



DOE ACCIDENT PREVENTION AND INVESTIGATION

Bi-Annual Summary Report



U.S. Department of Energy ▪ Office of Health, Safety and Security ▪ AI-2010-02 ▪ November 1, 2010

Type B Accident Investigation

Employee Injury at Building 1005H
Upton, New York

October 9, 2009



Level 1 Accident Investigation

Fatal Bobcat/Backhoe Accident
at the White Bluffs Substation

March 1, 2010



Type B Accident Investigation

Employee Puncture Wound at the
F-TRU Waste Remediation Facility

June 14, 2010



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This series of reviews is intended to provide 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.

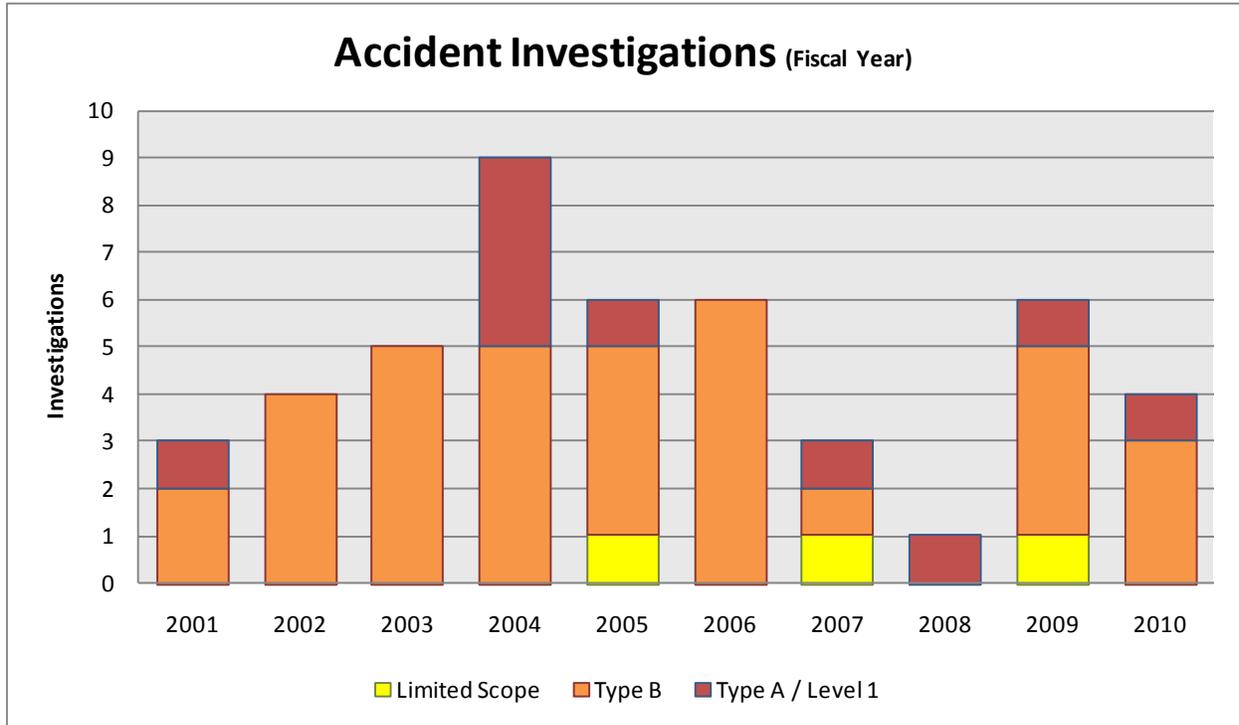
The Office of Health, Safety and Security (HSS) encourages both DOE and contractor management to review these reports and use the information provided to assess the identified weaknesses against current work practices to ensure a safe work environment.

Accident Investigations Completed:

ORPS Event	Description	Investigation Initiated
SC--BHSO-BNL-BNL-2009-0021	Employee Injury at Building 1005H, October 9, 2009, Brookhaven National Laboratory	10/16/2009
EM-RL--GORL-DDSC-2010-0002	Fatal Bobcat/Backhoe Accident at the White Bluffs Substation, March 1, 2010, Bonneville Power Administration	03/02/2010
EM-SR--SRNS-CPWM-2010-0008	Employee Puncture Wound at the F-TRU Waste Remediation Facility, June 14, 2010, Savannah River Site	07/28/2010

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Overall Condition: Historical Perspective



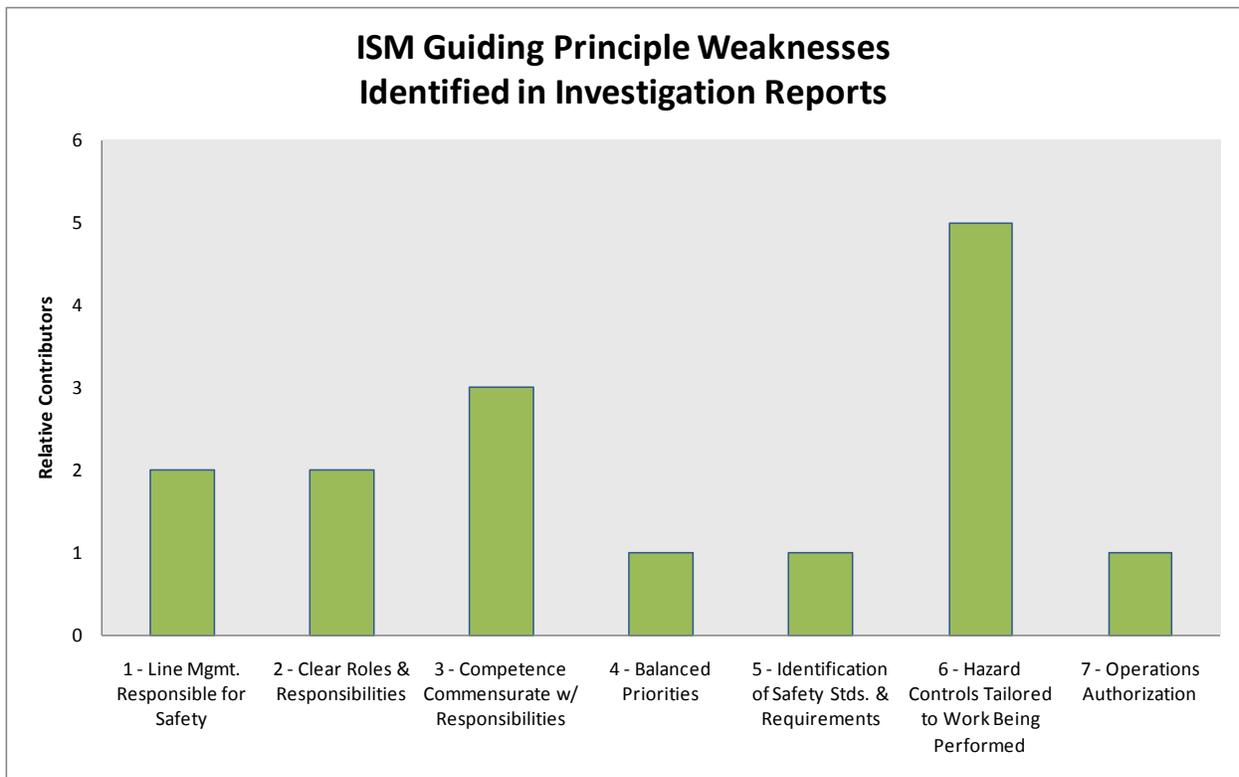
Fiscal Year (FY) 2010 showed one less Type B investigation compared to last year. This remains above the downward trends seen in FY 2007 and FY 2008. Of the last four Type A investigations conducted (since FY 2007), it is important to note that three involved worker fatalities. Of those three, two fatalities involved motor vehicle accidents, leaving one fatality as the result of an operational event.

For DOE as a learning organization, the principal goal of the Accident Investigation Program is to understand what happened, why it happened and what needs to be done to prevent recurrence of accidents. The goal of this report is to provide information that can be used toward prevention of accidents by becoming alert to identified weaknesses in the Integrated Safety Management Systems (ISMS) as they are implemented throughout the DOE complex.

Causal Analysis Summary

HSS reviewed the three reports completed with special emphasis on the analyses and conclusions presented in each of the investigation reports. The contributing causes as listed in the three 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 6 – Hazard Controls Tailored to the Work Being Performed – was identified as the most prevalent area of weakness in a rollup of the three investigation reports. In comparison to the investigation reports, the available data from ORPS reports for the involved sites and program offices for the previous six months indicated *Management Problem* (ORPS CAT Tier 1, A4) deficiencies as the greatest contributor over all operational events filed. The second level (ORPS CAT Tier 2) greatest contributors were *Management Methods LTA* (B1) and *Work Organization & Planning LTA* (B3).

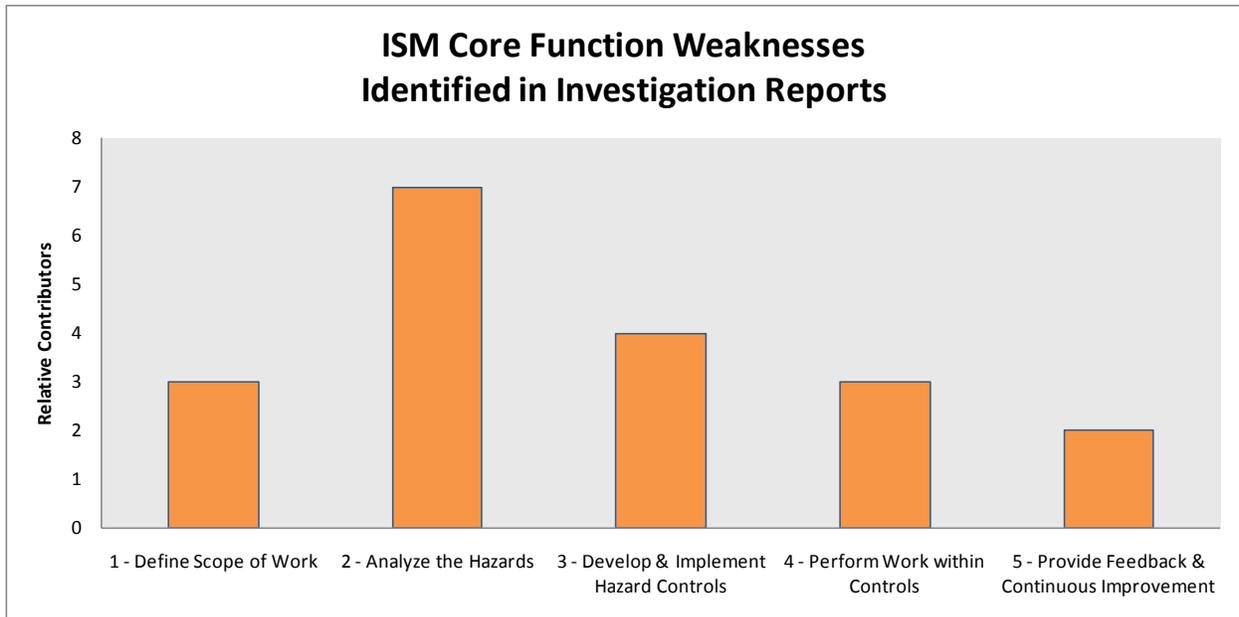
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In assessing the safety management systems overall, these attributes couple well between the Guiding Principles, whose function is to establish the safety systems, and the Core Functions whose purpose is to control the performance of work. Managers and oversight personnel should be alert to ensure the safety systems appropriately match hazard controls to the risk and potential consequences during the performance of work.

Worker competency issues (training, knowledge, skills and abilities) ranked second as a contributor in the three accident investigations reviewed. Managers should assure themselves that their workers are receiving the proper training and certification 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 (KSAs) are possessed by the workers, but that KSAs are properly identified and implemented in the work control processes.

ISM Core Functions

Failures to define the scope of work, analyze the hazards, and develop and implement hazard controls were the weaknesses most frequently identified in the investigation reports. This general theme was also identified in the review of the six months' prior occurrence reports. Failing to identify weaknesses in the work planning or execution processes provided a lost opportunity for improving any and all work processes.

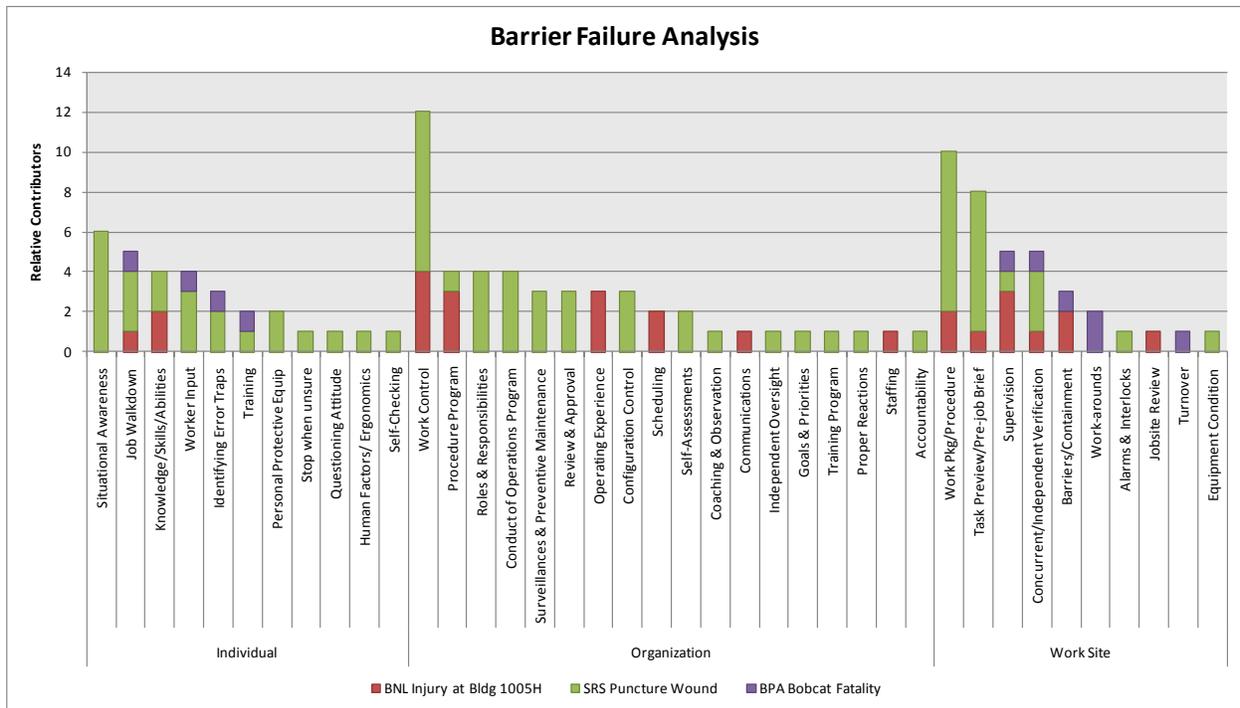


Managers and oversight personnel should include reviews of work planning and control documents at their facilities to assure those documents include formalized hazard identification sufficient to apply the appropriate hazard controls prior to the execution of work. Feedback mechanisms should be in place to capture workers' input regarding

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problems encountered in the work planning or execution and ideas for improving safety during the conduct of work.

Barrier Failure Analysis



Barrier failures were identified in each of the three 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 Brief*, 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 worker competencies, are meeting the rigor necessary to perform work safely.

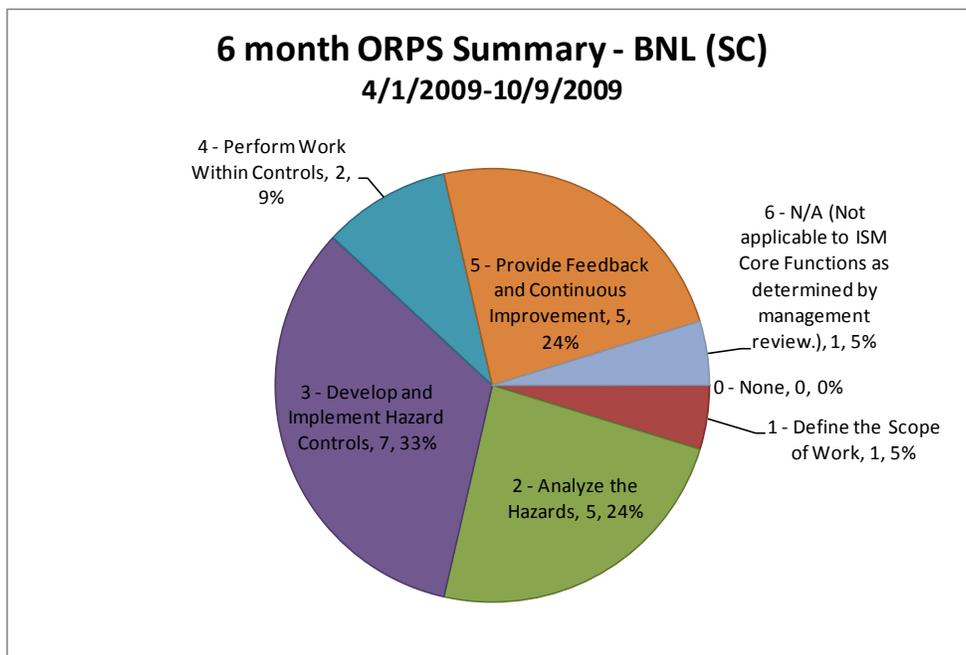
Occurrence Reporting and Processing System Precursor Analysis

HSS conducted a review of occurrence reports filed at each of the sites and respective program offices involved in the accident investigations for the six months prior to the accident¹.

The ORPS requires the selection of one or more ISM codes 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 through Five for the five Core Functions and Six, "N/A." ISM Guiding Principles are not accommodated in the ORPS entry forms.

Brookhaven National Laboratory

13 occurrence reports were filed for Brookhaven National Laboratory (Science) between April 1 and October 9, 2009 prior to the Employee Injury at Building 1005H.



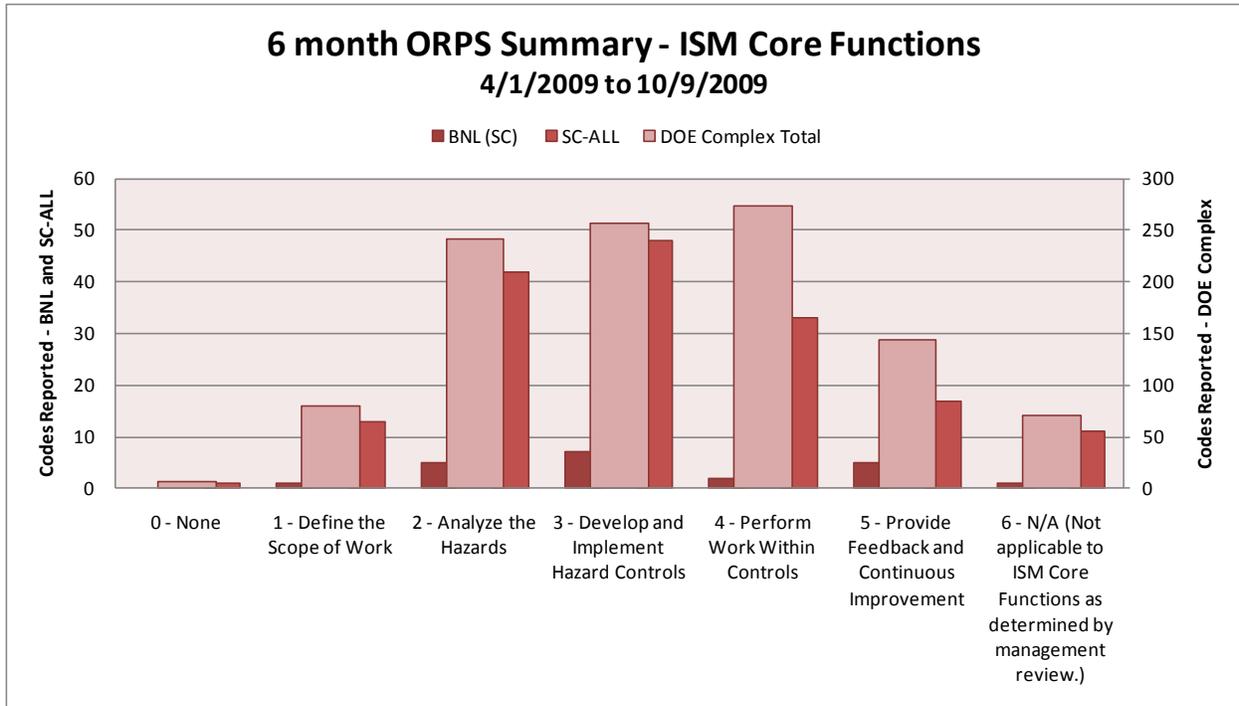
In terms of the ISM Core Functions for the occurrences reviewed, 81% of the reported codes indicated deficiencies to properly:

- Develop and implement hazard controls (33%);
- Analyze the hazards (24%); and
- Provide feedback and continuous improvement (24%).

¹ ORPS data as of September 14, 2010; reports were queried by Discovery Date.

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During the same six month period, ISM Core Function 3 – Develop and Implement Hazard Controls – was also the most frequently reported across the Science program office in its 100 occurrence reports. The DOE Complex in total filed 668 occurrence reports. The most frequently reported complex-wide was ISM Core Function 4 – Perform Work Within Controls, followed by Core Function 3 – Develop and Implement Hazard Controls.



Bonneville Power Administration

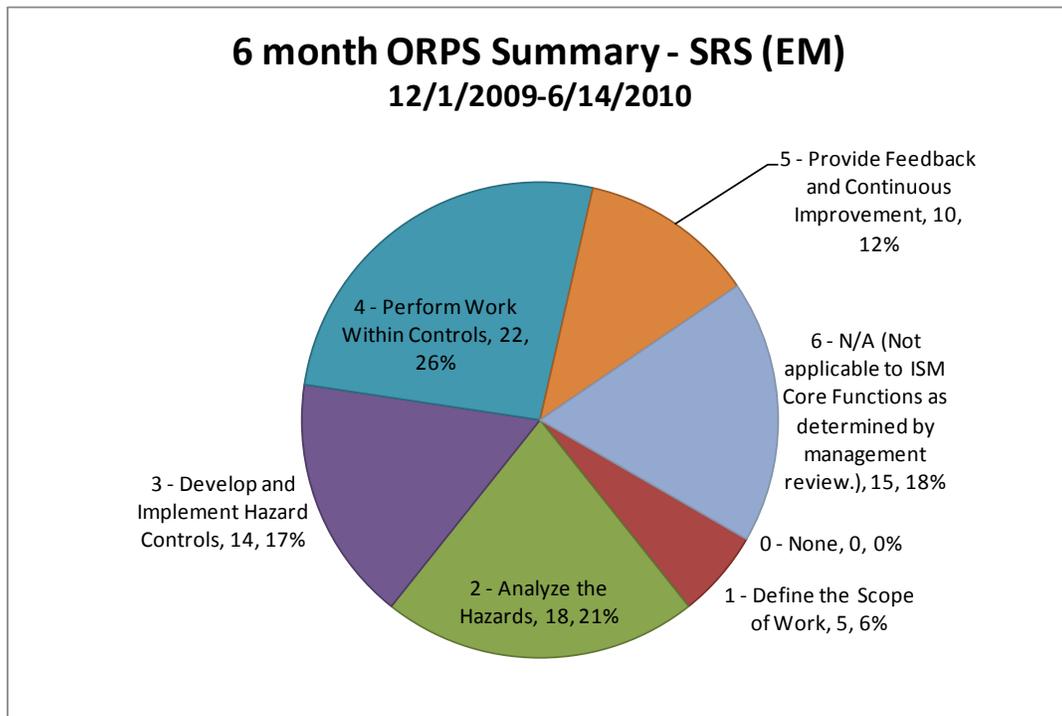
BPA, as part of the Power Marketing Administration, does not report operational events in the ORPS; a special occurrence report was filed for the March 1, 2010 Bobcat fatality under the DOE-Richland site.

As stated in the ORPS report, “The BPA White Bluffs substation is located on Hanford land but is fully operated by BPA via permit from DOE-Richland. Although this is not a DOE-Richland event, it was reported to local stakeholders based upon the expected off-site interest.”

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Savannah River Site

65 occurrence reports were filed for the Savannah River Site (Environmental Management) between December 1, 2009 and June 14, 2010 prior to the Employee Puncture Wound at the F-TRU Waste Remediation Facility.



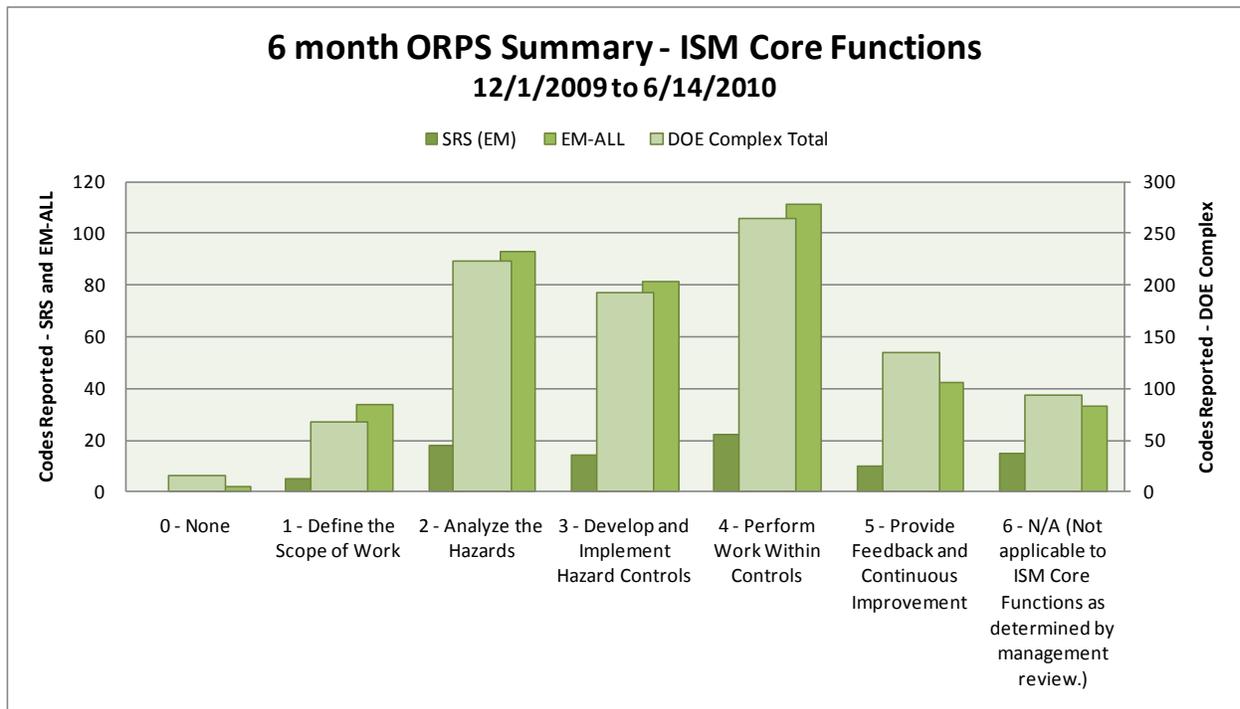
In terms of the ISM Core Functions for the occurrences reviewed, 64% of the reported codes indicated deficiencies to properly:

- Perform work within controls (26%);
- Analyze the hazards (21%); and
- Develop and implement hazard controls (17%).

The third largest group, 18% of the reported codes, was classified N/A (Not applicable to ISM Core Functions as determined by management review).

During the same six month period, ISM Core Function 4 – Perform Work Within Controls – was also the most frequently reported across both the Environmental Management program office in its 258 occurrence reports and the DOE Complex in total which filed 657 occurrence reports.

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ORPS Precursor Analysis Summary

For the Employee Injury at Building 1005H accident at Brookhaven National Laboratory, the Board concluded that:

- the scope of work for the task was not fully defined (pg 3-1),
- the hazards associated with the work performed were not identified or analyzed (pg 3-2),
- both C-AD and F&O management failed to develop and implement appropriate hazard controls for the work performed (pg 3-3),
- the performance of work within controls failed because there were no controls developed or implemented for the work performed (pg 3-3), and
- C-AD and F&O failed to effectively utilize the feedback and improvement process to identify and control the noise hazard associated with the accident (pg 3-4).

The ORPS report for this incident cites ISM codes **2 – Analyze the Hazards** and **3 – Design and Implement Hazard Controls**.

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For the Fatal Bobcat/Backhoe Accident at the White Bluffs Substation, some of the key findings of the Board were that:

- the Supplemental Labor contract lacks a mechanism to ensure the vendor is meeting the terms of the contract to verify training and certification of supplemental labor employees (pg 13),
- the CHEO bypassed Bobcat safety systems, and failed to follow instructions in operation and maintenance manual (pg 14),
- the CHEO did not receive an adequate job briefing, and that the job briefing for the entire crew was inadequate for work tasks being performed (pg 15), and
- BPA and contract personnel have not been adequately trained on the safe operation of skid-steer loaders and attachments (pg 17).

The ORPS report for this incident cites ISM code **6 – N/A (Not applicable to ISM Core Functions as determined by management review)**.

For the Employee Puncture Wound at the F-TRU Waste Remediation Facility at Savannah River, some of the key conclusions of the Board were that:

- the scope of work for the remediation and repackaging work was not fully defined and the methods used to ensure the development of procedures compliant with SRNS Manual 2S, Conduct of Operations, had not matured (pg 18),
- hazards associated with TRU waste remediation activities were not adequately identified and analyzed (pg 20),
- management failed to ensure the development and implementation of adequate controls to protect workers during the TRU waste remediation process (pg 22),
- an opportunity was missed to effectively use a “Time Out” to address issues related to survey flag installation and receive formal disposition (including a proper hazards review) prior to development new methods of installation and shortening the survey flags (pg 23), and
- management did not consider installation of the survey flags a critical step or a hazardous activity, and the activity was therefore not necessarily observed or recorded on video (pg 24).

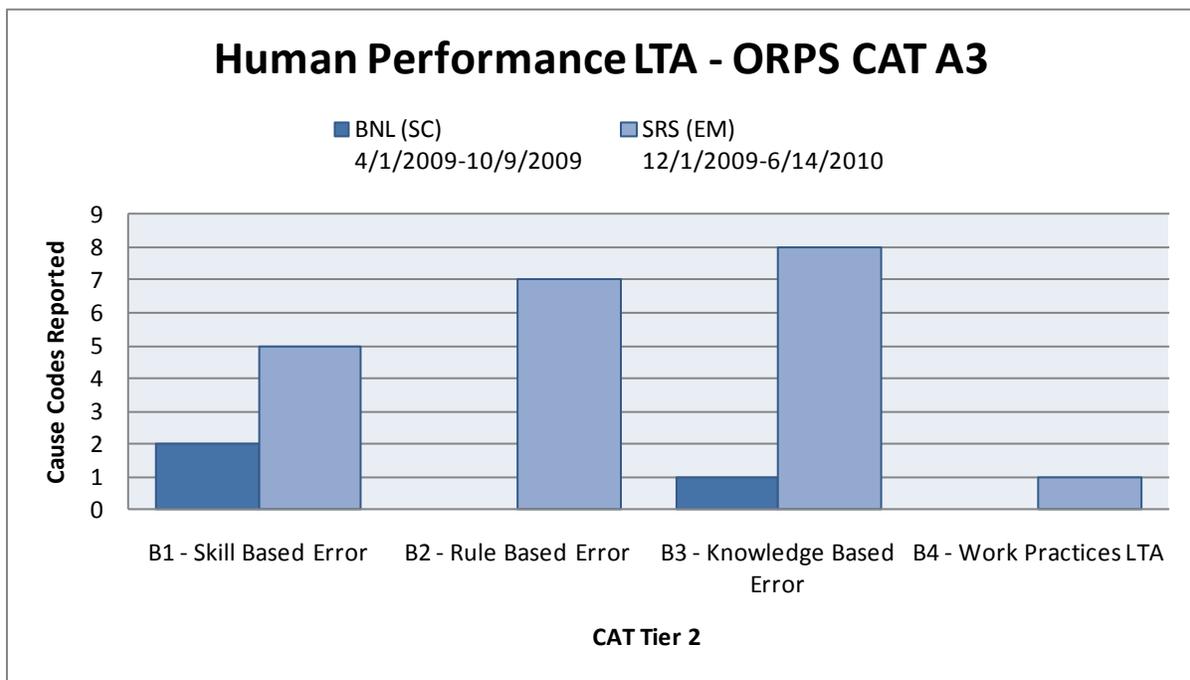
The ORPS report for this incident cites ISM code **2 – Analyze the Hazards**.

HSS concluded the precursor information available from the ORPS database regarding identification and control of hazards at the worksite was generally consistent with the Board’s observations in the accident investigation reports at both Brookhaven National Laboratory and the Savannah River Site.

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. Three of the 13 BNL (SC) and 21 of the 65 SRS (EM) ORPS reports reviewed attributed Human Performance as causal factors in these events (ORPS CAT Tier 1, A3). For BNL (SC) reports the most recurrent second tier causal factor was Skill Based Error (B1) followed by Knowledge Based Error (B3). For SRS (EM) reports the most recurrent second tier causal factor was Knowledge Based Error (B3) followed by Rule Based Error (B2). In combination these areas point to opportunities for improvement around ISM Guiding Principle 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 prior to these accidents, BNL (SC) facilities reported 13 operational events and SRS (EM) facilities reported 65 operational events. A review of those events concluded the majority of the ISM Core Function deficiencies reported were in the areas of failures to analyze and control hazards (BNL 57%, and SRS 38%) prior to the performance of work. These results for these sites are, for the most part, consistent with the rest of DOE complex. Failure to perform work within controls was identified by BNL (SC) as 9% and by SRS (EM) as 26%, accounting for approximately two-thirds of the reported weaknesses to analyze and control hazards, and work within those controls.

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 either Brookhaven National Laboratory or Savannah River Site DOE or contractor Management. However, this does point to an opportunity for both contractor and DOE Management to assess performance as reported and recorded in the ORPS data system and use those results to guide oversight activities.

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Accident Investigation Report Summaries

This section contains abstracts for the three Accident Investigations summarized in this report, and one Independent Review of an operational event which also occurred during the second half of the fiscal year. Web links to the occurrence reports from the ORPS 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.

Employee Injury at Building 1005H, October 9, 2009, Brookhaven National Laboratory ([ORPS Event SC--BHSO-BNL-BNL-2009-0021](#))

BNL Investigation Background – During the course of the investigation, the Board identified another recent accident at BNL (specifically, the BNL Well House #12 fire) for which corrective actions had not been addressed. The Board chose to adopt and use the Judgments of Need (JONs) from that accident as opposed to developing JONs for the Building 1005H Injury Accident. While the Board would have been better served to develop JONs to address the causal factors of this particular accident, the Board did identify some systemic deficiencies in the Brookhaven Site Office (BSO) and BNL corrective action tracking process, implementation and validation system. The Board believed the JONs from the Well House #12 accident were not addressed, which resulted in this accident. Some additional contributing factors were also identified.

Accident Investigation Report Summary – On the afternoon of October 9, 2009, a Lead Rigger for Brookhaven Science Associates (BSA), LLC at the Brookhaven National Laboratory (BNL) was injured while at the Relativistic Heavy Ion Collider (RHIC) Compressor Building 1005H. The Lead Rigger and two other Riggers were matrixed by the Facilities and Operations (F&O) Directorate to perform skilled craft work for the Collider-Accelerator Department (C-AD). The F&O Rigger Supervisor dispatched the Riggers to Building 1005H to retrieve an aerial lift that had been left in the building. Upon arriving at the building, the Riggers discovered that the west roll-up door and man-door were locked. There were no signs on these doors to instruct personnel to contact the Cryogenic Control Room or the Building Manager prior to entry.

The Lead Rigger then proceeded around the building in the direction of the C-AD Cryogenic Control Room, located in Building 1005S, looking for an open roll-up door or man-door. Inside the building, a helium venting operation was underway. As the Lead Rigger passed under a building vent, which was approximately 9 feet above his head, the high pressure helium began to vent. A loud noise (>140 decibels [dBA]) was produced by the helium venting which startled the Lead Rigger. The Lead Rigger began to run from the area and injured both of his legs in the process. The Lead Rigger experienced bilateral quadriceps tendon ruptures. The injury required surgery to his legs and a hospital stay with rehabilitation greater than 5 days.

The Board determined the Direct Cause of the accident was the unanalyzed loud sound produced by the Cryogenic venting process.

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The Board determined the Root Cause of the accident to be BNL's failure to implement an effective ISMS program to ensure all hazards associated with the operations of its facilities are identified, analyzed, and controlled.

The Board determined the following Contributing Causes to the accident:

- BNL failed to implement an effective Work Control Process.
- BNL failed to establish formal controls for building access.
- BNL failed to perform adequate operational awareness.
- BNL failed to address all safety hazards in design.

Fatal Bobcat/Backhoe Accident at the White Bluffs Substation, March 1, 2010, Bonneville Power Administration ([ORPS Event EM-RL--GORL-DDSC-2010-0002](#))

Background on the Power Marketing Reporting and Investigative Processes – BPA, as part of the Power Marketing Administration, does not report operational events in the Occurrence Reporting and Processing System. BPA does however, use several processes to track and inform employees and of health and safety related issues. These are basically divided into two process areas: reporting and investigation. The reporting processes include Safety Alerts, which require action be taken, Safety Notices which are used to inform employees of potential health and safety issues and Near Miss/Lessons Learned, which convey operational events.

Investigations are categorized as Level 1, Level 2 and Level 3. Level 1 and Level 2 closely correspond to Type A and Type B accident investigations, with Level 1 being the most severe consequence accidents.

BPA Performance History – Prior to the accident at the White Bluffs Substation, BPA did identify an issue involving Bobcat modifications. That particular event involved the installation of a “limiter” on the lifting tines of BPA-owned Bobcats. The “limiter” was used to prevent contact with overhead conductors in substations. BPA identified that they needed to modify the equipment and still remain within the manufacturer’s specifications for the equipment.

Accident Investigation Report Summary – On March 1, 2010, at approximately 0850, a Christenson Electric, Inc. (Christenson) employee was fatally injured at the Bonneville Power Administration’s (BPA) White Bluffs Substation near Richland, Washington while loading a Bobcat equipped with a backhoe attachment onto a trailer for transport to another work site.

At approximately 0700, a mixed carpenter crew of two BPA and four Christenson personnel were preparing to load their equipment and tools to move to a different job location. The Christenson Heavy Equipment Operator (CHEO) reported to the job site and the BPA Carpenter Foreman I (BCFMI) at approximately 0750 (1 hour ordered travel) and as a result, missed the crew’s J-1 job briefing. Upon arrival, the CHEO received a verbal briefing from the BCFMI and proceeded with assigned tasks. At approximately 0830 the

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CHEO and the Christenson Laborer (CL-1) prepared to load a BPA-owned Bobcat equipped with the backhoe attachment onto its transport trailer. While the CL-1 hooked the pickup to the trailer, the CHEO drove the Bobcat to retrieve the backhoe attachment from where it had been stored near the fence. As the CHEO approached the trailer ramps, the backhoe attachment came into contact with the trailer preventing the machine from being loaded. The CHEO reversed motion and backed up approximately one foot and stopped. The CHEO exited the machine twice attempting to connect and reconnect the hydraulic hoses for the backhoe attachment and re-entered the machine. The CHEO may have intended to use the hydraulics on the backhoe attachment in an effort to facilitate the loading of the Bobcat and backhoe attachment onto the trailer.

After re-entering the machine, the CHEO bypassed the Bobcat Interlock Control System (BICS™) and depressed the left foot hydraulic pedal which resulted in the Bobcat lift arms being raised, pinning the CHEO between the backhoe attachment seat and the Roll Over Protection Structure (ROPS) of the Bobcat. The CHEO received fatal injuries and was pronounced dead at Kadlec Medical Center in Richland, Washington at 1005.

The Board concluded that the Direct Cause of this accident was that the CHEO activated the hydraulic controls while standing in the pinch point.

The Board determined the Root Cause of the accident was that the CHEO bypassed the Bobcat safety features.

The Board also identified the following contributing causes to the accident:

- The CHEO did not receive a sufficient J-1 (pre-job briefing that included work planning, job hazards analysis, and controls).
- The J-1 briefing for the entire crew was insufficient on the day of the accident. A review of the written J-1 from the day of the accident indicated that the work to be performed at the work site was unchanged from previous days' J-1's which included setting forms and pouring concrete and in fact did not reflect the actual work that was planned for that day (loading materials, tools, equipment to mobilize to next job site).
- Although this accident involved a supplemental labor contractor, the Board also could not determine if BPA personnel have been trained on all aspects of the Bobcat and attachments. The Board concluded that employee training and equipment issues should be addressed before the moratorium is lifted on the use of backhoe attachments. Equipment issues would include completion of safety inspections, addressing recall compliances and correcting identified deficiencies.

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Employee Puncture Wound at the F-TRU Waste Remediation Facility, June 14, 2010, Savannah River Site ([ORPS Event EM-SR--SRNS-CPWM-2010-0008](#)) — While performing transuranic (TRU) waste remediation work inside a special process enclosure (Enclosure), a Technician received a puncture wound near the base of the index finger on his right hand. The Technician was placing a hole indicating device (a wire survey flag) into a quart-sized waste can that had previously been punctured. The can had been punctured to eliminate a potential concern with pressurization and to ensure no free liquids were present in the interior of the can. The hole indicating device was used to enable radiography to confirm at a later date that the can had been punctured and was not pressurized. The Technician bent the indicating device into a "u" shape and the uncovered end of the device punctured his personal protective equipment, resulting in internal contamination with transuranic elements. At the time of the accident, other workers were present in the area conducting similar work and performing radiological surveys. Personal protective equipment (PPE) was in use for the work being performed.

Savannah River Nuclear Services, LLC (SRNS) provided an initial range (low and high) projection of the worker's final dose on August 9, 2010. The range was estimated to be between 5 and 50 rem committed effective dose to the whole body and between 166 and 1657 rem committed equivalent dose to the bone surface from this uptake. Based on the dose projections provided, it is indeterminate whether this event met the threshold for a Type A Investigation.

The Board determined the Direct Cause of this accident to be that a contaminated survey flag punctured the worker's PPE and hand, resulting in a radiological intake.

The Board determined the Root Cause of the accident was a less than adequate graded approach used for high hazard TRU waste remediation work; this did not coincide with the discipline warranted for high hazard work.

The Board determined the following Contributing Causes of the accident to be:

- Management did not follow established protocols to ensure that Subject Matter Experts were involved in the identification and analysis of hazards.
- Management did not ensure that a formal hazard analysis was conducted for use of the hole indicating devices.
- The procedure did not identify a method for hole indicating device installation.
- Formal training was not provided on survey flag installation. Management demonstrated survey flag installation for one-gallon cans but did not provide additional training on one-quart cans.
- Waste Remediation Technicians (WRTs) did not follow the demonstrated method of installing survey flags and did not notify management of their concerns that the survey flag would fall out of the one-quart cans.
- Management was unaware that alternate, unapproved methods of installing survey flags were being used.

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- WRTs did not understand the safety significance of modifying prescribed equipment and not following survey flag installation as demonstrated.
- Management did not reinforce to workers the importance of disciplined operations, including use of time-outs and the need to discuss issues during pre- and post-job briefings.
- Known accident precursors were not adequately dispositioned and continued to exist in the workplace.

Crude Oil Storage Tank Cleaning Project Fatality, July 8, 2010, Bryan Mound Site ([ORPS Event FE--SPRO-SPR-BM-2010-0001](#)) — The DOE Chief Health, Safety and Security Officer established an Independent Review Board (IRB) to review the July 8, 2010, fatality incident involving a subcontractor employee at the Bryan Mound Site, Strategic Petroleum Reserve (SPR). The employee was performing work activities involving cleaning the tank floor in a large crude oil storage tank. Recognizing that the Occupational Safety and Health Administration (OSHA) is investigating this incident and that DOE line management and site contractors are concurrently performing a joint incident analysis, the IRB was directed to perform an independent review of selected aspects of the broader safety management programs applicable to the safety elements that were in place at the time of the incident.

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Accident Investigation Training

HSS conducted Operational Safety / Accident Analyst training (SAF-231) at DOE's Idaho Site NE-ID in July. The Accident Investigator Training (SAF-230) course was held at the Savannah River Site the week of September 20, 2010 and at Lawrence Livermore National Laboratory the week of October 19, 2010.

The Operational Safety / Accident Analyst (SAF-231) is planned to be held March 15-18, 2011 at the National Training Center. This course is also being planned for April 4-8, 2011, location TBD.

Also note that the Accident Investigator course scenario has been completely changed and revised. The new scenario was introduced in April 2010.

To arrange for training, contact:

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