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

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2002-08
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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 2002-08

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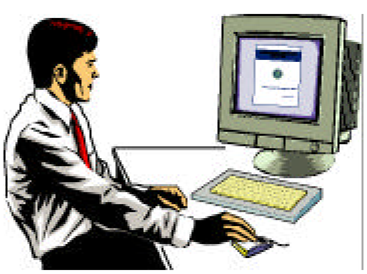

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EVENTS

1. GANTRY CRANE COLLAPSE DURING LIFT

On January 9, 2002, at the Kansas City Plant, a gantry crane holding a 14,000-pound spindle column of a milling machine fell over, damaging the spindle column and a nearby lathe. A subcontractor construction crew was in the process of lifting the spindle column of a K&T Modu-Line® five-axis milling machine and preparing it for transport (see Figure 1). No workers were struck by falling equipment, and no serious injuries occurred. However, property damage to the spindle column and lathe was approximately $111,000. (ORPS Report ALO-KC-AS-KCP-2002-0001; final report filed February 21, 2002)

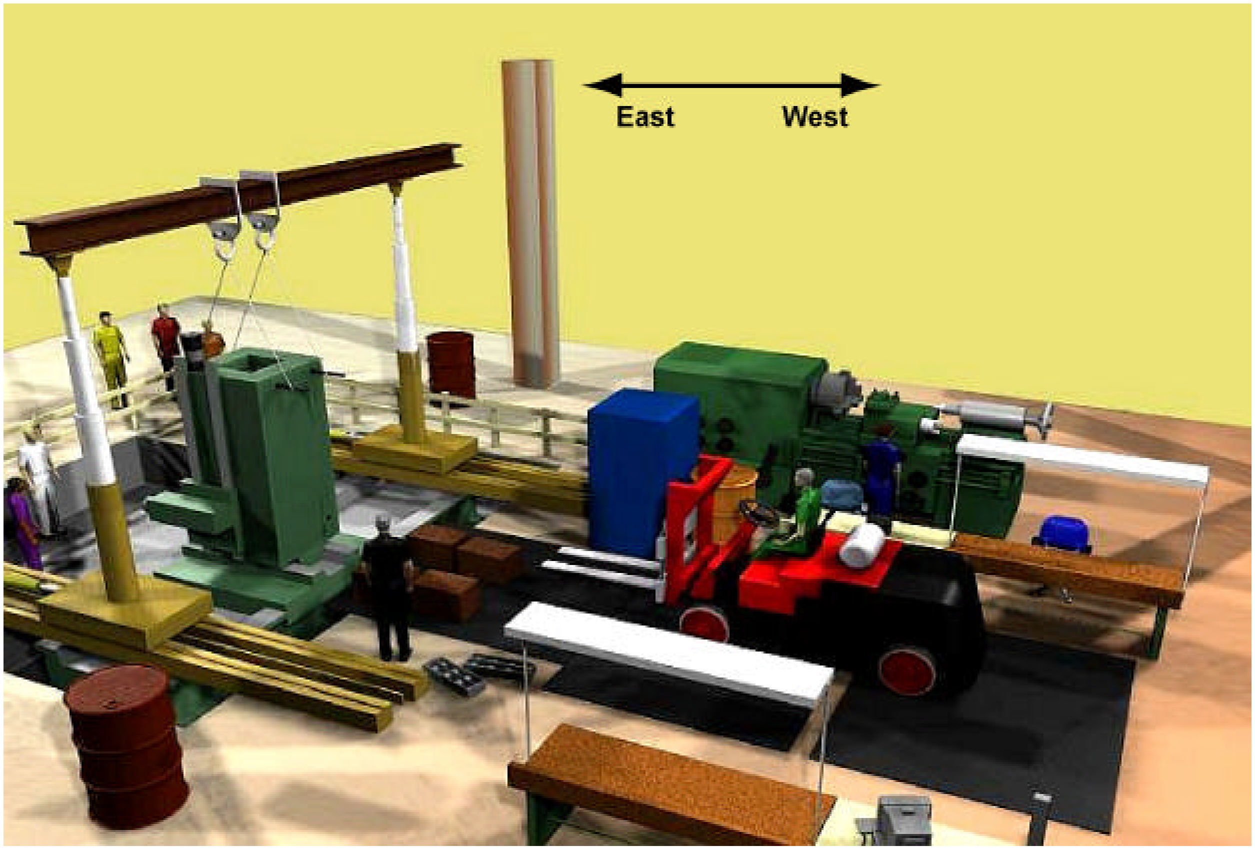

Figure 1. Initial configuration of gantry crane and spindle column

The spindle column was suspended from a gantry crane that consisted of an I-beam supported by two hydraulic cylinders located on two parallel rails. The spindle column required a vertical lift, transitioning to a horizontal position, and ultimately resting on a flat side. The subcontractor had taped off the work area with caution tape to prevent anyone from entering the work zone. The caution tape was removed on one side to allow access for a forklift being used in the operation.

The subcontractor was having difficulty laying the spindle column down using standard rigging techniques. Subsequently, the subcontractor attached a chain and sling arrangement from the forklift to the lower portion of the spindle column to pull the base of the spindle column west with the forklift, allowing it to be lowered down flat with the top to the east. When the spindle column resisted, the forklift operator applied more force. A witness reported that the spindle column stopped and rocked forward to the west in the direction of the forklift.

The forklift operator jumped off the vehicle to clear the falling gantry crane. Simultaneously, an associate working on the lathe heard the warning yell of a coworker, looked up, and saw the falling gantry crane. The associate immediately ran to the west to avoid the falling gantry crane and spindle column. The I-beam of the crane came to rest on the forks of the forklift and on the lathe (Figure 2).

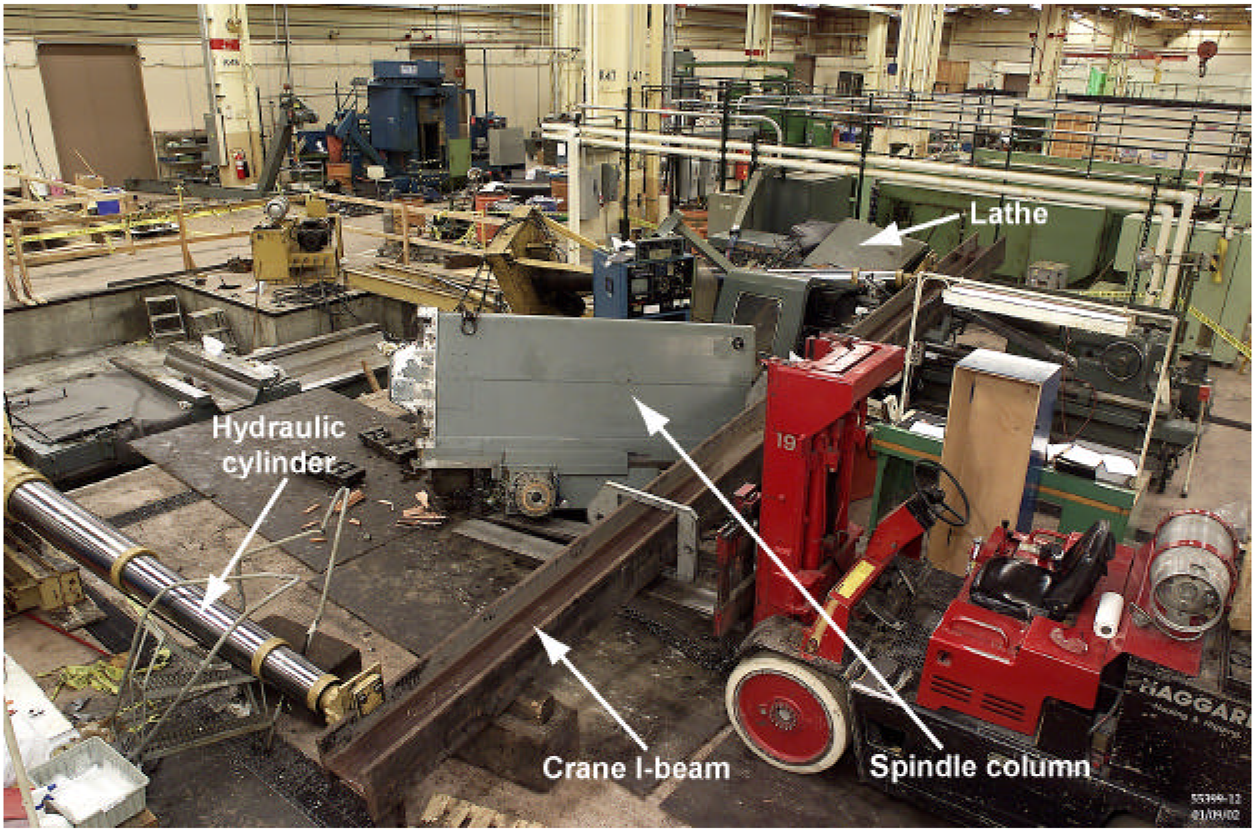

Figure 2. The collapsed gantry crane

The subcontractor immediately secured the scene pending an accident investigation. Part of the investigation included a video animation that recreated the accident. The video can be accessed at http://tis.eh.doe.gov/paa/oesummary/oesummary2002/crane.mpg. Due to the large size of the video file (13 MB), it may be advisable to save the file to the local disk before viewing. The animation shows the crane being set up for the hoisting and rigging operation. The workers first rotate the spindle column and position it on blocks. Then slings are attached to the bottom of the spindle column, and a forklift is used to pull on the bottom of the spindle column. When the spindle column does not move in the direction that the workers had anticipated, the forklift operator begins to pull back on it with more force. As he does, the center of gravity of the spindle column shifts, producing a horizontal force on the I-beam. The crane and load fall forward onto the tines of the forklift and the lathe. The lathe operator and forklift driver are both able to run clear of the falling crane and spindle column.

The causal analysis for the crane collapse cited a procedure problem as the root cause. Because the lift was complex and unusual in nature, the subcontractor failed to apply the correct safety rules and techniques. The direct cause was the horizontal force created when the center of gravity of the spindle column shifted. This force, acting on the top member of the two-point gantry crane, caused the crane and the attached load to topple. No one anticipated that pulling the base of the spindle column would shift the center of gravity. In addition, the subcontractor did not re-evaluate the work area after initial attempts at laying the spindle column on its side failed, to ensure that nearby workers were clear of the potential hazard.

A DOE Lessons Learned Alert, *Gantry Crane Collapse*, Identifier Number 2002-KCP-FM&T/KC-0001, was issued on March 19, 2002. The alert lists the following lessons learned.

- NNSA Hoisting and Rigging Guidelines should be used to apply correct rules and techniques for complex and unusual lifts.
- All potential hazards of the job should be identified before a lift is initiated.
- No lift should be considered routine.
- Lifting recommendations and techniques specified by the lifting equipment manufacturer should be reviewed prior to attempting lifts.
- Employee empowerment (stop-work authority), accountability, and the expectation of management intervention when unsafe actions or conditions exist should be clearly established, understood, and implemented.
- Any employee or subcontractor is expected to question the adequacy of identified work zones.
- Lifting processes should be stopped and re-evaluated whenever the load does not respond in the manner anticipated.

KEYWORDS: *Hoisting, rigging, gantry crane, lift*

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

2. FAILURE TO ISSUE AND USE A FIT-TESTED RESPIRATOR

On January 24, 2002, at the Hanford Site, a worker was issued, and used, a respirator for which he had not been fit-tested to perform a cell intrusion activity in the 327 Facility. This activity requires the use of a properly fitted respirator. The respirator the worker used during the activity was surveyed for internal contamination, and the results were negative, indicating that the respirator had provided an adequate seal. An air sample taken during the evolution did not indicate elevated levels of airborne contamination. (ORPS Report RL--PHMC-327FAC-2002-0001; final report issued March 11, 2002)

Scott Technologies, Inc. manufactures air-purifying respirators, two of which (see Figure 1) are used at Hanford: the Scott AV-2000® and the Scott-O-Vista®. Scott Technologies specifies that each of these models must be fit-tested to confirm a proper seal. In this event, an operator was fit-tested for the AV-2000 model; however, the Scott-O-Vista was being used on this project, so when the worker requested a Scott respirator, neither he nor the issuer realized that two different Scott respirator models are available for use at Hanford. This confusion was complicated by the fact that both respirators are identified as "Scott-O-Vista" and the fact that the respirator most commonly used at Hanford is manufactured by MSA, not Scott Technologies. The only readily discernible difference between the two respirator models is the speaker diaphragm on the AV-2000. There was no effect on the worker, although the potential for an uptake existed because he wore a mask that he was not fit-tested to use. A subsequent mask fitting verified that the respirator type he wore in the cell had sealed properly.

Figure 1. Scott AV-2000® (left) and Scott-O-Vista® respirators

The procedure governing this activity requires that the issuer provide the user with the respiratory protection for which the user has been fit-tested. In this instance, the issuer provided a respirator for which the user was not fit-tested. Following an investigation of the incident, it became clear that the issuer was unable to differentiate between the two types of respirators.

Corrective actions include awareness training for respirator users and issuers on the differences in respirator models, placing posters at issuing stations to illustrate these differences, evaluating other site projects for similar problems, and evaluating training and fit-test practices to ensure that these differences are appropriately communicated.

This event illustrates that, when working in areas that require wearing respirators on a routine basis, workers need to ensure that they use the appropriate equipment for the task rather than making assumptions. Personnel using and issuing respirators should verify that the user is fit-tested for the respirator equipment necessary for the job.

KEYWORDS: *Respirator, mask, air-purifying respirator, fit test*

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

3. WATER INTRUSION DAMAGES STORED DIESEL GENERATOR

On March 21, 2002, at the Savannah River Site, a diesel generator unit that had been stored outside in a laydown yard was reported to have suffered rust and corrosion damage because of rainwater intrusion. The diesel generator had recently been obtained from Central Shops to replace an inoperable stationary generator when the damaged condition was discovered. Mechanics were changing the oil in preparation for placing the diesel generator in service when approximately 14 gallons of water drained out of the crankcase. Investigators later determined that the diesel generator sat outside without any maintenance and with the exhaust ports uncovered (off and on) over a period of 5 years. (ORPS Report SR--WSRC-FSSDGEN-2002-0003)

The diesel generator was one of two emergency diesel generator power modules purchased in 1996 as part of an upgrade project. Each generator is rated at 800 kW and 480 volts, and is driven by a 12-cylinder engine. Each diesel generator is housed in a large enclosure (40 feet long by 12 feet wide).

In September 1997, the new generators arrived uncovered at Savannah River on two trucks. Procurement and Materials Management Department (PMMD) personnel offloaded the units in the laydown yard for outside storage because the equipment configuration prevented them from being placed in Level B (i.e., climate-controlled) storage as required. A reinforced plastic tarp material was placed over the openings on top of the equipment in accordance with management instructions. One of these openings was for the diesel exhaust system, which is designed to extend from within the enclosure, through the roof, and through a horizontal muffler on top. The muffler system had been removed for shipment by the vendor. Over the years, the covering had to be replaced on several occasions because of deterioration from the sun (ultraviolet radiation), severe rain, and wind, and this deterioration allowed water into the exhaust port.

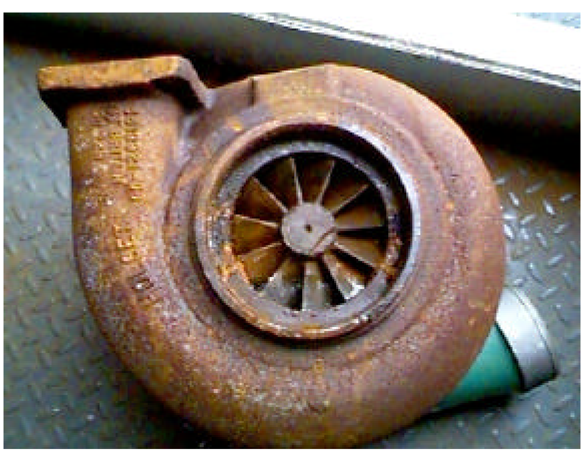

Figure 1. The rusted turbocharger

Investigators believe that without the horizontal muffler installed, a path was provided to allow rainwater to enter the exhaust system and ultimately the engine. Figure 1 shows the rusted condition of the turbocharger, which is driven by diesel exhaust. This rust damage might have been prevented by placing a heater in the diesel enclosure during storage. Figure 2 shows the condition of the even-numbered bank of cylinders (2 through 12) with the heads removed. The lack of rust damage to cylinder number 8 indicates that the exhaust valve was closed for that cylinder. There were only 17 hours of runtime on the diesel and that time was clocked during factory testing.

Figure 2. Damaged cylinder bank

A critique of this issue was conducted on March 27. Critique members learned that in mid-1997, after the purchase order was placed for the diesel generators, the Nuclear Materials Management Division project engineer decided that the diesel generators would no longer be required for the project, and the procured units would serve as facility spares. In 1998, the diesel generators were assigned to the F and H Canyons. During these changes in equipment status and ownership responsibility, no maintenance requests were ever made for the equipment, and the equipment was never entered into a routine maintenance program. Replacement costs for renting a diesel generator are estimated to be $50,000 to $75,000 per month, and a preliminary cost estimate to repair the damage to the diesel engine is approximately $30,000. Actual costs could be higher because of possible damage to the electrical generator and to the second diesel, which was later found to have 8 gallons of water in the crankcase. Some of the causes and concerns identified during the critique include the following.

? Failure to ensure that the necessary Level B storage was available onsite for equipment of this physical configuration
? Inadequate control and storage of project equipment
? Failure to perform in-storage maintenance (no request for maintenance was made to PMMD)
? Lack of ownership responsibility

As a result of this investigation, it is expected that all stored mechanical equipment will be examined for similar deficiencies.

The contractor has not finished developing formal corrective actions, root cause analysis, or the lessons learned; however, this event illustrates the importance of performing periodic maintenance on equipment that has been placed in short- or long-term storage and ensuring that stored equipment is properly protected from the weather. It is a good practice to store and maintain newly procured equipment in accordance with any manufacturer's recommendations. It is also important that ownership of new equipment be clearly established and properly transferred, so that the owner can ensure the equipment is entered into a routine maintenance program, even if the equipment is to be placed in a temporary storage status. This will help ensure that the equipment will function properly when it is placed into operation.

KEYWORDS: *Water intrusion, maintenance, equipment storage, procurement, diesel generator*

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

4. DEFICIENCIES IN QUALITY ASSURANCE PROCESS ALLOW SHIPMENT OF NONCONFORMING PARTS

On April 8, 2002, the Reactor Research Division facility manager at the Oak Ridge National Laboratory (ORNL) declared a positive Unreviewed Safety Question (USQ) for nonconforming parts. This was based on a review of the manufacturer's nonconformance reports submitted to ORNL concerning dimensional anomalies associated with the manufacture of five reactor fuel elements. The reactor is currently shut down for a scheduled cycle outage. (ORPS Report ORO--ORNL-X10HFIR-2002-0003)

Deficiencies in the implementation of the quality assurance (QA) plan by the manufacturer allowed acceptance and eventual assembly of the final product of fuel plates that had not undergone the necessary verifications on dimensional specifications. The fuel plates are manufactured according to ORNL specifications and, after passing inspection criteria, are assembled by the manufacturer into fuel elements and shipped to the site. The ORNL-approved manufacturer's QA plan is relied upon to ensure acceptability of the product. The manufacturer discovered the nonconformances in question upon reviewing documentation after the affected fuel plates had already been assembled into fuel elements. Two of the five fuel elements had been shipped to Oak Ridge before the dimensional anomalies were discovered.

Procuring organizations generally use QA receipt inspections to detect nonconforming product; however, for critical mid-process specifications (e.g., individual fuel plate dimensions) that cannot be verified by the receipt inspection process on the fully assembled fuel element, oversight of the manufacturer's operations is necessary. ORNL has a dedicated fuel fabrication engineer who periodically inspects the manufacturing and quality assurance processes and investigates items of particular interest.

After the discovery of the nonconformances, the following actions were taken: (1) ORNL placed a hold on the fuel element final assembly process pending a re-inspection of all in-process fuel plates; (2) ORNL conducted a review of the fuel supplier's quality assurance program and procedures, and made changes as required; (3) ORNL is procuring updated inspection equipment to be placed in service at the manufacturer's facility.

This event illustrates that a judicious use of QA holdpoints by the procuring organization on a manufacturer's process (i.e., before assembly of product) can minimize the potential of having to reject or accept nonconforming product at a later date.

KEYWORDS: *Quality control, quality assurance, oversight, procurement, nonconformance, reactor fuel*

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

5. WORKER REMOVES RESPIRATOR INSIDE AIRBORNE RADIOACTIVITY AREA

On March 11, 2002, at the Hanford Site, a new radiological control technician (RCT) doffed his personal protective equipment (PPE) and removed his respirator before exiting an airborne radioactivity area (ARA). The RCT was observing sealout operations for personal training in the Plutonium Finishing Plant. The person in charge, who saw the new RCT remove the respirator, instructed him to immediately leave the ARA. A whole-body survey and nasal smears were taken with no contamination found. (ORPS Report: RL--PHMC-PFP-2002-0010)

On the day of the event, while sealout operations (removal of materials from glovebox) were being performed, the room was placed on ARA status and a temporary contamination area boundary was established outside the doorway with a new stepoff pad for egress from the room. The normal stepoff pad inside the room was covered, but the existing boundary rope and radiological signs were left in place. About midway through the sealout evolution, the new RCT was given permission to leave the room. When he reached the rope boundary on the ARA side of the doorway, he began doffing his PPE and removed his respirator. The person in charge heard tape being removed from anti-contamination clothing and saw the RCT with his respirator removed. The RCT was instructed to leave the ARA immediately. A decision was made to complete the work inside the room after confirming that everyone remaining in the area understood the contamination area boundary. The post-job air samples showed that the air concentration levels in the room had remained below 10 percent of the derived air concentration limit.

A critique held on March 12 found that the new RCT was not aware that, after entering the room, a temporary contamination area boundary had been established outside the room. The temporary boundary had not been discussed at the pre-job meeting. When leaving the area, the RCT became confused when he encountered ropes and radiological boundary signs while still inside the ARA. Believing that he stood at the contamination area boundary, the RCT proceeded to doff his PPE. The critique also found that the room had in effect been double-posted. Normally, the contamination area boundary for this room is inside the doorway. However, this boundary remained in place (except for covering the stepoff pad) after the room went on ARA status, and the temporary contamination area boundary was established outside the doorway.

This event illustrates the importance of ensuring that radiation, contamination, and airborne radioactive area postings and boundaries are correct and clearly marked. Personnel working in posted areas must clearly understand these boundaries, particularly if conditions change, in order to prevent the spread of contamination or personnel exposure to radiation.

KEYWORDS: *Respirator, contamination area, airborne radioactivity area, personal protective equipment*

ISM CORE FUNCTION: *Develop and Implement Hazard Controls*

6. INADEQUATE LOCKOUT DISCOVERED BY PRE-WORK VOLTAGE CHECK

On March 26, 2002, at the Savannah River Defense Waste Processing Facility, an electrical and instrumentation (E&I) electrician discovered 120 volts inside an electrical distribution/control panel that should have been de-energized. The electrician found the energized condition while conducting a voltage check before beginning preventive maintenance on motor control center (MCC) cubicles. A lockout/tagout had been installed as part of the maintenance work order, but the lockout was less than adequate. All activities associated with the lockout/tagout were terminated. There were no injuries or property damage. (ORPS Report SR--WSRC-WVIT-2002-0002)

The main voltage at the MCC is 480 volts, which is stepped down to 120 volts and distributed to the electrical distribution/control panel. Before the lockout was established, a zero-energy check was performed in accordance with the lockout procedure. The zero-energy check verified that all MCC cubicles and the 120-volt electrical distribution/control panel were de-energized. Before starting the preventive maintenance, electricians assigned to do the maintenance opened the door to the distribution/control panel and discovered motor starters, terminal boards, and fuses located behind the door. These components had not been identified in the work package, and a voltage check revealed four terminals that were energized (120 volts). This panel is one of approximately four panels in the facility that have a door-mounted distribution panel with other electrical control devices installed behind it in the same cabinet.

The scope of work given to the preparers of the lockout did not consider that E&I personnel would open the panel door or that other electrical equipment was installed in the same cabinet as the 120-volt control panel. However, E&I personnel were directed to perform general cleaning of the entire enclosure as general preventive maintenance. The work package referenced only the door-mounted panel and not the area behind the panel door. Neither the lockout preparers nor the E&I personnel conducting verification identified the additional panel. The lockout preparers did not review the blueprints, and therefore did not know that other electrical equipment was located behind the panel door.

An article in Operating Experience Summary issue 2001-08 described how a worker's safe-to-work check prevented a possible serious injury while working on a lift table and conveyor for a glovebox. In this case, before beginning the work, the worker requested that a second safe-to-work check be performed. During the second check, an operator discovered that the wrong circuit breaker had been locked and tagged. (ORPS Report RL--PHMC-WRAP-2001-0004)

These occurrences illustrate the importance of performing a zero-energy (safe-to-work) check before working on electrical equipment, particularly in situations where the scope of work is not well defined. It is also important to understand the system configuration and its associated hazards when planning and preparing lockout/tagouts.

KEYWORDS: *Electrical, lockout/tagout, zero-energy check*

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

7. UNDETECTED VESSEL OVERFILLING

On March 25, 2002 at the Savannah River Site F-Canyon, the facility manager reported an undetected overfilling of a process vessel and eventual overflow to its sump that occurred as a result of a leaking steam block valve that allowed condensate to enter the vessel over a period of time. The overflow was contained in the sump, and no release of radioactivity outside the facility occurred. (ORPS Report SR--WSRC-FCAN-2002-0004)

On February 21, 2002, maintenance was conducted on the gang valve steam eductor of a vessel. On the same day, the vessel was filled to a level above its high-alarm setpoint. The gang valve is an electromechanical device that has three positions (jet, air blow, or vent), and uses a rack gear to actuate cams to align the vessel for process flow. The gang valve failed during the post-maintenance test, and was left in the jet (flow into vessel) position while its upstream steam block valve was closed. The block valve leaked over time, adding condensate to the vessel, which had already been filled to above its high-level alarm setpoint. It is not a common practice to fill a vessel to such a level, but it was done in this case because the tank was scheduled to be in a static condition. A high-level alarm in the sump, which services three other vessels, annunciated on March 24, 2002, and the source of the increase was traced back to the vessel and ultimately the steam block valve. Due to the relatively small capacity of the sump compared to that of the vessel, the sump level increased from normal to the high-level alarm setpoint between the scheduled operator rounds, which were being taken and recorded.

In situations where a tank is filled above its high-level alarm setpoint, a compensatory measure is taking scheduled operator measurements on the tank level. This was not accomplished during this event due to the fact that the tank was placed back in service without including tank-level readings on the round sheet. The round sheets recording the measurements taken during operator rounds now include tank-level readings. Additionally, the level in the vessel will be lowered by transferring some of the contents out so that a high-level alarm setpoint can be re-established. Selecting any of the other positions of the jet eductor upon completion of post-maintenance testing would have prevented the condensate flow into the vessel.

This event illustrates the importance of analyzing the potential consequences of placing equipment back into service and ensuring that compensatory measures to mitigate these potential consequences are followed, especially in situations that are relying on a single physical barrier.

KEYWORDS: *Vessel overflow, tank, post-maintenance testing*

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