Rev. 0, March 2014
8. Policy 4.3, *Emergency Lighting*, Rev. 3, September 15, 2011
9. Emergency Management Department Policy 400.00, *Fire Protection and Life Safety Equipment Inspection Program*, Rev. 2, 07/01/15
10. Policy 430.00, *Automatic Sprinkler System Impairment Control and Restorations*, 09/23/13
11. Fire Hazards Analysis Building 191, Revision 5, August 2009
12. Fire Protection Assessment Checklist B191, 9/1/15
13. Facility Safety Procedure for the High Explosives Applications Facility
14. Emergency Management Department Policy NO. 100.00, *Impairment Control of Fire and Life Safety Systems*, 9/30/13
15. Lawrence Livermore Fire Department Policies and Procedures 1412, *Hydrant Flow Testing and Inspections, Procedure for Inspection and Maintenance of Hydrants, Procedure – Fire Protection System Design Testing*, 3/30/05

	<p>16. Technical Memorandum, <i>Lawrence Livermore National Laboratory Water Piping Condition Assessment Methodology Evaluation</i>, November 8, 2012</p> <p>17. Pre-fire Plan RunCard for Building 191, January 4, 2016</p> <p>18. Issues Tracking System (ITS) ID 36213 through 36213.13.1, 9/30/2013 through 8/26/2014</p> <p>19. Interdepartmental Letterhead, <i>Standards for Water Utilities ITS #36213.5.1</i>, July 31, 2014</p> <p>20. Interdepartmental Letterhead, <i>Documentation of Interpretation on Zone 7 Pumps</i>, August 15, 2013</p> <p>21. Interdepartmental Letterhead, <i>Impairment Control Authorizers</i>, September 24, 2013</p> <p>22. Interdepartmental Letterhead, <i>Hydrant Flow Tests</i>, July 22, 2009</p> <p>23. Hydrant Information Spreadsheet, 08/11/16</p> <p>24. B-191 Emergency Lighting Inspection Data Spreadsheet, 08/11/16</p> <p>25. Email correspondence between D. Darwin, R. Ricardo, and H. Larson, September 25, 2015</p> <p>26. LLNL Newline Article, <i>Status of LLNL's Emergency Egress Lighting</i>, 07/17/2014</p> <p>27. ePegasus Records:</p> <ul style="list-style-type: none"> • ASRP-SI-1.13.2016-658844 • ISS-SI-5.27.2015-627454 • ASRP-SI-9.20.2013-536483 <p>Interviews:</p> <ol style="list-style-type: none"> 1. LFO Fire Protection Program Subject Matter Expert/Fire Protection Engineer 2. LFO Fire Protection Engineer 3. LFO Maintenance Program Subject Matter Expert 4. B191 Facility Manager 5. B191 Fire Protection Engineer <p>Observations:</p> <ol style="list-style-type: none"> 1. Walkdown of Building 191 High Explosives Applications Facility 2. Walking tour of LLNL Site 200
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Were there any items for EA follow-up? Yes No

EA Follow-Up Items

Finding 2: Actions taken to resolve the proper storage of flammable/combustible liquids and the installation of NFPA compliant riser placards and control valve signage are inadequate and/or incomplete

Finding 3: Testing of fire hydrant valves, hydrant flushing, and ITM on fire water components.

Finding 4: Emergency lighting response plan and/or compensatory measures.