Operating Experience Summary

HSS
Office of Health, Safety and Security

U.S. Department of Energy
Office of Health, Safety and Security
OE Summary 2012-01
March 27, 2012

Inside This Issue

1 Preparing for Tornadoes and Their Aftermath

The following article discusses the importance of being properly prepared for tornadoes and how the Department of Energy (DOE) prepares for natural phenomena. From knowing the first warning signs of a tornado to safe recovery following a tornado, planning ahead is essential. DOE directives provide requirements and guidance on specific potential safety issues associated with tornadoes at DOE facilities. To be best prepared for natural phenomena such as tornadoes, DOE site emergency management plans are required to include procedures for both preparation for and recovery from disasters.

After reading the article, 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 and/or identify topics that would be of interest to you for future articles.*

We also encourage readers to submit articles of their own for sharing in the Operating Experience Summary. *Please let us know if you have something to share.*

On May 25, 2011, at the Kansas City Plant (KCP), Patrol Headquarters (HQ) made a plant-wide tornado sheltering announcement after receiving an automated notification by the National Weather Service (NWS) that tornadoes had struck in the vicinity of the Plant. The KCP Incident Command (IC) was activated, and IC staff monitored the warning status and initiated planning in case a tornado would actually strike. Later, an NWS automated notification that the tornado warning had expired was received, so an all-clear announcement was made to all plant personnel. Thankfully no injuries or property damage resulted from the nearby tornadoes or the indoor sheltering action; however, since natural phenomena events could happen at any time and any place, it is important to be prepared. (ORPS Report NA--KCSO-AS-KCP-2011-0006; final report issued May 26, 2011)

It is important for Department of Energy (DOE) sites across the country, particularly those in the high-risk areas identified in Figure 1-1, to be properly prepared, both for the potential destruction caused by a tornado and for safe recovery following a tornado.

Tornado Warning Signs

Knowing the signs of an impending tornado is the first step in preparing for it. This article primarily addresses workplace preparedness, but some of the information is applicable whether you are at work, at home, or on the road. A tornado has been defined as a rotating column of air ranging in width from a few yards to more than a mile and whirling at destructively high speeds, usually, but not always, accompanied by a funnel-shaped downward extension of a cumulonimbus cloud. When the National Oceanic and Atmospheric Administration (NOAA)

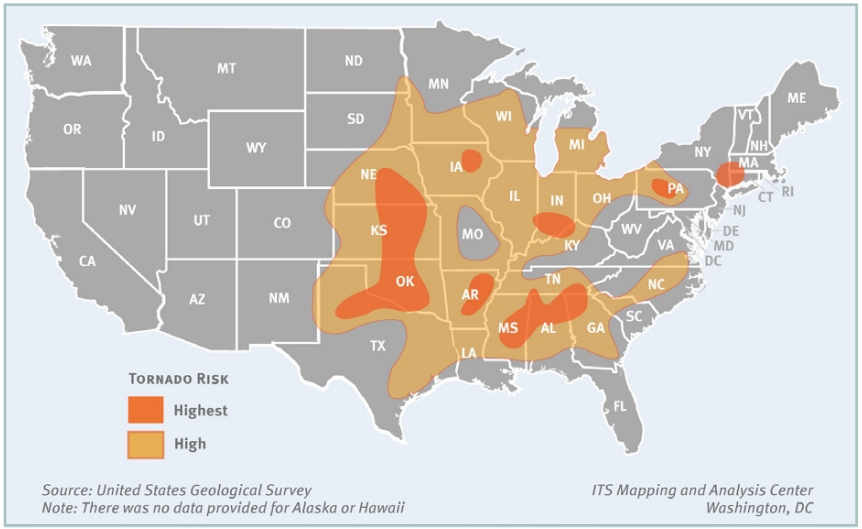

Figure 1-1. Areas at risk for tornadoes

or NWS issues a tornado watch, it is time to pull out your emergency action plan and start following it. The textbox below shows indicators to watch for when NOAA issues a tornado watch or warning.

INDICATORS THAT A TORNADO MIGHT STRIKE

From the National Oceanic and Atmospheric Administration (NOAA)
http://www.spc.noaa.gov/faq/tornado/

- Strong, persistent rotation in the base of a cloud (i.e., cloud base).
- Whirling dust or debris on the ground under a cloud base. (Note that tornadoes do not always have a funnel.)
- Hail or heavy rain followed by either dead calm or a fast, intense wind shift. Many tornadoes are wrapped in heavy precipitation and cannot be seen.
- **Day or Night:** Loud, continuous roar or rumble that doesn't fade in a few seconds.
- **Night:** Persistent lowering from the cloud base, illuminated or silhouetted by lightning, especially if it is on the ground or there is a blue-green-white power flash underneath. This could indicate fallen power lines, potentially caused by strong winds or a tornado.

From The Tornado Project
http://www.tornadoproject.com/safety/safety.htm

- A sickly green or greenish-black color to the sky.
- If there is a watch or warning posted, then the fall of hail should be considered as a real danger sign.
- A strange quiet that occurs within or shortly after a thunderstorm.
- Clouds moving by very quickly, especially in a rotating pattern or converging toward one area of the sky.
- A sound a little like a waterfall or rushing air at first, but turning into a roar as it comes closer. The sound of a tornado has been likened to that of both railroad trains and jets.
- Debris dropping from the sky.
- An obvious "funnel-shaped" cloud that is rotating, or debris such as branches or leaves being pulled upwards, even if no funnel cloud is visible.

Additional information on tornado watches, warnings, and the actions that should be taken is available on the NOAA website and on The Tornado Project website. The textbox on the right lists important actions to take when a tornado is anticipated.

Plan Ahead

DOE Order 151.1C, *Comprehensive Emergency Management*, which specifically mentions tornadoes, includes the following emergency planning and preparedness requirements.

- Emergency planning must include identification of hazards and threats, hazard mitigation, development and preparation of emergency plans and procedures, and identification of personnel and resources needed for an effective response.

TAKE THESE ACTIONS WHEN A TORNADO IS ANTICIPATED

During a Tornado Watch:

- Keep alert and watch for changing weather conditions
- Listen to your local news reports and weather updates
- Review your family or business emergency preparedness plan
- Review your disaster kit
- Be ready to seek shelter at a moment's notice

When a Tornado Warning is issued:

- Take shelter immediately
- Listen to your local radio for updates
- Follow these National Weather Service Safety Guidelines:

  If you are in a building: Go to a predesignated shelter area, such as a basement, storm cellar, or the building's lowest level. If none of these options is available, take shelter in the center of an interior room on the lowest level, such as a bathroom, closet or interior hallway that is away from corners, windows, doors and outside walls.

  If you are in a vehicle, trailer, or mobile home: Get out immediately and go to a nearby sturdy building or storm shelter and seek shelter on its lowest floor.

  If you are outside without nearby shelter: Lie down in a ditch, ravine, or depression and cover your head with your hands.

- Emergency preparedness must include acquisition and maintenance of resources, training, drills, and exercises.

In addition, actions that may be particularly useful in the event of a tornado can be found in an Occupational Safety and Health Administration (OSHA) e-tool. Suggestions in the e-tool include having a hard-wired telephone and disaster supplies available in sheltering areas, as well as a means of obtaining updates from local officials (e.g., radio, television, internet) about when to evacuate or when all is safe. At KCP, for example, employees were frequently provided with updates on the tornado warning status, with an all clear issued when the danger had passed. Besides sheltering as a precautionary measure, no other actions were required.

It is important for every worker to be aware of the safety procedures to follow in an emergency, and this information should be posted in conspicuous areas where it is readily available to workers. Workers should also be aware of how they will be alerted to an emergency and their personal responsibilities for safety in the face of an emergency, so it is important for all employees to participate in regular emergency drills. To make them more realistic, unannounced drills should be conducted at least once a year, and, in an area that is prone to tornadoes, management should consider planning a drill just before the beginning of tornado season to specifically address steps to take during a tornado.

Potential Safety Issues at DOE Facilities Associated with Post-Tornado Cleanup

Should a tornado actually touch down, leaving destruction in its path, it is important to be aware of any new safety issues that the disaster may have created. DOE Order 420.1B Chg 1, *Facility Safety*, Section 4, "Natural Phenomena Hazards Mitigation," requires facilities or sites with hazardous materials to have procedures in place for inspecting facilities for any damage from severe events caused by natural phenomena, such as tornadoes and earthquakes, as well as procedures for placing facilities into a safe configuration when damage has occurred. DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, provides additional information on implementing the requirements in the Order. In addition, emergency response requirements in DOE Order 151.1C include "the application of resources to mitigate consequences to workers, the public, the environment, and the national security, and the initiation of recovery from an emergency." DOE Order 151.1C also requires planning and actions post-event that will return facility/operations to normal.

Among the work-related hazards that could be encountered in tornado cleanup and recovery are electrical hazards, carbon monoxide exposures, musculoskeletal hazards, heat stress, motor vehicle and large machinery hazards, hazardous materials issues, fire protection system failures, and slip, trip, and fall hazards. The American Society of Safety Engineers (ASSE) recommends a number of safety checks that should be made following a disaster, including those listed below.

- Air Quality Assessment: Ensure the atmosphere in the workplace environment is tested for asbestos and other chemical/toxic agents.
- Protection Equipment: Ensure that fire and smoke alarms have been cleaned and tested and sprinklers are operating properly before allowing occupancy of the building.
- Electrical Safety: Check electrical systems, computer cables, and telecommunications equipment to ensure that they are still safe and that there is no danger of exposure to electricity. Inspect wiring from the outside in to ensure wiring and connections are not in danger of shorting out because of water damage from rain or firefighting efforts.

- Machine Inspections: Inspect the condition of drain, fill, plumbing and hydraulic lines on processes and machines. Have plumbing lines evaluated and tested to detect any hazardous gases.
- Surfaces: Make sure flooring surfaces are safe and free from possible slip, trip, and fall hazards.

A May 24, 2011, article on the safetyXchange website provides a complete listing of the ASSE safety tips. In addition, the Center for Disease Control website has information about cleanup hazards associated with tornadoes and other natural disasters to help employers and workers prepare in advance for anticipated response activities and prevent work-related injuries and illnesses in the field once rescue, recovery, and cleanup begin.

Recommendations

DOE site emergency management plans are required to include procedures for both preparation and recovery from disasters caused by natural phenomena. Site management should ensure that all workers onsite are adequately prepared to identify and react to a tornado watch or warning, are aware of how they will be alerted to an emergency, and know their personal responsibilities for safety. Posting specific information about safe areas and steps to take in the event of an emergency in highly visible areas of the facility, so that workers can immediately access necessary information, is essential. Conducting realistic, unannounced emergency drills at least yearly is also essential in preparing workers for safe actions in the event of an emergency. In areas prone to tornado activity, management should consider conducting an emergency drill specifically tailored to tornado safety just before the tornado season begins.

Following a tornado, it is important to ensure that all personnel are safe and accounted for and that all facilities are inspected for any damage that may have occurred and put into a safe configuration, if necessary. To determine their status post-event, electrical equipment; air quality; fire protection systems; slip, trip, and fall hazards; hydraulic and plumbing lines; and any systems or materials that could fail and impact safety should also be inspected.

KEYWORDS: Tornado, tornado watch, tornado warning, recovery plan, emergency planning, emergency response, emergency management plans

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

Accident Investigation Results — Worker Injured in Fall from Scaffold

2

The following article provides a summary of the Accident Investigation Report about an event that took place at the Department of Energy's Savannah River Site on July 1, 2011, resulting in the serious injury of a worker who fell from a scaffold 12 feet above the ground. The Accident Investigation Board identified error precursors in three areas for this event. Unclear goals, roles, or responsibilities; hazardous attitude for critical task; and inaccurate risk perception were identified as contributing causes.

After reading the article, 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.*

We also encourage readers to submit articles of their own for future sharing in the Operating Experience Summary. *Please let us know if you have something to share.*

On July 1, 2011, at the Savannah River Site (SRS), a worker demolishing and removing gypsum wallboard fell approximately 12 feet from a scaffold Tele-Tower® to the concrete floor below. Figure 2-1 shows the scaffolding that workers were using at the time of the accident. The worker was transported by helicopter to a local hospital where he was diagnosed with head trauma and broken ribs. (ORPS Report EM-SR--SRNS-KAREA-2011-0002)

The Department of Energy's Office of Environmental Management appointed an Accident Investigation Board to investigate this event, determine its causes, and identify Judgments of Need (JON) to reduce the potential for similar accidents. The Board's report is available at http://www.hss.doe.gov/sesa/corporatesafety/aip/docs/accidents/typea/srs_fall_injury_report.pdf.

Figure 2-1. Scaffolding in use when accident occurred

The Accident

On the day of the accident, workers were removing gypsum wallboard and cutting it into smaller pieces with saws. To provide access to the elevated work location, the workers used three adjustable work platforms. Workers moved the scaffolding as needed to support the work.

When the injured worker, who had been detailed to the task as a supervisor, returned to the work site after the lunch break, he relocated scaffolding Unit A either against or close to a wall in another area of the work site and climbed the scaffolding. Other members of the work crew saw him climbing the scaffolding or standing in the middle of the work platform. They said that he did not appear to have any tools in his hands. A few minutes later, one worker heard what he described as a "chain noise," looked in the direction of Unit A, saw the worker in mid-air as he fell, and then saw him land on his right side. Other workers reported hearing "a horrible noise" and turning to see the injured worker lying on the floor. No one witnessed the beginning of the fall.

The Investigation

The Board could not establish the exact cause of the injured worker's fall and it could not interview him because of the nature of his injuries. Although the Board observed that the injured worker's shoes showed wear and were in questionable condition (Figure 2-2), it could not determine if the worn footwear contributed to the accident.

Figure 2-2. Wear pattern on worker's shoe

In the absence of objective evidence, such as an eyewitness or a video of the accident, the Board evaluated a number of factors that it believed may have contributed to the accident, including unsafe work practices and Human Performance Indicator (HPI) error precursors (e.g., unclear goals, roles, and responsibilities).

Unsafe Work Practices

The Board identified the root cause of this accident as unsafe work practices that were not recognized or corrected. During interviews, workers cited numerous instances where actions taken on the day of the accident deviated from prescribed hazard controls. For example, scaffolding inspections were not completed, as required, at the beginning of the shift, after modifications, or before use. Further, large pieces of gypsum were pulled off the walls and dropped to the floor where other members of the work crew were located. Additionally, the scaffolding was moved from one location to another while workers were on top of it.

The Board also identified deficiencies that may have affected the stability of scaffolding Unit A, including loose wing nuts, non-uniform ladder spacing, unhooked safety chains at all four platform edges, and locking pins that were not engaged (Figure 2-3). In addition, because of the narrowness of the work platform and its construction, it was not as stable as other scaffolding that workers could have used.

There was an overhead cable near the west ladder of Unit A. The Board believes that the injured worker may have been exiting the scaffold, and the cable may have interfered with his egress and contributed to the fall. The cable height was 63 inches above the working platform, which would have been about chin high when he was standing on the platform. Figure 2-4 shows the location of the cable.

Figure 2-3. Example of locking pin not fully engaged

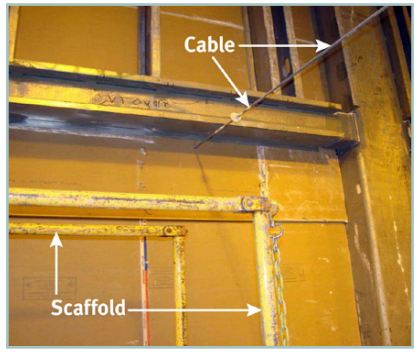

Figure 2-4. Cable near end of scaffold

In addition, the Board learned that a chisel and other tools and debris were found on the injured worker's work platform, as well as on the other two Tele-Towers,® even though the manufacturer's instructions and the procedure that the workers used cautioned against obstructions and tripping hazards. During interviews, workers cited numerous instances where actions taken on the day of the accident deviated from prescribed hazard controls. The Board determined that ambiguities in procedures for the work allowed the workers to improvise new approaches to the task without re-evaluating potential hazards and implementing additional controls.

The Board found that the initial pre-job briefing did not include all workers; however, the worker who was later injured had attended the pre-job briefing in his capacity as Detailed Superintendent, and he later conducted a pre-job briefing for the laborer crafts. Regardless of whether a worker attended such pre-job briefings, the Board concluded that the briefings did not ensure that the workers understood the appropriate hazard controls or recognized unsafe conditions (e.g., moving the scaffolding while other workers were on it, removing handrails, unhooking safety chains) and that the work was not being performed within the controls specified on the day of the accident.

Human Performance Indicators

The Board identified error precursors in three areas: (1) unclear goals, roles, or responsibilities; (2) hazardous attitude for critical tasks; and (3) inaccurate risk perception.

1) Unclear Goals, Roles, or Responsibilities: The superintendent and both foremen were detailed to their positions on the day of the accident, but none of the three had received training on performing their supervisory duties. All of them were performing work alongside craft workers on the day of the accident rather than focusing on overseeing the work to ensure that it was being performed safely. This error precursor directly affected their role of coaching workers on proper behavior and reinforcing expectations for working within controls.
2) Hazardous Attitude for Critical Tasks: Personnel often demonstrated a perception of invulnerability while performing safety critical tasks. For example, two workers removed the upper handrails of a scaffold while standing on the ladders at each end of the scaffold, thus working over 12 feet above the floor without fall protection. In addition, in an effort to demonstrate that the wallboard could be removed more quickly, one worker removed a large piece of wallboard while another stood on an unapproved section of the scaffold to hold the wallboard so it could be cut. These incidents indicate that this error precursor placed workers at risk for injuries on the day of the accident.
3) Inaccurate Risk Perception: Workers took risks without understanding the potential consequences and defeated defenses or failed to recognize degraded defenses. For example, the scaffolding was moved from one location to another while workers were on top of it, defeating several safety features. A simple error (e.g., jerking the scaffold while moving it) could have resulted in the scaffold tipping over and two workers falling 16 feet to the floor. Behaviors such as these could easily have resulted in a similar accident.

The Board also determined that instead of self-demonstrating a value for safety and providing feedback to workers when at-risk practices were observed, the detailed supervisors engaged in risky behavior themselves and permitted it from the work crew. They assisted in removing scaffold handrails while workers stood on the scaffolding ladders without fall protection; directed the movement of scaffolding while it was raised, loaded with tools and with personnel on board; and demonstrated risky behavior by reaching beyond the ends of the scaffold to perform work. The Board concluded that the knowledge and training of workers and craft supervisors did not support successful implementation of HPI mitigation tools for expected human error.

Judgments of Need

The Board identified 21 contributing causes for this event and recommended a number of JONs, including the following.

- Strengthen implementation of the work planning process by applying a graded approach and considering more rigorous methods of identifying hazards, removing ambiguities in work steps (e.g., “when necessary” and “as required”), and clearly identifying hazards and controls to ensure that a re-evaluation is performed when workers approach safety boundaries.
- Evaluate and modify the oversight process to ensure that all activities that pose a risk for worker injuries receive appropriate oversight.
- Evaluate and modify the pre-job briefing process to ensure that workers have a full understanding of the scope of work and the prescribed hazard controls.
- Evaluate HPI implementation to ensure that it is effective.
- Evaluate and modify the procedures, training, and proficiency for scaffold users and competent persons to ensure that scaffolding is erected and used in accordance with Occupational Safety and Health Administration (OSHA) requirements and 10 Code of Federal Regulations 851, *Worker Safety and Health Program*.

- Review and resolve differences between the site ladder and scaffold safety requirements procedure, OSHA, and vendor requirements.

The complete investigation report can be accessed at http://www.hss.doe.gov/sesa/corporatesafety/aip/docs/accidents/typea/srs_fall_injury_report.pdf.

KEYWORDS: Scaffolding, Tele-Tower,® work platform, fall, injury, unsafe work practices, inspections, safety chain, locking pin, cable, Human Performance Indicators, HPI

ISM CORE FUNCTIONS: Define the Scope of Work, Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls

The Office of Health, Safety and Security (HSS), Office of Analysis publishes the *Operating Experience Summary* to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, HSS relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Mr. Stephen Domotor, (301) 903-1018, or e-mail address stephen.domotor@hq.doe.gov, so we may issue a correction. If you have difficulty accessing the Summary on the Web (http://www.hss.energy.gov/sesa/analysis/oesummary/index.html), please contact the Information Center, (800) 473-4375, for assistance. We would like to hear from you regarding how we can make our products better and more useful. Please forward any comments to Mr. Domotor at the e-mail address above.

The process for receiving e-mail notification when a new edition of the Summary is published is simple and fast. New subscribers can sign up at the Document Notification Service web page: http://www.hss.energy.gov/InfoMgt/dns/hssdnl.html. If you have any questions or problems signing up for the e-mail notification, please contact Mr. Stephen Domotor by telephone at (301) 903-1018 or by e-mail at stephen.domotor@hq.doe.gov.