
**Type B Accident
Investigation Board Report
For the January 11, 2006,
Personal Injury During Table Saw Use
at the
Heyrend Way Facility
Idaho Falls, Idaho**

February 10, 2006



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On January 18, 2006, I appointed a Type B Accident Investigation Board to investigate the January 11, 2006, Personal Injury During Table Saw Use at the Heyrend Way Facility, at the Idaho National Laboratory, located in Idaho Falls, Idaho. The responsibilities of the Board have been satisfied with respect to this investigation. The analysis, identification of contributing and root causes, and judgments of need reached during the investigation were performed in accordance with DOE Order 225.1A, *Accident Investigation*.

I accept the report of the Board and authorize release of the report for general distribution.

A handwritten signature in black ink, appearing to read "Elizabeth D. Sellers". The signature is fluid and cursive, with a large initial "E" and "S".

Elizabeth D. Sellers
Manager
Idaho Operations Office

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This report is an independent product of the Type B Accident Investigation Board appointed by Elizabeth D. Sellers, Manager, Idaho Operations Office, U.S. Department of Energy.

The Board was appointed to perform a Type B investigation of this accident and to prepare an investigation report in accordance with DOE Order 225.1A, *Accident Investigations*.

The discussion of facts, as determined by the Board, and the views expressed in the report do not assume and are not intended to establish the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

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ACRONYMS

AI	Accident Investigation
ALD	Associate Laboratory Director
AMRD	Assistant Manager for Research and Development
BBWI	Bechtel BWXT Idaho, LLC
BEA	Battelle Energy Alliance
CBRNE	Chemical, Biological, Radiological, Nuclear and High Yield Explosives
CTPS	Cold Test Pit South
DOE	Department of Energy
DOE-ID	DOE Idaho Operations Office
DTRA	Defense Threat Reduction Agency
EIRMC	Eastern Idaho Regional Medical Center
EMS	Emergency Medical Services
EPD	Employee Position Description
ES&H	Environment, Safety, and Health
FacRep	Facility Representative
FRAM	Functions, Responsibilities and Authorities Manual
IDSF	Integrated Defense Systems Facility
IHR	Independent Hazard Review
IAP	Integrated Assessment Program
INL	Idaho National Laboratory
ISMS	Integrated Safety Management System
ITP	Individual Training Plan
JSA	Job Safety Analysis
MCP	Management Control Procedure
M&O	Managing and Operating Contractor
NE	Office of Nuclear Energy, Science and Technology
NEPA	National Environmental Policy Act
NS	National Security
PI	Principal Investigator

PDD	Program Description Document
PPE	Personal Protective Equipment
PRD	Program Requirements Document
OJT	On the Job Training
OSHA	Occupational Safety and Health Administration
QSD	Quality and Safety Division
R&D	Research and Development
RWMC	Radioactive Waste Management Complex
S&H	Safety and Health
SMC	Specific Manufacturing Capability
SME	Subject Matter Expert
SOW	Statement of Work
STC/I	Science and Technology Complex/Infrastructure
TRM	Training Requirements Matrix
WFO	Work for Others

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EXECUTIVE SUMMARY

INTRODUCTION

An accident at the Idaho National Laboratory (INL) was investigated in which a technician sustained a serious injury to his right hand while operating a table saw. In conducting its investigation, the Accident Investigation Board (the Board) used various analytical techniques, including accident analysis, barrier analysis, change analysis, and event and causal factor analysis. The Board inspected and photographed the scene, reviewed conditions surrounding the accident, collected and analyzed physical evidence, and conducted extensive interviews and document reviews to determine the factors that contributed to the accident. Relevant Department of Energy (DOE) and Battelle Energy Alliance (BEA) management systems that could have contributed to the accident were evaluated within the framework of the DOE's applicable guiding principles of safety management.

ACCIDENT DESCRIPTION

At approximately 9:15 a.m., on Wednesday, January 11, 2006, a newly hired electro/mechanical technician (the "Technician") sustained a serious injury to his right hand while operating a table saw at the INL Integrated Defense Systems Facility (also referred to as the Heyrend Way Facility). The injury sustained by the Technician when his right hand contacted the rotating blade of a table saw was a wound that extended across the palm of his hand between the base of his little finger to the web between his thumb and index finger. The injury resulted in traumatic amputation of the little finger, and extensive reconstructive surgery was required to repair damage associated with the remaining three fingers. The Technician remained hospitalized following the reconstructive surgery and was released from the hospital on Tuesday, January 17, 2006.

CAUSAL FACTORS

The Board identified three root causes, one local and two systemic, for the accident, the elimination of which would have prevented the injury:

- Local Root Cause – Failure to ensure the blade guard assembly was in place when required for the specific cutting operation.
- Contractor Systemic Root Cause – BEA was inattentive to a number of deficiencies in work control processes and allowed informality in execution of the integrated safety management (ISM) program, including competence commensurate with responsibility.
- DOE Systemic Root Cause – DOE-ID did not ensure oversight activities were sufficient to identify deficiencies in the contractor's implementation of integrated safety management system (ISMS).

CONCLUSIONS AND JUDGEMENTS OF NEED

Table 1 presents conclusions and judgments of need determined by the Board. The conclusions are those the Board considered significant and are based on facts and pertinent analytical results. Judgments of need are managerial controls and safety measures believed by the Board to be necessary to prevent or minimize the probability or severity of a recurrence of this type of accident. Judgments of need are derived from the conclusions and causal factors and are intended to assist managers in developing follow-up actions.

Table 1. Conclusions and Judgments of Need.

CONCLUSIONS AND JUDGEMENTS OF NEED	
Judgments of Need	Conclusions
<p>BEA management needs to establish and institutionalize a formal process to confirm that employees are competent to perform work safely commensurate with their assigned responsibilities prior to performing work.</p> <p>BEA needs to establish a process to ensure that work supervisors, leaders, and others who provide work instructions are provided with quality work instructions that are adequate and can be clearly communicated to and understood by the employee.</p>	<p>The Board concluded that the Technician was allowed to perform work without the requisite training and without assurance that he possessed the competence commensurate with his responsibilities. Supporting facts include:</p> <ul style="list-style-type: none"> • The Technician was an electro/mechanical technician, whose position description did not require table saw or other carpentry skills. On the third day on the job, and with minimal instruction provided, the Technician was assigned to perform unsupervised operation of a table saw. • The Technician’s required ITP had not been created and completed. • Required PPE training had not been completed. • The process used to authorize use of facility equipment was “expert based”, informal, and incorrectly specified that gloves should be worn when using the table saw. • The Technician incorrectly believed the blade guard assembly needed to be removed to cut ETHAFOAM 900®. • The Technician experienced difficulty cutting the semi-rigid ETHAFOAM 900® and became uncomfortable, but was reluctant to stop work to seek assistance. <p>The Board concluded instructions regarding the use of the blade guard assembly were not clearly communicated to and understood by the Technician.</p> <p>The Board concluded that using a JSA in place of a formal work control document relied heavily upon the assumption that training was adequate to mitigate hazards.</p>

CONCLUSIONS AND JUDGEMENTS OF NEED

Judgments of Need	Conclusions
<p>BEA needs to develop, implement, and institutionalize processes to ensure that JSAs identify and control the specific hazards associated with the job tasks; are complete, including appropriate regulatory and equipment specific hazard control information; and are periodically assessed for effectiveness.</p>	<p>The Board concluded that the JSA used to control Chemical, Biological, Radiological, Nuclear and High Yield Explosives (CBNRE) project work was a JSA originally developed to address machine shop/fabrication work, and did not include hazards and controls associated with a table saw. As a result, the JSA did not include hazards and controls specific to table saw use contained in 29 CFR 1910.213(a)(15), (c)(1), (c)(2), (c)(3), and (s)(9) requiring the use of featherboards, guards, kerf spreaders, anti-kickback pawls, and push sticks/blocks.</p> <p>The Board concluded that the table saw manufacturer's safety warnings were not incorporated into the JSA document.</p> <p>The Board concluded that conflicting direction relating to the use of gloves and the operator's manual prohibition against the use of gloves was not identified and was not reconciled</p>
<p>BEA needs to develop and institutionalize a process that ensures the hazard review screening process for new projects or work activities against existing JSAs is conducted prior to the commencement of work. BEA needs to ensure this process is documented and the documentation is retained.</p>	<p>The Board concluded that the hazards associated with CBNRE project work activities were not adequately identified and compared with the hazards and controls included in the JSA used to authorize the work.</p> <p>The JSA used to control CBNRE project work was originally approved for machine shop/fabrication work use on October 1, 2001, and was applied to the CBNRE project sometime after December 3, 2004, when the project was approved.</p> <p>The Board concluded a formal review of the CBNRE project activities was not conducted against the JSA used as the work authorization/control document to ensure that the project did not introduce any unanalyzed hazards into the work place.</p> <p>No documented consideration of the special needs for ETHAFOAM 900® fabrication could be identified by the Board.</p>

CONCLUSIONS AND JUDGEMENTS OF NEED

Judgments of Need	Conclusions
<p>BEA needs to ensure MCP-3571 fully incorporates the five core functions of Integrated Safety Management, as they pertain to research activities, and needs to re-evaluate the use of MCP-3571 for research-related activities.</p> <p>BEA needs to develop and institutionalize a method to ensure the validity of the “R&D-related activities” determination when conducting work in accordance with MCP-3571 to ensure that the job-specific work hazards are properly controlled prior to the commencement of work.</p>	<p>The Board concluded that MCP-3571 did not ensure implementation of the five core functions of ISMS. The procedure did not provide for the definition of work scope, did not adequately control the performance of work, and did not provide a means for worker feedback.</p> <p>The Board concluded that the work being performed (fabrication of an equipment storage box) by the Technician under the CBRNE project did not meet the definition of a R&D-related activity, based upon the Project Execution Plan checklist.</p> <p>The Board concluded that BEA did not perform a prejob briefing or assure workers were properly trained and hazards were identified and controlled as required.</p>
<p>DOE-ID needs to establish and institutionalize a process to ensure properly trained, qualified, and cleared personnel are available – including alternate personnel – to ensure DOE’s obligation in carrying out line management’s responsibility for safety in accordance with DOE Policy 450.4, <i>Safety Management System Policy</i>, at all facilities.</p>	<p>The Board concluded that although the DOE-ID National Security (NS) Team had line management responsibility for safety in their programs, between June 2003 and October 2005 there was no documented safety oversight performed in the Heyrend Way Facility.</p> <p>The Board concluded that line management ownership of safety was clearly documented, but in practice, NS did not fulfill their management responsibility for safety at the Heyrend Way Facility.</p>
<p>BEA needs to assess Emergency Medical Services (EMS) response times at all work locations and ensure appropriate first aid kits and first aid trained individuals are available where needed.</p>	<p>The Board concluded that, contrary to the requirements of 29CFR1910.151(b), a first aid kit was not available at the Heyrend Way Facility, and that BEA did not ensure person(s) with appropriate first aid training were assigned to the Heyrend Way Facility.</p>
<p>BEA and DOE-ID need to ensure the physical street address where 911 is used to summon emergency services is readily available to all employees.</p>	<p>Although initial EMS response may have been delayed slightly because the street address of the Heyrend Way Facility was not immediately available for the 911 call, the Board concluded that the immediate response actions taken by facility personnel and the EMS were satisfactory.</p>
<p>BEA needs to ensure safety related assessments and inspections are conducted at a level of competence to ensure compliance with regulatory requirements is recognized and the effectiveness of the process is regularly assessed.</p>	<p>The Board concluded that regularly scheduled self-assessments and inspections were conducted at the Heyrend Way Facility. The assessments were predominately conducted by facility personnel, who were not specifically trained to conduct assessments of safety and health related topics. The checklists are not a substitute for comprehensive review by Subject Matter Experts (SMEs).</p>
<p>BEA needs to ensure all employees are aware of the obligation and necessity to preserve the scene of an accident and properly control evidence in accordance with DOE Order 225.1, <i>Accident Investigation</i>. This</p>	<p>The Board concluded the investigative readiness did not ensure the scene was properly controlled and resulted in disturbance of important evidence. (Workers/supervision were unaware of requirements</p>

CONCLUSIONS AND JUDGEMENTS OF NEED

Judgments of Need	Conclusions
Judgment of Need is a repeated Judgments of Need from previous accident reports.	to preserve the accident scene.)
DOE-ID and BEA need to develop, implement, and institutionalize a lessons learned program that effectively implements the corrective actions from past events and assess the program's effectiveness on a regular basis.	The Board concluded that DOE-ID and its contractors did not ensure corrective actions from past events were developed, implemented, and institutionalized to assure full compliance with integrated safety management principles to avoid preventable accidents.

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1.0 INTRODUCTION

1.1 BACKGROUND

On January 11, 2006, at approximately 9:15 a.m., an electro/mechanical technician (referred to as “the Technician”) sustained a serious injury to his right hand while operating a table saw at the INL, Integrated Defense Systems Facility (IDSF), also known as the Heyrend Way Facility. The injury resulted in the Technician losing the little finger of the right hand, serious damage to the ring and middle fingers, and less serious damage to the index finger.

1.2 FACILITY DESCRIPTION

The INL, established in 1949, is a science-based, applied engineering national laboratory dedicated to supporting the U.S. Department of Energy’s missions in science, national defense, and nuclear and energy research. The INL is operated for the DOE by BEA, providing unique educational, management, research, and scientific assets to a world-class national laboratory.

The Heyrend Way Facility is a leased facility located at 2556 Heyrend Way, a few miles south of Idaho Falls, Idaho. The facility is part of the INL’s Science and Technology Campus, where the INL achieves work in both basic science and the engineering that translates new knowledge into products and processes. Principle activities conducted within the facility include equipment development, fabrication, and assembly.

Contractor activities at the INL are managed by the DOE Idaho Operations Office (DOE-ID), which reported to the Office of Nuclear Energy, Science and Technology. The DOE offices of Environmental Management and National Nuclear Security Administration also funds programs in areas of waste management, environmental restoration, and national security. BEA, as a DOE prime contractor, replaced Bechtel BWXT Idaho, LLC (BBWI) as the INL contractor February 1, 2005.

1.3 SCOPE, PURPOSE, AND METHODOLOGY

The Type B Accident Investigation Board began its investigation on January 18, 2006, completed the investigation on February 8, 2006, and submitted its report to the Manager, Idaho Operations Office on February 10, 2006.

The **scope** of the Board's review was to review and analyze the circumstances of the accident to determine its cause. The Board also evaluated the adequacy of safety management systems and work control practices of DOE-ID and BEA, as they related to the accident.

The **purposes** of this investigation were to determine the cause of the accident, including deficiencies, if any, in safety management systems, and to assist DOE in understanding lessons learned to improve safety and reduce the potential for similar accidents.

The Board conducted its investigation using the following **methodology**:

- Facts relevant to the accident were gathered through interviews, document and evidence reviews, and examination of physical evidence.
- Event and causal factors analysis, barrier analysis, and change analysis were developed.
- Based on the analysis of the information gathered, judgments of need for corrective actions to prevent recurrence were developed.

2.0 FACTS AND ANALYSIS

2.1 ACCIDENT DESCRIPTION AND CHRONOLOGY

2.1.1 Background and Accident Description

Onsite activity at the Heyrend Way Facility included work on three separate projects: the Defense Threat Reduction Agency (DTRA) Mobile Training System project, the Idaho Explosives Detection System project, and the Chemical, Biological, Radiological, Nuclear and High Yield Explosives (CBRNE) Systems Integration project. Work on the CBRNE project began following the terrorist attacks of September 11, 2001. Funded by the U.S. Army, the CBRNE project encompasses a number of activities, including the procurement of specialty equipment, engineering support for deployability and modularity, and design and procurement of custom storage containers. The custom storage containers are made at the Heyrend Way Facility. It was during the fabrication of the custom made containers that the accident occurred.

The Technician involved in the accident was a new employee, having accepted employment by BEA on December 12, 2005. However, because of an annual INL-

wide contractor “curtailment” over the Christmas and New Years holidays, he did not report to work until January 9, 2006.

On January 5, 2006 (from an off-site location), and January 9, 2006, the Technician completed new employee orientation computer-based training. This included summary training on the Voluntary Protection Program, Stop Work Authority, and the Integrated Safety Management System (ISMS). At approximately 2:00 p.m. January 9, 2006, the Technician met with the project engineer that he was supporting, and they traveled to the Heyrend Way Facility for a facility walkthrough and brief indoctrination. At that time he met his facility co-workers, read and signed facility job safety analysis (JSA) documents, and was shown the location of the equipment and vendor manuals for the equipment within the facility.

On January 10, 2006, the Technician performed various tasks within the facility that included moving supplies and fabrication of the custom foam packaging and ruggedized cases for the CBRNE project. These fabrication activities included attaching the handles and hinges to the boxes and using a Jet Leaf Brake and Birmingham Hydraulic Shear. The Technician’s operation of this equipment was reviewed with and authorized by the Laboratory Custodian. In addition, operation of other facility equipment, including a band saw, drill press, foam cutter, and table saw, were also discussed.

On January 11, the Technician finished the metal fabrication activities he had been working and requested a new assignment from the Laboratory Custodian. As the next assignment was to use the table saw to cut plywood and ETHAFOAM 900®¹ for additional box fabrication, the Laboratory Custodian reviewed operation of the table saw with the Technician and authorized the Technician to operate it.



Figure 1. Table Saw at Accident Scene.

¹ ETHAFOAM 900® is a Dow Chemical Company semi-rigid polyethylene foam product, used in a variety of applications including shock absorbing, vibration dampening, insulation, cushioning, and floatation. It is procured for use in the Heyrend Way Facility in 2-in.-thick sheet form.

The first step involved sizing 3/4-in. plywood into pieces approximately 8-in. wide by 20-in. long. The Technician encountered no problems during the plywood ripping operation. During the plywood ripping operation, the blade guard assembly was in place and in use. The Laboratory Custodian observed the Technician during a portion of this operation.

In the next step of the process, the Technician again used the table saw to put three dado cuts into the plywood. To accomplish this, the table saw blade guard assembly had to be removed. The Technician had another facility employee instruct him in the process for removal of the blade guard assembly. The Technician then removed the blade guard assembly and completed the dado cuts of the plywood. The dado cuts consisted of a single pass with the 1/8-in. wide combination blade already in use.



Figure 2. Sample of Plywood Dado Cuts.

After a scheduled break, the Technician proceeded to rip cut the ETHAFOAM 900®. The blade guard assembly was not re-installed prior to this operation. The Laboratory Custodian observed the first cut of the ETHAFOAM 900® before leaving the Technician but did not notice that the blade guard assembly was missing. The Technician noted that the ETHAFOAM 900® was difficult to control while cutting with the table saw. While cutting the final piece of ETHAFOAM 900®, it became more difficult to control, and the Technician stopped using the push stick prior to completion of the cut. He placed both hands on the scrap portion (material on the side of the blade opposite the rip fence) of the material, leaving the product piece between the saw blade and rip fence unrestrained. Within several inches of completing the cut, an unexpected movement of the material occurred, and his right hand contacted the rotating saw blade. Based on the available physical evidence, the Board concluded that a kickback of the ETHAFOAM 900® occurred as part of the final accident sequence. Because no one witnessed the

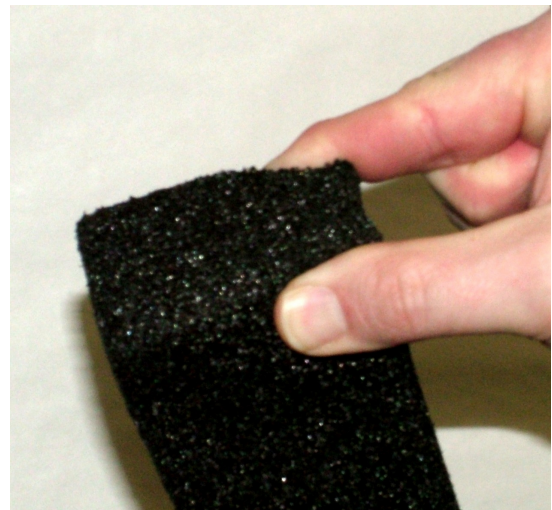


Figure 3. Flexibility of ETHAFOAM 900®.

accident and the Technician was unsure of the final sequence, the exact accident sequence could not be determined.



Figure 4. ETHAFOAM 900® Fits Under the Blade Guard Assembly.

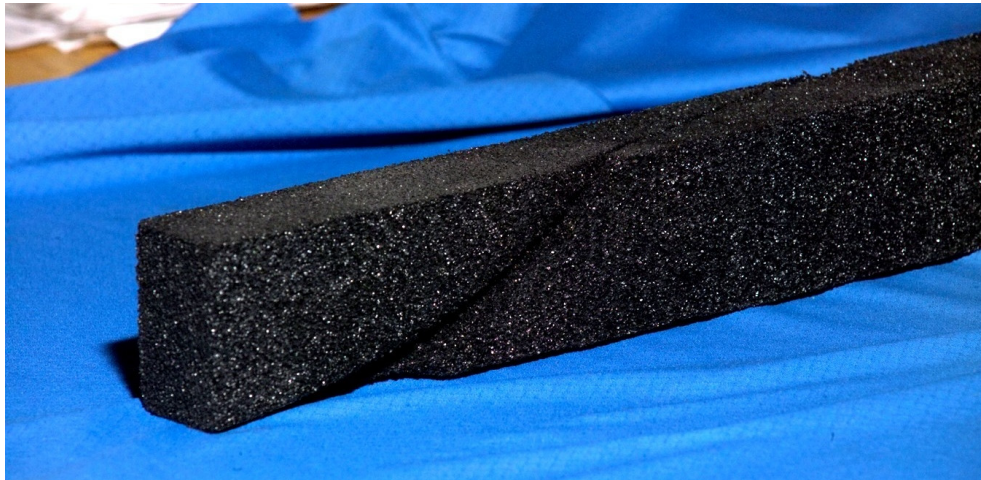


Figure 5. ETHAFOAM 900® Cut at Time of Accident Shows Evidence That Material Kickbacked.

2.1.2 Accident Analysis

The analysis of the accident included a review of the Technician's work history, training, and experience with the table saw and the ETHAFOAM 900® product. The Board also reviewed company policies, procedures, training documents, regulatory safety standards and regulations, equipment manufacturer's documentation, and industry consensus standards and guides. BEA and DOE-ID employees were interviewed, and the available physical evidence was examined.

The accident investigation was conducted in accordance with the requirements of DOE O 225.1A, *Accident Investigations*, and DOE G 225.1A-1, *Implementation Guide for use with DOE O 225.1 Accident Investigations*.

2.1.3 Chronology of Events

For a chronology of events refer to Appendix A.

2.1.4 Emergency Response and Investigative Readiness

Immediately following the accident, the injured Technician called out for assistance. Other personnel at the facility took immediate action and called 911 to report the accident and request medical assistance. Employees were not immediately able to provide the 911-dispatcher with a street address for the facility. The physical address of the facility had not been posted on the building. Bonneville County planning and zoning ordinances require a physical street address be posted prior to building occupancy.

Other employees provided emergency first aid assistance. Due to the lack of a first aid kit, cleaning rags were applied to the wound with pressure to stop the bleeding. The injured Technician was also helped to the floor and treated for shock.

Bonneville County records indicated that the call to 911 was received at 9:16 a.m. The emergency medical services (EMS) ambulance was dispatched from Fire Station No. 5 at 9:17 a.m. and arrived at the accident location at 9:29 a.m. The Technician was transported from the Heyrend Way Facility by ambulance at 9:41 a.m. and arrived at Eastern Idaho Regional Medical Center (EIRMC) at 9:51 a.m. The total time between the call to 911 and the arrival of the ambulance was 13 minutes.

When the response time is greater than three to four minutes for work areas where severe bleeding or other life threatening or permanently disabling injuries can be expected, Occupational Safety and Health Administration (OSHA) requires that first aid kits and personnel trained in first aid be available.

The Board concluded that contrary to the requirements of 29 CFR 1910.151(b), a first aid kit was not available at the Heyrend Way Facility, and BEA did not ensure that person(s) with appropriate first aid training were assigned to the Heyrend Way Facility.²

The Board concluded that the initial response of the workers and emergency medical services response were satisfactory.

The Contractor Requirements Document associated with DOE O 225.1A, *Accident Investigations*, specified that contractors establish and maintain readiness to respond to accidents, mitigate the consequences, assist in collecting and preserving evidence, and assist with the conduct of the investigation. This includes preserving the accident scene to the extent that it was under the control of the contractor, documenting the accident scene through photography, and other means.

Immediately following the injury, all activities focused on providing medical treatment for the injured Technician. During the initial response some ETHAFOAM 900® material at the accident scene was moved to provide support for the injured Technician's head and feet. Also, blood that had collected under the injured Technician's hand was cleaned to reduce the potential for anxiety when the injured Technician was moved from the accident scene.

The Board concluded the immediate response actions were appropriate.

After the Technician was moved from the area, technicians in the facility disturbed the accident scene beyond that which was necessary to provide first aid and treatment to the injured Technician; ETHAFOAM 900® material involved in the accident was removed from the scene and disposed of in a dumpster, the table saw blade was lowered before the height measurement was obtained, personal protective equipment and table saw tools were removed from the scene, and visible traces of blood were removed. The investigative readiness related to preservation of the scene and control of evidence did not ensure an accurate understanding of the accident scene.

The Board concluded the investigative readiness did not ensure the scene was properly controlled and resulted in disturbance of important evidence.

² OSHA interpretation dated February 9, 1994, 'In areas where accidents resulting in suffocation, severe bleeding, or other life threatening or permanently disabling injury or illness can be expected, a 3 to 4 minute response time, from time of injury to time of administering first aid, is required. In other circumstances, i.e., where a life-threatening or permanently disabling injury is an unlikely outcome of an accident, a longer response time such as 15 minutes is acceptable.'

Within an hour of the accident, a BEA manager familiar with the accident investigation process arrived at the accident scene and assumed control. The BEA manager directed responders to each write a statement on their level of participation, as well as what they observed prior to, during, and following the accident. The BEA manager secured what remained of the accident scene and retrieved and secured the ETHAFOAM 900® material associated with the accident from the dumpster.

The DOE Type B Accident Investigation Board convened on January 18, 2006, and received documents and photographs from the Chairman of the Contractor Accident Investigation Team. The documents and photographs were pertinent to the accident, well organized, and greatly assisted the Board in beginning its investigation. Later, the Board requested some additional contractor-related documentation and photographs.

2.1.5 Medical Analysis

The wound to the right hand extended across the palm of the hand between the area near the base the little finger to the web of the hand between the thumb and index finger. The wound was deepest at the little finger and became progressively shallower at the index finger. The blade did not make contact with the thumb. The accident resulted in extensive injury to the right hand and the traumatic amputation of the little finger. The Technician was hospitalized and underwent extensive reconstructive surgery. The Technician was released from the hospital on January 17, 2006.

2.2 HAZARDS, CONTROLS, AND MANAGEMENT SYSTEMS

2.2.1 Management Systems

The Office of Nuclear Energy, Science and Technology (NE) was the lead Program Secretarial Office for the DOE-ID Operations Office. DOE-ID managed the INL, a multi-program DOE national laboratory. BEA was under contract with DOE-ID as the Managing and Operating Contractor (M&O) for the INL. The contract between DOE and BEA delineated Environment, Safety, and Health (ES&H) requirements and expectations that the contractor had to follow while performing work activities. A primary example was DEAR 970.5223-1— *Integration of Environment, Safety, and Health into Work Planning and Execution*, which was included in contract clause I-22. This DEAR clause required institutionalization of ISMS to ensure that ES&H functions and activities became an integral but visible part of the contractor's work planning and execution processes.

The DOE-ID line-management organization for this project extended from the Idaho Operations Office Manager, through the Idaho Operations Office Deputy Manager, through the Assistant Manager for Research and Development (R&D), through the Director of the National Security/Science and Technology Division, to the Team Leader of the National Security (NS) Team. This line management organization was responsible for safety and programmatic oversight of all INL National Security activities, including those in the Heyrend Way Facility. At any given time there might

have been hundreds of NS programs/projects in progress at the INL. These programs/projects may have included any of a broad spectrum of activities, including R&D, production and supply of materials/equipment, and information consultation and analysis. These activities took place in several different work locations in and around the city of Idaho Falls and at the INL site area about 50 miles west of Idaho Falls. The majority of the work was performed under Work For Others (WFO) agreements.

The majority of the work overseen by the DOE-ID NS Team was performed by BEA under the Associate Laboratory Director (ALD) for National and Homeland Security. The ALD reported to the Deputy Laboratory Director, Science and Technology Research. The Deputy in turn reported to the INL Laboratory Director, who is also the President of BEA.

2.2.2 DOE-ID Safety Oversight

The DOE-ID R&D organization *Roles, Responsibilities, Accountabilities, And Authorities (R²A²)* document established responsibility and accountability for safety at each level, from assistant manager down to team leader. In the Heyrend Way Facility, the NS Team was the line management organization with primary responsibility for providing oversight of overall project management activities such as cost, schedule, and scope, in addition to project safety.

The Quality and Safety Division (QSD) was primarily responsible for oversight of quality and safety programs. In addition to ES&H program oversight, SMEs were available at request of line management for targeted assessments or technical consultation.

Facility representatives (FacReps) performed oversight of their assigned facilities/activities to ensure that the contractor was operating facilities safely and in accordance with contractual and regulatory requirements. FacRep oversight may have been planned and structured surveillances/assessments or in response to facility events, but was most often in the form of routine, unscheduled facility walkdowns and observation.

When the Heyrend Way Facility was first leased in April 2000, DOE-ID FacReps were organizationally assigned within facility line management. The FacReps responsible for oversight of the Heyrend Way Facility and the other Idaho Falls laboratories reported to the functional predecessor of the Science and Technology Complex/Infrastructure (STC/I) Team and were, in part, performing safety oversight of NS work activities. This management arrangement led to DOE-ID internal tension as FacRep oversight was perceived by the program as interference with program work, and NS security issues with FacReps (need-to-know, etc.) were perceived by FacReps and their line management as an attempt to restrict safety oversight. During this time, FacReps and SMEs raised issues with work/hazard controls in laboratory facilities, including the Heyrend Way Facility.

In June of 2003, the jurisdictional issues were resolved by an informal agreement between facility line management and NS program management that excluded FacReps and SMEs from certain NS activities unless their assistance was specifically requested by the NS Program. It was determined that NS Team personnel would provide the safety oversight that was previously performed by FacReps and SMEs. One of the NS program/project managers was a previously qualified DOE-ID FacRep and another had a strong OSHA inspector and laboratory safety background.

Although NS Team leadership and staff have stated their understanding of line management responsibility for safety and their own personal dedication to safe work, there was no documented evidence of safety oversight at the Heyrend Way Facility from June 2003 until October 2005. One visit each month to the Heyrend Way Facility was recorded by an NS Team project manager for October, November, and December 2005. The sole entry regarding safety oversight was recorded on October 26, 2005, stating, "Observed subcontractor interaction and ES&H approach." The time and effort required to manage the more than 300 projects/programs left little time for in-house safety oversight.

DOE Department-level guidance for performing FacRep staffing analysis did not require FacRep coverage at a non-nuclear facility unless the facility contained a high non-nuclear hazard (biological, high energy, chemical, etc.). However, in the fall of 2004, DOE-ID managers recognized the need for FacRep coverage of NS activities. In January 2005, a staffing analysis was performed that added FacRep coverage to non-nuclear facilities in recognition that most accidents and injuries DOE complex-wide were of an industrial nature. It was recognized that under the new staffing analysis, the FacRep program was now understaffed.

On September 28, 2005, ID Manager's Policy ID MP-226.A, *Policy Regarding Oversight Activities on National Security Program Activities*, was issued, establishing that a single dedicated FacRep would be assigned to NS programs. On November 21, 2005, the policy was converted to OD-113 – *Policy Regarding Oversight Activities on National Security Program Activities*. Also in November 2005, the DOE-ID NE FacReps were realigned to report to the DOE-ID Senior Operations and Safety Officer through a FacRep team leader. This allowed FacReps oversight with more independence from line management and a higher level of management visibility for their observations and concerns. At the same time, a FacRep was assigned to cover NS activities. This FacRep was determined to have the "need-to-know" for NS activities and was cleared to provide FacRep coverage of the Heyrend Way Facility. The FacRep assigned to cover NS activities (including the Heyrend Way Facility) was also temporarily assigned the duties of a second FacRep until the hiring and qualification process to fill the second FacRep vacancy could be completed. At the time of the accident, the NS FacRep had not been to the Heyrend Way Facility.

2.2.3 Contractor Safety Oversight

Per BEA, program requirements document (PRD) 5060, *Occupational Safety and Health Functions, Roles, Responsibilities, and Interfaces*, ES&H professionals were not required to perform routine in-field safety oversight. ES&H personnel reviewed safety documentation and plans, provided programmatic guidance, responded to line management requests for safety consultation, and other related tasks. ES&H field time might have been requested by line management or may have been in response to events or special higher-than-normal hazard activities.

Line management safety oversight was usually in the form of routine day-to-day presence in facilities, normally by lower tier supervisor/foreman personnel. This may have been supplemented by Senior Supervisory Watches (company managers who were assigned to a day of in-field work observation). There was no evidence that Senior Supervisory Watches were conducted at the Heyrend Way Facility.

The Integrated Assessment Program (IAP) described in PDD-1064 was designed to be an integrated, risk-based approach to determine compliance with requirements and the adequacy and effectiveness of programs and processes in meeting customer and management expectations. All organizations were required to perform management self-assessments and reviews and, as applicable, inspections and surveillances.

The Board reviewed BEA self-assessments conducted since January 2005 at the Heyrend Way Facility. Of the 12 assessments conducted, 10 comprised scheduled monthly and quarterly checklist assessments with topics including ES&H, training, and quality assurance. One assessment looked specifically at machine guarding and was checked as “ok.” One assessment specifically included first aid kits and was marked “not applicable.” The only findings for the year were that a dumping of wastewater sign was missing from the restroom, the chairs were not “the new ergo safe” chairs, two slings were missing tags, and a storage shelf had been placed on a wheeled platform without being properly bolted down. One self-assessment of JSAs only verified that the JSAs in the facility were up-to-date (within the five year period allowed). The Board noted that checking “not applicable” for first aid kits was contrary to OSHA requirements to assure their availability. This deficiency was not noted by BEA management.

Two BEA senior management assessments were documented from organizations outside the National and Homeland Security Associate Laboratory Directorship (ALD). In December 2005, the acting manager of Facilities and Site Services performed a walkdown of several facilities including the Heyrend Way Facility. In his report he expressed a concern regarding inconsistent standards of training, qualification, and tracking of personnel who use machine shop equipment. This concern was not entered into the INL issue tracking system (ICARE) and no corrective actions were evident.

Also in December 2005, a walkdown of the Heyrend Way Facility was performed by the ALD for the Specific Manufacturing Capability (SMC) and the ES&H manager of

SMC. The walkdown identified issues with blockage of electrical panels and an extension cord that was a tripping hazard. The team noted the minimal facility supervision and the minimal work authorization and control protocols. After review of Management Control Procedure (MCP) 3571, *Independent Hazard Review*, and conversations with facility management, the walkdown team concluded that the protocols being followed were in accordance with company procedure.

These work control questions were also noted in a Board interview of a craftsman performing work temporarily in the Heyrend Way Facility. He stated that the work environment was “like a different country” compared to elsewhere on the INL. The lack of prejob briefings and work control documentation seemed strange to him.

It was of note that the only challenging questions raised during a year of assessments were by external assessors. This called into question the effectiveness of an oversight program relying almost exclusively on internal review and assessment.

The Board concluded that regularly scheduled self-assessments and inspections were conducted at the Heyrend Way Facility. The Board further concluded that the assessments were predominately conducted by facility personnel, who were not specifically trained to conduct assessments of safety and health related topics and that checklists are not a substitute for comprehensive review by SMEs.

2.2.4 Analysis of Safety Management Systems

The framework for analysis of management safety systems consisted of the following principles, as described in DOE Policy 450.4, *Safety Management Systems Policy*:

- Line management responsible for safety
- Clear roles and responsibilities
- Competence commensurate with responsibility
- Balanced priorities
- Identification of safety standards and requirements
- Hazard controls tailored to work being performed
- Operations authorization.

Line Management Responsibility for Safety

DOE-ID roles and responsibilities were defined in the DOE-ID OD-101, *Functions, Responsibilities and Authorities Manual (FRAM)*, with further clarification provided by policy document OD-113, *Policy Regarding Oversight Activities on National Security Program Activities*.

DOE line management responsibility for the safety of NS work activities clearly flowed from NE to DOE-ID and then to BEA. The DOE-ID Manager was directly responsible for the protection of employees, the public, and the environment. In the DOE-ID management organization, the NS Team, under the DOE-ID Assistant

Manager for R&D, was the line management organization responsible for safety and programmatic oversight of all INL NS activities (including those in the Heyrend Way Facility).

The position description for the NS Team Leader referenced the OD-101 for any specific responsibilities related to safety oversight. Although NS was the line management organization, the NS section of the OD-101 did not contain specific roles and responsibilities related to safety oversight.

The safety role of NS was described in OD-101 under the parent organization, the Assistant Manager for Research and Development (AMRD). Here it stated that the AMRD organization (including NS) performed oversight to ensure adherence to contract cost, scope, and schedule commitments, as well as to ensure the projects were conducted safely and efficiently.

Also within DOE-ID, was the Science and Technology Complex/Infrastructure (STC/I) Team, under the Assistant Manager for Laboratory Operations. This team served a landlord function providing facility maintenance and oversight, including facility safety and authorization basis roles. Prior to June of 2003, the DOE-ID FacReps providing oversight for the Heyrend Way Facility were a part of this landlord line management group.

In June of 2003, due to issues of NS program security, an informal agreement was reached between facility line management and NS program management that excluded FacReps and SMEs from certain NS activities, unless the NS program specifically requested their assistance. It was determined that NS program personnel would provide the safety oversight that was previously performed by FacReps and SMEs. However, there is no documented evidence of safety oversight by NS at the Heyrend Way Facility from June 2003 until October 2005.

The Board concluded that although the NS Team had line management responsibility for safety in their programs, between June 2003 and October 2005 there was no documented safety oversight performed in the Heyrend Way Facility.

On September 28, 2005, ID Manager's Policy ID MP-226.A, *Policy Regarding Oversight Activities on National Security Program Activities*, was issued, establishing that a single dedicated FacRep would be assigned to NS programs. On November 21, 2005, the policy was converted to OD-113 – *Policy Regarding Oversight Activities on National Security Program Activities*. Also in November 2005, the DOE-ID NE FacReps were realigned to report to the DOE-ID Senior Operations and Safety Officer through a FacRep team leader. This allowed FacReps oversight with more independence from line management and a higher level of management visibility for their observations and concerns. At the same time, a FacRep was assigned to cover NS activities. This FacRep was determined to have the “need-to-know” for NS activities and was cleared to provide FacRep coverage of the Heyrend Way Facility. The FacRep assigned to cover NS activities (including the Heyrend Way Facility)

was also temporarily assigned the duties of a second FacRep until the hiring and qualification process to fill the second FacRep vacancy could be completed. At the time of the accident, the NS FacRep had not been to the Heyrend Way Facility.

The Board concluded that line management ownership of safety was clearly documented, but in practice, NS did not fulfill their management responsibility for safety at the Heyrend Way Facility.

Part of the purpose of BEA's Laboratory Excellence Program described in PDD-9000, *Laboratory Excellence Program and Organization Structure*, was to define the BEA organization structure and key roles and responsibilities that were intrinsic to safe and effective management. Responsibility and accountability for safety were incorporated at all levels of line management down to the worker level.

Clear Roles and Responsibility

DOE-ID roles and responsibilities were defined in OD-101 with further clarification provided by OD-113. Performance requirements, roles, and responsibilities contained in OD-101 were reflected in employee's position description and performance agreements.

The position description for the NS Team Leader referenced OD-101 for any specific responsibilities related to safety oversight. Although NS was the line management organization, the NS section of OD-101 did not contain specific roles and responsibilities related to safety oversight.

The safety role of NS was described in OD-101 under the parent organization, the AMRD. Here it stated that the organization (including NS) performs oversight to ensure adherence to contract cost, scope, and schedule commitments, as well as to ensure the projects were conducted safely and efficiently.

From April 2000, when the Heyrend Way Facility was first leased, until June 2003, when the informal agreement described above was established, roles and responsibilities for safety oversight of the facility were unclear. Since that time, the roles and responsibilities have been clarified.

Part of the purpose of the BEA Laboratory Excellence Program described in PDD-9000 was to define the BEA organization structure and key roles and responsibilities that were intrinsic to safe and effective management. Responsibility and accountability for safety were incorporated at all levels of line management down to the worker level.

Competence Commensurate with Responsibility

DOE-ID roles and responsibilities were defined in OD-101, with further clarification provided by OD-113. Safety oversight knowledge and skills were dependant upon

each employee's prior experiences and skills. There was no formal training program for NS staff. There were available resources such as FacReps or SMEs for each functional element; however, they were seldom coordinated and used by NS staff. Programmatic oversight and project management competence of NS personnel was commensurate with their responsibility.

The FacRep Program contained robust requirements for FacRep training and qualification, with periodic requalification. FacReps had competence commensurate with their responsibility.

BEA program personnel associated with the CBRNE project demonstrated weakness in the proper application of their work control procedures. BEA safety SMEs had the competence commensurate with their responsibilities.

Balanced Priorities

DOE-ID's oversight model was developed on a risk-based graded approach. Oversight elements were established and evaluated using the Tenera model. Line management had flexibility in establishing the oversight plan. Each division issued an oversight plan that delineated oversight technique, schedule, and deliverables.

NS line management oversight was focused mostly on the cost, scope, and schedule at NS facilities (including the Heyrend Way Facility). In accordance with the hazard classification of the facility (low hazard), the FacRep conducted six to 12 walkthroughs in NS facilities a year. While conducting walkthroughs, FacReps did not have direct access and could not perform real time observations or unannounced reviews unless the area was sanitized and they were escorted. In June 2003, NS line management decided to conduct oversight without FacReps. Since then, there have not been any FacRep oversight activities at the Heyrend Way Facility. The Board did not find evidence that the NS Team had performed formal safety oversight of the Heyrend Way Facility between June of 2003 and October of 2005.

In January 2005, DOE-ID conducted a FacRep staffing analysis using new criteria in DOE Memorandum 04-ORP-057. The analysis indicated the need for additional FacReps. A policy was issued regarding oversight activities on NS program activities in September 2005. The policy required a single dedicated FacRep for the program area. DOE-ID assigned a full-time FacRep to oversee NS programs in November 2005, but the FacRep had not yet conducted a walkthrough in Heyrend Way Facility by the date of the accident.

BEA line management did not employ its work control procedures in a manner that demonstrated an appropriate balance between performance of work and control of hazards.

Identification of Safety Standards and Requirements

Safety standards and requirements have been identified and have flowed down through DOE-ID procedures and into the BEA contract. BEA has not incorporated appropriate safety standards and requirements into its MCP-3571 work control processes.

Hazard Controls Tailored to Work Being Performed

The BEA procedure for tailoring hazard controls to research and development, and research- and development-related work, MCP-3571, was not as rigorous as it needed to be to appropriately control all hazards. Supporting procedures to MCP-3571, such as MCP-3450, *Developing and Using Job Safety Analysis*, were able to appropriately tailor hazard controls to the work but needed to be better employed by MCP-3571.

Operations Authorization

A process for work authorization at the DOE-ID level was established through the contracting and WFO organizations.

BEA PDD-1004, *Integrated Safety Management System*, section 11.7.2 stated that “...every employee involved in the evolution must clearly understand the hazards and hazard controls in place before any evolution may officially begin—no matter how complex or simple the evolution.” This was not the case on the day of the accident, as the Technician did not understand when the blade guard assembly was required to be used.

PDD-1004 section 11.7.2 further stated, “Work is performed by personnel who are trained and, as necessary, qualified or certified to perform their assigned task (see MCP-33, and AWP-4.1).” This was not the case on the day of the accident, as the Technician had not received all required training for the work.

PDD-1004 section 11.7.2 further stated, “Pre-job briefings (see MCP-3003, ‘Performing Pre-Job Briefings and Documenting Feedback,’ and AWP-2.1) are conducted and the work procedures or instructions, results of hazards analysis, and required permits and controls necessary to perform the job are reviewed with the worker.” While MCP-3003 was ambiguous as to its applicability to MCP-3571 work, MCP-3450 clearly stated that MCP-3003 prejob briefs were required when using a JSA. A prejob brief was not performed before starting work for the activity the day of the accident.

<p><i>The Board concluded that BEA did not perform a prejob briefing or assure workers were properly trained and hazards were identified and controlled as required.</i></p>
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PDD-1004 section 11.7.2 further states, “Line supervision is responsible to ensure that, during work execution, controls remain in place. Line managers are experienced

personnel who receive the necessary training and qualifications to carry out their assigned duties and responsibilities.” The individual filling a supervisory role over the Technician the morning of the accident was not his line supervision, and was not a trained or qualified supervisor. This individual did not ensure that hazard controls, specifically the blade guard assembly, remained in place for the ETHAFOAM 900® rip cutting operation.

2.2.5 Work Planning and Controls

The Board analyzed the work planning and control of work activities of BEA at the Heyrend Way Facility with reference to the five core safety management functions described in DOE Policy 450.4, *Safety Management System Policy*. These five core safety management functions provide the necessary structure for any work activity regardless of the performer of the work.

- Define the scope of work
- Identify and analyze the hazards associated with the work
- Develop and implement hazard controls
- Perform work within controls
- Provide feedback on adequacy of controls and continuous improvement

Define the Scope of Work

The work being performed at the Heyrend Way Facility was defined as WFO per MCP-5140, *Work for Others Contract Process*, and was performed at the activity level.

Per MCP-5140, a decision package was prepared consisting of a statement of work (SOW), which includes a description of the work requested by the sponsor, the deliverables and expected dates, a project schedule with milestones, and proposed reporting requirements. Also included in the decision package was an ES&H Budget Development Checklist that determined the level and types of ES&H support the project would require.

PDD-1004, described four activity-level work control processes and associated procedures tailored to safely accomplish work in four types of work areas: R&D (MCP-3571), operations (MCP-3562), maintenance (STD-101), and construction (MCP-7201). How a particular work control process was identified for a given WFO project was unclear.

MCP-3571 was created in 1999 with the intention of providing controls for the safe conduct of research by establishing defined, peer reviewed boundaries within which the researcher had latitude to work, rather than imposing specific controls on each research task. The procedure’s scope section specifically stated that it only applied to activities that had a research component. R&D was defined as work undertaken to acquire new knowledge or improve existing knowledge, with the distinguishing criterion being the presence of a scientific or technological uncertainty to be resolved.

Revision 3 of MCP-3571, dated October of 2000, contained a new term: “R&D Related Activities.” The definition of this term included “prototypical shop activities performed at R&D facilities.”

The CBRNE Systems Integration project being worked by the Technician the day of the accident was working under the MCP-3571 R&D work control process as an “R&D Related activity.” Per MCP-3571, work involving R&D or R&D-related activities was assigned to a Principal Investigator (PI) who was the central point of contact and coordination for all aspects of the project. A PI was not formally assigned to this project. The project manager and the laboratory manager at various points in the procedure made decisions in a PI capacity. (In the narrative to follow, references to the PI actually refer to a combination of the Laboratory Manager and/or the Project Manager.)

The Risk Identification Checklist in the Project Execution Plan for the CBRNE Systems Integration project answered “no” to the following questions:

- Is the technology new?
- Is the technology unknown or unclear?
- Is this a new application of an existing technology?
- Does the project modernize or advance technology in an existing application?

The activity of manufacturing the shipping containers did not involve scientific investigation or development of new scientific knowledge.

The Board concluded that the work being performed (fabrication of an equipment storage box) by the Technician under the CBRNE project did not meet the definition of a R&D-related activity, based upon the Project Execution Plan checklist.

Section 4 of MCP-3571 provided the instructions for implementing the procedure. Step 4.1 was titled “Define Scope of Work,” but neither of the two substeps provided scope definition. Substep 4.1.1 determined if the research was administrative in nature and, therefore, exempted from work control. Substep 4.1.2 read, “Determine if identified hazards are ordinary laboratory hazards and can be mitigated by skill of the researcher.” At this point in the procedure, hazards had not been identified so it was unclear how such a determination could be made. A preliminary hazards evaluation was performed as part of the WFO budgeting and approval process, but this was not the process prescribed (later) in MCP-3571 for the identification and mitigation of hazards. The broad scope definition for use in MCP-3571 was provided by the MCP-5140 WFO approval process. The only scope definition in MCP-3571 for R&D related work was the day-to-day informal scope direction provided by the PI to the crafts and technicians performing work. The written instructions to the Technician for the performance of cutting the ETHAFOAM 900® consisted of a one-page hand-drawn diagram (Appendix B). How this scope was to be defined was not specified in the procedure.

The Board concluded that MCP-3571 does not define the scope work, adequately control the performance of work, or provide for worker feedback and continuous improvement, as required by ISMS.

Identify and analyze the hazards associated with the work

The second core function of ISMS was hazard identification and analysis. Program Requirements Document (PRD) 25, *Activity Level Hazard Identification, Analysis, and Control* invoked the procedures required to implement the activity level hazard identification and analysis process. Per PRD-25, the documents that implemented these requirements were identified in the process flow diagram provided in Appendix A, “PRD-25 Implementation.” This flow diagram began with the type of work activity to be performed and identified seven types: operations, environmental restoration, maintenance, modifications, construction, decontamination and decommissioning, and research.

In September of 2001 the JSA controlling work in the Heyrend Way Facility was defined as an “operations” MCP-3562 process. In May of 2002, this work was determined to be a “research-related activity” as documented on Independent Hazard Review (IHR) Form 420.14. The reason for the change was not documented. No change to the JSA was made at that time.

MCP-3571 step 4.3 directed the PI to “choose the applicable hazard analysis.” The choice was to be made based upon whether the work was “research and development” or “R&D related.” The activity being performed by the Technician at the Heyrend Way Facility was determined to be a R&D-related activity. This led the PI to step 4.8 of MCP-3571.

Step 4.8 directed the PI to “Determine the type of Job Safety Analysis (JSA) or IHR that will be used for the R&D-related activity.” The options were IHR process, JSA, or JSA for subcontract service. No guidance was provided in the step for making the determination. The laboratory manager determined that the CBRNE project work could be performed using an existing JSA. MCP-3571 did not allow for this determination.

Developing a JSA

MCP-3571 step 4.9 began the development of a JSA. The first step (4.9.1) was to Complete Form 420.05, *Independent Hazard Review, Hazard Mitigation Worksheet*, to identify any potential hazard(s) and to identify appropriate SMEs to review the form and JSA. This form was not generated for the CBRNE project.

A determination was made between the Laboratory Manager and the Project Manager that the existing JSAs in effect in the Heyrend Way Facility appropriately covered the CBRNE work to be performed and that a new or revised JSA was not required. ES&H subject matter expert (SME) input was not requested.

The operation of the table saw was not included in a JSA, and, therefore, the manufacturer's warnings from the operator's manual were not included in the JSA.

Several DOE-ID oversight activities conducted at the Heyrend Way Facility in 2000 and 2001 identified deficiencies with development and use of JSAs. One report concluded that the single JSA that was written to cover all of the tasks and work in eight separate facilities was too broad in scope.

The Board concluded a formal review of the CBNRE project activities was not conducted against the JSA used as the work authorization/control document to ensure that the project did not introduce any unanalyzed hazards into the work place.

Develop and Implement Hazard Controls

The third core function of ISMS was the development and implementation of controls to mitigate the identified hazards. PRD-25 provided general requirements for the development and implementation of hazard controls and directed the use of MCP-3571 for performing research and development work.

Because the hazards of the CBRNE project tasks were assumed to be controlled by the existing JSA for machining and fabrication (JSA-IF6150718012), the JSA development process was not executed, with the result that CBRNE project-specific hazards were not all identified and appropriately controlled.

Perform Work

The fourth core function of ISMS was the performance of work following the established procedures or work control guidance for the work being performed.

Work activities at the Heyrend Way Facility were verbally authorized. The work guidance documents comprised the associated JSAs, as well as sketches and informal work directions provided by the project engineer. This was in compliance with MCP-3571.

When planning work using a JSA as the work guidance document, attention to detail in preparing the JSA, specifically, describing the steps of a job in sufficient detail for adequate hazard identification, analysis, and control, was critical. When performing work under a JSA, workers had to be thoroughly knowledgeable of the boundaries of the JSA to ensure the methods they employed to accomplish the work were within those boundaries.

The Board concluded that using a JSA in place of a formal work control document relied heavily upon the assumption that training was adequate to mitigate hazards.

Provide Feedback on Adequacy of Controls and Continuous Improvements

The Board reviewed the October 15, 2001, Grout Injection Operator Injury accident that occurred at the Radioactive Waste Management Complex (RWMC) Cold Test Pit South (CTPS). A fitting assembly from a subcontractor's high-pressure (6,000 psig) grout injection system failed and struck a subcontract worker on the right side of the head, resulting in injury and significant loss of vision in the injured eye.

A comparison to the Grout Injury Board identified contributing causes as follows:

- “Interface among appropriate DOE-ID organizations was inadequate to ensure effective oversight of ER [Environmental Restoration] activities.” In this most recent accident, the Board likewise identified DOE-ID organizational interface conflicts that contributed to the absence of appropriate safety oversight for period of more than two years at the Heyrend Way Facility.
- “BBWI’s process for ensuring implementation of ISM by sub-contractor’s was inadequate to ensure worker safety.” In this most recent accident the Board likewise identified deficiencies in the BEA implementation of ISM which contributed to the accident situation.
- A “...task level hazard analysis, i.e. job safety analysis...” was required for the grouting operation being conducted, but was not performed. In this most recent accident the Board likewise concluded that the JSA was not performed for the CBRNE project task, and the hazards associated with cutting of ETHAFOAM 900® were not identified.
- “DOE-ID needs to improve oversight of BBWI to ensure work is planned and executed in accordance with established ESH&QA requirements.” In this most recent accident the Board likewise identified multiple issues with DOE-ID oversight of contractor implementation of ES&H requirements.

Multiple lessons learned were available from the Grout Injection Operator Injury accident, several of which may have prevented or reduced the consequences of this accident. DOE-ID and BEA did not take full advantage of this valuable source of work control feedback.

The Board concluded that DOE-ID and its contractors did not ensure corrective actions from past events were developed, implemented, and institutionalized to assure full compliance with integrated safety management principles and avoid preventable accidents.

The MCP-3571 process did not include a prescribed method of providing worker feedback.

Incorporation of feedback from sources external to the project team was a weakness. DOE-ID Oversight Reports, IRC-2000-32, IRC-2001-3, and IRC-2001-9 identified the need to improve the use of JSAs at the Heyrend Way Facility, yet the quality of the JSAs and the adherence of workers to JSA requirements remained an issue five years later.

The Board concluded that MCP-3571 did not ensure implementation of the five core functions of ISMS. The procedure did not provide for the definition of work scope, did not adequately control the performance of work, and did not provide a means for worker feedback.

2.2.6 Equipment Safety

At the time of the accident the Technician was rip cutting 1-7/8-in. thick Dow ETHAFOAM 900® into 2-3/4-in. wide by 30-in. long strips. Prior to rip cutting the ETHAFOAM 900®, the Technician had rip cut and dado cut 3/4-in. plywood. During these operations, the Technician was wearing safety glasses and gloves. Hearing protection was deemed to be unnecessary by an industrial hygiene exposure assessment and was not included in the JSA.

The table saw assembly consisted of a Jet Model JSTS-10JF table saw with a Biesemeyer Delta T-Square fence and a Jet integral blade guard assembly that was intended to meet the requirements for a blade cover, anti-kickback pawls, and kerf spreader. The blade in use was an Oldham Pro Series Carbide 40-tooth carbide tip 10-in. smooth cut combination blade. The blade had recently been replaced and was in near-new condition. The table insert was a standard insert supplied by the manufacturer. After about six months of use, the original push stick that was delivered with the saw was replaced by a replica fabricated in the shop. The push stick had been in use for about five years and was still serviceable. The saw was purchased new in 2000 when the facility was first opened.

At the time of the accident, one of the anti-kickback pawls was missing from the blade guard assembly. The workers were aware of this condition but continued to use the saw without repair or mitigative action. The Board could not determine how long this condition had existed. During the plywood ripping operation, the blade guard assembly was in place and in use.

Gloves were used during the operation of the table saw contrary to the operator's manual statement that they should not be worn. Glove use was encouraged by BEA as a means to reduce hand injuries.

At the completion of the plywood ripping operation, the Technician had another employee instruct him in the process for removal of the blade guard assembly. The Technician then removed the blade guard assembly and completed the dado cut of the 3/4-in. plywood. The dado cut consisted of a single pass with the 1/8-in.-wide combination blade already in use. The drawing in use at the time of the accident did not specify the depth of the dado cut. The dado cut was completed with only the push stick. No combs (feather boards) or other special jigs were available for use during this operation. Only one type of push tool was available for use by the Technician. This tool was ineffective for the work in progress.

At the completion of the plywood dado cutting, the Technician proceeded with rip cutting the ETHAFOAM 900®. The Laboratory Custodian testified that he told the Technician to use the blade guard assembly when cutting ETHAFOAM 900®. The Technician did not reinstall the blade guard assembly. The Technician testified that he was instructed that it could not be used when cutting ETHAFOAM 900®. Eleven of the 12 cuts were completed successfully using the push stick. Two or three inches from completion of the final cut, the Technician noticed that the cutting operation became more erratic. At this point the Technician set the push stick aside and used both hands to steady the left side (scrap side) of the ETHAFOAM 900®. The Technician had no previous experience cutting this material. The injury occurred when the ETHAFOAM 900® was pushed into the saw to complete the final two inches of cut.

The Board concluded instructions regarding the use of the blade guard assembly were not clearly communicated to and understood by the Technician.

The Board concluded that the table saw manufacturer's safety warnings were not incorporated into the JSA document.

The Board concluded that the JSA used to control CBNRE project work was a JSA originally developed to address machine shop/fabrication work, and did not include hazards and controls associated with a table saw. As a result, the JSA did not include hazards and controls specific to table saw use contained in 29 CFR 1910.213(a)(15), (c)(1), (c)(2), (c)(3), and (s)(9) requiring the use of featherboards, guards, kerf spreaders, anti-kickback pawls, and push sticks/blocks.³

³ Jet Operator Manual for the JWTS-10JF Table Saw. Page 1 “19. Use blade guard for every applicable operation including all through cuts. If the guard is removed for special no-through cuts such as dado and rabbet cuts, replace before further use of the saw.”

The Board concluded that conflicting direction relating to the use of gloves and the operator's manual prohibition against the use of gloves was not identified and was not reconciled.⁴

2.2.7 Personnel Training and Qualifications

According to PRD-25, the implementation of hazard controls (Hazard Control Methods) as described by Appendix A, was accomplished by procedures (LWP-1201), work packages (STD-101), training plans (LWP-12003), permits (MCP-3447 SWP and MCP-7 RWP), IHRG plans (MCP-3571), and health and safety plans (MCP-255). (An attempt to review MCP-255 revealed it has been canceled for over two years.)

JSAs were the method used to implement hazard controls in the Heyrend Way Facility in conjunction with the training or qualification of the individual performing the activity.

PDD-1004, Section 9.17, stated that training and qualification programs were established to ensure employees were trained to safely, competently, and effectively perform their job functions, and it further stated in Section 11.3, "The employee and his/her manager verify that the employee is properly trained and qualified to perform a specific task before it is assigned."

PDD-1004 described the "Competence Commensurate with Responsibility (CCR)" process used at the INL. According to PDD-1004, the CCR process would begin with the line manager filling out an employee position description (EPD) that defined the required skills, experience, and education required of the position. This EPD would then be used to hire an appropriate candidate for the position. PDD-1031, *Training Program For Organizations Performing R&D and Supporting Organizations*, listed acceptable documentation for verification of experience and education of the new hire. For experience these included, "position descriptions; training records associated with position; personnel record of laboratory assignments; documentation of previous employment; and military records."

The EPD for the Technician described the position's role to include the following: "Support a variety of multi-disciplined, technical and innovative tasks in electrical and/or electronic, mechanical, or other physical disciplines to support sophisticated and complex laboratory programs, tests, and engineering or scientific projects." The "Special Requirements" block of the EPD listed, "Strong skills and work experience in electronics and electro-mechanical design, fabrication, and installation." It also stated, "Must be computer literate and have good typing skills."

⁴ Jet Operator Manual for the JWTS-10JF Table Saw. Page 1 "4. Before operating the machine, remove tie, rings, watches, other jewelry, and roll up sleeves above the elbows. Remove all loose clothing and confine long hair. Do **not** wear gloves."

The EPD did not accurately and comprehensively describe the position. No mention was made of carpentry skills or experience with table saws. The Technician's resume, work history, and educational background did not specifically support such skills. The Technician stated that he informed the Laboratory Custodian verbally that he had experience using a table saw in a relative's home wood shop and on home construction job sites as part of a family business. This did not relieve line management of the responsibility to verify the Technician's skills and compliance with INL standards of safe conduct.

PDD-12005, *INL Training*, described the processes ensuring that the INL workforce was properly trained to work effectively and safely and that ISMS has been incorporated into these processes. Per PDD-12005, Section 4.1.3, line and functional area managers were responsible for identifying training requirements and needs within their area that might have been necessary for their personnel to work safely and effectively. Per PDD-12005, section 4.2, the manager began to establish new employee competency by developing an Individual Training Plan (ITP) for the employee. PDD-12005 handed off to LWP-12003, *Individual Training Plans*, for the development and use of ITPs.

LWP-12003 provided a process to ensure that training requirements for employees was established in ITPs. ITPs described the required training pertaining to an employee's job function and included facility-specific training requirements. Per LWP-12003, Section 4.1.5, any facility specific training requirements applicable to an employee's job function should be identified on a training plan. The Technician did not have an ITP.

The Technician did receive some training as part of his new employee indoctrination. The Technician received computer based training in basic INL ES&H programs, BEA policies, a security brief and facility-specific access training. Of the 10 classes listed in the BEA Training Requirements Matrix (TRM) as required for new hires, only four were received by the Technician. Notably missing was expanded Stop Work Authority Training. The JSA required personal protective equipment (PPE) training for all personnel. The Technician did not receive this training prior to conducting work.

The employee's right to stop work was presented as a one-page slide in the INL ES&H training that the Technician received. Stop Work was also included as a bullet on the new employee checklist filled out with the Technician two days before the accident. The expanded version of stop work training required by the TRM covered the process for stopping and resuming work. Most of its content was directed at supervisory personnel, but it could have served as useful reinforcement of the INL's commitment to this policy. The Technician stated at the time of the accident he was aware of but reluctant to initiate a stop work.

On January 9, 2006, the Technician signed a document titled, "Use of Machine Equipment," containing bulleted lists of machine tool safety, cleaning, and maintenance practices. This document was not an official company document, but

rather a shop developed amalgam of two or three smaller documents of unknown origin. The table saw was not included in this document.

On January 11, 2005, the Laboratory Custodian signed the “Certifier’s Signature” block of another unofficial form entitled, “Authorization to Operate Machinery at the Heyrend Facility,” that “authorized” the Technician to operate the Jet table saw. The instructional paragraph of this document stated (in full):

“The equipment listed below [Jet Table Saw] shall be operated only by the following persons who have taken appropriate safety training related to this equipment, have knowledge of operation of the equipment, and have either demonstrated to or have been trained by the Laboratory Custodian or his designated alternate, who then certifies below the operator’s capability.”

Below this paragraph were blocks in which the Technician’s name and employee S No. were filled in beside which was the Laboratory Custodian’s signature and date. “Appropriate safety training” was not defined.

Neither of the forms was an approved INL form for documenting the provision and completion of training. There were no performance standards provided by which to evaluate the trainee’s performance. These forms appeared to document unapproved On the Job Training (OJT) performed by an unqualified OJT instructor. Although this document and the “Use of Machine Equipment” document appeared to be a step in the right direction toward ensuring worker competence, they were not in compliance with the BEA’s MCP-52 and -61 OJT requirements or the INL Training Manual.

The Board concluded that the Technician was allowed to perform work without the requisite training.

2.3 BARRIER ANALYSIS

Barrier analysis was based on the premise that hazards were associated with all tasks. A barrier was defined as any management or physical means used to control, prevent, or impede the hazard from reaching the target (i.e., persons or objects that a hazard may damage, injure, or harm). The results of the barrier analysis were integrated into the events and causal factors chart to support the development of causal factors. Appendix C contained the Board’s complete Barrier Analysis of physical and management barriers that did not perform as intended and thereby contributed to the accident.

2.4 CHANGE ANALYSIS

Change analysis examined planned or unplanned changes that caused undesirable results related to the accident. This process analyzed the difference between what was normal, or expected, and what actually occurred before the accident. The results of the change analysis conducted by the Board were integrated into the events and causal factors chart

to support the development of causal factors. Appendix D contains the Board’s Change Analysis and reinforces the Barrier Analysis.

2.5 CAUSAL FACTORS

The Events and Causal Factors Analysis was a systematic process that used various methods to determine the Causal Factors of an accident. Causal Factors were the significant events and conditions that produced or contributed to the Direct Cause, the Contributing Causes, and the Root Cause(s) of the accident. A Tier Diagram in Appendix E contains the Board’s Direct, Contributing and Root Causes. This investigation followed the processes described in the DOE Workbook, *Conducting Accident Investigations*, Revision 2, where the Direct, Contributing and Root Causes were defined as:

- Direct Cause - The immediate events or conditions that caused the accident.
- Root Cause(s) - Causal factors that, if corrected, would prevent recurrence of the same or similar accidents.
- Contributing Causes - Events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident.

3.0 CONCLUSIONS AND JUDGEMENTS OF NEED

CONCLUSIONS AND JUDGEMENTS OF NEED	
Judgments of Need	Conclusions
<p>BEA management needs to establish and institutionalize a formal process to confirm that employees are competent to perform work safely commensurate with their assigned responsibilities prior to performing work.</p> <p>BEA needs to establish a process to ensure that work supervisors, leaders, and others who provide work instructions are provided with quality work instructions that are adequate and can be clearly communicated to and understood by the employee.</p>	<p>The Board concluded that the Technician was allowed to perform work without the requisite training and without assurance that he possessed the competence commensurate with his responsibilities. Supporting facts include:</p> <ul style="list-style-type: none"> • The Technician was an electro/mechanical technician, whose position description did not require table saw or other carpentry skills. On the third day on the job, and with minimal instruction provided, the Technician was assigned to perform unsupervised operation of a table saw. • The Technician’s required ITP had not been created and completed. • Required PPE training had not been completed. • The process used to authorize use of facility equipment was “expert based”, informal, and incorrectly specified that gloves should be worn when using the table saw. • The Technician incorrectly believed the blade guard assembly needed to be removed to cut

CONCLUSIONS AND JUDGEMENTS OF NEED	
Judgments of Need	Conclusions
	<p>ETHAFOAM 900®.</p> <ul style="list-style-type: none"> The Technician experienced difficulty cutting the semi-rigid ETHAFOAM 900® and became uncomfortable, but was reluctant to stop work to seek assistance. <p>The Board concluded instructions regarding the use of the blade guard assembly were not clearly communicated to and understood by the Technician.</p> <p>The Board concluded that using a JSA in place of a formal work control document relied heavily upon the assumption that training was adequate to mitigate hazards.</p>
<p>BEA needs to develop, implement, and institutionalize processes to ensure that JSAs identify and control the specific hazards associated with the job tasks; are complete, including appropriate regulatory and equipment specific hazard control information; and are periodically assessed for effectiveness.</p>	<p>The Board concluded that the JSA used to control CBNRE project work was a JSA originally developed to address machine shop/fabrication work, and did not include hazards and controls associated with a table saw. As a result, the JSA did not include hazards and controls specific to table saw use contained in 29 CFR 1910.213(a)(15), (c)(1), (c)(2), (c)(3), and (s)(9) requiring the use of featherboards, guards, kerf spreaders, anti-kickback pawls, and push sticks/blocks.</p> <p>The Board concluded that the table saw manufacturer’s safety warnings were not incorporated into the JSA document.</p> <p>The Board concluded that conflicting direction relating to the use of gloves and the operator’s manual prohibition against the use of gloves was not identified and was not reconciled</p>

CONCLUSIONS AND JUDGEMENTS OF NEED	
Judgments of Need	Conclusions
<p>BEA needs to develop and institutionalize a process that ensures the hazard review screening process for new projects or work activities against existing JSAs is conducted prior to the commencement of work. BEA needs to ensure this process is documented and the documentation is retained.</p>	<p>The Board concluded that the hazards associated with CBNRE project work activities were not adequately identified and compared with the hazards and controls included in the JSA used to authorize the work.</p> <p>The JSA used to control CBNRE project work was originally approved for machine shop/fabrication work use on October 1, 2001, and was applied to the CBNRE project sometime after December 3, 2004, when the project was approved.</p> <p>The Board concluded a formal review of the CBNRE project activities was not conducted against the JSA used as the work authorization/control document to ensure that the project did not introduce any unanalyzed hazards into the work place.</p> <p>No documented consideration of the special needs for ETHAFOAM 900® fabrication could be identified by the Board.</p>
<p>BEA needs to ensure MCP-3571 fully incorporates the five core functions of Integrated Safety Management, as they pertain to research activities, and needs to re-evaluate the use of MCP-3571 for research-related activities.</p> <p>BEA needs to develop and institutionalize a method to ensure the validity of the “R&D-related activities” determination when conducting work in accordance with MCP-3571 to ensure that the job-specific work hazards are properly controlled prior to the commencement of work.</p>	<p>The Board concluded that MCP-3571 did not ensure implementation of the five core functions of ISMS. The procedure did not provide for the definition of work scope, did not adequately control the performance of work, and did not provide a means for worker feedback.</p> <p>The Board concluded that the work being performed (fabrication of an equipment storage box) by the Technician under the CBRNE project did not meet the definition of a R&D-related activity, based upon the Project Execution Plan checklist.</p> <p>The Board concluded that BEA did not perform a prejob briefing or assure workers were properly trained and hazards were identified and controlled as required.</p>
<p>DOE-ID needs to establish and institutionalize a process to ensure properly trained, qualified, and cleared personnel are available – including alternate personnel – to fulfill DOE’s obligation in carrying out line management’s responsibility for safety in accordance with DOE Policy 450.4, <i>Safety Management System Policy</i>, at all facilities.</p>	<p>The Board concluded that although the DOE-ID NS Team had line management responsibility for safety in their programs, between June 2003 and October 2005 there was no documented safety oversight performed in the Heyrend Way Facility.</p> <p>The Board concluded that line management ownership of safety was clearly documented, but in practice, NS did not fulfill their management responsibility for safety at the Heyrend Way Facility.</p>

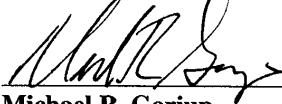
CONCLUSIONS AND JUDGEMENTS OF NEED	
Judgments of Need	Conclusions
BEA needs to assess EMS response times at all work locations and ensure appropriate first aid kits and first aid trained individuals are available where needed.	The Board concluded that, contrary to the requirements of 29CFR1910.151(b), a first aid kit was not available at the Heyrend Way Facility, and that BEA did not ensure person(s) with appropriate first aid training were assigned to the Heyrend Way Facility.
BEA and DOE-ID need to ensure the physical street address, where 911 is used to summon emergency services, is readily available to all employees.	Although initial EMS response may have been delayed slightly because the street address of the Heyrend Way Facility was not immediately available for the 911 call, the Board concluded that the immediate response actions taken by facility personnel and the EMS were satisfactory.
BEA needs to ensure safety related assessments and inspections are conducted at a level of competence to ensure compliance with regulatory requirements. is recognized and the effectiveness of the process is regularly assessed.	The Board concluded that regularly scheduled self-assessments and inspections were conducted at the Heyrend Way Facility. The assessments were predominately conducted by facility personnel, who were not specifically trained to conduct assessments of safety and health related topics. The checklists are not a substitute for comprehensive review by SMEs.
BEA needs to ensure all employees are aware of the obligation and necessity to preserve the scene of an accident and properly control evidence in accordance with DOE Order 225.1, <i>Accident Investigation</i> . This Judgment of Need is a repeated Judgments of Need from previous accident reports.	The Board concluded the investigative readiness did not ensure the scene was properly controlled and resulted in disturbance of important evidence. (Workers/supervision were unaware of requirements to preserve the accident scene.)
DOE-ID and BEA need to develop, implement, and institutionalize a lessons learned program that effectively implements the corrective actions from past events and assess the program’s effectiveness on a regular basis.	The Board concluded that DOE-ID and its contractors did not ensure corrective actions from past events were developed, implemented, and institutionalized to assure full compliance with integrated safety management principles and avoid preventable accidents.

4.0 SIGNATURES OF THE BOARD MEMBERS



Robert C. Seal
DOE Accident Investigation Board Chairperson
U.S. Department Of Energy
Idaho Operations Office

Date: Feb 10, 2006



Michael R. Goriup
DOE Accident Investigation Board Member
U.S. Department Of Energy
Idaho Operations Office

Date: 2/10/2006



H. Marcus Worrell
DOE Accident Investigation Board Member
U.S. Department Of Energy
Idaho Operations Office

Date: Feb. 10, 2006



Won S. Yoon
DOE Accident Investigation Board Member
U.S. Department Of Energy
Office of Nuclear Energy, Science and Technology

Date: Feb. 10. 2006

5.0 LISTING OF BOARD MEMBERS, ADVISORS, AND STAFF

Chairperson	Robert Seal, DOE, Idaho Operations Office DOE Trained Accident Investigator
Member	H. Marcus Worrell, DOE, Idaho Operations Office
Member	Michael Goriup, DOE, Idaho Operations Office
Member	Won Yoon, DOE, Office of Nuclear Energy, Science and Technology
Advisor	William McQuiston, DOE, Idaho Operations Office DOE Trained Accident Investigator
Advisor	James R. Wade, DOE, Idaho Operations Office
Attorney	Eva A. Auman, DOE, Idaho Operations Office
Attorney	Amy E. Grose, DOE, Idaho Operations Office Chief Council
Technical Writer	Lalove Foster, Idaho National Laboratory
Administrative Support	Rebecca Hanson, DOE, Idaho Operations Office

APPENDIX A: EVENT CHRONOLOGY

EVENT	DATE / TIME
MCP-3571 was created for control of research and development work.	2-99
Heyrend Way Facility (IF-664) leased.	4-01-00
Hazard classification for IF-664 completed.	11-10-00
DOE-ID oversight report IRC – 2000 – 32.2: Heyrend Way Facility Work Control JSA activity description did not cover all activities.	1-08-01
DOE-ID oversight report IRC – 2001 –3: ISMS surveillance observations/conclusions of poor ISMS. Failed to identify ES&H hazards at Heyrend Way Facility. Poor JSA (not completed). Failed to properly scope job for JSA.	2-06-01
DOE-ID oversight report IRC – 2001 – 9: Failed to work in accordance with the JSA. Failures of hoisting and rigging application.	2-23-01
Machining/Fabrication JSA approved (JSA-6150718012).	10-01-01
JSA-6150718012 designated by IHR process, Form 420.14, as a R&D-related activity.	5-02-02
DOE-ID safety oversight assigned to NS Team line management; FacReps and SMEs were excluded from the Heyrend Way Facility.	6-04-03
CBRNE project began.	12-04
INL contractor changed from BBWI to BEA.	2-01-05
Idaho Cleanup contractor assumed operations.	5-01-05
The Technician accepted employment by BEA.	12-12-05
The Technician completed safety and health (S&H) access qualification.	1-05-06
The Technician reported to Heyrend Way Facility for the first time.	1-09-06
The Technician completed INL site orientation qualifications.	1-09-06

Appendix A

EVENT	DATE / TIME
The Technician completed BEA site orientation.	1-09-06
The Technician signed “use of machine equipment” form.	1-09-06
The Technician reported to work.	1-11-06
The Technician was signed off by the Laboratory Custodian to use the table saw.	1-11-06 7:35 a.m.
The Technician ripped plywood.	1-11-06 7:45 a.m.
The Technician removed the blade guard assembly to perform dado cuts of plywood.	1-11-06 8:30 a.m.
The Technician made dado cuts in plywood using a push stick.	1-11-06
The workers took a break to welcome the Technician.	1-11-06 8:30-9:00 a.m.
The Technician did not reinstall the blade guard assembly.	1-11-06
The Technician completed ripping 11 of 12 ETHAFOAM 900® pieces using the push stick.	1-11-06
Within about 2 inches of completion of the last cut, the Technician noted that the ETHAFOAM 900® was behaving erratically.	1-11-06
The Technician set the push stick to the side.	1-11-06
The Technician used both hands to steady the left side (scrap side) of the ETHAFOAM 900®.	1-11-06
The Technician pushed the remaining length of the ETHAFOAM 900® by hand into the blade.	1-11-06
The ETHAFOAM 900® piece kicked back, and the Technician’s right hand made contact with table saw blade causing severe injury.	1-11-06 9:15 a.m.

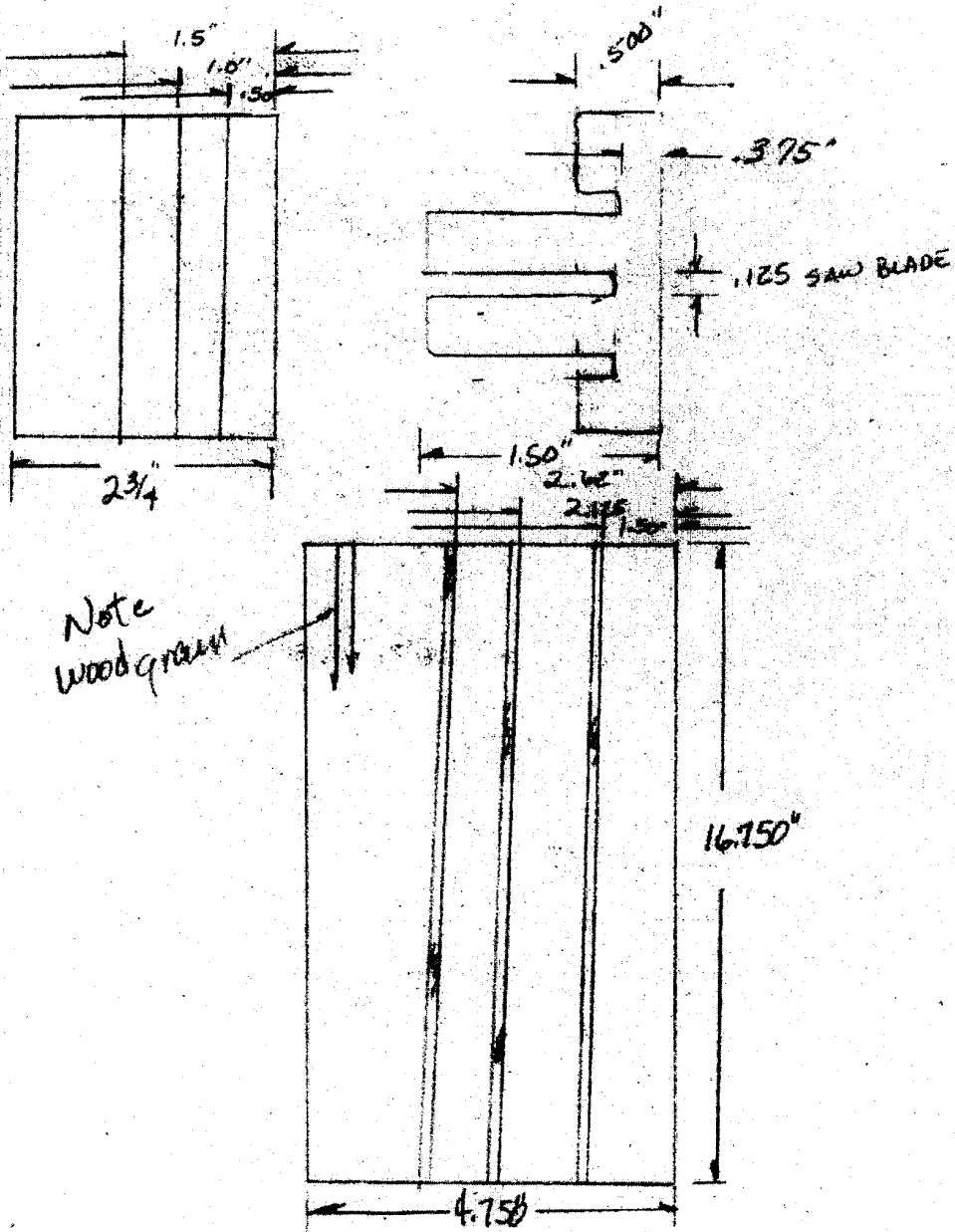
Appendix A

EVENT	DATE / TIME
Co-workers responded.	1-11-06 9:15 a.m.
Co-workers called 911.	1-11-06 9:16 a.m.
Co-workers administered first aid.	1-11-06 9:16 a.m.
Bonneville County received EMS 911 call.	1-11-06 9:16 a.m.
Ambulance dispatched from Idaho Falls Fire Department Station No. 5.	1-11-06 9:17 a.m.
The ambulance arrived at the Heyrend Way Facility.	1-11-06 9:29 a.m.
The Laboratory Custodian cleaned up a portion of the accident scene (accident scene disturbed).	1-11-06
The ambulance departed the Heyrend Way Facility for EIRMC.	1-11-06 9:41 a.m.
Management and safety professional arrived.	1-11-06
Accident scene was secured.	1-11-06
Management and safety professional began to examine the accident scene.	1-11-06
The ambulance arrived at EIRMC.	1-11-06 9:51 a.m.
The Technician was treated.	1-11-06
BEA began investigation.	1-11-06
DOE-ID Manager appointed Type B investigation.	1-18-06

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APPENDIX B: TECHNICIAN'S WORK DIAGRAM

SAW BOX BLADE
Poly 1/2" x 13" x 16 3/4" 3ea
Plywood 3/4" x 4 7/8" x 16 3/4" 1ea
H.D. Foam 2" - 11" x 2 3/4" x 13"



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APPENDIX C: BARRIER ANALYSIS

BARRIER ANALYSIS			
HAZARD – ROTATING TABLE SAW BLADE		TARGET – TECHNICIAN (T-1)	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Incident?
<i>Physical Barriers</i>			
A blade guard assembly is used to prevent contact with rotating saw blade.	A blade guard assembly was not used.	The blade guard assembly was removed by T-1 * to perform dado cuts in plywood and was not reinstalled prior to rip cutting ETHAFOAM 900 ®.	Absence of the blade guard assembly allowed T-1’s hand to come in contact with the rotating saw blade.
Anti-kickback pawls, which are integral to the blade guard assembly, are used to prevent material kickback.	Anti-kickback pawls were not used.	The saw guard assembly with integral anti-kickback pawls was not used.	An unabated kickback situation occurred, which may have directly contributed to the accident.
A kerf splitter, which is integral to the blade guard assembly, is used to prevent initiation of material kickback.	A kerf splitter was not used.	The saw guard assembly with integral kerf splitter was not used.	A kickback situation occurred, which may have directly contributed to the accident.
Push sticks/blocks are used to prevent a worker’s hands from coming in close proximity to the rotating saw blade.	A push stick, though used initially, was not used at the time of the accident.	T-1 did not use the push stick for the entire rip cutting operation because he was unsure how to complete the final cut while using the push stick.	By not using the push stick for the entire rip cutting operation, T-1 placed his hands in closer proximity to the rotating saw blade than if he would have used the push stick.
A no-clearance table insert is used to prevent relatively flexible ETHAFOAM 900 ® from deforming into the opening between the saw blade and table insert to minimize the possibility of binding between the material and the saw blade.	The table insert, as supplied by the manufacturer, left an approximate 3/8-in. gap between the saw blade and table insert, rather than a very small gap between the saw blade and table insert.	No evaluation concerning the appropriateness of the table insert was conducted prior to cutting the ETHAFOAM 900 ®.	T-1 and other technicians who had previously used the table saw to cut ETHAFOAM 900® stated the material did not cut smoothly and was difficult to control. The approximate 3/8-in. gap between the saw blade and table insert may have contributed to binding between the material and the saw blade.

* T-1 = Technician throughout Appendix C.

Appendix C

BARRIER ANALYSIS			
HAZARD – ROTATING TABLE SAW BLADE		TARGET – TECHNICIAN (T-1)	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Incident?
Administrative Barriers			
<p>Warnings in the table saw manufacturer operator’s manual are used to develop hazard identification and controls (JSA).</p> <ul style="list-style-type: none"> • Do not wear gloves. • Keep machine guards in place at all times. • Never place hands directly in line with the saw blade. • Always use push sticks when cutting small material. • Use blade guard for every applicable operation including all through cuts. 	<p>Failed.</p> <p>Hazard identification and controls listed in the warning section of the table saw manufacturer operator’s manual were not used.</p>	<p>Not used.</p>	<p>Failure to incorporate warnings from table saw manufacturer operator’s manual into the hazard identification and controls resulted in inadequate controls for the table saw operations associated with rip and dado cutting.</p>
<p>Gloves are not to be worn when operating a table saw to prevent possible loss of tactile sense and possible entanglement with the rotating saw blade.</p>	<p>Failed.</p> <p>T-1 was wearing leather gloves while operating the table saw.</p>	<p>The employee responsible for authorizing use of the table saw was not aware of the table saw manufacturer’s warning not to wear gloves while operating the table saw.</p> <p>The employee responsible for authorizing use of the table saw was aware of the BEA effort to reduce employee injuries through the use of gloves and ensured T-1 was wearing gloves while working with the table saw.</p> <p>T-1 was unaware he should not wear gloves while using the table saw.</p>	<p>The direct consequence of wearing leather gloves at the time of the accident could not be determined.</p>

Appendix C

BARRIER ANALYSIS			
HAZARD – ROTATING TABLE SAW BLADE		TARGET – TECHNICIAN (T-1)	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Incident?
Hands are not positioned directly in line with the rotating saw blade.	Failed. T-1's hand position placed the right hand in line with the saw blade when using the table saw.	Hand position was not addressed by either the JSA document or by BEA employee training.	T-1's right hand came in contact with the rotating saw blade.
A JSA is used to identify the task specific hazards and controls necessary to accomplish work safely.	Failed. The JSA used for the task did not identify specific hazards and controls associated with operating the table saw.	The JSA used was specific to a metalworking machine shop and associated fabrication activities. It did not include table saw operation.	Hazards associated with the use of table saw were not identified and controlled to prevent the accident.
A JSA is used to identify the task specific hazards and controls necessary to accomplish work safely.	Failed. The JSA used for the task did not identify specific hazards and controls associated with cutting ETHAFOAM 900 ® using the table saw.	The JSA used was specific to a metalworking machine shop and associated fabrication activities. It did not include cutting ETHAFOAM 900 ® with the table saw.	Hazards associated with cutting ETHAFOAM 900 ® with the table saw were not identified and controlled to prevent the accident.
Observation/Supervision of recently hired employees to ensure they are performing work safely.	Failed. A Laboratory Custodian observation of T-1 failed to recognize inappropriate PPE and safety equipment.	Observation/Supervision was inadequate. The Laboratory Custodian did not recognize unsafe behavior. There were no formal criteria for what to look for when observing new employees.	T-1 performed work in an unsafe manner.
Employee's right to apply Stop Work Authority when an unsafe or uncertain condition is encountered.	Failed. T-1 did not apply Stop Work Authority.	Although T-1 was aware of his Stop Work Authority, he was reluctant to use that authority because of his short tenure with the company.	Failure to apply Stop Work Authority allowed the unsafe condition to continue unabated until the accident occurred.

Appendix C

BARRIER ANALYSIS			
HAZARD – ROTATING TABLE SAW BLADE		TARGET – TECHNICIAN (T-1)	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Incident?
Training is conducted to ensure the hazards associated with equipment are understood and controlled.	Failed. No formal task-specific training was provided.	Line management failed to provide formal task-specific training.	Lack of training on the table saw resulted in T-1's failure to recognize the need for having the blade guard assembly in place, the need to use a push stick, the requirement to not position hands directly in line with the rotating saw blade, and the warning not to wear gloves when using the table saw.
The worker demonstrates competence prior to being allowed to work unsupervised.	Failed. T-1's competence was not demonstrated.	Line management failed to ensure T-1 was competent to use the table saw.	T-1's lack of competence on the table saw resulted in failure to recognize the need for having the blade guard assembly in place, the need to use a push stick, the requirement to not position hands directly in line with the rotating saw blade, and the warning not to wear gloves when using the table saw.
Worker is experienced in the techniques and characteristics associated with material being cut.	Failed. T-1 did not have any previous experience cutting a semi-rigid material such as ETHAFOAM 900 ® with a table saw.	The job was T-1's first experience with rip cutting ETHAFOAM 900 ® on a table saw. T-1 did not properly configure the table saw for the evolution and did not know the proper technique for completing the final rip cut. T-1 chose to make the cut without a push stick, by pushing the material with both hands on the outside (scrap) portion of the material. T-1 incorrectly believed that the blade guard assembly could not be installed when rip cutting the ETHAFOAM 900 ®.	T-1's lack of experience in cutting ETHAFOAM 900 ® directly contributed to the accident.

Appendix C

BARRIER ANALYSIS			
HAZARD – ROTATING TABLE SAW BLADE		TARGET – TECHNICIAN (T-1)	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Incident?
BEA implements and provides effective oversight of their safety and health programs.	Failed. BEA (and the previous contractor) performed management walkthrough inspections and ad hoc inspections of the Heyrend Way Facility, but no structured/scheduled assessments specifically associated with safety and health program implementation and compliance were conducted. Assessments conducted at the facility did not identify deficiencies in the JSAs.	BEA did not have a process in place to determine that adequacy of safety and health program implementation and compliance at the Heyrend Way Facility.	Deficiencies associated with implementation of the safety and health program, the Independent Hazard Review (IHR) process, and technician training at the facility were not identified, and non-compliant conditions that contributed to the accident were allowed to exist.
DOE-ID provides effective oversight of contractor safety and health programs.	Failed. There is no evidence that DOE-ID performed safety and health related oversight at the Heyrend Way Facility between June 2003 and the time of the accident in January 2006.	In June 2003, citing a “need-to-know” issue with NS programs, DOE-ID management removed FacRep and DOE-ID SME safety oversight from the facility and assigned safety oversight responsibilities entirely to DOE-ID NS Team line management. NS Team line management failed to conduct safety and health oversight.	Deficiencies associated with implementation of BEA’s safety and health program, the IHR process, and technician training at the facility were not identified, and non-compliant conditions that contributed to the accident were allowed to exist.

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Appendix D

APPENDIX D: CHANGE ANALYSIS

CHANGE ANALYSIS			
Prior, Ideal, or Accident-Free Situation	Accident Situation	Difference	Evaluation of Effect
A task specific hazard analysis is completed and is used to implement hazard controls.	A task specific hazard analysis that included the table saw was not completed.	Hazards specific to the table saw operation were not explicitly identified and controlled.	Hazards associated with the operation of the table saw were not formally recognized, assessed, and controlled in a formal work control document.
A blade guard assembly is in place on the table saw when rip cutting material.	A blade guard assembly was not used when rip cutting the ETHAFOAM 900 ® material.	The saw blade was exposed to T-1*.	Absence of the blade guard assembly allowed T-1 to contact the rotating saw blade.
Anti-kickback pawls (integral to the blade guard assembly) are used to prevent kickback.	The blade guard assembly was not used, so anti-kickback pawls were not in place.	Anti-kickback pawls were not available to prevent a kickback.	A kickback situation occurred concurrent with the accident.
In accordance with the warning section of the manufacturer operator's manual, gloves are not worn to prevent entanglement.	T-1 was wearing leather gloves when using the table saw to cut ETHAFOAM 900 ®.	T-1 wore leather gloves when using the table saw to cut ETHAFOAM 900 ®.	The use of leather gloves may have reduced T-1's tactile sense and increased the chance of entanglement with the saw blade.
A no-clearance table insert is used when cutting foam to reduce the unsupported section of the ETHAFOAM 900 ® while cutting.	A dado table insert was used when the accident occurred.	A wider gap existed between the saw blade and the supporting surface of the table, which allowed the foam surface in contact with the saw blade to distort.	Based on physical evidence, the wider space between the saw blade and the supporting surface of the table was sufficient to allow the foam to be deformed and pulled into gap by the motion of the saw blade.
T-1 had been cutting plywood (stiffer/firmer material than cutting ETHAFOAM 900 ®)	Worker was cutting ETHAFOAM 900 ® (flexible material).	The ETHAFOAM 900 ® was more flexible and more difficult to control while cutting than the plywood.	The unusual movement of the ETHAFOAM 900 ® caused T-1 to be uncomfortable and concerned.
Workers are comfortable in their work organization and are willing to exercise their "Stop Work" authority.	T-1 was recently hired, and was reluctant to raise questions or issues and to exercise "Stop Work" authority.	Although uncomfortable with the situation, T-1 did not exercise "Stop Work" authority.	T-1 was reluctant to exercise "Stop Work" authority for this task and so, did not.

* T-1 = Technician throughout Appendix D.

Appendix D

CHANGE ANALYSIS			
Prior, Ideal, or Accident-Free Situation	Accident Situation	Difference	Evaluation of Effect
Defective safety equipment is reported and promptly corrected prior to continued use.	Although not used, one anti-kickback pawl on the blade guard assembly was missing, but the blade guard assembly remained in service.	A defective safety device was in use in the shop.	No effect on this accident because the blade guard assembly was missing. However, with one anti-kickback pawl missing the blade guard assembly was not capable of performing its safety function.

APPENDIX E: TIER DIAGRAMS

Root Cause

The Local Root Cause was the failure to ensure the blade guard assembly was in place when required for the specific cutting operation.

The Systemic Root Causes

BEA was inattentive to a number of deficiencies in work control processes and allowed informality in execution of the ISM program, including competence commensurate with responsibility.

DOE-ID did not ensure oversight activities were sufficient to identify deficiencies in the contractor’s implementation of ISMS.

Tier Diagram for BEA		
Tier	Causal Factors	Causes
President, BEA	11	First aid kits were removed from facilities to encourage reporting of first aid injuries.
Deputy Laboratory Director	12	Initially, MCP-3571 was created intentionally broad to allow for flexibility in conducting research. MCP-3571 was later changed to include R&D-related activities, broadening its application.
Associate Laboratory Director	14	BEA management was not aware that the assessments performed in the Heyrend Way Facility were not identifying regulatory compliance issues.
Director, Defense Systems & Technology		
Supervisor	1, 2, 3, 4, 5, 6, 7, 9, 10, 13	BEA supervision did not ensure work was conducted in accordance with prescribed work control procedures for research and development; allowed the use of informal systems to authorize equipment use and training; and did not ensure the Technician had the requisite training prior to his commencement of work.
Worker	8	The Technician was hesitant to stop work and demonstrated a lack of judgment in balancing the consequences of his actions.
Direct Cause	The Board concluded the direct cause of the accident was the Technician’s hand contacting the rotating saw blade.	

Causal Factors

1. The JSA (IF-615) was a “carbon copy” of other machine shop/fabrication facility JSAs; no other Heyrend Way Facility specific hazards were identified. The JSA for the Heyrend Way Facility did not identify the table saw, its associated hazards, or hazard controls or manufacturer’s safety warnings.
2. The CBRNE project was not reviewed against the JSA to ensure hazards were properly controlled.

3. No task specific hazard identification was conducted for this activity. A task specific hazard identification was not performed to assess foam-cutting operation to determine proper method. Task specific hazard identification and control did not identify the need for special tool training for the task.
4. The training process was “expert based” and informal.
5. Conflicting direction relating to the use of gloves existed, and the operator’s manual prohibition against the use of gloves was not identified.
6. Instructions regarding the use of the blade guard assembly were not clearly communicated and understood.
7. The blade guard assembly was removed (not replaced) to make dado cuts.
8. The Technician was reluctant to stop work because of being a “new hire” and a desire to prove himself.
9. The push stick did not work to control the foam.
10. OSHA requirements not implemented - 29 CFR 1910.213(a)(15), (c)(1), (c)(2), (c)(3), and (s)(9).
11. OSHA requirements not implemented - 29 CFR 1910.151(b).
12. MCP-3571 does not address the “five core functions” as required by ISMS.
13. The work being performed by the Technician under the CBRNE project did not meet the definition of research-related activities per MCP-3571.
14. The assessments were predominately conducted by facility personnel, who were not specifically trained to conduct assessments of safety and health related topics. The checklists are not a substitute for comprehensive review by SMEs.

Tier Diagram for DOE-ID		
Tier	Causal Factors	Causes
Manager		
Deputy Manager		
AMRD		
Director		
NS Team Leader	1, 2	The NS Team Leader did not utilize available DOE-ID safety resources to accomplish oversight.
Program Manager		
Direct Cause	The Board concluded the direct cause of the accident was the Technician’s hand contacting the rotating saw blade.	

Causal Factors

1. The ownership of line management for safety was clearly documented, but in practice, NS lacked the ownership of line management responsibility for safety at the Heyrend Way Facility.
2. The NS Team had line management responsibility for safety in their programs. Between June 2003 and October 2005 there was no documented safety oversight performed in the Heyrend Way Facility.

United States Government

Department of Energy

memorandum

Idaho Operations Office

Date: January 18, 2006

Subject: Type B Accident Investigation - Personal Injury During Table Saw Use at the Heyrend Way Facility (OS-QSD-06-009)

To: R. C. Seal, Facility Representative

You are hereby appointed Chairperson of the Investigation Board to investigate the January 11, 2006, personal injury to an employee of Battelle Energy Alliance (BEA) at the Idaho National Laboratory. I have determined, based upon the extended hospitalization, that a Type B Accident Investigation, as described in DOE O 225.1A, *Accident Investigation*, is warranted.

You are to perform a Type B investigation of this incident and to prepare an investigation report. The report shall conform to the requirements detailed in DOE O 225.1A and DOE G 225.1A-1, *Implementation for Use With DOE O 225.1A, Accident Investigations*. The Board will comprise the following members:

H. Marcus Worrell, Industrial Safety Team, Quality and Safety Division, Team Member
James R. Wade, NE-30/50 Team, Nuclear Energy Division, Team Member
Michael R. Goriup, Facility Representative, Team Member
Won S. Yoon, NE-70, Team Member

The scope of the Board's investigation is to include, but is not limited to, identifying all relevant facts; analyzing the facts to determine the direct, contributing and root causes of the incident; developing conclusions; and determining judgments of need that, when implemented, should prevent the recurrence of this and similar incidents. The Board will focus on and specifically address the role of DOE and contractor organizations and Integrated Safety Management Systems. The scope will also include an analysis of the application of lessons learned from similar accidents within the Department.

I am aware that BEA has initiated an investigation of this incident. The Board will take advantage, to the extent practical, of the BEA actions taken to date. My expectation is that the BEA team will support the Board as technical advisors.

If additional resources are required to assist you in completing this task, please let me know and they will be provided. A representative from the Office of Chief Counsel will be appointed to serve as the Board's legal liaison. You and members of the Board are relieved of your other duties until this assignment is completed.

The Board will provide my office with frequent reports on the status of the investigation, but will not include any findings or arrive at any premature conclusions until analysis of all the causal factors has been completed. Draft copies of the factual accuracy portion of the

R. C. Seal

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January 18, 2006

investigation report will be submitted to my office and the contractor for factual accuracy review prior to the report finalization.

The final investigation report should be provided to me by February 18, 2006. Any delay to this date shall be justified and forwarded to this office. Discussions of the investigation and copies of the draft report will be controlled until I authorize release of the final report. If you have any questions, please contact me.



Elizabeth D. Sellers
Manager

cc: R. S. Johnson, NE-1
D. M. Miotla, NE-2.3
J. S. Shaw, EH-1
G. S. Podonsky, SP-1
J. J. Grossenbacher, BEA