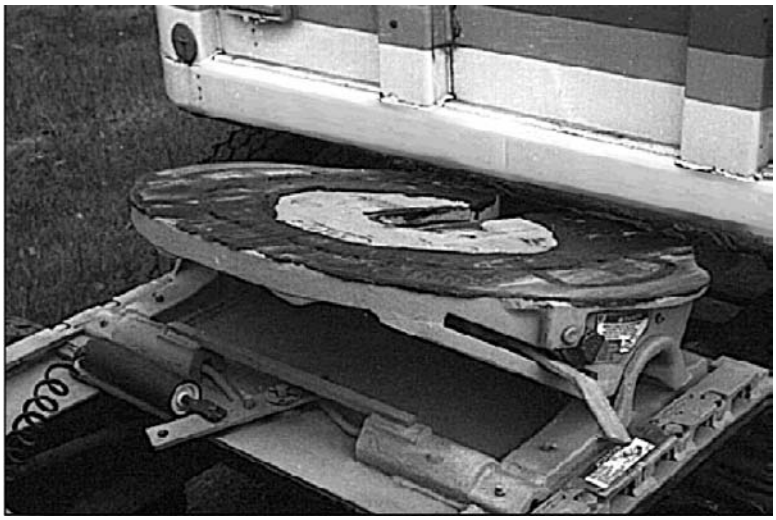
OPERATING EXPERIENCE SUMMARY

Inside This Issue

- *Five workers were exposed to concentrated nitric acid fumes when two of the workers inadvertently removed a valve bonnet*
- *An increasing trend was noted involving tractor trailers uncoupling from fifth wheels*
- *A storage cylinder containing more than 21,000 pounds of uranium hexafluoride dropped about 1 foot to a concrete surface*
- *Three subcontractor workers attempted to perform electrical work without installing an over-lock on an electrical disconnect*



U.S. Department of Energy

Office of Environment, Safety and Health

OE Summary 2002-24

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The Office of 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 2002-24

TABLE OF CONTENTS

EVENTS

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EVENTS

1. NITRIC ACID SPILL RESULTS FROM INADVERTENT REMOVAL OF VALVE BONNET

On August 23, 2002, at the Rocky Flats Environmental Technology Site, two workers were removing the actuator from a valve in a nitric acid line when they inadvertently removed the valve bonnet, spilling about 8 ounces of acid with a pH between 0 and 1. Five workers were exposed to the acid fumes. They were evaluated by medical personnel and released without restriction. (ORPS Report RFO--KHLL-371OPS-2002-0049; final report filed October 9, 2002)

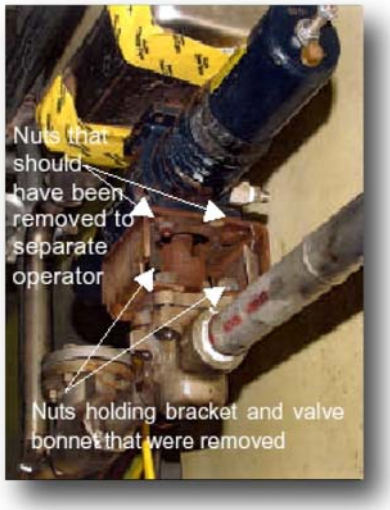

Figure 1-1. The air-operated valve configuration

One of the operators had removed actuators from air-operated valves before, and presumed that this valve was similar to the others he had disassembled: four fasteners (nuts) holding the bracket and additional fasteners holding the valve bonnet. Figure 1-1 illustrates the valve and bracket with the fasteners, and Figure 1-2 shows the valve assembly with the actuator removed. He removed four fasteners holding the bracket and valve body, anticipating that other fasteners secured the valve. Instead, the fasteners held the valve bonnet to the valve body as well, allowing nitric acid to leak from the bonnet-to-body joint. The operator quickly secured the valve, and he and the other four workers in the room evacuated. Plant firefighters responded to the scene, and the ventilation system was aligned to exhaust the fumes from the building. The spilled acid was cleaned up the same day and industrial hygiene personnel verified the atmosphere free of acid fumes.

Figure 1-2. Bracket attached to the valve bonnet with the actuator removed

Two workers went to a hospital for evaluation, and the other three went to the plant occupational medicine facility. All five were released without restriction.

Facility management took a number of corrective actions. The engineering group evaluated a method for removing air-operated valve actuators without breaching the system. Walkdown training was given to foremen, operations, engineering and maintenance personnel, and job planners on using the proper disassembly method and verifying the valve configuration before work begins. All outstanding work packages and job hazard analyses have been reviewed and evaluated to ensure that the hazards are properly identified and the procedures are accurate and complete. A Lessons Learned Toolbox was distributed throughout the site, and the project manager held an all-hands meeting on the importance of invoking stop-work authority whenever a safety issue arises or if there is doubt about how to proceed.

The direct cause of this event was the operator's error in assuming that this valve assembly was configured like those he had disassembled previously. The root cause was inadequate work planning. No one had recognized the potential for confusion as to which nuts should be removed; as a result, neither the work package nor the pre-job walkdown identified the nuts to be removed, or indicated that only one set of fasteners held both the bracket and valve bonnet. The work package failed to utilize lessons learned from a similar event at Rocky Flats, described below.

On December 12, 2001, a steam control valve expelled steam and valve packing when a mechanic accidentally removed the packing gland and

follower. The mechanic should have removed the valve actuator, but removed the wrong fasteners because of inadequate instructions in the repair work package. The valve, which is exposed to steam at 100 pounds per square inch, had been isolated, but the pressure between the isolation points was not released, thereby keeping the valve internals pressurized. The job was stopped, and personnel left the area until the valve was locked and tagged out. No personnel injuries or equipment damage resulted from this event. (ORPS Report RFO--KHLL-374OPS-2001-0004; OE Summary 2002-04)

These events demonstrate the importance of adequate work planning. Work packages should specifically describe all potential hazards that could be encountered during a work evolution. Job planners may consider the use of drawings or photographs to illustrate procedures that may be unclear. Workers should verify component configuration before they begin working rather than relying on skill-of-the-craft.

KEYWORDS: *Nitric acid, fumes, valve bonnet, air-operated valve*

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

2. TRANSPORTATION EVENTS INVOLVING UNCOUPLED TRACTOR-TRAILER FIFTH WHEELS

Six events involving the unintentional uncoupling of trailers have been reported in the Occurrence Reporting and Processing System since August 2001. Although these types of events are reported relatively infrequently, they represent an increasing trend from previous years; one that is not necessarily uncommon within the transportation industry. The safety significance of these events is the potential involvement of radioactive or hazardous materials in an accident caused by the separation of a loaded trailer.

On August 20, 2002, at the RMI Decommissioning Project, a chassis with a loaded container uncoupled from the fifth wheel of a tractor about a quarter of a mile from the site. There was no spill of material from the trailer. (ORPS Report OH-AB-RMI-RMIDP-2002-0005)

On June 23, 2002, a 32–foot, fifth-wheel trailer uncoupled when the driver applied the brakes, causing the trailer to slide into the bed of the truck. The impact caused minor damage to the bed and trailer. (ORPS Report HQ--SPR-NO-2002-0001)

On October 31, 2001, at the Hanford Liquid Effluent Facility, an empty tank trailer detached from the fifth wheel and came to rest on the frame of the tractor as it was being pulled from the unloading facility. (SELLS Identifier 2001-RL-HNF-0047)

On October 25, 2001, a commercial motor carrier driver at the Hanford Central Waste Complex was beginning to transport a mixed-waste shipment when the fifth-wheel latch failed, dropping the trailer onto the retracted landing gear. (ORPS Report RL--PHMC-SOLIDWASTE-2001-0007)

On November 15, 2001, at the Los Alamos National Laboratory, a trailer decoupled while carrying a shipment of low-specific-activity waste. The trailer slid approximately 10 feet and came to rest on the front leg supports. No radioactive material was released. (ORPS Report ALO-LA-LANL-WASTEMGT-2001-0011)

In August 2001, at Rocky Flats, a TRUPAC II trailer with two loaded containers separated from the tractor and fell onto the landing gear. (SELLS Identifier RFETS-02-0010)

Figure 2-1 shows the fifth wheel of a tractor in position to couple with a trailer.

Figure 2-1. Uncoupled tractor and trailer

Contractors identified various causal factors for these events in the causal analyses. The causes listed below are representative of their findings.

- Lubricant was not properly applied to the fifth-wheel mechanism.
- There was no procedure for inspecting the fifth wheel.
- Drivers failed to verify proper coupling.
- Manufacturers' recommendations for cold weather service were not followed.
- The latching tongue on the fifth wheel cracked while towing a trailer.
- The height between trailer and tractor was such that a high-hitch condition resulted.
- The safety latch pin was either not installed or vibrated out.

Fifth-wheel latching failures can result from the following conditions or circumstances.

- Buildup of hardened grease on the fifth wheel assembly or contamination of the grease with debris.
- Cold weather effect on grease in the latching mechanism.
- Vertical misalignment between the fifth wheel and trailer during coupling (high hitch).
- Variations in the flatness between the trailer plate and fifth wheel plate.

Corrective actions and recommended actions from these events include the following.

- Perform maintenance on all fifth wheels that stick, hang-up, or do not operate freely.
- Clean and degrease fifth-wheel mechanisms and apply new grease before cold weather.
- Use 90-weight oil in freezing temperatures for latching mechanisms rather than using grease.
- Ensure latching mechanisms operate freely.
- Perform a test tug on the trailer.
- Check the alignment of the tractor to the trailer as well as the surface of the ground. If the trailer is slightly higher or at an angle, the latching mechanism may not completely latch, which may not be revealed during a test tug.
- Ensure the fifth wheel makes contact with the trailer and raises it during latching.
- Watch for fifth-wheel failure while pulling the trailer slowly in low gear following coupling.

A tractor and trailer are separate units joined together by a fifth wheel (Figure 2-2). The fifth wheel consists of two metal plates: one on the

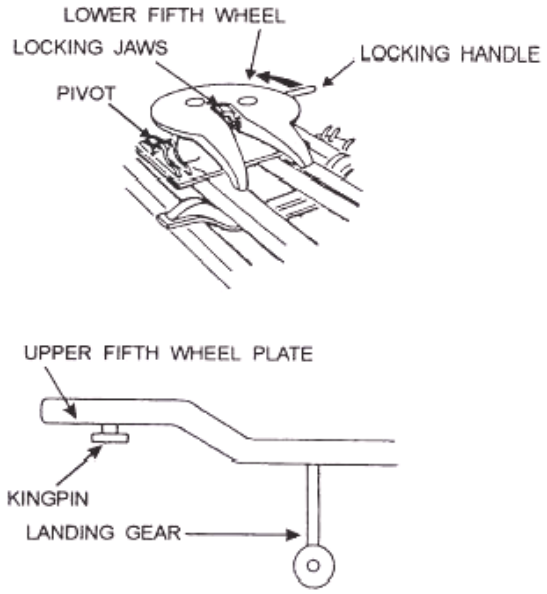

Figure 2-2. Fifth- wheel arrangement

tractor (lower fifth wheel) and one on the trailer (upper fifth wheel). The upper and lower fifth wheels form a flexible coupling that permits both rotational and vertical movement between the tractor and trailer. The upper fifth wheel consists of a flat plate and a kingpin. The lower fifth wheel has locking jaws that lock around the kingpin to couple the tractor-trailer together. Figure 2-3 shows a well-greased lower fifth-wheel plate.

Figure 2-3. Lower fifth-wheel plate

Commercial driver's manuals typically provide guidance and instructions for tractor trailer coupling and uncoupling, including coupling inspections and general vehicle walkaround inspections. These inspections should include a check to ensure that the trailer bed plate is resting on the top surface of the fifth-wheel plate with no visible gap or indication of high hitching (Figure 2-4).

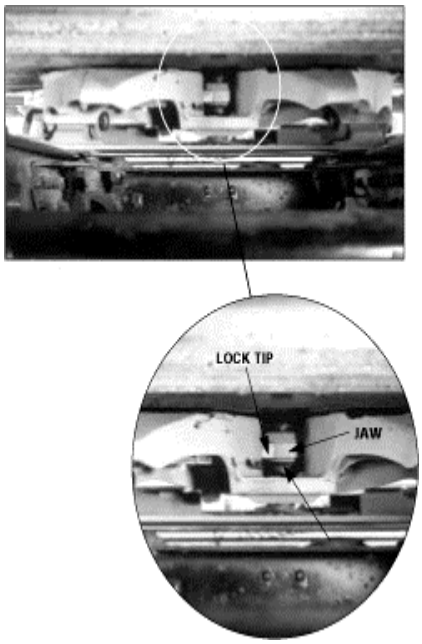

Figure 2-4. No gap between upper and lower plates

Federal regulations require positive locking mechanisms on tractor trailers. CFR 49, Subpart F, 393.70(b)(2), *Locking*, states that every fifth-wheel assembly must have a locking mechanism. The locking mechanism, and any adapter used in conjunction with it, must prevent separation of the upper and lower halves of the fifth wheel assembly unless a positive manual release is activated.

These events underscore the importance of ensuring that fifth-wheel mechanisms are maintained in proper working condition and that drivers verify the fifth wheel and trailer kingpin are securely latched. Qualified transportation personnel should inspect all commercial transportation equipment before loading any hazardous material. Accidents involving tractor trailers that transport radioactive or hazardous materials can result in injury, vehicle damage, and loss of load with potential environmental impact.

KEYWORDS: *Uncoupled, detached, fifth wheel, trailer, maintenance, inspection, transportation*

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

3. UF_6 CYLINDER DROPPED DURING HANDLING

On August 27, 2002, at the East Tennessee Technology Park (ETTP), one end of a storage cylinder containing more than 21,000 pounds of solid uranium hexafluoride (UF_6) dropped approximately 1 foot onto a concrete surface when the tines on a cylinder handler accidentally released. The carbon-steel cylinder sustained only minor damage and did not breach as a result of the drop. There was no release of UF_6 and no injuries. (ORPS Report ORO--BJC-K25GENLAN-2002-0016; final report issued November 20, 2002)

The Model NCH-35, Allied-Wagner cylinder handler (Figure 3-1) is classified as a safety-significant component in the safety basis for the UF_6 cylinder storage yards at ETTP. The handler was being used to transport a 10-ton depleted UF_6 cylinder (Model 48, Serial #9209, gross weight 24,010 pounds at 0.2 percent assay). As the handler moved forward, the tines on one end of the cylinder opened unexpectedly, and the cylinder dropped. Workers lowered the supported end of the cylinder to the concrete, placed the cylinder in a secure position, and inspected it for damage. They moved the cylinder handler to the ETTP garage for additional inspections and tests.

Facility personnel critiqued the event, and partially reconstructed it using a concrete-filled cylinder. During event reconstruction, an interlock design feature failed in two of four trials, with the concrete cylinder dropping only when the operator intentionally actuated the lever to open the tines. An Allied-Wagner factory representative stated that, because of the interlock design feature, the arms should never release under

Figure 3-1. Allied-Wagner cylinder handler

load, even in the total absence of hydraulic pressure.

Management suspended cylinder handling using the Allied-Wagner cylinder handlers at ETTP, as well as at the Paducah Gaseous Diffusion Plant and the Portsmouth Gaseous Diffusion Plant. Operations will remain suspended at all three locations until investigations have been completed and managers identify corrective actions and implement them.

On August 29, 2002, an Allied-Wagner factory representative directed several functional tests of the two NCH-35 cylinder handlers at ETTP, including the one involved in the incident. Testers first checked the cylinder handlers for general operational condition, then measured the hydraulic pressures on the tine opening and closing lines and compared them to factory settings. They determined that the hydraulic line pressures for the lines used to open and close the tines on the handler involved in the event were equivalent to the factory settings.

Testswere also performed to determine whether the tines would open while a cylinder was suspended. Although the tines opened under these conditions in two of the four trials, a cylinder never dropped unless the operator intentionally signaled the tines to open using the open/close lever.

Investigators identified the direct cause of this occurrence as personnel error (inattention to detail). Tests indicated that the only way a cylinder could be dropped was if the operator actuated the lever to open the tines. The root cause of the event was identified as a design problem. There was no designed fail-safe feature to preclude an operator from accidentally actuating the open lever while carrying a cylinder. An equipment/material problem was a possible contributing cause. The hydraulic cylinder packing may have reached its end of life and allowed the hydraulic pressure in the actuating mechanisms for the tines to decay.

Corrective actions included implementing the following recommendations from the Allied-Wagner factory representative to improve the reliability of the cylinder handlers.

- Install a proximity sensor to signal the presence of a cylinder in the tines and disable the operator's open/close actuating lever for the tines.
- Install a set of pilot-operated check valves designed to maintain the hydraulic pressure level in the tine-closing line when the open/close actuating lever is in the neutral position.
- Inspect and rebuild the hydraulic cylinder piston packing on the handling units as necessary to reduce the probability of hydraulic pressure decay in the tine closing lines.

Airborne UF_6 reacts vigorously with water vapor in air, forming hydrogen fluoride vapor (a powerful acid and lung/skin irritant) and oxides of uranium. Because of the low sublimation rate of solid UF_6 at storage yard temperatures, the safety analysis calculations indicated that, even with a breached cylinder, facility workers and collocated workers could evacuate prior to any significant exposure. Calculations also indicated that the consequences of a breached UF_6 cylinder accident would not challenge offsite evaluation guidelines, and no actions were required to protect the public from this accident sequence.

A search of the ORPS database for events related to UF_6 cylinders over the last several years

identified no other dropped cylinder occurrences.

This event demonstrates the need to emphasize attention to detail while operating, maintaining, or inspecting safety significant structures, systems, equipment, and components. This occurrence also supports the concept of continuing training for heavy equipment operators on a regular schedule to minimize the frequency of human errors. When designing equipment or conducting design reviews, consideration should be given to making the system as fail-safe as economically feasible, to preclude common human errors that could result in undesirable consequences.

KEYWORDS: *UF_6, dropped cylinder, cylinder handling equipment*

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

4. WORK CONTROL DEFICIENCIES LEAD TO LOCKOUT/TAGOUT VIOLATION

On September 12, 2002, at Pacific Northwest National Laboratory (PNNL), a staff member noticed three subcontractor workers performing electrical work without having installed an over-lock on an electrical disconnect (circuit breaker). The workers were installing a new environmental growth chamber in a laboratory when the violation was discovered. Subsequent investigations revealed work planning deficiencies, use of unqualified individuals to manage the work, lack of communication at several levels, subcontractor refusal to follow direction to install a lockout/tagout over-lock, and training deficiencies. (ORPS Report RL--PNNL-PNNLBOPER-2002-0013)

The environmental growth chamber has a 100-amp, 120/208-volt, 3-phase, 4-wire electrical supply. When the lockout/tagout violation was discovered, PNNL management immediately stopped the work. They discussed lockout/tagout requirements with the subcontractor. Subsequently, the subcontractor workers implemented the appropriate lockout/tagout requirements, and PNNL managers approved resumption of work.

Early in the installation process, a PNNL Facilities and Operations (F&O) staff electrician informed the subcontractor supervisor that before beginning electrical work his workers had to add their own over-lock to the "Do Not Operate" tags placed at the electrical disconnect by the F&O organization. However, the supervisor did not follow this instruction, apparently because the electrical disconnect was in plain view of those performing the work.

Uncertainty concerning who had project management authority, as well as the lack of qualified project oversight, also may have contributed to the subcontractor's decision. The F&O organization (the owners of the building) should have been assigned to manage the installation work, but were not. Instead, the staff of the Environmental Technology Division (ETD), the research organization that would be using the chamber, assumed project management responsibilities. The ETD staff was not experienced in construction management and was not trained in electrical work or in site lockout/tagout policies and practices.

Investigators identified the direct cause of this occurrence as personnel error (procedure not used or used incorrectly). They determined that subcontractor personnel did not follow their own procedures for control of hazardous energy sources, patterned after OSHA regulation 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout).* Also, the subcontractor supervisor did not follow the F&O electrician's direction to apply an over-lock.

Several contributing causes were also identified, including inadequate work planning and inadequate communications in several areas. For example, the power supply was energized before chamber installation rather than after, as originally planned. There was insufficient field coordination, no written direction to the subcontractor on the site lockout/tagout requirements, and inadequate involvement of subject matter experts in contracts and construction management. In addition, there were training deficiencies both at the subcontractor level (i.e., no lockout/tagout training) and the project manage-

ment level (i.e., the ETD staff was not trained in construction management).

The root cause of this occurrence was identified as a work organization/planning deficiency because a construction task was managed by a research organization instead of by an experienced construction manager.

The following corrective actions resulted from this occurrence.

- Issue instructions to construction managers and building managers on work control processes to ensure that all parties clearly understand who is in charge of the activity, all significant activities are included in work planning documents, and a formal process is followed for changes in work controls or procedures.
- Revise engineering, project management, work flow, and work control procedures to clarify that project management responsibilities for facility modifications include the entire project scope, unless specific responsibilities are formally transferred in writing and documented.
- Revise facility use agreements between building owners and the researchers to clarify that the building owner has project management authority for all activities involving facility modifications.
- Conduct information sessions on the event with PNNL staff and specifically address breakdowns in communications, lock and tag requirements, and the expectations for individual roles, responsibilities, authorities, and accountabilities for project execution.
- At an appropriate time in the future, conduct management assessments to evaluate the effectiveness of the revised and clarified procedures and processes.

A review of the ORPS database for events involving lockout/tagout issues over the last 6 months identified more than 50 events, most of which addressed electrical (vs. mechanical) lockout/tagout problems. Typical problems addressed in these reports included unintentional cutting of energized wires (ORPS Report ALO-AO-BWXP-PANTEX-2002-0021), failure to apply and verify a comprehensive lockout/tagout before starting work (ORPS Report OH-WV-WVNS-FPS-2002-0001), failure to identify and isolate all energy sources to a component (ORPS Report SR--WSRC-FTANK-2002-0004), and failure to perform zero-energy checks before starting work (ORPS Report ID--BBWI-SMC-2002-0001).

These events underscore the need to follow existing requirements and procedures for controlling hazardous energy sources (electrical, mechanical, pneumatic, and hydraulic) to avoid injuries to workers. For electrical energy sources, this involves identifying, isolating, and applying a proper lockout/tagout to all circuits affecting the component to be worked on in accordance with OSHA regulation 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout). *Furthermore, when staff members assume responsibility for activities in which they have not been trained or when staff fail to execute the work processes for which they are responsible, performance degradation can occur. For any individual task or project, the source of project management responsibilities for the entire scope of work must be clear.*

KEYWORDS: *Project management, work controls, procedure compliance, lockout/tagout, LO/TO, electrical safety*

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