

OE-3: 2014-06

December 2014

Industrial Equipment Impacts Infrastructure

PURPOSE

This Operating Experience Level 3 (OE-3) document provides information on a safety concern related to heavy industrial equipment that contacts and damages structures and electrical, gas, and water lines. Although these contacts did not cause injuries, the events did impact mission and schedule, divert resources, and change momentum.

BACKGROUND

From January 1, 2011, to June 30, 2014, more than two dozen Department of Energy (DOE) non-injury events were reported regarding equipment striking something for reasons ranging from lack of communication between or within departments before work started, unmarked utilities, as-builts not matching drawings, unsuccessful locate efforts, or inadequate ground-penetrating radar. A variety of equipment was involved, including backhoes, forklifts, and excavators. Although no injuries resulted from the events reported to the Occurrence Reporting and Processing System (ORPS), the potential for harm existed. The events resulted in property damage, stopped work, and increased time and resources to complete the interrupted tasks.

EVENTS

On March 24, 2014, at Pittsburgh National Energy Technology Laboratory, an equipment operator using a backhoe to excavate for a water line installation hit a 2-inch natural gas line, resulting in a low audible hissing sound and the smell of natural gas (mercaptan). Work was stopped, and the gas line was repaired and tested. Investigators determined that, although the gas

line was shown on the permit drawings, the contractor did not review the drawings with the crew before they began excavating. In addition, because of the age of the gas line, standard underground utility locating equipment could not identify the exact location or depth of the gas line. In the future, foremen should have the drawings and underground utility identification documents with them at all times, use a utility excavation spotter to help identify obstacles, and instruct their teams to hand dig as appropriate. (ORPS Report FE-NETL-GOPE-NETLPIT-2014-0002)

On February 18, 2013, during exploratory excavations at the Portsmouth Gaseous Diffusion Plant, a backhoe bucket hit two underground power cables, slightly damaging the outer insulation and exposing bare wire. The cables, believed to have been de-energized under lockout/tagout, did not arc. An Excavation Permit and sub-site survey performed earlier noted that the cables were in the area but did not identify their specific location. The crew members were cautious: they had attended pre-job briefings, and when the spotter noticed a change in soil conditions, he notified the backhoe operator, who slowed and removed only 2 to 3 inches of soil at a time. Despite the operator's extra care, the backhoe scraped the cables, which were not marked with red warning tape. After the hit, the cable damage was evaluated and repaired, and the excavation was backfilled. Work should have stopped at this point because conditions had changed. However, the work documents had been written to compensate for all possible field conditions, and allowed work to continue at an adjacent location.

Although workers uncovered more of the power cables at the adjacent location, they did not find an expected water line. The subsequent investigation determined that 22 *Problem Reports* had previously been filed about finding unexpected underground utilities, scope changes, failure to stop work, and omission of pre-work walkdowns. Despite the number of reports, they had not been disseminated. Corrective actions were planned to consider programmatic issues (non-dissemination of lessons learned) and address weaknesses associated with sub-site surveys and subsequent excavations. (ORPS Report EM--PPPO-FBP-PORTSDD-2013-0008)

During calendar year 2012, DOE sites reported 19 events where heavy equipment struck buried utilities. Since then, the number of reported events has dropped significantly. (Note: additional events where equipment such as cranes hit lines at height or where workers struck lines while hand-digging are not included here.) The following selected events demonstrate the primary lessons learned from 2012 heavy equipment events.

In October 2012, Y-12 filed a report describing 21 incidents involving powered industrial truck (forklift) operations over a 2-year period. Although only 2 events were ORPS-reportable, management concluded that the potential for personnel injury during forklift operations and the negative trend constituted a management concern. Events included a forklift striking two pillars; forklift tines contacting loading dock flashing and pulling it loose; and a forklift boom contacting and breaking an abandoned communication line. (ORPS Report NA--YSO-BWXT-Y12SITE-2012-0049)

On June 25, 2012, at Idaho National Laboratory, as a heavy equipment operator pulled up asphalt with a track hoe, the bucket contacted an electrical conduit directly underneath the asphalt. A pre-work subsurface investigation had identified conduit, but the drawings did not identify the buried line within the conduit. Based on past

experience removing asphalt, workers assumed lines would not be high enough to be in contact with the asphalt, and the work control document did not direct workers to hand dig. (ORPS Report EM-ID--GOID-IDDIRECT-2012-0001)

On April 25, 2012, at Oak Ridge National Laboratory, an excavator contacted and damaged a Polyvinyl Chloride conduit containing a 120-volt electrical cable while digging a trench for electrical lines. Personnel had conducted a pre-job briefing and were following appropriate excavation procedures, including field markings of existing utilities, the use of a field spotter, and hand digging. The electrical line itself was not damaged, but the event underlined the fact that drawings can be misleading or even incorrect. In this case, the drawings showed the utilities buried 2 feet underground, when in reality the conduit above the utilities was only 8 inches deep – and was not included in the drawings. Utility locating equipment did not distinguish the conduit. To its credit, the work crew hand-dug until it was time to remove the soil, when the backhoe was called in. (ORPS Report SC-ORO--ORNL-X10CENTRAL-2012-0004)

On April 12, 2012, an electrical subcontractor using a trencher hit and punctured a marked natural gas line. The contractor had previously dug holes for and installed light pole bases under a different work permit; however, a new permit was required for additional digging and installing the lighting conduit. The work permit was updated and signed, and the area was walked down. The update reflected a requirement for hand digging within 5 feet of the utility locates. As the trencher operator cleared debris soil, he realized he had come too close to the newly-installed light pole and decided to turn around. He noticed that the trencher “stinger” was about 24 inches deep and knew that the utilities were between 30 and 32 inches deep. He also believed he was outside the 5-foot hand-digging boundary due to the absence of a natural gas ground locate (flag). However, the flag had faded and fallen, obscured by the soil around it. The operator did not see the water locates, which were marked by blue and pink paint

on the parallel curbing. So, even though the gas locates were not clearly identified, the water locates were visible and required the operator to hand dig. (ORPS Report EE-GO--NREL-NREL-2012-0009)

On February 3, 2012, at Los Alamos National Laboratory, a front end loader clearing an area covered in 1 to 3 feet of snow severed a 480-volt power cord buried 2 inches below the earth/dirt surface. The rough terrain caused the bucket to dip below grade, where it contacted the buried cord. The subsequent fact-finding determined that, although the engineering drawings for the area required power cords to run on top of the ground, this cord had posed a tripping hazard and had been buried. The change was made without engineering approval, so the drawing was not updated accordingly. In addition, the crew members that had been directed to remove the snow were doing so outside the scope of their jobs as standby spill response, so the activity had not been reviewed for hazards and/or approved. Finally, the driver used a spotter, but since he was 10 to 15 feet ahead of the front end loader, he did not see the cord. (ORPS Report NA--LASO-LANL-DPWEST-2012-0001)

RECOMMENDATIONS

The following recommendations for the safe operation of industrial equipment are provided as examples only. They are based on the corrective actions performed as a result of the previous events.

- Require use of spotters.
- Modify construction subcontracts to indicate a zero tolerance policy for violations of safety or work rules. Deviations in scope will result in immediate suspension of work until hazards associated with the change(s) have been identified and controls put into place.
- Modify construction subcontracts to require safety training; develop training to cover construction safety, work control, job hazard analysis, and performance.

- Verify employee training /certification. Perform evaluations of heavy equipment operators to assess ability and competency.
- Include "situational awareness" in training.

CONCLUSION

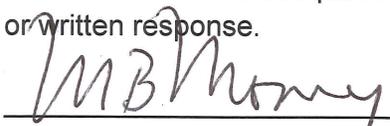
DOE's work planning and control process cannot control all possibilities. Workers and supervisors must pay close attention to the areas where digging will occur, requesting additional drawings or radar if they have questions about unknown utilities that might be impacted by their work.

REFERENCES

- FE--NETL-GOPE-NETLPIT-2014-0002, *Natural Gas Line Damaged During Excavation Operations*
- EM--PPPO-FBP-PORTSDD-2013-0008, *Near Miss -- X-608 Exploratory Excavation Contacts Electrical Wires*
- NA--YSO-BWXT-Y12SITE-2012-0049, *Recurring Forklift incidents at Y-12*
- EM-ID--GOID-IDDIRECT-2012-0001, *Energized Electrical Conduit Contacted During Asphalt Removal*
- SC-ORO--ORNL-X10CENTRAL-2012-0004, *Electrical Conduit Damaged During Excavation*
- EE-GO--NREL-NREL-2012-0009, *Construction Activity Punctures Buried 2-inch Natural Gas Line*
- NA--LASO-LANL-DPWEST-2012-0001, *Unexpected Discovery of Hazardous Energy During Snow Removal*

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


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