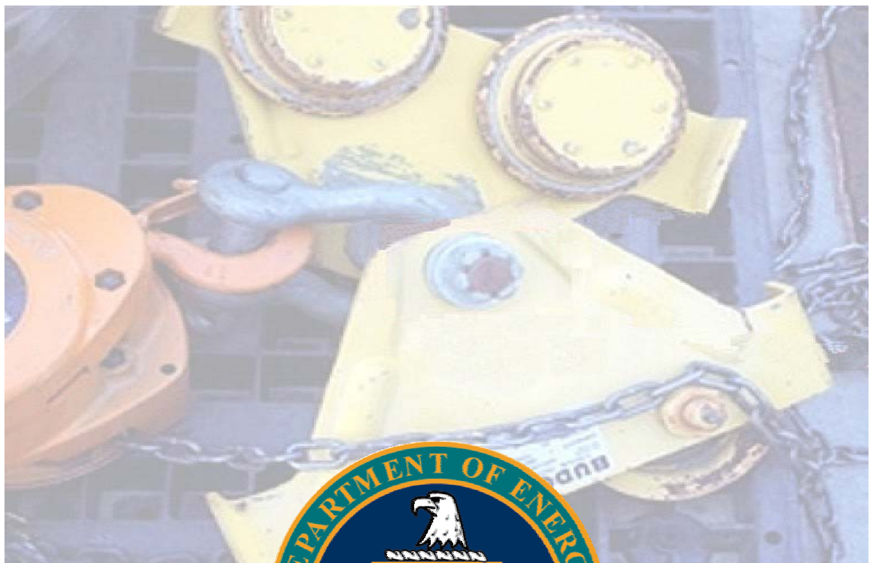
Office of Environment, Safety and Health • U.S. Department of Energy • Washington, DC 20585

OPERATING EXPERIENCE SUMMARY



Office of Environment, Safety and Health
OE Summary 2002-14
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Operating Experience Summary 2002-14

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EVENTS

1. I-BEAM TROLLEY FAILURE UNDER LOAD

On April 18, 2002, at the Hanford Waste Encapsulation and Storage Facility, a trolley supporting a 1-ton chain hoist separated from an I-beam, causing a 1,500-pound cask lid to fall approximately 2½ feet onto a plastic pallet. The trolley failed because of loose fasteners that allowed the two halves of the trolley to separate. The event occurred while workers were performing an annual inspection of the shipping cask. All personnel were well away from the load when it fell, and no injuries or equipment damage occurred. (ORPS Report RL--PHMC-WESF-2002-0001; final report issued June 4, 2002)

Workers had positioned an A-frame gantry with the 1-ton-rated I-beam trolley over the cask. After removing the lid with a chain hoist and moving the lid to the side of the cask, a millwright noticed that the trolley was beginning to spread apart, and realized the load could fall. Workers stopped the movement and placed a plastic pallet under the cask lid. While standing well back from the load, the millwright began to lower the load to minimize the potential hazard. At approximately 2½ feet the trolley separated, and the lid dropped onto the pallet.

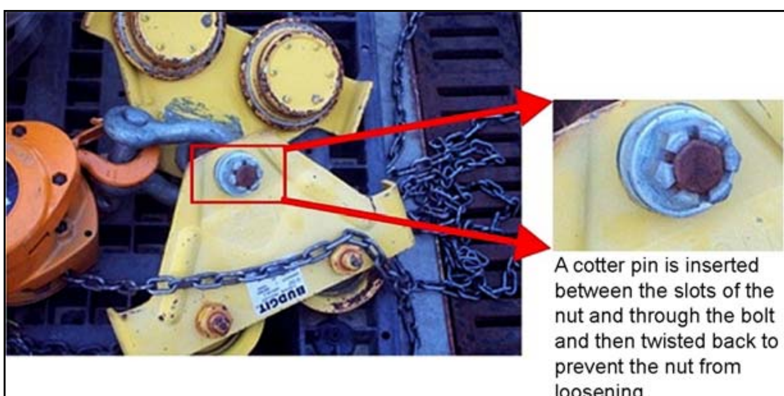

Figure 1-1. Separated trolley showing castle nut arrangement

Investigators determined that the trolley failed because the retaining nut that held the two halves of the trolley together had loosened. There was no cotter pin or locking device installed in either of the two castle nuts, as is shown in Figure 1-1. During a root cause evaluation it was learned that the manufacturer's information (obtained after the event) contained a warning that the trolley could separate from the I-beam if the nuts were allowed to loosen, causing excessive trolley wheel clearance with the I-beam. However, no manufacturer's instructions were available at the facility. The Hanford Hoisting and Rigging Manual does not specifically address trolley and A-frame inspections. The castle nuts were verified hand-tight during the prior-to-use inspection.

The direct cause of this event was inattention to detail because equipment inspectors did not identify all adverse conditions on the trolley and A-frame. The root cause was determined to be a training deficiency because training courses did not specifically address inspections of trolleys and A-frames, nor did they instruct personnel to obtain and use the manufacturer's information as inspection criteria. One of the contributing causes was that personnel failed to understand that periodic inspections identified in the Hanford Hoisting and Rigging Manual applied to trolleys and A-frames. Another contributing cause was that when the equipment was obtained from another facility in 1998, inspection criteria were not developed, nor was the manufacturer's information for the trolley and A-frame obtained.

This event underscores the importance of maintaining equipment in accordance with manufacturer's instructions and of heeding manufacturer's cautions and warnings. Because retaining nuts on I-beam-type trolleys can loosen enough to allow the trolley to disengage from the I-beam under load, retaining devices should be used to secure the nuts. Qualified personnel should inspect them in accordance with the manufacturer's written instructions. The inspections should include proper adjustments and a check that retention devices are in place. Properly maintained and inspected hoisting and rigging equipment is important because failures under load can result in serious injuries or equipment damage.

A lessons-learned report (Identifier 2002-RL-HNF-0025) on this topic can be accessed from the Society for Effective Lessons Learned Sharing (SELLS) website at http://tis.eh.doe.gov/ll/listdb.html.

KEYWORDS: *Hoisting and rigging, trolley, fastener, dropped load*

ISM CORE FUNCTIONS: *Develop and Implement Hazard Controls, Perform Work within Controls*

2. LABORATORY RESEARCHER RECEIVES ELECTRIC SHOCK

On May 15, 2002, at the Pacific Northwest National Laboratory (PNNL), a researcher received a mild electric shock because of an improperly grounded electrical receptacle. The researcher was attaching a sensor head to a radar unit when the shock occurred. He reported to the Hanford Environmental Health Foundation for medical evaluation the next day, and returned to work without restrictions. Investigators tested and evaluated the electrical receptacle and equipment involved in the occurrence, and concluded that the cause was an improperly grounded receptacle. (ORPS Report RL--PNNL-PNNLBOPER-2002-0005)

The researcher was assembling a 35 GHz radar unit and testing it with a microwave power sensor. Figure 2-1 shows the general layout of the equipment and receptacles involved in the occurrence. In the event description that follows, the problem receptacle is identified as outlet #1 and a second receptacle in use is identified as outlet #2. A surge suppressor was plugged into outlet #1, and an oscilloscope was plugged into the surge suppressor. Both the surge suppressor and the oscilloscope sat on the radar unit's metal housing. A power meter was plugged into outlet #2, and a microwave power sensor was attached to the power meter.

With the microwave power sensor head in one hand and the other hand touching the metal housing of the radar unit, the researcher felt a

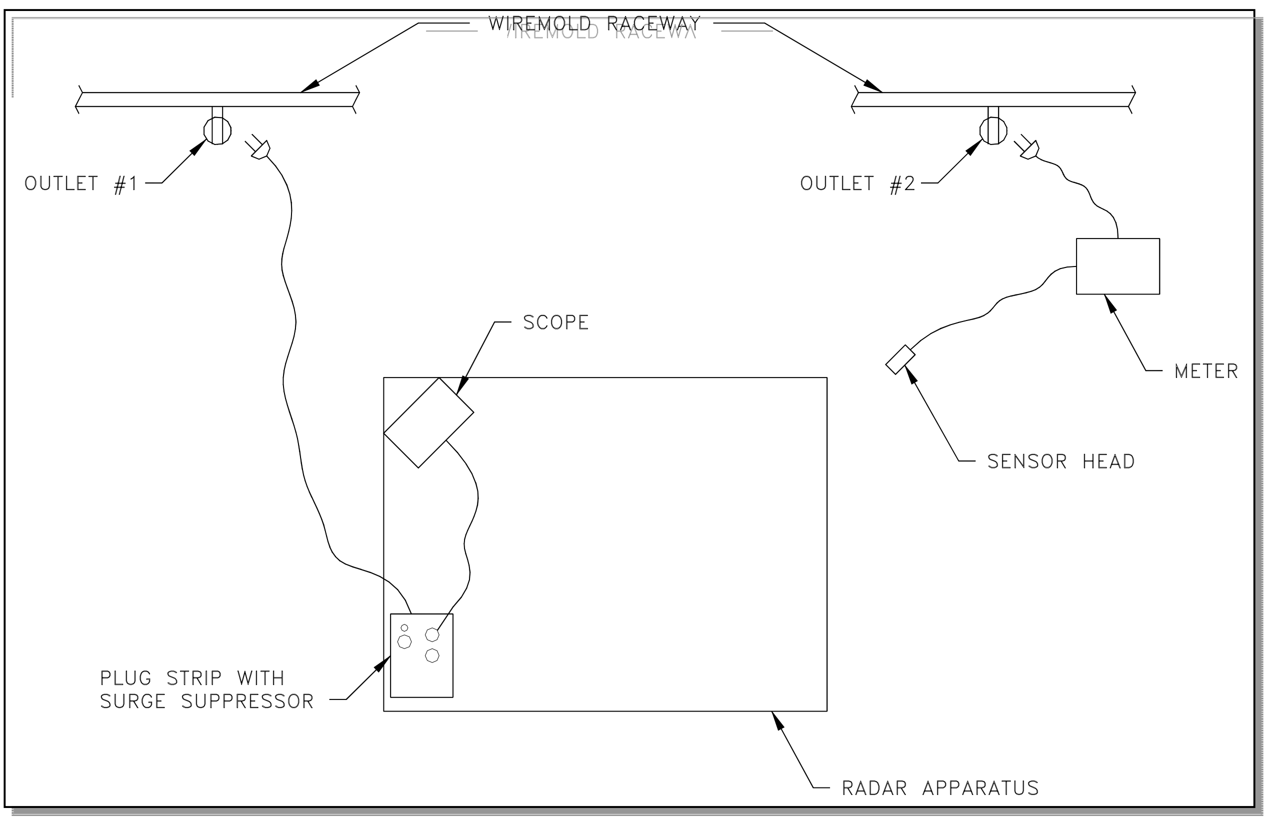

Figure 2-1. General layout of equipment and receptacles

mild shock. He then noticed that the surge suppressor was showing a fault light, indicating a possible grounding problem. He unplugged the surge suppressor from outlet #1 and plugged it into outlet #2; the fault light went away, and he continued working. The researcher suggested to a co-worker that outlet #1 not be used because he suspected a problem with it.

PNNL electricians tested outlet #1 with the surge suppressor still connected to it, and discovered 60 VAC between the neutral lead and ground, where no voltage should have been present, indicating that the receptacle was not properly grounded. After reviewing the results of the tests, PNNL electrical engineers concluded that the likely shock pathway involved voltage from the surge suppressor transient control circuit causing a small current to pass through mounting screws on its housing to the housing of the radar unit, through the researcher and the microwave power sensor to the proper ground on outlet #2.

Event investigators conducted a preliminary causal analysis and identified the direct cause as equipment/material problem (defective or failed part) because of the defective receptacle. The root cause was a design problem (error in equipment or material selection) because the original design did not provide proper grounding of the receptacle. The flawed design relied on an inadequate ground strap and mounting screws contacting the electrical raceway for establishing a ground. There was no separate ground wire from the receptacle ground lug to the body of the raceway.

Corrective actions included checking all Wiremold® electrical raceway receptacles in the building for correct polarity and proper grounding with a plug-in circuit tester and evaluate whether the radar unit can be provided a means for grounding while it is being assembled.

A search of the ORPS database revealed 14 other electrical shock events within the DOE complex in the first half of 2002, and many more near-misses where an electrical shock event nearly occurred. None of the shock events in the first half of 2002 resulted in a major injury to the affected worker, although the potential for a severe injury was present in each event.

This event underscores the fact that the safe use of electrical equipment requires adequate grounding and bonding of noncurrent-carrying metal components. An adequately grounded circuit ensures that electrical faults will trip the circuit breaker before equipment damage or unsafe conditions can occur. In retrospect, it also would have been a good practice for the researcher to have stopped work when the shock event occurred and reported the event to a supervisor for investigation instead of changing receptacles and continuing work.

The National Fire Protection Association (NFPA) Standard 70, National Electrical Code® (NEC), provides standards for circuit and system grounding for enclosures, raceways, and receptacles in Article 250. Specifically, NEC 250.146 requires a bonding jumper between the receptacle ground terminal and the grounded enclosure unless the receptacle is otherwise effectively grounded. Article 250 also describes methods for proper equipment grounding and bonding. A copy of the 2002 edition of the NEC can be obtained by calling the NFPA at 1-800-344-3555 or from the NFPA website at http://www.nfpa.org/Codes/NFPA Codes and Standards/List of NFPA documents/NFPA 70.asp.

KEYWORDS: *Electrical shock, ungrounded receptacle, ground fault, Wiremold® electrical raceway*

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

3. WORKER INJURED BY FALL WHILE INSTALLING HANDRAIL

On June 5, 2002, at the Oak Ridge National Laboratory (ORNL), a subcontractor worker was installing a handrail on a 21,000-gallon liquid storage tank when he lost his balance, fell backwards down the tank stairs, and landed on a gravel surface on his back. The railing he was installing struck him in the lower back, bruising several lumbar vertebrae. The worker was transported to an offsite hospital, where he was examined and held overnight for observation. Contractor personnel secured work area and initiated an investigation. (ORPS Report ORO--BJC-X10ENVRES-2002-0007)

Figure 3-1. The liquid storage tank

The storage tank, shown in Figure 3-1, was being used to hold wastewater from ongoing concrete drilling operations. A pre-job briefing was held on the morning of the event; however, the briefing addressed neither the need for handrail installation nor the fact that the work would be conducted at a height of approximately 10 feet. In addition, the third-tier subcontractor workers who would be performing the work did not attend this briefing.

Two pipefitters went to the top of the tank to loosen flanges on a riser. A folding handrail used to facilitate access to the top of the tank lay on the stairs. One of the pipefitters lifted the handrail into the upright position, but did not lock it in place or lower it when leaving the area.

Several hours later, two workers began installing handrails on top of the tank. One of the workers took the brace bar (Figure 3-2), weighing approximately 25 pounds, and began to attach it to the upright, but not secured, handrail. He was not wearing fall protection because there was a handrail at the right side of the working area. He held the brace bar in his left hand and attempted to support himself with his right hand on the unsecured handrail, which folded down. The worker lost his balance, stumbled down the steps, and fell about 3 feet to the gravel surface with the brace bar under his back.

The direct cause identified by the investigators was the failure of the pipefitters and workers to use fall protection when working at an elevated position. The root cause was inadequate work planning, as no instruction or training was given for the handrail installation. Contributing causes included the failure of the subcontractor to participate in the pre-job briefing and inadequate communication between the contractor and the various levels of subcontractor workers and between the pipefitters and the workers who installed the handrails.

The contractor identified and implemented a number of corrective actions. Facility management conducted a readiness review in which all workers took their positions on the job site, and each discussed his or her role as management performed a walkthrough. In this way, all workers verified that they understood both their own roles and that of the others on the job. In the long term, management will ensure that contracts that are developed for future work clearly specify lines of communication and the safety requirements that subcontractors must follow.

This event illustrates the importance of pre-job planning and clear communication among personnel from all involved organizations. All potential hazards must be identified before work begins, and each worker needs to understand both his own role and that of other personnel performing the work. Pre-job briefings need to include all involved personnel to ensure that procedures and requirements are clearly communicated and understood and that all hazards have been addressed.

Figure 3-2. The worker was attempting to attach the brace bar to the handrail when he fell

KEYWORDS: *Handrail installation, storage tank, fall protection, injury*

ISM CORE FUNCTIONS: *Analyze the Hazards, Perform Work within Controls*

4. RESPIRATORS CONNECTED TO ISOLATED BREATHING AIR BOTTLES

On July 2, 2002, at the Hanford Remedial Action Projects, four workers entered a contamination area wearing respiratory protection and protective clothing when they realized that the air supply to their masks was not available. The subcontractor site superintendent immediately signaled the workers to stop and exit the area after he discovered that there was no attendant at the breathing air bottles. At the time of the incident, there was no intrusive work occurring that would have required respirators. (ORPS Report RL--BHI-REMACT-2002-0008)

The workers (two laborers, a radiological control technician, and an industrial hygienist) entered a burial ground to perform work that required respirators and protective clothing. Several minutes after they placed the regulators in their face masks, the workers discovered their breathing air had decreased. At the same time, it was discovered that the air supply from the bottles to the hoses was not on and there was no air bottle attendant at the air bottle station as required by procedure. The four workers removed their respirators and were surveyed out of the contamination area.

A critique was held on July 3, 2002 concerning the procedure violation (no positive communication with a breathing air attendant before donning regulators) at the burial ground operations. It was learned that no attendant had been assigned to the bottle cart, as is required by procedure. The workers saw many other people around the breathing air bottles and assumed that one of them must be the attendant. Also, because there was residual air pressure in the lines from previous use, the workers assumed the breathing air system was functional and it was safe to wear their masks. Procedures required that workers verify clear communications with the attendant before connecting to the breathing air bottles.

The following immediate corrective actions were initiated before work was allowed to continue.

- The superintendent will ensure that the bottle cart attendant is present at the bottle cart. The attendant will be announced to the work crew at the morning and afternoon plan-of-the-day meeting.
- The bottle cart attendant will give verbal notification over a radio that the system is ready to use before workers don their face pieces.
- A raised flag at the bottle cart will mean that the air system is ready to use and the attendant is present. If the flag is not raised, workers cannot don face pieces and hook up to the air system.
- The work process described above will be posted in the change trailer.
- The subcontractor will investigate additional alarm methods to warn of low air supply for use in high-noise backgrounds.

Other occurrences have been reported in ORPS regarding the loss of breathing air while a breathing air supply system was in use. Some of these events occurred because of personnel errors when attendants cut or isolated the wrong hoses or shut down compressors. Other events involved equipment failures associated with hose connections at regulators or masks.

Although there was no adverse effect on the workers' safety, this occurrence illustrates the importance of observing procedures governing the operation and use of breathing air supply systems. Users of respiratory equipment that is supplied from breathing bottles or compressors need to ensure that the systems provide an adequate air supply before use and that the source of air is properly attended to ensure a continuous supply. Breathing air attendants and manifold operators should be formally trained in their responsibilities and identified during pre-job briefings or plan-of-the-day meetings.

KEYWORDS: *Breathing air, respiratory protection, procedure violation*

ISM CORE FUNCTION: *Perform Work within Controls*

5. OSHA CITES CONSTRUCTION COMPANY FOR TRENCHING FATALITY

On July 3, 2002, the federal Occupational Safety and Health Administration (OSHA) proposed fining a Texas construction company $238,000 following a trenching accident that claimed the life of a construction worker. The underground utility construction company was cited for nine alleged safety and health violations, including three willful violations for not protecting employees involved in excavation work from cave-in hazards. The fatal accident occurred on January 4, 2002, when a pipelayer was struck by the collapsing wall of a 20-foot-deep trench and suffered fatal blunt force injuries and asphyxia. (OSHA National News Release USDL 02-377)

The construction company has had three deaths related to trenching operations in the last four years, and this is the eighth trenching accident since 1998. This most recent fatality occurred while the company was laying approximately 7 miles of water pipeline. One of 15 employees in the pipe-laying crew died of injuries because he was allowed to work outside the protection of a trench box. OSHA's investigation found that the employer permitted these same working conditions over the preceding five months when more than 6½ miles of the pipe had been installed. These fatalities could have been avoided had the employer provided basic protection.

OSHA cited the company with three alleged willful violations for failing to protect workers from cave-in hazards on three separate occasions during the project. The alleged willful violations carry a total proposed penalty of $210,000. Willful violations are those committed with an intentional disregard of the requirements of the Occupational Safety and Health Act and OSHA regulations, or indifference to employee safety and health. The company also received citations for six alleged serious violations, with proposed penalties of $28,000, for hazards associated with entry into confined spaces, and fall and impalement hazards. OSHA defines a serious violation as one in which there is a substantial probability that death or serious physical harm could result, and the employer knew or should have known of the hazard.

There have been three near-miss events over the past two years at DOE facilities involving trenching and excavation work.

- On August 29, 2001, at the DOE North Las Vegas Facility, a clod of compacted earth came loose from a trench sidewall and struck a contractor pipefitter on his hard hat. The impact caused the pipefitter's head to strike a pipe he was working on, causing contusions and a laceration near his right eye. (ORPS Report NVOO--BN-BNNLV-2001-0002)

- On May 16, 2000, at the Brookhaven National Laboratory, a stop-work order was issued when a supervisor noticed a laboratory employee working in the 7½-foot deep excavation with walls that were not adequately stepped or shored up to prevent collapse. (ORPS Report CH-BH-BNL-PE-2000-0002)

- On April 25, 2000, at the Los Alamos National Laboratory, facility management stopped work because of improper trenching operations. Contractor personnel had been working in a trench that was more than 10 feet deep without shoring, benching, or other standard excavation safety measures. (ORPS Report ALO-LA-LANL-TA55-2000-0010)

Requirements for trenching and excavation safety can be found in the OSHA regulation 29 CFR 1926, Subpart P, *Excavations*. Requirements for protective systems when excavations are 5 feet or more in depth can be found in 29 CFR 1926.652. The following two websites contain information on excavation and trenching safety.

- http://www.osha-slc.gov/SLTC/trenching excavation/index.html, for the Occupational Safety and Health Administration, U. S. Department of Labor.
- http://www.trenchsafety.org, sponsored by the Building Science Department at Auburn University, Auburn, Alabama.

These events emphasize the importance of complying with excavation safety requirements. Individual workers and supervisors need to be knowledgeable enough to recognize hazardous conditions related to excavations, and safety conscious enough to stop work when such conditions are encountered. The U.S. Department of Labor Bureau of Labor Statistics for 2000 reported 40 construction fatalities from trench and excavation cave-ins.

KEYWORDS: *Excavation safety, trench safety, cave-ins*

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