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

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2002-07
April 8, 2002

The Environment, Safety and Health (EH) Office of Performance Assessment and 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, EH relies on preliminary information such as daily operations reports, notification reports, and, time permitting, 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 Frank Russo, 301-903-1845, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction.

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Operating Experience Summary 2002-07

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EVENTS

1. LOW FALL FROM A SCAFFOLD RESULTS IN INJURY

On April 3, 2002, at the Savannah River Site, a subcontractor carpenter was ascending a shoring frame scaffold when he slipped and fell backward, striking his head on an adjacent concrete wall. The fallen worker was stabilized and transported to the Medical College of Georgia. The injured worker suffered head trauma and is listed in serious condition following surgery. At the time of the fall, the worker was standing on a frame rung approximately 3 feet above the floor. The accident scene was secured. The subcontractor has ceased using the shoring scaffolds. A formal investigation is being conducted, and updates will be detailed in a future issue of the Operating Experience Summary. (ORPS Report SR--WSRC-CMD-2002-0002)

The worker slipped from the scaffold and struck his head on the wall on the right.

2. TRENCHING ACCIDENT RESULTS IN OCCUPATIONAL INJURY

On March 26, 2002, at the Princeton Plasma Physics Laboratory, a subcontractor worker was injured while working in a trench less than 5-feet deep. A dense mass of clay, stone, soil, and sand broke loose from the sidewall of the trench and fell onto his lower leg, pinning him in the trench. The worker was removed from the trench and transported to the local medical center. The worker sustained fractures to both the tibia and fibula of the right leg; surgery was performed that evening. A formal investigation is being conducted, and further updates will be detailed in a future issue of the Operating Experience Summary. (ORPS Report CH-PA-PPPL-PPPL-2002-0001)

3. ENERGIZED ELECTRICAL LINES CUT DURING DECOMMISSIONING

On March 18, 2002, at the Rocky Flats Environmental Technology Site, an electrician inadvertently cut an energized 120-volt line with a pair of wire cutters. The associated circuit breaker tripped automatically as designed, resulting in the loss of power to a continuous air monitor. At no time did the electrician notice any arcing or feel any shock. The electrician was part of an electrical crew that was removing previously de-energized conduits in Building 776. Although there were no injuries or damage to equipment, the contractor reported this as a near miss. (ORPS Report RFO--KHLL-SOLIDWST-2002-0024)

During D&D operations in Building 776, the work crew wore air-purifying respirators, hardhats, and hearing protection while working from a manlift to remove conduit from a ceiling area of a room. They separated the conduit at mechanical joints using hand tools and then cut the conductors with wire cutters. The electricians failed to perform voltage verification checks before they cut the conductors even though the conduits were not marked with the green stickers that are used to indicate a de-energized status. They assumed the stickers had fallen off and decided not to stop work. In addition, they did not perform a physical check of the conduit routing from where it penetrated a concrete wall to where they completed the next cut, relying only on a visual scan. Unknown to the crew, the conduit that they had been removing left the conduit rack when it came through the wall and a different (energized) conduit entered the rack at the same level between the wall penetration and the visually identified cut point.

The work package for removal of conduit contained a detailed scope and an individualized job hazard analysis. In addition, conduit that has been air-gapped (physically separated from an electrical source) is

marked with a green sticker, while conduit that is to remain in place and contains energized conductors is marked with orange tape. An investigation of the event determined that the electricians had failed to comply with the following guidance in the work package.

- Perform voltage checks.
- Visually inspect that all ends have been air-gapped.
- Stop work and evaluate the energized status of the conduit if it is questionable (i.e., it bears no stickers).

A similar event occurred on March 13, 2002, in Building K-31 at the Oak Ridge East Tennessee Technology Park. Electricians were air-gapping and removing conductors from conduits for demolition in accordance with an enhanced work plan when they cut an energized 480-volt line. The electricians failed to visually verify the point of supply, the load, and an interconnecting circuit, including junction boxes, conduit fittings, and other devices to verify the routing and termination of the circuits to be removed. Verification procedure steps, including a zero-voltage test, were performed on one end of the conduit and conductors, but these conductors had been previously isolated during an electrical upgrade project at K-31. Failure to comply with the task plan and procedures resulted in the electricians cutting an energized conductor. There were no injuries, and ground fault equipment and circuit breakers functioned as intended. (ORPS Report ORO--BNFL-K31-2002-0001)

These events underscore the importance of performing work in accordance with the approved work package and procedures. Workers need to adhere to procedures in a deliberate and conscientious fashion. In both of these events, the work plans provided specific guidance for removal of electrical conduits, which was based upon an analysis of the hazards. In addition to the issue of procedural compliance, an important lesson from these events is never to assume that something is de-energized without first performing a zero-energy check, and to stop work if the energized status cannot be determined. It is important that the requirements of Integrated Safety Management be implemented as an integral part of the work package and job-control processes. However, personnel safety can only be assured if the work is performed within the established controls.

On February 26, 2002, the Office of Performance Assessment and Analysis issued a lessons learned on Electrical Intrusion Events through the DOE Society for Effective Lessons Learned Sharing (SELLS). The analysis in the lessons learned includes events that involved cutting and removal of electrical conduit during facility demolition. This document (Identifier: HQ-EH-2002-01) can be accessed from the SELLS website at http://tis.eh.doe.gov/ll/listdb.html.

KEYWORDS: *Electrical, energized, conduit, cutting, demolition*

ISM CORE FUNCTION: *Perform Work within Controls*

4. HEPA FILTER FIRE CAUSED BY MISSING SPARK ARRESTOR

On February 13, 2002, at Building K-33 of the East Tennessee Technology Park (ETTP), filters in a High-Efficiency Particulate Air (HEPA) filter system caught fire. Hot kerf (debris) from plasma arc torch cutting in the Decontamination and Decommissioning (D&D) Workshop probably ignited combustible material that passed through ventilation ducting and into a bank of polyester/paper cartridge filters. The cartridge filters ignited and burned, and the ventilation airflow spread the fire into a separate HEPA filter unit downstream. Both the pre-filters and HEPA filters (Figure 1) in that unit burned. Workshop workers shut off the ventilation fans and partially extinguished the fire using portable fire extinguishers. The fire department arrived and completed extinguishing the smoldering filters after removing them from their casings. Because of a rubber-like smell in the building, the contractor directed that all workers evacuate Building K-33 during the event. Samples taken from a continuous air monitor at the work area and from

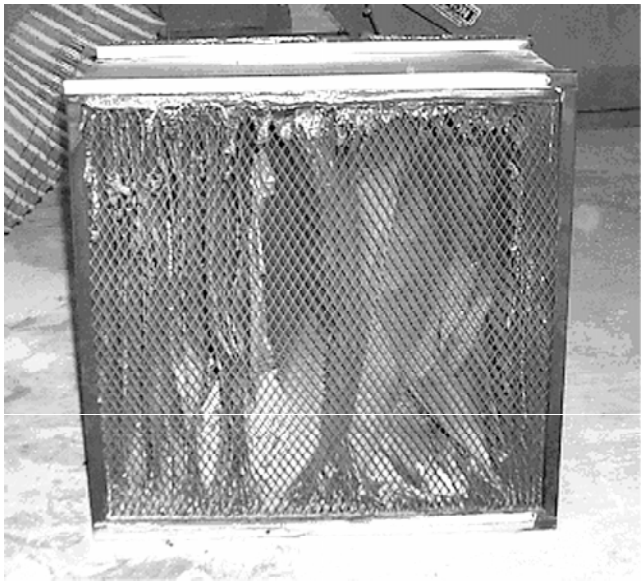

Figure 1. Burned fiberglass/cellulose HEPA filter

the stack monitor on the duct line showed no elevated airborne radiological contamination. (ORPS Report ORO--BNFL-K33-2002-0001)

Workers in the K-33 D&D Workshop use either portable HEPA filter units or 10-inch flexible hoses connected to a central ventilation/HEPA filter system to vent fumes caused by hot-cutting uranium enrichment equipment. In this incident, workers were cutting a converter shell with a plasma arc torch and placed a flexible hose from the central system on the floor next to the shell. To prevent hot kerf and burning debris from contacting the filters, metal-mesh spark arrestors are installed upstream in the ventilation ducting. In this event, however, the spark arrestor was missing from the casing (Figure 2), located at the junction between the flexible hose and rigid ducting. An investigation also found that a spark arrestor was missing from one of the portable HEPA filter units. The spark arrestor casings could not be opened easily for inspection, and there was no procedure to verify that the arrestors were in place before hot-cutting work commenced.

The investigation also found that tape used to connect and repair the flexible hose had burned. A burning tape fragment could have been the ignition source for the polyester/paper cartridge filter fire. As a result of this fire, the contractor has developed corrective actions that include the following.

- Establish procedures to inspect spark arrestors and HEPA hoses before hot cutting begins.
- Issue a procedure requiring debris screens for all HEPA hoses placed on the floor.
- Procure spark arrestor casings that can be easily accessed for inspection.
- Issue Toolbox Topics on HEPA hose inspections, combustibles in hot work areas, and the exclusive use of flame-retardant tape within 35 feet of hot work.

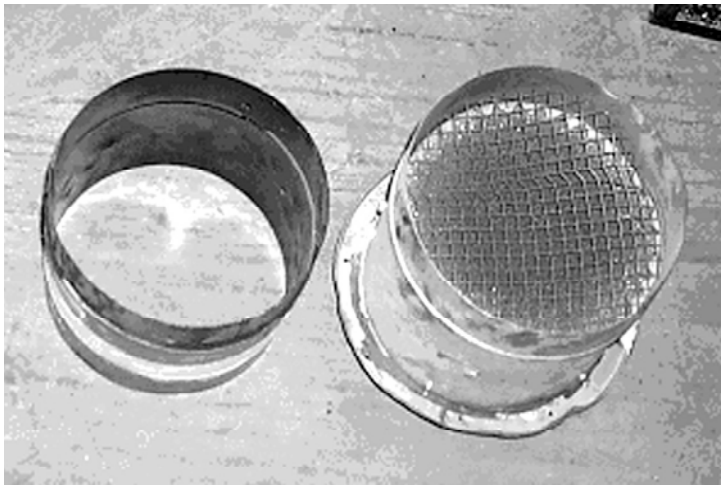

Figure 2. The casing on the left was missing a spark arrestor

This event illustrates that the absence of a spark arrestor, lack of pre-job inspection requirements, and inaccessible spark arrestor casings led to the fire in this occurrence. One of the factors influencing the selection of safety equipment should be the ease with which it can be inspected.

KEYWORDS: *Fire, HEPA filter, spark arrestor*

ISM CORE FUNCTIONS: *Develop and Implement Hazards Controls, Perform Work Within Controls*

5. CUT BOLT UNDER TENSION BECOMES MISSILE

On March 15, 2002, at the Rocky Flats Environmental Technology Site, a contractor construction crew member cut off a bolt from a depressurized hydraulic unit, suddenly releasing the tension in the bolt. The bolt traveled approximately 10 feet in a horizontal direction, creating a near-miss situation because of the potential for injury to workers in the area. No personnel were injured, and no property damage occurred. (ORPS Report RFO--KHLL-PUFAB-2002-0023)

The crew had finished removing two depressurized hydraulic cylinders from autoclave doors. Waste Guidance personnel suggested unbolting the cylinder covers to check for oil The procedure for removing the covers stated that caution must be used when removing bolts, and specified a series of steps for determining the presence of stored mechanical energy. This requirement had been added to the work package as a corrective action from a previous similar incident. A worker tried to loosen the bolts on the cylinder with a 1-inch Allen wrench, but was unsuccessful. He then decided to cut the bolts off. The worker had cut approximately halfway through the first bolt when it snapped, shooting approximately 10 feet across the hallway. Work on the damaged unit was suspended, and a safety plate was placed over the additional bolts on the cylinder.

A similar incident occurred on December 18, 2000, at the Rocky Flats solid waste operations facility. A worker had cut a bolt during disassembly of a compactor and the bolt shot out vertically, hit a ventilation duct, and fell to the ground. No injuries or property damage occurred from this incident. (ORPS Report RFO--KHLL-SOLIDWST-2000-0088)

In this event, deactivation and decommissioning workers had disconnected the hydraulic lines from a compactor and were attempting to remove a plate connected to four supporting rods that held a hydraulic cylinder in place. A worker with a 16-inch crescent wrench was unable to loosen a nut that held one of the rods to the plate. A decision was made to cut the rod below the plate using a portable band saw to allow the bolt to be removed. The rod snapped when the worker cut halfway through the rod. The top portion of the rod and the attached nut were propelled upward into a ventilation duct. A number of smaller compaction cylinders with shorter rods had previously been disassembled, but none had presented such difficulty in removing the nuts.

The root cause of this event was inadequate knowledge of the potential for stored mechanical energy in the compactor. According to the vendor's specifications, the nuts on this compactor could have been tightened with up to 1,300 pounds of torque.

Management took the following corrective actions.

- Performed a walkdown within the Building 776/777 Closure Project to identify potential sources of stored mechanical energy. Personnel, knowledgeable of the building configuration, identified several sources such as; counterbalance systems, heavy and asymmetrical equipment, overhead equipment and systems, hydraulic systems, the building structural system, and bolts, piping, and components under tension. This information will be included in planning future work.

- Revised the procedure and the job hazard analysis to include tension hazard warnings and to provide direction on the proper tools to use when removing nuts from the remaining hydraulic cylinders.

- Established a process for collecting and disseminating post-job reviews. A post-job review binder is available to assist integrated work control program planners when developing work packages.

The more recent occurrence illustrates the need for clear, complete work packages that incorporate all potential hazards. In addition, pre-job briefings need to emphasize these hazards so that the work crew is aware of them and will use the appropriate equipment to safely perform the work.

KEYWORDS: *Bolt stored energy, near miss*

ISM CORE FUNCTIONS: *Analyze the Hazard, Perform Work Within Controls*

6. EXCAVATOR SNAGS GUY WIRE OF A UTILITY POLE

On February 25, 2002, at the Fernald Environmental Management Project (FEMP), the counterweight of an excavator performing a shearing operation snagged a guy wire of a utility pole, causing it and two other poles carrying energized 480-volt lines to list. A spotter and a foreman were on hand to assist the heavy equipment operator in performing the shearing operation. There were no injuries to any of the personnel involved in this incident. However, there was a significant potential for injury to personnel from physical as well as electrical hazards resulting from this incident. (ORPS Report OH-FN-FFI-FEMP-2002-0010)

A Caterpillar model 235C excavator was being used to lift and transport empty stainless-steel tanks for shearing. The location where the work was being performed is isolated from other site activities, and both a 75-foot exclusion area and a source of water, which are required when shearing is performed, were present.

The spotter was positioned in front of the excavator, guiding the operator along the path of travel. The foreman monitored excavator clearance from a pipe bridge approximately 250 feet east of where the tanks were to be staged. The spotter, operator, and foreman had walked down the path of travel earlier in the day. A subcontractor safety representative was also present to observe the first move. To reach the shearing site, the operator had to navigate the excavator and maneuver it around and between a utility pole and a diesel fuel tank and a pile of concrete rubble (see Figure 1), as well as over a trench that had been backfilled with gravel. The work team successfully moved one tank without incident.

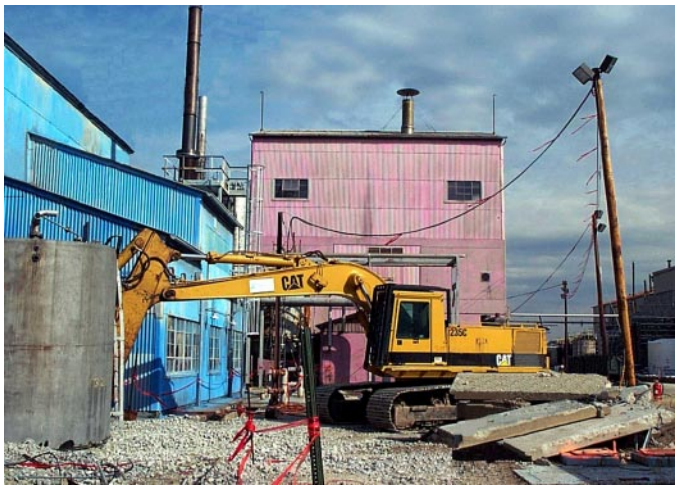

Figure 1. The excavator at the scene of the incident

As the operator maneuvered a second tank around a building, the foreman, who was standing back near the pipe bridge, saw the overhead electrical lines moving. He looked at the excavator and saw that the right end of the counterweight on the rear of the excavator had snagged the guy wire of a utility pole, causing the pole to lean inward. The foreman directed the operator to immediately stop the excavator. The foreman and spotter proceeded to the rear of the excavator and found that a guy wire was caught on the counterweight of the excavator and that the pole to which the guy wire was attached was leaning. In addition, two other poles along the roadway were leaning and the energized 480-volt electrical lines running between them were stretched tight, leaving almost no sag. It was later found that the guy pole on one of the utility poles had broken as a result of this incident. The operator backed the excavator to release the guy wire from the counterweight and then moved the excavator forward to set down the tank that he had been moving. The electrical lines were de-energized and will remain isolated until repairs are completed.

A debriefing was conducted near the incident scene with the personnel directly involved. A critique of the occurrence was conducted with Fluor Fernald management and DOE-FEMP personnel. The subcontractor project director for decontamination and decommissioning projects held a safety stand-down and safety stand-down briefings.

This occurrence demonstrates that spotters should be required for all construction activities involving heavy equipment. Although a single spotter was used in this event, additional spotters would have ensured that all sides of the excavator remained at a safe distance from surrounding obstructions. In future operations involving this activity, Fluor Fernald will place an additional spotter at the rear of the excavator to monitor the rear area for potential obstacles.

KEYWORDS: *Excavator, spotter, energized 480-volt lines*

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

7. NEAR MISS FROM OVERTURNED TRENCHER

On March 4, 2002, at the Y-12 Site, a trencher machine operator was backfilling a trench when the trencher tipped over and slid down an earthen slope into a chain link security fence (Figure 1). The trencher's seatbelt constrained the operator, and its roll bar kept him from striking the fence. The operator was uninjured; however a slightly different orientation of the trencher to the fence and fence poles could have led to serious injury. The contractor reported this as a near-miss occurrence. (ORPS Report ORO--BJC-Y12WASTE-2002-0003)

Figure 1. The trencher slid down the slope and was caught by the fence

The operator had cut a trench for electrical conduits along the side of a road, leaving a spoils pile of loose dirt along the road edge. After conduits and marking tape were laid into the trench, the operator started to backfill. He used the front blade of his Ditch Witch® 3500 trencher (Figure 2) to push loose dirt into the trench, placing the right wheels of his trencher on the spoils pile for support. As he began to backfill, the soft spoils pile gave way, and the trencher slid to the right, towards the downhill slope. The wheels next caught in firmer soil, and the trencher overturned and slid into the fence. The fence stopped what could have been a much longer downhill slide. The operator extricated himself from the trencher and was allowed to go home, after refusing medical evaluation but having been observed for nearly an hour by a safety representative.

At this time, the contractor has not finished developing corrective actions and lessons learned. However, preliminary causal analyses indicate that the job planners failed to address the hazards posed by the steep slope next to the road, and by the instability of the soft spoils pile.

This occurrence underscores the importance of selecting equipment appropriate for the hazards posed by an activity. The trencher was the wrong

Figure 2. The trencher

equipment for backfilling the trench. The front blade did not extend far enough to the right, forcing the operator to place the right wheels on the unstable spoils pile. Also, raising the chain bar moved the center of gravity of the trencher high and to the right, towards the sloping side of the road.

KEYWORDS: *Trencher, near miss*

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

8. INADEQUATE WELDING GROUND DAMAGES ELECTRICAL EQUIPMENT

On October 30, 2001 at the Hanford Tank Farms, a work team observed smoke coming from the 241-AY-101 record sampler cabinet while they were welding a fitting to an exhaust duct as part of a modification for the 241-AY-101 annulus continuous air monitor (CAM) cabinet air return line. Investigators later determined that the welding equipment was inadequately grounded and caused electrical wiring in the cabinet to overheat. No personnel injuries resulted from this event. (ORPS Report RP--CHG-TANKFARM-2001-0095, Final Report issued February 19, 2002)

The work team used a recently-purchased welding machine, which had not been equipped with extra hoses, clamps or cables. They positioned a grounding clamp on the Unistrut® metal frame of the record sample cabinet. A welder struck an arc to verify that the welding machine was grounded. Welding progressed for approximately 40 minutes until the team observed smoke coming out of the cabinet. They secured the welding equipment and safely exited the Tank Farm. Power was subsequently isolated to the annulus CAM cabinet, which supplies power to the record sample cabinet.

Figure 1 illustrates the physical layout of the area where the welding work was performed, as well as the electrical configuration.

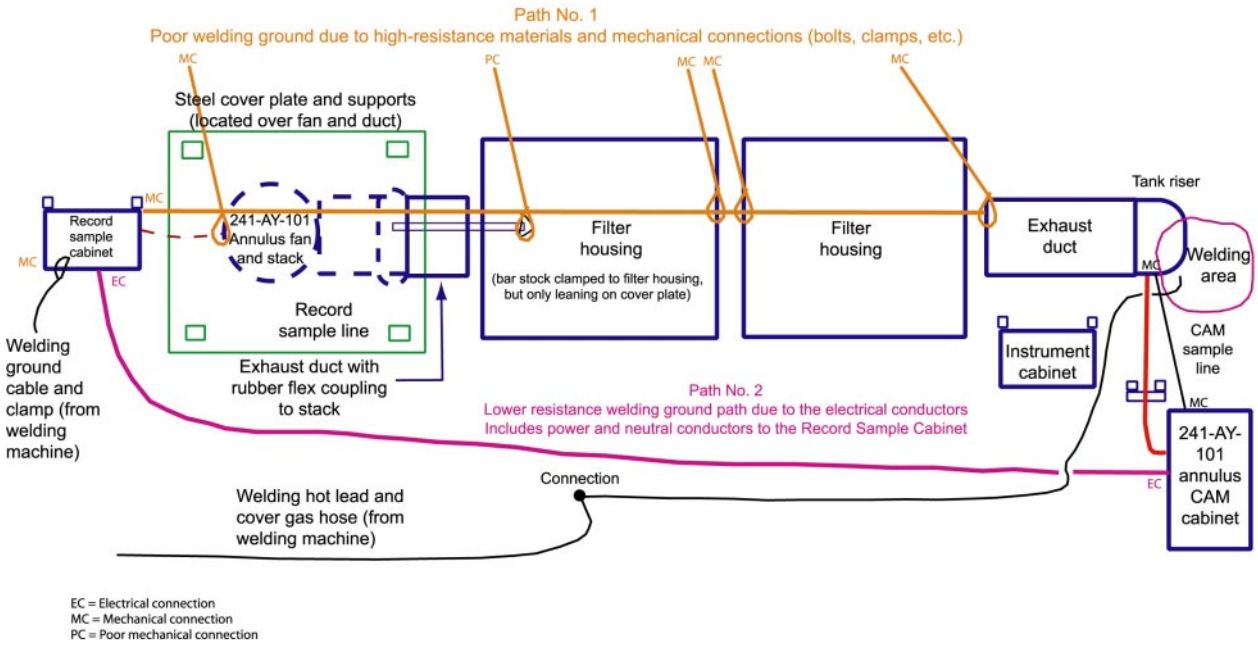

Figure 1. Physical layout and electrical paths

An investigation found that the welding machine current had flowed in two paths. One path (high resistance) went through the equipment and associated mechanical connections. The second path (lower resistance) was mostly through the electrical equipment grounds and associated cabling where the majority of the welding machine current flowed. The grounding cable for the cabinet was rated for

electrical equipment grounding, but not for welding. The insulation on the grounding cable had melted, causing the insulation on an adjacent power cable into the cabinet to fail. When the power cable failed, it tripped a circuit breaker in the annulus CAM cabinet power distribution panel.

The apparent cause of this event was that the welding ground was placed too far from the actual welding operation. The distance between the ground attachment and the weld was approximately 10 to 15 feet. The welder used the closest metallic object (the Unistrut® frame) to establish and maintain an arc because the welding ground cable was too short and no other welding-rated cables were available. The high-resistive mechanical connections used to ground the welding machine forced the welding current to seek the less resistive grounding path provided by the electrical equipment. This overheated the wire insulation and ultimately led to the electrical equipment cable failure.

Interviews with experienced welders indicated that it is general practice to locate the grounding cable as close as possible to the weld piece. The Occupational Safety and Health Administration (OSHA) welding standard, 29 CFR 1926.351, *Arc Welding and Cutting,* states that "All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required safe means of arc welding." However, the standard does not specify what distance the ground connection should be from the welding activity. The welder failed to ensure that the ground was attached as close as possible to the point of weld.

The contractor has issued a lessons-learned bulletin to:

- clarify the grounding requirements (including connectors for cable/hose extensions) associated with welding at the Tank Farms,
- specify the field approach for welding and the use of welding experts at the Tank Farms, and
- provide information applicable to Tank Farm work activities (e.g., stray current corrosion, high-frequency impacts, and welding near sensitive equipment or instrumentation).

The contractor is also updating work control documents to require that work planners use welding subject matter experts to assist in identifying proper grounding.

A search of ORPS found the following similar occurrences.

- On April 6, 2001, at the Idaho National Engineering and Environmental Laboratory, improper grounding of a crane guide rail during a welding caused sparks, smoke, and extreme heat buildup in a connecting chain. A welder attached the grounding cable to the crane guide rail, where it was most convenient; however, the crane guide rail was not grounded, thereby setting up a secondary path for the current through the crane structure. Attaching the ground cable to a point close to the weld area would have prevented the event. (ORPS Report ID--BBWI-RWMC-2001-0008)
- On December 11, 2000, at the Rocky Flats Environmental Technology, a pipefitter received an electrical shock resulting from a non-continuous mechanical connection (ground) between two pipe components that were being welded. (ORPS Report RFO--KHLL-371OPS-2000-0088)
- On August 24, 2000, at the Hanford Site, a welding machine was improperly grounded when the ground lead was not connected close enough to the work being performed. A process vent hose, which connected a rupture disk on the process hood to a process vent system, was warm to the touch, indicating that it was potentially damaged. (ORPS Report RL--PHMC-SNF-2000-0020)

This event illustrates that using proper welding techniques ensures that the welds are performed correctly, safely, and without damaging electrical equipment. The importance of properly grounding welding equipment is paramount in the welding process. Welders must ensure that grounding is as close as possible to the actual welding operation and that the ground is established through mechanical equipment rather than electrical.

KEYWORDS: *Weld, ground, electrical*

ISM CORE FUNCTION: *Perform Work Within Controls*