DOE Accident Prevention and Investigation

Bi-Annual Summary Report

U.S. Department of Energy ▪ Office of Health, Safety and Security ▪ AI-2012-01 ▪ February 28, 2011

Federally Led Accident Investigation:

Injury from Tele-Tower Fall in KAC PAV,

July 1, 2011

Federally Led Accident Investigation:

Grass Cutting Fatality at SPR Storage Site,

September 13, 2011

Federally Led Accident Investigation:

ZPPR Workroom Pu Contamination Event in MFC-775,

November 8, 2011

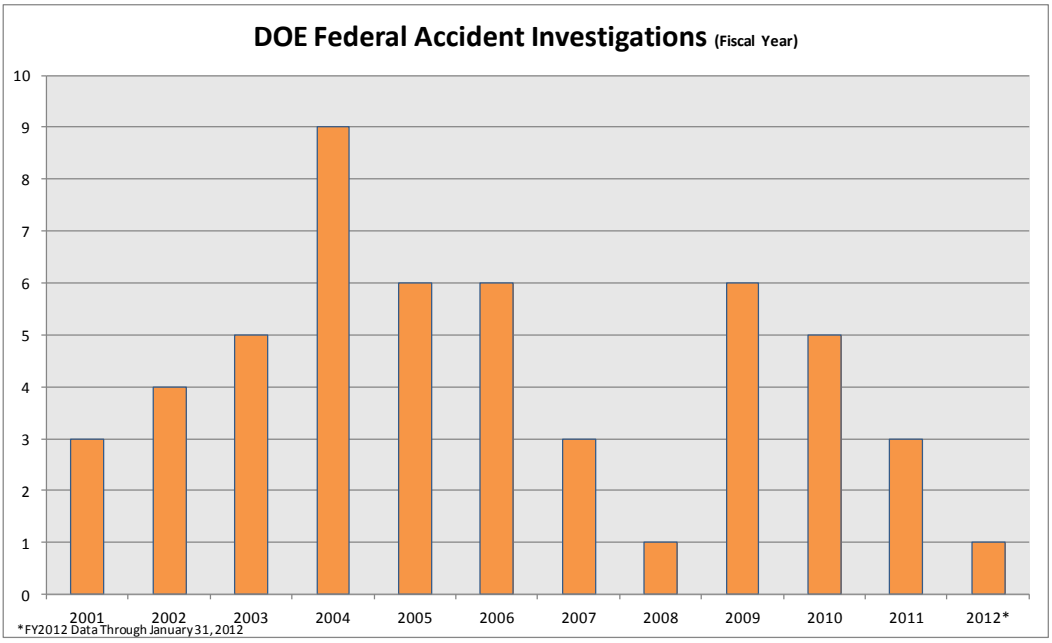
This series of reviews is intended to provide summary analyses of federally appointed investigations conducted by the Department of Energy (DOE). The goal of conducting these reviews and analyses is to provide DOE and contractor management with an overview of the safety management system weaknesses identified and discussed in each of the investigation reports and related 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 Event	Description	Investigation Initiated
EM-SR--SRNS-KAREA-2011-0002	Injury from Tele-Tower Fall in KAC PAV, July, 1, 2011	July 8, 2011
FE--SPRO-SPR-BM-2011-0001	Grass Cutting Fatality at SPR Storage Site, September 13, 2011	September 19, 2011
NE-ID--BEA-ZPPR-2011-0001	ZPPR Workroom Pu Contamination Event in MFC-775, November 8, 2011	November 10, 2011

Overall Condition: Historical Perspective



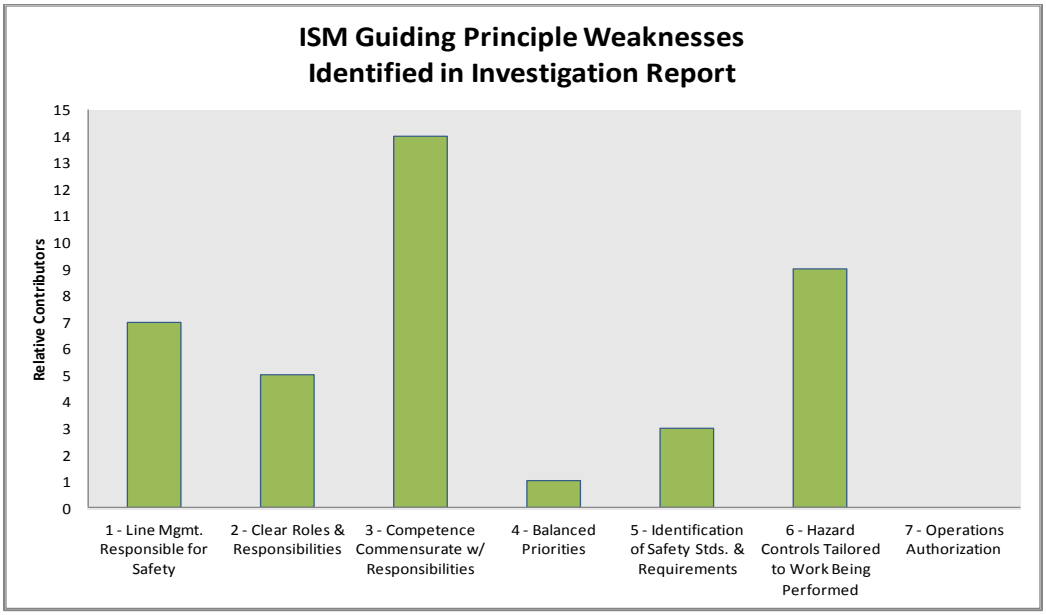
The sharp rise in accidents seen in FY-2009 continues to decline overall. However, the last three accidents occurred in a period of less than a five months indicating an increasing rate of occurrence.

DOE O 225.1B, *Accident Investigations*, states in part, "Moreover, accident investigations are used to promote the values and concepts of a learning organization. The Department's Integrated Safety Management (ISM) Feedback and Improvement function envisions organizations that are continually monitoring performance; identifying deviations or questionable conditions; self-assessing; and using quality analysis to improve." Each of the three investigation reports reviewed in this summary identified significant deficiencies in the area of organizational feedback and continuous improvement. With this recurrent theme, organizations are encouraged to review their processes for effectiveness in monitoring and correcting safety management systems deficiencies.

Causal Analysis Summary

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

ISM Guiding Principles

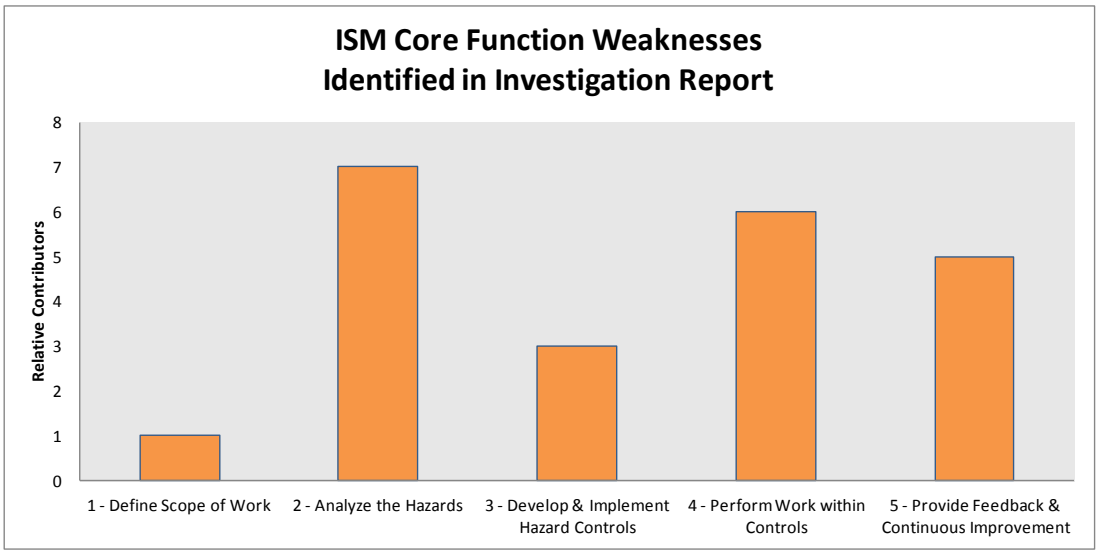


ISM Guiding Principle 3 – Competence Commensurate with Responsibilities – was identified in all three investigation reports as a leading contributor to safety management system weaknesses. This trend continues from the last summary report. Those weaknesses were identified and discussed at both the worker and organizational levels and resulted in specific contributing causes, conclusions and resulting judgments of need.

ISM Guiding Principle 6 – Hazard Controls Tailored to the Work Being Performed – was identified as the second greatest contributor overall to safety management system weaknesses.

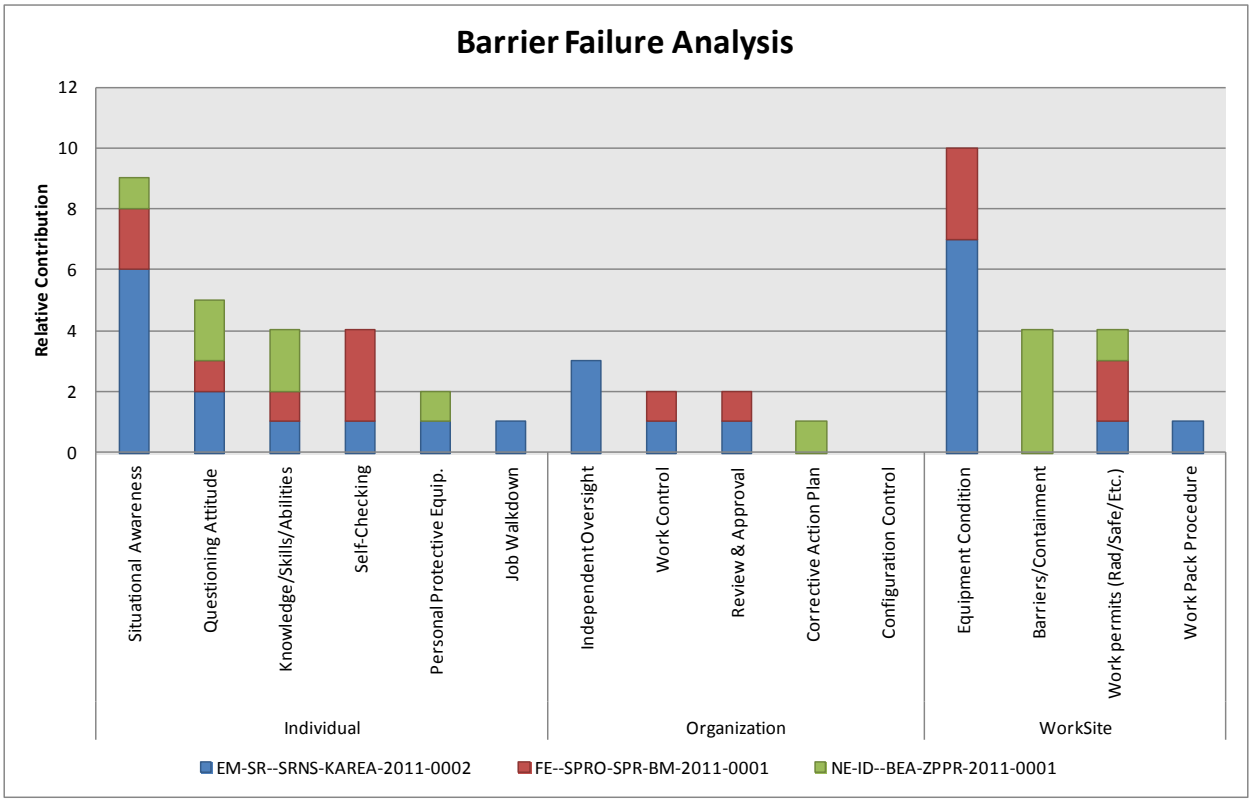
ISM Core Functions

Failure to analyze the hazards, and develop and implement hazard controls were the most frequently cited weaknesses identified in the investigation reports. This general theme continues unchanged from the previous bi-annual summaries.



Managers and oversight organizations should refocus efforts to assure work planning and control documents at their facilities include formalized and rigorous hazard identification practices and apply the appropriate hazard controls prior to the execution of work. Management observations of work in progress need to be in place to capture workers' actions in response to written work instructions and adherence to performing work steps within the established controls.

Barrier Failure Analysis



Barrier failures were identified in each of the three investigation reports. HSS classifies barrier failures into three levels: the individual, the organization, and the work site. Situation awareness coupled with a good questioning attitude was identified in all three accidents as deficient barriers to the safe performance of work.

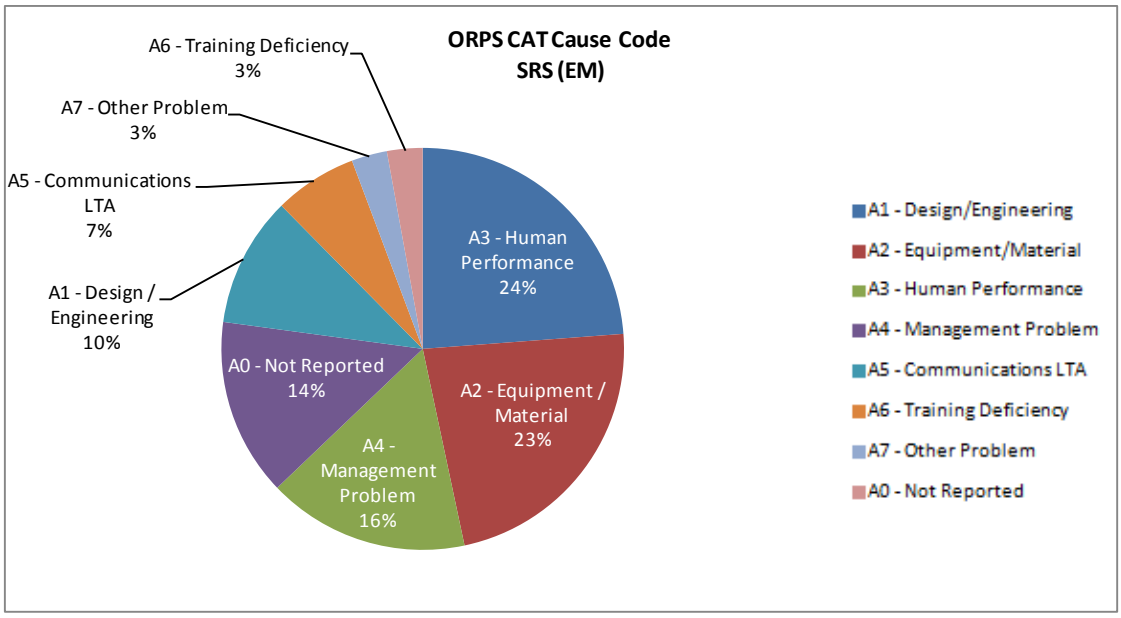
Whether grouping causal factors into ISM categories or the HSS Barrier Failures method of grouping causal factors, the results indicate that failures in hazard identification and control, and worker competencies continue to be the most challenging barriers to overcome. Managers should take steps to assure on a regular basis that their work planning and execution, including worker competencies, are meeting the rigor necessary to perform work safely.

Occurrence Reporting and Processing System Precursor Analysis

HSS conducted a review of ORPS reports filed at each of the sites and respective program offices involved in the accident investigations for the six months prior to the respective accidents. The Office of Environmental Management (EM) Savannah River Site (SRS) had 55 ORPS reports filed, with 192 EM-wide reports on file. The Office of Nuclear Energy (NE) Idaho (ID) had 40 ORPS reports filed with 43 NE-wide reports on file and, the Office of Fossil Energy (FE) Bryan Mound (BM) filed no ORPS reports for the six month period.

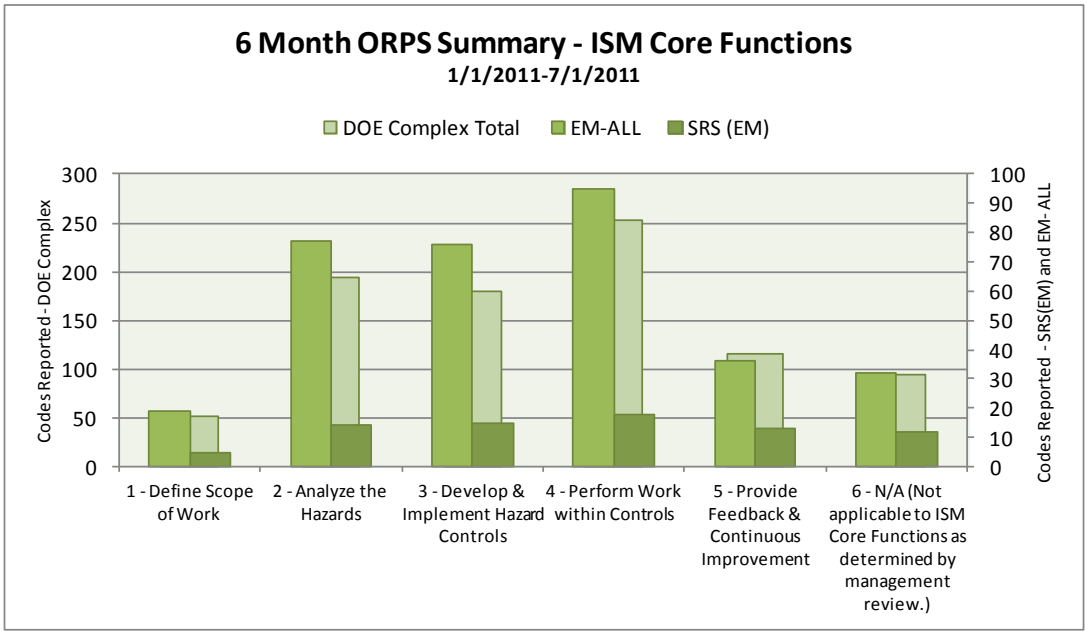
Savannah River Site

The Savannah River Site (SRS-EM) filed 55 ORPS reports in the six months prior to the fall injury at the Purification Area Vault. In 24 percent of these reports, Human Performance was identified as a cause code and in 23 percent of those reports; Equipment or Material problems were identified as a cause code. These observations from the prior six months are similar to the findings of the accident investigation board.



A review was conducted of the ORPS reports filed by SRS prior to the accident comparing those to reports filed in the Office of Environmental Management (EM) and the DOE Complex for the same period. The reports filed by both EM and DOE showed Core Function 1, *Define the Scope of Work*, as the smallest contributor, as did SRS. The Savannah River Site, EM, and the DOE Complex reports identified Core Function 4, *Perform Work Within Controls*, as the greatest contributing cause. The Savannah River

Site appears to follow a similar distribution to that of EM and the DOE Complex, indicating the cross-Complex nature of the ISM core functions observed at SRS.

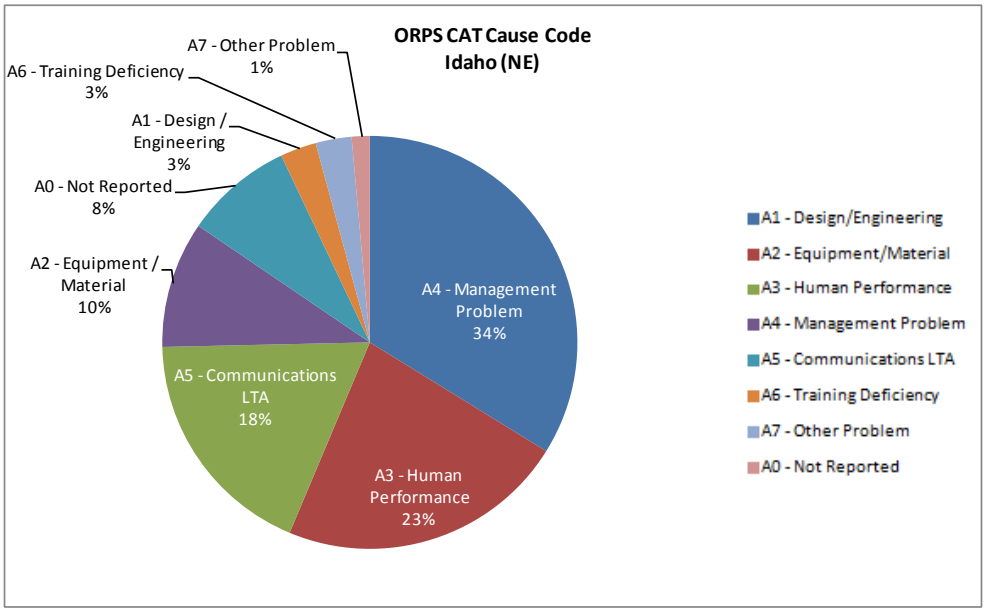


Strategic Petroleum Reserve Bryan Mound Site

For the six months prior to the September 13, 2011, grass cutting fatality at the Bryan Mound facility, no occurrence reports were filed in ORPS. The last occurrence report filed by Bryan Mound documented the July 8, 2010, fatality which occurred during a crude oil storage tank cleaning project involving a sub-contractor (FE--SPRO-SPR-BM-2010-0001). That occurrence report remains a Notification report as of this summary report and contains no causal codes or descriptions.

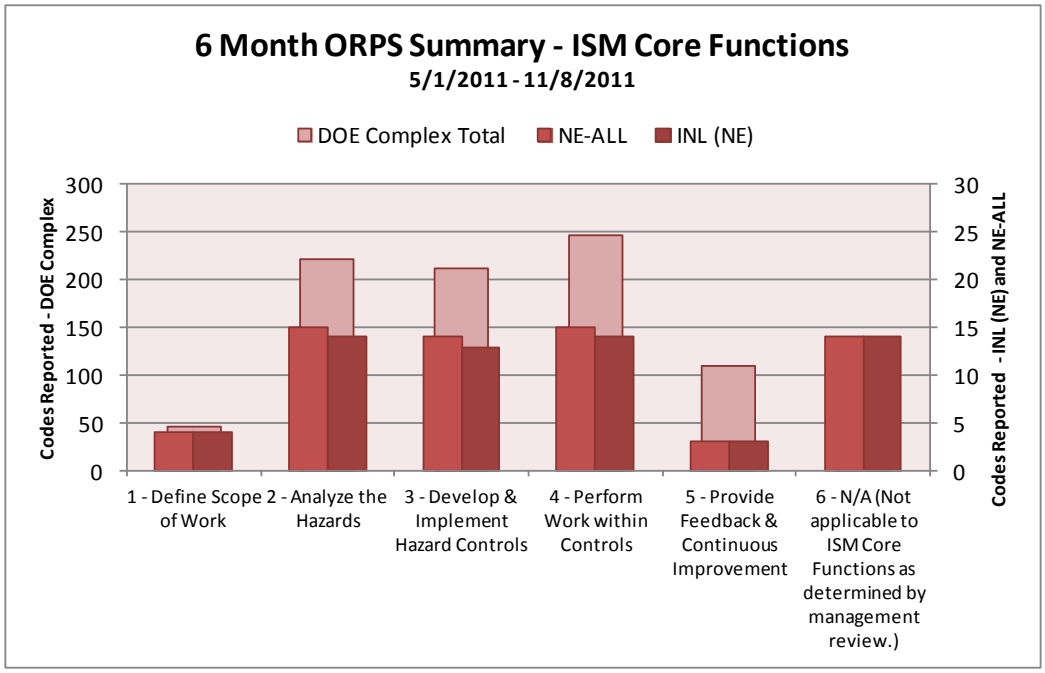
Idaho National Laboratory

NE-ID filed 40 ORPS reports in the six months prior to the plutonium accident at the Zero Power Physics Reactor. In 34 percent of those occurrences the contractor identified Management problem (ORPS CAT Tier 1, A4) as a contributing cause of the occurrences. The next highest contributing cause identified was Human Performance with 23 percent (ORPS CAT Tier 1, A3).



In comparison to the management system weaknesses identified in the investigation report, the Board developed several conclusions related to management failures in identifying and responding to information which should have resulted in changes to the safety basis for the facility and resultant procedural changes to work procedures.

The most cited cause codes identified the ORPS reports were evenly distributed amongst analyze the hazards, develop and implement hazard controls, and perform work within controls. Defining the scope of work and feedback and improvement were the least cited. This closely follows the pattern of the rest of NE and the DOE Complex.



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. Of the 55 EM-SRS occurrence reports filed in the six months previous to the accident, human performance issues (ORPS CAT Tier 1, A3)[1] ranked first, contributing to 24 percent of the occurrences filed. Skills based (ORPS CAT Tier 2, A3B1) errors ranked top among the human performance issues.

Of the complex-wide EM occurrences during that same period, 192 occurrence reports were filed, of which Human Performance issues were attributed to 26 percent of the occurrences, ranking second to Management Problems (29 percent). Likewise with the EM-SRS reports, ORPS CAT Tier 2, A3B1 – skills based errors – ranked top within the human performance category.

NE-ID attributed Human Performance issues to 23 percent of the 40 occurrence reports filed. Rule based errors narrowly topped skills based errors at ORPS CAT Tier 2, A3B2 over A3B1 (six vs. five reports). NE-wide there were only 43 occurrences filed in the six months previous to the accident. Of those, human performance issues ranked second at 22 percent, with Management Problems ranking first at 33 percent. While there were far fewer occurrences in the NE-wide case, the overall ranking closely mirrors that of EM.

[1] The DOE Order 232.2, *Occurrence Reporting and Processing of Operations Information*, dated August 30, 2011, describes the tools used to categorize ORPS reportable incidents: "Occurrences must be investigated and analyzed, as described in the Occurrence Reporting Model (Attachments 4), and causes provided using the causes listed in the Causal Analysis Tree (Attachment 5)."

Conclusion

The overall trend in accidents meeting the criteria for an accident investigation is declining, following the increase seen in FY-2009. However, the recent three accidents have occurred in a relatively short period of time. This *could* indicate an increase in the accident rate; however, this is not clearly a trend.

The SRS fall accident and IDL Materials and Fuels Complex (MFC) Pu contamination accident show that organizational feedback and improvement weighed in heavily when considering management's responsibility to observe and correct management systems intended to identify and correct weaknesses in the safety management systems. The Bryan Mound fatality investigation identified serious issues related to Stop Work processes and implementation for "less than imminent danger" situations, which may have played a role in preventing the accident.

In all three accidents, weaknesses in feedback and improvement were identified as common deficiencies in the management systems used to identify and correct existing unsafe or developing safety issues to preclude any unsafe performance of work. Human performance, principally workers competencies, played an important role relative to workers possessing the necessary skills, abilities and questioning attitudes to performance work safely in all three investigations

Managers should be alert to those areas of ISM weaknesses identified in these investigation reports which played key roles in failing to assure the safe performance of work.

Managers are also encouraged to review and implement the principles of Human Performance Improvement which complement the Integrated Safety Management System (ISMS) to assure the worker and organizational behaviors support a defense in depth against error and the safe performance of at work at all levels.

Accident Investigation Report Summaries

This section contains the summaries for the three accident investigations citied in this report. Web links to the original occurrence reports and investigation reports are included. Occurrence reports whose status is Final are available through public ORPS; reports that are not Final are not available through public ORPS and require a valid ORPS login to view. All accepted investigation reports are available on the HSS web site.

Fall Injury Accident at the Savannah River Site (ORPS Event EM-SR-SRNS-KAREA-2011-002)

On the afternoon of July 1, 2011, while performing construction activities on a portable scaffold (Tele-Tower®) in support of the Purification Area Vault (PAV) modifications, a Detailed Superintendent fell from the scaffold onto a concrete floor. The injured worker (IW) was immediately attended to by co-workers in the area and emergency response was summoned via phone and radio within several minutes. First responders arrived at the scene of the accident within about five minutes. After assessing the worker's condition, the IW was transported to the MCG Health Medical Center via SRS helicopter. The worker sustained head trauma and broken ribs. During the time period of the investigation, the IW remained under medical care and had not returned to work.

The work being performed at the time of the accident was the disassembly and removal of gypsum wall board up to heights of approximately 16 feet. The elevated work was being performed using three portable scaffolds.

The work package for this task was authorized by the shift manager to start on June 24, 2011. Work commenced on June 24 and continued on June 25, 27, 28, 29, 30 and through July 1, the day of the accident. The work performed on June 24, 25 and July 1 was considered "backshift" as it was performed outside the normal shift of four ten-hour days in a work week. Crews generally consisted of two carpenters and four laborers. On the day of the accident, the IW was also acting as the Detailed Superintendent. The work required the use of general hand and power tools and working at elevation using the portable Tele-Tower® scaffolds.

The Board concluded that ambiguities in the requirements, inconsistencies in the steps, and a lack of Safety Professional involvement outside of electronic document approval in the planning process to ensure hazards are mitigated resulted in the creation of a work order that did not establish the necessary controls to safely execute the specified work scope.

The Board also identified a number of discrepancies with the condition and use of the portable scaffolds, questionable condition of the IW's footwear, and unsafe work practices, as well as other DOE and contractor safety management weaknesses.

The Board could not positively establish the exact cause of the IW's fall. In the absence of objective evidence such as an eye witness or a video of the accident, the Board evaluated several factors that could contribute to this accident. While all potential fall scenarios were not specifically documented in the report, many of the potential contributors were analyzed.

The Board concluded this accident was preventable. The Board determined the direct cause of the accident was the IW fell from the portable scaffold, and determined the root cause as SRNS did not recognize and correct unsafe work practices being performed prior to or during the work on the day of the accident.

Fatality at the Strategic Petroleum Reserve Bryan Mound Site, September 13, 2011 (ORPS Event FE—SPRO-SPR-BM-2011-0001)

On the morning of September 13, 2011, DM Petroleum Operations Company subcontractor employees were performing grass cutting activities at the Cavern 5 area of the SPR-BM site. At about 1125 hours, a front deck mower operated by a recently-hired, untrained subcontractor employee struck three large elevated pipes. The accident condition was quickly discovered and reported by one of the co-workers cutting grass in the vicinity, who found the employee pinned between the mower and an elevated pipe. The onsite Emergency Response Team (ERT) was activated and offsite emergency medical services were requested. Cardiopulmonary resuscitation was initiated by trained ERT members within about five minutes, and that treatment continued until the employee was placed into a Surfside ambulance that had arrived at the accident scene. The employee was pronounced dead by medical authorities at about 1220 hours. On September 14, 2011, the Galveston County Medical Examiner's Office issued a preliminary cause of death statement identifying the cause of death as blunt force trauma.

Although the final cause of death has not yet been determined by the Medical Examiner's Office, the deficiencies associated with the conclusions and judgments of need (JON) presented in this report are significant and warrant immediate management attention and appropriate corrective actions. Further, based on the Board's review of previously identified and completed corrective actions for the SPR-BM site from 2000 to present, including actions identified in response to a subcontractor worker fatality at the site on July 8, 2010, the Board concluded that long-standing issues associated with specific elements of the site's work planning and control process were also evident in this accident. Additionally, it is noteworthy that the DOE Independent Review Board that evaluated the July 8, 2010, fatality, identified several opportunities for improvement in the understanding of and adherence to safety requirements, oversight programs, and other areas that are pertinent to this accident.

The Conclusions of the Board were focused in the areas of:

- Work Planning and Control
- Training
- Stop Work authority
- Equipment inspection and maintenance
- Human Performance Improvement
- Lessons Learned/Feedback and Improvement
- Supervision, and
- Safety Organization.

Based upon the findings of this accident investigation, the Board concluded that this accident and the resulting fatality were preventable.

The Board identified the direct cause of this accident as: an untrained subcontractor employee struck three large elevated pipes with significant force while operating a front deck mower.

The Board identified two root causes of this accident: failure by the untrained subcontractor employee to follow the supervisor's direction to stay off the mower; and failure of the SPR-BM site stop work policy and its implementation in addressing less than imminent danger situations.

The Board identified five contributing causes to this accident:

- Less than adequate work control process (Job Hazard Analysis, Safe Work Permit, pre-job briefing, work assignments),
- The employee's lack of competency in operating the mower,
- The recently-hired employee had previous experience at the SPR-BM site,
- Unavailability of the supervisor due to other duties, and
- The employee was left alone with the mower when two of his co-workers left the worksite.

Plutonium Contamination in the Zero Power Physics Reactor facility at the Idaho National Laboratory, November 8, 2011 (ORPS Event NE-ID—BEA-ZPPR-2011-0001)

On November 8, 2011, workers at the Idaho National Laboratory (INL) Materials and Fuels Complex (MFC) Zero Power Physics Reactor (ZPPR) Facility were packaging plutonium (Pu) reactor fuel plates. Two of the fuel storage containers had atypical labels indicating potential abnormalities with the fuel plates located inside. Upon opening one of the storage containers, the workers discovered a Pu fuel plate wrapped in plastic and tape. When the workers attempted to remove the wrapping material, an uncontrolled release of radioactive contaminants occurred, resulting in the contamination of 16 workers and the facility.

The accident resulted in the contamination of all 16 individuals. The external contamination levels ranged from 600 cpm on the head and hand of one individual down to non-detectable. The six individuals with the highest nasal smear results (overall results ranged from 3 to 289 dpm) were sent to CFA Medical for chelation; only four of these individuals opted for chelation. The ten individuals who had lower nasal smear results were sent to the lung counting facility and were also offered the option of chelation. One individual stated that he did not recollect being offered chelation.

The Board concluded that this accident was preventable and that, over time, a number of opportunities had been missed that could have prevented the accident. The Board analyzed information and events dating back to the 1972 ZPPR Facility final safety analysis report, as well as events as recent as the initial medical treatment of the contaminated workers on

the day of the accident. The investigation addressed the impacts of organizational transitions; past processes and procedures used when ZPPR was in operation; the historical and current technical assumptions of the ZPPR safety basis; current work planning and control programs and procedures; and the emergency management and response programs and implementation. In addition, the Board evaluated the oversight and self-assessment systems used by DOE and by the management and operating contractor, Battelle Energy Alliance, LLC (BEA), at MFC over the past several years relative to work planning and control and radiological protection programs.

The Board determined that this accident was preventable.

The Board determined that the direct cause of the accident was the cutting and handling of the plastic wrapping around the Pu fuel plate, which released the Pu contaminants.

The Board determined that the local root causes were:

- BEA did not accurately analyze the Pu hazard in the safety basis and establish commensurate controls.
- The management system lacked requirements intended to influence the decision making of the Nuclear Facility Manager and Shift Supervisor, resulting in a single-point decision to cut the wrapping.

The Board determined the following systemic root causes:

- DOE-ID accepted the risk of known safety basis deficiencies and allowed continued operation of the ZPPR Facility within the framework of a multi-year safety basis upgrade plan without putting effective interim controls in place.
- BEA continued operation of the ZPPR Facility with known safety basis deficiencies and without adequately analyzing the hazard to the worker or establishing effective work control processes.

The Board identified three contributing causes to this accident:

1. The organizational transition resulted in a loss of knowledge and past practices and records that indicated the conditions associated with the fuel plates.
2. Senior MFC management did not recognize the significance of information provided by the history of Pu fuel plate failures and by a white paper from the Chairman of the previously appointed MFC Independent Safety Review Committee.
3. The process work sheet used to conduct the work did not contain directions governed by any of the referenced operating instructions, leading to the creation of work steps without an appropriate hazard analysis or accompanying means of mitigation.

Accident Investigation Training

The HSS National Training Center (NTC) provides training for the DOE Accident Prevention and Investigation Program. The Accident Investigator course (SAF-230) scenario was completely revised in 2010, and has received many good comments from those who have attended since the change was implemented in April of 2010. For course description information and planned training sessions please visit the HSS National Training Center website at: http://ntc.doe.gov.

To arrange for training, contact:

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