Operating Experience Summary

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1 Lessons Learned from Recurring Violations of Posted Signs and Barriers

With permission from the Los Alamos National Laboratory (LANL), the following article is being reprinted, with slight modification, from the 2010 4th Quarter edition of the Los Alamos Mirror*, a LANL trending and analysis publication.*

We are excited about this reprinting of a LANL article, since it provides wider coverage of an issue that may have Complex-wide applicability. We encourage other sites to offer their own lessons-learned articles for consideration for reprinting in the Operating Experience Summary (OE Summary).

After reading the article, we encourage you to visit the OE Summary *Blog at* http://oesummary.wordpress.com *and rate the article in terms of value to you and provide a comment on the article itself and/or identify topics that would be of interest to you for future articles. You may also identify an article that your site might like to share through the* OE Summary.

Based on the results of a recurring occurrence report submitted by the Los Alamos National Laboratory (LANL), LANL management concluded that standardization of access control to include procedures, site-specific training, barrier types, and signage across the sub-sites can help improve human performance, especially for individuals who do not always work at the same sub-site. During 2009, there were five Occurrence Reporting and Processing System (ORPS) reportable events and one non-reportable event at LANL explosives area facilities where an individual(s) either crossed a barrier(s) or nearly crossed a barrier. Most of these events involved workers who were current in site-specific training, but were focused on performing their work-related activities. Violations of posted signs and barriers create risk of injury to workers and delays for projects and programs. The following is a reprint from the *Los Alamos Mirror* article. (ORPS Reports NA--LASO-LANL-FIRNGHELAB-2009-0002; NA--LASO-LANL-FIRNGHELAB-2009-0014; NA--LASO-LANL-FIRNGHELAB-2009-0016; NA--LASO-LANL-FIRNGHELAB-2009-0017; NA--LASO-LANL-FIRNGHELAB-2009-0019; NA--LASO-LANL-FIRNGHELAB-2009-0020, recurring report finalized on August 4, 2010)

Synopsis

On November 17, 2009, the Weapons Facility Operations (WFO) Facility Operations Director (FOD) at LANL determined that the failure to heed barriers site-wide is considered to be a "recurring event" because of the number of events (six) that occurred within an 11-month period. These events involved:

1) Workers entering a tech area without making the required positive contact with the site leader;
2) An employee entering the accelerator hall through an interlocked door that was not properly locked;
3) Two hikers with three dogs entering Department of Energy (DOE) property;
4) A maintenance worker entering a building while it was posted (Figure 1-1);
5) A worker crossing a high explosives barrier during operations; and
6) A sub-ORPS event.

Figure 1-1. Posting at building entered by maintenance worker

The FOD directed a work pause on November 11, 2009, for all High Explosive (HE) activities and all HE site work activities (other than administrative work) to reinforce hazard controls and communication, and a standing order was initiated on November 12, 2009, to implement compensatory measures. Investigators found that signs and barriers were either misinterpreted or ignored in the four events in which employees crossed barriers. In two events, two longtime LANL employees made decisions to cross HE barriers, and in the other two events employees were prevented from crossing a barrier or engaged interlock systems. All four employees work across the firing site, were trained to applicable site-specific procedures, and were current in site-specific training that iterated barrier protocol. The hikers said that they believed the "Danger" sign was a legacy sign, as similar signs are posted across the highway and on Federal government land that is open to hikers. Investigators determined that the root cause for these events was a lack of standardized access control procedures, site-specific training, barrier types, and signs.

Nine specific corrective actions were developed for these events. The *generalized* corrective actions that are recommended for others to consider are as follows:

1) Evaluation of barrier engineering controls for consistency and effectiveness at site entry points;
2) Development and implementation of a standardized approach to access control, including training, across sub-sites;
3) Development and implementation of a standard set of posting requirements for hazardous areas;
4) Development, implementation, and maintenance of a standardized approach to perimeter fencing and posting; and
5) Clear communication of management behavioral expectations associated with barriers, postings, and access control.

Events

Investigators noted that the FOD is responsible for non-programmatic work and receives support from up to seven organizations: Maintenance; Operations; Environment, Safety, Health and Quality; Waste Management; Engineering; Craft Support; and Security. Individuals from these organizations frequently encounter similar or identical barriers, signs, and protocols at sub-sites that require unique interpretations of meaning, increasing the potential for human error. This was also found to be true as it pertains to the ability of the general public to recognize and interpret barriers and signs.

Analysis

Investigators determined that these events represented failures related to Integrated Safety Management (ISM) Step 2, Analyze Hazards, and Step 3, Develop and Implement Hazard Controls, in that all of these events are examples of improper hazard identification and less-than-adequate hazard controls. Investigators noted that management must ensure that site signs and site-specific training identify the hazards associated with the work activity and that safety-related signage and training are consistent site-wide. Additionally, management must ensure that proper tools are available to guarantee personnel accountability.

Investigators determined that the first root cause of this event was a lack of standardized access control to include procedures, site-specific training, barrier types, and signage. Investigators noted that there are seven different areas requiring access control, which has not historically been standardized. Investigators also noted that the risk of independent site access processes was not considered when organizational changes resulted in the deployment of non-programmatic workers across the firing sites.

Investigators concluded that the second root cause of this event relates to the inadequate implementation by site resident personnel of site-access procedure requirements, evident in that some visiting workers and site access control personnel did not understand management expectations, and that management did not always enforce expectations to ensure site access requirements were implemented.

The following four contributing causes were identified for this event.

1) **Non-Standardized Administrative and Physical Controls.** Although each firing site area has a process to track personnel, those that utilize entry and exit logs did not use standardized logs. Additionally, resident workers for many sites may have come and gone without notification being made to the access control office associated with their area. The two hikers who trespassed onto DOE property when they crossed a posted gate reported that they believed the "Danger" sign was a legacy sign, as similar signs were posted on Federal government land across the highway that is open to hikers.

2) **Non-Standardized Site-Specific Procedures.** Six of eight access control points operated under approved access control procedures; however, the documents differed in scope and comprehensiveness. Two sites lacked approved access control procedures.

3) **Lack of Training-Effectiveness Evaluations.** Effectiveness evaluations for site access training had not been conducted. Access control training at some sites used the "Training Validation System" in which workers were required to read on-line training material and then take a quiz. The training at other sites did not require a quiz. Additionally, there was no follow-up by either Central Training Facility Training Services (CT-FTS) personnel or the workers' first-line management to ensure that workers understood and performed to the training.

4) **Inconsistent Implementation of Firing Point Site Access Protocols.** Investigators noted that there was anecdotal evidence that there were variations in how access was granted to the firing point sites. Firing Site (FS) leaders are the only authorized individuals empowered to grant firing point site access. However, the anecdotal evidence suggests that some FS leaders allowed others to grant access and then inform the FS leader. In addition, investigators reported that the clear delineation between the formalities required for testing activity and the lesser formality when there is no testing activity had blurred over time. Rigorous procedural steps were implemented when explosive operations were in progress, but access to the firing point site was not as rigorous when explosive operations were not in progress. This is consistent with a graded approach to Conduct of Operations, but in some areas the formal separation between the two types of test site operational modes had become ambiguous.

HPI Error Precursors/Latent Organizational Conditions

Investigators reported that the Human Performance Improvement (HPI) error precursors for this event were related to *assumptions* (i.e., suppositions made without verification of facts, usually based on perception of recent experience) and *confusing displays/controls* (i.e., characteristics of installed displays and controls that could possibly confuse an individual, such as missing or vague content and illogical organization and/or layout). Investigators also noted that in examining these events, they were reminded that human beings are primarily goal-oriented by nature, and therefore people tend to focus more on what they want to accomplish (a goal) and less on what needs to be avoided.

Investigators identified the following latent organizational conditions.

- Inadequate site perimeter gates limiting public access; postings were old and degraded.
- Access control and site-specific training inconsistencies, including the following.
  1) Access control and site-specific procedures had not been standardized.
  2) Two sites did not have access control procedures.
  3) Effectiveness evaluations of the delivery methods (live versus on-line) for site-specific training had not been performed.
  4) Site-specific procedure violation consequences had not been codified.
  5) "Knowledgeable Person" is a uniformly defined LANL term; however, the qualifications standards were not uniformly implemented.
- Firing site leader access control protocol was not enforced uniformly during a declared clearance.
- Firing test site personnel were unable to clearly discern test site access-control protocol activation.
- Firing test site entry and exit logs that accounted for personnel were inadequate.
- Access control procedures were not consistent across the firing site facility.
- Signage was not consistent across the firing site.
- Barrier types such as gates (referred to as "wig-wags") and chains were inconsistent.
- Use of engineered controls was not consistently applied.
- Location of firing site residents and Knowledgeable Persons, and for visitors escorted by a Knowledgeable Person, was inconsistent at the test sites.
- Use of gate configuration (open versus closed) to communicate hazards across the site was inconsistent.

Corrective Actions

Specific corrective actions developed as a result of this recurring event included the following.

- A Barrier Engineering Control Improvement Plan was developed and implemented to identify (based on a graded approach) implementation of engineered controls at several site entry points.
- The integrated information system (badge readers) in use at a tech area (which is coupled with the badge reader access database) was evaluated to determine if the integrated information system should be implemented at other access control areas.
- A standardized approach for access control was developed and implemented. The standardized access control procedure contains appendices specifying site-specific details for individual access control as necessary. This procedure includes off-hour access control protocols, gate positions, and the location of personnel for accountability. This procedure establishes specific instructions that require the firing point lead to be the only person able to formally authorize personnel access to the firing point.
- Appropriate level of training, including effectiveness evaluations, for the access control process identified in Corrective Action 3 was identified and implemented. An effectiveness evaluation will be performed 6 months after training implementation.

- A standardized posting requirements procedure for HE areas was developed and implemented. The posting requirements define standardized postings for HE areas to include a process for inspection and maintenance of postings. The procedure requires and assigns the role and responsibility for periodic documented inspections and correction of identified deficiencies.
- Site perimeter fencing and signage along State Road 4 were inspected, and deficiencies were corrected.
- Area Round Sheets Procedures were revised and implemented to include an annual explosive sites perimeter fence inspection.
- Management expectations were communicated through an all-hands meeting and a memorandum. This all-hands briefing included management expectations for access control, consequences, and management's commitment to support compliance with access control protocol when compliance may impact work schedule.

The lessons learned at LANL, as well as the investigation results and identified corrective actions, may be applicable across the Complex to help prevent violations of postings and to improve or standardize access control methods.

KEYWORDS: Signs, barriers, violations, *Los Alamos Mirror*, access control, standardization

ISM CORE FUNCTION: Analyze the Hazards, Develop and Implement Hazard Controls

U.S. Safety Improvements Resulting From the Historic Triangle Fire

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The following article describes the historic Triangle Waist Company fire that took place in 1911 in New York City, killing 146 people and injuring scores more. This fire sparked sweeping reforms in the United States, including the development and implementation of NFPA 101, Life Safety Code®. *Now, a century later, what really has changed and what hasn't? Are similar fires still taking place?*

A number of videos pertaining to this event and the resulting safety reforms have been posted on the Operating Experience Wiki at http://operatingexperience.doe-hss.wikispaces.net/videos.

- *The Triangle Shirtwaist Factory Fire*
- *Bangladesh Factory Fire*
- *NFPA's response to the Triangle Waist Company Fire*

Please be sure to watch the videos in addition to reading the article. When you are done, we encourage you to visit the Operating Experience Summary *Blog at* http://oesummary.wordpress.com *and rate the article in terms of value to you and provide a comment on the article itself and/or identify topics that would be of interest to you for future articles.*

When the workrooms of the Triangle Waist Company, a maker of women's blouses in New York City, New York, caught fire and burned on March 25, 1911, 146 workers—primarily women, mostly poor, and some of whom were only teenagers—died and scores more were injured. Workers trying to escape the flames found doors to the stairwells locked, causing many of them to jump out of windows and fall 7 to 10 stories to their death. Others, some of them already burning, fell 100 feet and died when a fire escape collapsed.

Fast-forward to a similar fire—a century and world away. On December 14, 2010, in Dhaka, Bangladesh, a fire began on the ninth floor of a high-rise building that housed the Ha-Meem Garment Company. Reports put the number of dead at 30, with more than 100 injured. As in the 1911 Triangle fire, some exit doors were locked and a number of workers jumped to their death while trying to escape the fire and smoke. Most of the dead or injured in the Bangladesh fire were also young, poor women. Figure 2-1 shows the buildings where the two eerily similar fires occurred a hundred years apart. More details about both fires are available on the Operating Experience Wiki (http://operatingexperience.doe-hss.wikispaces.net/videos) and at the National Fire Protection Association (NFPA) website (http://www.nfpa.org/publicJournalDetail.asp?categoryID=2157&itemID=50572&src=NFPAJournal&cookie_test=1).

Triangle Fire Led to Workplace Safety Measures

According to NFPA, technology and practices that could have protected workers (e.g., enclosed stairways, fire walls, fire doors, automatic sprinkler systems, and fire drills) existed in 1911, and in some cases were required when constructing build-

Figure 2-1. Similar fires in similar high-rise buildings, 100 years apart

ings. However, design shortcuts were common, and regulatory emphasis was on construction that would withstand fire, not on protecting building inhabitants. For example, although the law called for buildings like the one where the Triangle fire occurred to have three stairways accessing each floor, the Triangle building was exempted, and only two stairways were incorporated into the building design. There was also an exterior fire escape at the rear of the building that descended only to the second floor. The lack of sufficient egress routes, in addition to the locked doors, resulted in the deadliest accidental industrial building fire in U.S. history.

The Triangle fire sparked sweeping reforms in the United States that included the adoption and enforcement of a host of workplace safety measures. NFPA traces the development and creation of NFPA 101, *Life Safety Code*® directly to the Triangle fire. NFPA created the Committee on Life Safety in 1914, and in 1927 issued the Building Exits Code, which was the forerunner to today's *Life Safety Code*®, the registered trademark of an American consensus standard. While NFPA 101 is not a legal code, is not published as an instrument of law, and has no statutory authority unless adopted by the authority having jurisdiction, it has been widely adopted in the United States and is deliberately crafted with language suitable for mandatory application to facilitate adoption into law by those empowered to do so.

The NFPA *Life Safety Code*® addresses the construction, protection, and occupancy features needed to minimize danger to life from the effects of fire. The Code addresses smoke, heat, and toxic gases created during a fire; minimum criteria for the design of egress facilities to allow prompt escape from buildings or to safe areas within buildings; and protective features and systems that help provide adequate egress time or protection for people exposed to fire (e.g., many buildings, especially new construction, are required to have sprinkler systems). In addition to the NFPA *Life Safety Code*®, lessons learned from the fire led to legislation that required all doors in the workplace to open outward, banned the locking of doors during working hours, and made fire drills mandatory for buildings without sprinklers. These important and life-saving safety requirements, which were developed and implemented as a result of the Triangle fire, have been acknowledged for protecting generations of U.S. workers.

Lack of Safety Standards Led to Ha-Meem Fire

In contrast to the United States, many workers in Bangladesh lack the protections afforded by the NFPA *Life Safety Code*® and safety regulations. In Bangladesh, there is a seemingly endless supply of cheap labor, minimal protections for workers, few workplace regulations, and work is often conducted in multi-story buildings where building codes do not comply with industry standards. According to the International Labor Rights Forum, between 2006 and 2009, 414 workers were killed in 213 reported garment factory fires in Bangladesh.

In the case of the December 2010 Ha-Meem fire, a survivor stated that the fire "created a vast smoke (Figure 2-2) which made us suffocate." Several workers did apparently suffocate from the smoke, while others jumped to their deaths trying to escape the burning building or were trampled as they rushed toward the six exits—at least two of which were locked.

On March 25, 2011, many of the observances of the 100th anniversary of the Triangle fire will call for the creation and enforcement of regulations protecting workers worldwide, with the hope that change will come in time to prevent more deaths in the modern-day equivalents of the Triangle Waist Company fire.

Figure 2-2. Suffocating smoke pouring from the Ha-Meem fire

Commemorating the Triangle Fire

A number of events are planned for March 24 and 25 to commemorate the Triangle fire. In New York City, there will be a reading of the names of those who died in the fire. More information about this event is available at rememberthetrianglefire.org. There will also be a day-long conference focused on the Triangle fire at the City University of New York that includes a roundtable discussion about fire safety and features NFPA's department manager for building and life safety codes (http://trianglefireconference.org/). In addition, HBO is presenting "Triangle: Remembering the Fire," a documentary that began airing on March 21, 2011 (check your local listings for date and time).

KEYWORDS: Triangle Waist Company, Ha-Meem Garment Company, fire, injuries, fatalities, National Fire Protection Association, NFPA *Life Safety Code*®, Operating Experience Wiki video, safety measures

ISM CORE FUNCTIONS: Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work Within Controls, Provide Feedback and Continuous Improvement

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