



DOE ACCIDENT PREVENTION AND INVESTIGATION

Bi-Annual Summary Report

U.S. Department of Energy ▪ Office of Health, Safety and Security ▪ AI-2010-01 ▪ April 23, 2010

Type B Accident Investigation

Employee Burn Injury
at the D Area Powerhouse

September 23, 2009



Type B Accident Investigation

Hand Injury at the
Salt Waste Processing Facility

October 6, 2009



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This first in a series of reviews will be providing summary analyses of Type A, Type B, and Limited Scope Investigations conducted by the Department of Energy (DOE). The goal of conducting these reviews and analyses is to provide DOE and contractor management with an overview of the safety management system weaknesses identified and discussed in each of the investigation reports and occurrence reports on file in the Occurrence Reporting and Processing System (ORPS) database.

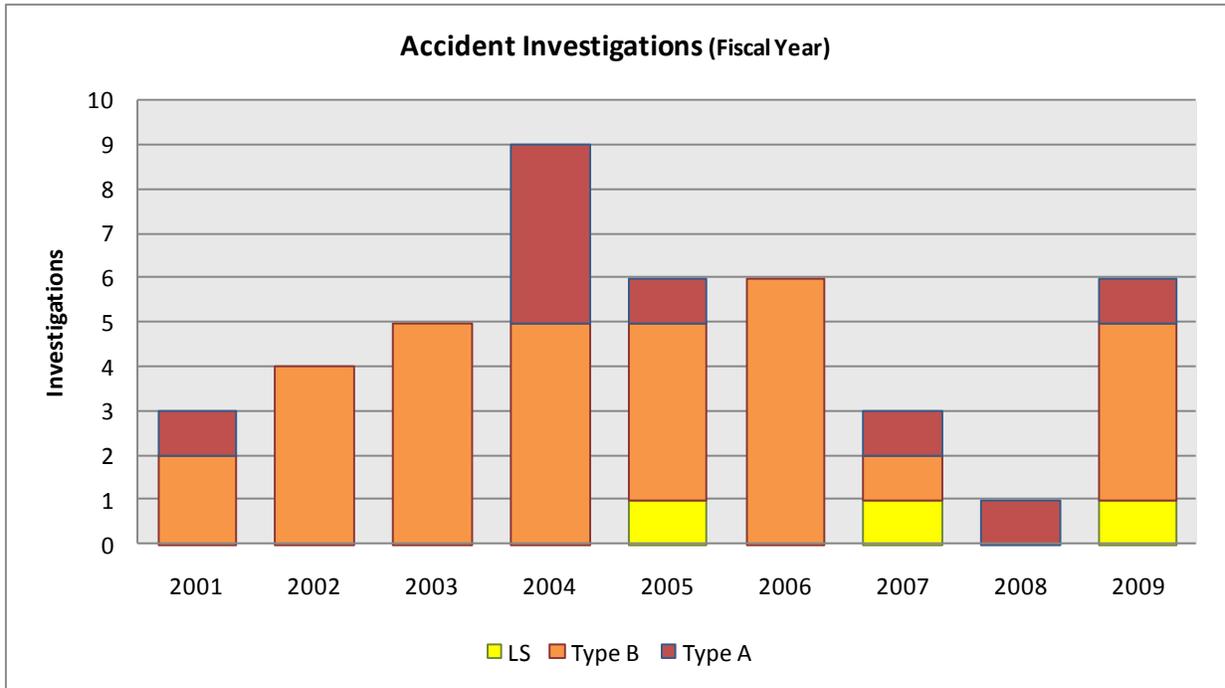
The Office of Health, Safety and Security (HSS) encourages both DOE and contractor management to review these reports and use the information provided to assess the identified weaknesses against current work practices to ensure a safe work environment.

Accident Investigations Completed:

| ORPS Events | Description | Investigation Initiated |
|----------------------------|---------------------------------------------------------------------------------------------------------|-------------------------|
| EM-SR--SRNS-SIPS-2009-0008 | Employee Burn Injury at the D Area Powerhouse, September 23, 2009, Savannah River Site | 09/25/2009 |
| EM-SR--PSC-SWPF-2009-0010 | Hand Injury at the Salt Waste Processing Facility, October 6, 2009, Savannah River Site | 10/15/2009 |

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Overall Condition: Historical Perspective

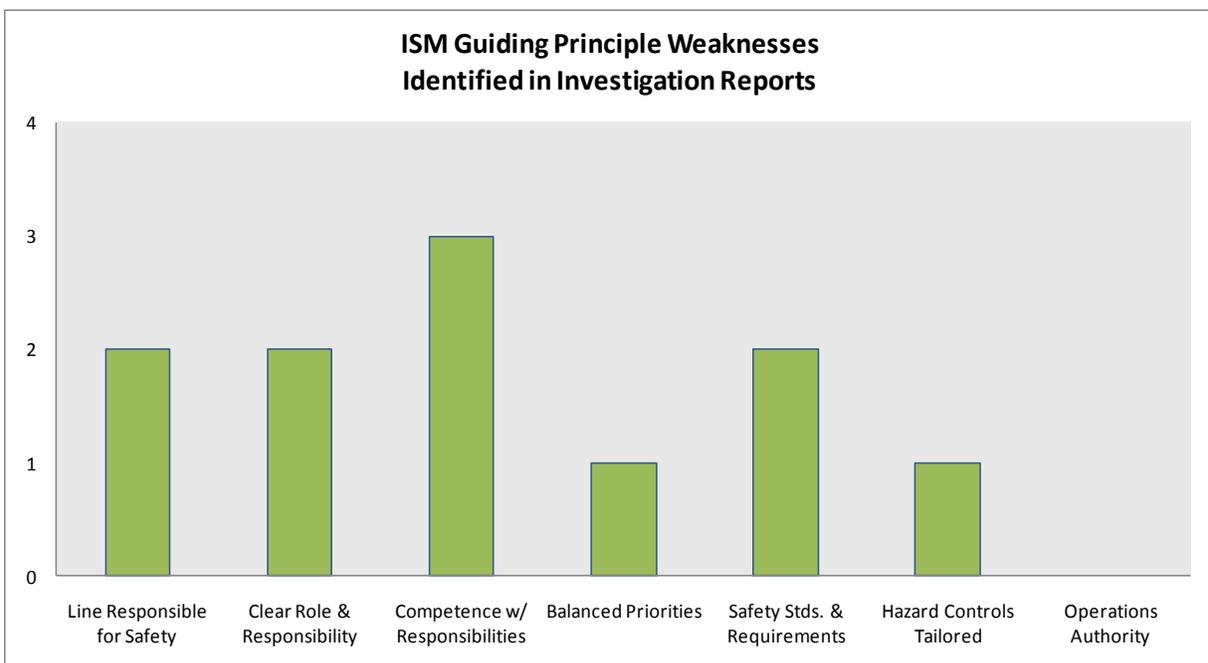


2009 shows a definite rise in the number of accident investigations overall, a trend last seen from 2001 through 2004. This upturn in the number of serious accidents within the Complex is one reason this report is being published. The main goal being to provide information that can be used toward *prevention* of accidents by becoming alert to identified weaknesses in the Integrated Safety Management Systems they are implemented throughout the DOE complex.

Current Quarter Causal Analysis Summary

HSS reviewed the two reports completed with special emphasis on the analyses and conclusions presented in each of the investigation reports. The contributing causes as listed in the two investigation reports were reviewed and summarized. The summary causes from these reports were binned and assessed against the Integrated Safety Management (ISM) *Guiding Principles* and *Core Functions*.

ISM Guiding Principles

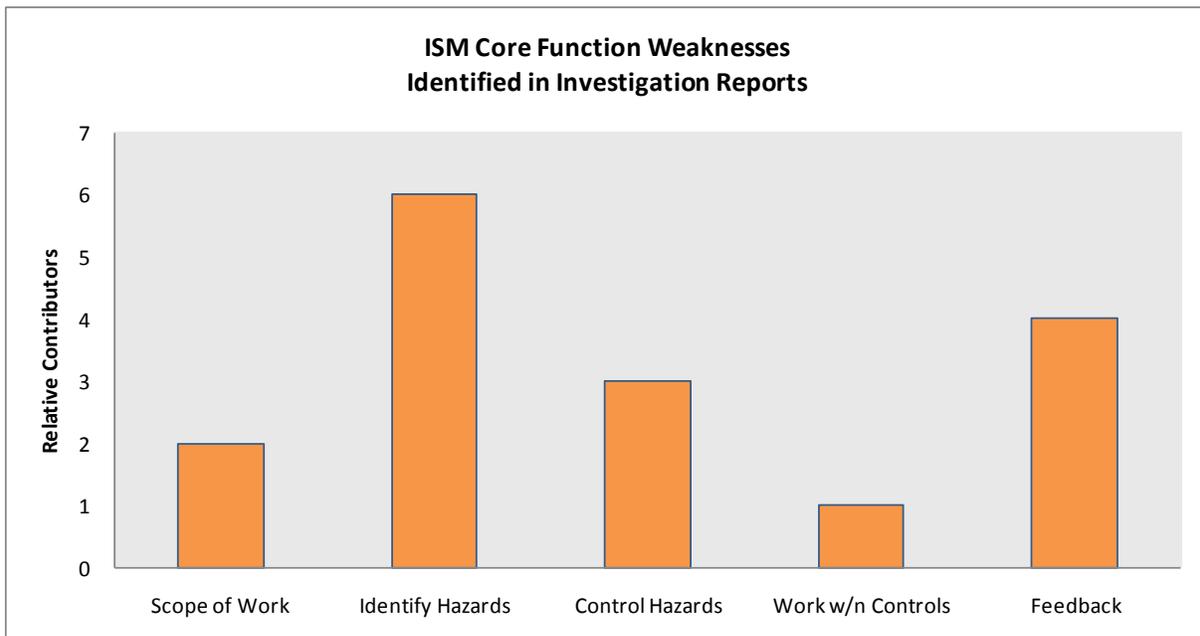


ISM Guiding Principle 3 – Competence Commensurate with Responsibilities was identified as the greatest contributing cause in the two investigation reports. In comparison to the investigation reports, the available data from ORPS reports for the previous six months indicated “Human Performance” (Tier 1, A3) deficiencies as the greatest contributor those operational events filed. The second level (Tier 2) greatest contributors were Skill Based Errors (B1) and Knowledge Based Errors (B3).

Managers should be alert to ensure workers are receiving the proper training and certification, where required, to carry out their work responsibilities in a safe manner. Workers should be observed from time to time during the conduct of work to not only assure the required knowledge, skills and abilities are possessed by the workers, but properly identified and implemented in the work control processes.

ISM Core Functions

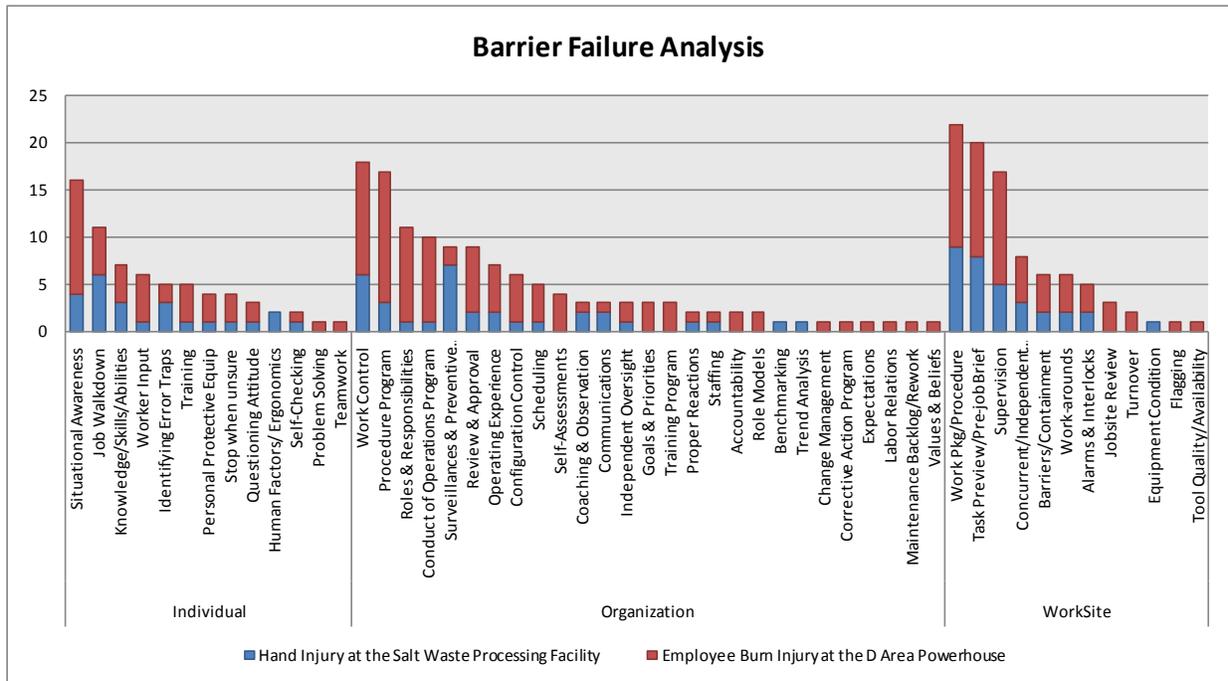
Failure to identify hazards, either as part of the work planning or work execution was the greatest weakness identified in the investigation reports. This general theme was also identified in the review of the six months' prior occurrence reports. A weakness in Feedback and Continuous Improvement was the second greatest contributor. Failing to identify weaknesses in the work planning or execution processes provided a lost opportunity for improving any and all work processes.



Managers should assure themselves that the work planning and control at their facilities provides for formalized hazard identification sufficient to apply the appropriate hazard controls in place prior to the execution of work. Feedback mechanisms should be in place to capture workers input as to problems encountered in the work planning or execution and ideas for improving safety during the conduct of work.

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Barrier Failure Analysis



Barrier failures were identified in each of the two investigation reports. HSS classified barrier failures in three levels: The individual, the work site and the organization. At the individual level, Situational Awareness was the greatest contributor, followed by Job Walkdowns and Worker Knowledge, Skills, and Abilities.

The most common barrier failures at the work site level included Work Package/Procedure, Task Preview/Pre-job, and Supervision. At the organizational level, Work Control, Procedure Program, and Roles and Responsibilities are leading contributors in the investigation reports reviewed.

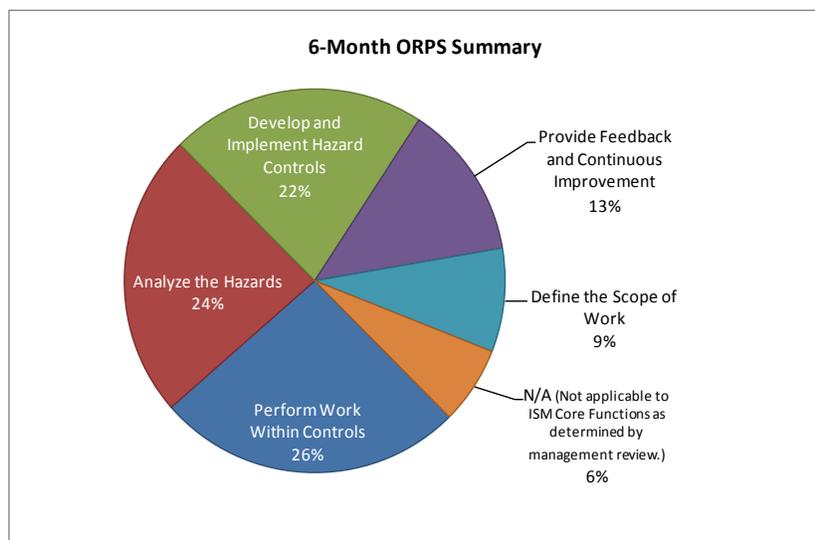
Whether grouping causal factors into ISM categories or the newer HSS Barrier Failures method of grouping causal factors, the results indicate that failures in hazard identification and control, and worker competencies were the leading contributors to these accidents. Managers should take steps to assure on a regular basis that their work planning and execution, including workers competencies, are meeting the rigor necessary to perform work safely.

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Occurrence Reporting and Processing System Precursor Analysis

HSS conducted a review of occurrence reports filed at The Savannah River Site(SRS) for the six months prior to the September 23rd and October 6th 2009 accidents (April to September). During that time 60 occurrence reports were filed.

The ORPS requires the selection of an ISM code when entering an occurrence into the system. However, the ORPS field accommodates only codes related to the Five Core Functions. The selection includes six codes: One of the Five Core Functions and “N/A.” ISM Guiding Principles are not accommodated in the ORPS entry forms.



In terms of the ISM Core Functions for the occurrences reviewed, 72% of the reports cited deficiencies to properly:

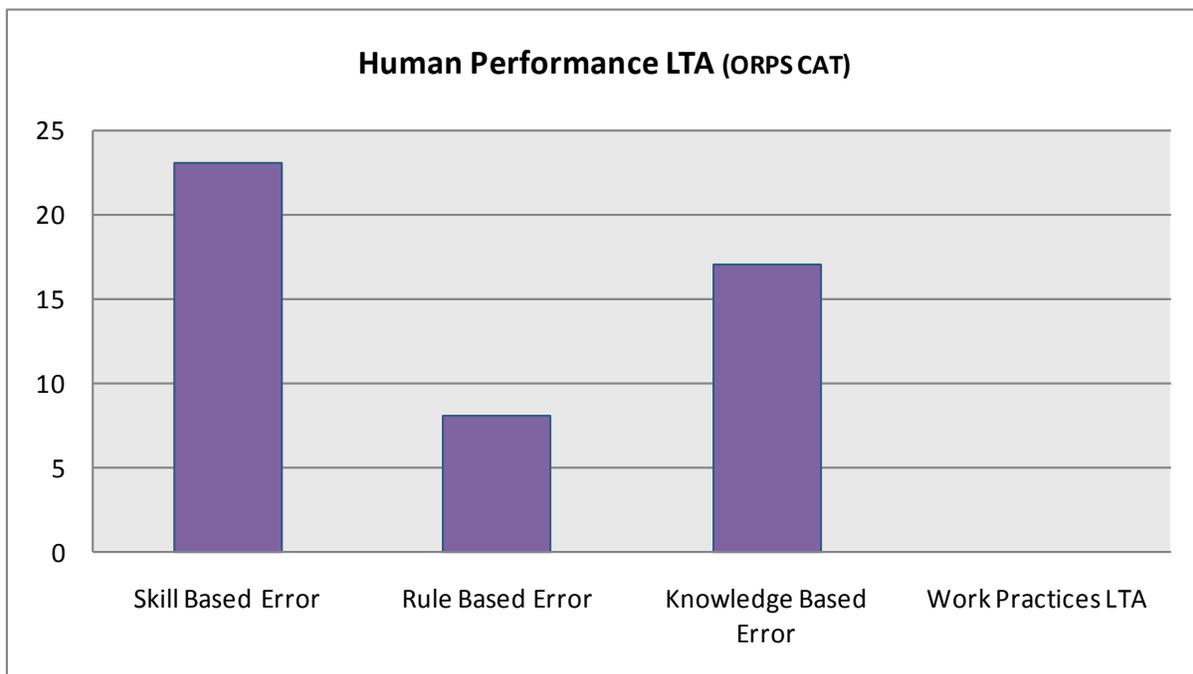
- Perform work within controls (26%);
- Analyze the hazards (24%); and
- Develop and implement hazard controls (22%).

In the Salt Waste Processing Facility Hand Injury accident, the Board concluded a failure to recognize the wire rope lubrication as a hazardous activity (or even a maintenance activity) was a major contributing factor. In the Employee Burn (Arc Flash) Injury at the D-Area Powerhouse, the Board concluded the Qualified Electrical Workers involved did not fully define the scope of work or analyze the hazards (pg 14), and disregarded proper implementation of hazard controls (pg 13). HSS concluded the precursor information available from the ORPS database regarding identification and control of hazards at the worksite was consistent with the Board’s observations in the accident investigation reports.

Human Performance Improvement Considerations

Human Performance Improvement (HPI) is about reducing errors and managing defenses to prevent significant events. The application of HPI Principles in numerous organizations (medical, nuclear, chemical, etc.) has resulted in improved safety, quality, and productivity. HPI is not a program, but rather a distinct way of thinking based on a performance model that illustrates the organizational context of human performance.

ORPS allows multiple causal factors to be associated with any one event. Twenty-two of the sixty SRS ORPS reports reviewed attributed Human Performance as causal factors in these events (ORPS CATS Tier A3). For these 22 reports the most recurrent second tier causal factor was Skill Based Error followed by Knowledge Based Error. In combination these areas point to weaknesses in ISM Guiding Principal 3, *Competence Commensurate with Responsibilities*: Personnel shall possess the experience, knowledge and abilities that are necessary to discharge their responsibilities.



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Conclusion

During the six months previous to these two accidents, SRS facilities reported 60 operational events. A review of those events concluded the majority of the ISM Core Function deficiencies were related to identification and control of hazards. This report does not include a review of planned and unplanned work place and work planning and control assessments that may have been conducted by SRS and DOE Management. However, this does point out an opportunity for both SRS and DOE Management to assess performance as reported and recorded in the ORPS data system and use those results to guide oversight activities.

Accident Investigation Report Summaries

Employee Burn Injury at the D Area Powerhouse, September 23, 2009, Savannah River Site ([ORPS Event EM-SR-SRNS-SIPS-2009-0008](#)) — While troubleshooting in a 480 volt breaker cubicle, an electrical and instrumentation (E&I) mechanic received second and third degree burns to his arms and first and second degree burns to his face when a metal tool (9-inch torpedo level) contacted the energized "A" phase of the breaker causing a direct short to ground and arc flash event. The tool had been placed in the energized cabinet by a second E&I mechanic as part of troubleshooting activities to determine the extent of “adjustments” needed to align the breaker within the cabinet.

Procedurally, the breaker cubicle was of a sufficient arc flash hazard category that work in the vicinity of the cubicle was not allowed with the cubicle door open and the conductors energized. In addition, neither E&I mechanic was wearing arc flash suits or flame retardant coveralls with face shields that are normally required for working within the vicinity of energized switchgear. Immediate supervision was aware of ongoing troubleshooting and repair with the equipment energized.

The Board determined the Direct Cause as “Metal torpedo level fell and came into contact with Phase ‘A’ of an energized 480 volt breaker.”

The Board determined the Root Cause as “Experienced Qualified Electrical Workers (QEW) failed to comply with required and expected safe electrical work practices.”

The Board determined the following Contributing Causes:

- Degraded equipment and facility conditions necessitated frequent reactive maintenance.
- Past operating practices fostered an environment conducive to shortcuts and work-around being used without proper analysis.
- Management had not effectively enforced requirements and reinforced expectations regarding procedural compliance and personal accountability to perform electrical work safely.
- It was an accepted practice in 484-D for the main breakers to be worked without Procedure 18Q-2 being properly implemented (i.e., a lockout or special energized electrical work permit was not used).
- QEWs had an incomplete understanding of Procedure 18Q-2 requirements and did not refer to the procedure for the specific work application.
- A QEW placed an unauthorized tool (9-inch metal torpedo level) into the restricted space near exposed energized 480 volt electrical components.
- Lack of effective 484-D work planning and control process, including use of a monthly troubleshooting work package that was non-compliant with Procedure 1Y-8.03 requirements, allowed electrical work to occur without appropriate identification of specific scope, hazards, and controls.

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- Operations did not demonstrate a sense of ownership and responsibility for facility electrical activities.
- Conduct of Operations and Maintenance requirements had not been effectively implemented in 484-D and the safety culture had not fully matured.
- The pre-job briefing failed to address specific scope, hazards, and controls.
- Corrective actions resulting from previously identified deficiencies did not ensure that electrical work practices were understood by all QEWs or reduce the excessive reliance on QEWs as the single line of defense to identify needed controls.

Hand Injury at the Salt Waste Processing Facility, October 6, 2009, Savannah River Site ([ORPS Event EM-SR--PSC-SWPF-2009-0010](#)) — An Apprentice Crane Operator received a serious injury to the left hand and fingers while performing lubrication of the wire rope on a mobile crane. The Apprentice had his hand caught between the wire rope and the sheave over which the rope passes, resulting in a crushing injury to the left hand and fingers.

Construction site supervision was aware that the lubrication evolution was to be conducted, but the evolution was not identified in the listing of work activities for the shift. A task-specific Job Hazards Analysis had not been performed to develop formal controls for the evolution. The job was discussed in the Safe Work Briefing for the shift, but the specific lubrication method being used at the time of the accident was not discussed. The lubrication method being used at the time of the accident was not in accordance with methods specified in the mobile crane's operating manual.

The Board determined the Direct Cause as "The Apprentice Crane operator's left hand was caught between the wire rope and the crane sheave."

The Board determined the Root Cause as "An unsafe method was used to apply lubricant to the wire rope."

The Board determined the following Contributing Causes.

- Construction supervision failed to recognize wire rope lubrication as a maintenance activity as described in procedure PP-SH-4382, *Mobile Crane and Hoisting and Rigging*, which requires a work order per procedure PP-CS-7201, *Construction Work Release Procedure*.
- A task-specific Job Hazards Analysis was not developed for implementing controls to mitigate hazards associated with the wire rope lubrication activity.
- The Safe Work Brief failed to ensure that the workers understood the scope of work, associated hazards, and the methods specified in the crane operating manual to perform the work activity in a safe and compliant manner.
- The roles and responsibilities of the Certified Crane Operator (journeyman) were not maintained for the task of lubricating the wire rope.
- The Certified Crane Operator (journeyman) failed to recognize the hazards associated with lubricating the wire rope while it was traveling toward the sheave and did not initiate a "time out for safety."

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- A work activity, lubricating the wire rope while the rope was moving toward the sheave, was performed not in accordance with the guidance in the Manitowac 888 Crane Operators Manual.
- Corrective actions taken as a result of previous facility events to improve the rigor of ISMS functions related to job scope definitions, hazard analysis, and hazard controls were not sufficient to prevent this accident.

Accident Investigation Training

HSS conducted Accident Investigator training at the Brookhaven National Laboratory for both federal and contractor employees in February. HSS conducted Accident Investigator training at the DOE National Training Center in Albuquerque, NM the week of April 26, 2010. This course integrated a new accident scenario into the training program.

HSS is planning to conduct Operational Safety/Accident Analysts training (a 3-day course) at Idaho in late July 2010. HSS is also planning on conducting an Accident Investigator course in September at the Savannah River Site.

To arrange for training, contact:

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