Battelle Energy Alliance, LLC
Idaho National Laboratory

Report from the Department of Energy
Voluntary Protection Program
Onsite Review
September 20-29, 2016

U.S. Department of Energy
Office of Environment, Health, Safety and Security
Office of Health and Safety
Office of Worker Safety and Health Assistance
Washington, DC 20585

Foreword

The Department of Energy (DOE) recognizes that true excellence can be encouraged and guided, but not standardized. For this reason, on January 26, 1994, the Department initiated the DOE Voluntary Protection Program (VPP) to encourage and recognize excellence in occupational safety and health protection. This program closely parallels the Occupational Safety and Health Administration's (OSHA) VPP. Since its creation by OSHA in 1982 and implementation by DOE in 1994, VPP has demonstrated that cooperative action among Government, industry, and labor can achieve excellence in worker safety and health.

DOE-VPP outlines areas where DOE contractors and subcontractors can surpass compliance with DOE Orders and OSHA standards. The program encourages a *stretch for excellence* through systematic approaches, which emphasize creative solutions through cooperative efforts by managers, employees, and DOE.

Requirements for DOE-VPP participation are based on comprehensive management systems with employees actively involved in assessing, preventing, and controlling the potential health and safety hazards at their sites. DOE-VPP is available to all contractors in the DOE complex and encompasses production facilities, laboratories, and various subcontractors and support organizations.

DOE contractors are not required to apply for participation in DOE-VPP. In keeping with OSHA and DOE-VPP philosophy, *participation is strictly voluntary*. Additionally, any participant may withdraw from the program at any time. DOE-VPP consists of three programs with names and functions similar to those in OSHA's VPP: Star, Merit, and Demonstration. The Star program is the core of DOE-VPP. This program is aimed at truly outstanding protectors of employee safety and health. The Merit program is a steppingstone for participants that have good safety and health programs, but need time and DOE guidance to achieve true Star status. The Demonstration program, expected to be used rarely, allows DOE to recognize achievements in unusual situations about which DOE needs to learn more before determining approval requirements for the Merit or Star program.

By approving an applicant for participation in DOE-VPP, DOE recognizes that the applicant exceeds the basic elements of ongoing, systematic protection of employees at the site. The symbols of this recognition provided by DOE are certificates of approval and the right to use flags showing the program in which the site is participating. The participant may also choose to use the DOE-VPP logo on letterhead or on award items for employee incentive programs.

This report summarizes the results from the evaluation of Battelle Energy Alliance, LLC (BEA) at the Idaho National Laboratory (INL) in Idaho Falls, Idaho, from September 20-29, 2016, and provides the Associate Under Secretary for Environment, Health, Safety and Security with the necessary information to make the final decision regarding BEA's continued participation in DOE-VPP as a Star site.

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ABBREVIATIONS AND ACRONYMS

ALARA	As Low As Reasonably Achievable
ALD	Associate Laboratory Director
ANSI	American National Standards Institute
ATR	Advanced Test Reactor
AU	Office of Environment, Health, Safety and Security
BEA	Battelle Energy Alliance, LLC
BLS	Bureau of Labor Statistics
CFA	Central Facilities Area
CIH	Certified Industrial Hygienist
CSP	Certified Safety Professional
DART	Days Away, Restricted or Transferred
DLA	Dynamic Learning Activity
DOE	Department of Energy
ECC	Emergency Communications Center
EES&T	Energy and Environment Science and Technology
EOC	Emergency Operations Center
EROB	Engineering Research Office Building
ES&H	Environment, Safety and Health
EST	Employee Safety Team
F&SS	Facilities and Site Services
HaRPS	Hazards and Risks Planning System
HASS	Hazard Assessment Sampling System
HDBK	Handbook
HPI	Human Performance Improvement
IH	Industrial Hygiene
INL	Idaho National Laboratory
IRC	Idaho Research Center
IS	Industrial Safety
ISMS	Integrated Safety Management System
ITP	Individual Training Plan
LEST	Laboratory Employee Safety Team
LI	Laboratory Instruction
LM	Laboratory Manager
LOSA	Leadership Operations Supervisors' Academy
LO/TO	Lock-out/Tag-out
LRD	Laboratory Requirements Document
LSC	Laboratory Space Coordinator
LTRIB	Laboratory-wide Training Review and Implementation Board
LWP	Laboratory-wide Procedure
MFC	Materials and Fuels Complex
NAICS	North American Industry Classification System
N&HS	National and Homeland Security
NS&T	Nuclear Science and Technology
NTS	Noncompliance Tracking System
OJT	On-the-Job Training
OSHA	Occupational Safety and Health Administration

PPE	Personal Protective Equipment
RD	Requirements Document
RWP	Radiation Work Permit
SFO	Site-wide Facilities and Operations
SMC	Specific Manufacturing Complex
SME	Subject Matter Expert
SOAR	Safety Observations Achieve Results
Team	Office of Environment, Health, Safety and Security DOE-VPP Team
TRAIN	Training Records and Information Network
TREAT	Transient Reactor Test Facility
TRC	Total Recordable Case
VPP	Voluntary Protection Program

EXECUTIVE SUMMARY

The Department of Energy (DOE) Voluntary Protection Program (VPP) Team (Team) from the Office of Environment, Health, Safety and Security (AU) recommends that Battelle Energy Alliance (BEA) at the Idaho National Laboratory (INL) continue participation in DOE-VPP at the Star level. This report documents the results of the onsite assessment and establishes the basis for the Associate Under Secretary for Environment, Health, Safety and Security to determine if BEA meets the expectations for continued participation in DOE-VPP.

INL, managed by BEA, is part of the DOE's complex of national laboratories. It is a multi-program laboratory that performs work in the Department's strategic goal areas of energy, national security, science and environment. INL is a science-based, engineering laboratory that emphasizes applied engineering solutions for use across the DOE complex and industry, regionally, nationally, and worldwide. INL also supports other Government Agency work, including the manufacture of tank armor for the Department of Defense, and the production of power sources used by the National Aeronautical and Space Administration for space exploration. Nuclear reactor design, infrastructure testing, unmanned aerial vehicle development, and biotechnology applications are among INL's diverse capabilities.

DOE last certified BEA as a DOE-VPP Star site in September 2013. The Team conducted the current review from September 20-29, 2016.

The BEA 3-year total recordable case (TRC) rate rose from 1.02 cases per 200,000 hours to 1.19 cases per 200,000 hours since the 2013 assessment. Recognizing the upward trend, BEA is pursuing multiple methods to reverse that trend. The Team did not find any incentives that discouraged the reporting of injuries, illnesses, or safety concerns by workers.

Managers from the Laboratory Director down, have increased their visibility to the workforce, established their credibility by responding and correcting issues, and committing to investments in the INL infrastructure that support future missions. BEA managers are demonstrating the proactive leadership expected by employees to ensure employees have the necessary policies, procedures, processes, and tools to perform their work safely. Managers engage with employees to learn about issues, identify improvement strategies, and create a safety conscious work environment. Managers understand that organizational influences affect human performance and are encouraging workers to speak up and identify procedural and process issues rather than use workarounds that lead to undesired outcomes.

Employee engagement, always a strong element in the BEA safety culture, has improved as employees feel empowered to ask questions, pause or stop work, raise safety issues, and report problems. BEA continues to seek improvements in mature programs that involve employees in safety programs at INL. BEA effectively empowers and engages employees to take ownership of those safety programs.

BEA has knowledgeable and experienced personnel who are familiar with nearly all the hazards they may encounter during the course of work. Subject matter experts (SME) and effective tools to perform hazard analysis supports personnel performing work. The BEA work control process has matured at INL and the systems in place are familiar to the personnel that must use those systems.

In the past 3 years, BEA has experienced a couple incidents that resulted in severe injuries, and some near-miss incidents, all of which were avoidable. BEA's root cause analyses of these incidents identified the need for BEA to improve its maintenance work control process. BEA has implemented numerous compensatory actions to help make up for errors in hazard identification and analysis. In order to address the increasing trend of minor injuries, BEA should focus on applying more rigorous hazard identification, coupled with better hazard analysis, particularly for those tasks considered to be skill-based activities, and ensure the identified controls address the likelihood of human error. In particular, BEA should use an iterative hazard analysis process for minor maintenance and skill-based work that identifies additional hazards introduced by standard or normally accepted work practices.

Managers and employees are collaborating to install effective engineered controls, develop and implement usable procedures and instructions that permit safe conduct of research, and ensure effective training. BEA effectively uses the hierarchy of controls, and workers use proper personal protective equipment (PPE). However, BEA's reliance on generic postings for hazard controls in workshop areas may result in unintended noncompliance with established PPE requirements. BEA continues to invest in new technologies and equipment to eliminate hazards to the workers.

Since the last review, BEA has focused on documenting the training process in Laboratory-wide Procedures (LWP) and training job aids. Additionally, BEA is undertaking a comprehensive review of laboratory-wide training to ensure frequency and content are appropriate, as well as focusing on eliminating redundant training. INL uses Dynamic Learning Activities (DLA) to reinforce recognition of hazards that workers may encounter and ensure employees are capable of acting in accordance with management expectations and approved procedures.

TABLE 1
OPPORTUNITIES FOR IMPROVEMENT

Opportunity for Improvement	**Page**
BEA should expand its suite of safety and health indicators to include more leading indicators, such as number of management observations, number of Safety Observations Achieve Results (SOAR) observations, number of personnel actively participating in health and wellness initiatives, number of employee-identified issues, and employee safety team meeting attendance.	**7**
BEA should monitor its transition from SOAR to Human Performance Improvement (HPI), engage the safety teams and managers to help develop a program structure, and provide a communication mechanism to help all employees effectively employ HPI techniques and principles.	**11**
BEA should consider including specific controls within the Laboratory Instructions (LI) for expected hazards (as determined by an SME) or require that any work needing additional SME review be performed as planned work, including appropriate hazard analysis.	**14**
BEA should incorporate more detailed hazard analysis into its maintenance work planning processes to document the basis for control decisions, validate assumptions, and verify those assumptions remain valid in future work evolutions.	**16**
BEA should emphasize to planners and expediters the need to request additional information, or perform a walkdown of the work, even for minor work, ensure the workscope statement accurately reflects the specific work task, and aid them in selecting the appropriate work package for the work request.	**16**
BEA should analyze the current suite of facility inspections at the Materials and Fuels Complex (MFC) and ATR, and use that analysis to demonstrate whether the assessments meet the laboratory requirements and DOE-VPP expectations to inspect the whole site quarterly.	**17**
BEA should review the use of generic postings for hazard controls, revise the postings to state the actual expectations, and ensure workers comply with those postings.	**20**
BEA should take steps to ensure that during the laboratory relocations that all established hazard controls are in place and operational during all phases of physical changes to the laboratories.	**21**

I. INTRODUCTION

The INL is a science-based, applied engineering National laboratory dedicated to meeting the Nation's environmental, energy, nuclear technology, and national security needs. INL is a multi-program, Federally-funded research and development center emphasizing applied engineering solutions for use across the DOE complex, as well as regionally, nationally, and worldwide. Scientists and engineers work at research facilities in Idaho Falls and various locations across INL's 890 square-mile (2,300 square kilometer) section of desert in southeast Idaho. Using state-of-the-art laboratories, INL conducts a wide range of engineering and scientific research supporting multiple programs and missions including:

- Advanced nuclear fuels, materials, and separations;
- Bioenergy, fossil energy, geothermal energy, hydrogen and renewable energy systems;
- Robotics, instrumentation control and intelligent systems; and
- Microbiological, geological, and environmental systems.

INL also supports other Government Agency work, including the manufacture of tank armor for the Department of Defense, and the production of power sources used by the National Aeronautical and Space Administration for space exploration. Nuclear reactor design, infrastructure testing, unmanned aerial vehicle development, and biotechnology applications are among INL's diverse capabilities.

In addition, the laboratory develops technologies and equipment for private industry and the Department of Homeland Security, which helps to:

- Protect important infrastructures, like electric grids, telecommunication networks, and transportation systems;
- Reduce risks to worldwide nuclear energy systems; and
- Secure our borders and cities from terrorist threats.

INL researchers pioneered many of the world's first nuclear reactor prototypes and advanced safety systems. INL's internationally recognized contributions in nuclear science, engineering and materials testing underpin the safe operation of nuclear power plants throughout the world. INL continues to lead the development of the next generation of nuclear energy technologies and is educating the next generation of nuclear scientists and engineers.

INL was established in 1949 as the National Reactor Testing Station. Initially, the missions at INL were the development of civilian and defense nuclear reactor technologies and management of spent nuclear fuel. Fifty-two reactors, most of them first-of-a-kind, were built, including the Navy’s first prototype nuclear propulsion plant. Of the 52 reactors, 3 remain in operation at the site.

Sponsorship of INL was formally transferred to DOE’s Office of Nuclear Energy in July 2002, supporting: (1) the Nation’s expanding nuclear energy initiatives; (2) placing INL at the center of work to develop advanced Generation IV nuclear energy systems, nuclear energy/hydrogen coproduction technology, and advanced nuclear energy fuel cycle technologies; and (3) providing national security answers to national infrastructure needs. In February 2005, Battelle Energy Alliance, LLC (BEA), was selected to operate INL. DOE entered into a 10-year management and operating contract with BEA valued at approximately $4.8 billion. In March

2014, DOE extended that contract for an additional 5 years, citing BEA's consistently strong performance and success in managing the INL as reasons for the extension. BEA is led by Battelle Memorial Institute and the organization includes Babcock & Wilcox Technical Services Group, Inc., Washington Group International, Electric Power Research Institute, and an alliance of university collaborators. The alliance of university collaborators is led by the Massachusetts Institute of Technology and includes other nuclear engineering departments from the University of New Mexico, North Carolina State, Ohio State, and Oregon State. The alliance also collaborates regionally with Boise State, Idaho State, and the University of Idaho.

Located 45 miles west of Idaho Falls, the Advanced Test Reactor (ATR) complex is engaged in research and development of nuclear reactor technologies. The ATR is a DOE National Scientific User Facility. The ATR is vital for testing materials for the Nation's next generation of nuclear power plants. The ATR is also used to manufacture a significant portion of the Nation's medical nuclear isotopes.

MFC, located 28 miles west of Idaho Falls, focuses on research and development of nuclear fuels. Pyroprocessing, which uses electricity to separate waste products in the recycling of nuclear fuel, is also researched here. Within the MFC, the Space and Security Power Systems Facility workers make radioisotope thermoelectric generators, or nuclear batteries, for use on the Nation's space missions. These batteries are crucial to the Nation's deep space missions, which travel to extremely cold regions of space where sunlight is too weak to power photovoltaic cells.

Since 2013, BEA has also worked to reactivate the Transient Reactor Test Facility (TREAT). This reactor, located adjacent to the MFC, is a high-powered, short-pulse reactor used to evaluate materials during simulated reactor accident conditions. Initially built in 1959, DOE placed it into a nonoperational surveillance and maintenance mode in 1994. BEA is in the process of preparing it for operation following DOE approval.

The Research and Education Campus, located in Idaho Falls, is home to INL administration (located in the Engineering Research Office Building (EROB) and the Willow Creek Building)) and a wide variety of other facilities. At the INL Research Center, scientists working in dozens of laboratories conduct cutting-edge research in fields as varied as robotics, genetics, biology, chemistry, metallurgy, computational science, and hydropower. The Center for Advanced Energy Studies, which opened in 2009, houses the Energy Policy Institute. Other facilities house national security programs and INL's precision machining and glass shops. In 2014, BEA opened the Energy Innovation Laboratory, a 148,000 square-foot facility that provides laboratory and meeting spaces for INL programs.

BEA was last certified as a DOE VPP Star site in September 2013. The current review was performed by the AU DOE-VPP Team (Team) from September 20-29, 2016. The multidisciplinary Team included Federal employees and subject matter experts (SME) from other DOE-VPP participant sites. The Team conducted work observations at all major areas operated by BEA; interviewed personnel at all levels; and performed walkdowns of BEA facilities. This report documents the results of the onsite assessment and establishes the basis for the Associate Under Secretary for Environment, Health, Safety and Security to determine if BEA meets the expectations for continued participation in DOE-VPP.

II. INJURY INCIDENCE/LOST WORKDAYS CASE RATE

Injury Incidence/Lost Workdays Case Rate (BEA and staff augmentees)					
Calendar Year	Hours Worked	Total Recordable Cases (TRC)	TRC Incidence Rate (cases per 200,000 hours)	DART* Cases	DART* Case Rate (cases per 200,000 hours)
2013	6,552,642	32	0.98	13	0.40
2014	6,513,782	46	1.41	29	0.89
2015	7,167,640	42	1.17	21	0.59
3-Year Total	20,234,064	120	1.19	63	0.62
Bureau of Labor Statistics (BLS-2014) composite for NAICS** Code (5417,811,221, 332) and 2013 average for 5616			1.84		0.84
Injury Incidence/Lost Workdays Case Rate (Subcontractors)					
Calendar Year	Hours Worked	TRC	TRC Incidence Rate	DART* Cases	DART* Case Rate
2013	302,350	1	0.66	0	0
2014	390,557	5	2.56	4	2.05
2015	466,212	1	0.43	1	0.43
3-Year Total	1,159,119	7	1.21	5	0.86
Bureau of Labor Statistics (BLS-2014) composite for NAICS** Code (5417,811,221, 332) and 2013 average for 5616			1.84		0.84

* Days Away, Restricted or Transferred
** North American Industry Classification System

3-year TRC Incidence Rate, including subcontractors: 1.19
3-year DART Case Rate, including subcontractors: 0.64

Conclusion

The BEA 3-year TRC rate rose from 1.02 cases per 200,000 hours to 1.19 cases per 200,000 hours since the 2013 VPP assessment. BEA recognizes the upward trend in injuries, driven primarily by an increase in minor injuries in 2014, and is pursuing multiple methods to reverse that trend. Because of the diversity of work at INL, BEA applies a weighted average of multiple NAICS codes for its comparison to industry. Even with the increase, BEA remains well below this comparison composite average. Subcontractors working for BEA experienced an increase in both the TRC and DART rates in 2014. Injuries occurred in occupations of custodial services, carpentry, and iron workers. The trend diminished in the following year. Injury rates thus far for 2016 are comparable to the previous year. The Team did not find any incentives that discouraged the reporting of injuries, illnesses, or safety concerns by workers. The BEA injury/illness and DART rates meet the expectations for continued participation in DOE-VPP.

III. MANAGEMENT LEADERSHIP

Management leadership is a key element to obtain and sustain an effective safety culture. The contractor must demonstrate senior level management commitment to occupational safety and health, in general, and to meeting the requirements of DOE-VPP. Management systems for comprehensive planning must address health and safety requirements and initiatives. Elements of that management system must include: (1) clearly communicated policies and goals; (2) clear definition and appropriate assignment of responsibility and authority; (3) adequate resources; (4) accountability for both managers and workers; and (5) visible, accessible, and credible managers. As with any other management system, authority and responsibility for employee health and safety must be integrated with the management system of the organization and must involve employees at all levels of the organization.

In 2013, AU determined that managers were committed to creating and sustaining a culture of safety excellence at BEA. This commitment was demonstrated through support of safety initiatives, active participation, and leadership by example. The Team recommended that BEA managers expand their efforts to improve communications and foster trust with the unions and closely involve the unions in developing solutions to safety issues.

BEA continues to maintain a system of policies and procedures that define and integrate safety policies with the mission of the laboratory. POL-111, *Policies and Standards of Performance*, serves that purpose. Roles, responsibilities, authorities, and accountability are established through an effective system of policies, procedures, and instructions, as well as by the overall organizational structure. In 2014, a new Laboratory Director restructured the management team under two Deputy Laboratory Directors. One Deputy is responsible for Management and Operations and serves as the Chief Operating Officer while maintaining the facilities and infrastructure. The other is responsible for Science and Technology and is the Chief Research Officer, and is responsible for mission execution. This change provided enhanced management oversight and consistent operations across all INL activities. The Deputies are now supported by five Associate Laboratory Directors (ALD): (1) Energy and Environment Science and Technology (EES&T); (2) Nuclear Science and Technology (NS&T); (3) National and Homeland Security (N&HS); (4) MFC; and (5) ATR Complex. One program director remains for the TREAT restart. The laboratory has several mission-enabling organizations: Business Management; Facilities and Site Services (F&SS); Partnerships, Engagement and Tech Deployment; Laboratory Protection; Information Management, Human Resources and Diversity; and Environment, Safety, Health and Quality. The Offices of Audits and General Counsel provide risk management and assurance, and report directly to the Laboratory Director.

As in all previous evaluations, managers interviewed by the Team continued to express their support for excellence in safety and health and recognized safety performance not only as a prerequisite for all work, but as a significant contributor to mission excellence. The Laboratory Director espoused his commitment to achieving world class safety performance, and all managers interviewed by the Team echoed that commitment. The strong support by managers was consistently echoed by most workers encountered by the Team. All managers supported an open-door policy for the workforce.

Managers continue demonstrating their commitment to safety through their words and actions. During the Team's walkthroughs of the major facilities and areas of INL with managers, workers frequently spoke with the managers, discussed current issues, and were comfortable in their relationships with managers and supervisors. BEA expects managers to be present frequently in the facility to conduct formal management observations as well as to address and understand workers' issues and concerns. BEA provides both financial and personnel resources to maintain the VPP effort as a stand-alone project that involves people throughout the laboratory. Managers and workers consistently use those resources in creative ways to foster additional improvement, educate employees, build camaraderie, and improve teamwork in all organizations.

BEA actively participates in the Battelle "Communities of Practice," a process by which Battelle leverages its management role with multiple laboratories. This process is a learning practice that focuses on sharing best practices, implementing innovative business solutions, and developing future laboratory leaders through integrated talent management.

Since 2013, BEA has continued refining its annual survey of employee engagement and safety-conscious work environment. Results from the survey are reviewed by managers and used to identify areas for improvement and management action.

BEA continues to invest in new equipment and facilities that support its mission and improve safety. It has continued to identify new tools and equipment in the vehicle maintenance "Big Shop" in the Central Facilities Area (CFA) and provided the funds for workers to travel to vendor locations to evaluate new equipment "hands-on" prior to selection. It purchased new machine tools for the MFC machine shop that resulted in improved machining capabilities, faster production, and reduced worker hazards.

Certified safety professionals (CSP), certified industrial hygienists (CIH), and industrial hygiene (IH) technicians are readily available when needed. These personnel are assigned to the Environment, Safety and Health (ES&H) organization and are deployed to specific field organizations. As SMEs, these personnel are part of the work planning process, and no issues were raised regarding their availability. In some cases, these SMEs are leading innovative approaches to improving safety and health, particularly in ergonomic improvements (see Hazard Prevention and Control).

BEA remains effective in managing subcontracted work. The LWP-7201, *INL Construction,* and LWP-7205, *Subcontracted Work*, establish the procedures and requirements for subcontract management. BEA considers safety and health performance of the subcontractor during the evaluation and selection process. Subcontractors must follow the BEA safety and health plan. Requirements Document (RD)-1003, *Subcontractor Oversight*, establishes how INL oversees and enforces the safety and health programs at INL. RD-1003 allows for the prompt correction and control of hazards by BEA in the event that subcontractors or individuals fail to correctly control hazards. This document also allows BEA to dismiss the subcontractor from the site for willful or repeated noncompliance. RD-1008, *Training and Indoctrination*, establishes subcontractor training requirements and ensures that subcontractor and lower-tiered contractors possess the experience, knowledge, skills, and abilities that are necessary to discharge their assigned responsibilities under the contract. The requirements of RD-1008 must be met prior to the execution of work.

The 2013 assessment reported some growing distrust of senior managers among segments of the worker population. BEA has effectively corrected this situation. In part, the situation improved when BEA ceased its efforts to use medical technology to determine workers' fitness-for-duty. When the new Laboratory Director arrived, he made efforts to visit with workers at the worksites, listen to their concerns, and address the issues. Meetings between the Laboratory Director, ALDs, and union personnel continue on a monthly basis, and these meetings are used as an open forum for issue discussion and resolution.

Laboratory managers have a suite of performance indicators they use to make decisions and identify performance issues. Safety and health indicators remain primarily lagging indicators. These indicators include: recordable injury rates, DART case rates, radiological contamination cases, days between incidents, and the number of reportable occurrences. From a safety and health perspective, managers have not identified indicators related to specific actions that are expected to improve safety. Managers perform regular observations, with most managers expected to perform two formal observations each month. These observations are reviewed for trends, and future management observations are targeted at issues leading to those trends. BEA does not track the number of management observations as a leading indicator, although other VPP participants have used the number of management observations as an effective leading indicator of safety performance.

Similarly, BEA managers are not tracking the number of peer observations. Although portions of the laboratory continue performing the Safety Observations Achieve Results (SOAR) (the behavior based peer observation program), other portions no longer participate in SOAR or track the number of peer observations (an effective leading indicator). In those areas, BEA managers believe employees did not support performing these observations, nor did managers effectively encourage participation. Managers across the laboratory are focusing on human performance improvement (HPI) principles. Workers and supervisors are asked to identify accident precursors and error likely situations during prejob briefs and work planning, but lack of behavioral data during normal work limits the application of HPI techniques. Rather than being applied proactively during normal work to prevent accidents, BEA uses HPI primarily in response to abnormal events and incidents.

BEA has also expended considerable resources in the “Back and Shoulder” school, and hired a physical therapist to help prevent motion-related injuries. These efforts are demonstrating reductions in severity of injuries, but BEA is not keeping track of the number of people that continue to participate in stretching and exercise programs, another good leading indicator.

BEA should expand its suite of safety and health indicators to include more leading indicators, such as number of management observations, number of peer observations, number of personnel actively participating in health and wellness initiatives, number of employee-identified issues, and employee safety team meeting attendance. While these numbers do not have absolute goals for “good” or “bad” performance, the trends of these numbers do effectively provide managers with data that indicate changes that may lead to reduced safety performance. Further, managers can take actions that directly encourage employees to participate in these activities, and managers get feedback through the numbers whether those encouragement efforts are working.

Opportunity for Improvement: BEA should expand its suite of safety and health indicators to include more leading indicators, such as number of management observations, number of peer observations, number of personnel actively participating in health and wellness initiatives, number of employee-identified issues, and employee safety team meeting attendance.

Conclusion

BEA managers are demonstrating the proactive leadership expected to ensure employees have the necessary policies, procedures, processes, and tools to perform their work safely. Managers listen to employees' issues, identify improvement strategies, and create a safety conscious work environment. Managers understand that human performance can be affected by organizational influences and are encouraging workers to speak up and identify procedural and process issues rather than use work arounds that lead to undesired outcomes. BEA continues to meet the DOE-VPP expectations for Management Leadership.

IV. EMPLOYEE INVOLVEMENT

Employees at all levels must continue to be involved in the structure and operation of the safety and health program and in decisions that affect employee health and safety. Employee involvement is a major pillar of a strong safety culture. Employee participation is in addition to the individual right to notify appropriate managers of hazardous conditions and practices. Managers and employees must work together to establish an environment of trust where employees understand that their participation adds value, is crucial, and is welcome. Managers must be proactive in recognizing, encouraging, facilitating, and rewarding workers for their participation and contributions. Both employees and managers must communicate effectively and collaboratively participate in open forums to discuss continuing improvements, recognize and resolve issues, and learn from their experiences.

In 2013, the Team found that BEA had developed and implemented programs to involve employees in the safety program at INL. Employees were empowered to take ownership of VPP. Restructuring employee safety teams (EST) into a geographically-based system increased employee involvement, and laboratory employee safety team (LEST) chairs strengthened the VPP core within INL. The use of sub-teams at CFA and huddles at MFC were innovative ways to increase participation and involvement. BEA demonstrated a continued strong commitment to Employee Involvement as a significant element of safety.

BEA provides employees with many ways to participate in health and safety problem identification and resolution, and to be active in their own safety while working at INL. Employee ownership and empowerment were very evident during Team interviews with employees, prejob briefings, and Safety Team meetings. At no time during this assessment did an employee express to the Team any fear of stopping work or pausing (locally referred to as a “time out”) for a safety issue. One example of employee involvement was an employee at MFC who suggested new footwear that reduced stress and fatigue for operators standing on concrete all day. The ES&H Manager supported the suggestion, performed research, and now the company makes the shoes available in its catalog for employees that work on concrete floors for a large part of their shifts. Employees also demonstrated their involvement at the fleet maintenance garage by developing ways to facilitate their work, improve safety, and reduce physical effort. Based on worker’s suggestions, supervisors provided job task carts with the tools and parts necessary for regularly performed specialized tasks, such as bearing replacement for the fleet buses. Fleet maintenance personnel also developed an oil pan drain system to eliminate hazards of oily residue on the floors that could lead to slips and falls. Another employee developed a remote tool to retap threads in a radiological environment, thereby reducing exposure.

ESTs have been part of the BEA VPP culture for many years. In 2011, BEA rearranged its ESTs by geographic location rather than organizationally and saw increased participation. In addition, with geographic ESTs, the Team observed that the interaction with managers is easier and fosters a significant improvement in trust. Recent increases in the employee population have also resulted in an increase in EST participation. Each EST continues to use sub teams (i.e., facility inspections, injury analysis, safety improvement plan, SOAR, recognition and promotions, communications and neighborhood, new member orientation, Safety 24/7). BEA continues to use an LEST, which is the higher level EST that includes the chair and vice chairs from each EST, the Laboratory Manager (LM), and one of the Deputy Laboratory Directors, who is the management champion for the LEST.

The Team attended several EST meetings where there was standing room only. All consisted of good presentations, including nationally-recognized speakers and local SMEs from BEA safety organizations. BEA continues to maintain eight ESTs, but discussions indicate more ESTs may be added because of the increase in employees and employee participation. EST participation was encouraged by all managers interviewed. During this assessment at the Willow Creek Building, EST members were providing free popcorn for employees who took the time to write down personnel safety shares and put them on a poster board. Although the Team did identify some employees who were not fully aware of EST activities and accomplishments, ESTs continue to be an effective venue for encouraging and enabling employee involvement.

The Team also observed that BEA was encouraging employees to complete their "Galactic Passport" as part of a VPP employee involvement campaign. The passport is a means to refresh employees' basic knowledge of VPP and INL's safety and health program, encourage personal health and wellness, and provide opportunities for employees to perform safe behaviors both on and off the job. The period for participation was May 1 through September 30, 2016. According to the passport pamphlet, an employee is expected to complete 7 of 12 activities per month (e.g., fill in the blank questions, set health goals, attend an EST meeting) plus Web-based training; then obtain a star stamp from the EST to acknowledge completion of the five VPP elements. The pamphlet states that employees who receive all five stars will receive recognition and be better prepared for the DOE-HQ VPP review. Over 70 percent of BEA employees participated in the passport activity, indicating the extent of employee involvement.

Other participation activities that foster employee involvement include opportunities both within and outside of BEA. Some examples include the United Way Campaigns that contribute to organizations that provide health care and assistance to employees and their families; safety presentations to Boy Scout and Girl Scout functions, such as firearm safety; educational involvement with local schools through classroom presentations by BEA employees; corporate donations for education; and onsite safety fairs. BEA employees' volunteer efforts and corporate's support is evident throughout the local community as they have completed over 400 community projects since 2005. Although these activities are not directly related to safety and health, they do help engage employees, give them a sense of belonging, and contribute to better morale, which in turn leads to greater job satisfaction and improved health and safety. In addition, BEA employees use these opportunities to include messages about BEA's commitment to safety as part of its community involvement.

In 2015, BEA engaged in mentoring activities with 48 companies and organizations both within the DOE community and outside the DOE community. These mentoring activities permit BEA to share its safety and health successes with other VPP participants, and contribute to better health and safety performance of the recipients. These activities also permit BEA employees to work with other companies to learn new ideas, and identify new ideas to try at INL. Examples within the DOE community include Los Alamos National Laboratory and the Pacific Northwest National Laboratory. Mentoring activities outside the DOE community included Phillips 66, Cintas Corporation, Comcast Corporation, Southwire, Olin Brass, and Miller Coors.

BEA has continued to support employee recognition through several avenues. Employees can nominate someone for going above and beyond in a peer-to-peer scenario. Managers can reward individuals or a group for jobs well done, first line working groups can recognize individuals for performing a task or work safely, and some groups nominate a monthly winner for their contribution to a safe work environment. For example, a worker who performs SOAR observations can accumulate points for rewards. During an interview with a machine shop operator, the interviewee related that he received a significant monetary award ($500) from managers for participation on a project. At the Specific Manufacturing Complex (SMC), there is a "Tanks a Lot" reward program for rewarding workers. At ATR, its machine shop group reward program is "You Reactored Right." An employee observed performing a task safely is given a candy bar and entered into a monthly drawing for a prize. Fleet maintenance has a "mechanic of the month" program that recognizes one person chosen by the mechanics as the "most supportive" mechanic. The winner receives a $150 gift card. The bus drivers have a similar system to recognize individuals.

During the course of this assessment, the Team interviewed employees at sites that were moving away from SOAR, BEA's safety behavior observation program, to HPI programs. Most BEA employees are very familiar with SOAR, the program is mature, and most employees are very familiar with the concepts and expectations, but BEA has not yet established that level of familiarity and comfort with HPI. Furthermore, BEA's HPI program has not incorporated structured peer observations that identify errors and the systemic influences that lead to those errors, which was a key component of SOAR. Specifically, MFC has stopped performing SOAR observations. MFC has provided up to 8 hours of training to employees as a starting point for change. In addition to classroom training, employees at MFC received a booklet to help them transition from SOAR to HPI. When asked, interviewed employees were not able to convey the structure and expectations for an HPI program at their facility. Further, they were unsure of what their participation entailed and how they were to engage in identifying error precursors and latent defects. BEA should monitor its transition from SOAR to Human Performance Improvement (HPI), engage the safety teams and managers to help develop a program structure, and provide a communication mechanism to help all employees effectively employ HPI techniques and principles.

Opportunity for Improvement: BEA should monitor its transition from SOAR to Human Performance Improvement (HPI), engage the safety teams and managers to help develop a program structure, and provide a communication mechanism to help all employees effectively employ HPI techniques and principles.

Conclusion

BEA continues to seek improvements in mature programs that involve employees in safety programs at INL. Instituting new safety programs such as HPI will require developing a structure and time to mature and reap the benefits of employee ownership and involvement. BEA effectively empowers and engages employees to take ownership of VPP. The restructuring of ESTs into a geographically-based system, with closer proximity of managers to the ESTs has increased employee involvement and is building a trusting relationship between managers and workers. Managers are encouraging new employees to take part in ESTs. BEA demonstrates a continued strong commitment to employee involvement as a significant element of safety and continues to meet the expectations for participation in DOE-VPP.

V. WORKSITE ANALYSIS

Management of health and safety programs must begin with a thorough understanding of all hazards that might be encountered during the course of work and the ability to recognize and correct new hazards. Implementation of the first two core functions of an integrated safety management system (ISMS), defining the scope of work and identifying and analyzing hazards, form the basis for a systematic approach to identifying and analyzing all hazards encountered during the course of work. The results of the analysis must be used in subsequent work planning efforts. Effective safety programs also integrate feedback from workers regarding additional hazards that are encountered and include a system to ensure that new or newly recognized hazards are properly addressed. Successful worksite analysis involves implementing preventive and/or mitigating measures during work planning to anticipate and minimize the impact of such hazards.

BEA is maintaining its hazard baseline surveys in the Hazard Assessment Sampling System (HASS) database. The Team requested an update to air sampling for cleaning solvents used for the maintenance and calibration of high pressure gauges (noted as unavailable in the 2013 assessment). The industrial hygienist retrieved the data and showed sampling occurred shortly after the Team identified the issue in 2013 and that worker exposures were below allowed limits. The industrial hygienist updated the corresponding laboratory instruction (LI) for the repair of high pressure gauges with the hazards and controls to include the appropriate glove to protect against skin exposure. The HASS remains a reliable system to document and retrieve exposure assessment data.

BEA continues to use LWP-21220, *Work Management*, as the guiding document for the development of various research and operations work packages. The document provides work planners a graded approach, based on risk, to guide the work request to the appropriate work package. The simplest work package is the routine activity envelope, which requires no documentation. The next work package is the performer-controlled activity for low risk activities, and the LI is for complex work. The planner can use SME walkdowns and tabletops to identify and evaluate hazards and provide the best control options. These options include elimination, substitution, and engineering controls, before seeking personal protective equipment (PPE) options.

Although LWP-21220 adequately covers INL work planning, BEA realized that it needed to develop a supplement that provides work planning guidance for researchers to address their specific requirements after an accident at a molten salt research project injured a researcher in 2013. Prior to the 2013 assessment, BEA began developing LWP-20000, *Conduct of Research,* to involve key positions with research projects, to tailor document requirements to create research LIs, and create common language that researchers could understand. Since 2013, BEA has completed LWP-2000, trained research personnel to use it, and implemented it for all research activities. It is proving an effective approach to conducting research activities. The document, in electronic form, provides researchers, managers, and other support staff with active links to appropriate procedures and guidance, explains in detail BEA's expectations for planning and conducting research activities, and provides "cradle-to-grave" management of experimental activities. The approach incorporates a thorough hazard analysis that includes potential accident scenarios, SME review of hazards, and both peer and manager reviews before approval. This approach uses a computer system adapted from the Pacific Northwest National Laboratories (another Battelle laboratory), to guide researchers in building the LI for the activity they intend to perform. This process helps them identify existing laboratory requirements related to the hazards identified, such as permits or required reviews. For example, the Team reviewed LI-658, *Analytical Chemistry* (2016). This LI includes specific hazard analysis, such as the potential of asphyxiation from Argon, concentrations and quantities of acids used, and justifies the selected controls based on that analysis.

Researchers can also request SME assistance when preparing an LI. The EES&T directorate hired a technical writer dedicated to helping researchers create the LI. EES&T places the LI on a shared network site for all SMEs to provide comments and to allow the researcher to update the LI and respond to comments. As an example, a technical writer demonstrated the review process of LI-606, *Archeological Field Work*, on the shared site. The LI analyzes archeology field work hazards on and off the INL site, including the possibility of unexploded ordinance, the risks of working remotely, and heat stress. The LI incorporates appropriate controls for those hazards based on the analysis. The NS&T and the N&HS directorates use an alternate approach sending the LIs to SMEs to review through e-mail or through the electronic document management system. Both of these processes have helped researchers involve SMEs and ensure LIs incorporate appropriate controls for mission-related work.

Managers' involvement in research projects also increased due to the 2013 molten salt accident. As part of the LWP-20000 implementation, BEA established Operations Leads for each of the EES&T, NS&T, and N&HS directorates. The operations leads are responsible for safe operations within their organizations, for coordinating experiments across the site, and resolving conflicting requirements between activities. Under each Operations Lead, the LM approves LIs and ensures the hazards and selected controls maintain the safety envelope of the laboratory. The Laboratory Space Coordinator (LSC) authorizes research activities to occur in the LSC's respective area and keeps the LM informed of any changes that might affect other laboratories or facility operations. All personnel from the Operations Leads down through the organization have responsibility for identifying and contributing to the analysis of hazards and ensuring appropriate mitigation and control.

Maintenance work control uses LWP-6200, *Maintenance Integrated Work Control Process* (2016). As with LWP-21220, maintenance work planning uses a graded approach, based on risk, to guide the work request to the appropriate work package. Work requests enter the computer based maintenance management system, Labway, and the lead planner or expediter screens the work description to determine the appropriate work package. The three types of work packages for maintenance work are similar to research work. The first and simplest work package is the Tool Pouch, which is determined to be within the skill of the craft person performing the work, and does not need additional documentation beyond a simple work ticket. Preventive and predictive maintenance is performed using the minor maintenance work package, and INL prints the work package on green sheets, which identify it as a minor maintenance. If an existing LI already covers a maintenance task, the minor maintenance task will reference that LI. The planned work package, which parallels a laboratory LI, is for corrective maintenance or more complex work and contains input from SMEs on the hazards and controls for the requested work. Appendix A of LWP-6200 contains an extensive list of conditions for work package determination that help the expediter make the correct planning decision. If a work request is screened through Appendix A and determined to be minor maintenance, the work is released without undergoing the formal hazard analysis process required for planned work. As minor maintenance, the work is considered "skill of the craft" and can be performed under the workers' skills, training, and knowledge (representing the hazard analysis).

The Hazards and Risks Planning System (HaRPS) is an optional computer-based hazard analysis tool available for both maintenance and laboratory work that has been in use at INL for several years. Planners can use HaRPS to assist in the identification and control of hazards for work packages. Depending on the hazard selected by the user, HaRPS suggests controls from previously identified hazards, directs the planner to confer with specific SMEs, or provides hyperlinks/references to BEA documents. HaRPS provide those suggestions and directions as a pick list of tasks or activities and associated hazards and controls.

BEA defines the workers' skills and knowledge in an associated worker LI (i.e., painter, carpenter, laborer, etc.). The Team's review of several LI's revealed cases where the LI instructed the worker to contact the appropriate SME for applicable PPE or additional hazard controls if working with certain chemicals or types of paints, for example. This approach requires the worker to recognize the unanalyzed hazard and obtain the input of an SME to perform work safely. This approach may set workers up for failure or over reliance on their own assumptions regarding hazards. To avoid this potential error, BEA should consider including specific controls within the LIs for expected hazards (determined by an SME) or require that any work needing additional SME review be performed as planned work, including appropriate hazard analysis.

Opportunity for Improvement: BEA should consider including specific controls within the Laboratory Instructions for expected hazards (determined by an SME) or require that any work needing additional SME review be performed as planned work, including appropriate hazard analysis.

During the past year, BEA experienced two accidents, in part because of inadequate hazard analysis for the associated work packages. In 2015 linemen performed preventive maintenance work of several breakers at a CFA substation. Some of the work included using a 'hot stick' to attach a protective ground cable. While working on one breaker, the ground wire came in contact with an energized 12.5kV cable on an adjacent breaker creating an arc flash. Workers were wearing appropriate arc-flash protective clothing and were fortunately outside the direct path of the arc and escaped without injury. According to the Noncompliance Tracking System (NTS) report: "Although they (linemen) perform the majority of their work on de-energized breakers and not near other energized systems…the job scope did not identify any special circumstances or conditions. Planning and scoping of the work package did not adequately identify and mitigate the hazard present on the top of the breaker…engineered barriers could have been established and electricity could have been rerouted or the equipment taken out of service to provide greater distance between the linemen and the hazard or remove the hazard entirely." Although the NTS report pointed to improving the scope, the identification of all hazards, and the identification of hazard controls, BEA issued a memorandum that focused on compensatory actions. Those actions include "when working near energized systems, the work must first be approved by the Site-wide Facilities and Operations (SFO) Division Director to review the need for the 'energized work', and mitigations." And the SFO will also bring "energized work or work in proximity to energized systems" to the F&SS Director or F&SS Deputy Director prior to proceeding with the work. The memorandum failed to mention improving the analysis of hazards and identifying hazard controls in work packages to eliminate workers making decisions on controls to mitigate hazards.

In another event, a subcontractor mechanic performed maintenance on an air-handling unit located at the Energy Innovation Laboratory in 2016. A simple lockout was used to deenergize the fan. After the mechanic removed the belt guard, he placed his hand on the belt to brace himself. The mechanic was unaware that backflow through the fan was causing the fan to windmill. When the worker grabbed the belt, his hand was pulled into the sheave, pinching his finger between the belt and the sheave. The result was a lacerated and fractured finger. The work package did not identify the hazard from the potential for the fan to windmill, so it was not controlled. Post-accident analysis discovered an unusual fan control mechanism for the system that was not analyzed during the work planning process. Compensatory actions included the F&SS Deputy Director issuing a standing order that requires managers to review all use of supplemental protection measures (e.g., blocks, wedges, chains) during the execution of the lock-out/tag-out (LO/TO) process. Also, the F&SS started conducting walkdowns on all preventive and corrective maintenance work packages and corrected issues in work packages prior to their release to the field. These compensatory measures are temporary and do not address the systemic issue of improving hazard identification and analysis in work planning documents.

Two other examples demonstrated the lack of hazard analysis for minor maintenance activities. The first case involved painting a floor at MFC in 2016. The painters received the minor maintenance work package and ordered an isocyanate paint to coat the floor. The purchasing system required a review by an industrial hygienist before that paint could be ordered. The industrial hygienist stopped the paint purchase order and identified a less toxic paint. The industrial hygienist also required the use of respirators, Tyvek suits, and two layers of gloves as protection for workers applying the paint, and required supplemental ventilation using large fans to dilute and remove the solvent vapor concentrations. In this case, the purchasing system requirement for the IH review of the new paint caught the error that would otherwise have authorized workers to conduct work that needed additional analysis. The work expeditor reviewing and approving the work request did not perform sufficient analysis of the work to ensure the appropriate controls were identified before releasing the work.

In the second example, the Team observed a worker that unnecessarily exposed himself to diesel fuel without fully understanding the potential health effects associated with chronic exposure to chemicals. In this case, the Team observed a mechanic performing a post maintenance test on a diesel powered firewater pump at the Idaho Research Center (IRC). The work order for the repair was minor maintenance, or green sheet, considered to be within the skill of the craft, and included a generic prejob brief that included use of the safety datasheets to understand the hazards and appropriate protection for diesel fuel. Earlier, the mechanic repaired a leaking fuel line. The worker mentioned that he had spilled a small quantity of diesel fuel inside the mechanical building and on his clothing while performing the repair. The odor of diesel fuel was noticeable in both the shop area where the mechanic was taking his break, as well as in the mechanical building housing the water pump. The mechanic was not familiar with the hazards of dermal exposure to diesel fuel and had not selected any additional PPE for performing this work (e.g., impermeable coveralls). In many skill-of-the-craft work packages, BEA relies on workers to identify and wear specific PPE based on their experience and knowledge, which is not an effective approach.

In 2013, the Team recommended that “BEA continue working toward documenting hazard analysis for all work that identifies assumptions, locations, work methods, or other parameters that define why identified controls ensure that all work is performed safely.” BEA has significantly improved its documentation of hazard analysis for research work, but the examples above indicate the work planning process for maintenance does not drive work planners or SMEs to ask critical questions to identify and analyze less obvious or unrecognized hazards, or to recognize and challenge assumptions. BEA should incorporate more detailed hazard analysis into its maintenance work planning processes to document the basis for control decisions, validate assumptions, and verify those assumptions remain valid in future work evolutions.

Opportunity for Improvement: BEA should incorporate more detailed hazard analysis into its maintenance work planning processes to document the basis for control decisions, validate assumptions, and verify those assumptions remain valid in future work evolutions.

Planned work orders provide the detailed steps needed to work on complex equipment without doing damage to such equipment, control complex tasks, or prevent errors that might cause significant harm to workers, facilities, or the environment. When maintenance work requests are entered into Labway, the requester enters a work description or scope. Lead planners or expediters then use the workscope statement, and their experience and knowledge, and often make assumptions to decide the appropriate level of planning to authorize the work. LWP-6200 establishes an expectation that the planner or expediter perform a walkdown of the work to ensure the scope is accurate, but in some cases, these walkdowns are omitted because the planners and expediters believe they know what work is being requested. The Team reviewed several minor maintenance work packages and found the scope statements were brief and not specific. In the case of the paint request discussed above, the planner did not recognize the paint being requested was not on the authorized paint list. Approximately 3,000 work requests are completed yearly, adding to the pressure on planners and expediters to quickly process requests they believe to be “simple” or within the skill of the craft without more detailed hazard analysis. BEA should emphasize to planners and expediters the need to request additional information or perform a walkdown of the work, even for minor work, to ensure the work scope statement accurately reflects the specific work task and help planners and expediters select the appropriate work package for the work request.

Opportunity for Improvement: BEA should emphasize to planners and expediters the need to request additional information or perform a walk down of the work, even for minor work, to ensure the workscope statement accurately reflects the specific work task, and help planners and expediters select the appropriate work package for the work request.

Fleet Maintenance uses STD-1094, *Fleet Maintenance* (2013), to conduct work at the CFA vehicle maintenance building (Big Shop). The service call center enters work requests into a commercially provided asset database and a repair sheet is generated for the mechanic to perform the work. The repair sheet refers to LIs on how to do the repair work and the hazards of the work. The database links vehicle maintenance requests to specific vehicles and cost centers. The LIs for the Big Shop are based on in-shop hazards identified by a team of managers, employees, mechanics, safety, health, and environmental professionals.

BEA performs monthly inspections of continuous activities, and inspects most facilities quarterly in accordance with DOE-VPP expectations. Laboratory Requirements Document (LRD)-1404, *Requirements for the Voluntary Protection Program Star Process at the INL* (2016), implements inspections as a BEA requirement. These inspections typically involve a formal team of safety and health professionals, who use a checklist when they perform a facility inspection. Issues from the inspection are entered into Labway for tracking and resolution, and may include pictures of the condition. However, BEA recently changed its facility inspection schedules at

MFC and ATR. MFC was conducting quarterly walkdowns of all its facilities but decided in 2015 to inspect nuclear facilities quarterly and the balance of plant as requested by facility managers. A roster of safety and health professionals who are available to conduct walkdowns with the facility managers is provided every month. Similarly, ATR has a list of all its facilities to inspect that identifies whether the facility is inspected quarterly, semi-annually, or annually. This new schedule may not meet the DOE-VPP expectation and BEA requirements. Managers at MFC and ATR believe these schedules more effectively use available resources to manage existing risks. Those managers further believe that there are many other walkdowns and inspections by professionals and SMEs that meet the intent of DOE-VPP expectations and BEA requirements. Those inspections and walkdowns include SMEs for fire protection, environmental protection, safety, industrial hygiene, radiation control, and engineering. These personnel walk through facilities monthly and report any issues. BEA should analyze the current suite of facility inspections at MFC and ATR and use that analysis to determine whether the assessments meet the laboratory requirements and DOE-VPP expectations to inspect the whole site quarterly.

Opportunity for Improvement: BEA should analyze the current suite of facility inspections at MFC and ATR, and use that analysis to determine whether the assessments meet the laboratory requirements and DOE-VPP expectations to inspect the whole site quarterly.

In an effort to better understand the cause of recurrent injuries, BEA performed an analysis in 2014 that evaluated 33 recordable fit-for-duty events, 75 percent of which were related to back and shoulder injuries. A review of the medical history for back and shoulder injuries indicated that two thirds of these injuries were re-injuries of either work or non-work-related injuries. Based on its analysis, BEA contracted with a physical therapist to develop a general training course and a more extensive spine and shoulder program referred to as the “Spine and Shoulder School” in an attempt to reduce the trend for these types of injuries. The Spine and Shoulder School training is a 4-week course requiring 1 hour a day instruction that teaches the fundamental mechanics of spine and shoulder function and their normal operating ranges and instructs the worker of the proper exercises to support those physiological mechanics to reduce injuries. As part of the training, BEA provided each employee TheraBand™ exercise bands and 3-foot wooden dowels to help perform the exercises taught. Recognizing the benefits that the program potentially offered to its employees, the F&SS group required all its employees to participate in the program to help prevent back and shoulder injuries. Over 2,700 BEA employees have received the general back and shoulder training through EST meetings and over 735 have completed the aforementioned Spine and Shoulder School. To assess the spine and shoulder program’s effectiveness, the occupational medicine group evaluated the TRC/DART rates related to back and shoulder injuries since 2014 and found a 69 percent reduction in DART and a 35 percent reduction in TRC rates from 2014 through 2016.

The Team observed excellent IH and industrial safety (IS) support to the sites. The IH/IS professionals are engaged in the facilities and respond when they are called to provide their expertise. Many of the IH/IS staff are CIH or CSPs. One individual who is a CSP is completing an industrial hygiene distance learning course to become qualified as a CIH as well.

BEA develops a quarterly Occupational Safety and Health report with key performance metrics for IH, IS, injury/illness, fire protection, occupational medicine, occupational safety and health management, and VPP. A color code is applied to the metric to determine status. During this assessment, the TRC and DART case rates received a red rating for exceeding the 5-year baseline (Fiscal Year 2010 to 2014) in 2016. BEA has identified several actions to reduce injuries by pursuing focused campaigns, back and shoulder schools, workplace safety themes, and ergonomic assessments. The report provides analysis of key metrics and actions taken to improve the health and safety programs.

Conclusion

BEA has knowledgeable and experienced personnel who are familiar with most of the hazards they may encounter during the course of work. They are supported by SMEs and have effective tools to perform hazard analysis. The BEA work control process has matured at INL and the systems in place are familiar to the planners, expediters, SMEs, and workers. INL can be a complex work environment, and injury rates have increased since the last VPP assessment. In the past 3 years, BEA has experienced a couple of incidents that resulted in severe injuries, and some near-miss incidents, all of which were avoidable. BEA’s root cause analyses of these incidents identified the need for BEA to improve its maintenance work control process. BEA has implemented numerous compensatory actions to help make up for errors in hazard identification and analysis. To drive further improvements, BEA should focus on evaluating hazards and assumptions associated with maintenance tasks. Overall, BEA’s performance meets the DOE-VPP expectations for Worksite Analysis.

VI. HAZARD PREVENTION AND CONTROL

The second and third core functions of ISMS, identify and implement controls and perform work in accordance with controls, ensure that once hazards have been identified and analyzed, they are eliminated (by substitution or changing work methods) or addressed by the implementation of effective controls (engineered controls, administrative controls, or PPE). Equipment maintenance processes to ensure compliance with requirements and emergency preparedness must also be implemented. Safety rules and work procedures must be developed, communicated, and understood by supervisors and employees. These rules and procedures must also be followed by everyone in the workplace to prevent, control the frequency of, or reduce the severity of mishaps.

BEA follows the hierarchy of controls to eliminate, mitigate, or protect the worker against the potential for exposure to many types of industrial, chemical, and radiological environments and materials. The proper use of the hierarchy of controls is clearly stated in LRDs. During the review, the Team observed numerous examples of hazard elimination, substitution, administrative controls, and proper use of PPE. All employees the Team interviewed expressed confidence in their ability to stop work, ask questions, or report problems without fear of retribution if they did not understand or had questions about the efficacy of identified controls.

BEA has implemented many engineered solutions to eliminate hazards to the workers. For example, at the Fleet Maintenance shop, BEA has invested heavily in new equipment that virtually eliminates the hazards associated with fleet vehicle maintenance. BEA now has an ergonomic automatic tire changer for most car and small truck tires. The device is fully automatic and is operated with the “go” foot pedal. It incorporates a space-saving wheel lift that eliminates the need for the operator to lift the tire or wheel assembly for installation. Hydraulic press arms automatically break the tire bead from, or set the tire bead on, the wheel during removal and installation, respectively. The device’s features nearly eliminate the hazards associated with tire changes, such as strains, pinch points, and lifting. Similarly, BEA purchased a tire changer for bus tires that also reduces worker effort for bus tire change-outs. Other improvements include a drive-on scissor lift with ergonomic side steps and undercarriage LED lighting, a bus alignment rack, and a hydraulically assisted tire leak detector. BEA investment in improved equipment has significantly reduced worker exposure to strains, pinch points, and lifting hazards associated with these daily operations.

Another example of reducing hazards while improving work processes was demonstrated by the high voltage electricians at CFA. These personnel replace high voltage power poles as part of routine utility maintenance. Previously, this work involved removal of the existing power pole before erecting the new pole, requiring significant elevated work, control of wires under high tension, and supplemental supports. A high voltage electrician recommended an alternative approach that builds the new power pole in place close to the old pole. The wires are then transferred to the new pole before the old pole is removed. The new process is both safer and quicker for the electricians.

MFC is piloting a Heat Stress Physiological Monitoring program modeled after similar efforts at the Savannah River and Hanford sites. This program uses real-time monitoring of temperature and heart rate to determine required rest times rather than relying on standardized work/rest cycles. This practice has been shown to better account for individual physiology and provide more effective work during hot temperatures.

In addition, the safety professionals at MFC have followed an approach used by the Los Alamos National Laboratory to study and prevent ergonomic injuries resulting from unusual positioning and repetitive motion trauma. This program focuses on manipulators, glove boxes, and fume hoods within MFC to proactively predict and prevent ergonomic injuries. MFC also invited a company, Heddoko, to demonstrate the use of "wearable" technology. The technology uses sensors in a suit worn by a worker to monitor body motion and positioning and develops a computer model to measure and identify potential ergonomic stresses.

Other examples of significant improvements by BEA to the hazard prevention and control area include replacing aging and unreliable diesels at ATR with battery-powered, uninterruptible power supply; a $23 million investment in the power distribution infrastructure; and plans to bring an AECOM Slip Simulator to MFC within the next 3 months. The portable slip simulator was developed by AECOM in connection with other DOE-VPP sites, including Los Alamos National Laboratory, Savannah River Remediation, and Washington River Protection Solutions, to safely train workers on slippery walking and working surfaces, and help prevent injuries from slips and falls.

The Fleet Maintenance Group converted two storage rooms into exercise rooms. One room includes free weights, and the second includes treadmills, stretching machines, and other cardio devices. The intent of the upgrades is to help maintain/improve worker health and alertness during the work day, the latter particularly for the bus drivers.

BEA makes extensive use of administrative controls, including warning signs, caution signs, and other postings identifying hazardous areas. These signs and postings are often related to the proper PPE required when entering an area. Many of these postings use generic language, such as requiring PPE "when work is being performed." Use of such generic terms requires a decision by the personnel in, or entering, the area whether work is being done or not. For example, the Team observed a case where workers in the machine shop at MFC were not wearing safety glasses although work was going on in the shop. This practice may have developed because the postings in the shop are too general (safety glasses required when work is being performed). BEA installed new machines that normally contain the work fully within the machine, reducing or eliminating the need for safety glasses in the shop. In one case, a worker opened the machine to use compressed air to remove residue from a machined part. That worker was wearing safety glasses, but no other personnel in the shop were wearing safety glasses contrary to the postings. The generic postings in the shop probably conflict with workers' understanding of the machines leading to a "normalized deviation." Many BEA shops and laboratories used this approach. The Team experience has demonstrated that generic postings often lead to misinterpretation and poor compliance. BEA should review the use of generic postings for hazard controls, revise the postings to state the actual expectations, and ensure workers comply with those postings.

Opportunity for Improvement: BEA should review the use of generic postings for hazard controls, revise the postings to state the actual expectations, and ensure workers comply with those postings.

Another potential concern identified during Team walkdowns of the IRC laboratory spaces discovered two cases where safety showers and safety eyewash stations were not accessible per the requirements of American National Standards Institute (ANSI) Z358.1-2014, *Emergency Eyewash and Shower Equipment*. ANSI recommends that eyewash and shower stations be located so that the "path of travel shall be free of obstructions." In both observation cases, obstructions were present that would have prevented an injured worker from accessing the safety systems. The Team recognizes that many of the laboratories reviewed at the IRC may have been involved in relocation activities, which may explain why the eyewash stations and safety showers were not accessible during the review. However, BEA should ensure that all established hazard controls are in place and operational during all phases of physical changes to the laboratories.

Opportunity for Improvement: BEA should take steps to ensure that during the laboratory relocations that all established hazard controls are in place and operational during all phases of physical changes to the laboratories.

Other than the exceptions noted above, the Team observed workers wearing the specified PPE in laboratories, shops, and other locations where it was required by work instructions or training. Common PPE are typically safety glasses, nitrile or other rubber gloves, safety shoes, anticontamination clothing, and hearing protection.

Most workspaces the Team visited demonstrated good housekeeping practices, free of tripping hazards with no minor distracting hazards present. The MFC carpenter shop, cited as a housekeeping and material storage problem corrected during the 2013 assessment, remains well kept. Workers have created additional storage cabinets for tools and materials, keeping the shop areas free of tripping hazards. Similarly, excess materials have been removed from the MFC machine shop.

BEA maintains a comprehensive radiological control program to protect workers, the public, and the environment from the hazards associated with ionizing radiation. BEA frequently evaluates its radiation protection program and makes refinements to ensure that radiological exposures are maintained as low as reasonably achievable (ALARA). Since the previous DOE-VPP onsite evaluation, BEA reevaluated and streamlined its radiation work permit (RWP). The Radiation Protection Program Manager indicated that a team approach was used to refine the RWP and the effort resulted in a more user-friendly permit. Another improvement in the radiation protection program includes the use of a Dynamic Learning Activity (DLA) training program patterned after the Leadership Operations Supervisors' Academy (LOSA), which targets performance and skill enhancement for Radiation Control Technicians through hands on activities. Another program improvement involves a new "ALARA Optimization" effort that engages radiation program resources early in the design or modification of facilities to avoid rework/problems or risks that could negatively impact employees and the environment after the project is completed.

Extensive metrics are being used to monitor the radiation protection program performance. Trends identified by these metrics are used to determine assessment priorities for the contractor assurance system and drive continuous program improvement.

The BEA Occupational Medicine Program has remained unchanged since the last review. It continues to provide services to all BEA employees, INL subcontractors, and DOE employees. The medical facilities are geographically located to provide rapid and effective response to employees. Occupational medicine providers occasionally visit the workplace and are involved with clinical evaluations, employee assistance, wellness programs to promote healthy lifestyles; they also administer claims and benefits for work-related injuries and illnesses. They also perform preplacement physicals, periodic physicals, health profile assessments, return-to-work evaluations, non-acute occupational injury and illness evaluations, and acute illness evaluation and referral. Overall, the medical program remains comprehensive and the physicians and technicians are highly-qualified and able to respond to any medical emergency.

BEA recently submitted an application for recognition by the American College of Occupational and Environmental Medicine for the Corporate Health Achievement award. This award recognizes quality occupational and environmental health programs. Recipients are judged on well-defined programs with measurable results that establish best practices, which other employers can emulate.

BEA has a comprehensive Emergency Preparedness program. The primary Emergency Operations Center (EOC) is located in town and two local Emergency Communications Centers (ECC) are located in the CFA and ATR. The Emergency Director duties rotate among a cadre of qualified managers. The EOC and ECCs are exercised on a regular basis. The emergency response capability at INL is provided onsite by the site fire brigades and the security forces. Emergency response in town is coordinated through the EOC with local law enforcement and fire and rescue. Three onsite fire stations are manned and equipped to handle the wide range of emergencies at INL. The emergency responders are supported by state-of-the-art communications equipment that interfaces with local authorities. All facilities onsite participate in regularly scheduled drills that include both evacuation and shelter-in-place responses. BEA continues to use “control cell” tabletops as part of its emergency preparedness drills. Control cell tabletops are a more enhanced tabletop exercise that incorporates the activation of the communication systems to and from the EOC and the responders to provide a real-time functionality test of the communication systems, as well as exercising the tabletop procedures’ effectiveness for potential improvements.

During this review, the Team had the opportunity to observe a real-time EOC response to a bomb threat. Due to the threat, the EROB personnel were required to shelter-in-place. EOC personnel responded promptly to the response and immediately began coordinating with the local law enforcement. The EROB was isolated by the Idaho Falls Police Department while the threat was evaluated and eventually resolved with an arrest.

The Team did not encounter or observe any significant changes in the BEA safety and health rules. The BEA expectation for employees continues to be that they follow company rules to produce a safe and productive work environment. The Team did not observe any significant changes to the BEA disciplinary system since the last review. The use of positive reinforcement and recognition for promoting safe behaviors was clearly visible across all facilities.

Conclusion

BEA effectively uses the hierarchy of controls, and workers use proper PPE. However, BEA’s reliance on generic postings for hazard controls in the shop areas may result in unintended noncompliance with established PPE requirements. BEA continues to invest in new technologies and equipment to effectively eliminate hazards to the workers. Since the 2013 review, BEA reevaluated and made improvements to the radiation protection program through employee involvement and management leadership. These efforts demonstrate BEA’s commitment to continuous improvement. BEA continues to meet the expectations of the Hazard Prevention and Control tenet of DOE-VPP.

VII. SAFETY AND HEALTH TRAINING

Managers, supervisors, and employees must know and understand the policies, rules, and procedures established to prevent exposure to hazards. Training for health and safety must ensure that responsibilities are understood, and that personnel recognize hazards they may encounter, and are capable of acting in accordance with managers' expectations and approved procedures.

Program Description Document -12005, *INL Training Program,* defines the INL training program, and Manual 12, *Training and Qualifications,* implements it. Manual 12 is a collection of procedures describing the requirements and process for the development and implementation of training throughout the laboratory. LWPs and training job aids are used to implement the training process. Since 2013, BEA revised Manual 12, and focused additional resources to document the training processes. There are now 17 LWPs and 63 job training aids available for training personnel to utilize. One of the newly developed LWPs, LWP-12029, *Training Staff Qualifications,* specifies the core training and qualification requirements for training personnel and allows the training organizations to apply additional rigor to support program-specific requirements.

The BEA training program is composed of several training organizations and facility-specific training programs that are independent and managed separately. Each training organization is responsible for developing and delivering training necessary to ensure personnel within its organization are qualified to perform their jobs safely and effectively. Training programs for ATR, Emergency Management, Fire Department, INL Training Services, Laboratory Protection, MFC, SMC, and TREAT are programmatically aligned with the BEA training program.

In 2013, the Team documented that BEA employees felt that they were trained beyond their scope of work especially for LO/TO and fire watch. This extent of training reflected management decisions to ensure enough employees were trained to support work activities and provide flexibility with work assignments. The BEA training services have recently begun a comprehensive review of BEA-wide training, asking SMEs to ensure training frequency and content is appropriate, and consolidate redundant training wherever possible. A decision tree was developed to assist SMEs in making these determinations.

The Laboratory-wide Training Review and Implementation Board (LTRIB) is chartered to oversee the review and implementation of all INL Laboratory-wide training courses and programs. The LTRIB reviews recommended training interventions; assists in defining the target audience, delivery methodology, and length of training; and coordinates laboratory-wide training.

The BEA training services use many types of training, including classroom and on-the-job training (OJT) by qualified instructors, Web-based training and DLA by qualified OJT instructors, and drills to develop or maintain response capability. Informal training consists of short meetings at job sites (tailgates), safety/security awareness meetings, and required reading. Training requirements for BEA employees are categorized into general employee training (e.g., Idaho General Employee Training), functional training (e.g., electrician), and facility-specific training (e.g., ATR electrician). An employee's line manager works with the training coordinator to develop and maintain an employee's individual training plans (ITP). Managers are required to review the ITPs for all employees on an annual basis in conjunction with the annual performance review process.

Management and conduct of training are supported using the Training Records and Information Network (TRAIN), Version 4.0. TRAIN provides all BEA employees with online access to reports, training plans, schedules, status, and history, which enables employees to monitor and maintain their training, facilitates the administration of training, and supports supervisor job assignment decisions.

Training coordinators receive weekly reports that identify employees in the coordinator's assigned organization that have training, administrative forms, and qualifications coming due. The report is divided into three sections that identify all items coming due in 30 days, 60 days, and 90 days. Training coordinators ensure that employees are notified of required training prior to the expiration date by scheduling courses, sending Web-based training links or administrative forms to employees for completion.

BEA's Training Department tracks several metrics associated with training, including required qualification percent expired (goal of less than or equal to, 1 percent), required qualification percent incomplete (goal of less than, or equal to, 10 percent), and no show rate (goal of less than, or equal, to 3 percent). The goals associated with expired or incomplete qualifications are being met; however, the no-show rate has steadily increased since April 2016 to 5.5 percent.

The training organization at MFC developed training for MFC personnel in the HPI principles presented in the Handbook (HDBK)-104, *Nuclear Safety Culture Pocket Guide*. The training consisted of group discussion, presentation of scenarios and use of HDBK-104 to present the components of a strong safety culture and apply HPI techniques. The goal of the training is to reduce errors, as well as to reduce the impact of any errors that do occur. Electronic audience feedback was also solicited at various times throughout the course to provide a baseline of responses. Managers were provided the results to identify areas of weakness and strengths so that improvements can be made. Use of the principles in the handbook is reinforced during new employee onboarding process, throughout the year in day-to-day work activities, all hands safety meetings, and training. A refresher course is currently being developed to be presented to all employees in November 2016.

BEA offers many training opportunities for development of managers and leaders through assessment, mentoring and coaching, special assignments and job rotation, peer and team learning, and classroom training. Classroom training includes License to Lead, Mandate to Manage, Frontline Leadership Fundamentals, and Advanced Leader-Manager Development Program.

The Team observed the final class of 13 participants for Mandate to Manage, a multi-day management development course designed to orient managers in their roles, responsibilities, resources, and tools for managing the Laboratory's business and resource. The course includes a half day presentation specific to occupational medicine, ISMS, Safe Conduct of Research, radiological protection, and other safety and health responsibilities. Prior to the start of the course, participants complete reading and a self-assessment and obtain a sponsor to assist class participants by reinforcing the concepts. Sponsors were observed attending the training with the class participants. It was evident from discussion during the class that the course was effective; participants learned not only from course material, but also from the co-workers during interactive portions of the course. One course participant shared his experience with management training by a previous employer consisting of being handed electronic discs of material to view. The individual expressed appreciation that BEA placed a high value on management training with high-quality, interactive courses, such as Mandate to Manage.

BEA participates in the LOSA, held at the Battelle corporate headquarters in Columbus, Ohio, with personnel from other Battelle laboratories across the country. LOSA is a 2-day leadership development opportunity for front-line supervisors and uses a fast-paced, simulation intensive approach that integrates training, case-study discussions, individualized feedback, and cross-laboratory networking. Managers meet with the attendees prior to the class to discuss Battelle's safety culture principles; and again after each class, to find out what attendees learned about themselves and provide support on personal development actions. Each class is limited to 20 individuals; over 100 individuals from BEA have attended LOSA.

BEA employees who have participated in LOSA have utilized the interactive training delivery methods from LOSA in others areas at the INL. An example of this is the use of DLA developed for the radiological technician quarterly requalification training that was initiated last year. The DLAs focus on worker technical competencies and the use of error prevention tools for a specific task to resolve problems in realistic working conditions. The DLA is performed as if the participants were executing an activity while faults, defects, or errors are introduced to challenge the participant's ability to perform the activity properly. The intent of the DLA is to provide participants and observers with opportunities to self-evaluate their application of knowledge, skills, and work practices or processes in a non-threatening environment. DLAs also allow transfer of knowledge from older, experienced employees to younger, less experienced staff. In addition to the radiological technician DLA, others observed by the Team included LO/TO, conduct of operations, and the ATR simulator. Lessons learned from across the complex, as well as those specific to the site, are utilized to ensure real-life scenarios are used for training opportunities.

Conclusion

Since the last review, efforts have been focused on documenting the training process in LWPs and training job aids. Additionally, a comprehensive review of laboratory-wide training is being undertaken to ensure frequency and content are appropriate, as well as focusing on eliminating redundant training. BEA uses DLAs to reinforce recognition of hazards that may be encountered and ensure employees are capable of acting in accordance with management expectations and approved procedures. INL meets the DOE-VPP expectations for the Safety and Health tenet.

VIII. CONCLUSIONS

Since 2013, the organizational culture at BEA has improved dramatically. Where personnel believed they were working safely in 2013 using their personal awareness and knowledge, there are now stronger systems in place for planning and conducting research activities that supplement that awareness and knowledge. Managers from the Laboratory Director down, have increased their visibility to the workforce, established their credibility by responding and correcting issues, and committing to investments in the INL infrastructure to support future missions. Employee engagement, always a strong element in the BEA safety culture, has improved as employees feel empowered to ask questions, pause or stop work, raise safety issues, and report problems. Managers and employees are collaborating to install effective engineered controls, develop and implement usable procedures and instructions that permit safe conduct of research, and ensure effective training. In order to address the steady or increasing trend of minor injuries, BEA should focus on applying more rigorous hazard identification, coupled with better hazard analysis, particularly for those tasks considered to be skill-based activities, and ensure identified controls address the likelihood of human error when applying those controls. In particular, BEA should ensure an iterative hazard analysis process for minor maintenance and skill-based work that identifies additional hazards introduced by standard or normally accepted work practices. The Team recommends that BEA at INL continue participation in DOE-VPP at the Star level.

APPENDIX A

Management

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