

OE-3: 2020-04

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Avoiding Hand Laceration Injuries

PURPOSE

This Operating Experience Level 3 (OE-3) document provides information that Department of Energy (DOE) federal employees and contractor partners can use to reduce the risks and severity of hand laceration injuries while conducting work and handling equipment on the job. In addition, it discusses importance of applying the [Seven Guiding Principles](#) and [Five Core Functions](#) of DOE's Integrated Safety Management (ISM) System.

BACKGROUND

The DOE Integrated Safety Management System (ISM) policy (DOE Policy 450.4A, *Integrated Safety Management System Policy*), identifies five Core Functions (see Figure 1) that provide the structure for any work activity that could potentially affect the public, workers, or the environment.



Figure 1. DOE Integrated Safety Management System Core Functions

The [Five Core Functions](#) are 1) *Define the Scope of Work*, 2) *Analyze the Hazards*, 3) *Develop and Implement Hazard Controls*, 4) *Perform Work Within Controls*, and 5) *Provide Feedback and Improvement*. Activity-level work planning should be guided by, and implement attributes associated with, ISM Core Functions 1, 2 and 3. The description of these attributes are listed in [DOE G 450.4-1C, Integrated Safety Management System Guide](#). Diligent adherence to all five of the ISM Core Functions and their attributes in the planning, execution and evaluation of work activities can help decrease risks and the severity of injuries that occur during the conduct of work at DOE sites. This OE-3 will focus on hand laceration injuries.

EVENT DESCRIPTIONS AND CAUSAL DISCUSSION

Since January 1, 2016, there have been twenty-one events involving hand lacerations reported into the Occurrence Reporting and Processing System (ORPS). The root cause analyses and lessons learned from these events demonstrate the importance of

- conducting effective hazard analyses and pre-job briefings,
- employing safe equipment handling practices, following established procedures, and
- using proper controls in the execution of DOE work.

The events identified below are excerpts taken directly from the ORPS reports cited and include causal details mentioned specifically in the respective ORPS reports. In addition, for each event described below, adherence to ISM Core Functions 2, 3 and 4 would have helped to ensure that hazards were assessed, controls were identified, and work was carried out within those controls, minimizing risk or eliminating the event from occurring.

- 1) A Savannah River Site employee working in Building 232-1H was positioning a rounded vintage shelf when the shelf dropped catching the employee's finger between the shelf and rack frame causing a laceration and broken finger. Gloves were not worn. A contributing cause of the injury was that the employee was not wearing appropriate PPE (protective gloves) during the shelving work activity. (ORPS Report NA--SRSO-SRNS-TRIT-2020-0002)
- 2) On February 12, 2020, a Savannah River Ecology Laboratory (SREL) employee performing work outdoors at or near a SREL field work site received a cut to his finger while cutting flexible polyvinyl chloride (PVC) irrigation tubing with a pocketknife. The nature of the injury was determined to be a laceration of the right index finger and an open fracture of the phalanx of the right index finger. A follow-up examination by the employee's orthopedic doctor on February 19 determined surgery would be required. Outpatient surgery on February 24 included repair of the bone fragment and tendon. In this event, the injured worker chose to use a cutting tool other than that specified and provided by the supervisor for this task, and also removed hand protection (gloves) during the task of cutting the PVC irrigation tubing. The knife blade the worker was using was not automatically self-locking, and the blade folded back toward the handle (closed position) upon the worker's attempt to cut the tubing. The worker's right index finger was caught in the pinch point of the blade and handle, resulting in a severe laceration and other finger injuries. (ORPS Report EM-SR--GOSR-GOSR-2020-0001)
- 3) On January 7, 2020, a Pacific Northwest National Laboratory (PNNL) staff member received an injury to their right hand while performing adjustments on a test apparatus. The staff member removed the 400-pound autoclave counterweight primary stop to make adjustments to it. The staff member then removed the bolts on a bracket securing the autoclave to the counterweight. When the autoclave bracket bolts were removed, the counterweight was no longer supported. The counterweight descended 36-inches to the secondary stop pulling the cable and bracket to the top of the test stand, which pushed the back of the staff member's hand against the test frame, causing a minor hand laceration. It was determined that the staff member unknowingly created a potential hazardous energy source when the L bracket of the counterweight primary stop was removed from the test stand. The subsequent removal of the autoclave bracket resulted in the release of hazardous kinetic energy causing the autoclave bracket to push the staff member's hand against the test frame causing the laceration. (ORPS Report SC--PNSO-PNNL-PNNLBOPER-2020-0001)
- 4) On November 7, 2019, an Oak Ridge maintenance worker was injured while moving a fan blower shaft axially 1/4" by striking the shaft coupling with a dead blow hammer. The hammer glanced off the back side of the coupling striking the thumb of the employee's left hand, which was positioned near the coupling for personal stability. The technician was wearing mechanics gloves at the time. The injured worker was provided first aid and then transported by company vehicle to Methodist Medical Center (MMC) by the Maintenance Manager. Upon performing an initial evaluation, the MMC physician referred the injured worker to the MMC emergency room where he was treated for a distal phalanx open/compound fracture and laceration injury requiring sutures and a splint. This injury resulted in the employee being placed on restricted duty. Although the maintenance worker was wearing appropriate PPE (mechanics gloves), a "skill of the craft" error occurred while using a dead blow hammer in the conduct of the work activity. (ORPS Report EM-ORO--NWS-TWPC-2019-0004)
- 5) On August 15, 2019, at Los Alamos National Laboratory (LANL), a quartz tube being installed into a flange assembly suddenly shattered in the hands of a student worker. The student received a laceration to his right pinky finger requiring several stitches and surgery to repair the damage to the nerves and the tendon. The main cause of the resulting injury was due to the student not wearing appropriate PPE (protective gloves) when the quartz tube he was inspecting shattered. In addition, the LANL Integrated Work Document (IWD), which covers the assembly activities in a laboratory setting, states that adequate PPE be



used for “tasks at hand”. However, the IWD was deficient because it does not specifically require the use of protective gloves for this type of work. (ORPS Report NA--LASO-LANL-CHEMLASER-2019-0001)

- 6) On March 30, 2019, a Y-12 National Security Complex maintenance crew was evaluating the operation of a machine during a machine maintenance evolution. An employee went to the back of the machine to check if a limit switch plate was loose. As the employee touched the limit switch plate, the machine immediately cycled causing the limit switch plate to move pinching the employee’s fingers between the limit switch plate and the machine. Emergency personnel responded and the employee was transported to a medical center. The extent of the injury included amputation and open fracture of the tuft of distal phalanx of their left middle finger, open laceration of their left fourth finger requiring stitches, and multiple blood filled blisters to their left second finger. (ORPS Report NA--NPO-CNS-Y12NSC-2019-0017)
- 7) On January 19, 2019, during roof bolting activities at the Waste Isolation Pilot Plant, a roof bolter’s drill steel began binding in the hole due to excessive debris, which resulted from failure of the roof bolting machine’s vacuum system. A spotter on the floor removed the vacuum hose and, at the same time, the roof bolter released the clamp on the drill steel to allow it to be lowered into a drill box. As the drill steel was being lowered, the spotter placed his hand on top of the drill box to determine if the vacuum was working. The drill steel suddenly dislodged and fell from the hole in the roof and struck the spotter’s left middle finger, causing lacerations and multiple bone fractures that required surgery. The cause of the injury was the failure of the roof bolter and spotter to maintain effective communication throughout the work activity. A contributing cause of the spotter’s hand laceration injury was due to the spotter’s failure to realize the need to stay clear of the roof bolter drill box throughout the bolting activity until the bolter operator has given the all clear. (ORPS Report EM-CBFO-NWP-WIPP-2019-0002)
- 8) On April 25, 2018, at Sandia National Laboratories

in New Mexico, maintenance work was required on a dry etch tool due to failing a qualification for high helium backside error related to the process chamber chuck. Employee 1 and 2 began work, a lockout/tagout was not previously identified as a requirement for the pneumatic system on this equipment as pneumatic actuation is required at various stages of this maintenance work. The top of the process chamber was opened and employee 1 and 2 noticed the chuck was bad. Employee 1 and 2 removed the quartz ring, replaced the chuck, and replaced the quartz ring. Employee 1 was making fine adjustments to quartz placement, when Employee 2 looking at the computer, not the chamber, actuated the chuck by pressing the wrong button while employee 1 hands were still in the chamber. The buttons for raising and lowering the chuck are located right next to each other on the tool interface screen and are the same color. Employee 1 was able to remove their right hand out of the chamber in time, but not their left hand. Employee 1 fractured two fingers and received a laceration on a third finger, all on the left hand. (ORPS Report NA--SS-SNL-5000-2018-0001)

- 9) On October 24, 2017, at PNNL, a senior radiation protection technician was using a pocket knife to remove two nylon cable ties from a piece of rope connected to a radiological warning sign he was preparing to post. The technician encountered more resistance with the second cable tie and applied additional force. As the knife cut through the second cable tie, it passed through and cut into the technician’s left hand, resulting in lacerations to the left palm and thumb. The technician subsequently received six stitches in the left thumb and four in the palm. The results of a follow-up visit with the technician’s orthopedic surgeon resulted in the need for surgical repair of nerve damage to the left thumb. The apparent causes included the RPT’s selection of a sign that required modification to complete the job although another sign not requiring modification, and appropriate for the job, was available, as well as using an improper tool (pocket knife) rather than readily available and appropriate cutting snips to modify the sign. Furthermore, a week prior to this event, the RPT’s manager observed him about to use his personal



pocket knife to cut a cable tie and informed him that a readily available pair of cutting snips was the appropriate tool to perform the work safely. (ORPS Report SC-PNSO-PNNL-PNNLBOPER-2017-0024) Note: This event illustrates the importance of ISM Core Function 5, *Provide Feedback and Improvement*. The injury would not have occurred had the feedback been acknowledged and effectively applied.

- 10) On September 26, 2016, at Brookhaven National Laboratory, a reciprocating saw being used by an employee “kicked back,” resulting in a hand laceration. The injury was reported two days after the event when the employee felt a sharp pain and a snap in the right hand, which required surgery to repair a tendon. The saw-kickback that led to the hand laceration and tendon damage was caused by either the blade tip striking the steel of a magnet structure situated below the pipe, or by the blade becoming pinched in the pipe as it was being cut. At the beginning of the work task, there was sufficient working space and the hazards in the work space were few and recognized. As the work progressed, the space to operate the saw became more constricted and the sharp edges of previously cut off pipes presented a hazard that was not given sufficient attention. Moreover, the employee was not wearing work gloves since they interfered with the operation of the saw’s trigger. The work gloves may have prevented the laceration, but would not have provided sufficient cushioning to prevent the tendon damage. (ORPS Report SC--BHSO-BNL-BNL-2016-0016) Note: In this event, the main cause of the injury was not solely due to the saw- kickback that occurred, but due to less than adequate job scoping that did not identify potential task interruptions and hazards that could emerge while work was being performed. According to one AU subject matter expert, work gloves should typically not be worn as PPE when using a saw. This could have made the injury much worse, not less severe, if the glove had become caught or snagged in the rotating saw blade.

- 11) On April 12, 2016, at Lawrence Berkeley National Laboratory, an attempt to lift and reposition a square steel tube on a sheetrock dolly resulted in laceration of an employee’s fingertip. A Facilities

Rigger noticed that the steel tube was not properly centered on the dolly and attempted to use one hand to reposition the tube while using the other hand for support. The tube slipped and landed on the tip of the middle finger, causing an open fracture and a loss of a fingernail. The Rigger was taken to the emergency room to receive three stitches. In this event, the direct cause of the injury was determined to be the Rigger’s lack of maintaining positive control of the square steel tube while repositioning it on the dolly. Instead of using both hands to lift the tube, he was using only one hand, not employing safe equipment handling practices, and thereby increasing the chances of losing control of the tube. An additional cause of the injury was due to the Rigger wearing sheep skin gloves instead of the normal leather gloves, the more appropriate PPE for this activity. (ORPS Report SC--BSO-LBL-OPERATIONS-2016-0005) Note: In this event, proper job scoping and hazard analysis could have ensured appropriate PPE was determined and donned prior to performing work, and no new hazards were created because of wearing the wrong PPE.

DISCUSSION

The events in this OE-3 reflect injuries that required treatment beyond first aid. Common factors and lessons learned from these events included unexpected circumstances that emerged in the conduct of work activities, with the lacerations occurring as a result of using inappropriate tools in response to the respective circumstances. These events demonstrate the importance of conducting effective pre-job hazard analyses, pausing to re-assess work when unexpected conditions are encountered, and safely adjusting to emerging hazards that arise during the conduct of work (i.e., Core Functions 2, 3, 4, and 5). Therefore, careful attention and follow-through of adherence to the five ISM Core Functions throughout the conduct of work activities can minimize worker exposure to unsafe conditions.

Injuries resulting in minor cuts and lacerations to the hand (e.g., those that can be treated the same day through first aid) tend to be less frequently reported in ORPS due to their low severity and not meeting the threshold for ORPS reporting. These types of events



may provide valuable feedback that can be used during activity level work planning to prevent more severe ORPS reportable events, supporting the need to plan work in adherence to the Five Core Functions.

RECOMMENDATIONS

10 CFR 851, *Worker Safety and Health Program* and DOE Order 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*, serve to establish the framework for providing DOE Federal and contractor employees with a safe and workplace through an effective safety and health program that will reduce or prevent accidental losses, injuries, and illnesses.

In addition, DOE Handbook 1211-2014, *Activity-Level Work Planning and Control Implementation*, emphasizes the importance of identifying and analyzing workplace hazards, including what-if scenarios, when selecting and implementing necessary safety control measures.

Consistent with the requirements and guidance provided in 10 CFR 851, DOE Order 440.1B, and DOE Handbook 1211-2014, the following steps are recommended for consideration to minimize worker risks and severity of hand laceration injuries when performing work:

- Assure workers are familiar with the scope of work, equipment configuration, and have proper access to equipment to perform work safely.
- Maintain effective communication during the task with other team members.
- Keep fingers and hands away from moving parts or potential impact zones.
- Do not move heavy equipment or parts without proper controls.
- Use the correct and appropriate tool(s) for the job.
- Assess the work environment to determine any workplace hazards that may be present.
- Select proper controls in accordance with the hierarchy of controls, with emphasis on elimination or substitution, followed by safe work practices, then proper selection of PPE.
- When control method requires PPE, choose the protection that it is appropriate for the

job, and ensure workers receive training on its proper use and limitations.

CONCLUSION

The events captured in these ORPS reports point out the importance of adequate work planning, safe equipment handling practices, choosing the right tool for the job, and the appropriate use of PPE for performing work safely. Furthermore, proper adherence to the ISM Five Core Functions throughout the planning, execution and evaluation of work can also be instrumental in avoiding hand laceration injuries on the job.

REFERENCES

ORPS Report NA--SRSO-SRNS-TRIT-2020-0002.
232-1H Finger Broken/Cut Injury

ORPS Report EM-SR--GOSR-GOSR-2020-0001.
Finger Laceration Resulting in Follow-Up Surgical Repair (Submittal for SREL)

ORPS Report SC--PNSO-PNNL-PNNLBOPER-2020-0001.
Release of Kinetic Energy Causes Minor Hand Laceration

ORPS Report EM-ORO--NWS-TWPC-2019-0004.
Thumb Injury Resulting in Compound Bone Fracture

ORPS Report NA--LASO-LANL-CHEMLASER-2019-0001.
E-1 Student Worker Lacerates Hand While Working on Quartz Tube

ORPS Report NA--NPO-CNS-Y12NSC-2019-0017.
Injury to Employee Finger

ORPS REPORT EM-CBFO--NWP-WIPP-2019-0002.
Employee Sustains Lacerations and Fractures to Finger during Roof Bolting Activities

ORPS Report NA--SS-SNL-5000-2018-0001.
858N MOW Sustained Injury to Hand During Work Activity

ORPS REPORT SC--PNSO-PNNL-PNNLBOPER-2017-0024.
Nerve Damage from Injury Requires Surgical Repair

ORPS REPORT SC--BHSO-BNL-BNL-2016-0016. *Employee Injures Hand While Using a Reciprocating Saw*



ORPS REPORT SC--BSO-LBL-OPERATIONS-2016-0005.
Rigger's Finger Injured While Unloading Square Tubing

[10 CFR 851, Worker Safety and Health Program](#)

[DOE Policy 450.4A, Integrated Safety Management System Policy](#)

[DOE-HDBK-1211-2014, Activity-Level Work Planning and Control Implementation](#)

[DOE O 440.1 B, Worker Protection Program for DOE \(Including the National Nuclear Security Administration\) Federal Employees](#)

OSHA has published a guide that can be a useful resource for selecting proper personal protective equipment that can be found at:
<https://www.osha.gov/Publications/osh3151.pdf>

Questions regarding this OE-3 document can be directed to Ross Natoli at 301-903-6096 or ross.natoli@hq.doe.gov.

This OE-3 document requires no follow-up report or written response.



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