Pacific Northwest National Laboratory
Battelle Memorial Institute

Report from the Department of Energy
Voluntary Protection Program
Onsite Review
January 8-17, 2019

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 excellence can be encouraged and guided, but not standardized. 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 and employees. Requirements for the DOE-VPP participation are based on comprehensive management systems with employees actively involved in assessing, preventing, and controlling potential health and safety hazards at their sites. All contractors in the DOE complex, including production facilities, laboratories, and various subcontractors and support organizations, may participate in DOE-VPP.

However, 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 recognizing 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 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 Memorial Institute at the Pacific Northwest National Laboratory (PNNL) in Richland, Washington, conducted January 8-17, 2019, and provides the Associate Under Secretary for Environment, Health, Safety and Security with the necessary information to make the final decision regarding PNNL's continued participation in DOE-VPP.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AnovaWorks	AnovaWorks, PLLC
AU	Office of Environment, Health, Safety and Security
BLS	Bureau of Labor Statistics
Battelle	Battelle Memorial Institute
CBT	Computer-Based Training
CFR	Code of Federal Regulations
CNS	Communicator Notification System
CPP	Chemical Process Permit
CSM	Cognizant Space Manager
DART	Days Away, Restricted or Transferred
DOE	Department of Energy
DSOC	Directorate Safety and Operations Council
EHSS	Environment, Health, Safety and Security
ELM	Enterprise Learning Management
EPR	Electronic Prep and Risk
F&O	Facilities and Operations
FY	Fiscal Year
GERT	General Employee Radiation Training
HAMMER	Volpentest Hazardous Materials Management and Emergency Response Federal Training Center
HAS	Hazard Awareness Summary
HCL	Hazardous Chemical Level
HDI	How Do I?
HEPA	High Efficiency Particulate Air
IOPS	Integrated Operations System
ISMS	Integrated Safety Management System
JPP	Job Planning Package
LA	Lab Assist
LOSA	Laboratory Operations Supervisor Academy
LOTO	Lock-Out/Tag-Out
NAICS	North American Industry Classification System
OSHA	Occupational Safety and Health Administration
PCSD	Physical and Computational Sciences Directorate
PIC	Person-in-Charge
PNNL	Pacific Northwest National Laboratory
PNSO	Pacific Northwest Site Office
PPE	Personal Protective Equipment
PSB	Process Safety Board
S&H	Safety and Health
SCoR	Battelle Safe Conduct of Research
SME	Subject Matter Expert
SUL	Shallow Underground Laboratory
Team	Office of Environment, Health, Safety and Security DOE-VPP Team
TET	Travel Emergency Team
TGM	Technical Group Manager
TRC	Total Recordable Case
VPP	Voluntary Protection Program

VPPPA	Voluntary Protection Programs Participants' Association, Inc.
VR	Virtual Reality
WPC	Work Planning and Control

EXECUTIVE SUMMARY

The Department of Energy's (DOE) Voluntary Protection Program (VPP) Assessment Team (Team) from the Office of Environment, Health, Safety and Security (AU) recommends that Battelle Memorial Institute (Battelle)/Pacific Northwest National Laboratory (PNNL) continue to participate in DOE-VPP as a Star site. Battelle is the prime contractor for management and operation of PNNL. Battelle has operated PNNL for DOE and its predecessors since 1965. The Pacific Northwest Site Office (PNSO) oversees PNNL for DOE's Office of Science.

Located in Richland, Washington, PNNL is one of 10 DOE National Laboratories managed by DOE's Office of Science. PNNL entered DOE-VPP at the Star level in 2001. Continued participation requires a triennial onsite review by the Team to determine whether the applicant is performing at a level deserving DOE-VPP Star recognition. The Team conducted the onsite review of PNNL January 8-17, 2019. PNNL has approximately 4,000 staff members and a business volume of about $1 billion. At the main campus in Richland, Washington, PNNL manages a variety of laboratory facilities. PNNL also operates the Marine Research Operations Facility (including the Coastal Security Institute) in Sequim, Washington, and has satellite offices in Seattle and Tacoma, Washington; Portland, Oregon; and Washington, DC. Additionally, PNNL has personnel deployed around the globe conducting a variety of scientific and engineering missions.

PNNL managers have provided the policies, procedures, tools, and resources necessary to make continuing improvements in worker safety and health. They have established appropriate expectations for all personnel to follow and accept responsibility for safe conduct of research. PNNL has an excellent process for implementing changes that allows personnel time to adapt and accept those changes.

PNNL continues to provide multiple avenues for employees to raise safety and operational improvement concerns. PNNL strongly supports employee involvement through the Directorate Safety and Operations Councils (DSOC), VPP Steering Committee, wellness programs, and participation in the Voluntary Protection Programs Participants' Association, Inc.'s (VPPPA) regional and national conferences. The VPP Steering Committee created and maintains sub-committees to address special focus areas that have site-wide implications, such as pedestrian and traffic safety and most recently, the depression awareness sub-committee.

PNNL continues to improve its work control process. It is changing to a new system that will improve research activity review and approval. The PNNL Exposure Assessment Process is well documented in the industrial hygiene procedures.

PNNL continues to identify and mitigate hazards by the proactive use of the hierarchy of controls. PNNL is continuing its efforts to monitor and protect workers deployed to remote locations. The emergency management and the occupational medicine programs serve the needs of PNNL workers and facilities.

The Training Division continues to meet its expectation to provide training courses that ensures workers are properly trained to work safely and identify hazards, and to schedule and track training progress of PNNL staff. In 2016-17, PNNL upgraded its Enterprise Learning Management (ELM) system and experienced implementation issues that the Training Division immediately recognized and took steps to correct. PNNL added the Researcher Supervisor program to improve newly hired researcher's training and integration into PNNL.

Since the last DOE-VPP assessment in 2015, PNNL has made significant improvement in its safety and health performance. It has experienced almost a 50 percent reduction in total recordable case (TRC) rates, but a smaller (20 percent) decline in Days Away, Restricted or Transferred (DART) case rates. The ratio of TRC to DART rate falls outside the typical range and warrants investigation for further improvement.

Rather than fostering a culture that is risk-averse, PNNL is fostering a culture that is risk-aware and ensuring risks are understood, controlled, and accepted by the appropriate authority. PNNL uses events and incidents as learning opportunities, and expects all laboratory personnel to report incidents, accidents, and injuries. Personnel that stop work, ask questions, and identify potential concerns are recognized and rewarded for preventing incidents and accidents. The opportunities for improvement identified in this report should help PNNL continue its improvement trend.

TABLE 1
OPPORTUNITIES FOR IMPROVEMENT

Opportunity for Improvement	Page
PNNL should ensure DSOC cochairs' authority is clearly defined, and nonmanager cochairs have sufficient authority in the absence of the manager cochair.	**4**
PNNL should further analyze the statistical anomaly in the TRC rate and DART rate data to help identify further improvement.	**6**
PNNL should find more ways to identify at-risk behaviors and encourage personnel to intervene and interrupt those behaviors in a positive manner.	**7**
PNNL should document its successes with this approach and share it with other DOE-VPP participants, the rest of the DOE complex, and consider presenting its results at other conferences.	**7**
PNNL should evaluate best practices implemented by individual Directorates and establish better communications between the DSOCs to share those practices.	**9**
PNNL should consider updating the VPP Steering Committee charter (dated 2006) to ensure leadership roles and responsibilities are clear and allow for a designated management champion to help address employee-raised concerns, remove barriers, and identify funding to address those issues.	**9**

I. INTRODUCTION

Battelle is the prime contractor for management and operation of PNNL. Battelle has operated PNNL for DOE and its predecessors since 1965. The PNSO oversees PNNL for DOE's Office of Science.

Located in Richland, Washington, PNNL is one of 10 DOE National Laboratories managed by DOE's Office of Science. Funding for work at PNNL comes from a wide variety of sources, including DOE's Office of Science, the National Nuclear Security Administration, other Government Agencies, private industry, and academia.

PNNL:

- Provides the facilities, unique scientific equipment, and world-renowned scientists/engineers to strengthen the United States' scientific foundations for fundamental research and innovation;
- Prevents and counters acts of terrorism through applied research in information analysis, cyber security, and the nonproliferation of weapons of mass destruction;
- Increases the United States' energy capacity and reduces dependence on imported oil through research of hydrogen and biomass-based fuels; and
- Reduces the effects of energy generation and its use on the environment.

PNNL entered DOE-VPP at the Star level in 2001. Continued participation in DOE-VPP requires a triennial onsite review by the Team to determine whether the applicant is performing at a level deserving DOE-VPP Star recognition. The Team conducted the onsite review of PNNL January 8-17, 2019. The Team evaluated PNNL's safety programs against the provisions of DOE-VPP by observing daily work activities, evaluating safety documents and procedures, and conducting interviews to assess the strength and effectiveness of PNNL's health and safety programs.

Hazards associated with PNNL activities include potential radiological and chemical exposure, electrical hazards, elevated work, hoisting and rigging, and a multitude of other industrial hazards. Activities observed included: plan-of-the-day meetings, prejob briefings, dispatch work, planned work, construction activities, office work, research work, vendor operations, and maintenance work.

PNNL has approximately 4,000 staff members and a business volume of about $1 billion. At the main campus in Richland, Washington, PNNL manages a variety of laboratory facilities. For example, the William R. Wiley Environmental Molecular Sciences Laboratory, a DOE Office of Science national scientific user facility, is located on PNNL's Richland campus. Other facilities are the Biological Sciences Facility, the Computational Sciences Facility, the Applied Process Engineering Laboratory, the Radiochemical Processing Laboratory, the Research Aircraft Facility, and the Physical Sciences Laboratory. PNNL also operates the Marine Research Operations Facility (including the Coastal Security Institute) in Sequim, Washington, and has satellite offices in Seattle and Tacoma, Washington; Portland, Oregon; and Washington, DC. Additionally, PNNL has personnel deployed around the globe conducting a variety of scientific and engineering missions.

II. INJURY INCIDENCE/LOST WORKDAYS CASE RATE

Injury Incidence/Lost Workdays Case Rate (PNNL)					
Calendar Year	Hours Worked	Total Recordable Cases (TRC)	TRC Incidence Rate per 200,000 hours	DART* Cases	DART* Case Rate per 200,000 hours
2016	7,684,304	38	0.99	19	0.49
2017	7,767,439	28	0.72	17	0.44
2018	7,660,970	13	0.34	10	0.26
3-Year Totals	23,112,713	79	0.68	46	0.40
Bureau of Labor Statistics (BLS-2017) average for NAICS** Code #5417 Scientific research and development services			0.90		0.40
Injury Incidence/Lost Workdays Case Rate Subcontractors (PNNL Subcontractors)					
Calendar Year	Hours Worked	Total Recordable Cases (TRC)	TRC Incidence Rate per 200,000 hours	DART* Cases	DART* Case Rate per 200,000 hours
2016	107,738	1	1.85	1	1.85
2017	100,819	0	0.00	0	0.00
2018	32,791	0	0.00	0	0.00
3-Year Totals	241,348	1	0.88	1	0.88
Bureau of Labor Statistics (BLS-2017) average for NAICS** Code #5417 Scientific research and development services			0.90		0.40

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

TRC Incidence Rates, including subcontractors: 0.69
DART Case Rates, including subcontractors: 0.40

Discussion
PNNL has experienced 46 recordable cases in the 3 years since the last onsite VPP review. This resulted in a TRC rate of 0.69 and a DART rate of 0.40. Many of the more serious injuries were due to falls. The injury and illness log, first-aid cases, recordkeeping policies, and procedures were consistent with the OSHA or DOE recordkeeping requirements. The PNNL case manager participates in the investigation of injuries and illnesses, determines recordability, and maintains the log and supporting records. The case manager confirmed that senior managers support the

recordkeeping decisions and do not attempt to influence those decisions. Workers interviewed felt comfortable reporting injuries and illnesses, and the Team did not identify any incentives tied to injury or illness rates that would suppress or discourage reporting. PNNL meets the expectations for DOE-VPP participation.

III. MANAGEMENT LEADERSHIP

Management leadership is a key element of developing and sustaining an effective safety culture. The contractor must demonstrate a senior-level management commitment to exceeding occupational S&H requirements and meeting the expectations of DOE-VPP. Management systems for comprehensive planning must address health and safety requirements and initiatives. Elements of the management system include: (1) clearly communicated policies and goals; (2) clearly defined and assigned responsibilities and authority; (3) adequate resources; (4) accountability for both managers and workers; and (5) managers must be visible, accessible, and credible to employees. Authority and responsibility for employee health and safety must be integrated with the management system and must involve employees at all levels.

In 2015, PNNL managers demonstrated and led a strong safety program. They provided the necessary resources to incorporate safety at the beginning of a project rather than adding it to the project after it had been planned. PNNL managers understood, supported, and implemented Battelle's Operations Excellence and Simultaneous Excellence models as a necessary function that permitted appropriate risk management in research work.

Recently, several senior managers left PNNL to go to Los Alamos National Laboratory where Battelle is a partner on the winning team for that contract and others have retired. Although PNNL normally expects three to five percent turnover on an annual basis, it has recently experienced turnover rates around seven percent. Those vacant positions are currently filled by acting personnel. These acting managers have done an excellent job furthering PNNL's efforts to improve operations and continue making improvements to support PNNL's mission.

In one case, the retirement of managers left an unfilled void. The Physical and Computational Sciences Directorate (PCSD) DSOC has only one chairperson due to two recent retirements. Normally, a manager and a nonmanager cochair the DSOCs. The current chair believes he, as a researcher, has limited authority to make decisions regarding the DSOC activities. PNNL should ensure DSOC cochairs' authority is clearly defined, and nonmanager cochairs have sufficient authority in the absence of the manager cochair.

Opportunity for Improvement: PNNL should ensure DSOC cochairs' authority is clearly defined, and nonmanager cochairs have sufficient authority in the absence of the manager cochair.

PNNL provides the VPP Steering Committee with an annual budget ($131,000 for fiscal year (FY) 2018) that it uses for promotional activities, travel to conferences, labor costs, etc. Providing a budget at the beginning of the year, including both allowable and nonallowable funds, allows the VPP Steering Committee to plan for conference attendance, activities that encourage employee involvement, and other training and awareness campaigns that improve safety. If the VPP Steering Committee identifies needs that exceed the identified budget, PNNL managers have helped obtain additional funding when warranted.

PNNL participates in the Battelle Safe Conduct of Research (SCoR) effort. This approach, developed jointly among all the Battelle-managed laboratories, promotes formal operations in laboratory practices and ensures all research staff at PNNL understand that safety is foundational to good research. The SCoR principles identify: that everyone is personally responsible for safe operations, trust permeates the organization, a questioning attitude is cultivated, and there is

a healthy respect for what can go wrong; all of which directly influence behaviors. To further spread the SCoR philosophy, the Deputy Director for Operations has made resources available to produce videos and other training and promotional materials that emphasize SCoR throughout the laboratory.

Most recently, PNNL developed a SCoR video identifying lessons learned from a fire that occurred in a large fumehood in the Physical Sciences Laboratory. The fire did extensive damage to the research equipment, but the fumehood limited damage to the room. Although no one was injured, PNNL management realized this event could have been worse and committed to learning from it and improving its operations. PNNL convened an investigation and hired professional investigators to determine the origin and cause of the fire, identified previously unrecognized hazards from unattended operations, and implemented new engineered controls for experiments and equipment that use hazardous or flammable gasses. The investigation identified several improvements, and PNNL managers demonstrated an appropriate response that used the event as a learning opportunity.

Managers have also recognized and rewarded personnel that asked questions and stopped work when they believed a hazardous condition existed. During this assessment, a researcher noticed the relief valve on a liquid nitrogen dewar had been changed. He immediately notified his management chain, and PNNL took swift action to remove the dewar from service, investigate the changed relief valve, and performed an extent-of-condition review. The researcher was given a recognition certificate at the next DSOC meeting.

For many years, researchers have repeatedly complained about the complexity of performing work at PNNL. This complexity arises from the multifaceted nature of the work, the funding sources, and the hazards associated with the research. PNNL manages the work through a project structure, but much of the work at PNNL lends itself to management as a service rather than a specific project. Therefore, the Deputy Director for Operations is working with the laboratory senior management team to "de-convolute" the processes for managing projects and work at PNNL. Efforts include better definition and separation of project work from services work, ensuring work is appropriately authorized, and ensuring the processes for implementing integrated safety management match the needs of the personnel performing that work.

PNNL is rolling out a new *Lab Assist* (LA) process for work control that will better implement the core functions of integrated safety management for laboratory work. This process is more activity-centric rather than "space-based" and will give workers a more logical, linear process to define activities, identify and analyze hazards, and delineate the necessary controls (see Worksite Analysis). PNNL managers have supported this change to ensure worker involvement and consideration for the Laboratory's mission. PNSO has included milestones to implement the LA process in the PNNL Performance Evaluation Monitoring Plan used to determine PNNL's annual award fee, but during interviews, PNNL managers made it clear that they will not compromise quality of the process just to meet a fee-related milestone.

PNNL continues to effectively evaluate project risks through its Electronic Prep and Risk (EPR) process. This process allows managers to focus on higher risk projects and ensure the project implements appropriate mitigations. The EPR process categorizes the overall risks of a proposed project and defines risk levels that require review by the Process Safety Board (PSB). The PSB is composed of senior research and operations personnel that can determine whether the proposed risk mitigation strategies are acceptable.

PNNL managers implemented the "QuickStarter" process, initially making $250,000 available in up to $30,000 increments, for employee-identified proposals and improvements. These funds come from the Laboratory Directed Research and Development funds. Employees submit their improvement ideas to the QuickStarter process board. Personnel proposing ideas then can "market" their proposals to laboratory staff. PNNL staff are each given $200 in virtual dollars that they use to "vote" on ideas. Ideas that reach the threshold of support are funded, and the employee(s) that proposed the idea are allowed to lead the improvement. This process is an excellent method of stimulating employee innovation and involvement and has resulted in several improvements that reduced risks to workers and improved worker training for general employee radiation training (GERT) (see Safety and Health Training). The process has been so successful that PNNL increased the funding to $500,000 for FY 2019.

An event occurred in 2016 when two new personnel at PNNL were exposed to a toxic material (cyanogen bromide). These research personnel did not fully comprehend the limits of their qualifications, and one of them introduced the sample into an inappropriate analytical device. There were other contributing causes that made managers realize they needed more robust controls on new personnel to ensure those personnel did not compromise safety. To address this need, PNNL implemented a new role, the Research Supervisor, to supervise and train new research personnel in safe laboratory practices. The Technical Group Manager (TGM) may assign new personnel to a Research Supervisor. The Research Supervisor, or his or her delegate, is the ONLY person that can direct the laboratory activities of the new person while the new person is indoctrinated to the PNNL philosophy, expectations, and safety conduct of research principles. The Research Supervisor determines when that person no longer requires such close supervision and makes the recommendation to the TGM that the person is ready to "graduate" from the program. The TGM then makes the final determination. This process has helped PNNL improve new researchers' understanding of PNNL laboratory safety expectations and reduce new personnel errors.

The S&H management organization is service oriented, and managers emphasize to field-deployed personnel that their role is to help researchers accomplish their work compliantly, not simply identify problems and walk away. This has produced an excellent teaming culture in laboratory spaces between researchers, cognizant space managers (CSM), and deployed S&H personnel.

PNNL injury statistics have trended downward dramatically in the past 2 years. The drop in TRC case rates has been proportionally greater than the drop in the DART case rate. The TRC to DART ratio has historically been in the 2 or 3 to 1 range. However, in 2018, the ratio has been approximately 1.5:1. This anomaly could be significant as it might arise from several possible conditions leading to some underreporting of injuries. PNNL has identified some reluctance in reporting in areas other than safety, but has not identified any reluctance in reporting injuries. There might be segments of the population that are not reporting injuries they perceive as minor; and as the number of injuries has decreased, this segment may be more relevant to the overall number. Other potential causes for underreporting injuries may include perceived peer pressure, employees are too busy to report injuries, or employees are not recognizing a reportable injury has occurred (for example, a muscle strain). PNNL should look for means to analyze these data and use those results to drive further improvement.

Opportunity for Improvement: PNNL should further analyze the statistical anomaly in the TRC rate and DART rate data to help identify further improvement.

PNNL has made efforts in the past 3 years to raise awareness of at-risk behaviors. Managers, particularly operations managers, recognize that individual behaviors can have a dramatic effect on safety. For example, PNNL experienced two events at the Shallow Underground Laboratory (SUL). The investigation identified that some personnel were not following the SUL policies and procedures and were not open and honest about their actions. Those individuals were removed from the laboratory while personnel that were open about the errors remained in their positions as PNNL worked to improve the culture in that laboratory. This action demonstrated PNNL's willingness to use errors as learning opportunities, but not accept a coverup or actions that could put other personnel at risk.

At-risk behaviors continue to be evident both in research spaces and in public areas, such as sidewalks, crosswalks, and stairwells. For example, housekeeping in laboratories is a direct, visible indication of the culture of the people working in those laboratories, and the managers that supervise and manage them. PNNL should find more ways to identify at-risk behaviors and encourage personnel to intervene and interrupt those behaviors in a positive manner. Techniques to consider might include more managers modeling good behavior, more frequent and visible manager presence in laboratories, and site-wide campaigns to observe and correct at-risk behaviors.

Opportunity for Improvement: PNNL should find more ways to identify at-risk behaviors and encourage personnel to intervene and interrupt those behaviors in a positive manner.

PNNL has implemented the Prosci® change management approach. This approach uses people certified by Prosci® in the ADKAR® model (Awareness, Desire, Knowledge, Ability, Reinforcement™) and has proven effective. A certified individual acts as an internal change management consultant who helps organizations develop change management plans. To date, this process is being successfully used to facilitate the change in work planning and control (Lab Assist). PNNL should document its successes with this approach and share it with other DOE-VPP participants, the rest of the DOE complex, and consider presenting its results at other conferences.

Opportunity for Improvement: PNNL should document its successes with this approach and share it with other DOE-VPP participants, the rest of the DOE complex, and consider presenting its results at other conferences.

Conclusion

PNNL managers have provided the policies, procedures, tools, and resources necessary to make continuing improvements in worker S&H. They have established appropriate expectations for all personnel to follow and accept responsibility for safe conduct of research. PNNL has adopted an excellent model for implementing changes that ensures personnel affected by the change quickly adapt and accept those changes. PNNL managers should continue looking for "small signals," such as the TRC to DART comparison, to identify additional opportunities for improvement as well as continuing to encourage individual interactions that identify and interrupt at-risk behaviors. PNNL demonstrates the Management Leadership expectations for continued participation in DOE-VPP.

IV. EMPLOYEE INVOLVEMENT

Employees at all levels must be involved in structuring and operating the safety and health program. Employee involvement is a major pillar of a strong safety culture in addition to the right to notify managers of hazardous conditions and practices. Managers and employees must work together to establish an environment of trust where employees understand that their involvement adds value, is crucial, and is welcome. Managers must be proactive in recognizing and rewarding workers for their contributions. Employees and managers must communicate and collaborate in open forums to discuss continuing improvements, recognize and resolve issues, and learn from their experiences.

In 2015, PNNL provided multiple avenues for employees to submit concerns. PNNL's support for employee involvement in safety committees, community outreach, wellness programs, VPP regional and national activities, and the Hanford Safety Expo was strong. PNNL had an extensive employee recognition program. It had not yet achieved the employee participation it desired for telework and was reevaluating the program and approach. Slightly increasing accident injury rates indicated that PNNL should refocus employees' attention on routine safety, health, and operational excellence.

PNNL employees and managers' communications at all levels continue to promote a safe and healthy work environment. Employees raise safety concerns to their managers, safety committees, or the 375-2400 Single Point-of-Contact phone number without fear of retribution. This includes both managers and employees stopping work without fear of retaliation.

PNNL continues to use the DSOCs as the primary safety committees for each Directorate. The DSOCs address operational improvements, as well as employee-raised safety issues. DSOC meeting minutes and issue tracking documents include examples of employee involvement and suggestions to address safety concerns. Instances include employees' concerns for improved traffic safety, particularly on George Washington Way, which PNNL managers have elevated to the city of Richland to address. In another example of good communication, Facilities and Operations (F&O) managers sought workers' involvement to address multiple hand lacerations in the building 350 shop. F&O managers and the industrial hygiene subject matter expert (SME) gathered the F&O work crew together and asked them to evaluate multiple types of cut-resistant/puncture-resistant gloves. The F&O work crew voted on the types of gloves they preferred. F&O managers accepted their recommendations and purchased those gloves.

Each DSOC functions independently, leading to some variations in the efficacy of DSOCs. For example, the Operational Systems Directorate DSOC had good attendance, addressed issues, and members were engaged. The PCSD DSOC had some areas where it could improve. The PCSD DSOC in Physical Sciences has experienced a drop in participation at the meetings, and two of the three chairs recently retired. This condition put additional strain on the remaining chair to lead the DSOC while the Directorate looked for new management chairs.

The DSOCs have implemented good approaches to address issues. In one case, the PCSD cochair felt the greatest risk was short-term researchers operating in PCSD laboratories. Short-term researchers are limited-term employees and guest researchers operating at the laboratory for a limited period of time. They can be experienced laboratory researchers, generally from university laboratories, but may not fully understand or comply with the PNNL safety expectations. To address this concern, the PSCD cochair initiated bimonthly safety meetings

that focused on those safety concerns. The safety meetings directly addressed the primary hazards associated with limited-term researchers. The meetings improved laboratory safety and helped implement the PNNL SCoR approach at the PCSD.

In a second case, a newly hired manager at Building 325 brought a good laboratory safety practice from his previous experience at the Hanford site. The manager recognized that laboratory housekeeping needed improvement and introduced the laboratory glovebox/hood/hot cell housekeeping checklist from his previous position. The checklist outlined proper housekeeping expectations. Managers, SMEs, and other personnel perform quarterly walkdowns that include the housekeeping checklist. They document the results and assign corrective actions for each space evaluated. Workers stated that these reviews improved laboratory space housekeeping. Both of these practices, implemented by separate DSOCs, demonstrate improvements but have not been shared with other Directorates. PNNL should evaluate best practices implemented by individual Directorates and establish better communication between the DSOCs to share those practices.

Opportunity for Improvement: PNNL should evaluate best practices implemented by individual Directorates and establish better communication between the DSOCs to share those practices.

PNNL continues to support multiple avenues for employees to submit concerns. Options include submitting anonymous concerns through the PNNL employee concerns Web site, submitting a written concern to a manager, calling a hotline, or sending an e-mail. In addition to anonymous avenues, employees can discuss any issue with their supervisors, contact the Hanford Atomic Metal Trades Council safety representative (both bargaining and nonbargaining employees), or contact the VPP Steering Committee representatives or DSOC members.

The PNNL VPP effort is led by a VPP Steering Committee that includes researchers, bargaining unit employees, and a dedicated staff lead. PNNL continues to send VPP Steering Committee members to the regional and National VPPPA conferences. Conference attendees include representatives from the Environment, Health, Safety and Security (EHSS) Directorate, scientists, technicians, and craft employees.

There is some confusion regarding the VPP Steering Committee's leadership roles and responsibilities. The VPP Steering Committee charter does not provide for participating managers to have a representative vote in any committee proceedings. PNNL should consider updating the VPP Steering Committee charter (dated 2006) to ensure leadership roles and responsibilities are clear and allow for a designated management champion to help address employee-raised concerns, remove barriers, and identify funding to address those issues.

Opportunity for Improvement: PNNL should consider updating the VPP Steering Committee charter (dated 2006) to ensure leadership roles and responsibilities are clear and allow for a designated management champion to help address employee-raised concerns, remove barriers, and identify funding to address those issues.

The PNNL VPP Steering Committee meets monthly and includes both bargaining and nonbargaining employees. The VPP Steering Committee is an informational resource that supports the VPP tenets and helps solve issues. The VPP Steering Committee publishes a

monthly newsletter, supports open forums for employees to discuss issues, participates in evaluations and outreach to other DOE sites to share S&H information, and mentors other sites considering applying for VPP participation. The VPP Steering Committee established several topical sub-committees, such as depression awareness, parking lot and bike path safety, and other hazard-specific committees that resolve site-wide issues using Employee Involvement.

PNNL conducts VPP Safety and Operations Mixers. These mixers provide opportunities for staff to raise awareness of safety culture, share best practices, and interact with safety and operations SMEs. Initially, PNNL only invited interns and newly hired personnel to these mixers, but recently opened them up for all staff to help everyone gain a better understanding of PNNL's safety culture. The mixers use survey feedback from participants and attendees to help the VPP Steering Committee members understand what resonates with staff and identify opportunities to improve the experience.

PNNL has other programs that foster team building and community outreach, which contribute to employee involvement. *Life@PNNL* is a program developed by PNNL that fosters employee community and outreach at the laboratory. Recreational activities, laboratory-wide events, staff-driven trips, clubs, and employee resource groups improve internal communications, team work, and offer networking opportunities. VPP activities are often coordinated or partnered with the *Life@PNNL* activities. Team Battelle is another program that offers employees opportunities to perform charity and outreach in the community. These programs create opportunities for employees to interact outside the work environment, and establish a stronger sense of community.

The monthly *Porcelain Press* newsletter continues to be one of the most read and recognized safety shares at PNNL as noted in the Operational Excellence Culture Survey. Strategically posted in facility restrooms and online, the *Porcelain Press* shares timely and pertinent safety, security, sustainability, and wellness information with staff on a monthly basis.

PNNL maintains a program that notifies employees about emerging events, such as inclement weather, emergency events, or other instances requiring worker knowledge. The process has been expanded to allow temporary staff to receive notifications as well (see Hazard Prevention and Control).

Conclusion

PNNL continues to provide multiple avenues for employees to raise safety and operational improvement concerns. PNNL strongly supports employee involvement through the DSOCs, VPP Steering Committee, wellness programs, and VPPPA regional and national conferences. The VPP Steering Committee created and maintains sub-committees to address special focus areas that have site-wide implications, such as pedestrian and traffic safety and, most recently, the depression awareness sub-committee. The VPP Committees' Safety and Operations Mixer has been a great success in improving workers' (new and experienced) understanding of PNNL. PNNL meets the DOE-VPP expectations for the Employee Involvement tenet.

V. WORKSITE ANALYSIS

Management of health and safety programs must begin with a thorough understanding of hazards that might be encountered during the course of work and the ability to recognize and control any 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 systematic approach to controlling hazards. The results of the analysis must be used in subsequent work planning efforts. Strong 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 also involves implementing preventive and/or mitigating measures during work planning to anticipate and minimize the impact of hazards.

In 2015, PNNL had improved its work control process by understanding the hazards through analysis. The Integrated Operations System (IOPS) approach to work control for laboratories proactively analyzed the hazards for activities performed within each facility and laboratory. It also confirmed that the majority of the laboratory work was within the skill of the researchers. While a few minor observations regarding some laboratory housekeeping issues and some ambiguity in the specificity of personal protective equipment (PPE) recommendations related to appropriate glove use for hydrofluoric acid were noted, most researchers were aware of the hazards present within their laboratories and understood the analysis that derived the controls required to perform safe operations. Site-wide, wireless networking increased the use of electronic access to IOPS, hazard analysis, controls, and other electronic documents for CSM and researcher use. Although there was a rise in the injury rates, PNNL was analyzing ergonomic hazards and providing solutions to reduce joint and body stresses.

For many years, PNNL has integrated multiple processes under its IOPS to identify hazards and develop controls. IOPS is a robust but complex system that provides user tools to CSMs, researchers, SMEs, and managers. IOPS provides workspace hazard identification, worker hazard interaction, laboratory access control/authorization, hazard communication and tailored hazard control information, training and worker qualification verification, and a tailored process to conduct self-assessments. IOPS is a "space-based" work planning and hazard control system used to define a *routine operating envelope* for a designated laboratory area. Higher hazard work requires permits that communicate tailored controls as prescribed by SMEs, such as S&H professionals.

In 2016, PNNL initiated an effort to strengthen the alignment of activities, hazards, and people within laboratory spaces by reviewing the current approach to laboratory work planning and control (WPC). PNNL also looked at other WPC approaches used in other Battelle-managed laboratories. This initiative resulted in a completely different approach to WPC for research and laboratory work.

During this assessment, PNNL was methodically phasing in its new WPC system called *Lab Assist* (LA). LA is a system that is activity-based in contrast to the space-based (IOPS) system it currently uses. PNNL decided to replace IOPS based on two primary considerations: several incidents that had occurred and the growing belief among researchers that the 20-year old IOPS system was not interactive enough (i.e., too time-intensive to use) and had reached the end of its service life.

PNNL employed several methods to ensure and promote the success of the LA program development and implementation. PNNL solicited employee feedback during the phased implementation and chose laboratory and research activities that were the best fit and candidates to test this new system. Because PNNL recognized this approach was a significant departure from the previous system, it engaged its inhouse change management specialist to employ the Prosci® method and are treating the effort as a project (see Management Leadership).

PNNL has defined roles for research personnel. The positions and their roles include:

- Activity Lead - the individual responsible for the activity, generally the principal investigator;

- Research Supervisor - the individual responsible for providing direct supervision and oversight of a researcher who does not have a demonstrated level of skill, expertise, and understanding of PNNL's core expectations for laboratory safety to work unsupervised; and

- CSM - responsible for maintaining the safety envelope of a given space, understand the interaction between activities in the space, and authorize work within that space.

Under this new LA mentoring program, research supervisors are assigned to new laboratory users to ensure they can safely perform work and learn PNNL's laboratory practices, processes, and policies. When both the TGM and Research Supervisor believe that a person can perform laboratory activities unsupervised, then that individual advances to the next phase. Graduation happens when the objectives for that activity are met. There is no predetermined time for completing this portion of the program. That decision is solely based on the TGM and Research Supervisor's recommendation. New researchers and their mentors, using a function built into the LA program, can determine if they are trained and approved to perform work before it is assigned.

As described in the 2015 evaluation observations, the laboratory spaces visited by the Team had a hazard awareness summary (HAS) posted on the outside of the laboratory entrance. The HAS, an IOPS required document, references other hazard analysis and control documents, such as a Chemical Process Permit (CPP). It also lists the hazards allowed in the laboratory that includes biological, chemical, and others. Some laboratory HAS postings had the most significant hazards marked on the form with highlighters; other laboratory HAS postings were multi-page documents that require that the reader turn pages to review the entire document. The utility of the printed HAS is limited and serves only as a basic reminder. The HAS is printed from IOPS and relies on embedded links to provide further hazard information, but that functionality is missing from a posted hardcopy of the summary. PNNL is retaining the HAS in LA, and the functionality will not change.

The General-Chemical work control document in "How Do I" (HDI), PNNL's Web-based portal for identifying requirements, is still used to provide information and controls for the use of chemicals. The process includes a graded assessment of chemical hazards that assigns hazardous chemical levels (HCL) of 1, 2, and 3. An HCL-3 is the highest risk level and requires a CPP that establishes specific chemical controls (i.e., quantity and/or concentration limits, expected PPE and/or engineered controls) prior to working with the chemical. CPPs are listed as links in the HAS posted at each laboratory.

The 2015 VPP onsite evaluation report noted that PNNL was making improvements to its exposure assessments based on discussions with the DOE Site office. Worker S&H replaced the workplace exposure assessment, which relied more on professional judgement, to determine exposures from potential hazards. The new exposure assessment report emphasized documented exposure assessments and data gathering. This approach built a better technical basis for exposure estimates that could be applied to similar exposure groups and exposure banding.

The PNNL Exposure Assessment Process is integrated with the CPP and documented in the industrial hygiene procedures. The process begins when a CPP is requested. Industrial hygiene uses a qualitative assessment process to consider the quantity, location, work methods, exposure risks, and chemical effects to determine the need for sampling and identify controls. The assessment is documented in an online system that is easily retrieved and connected to the IOPS Hazard Summary applicable to the space and task. The Team observed one laboratory preparing glass that had containers of approximately 2 liters of concentrated hydrofluoric acid. The CPP linked to the exposure assessment and the exposure assessment identified specific controls for the work, including the appropriate type of gloves to protect workers and actions in the event of an exposure. The Exposure Assessment Process had previously reviewed the activity and provided a documented hazard analysis basis. Therefore, no industrial hygiene sampling or monitoring was performed or necessary.

For F&O, PNNL continues to use ADM-016, *Work Control Procedure*, to analyze the work hazards involved with facility operations, maintenance-related services, and construction projects. It incorporates the tenets of Integrated Safety Management. The current two categories of F&O work are defined below:

1. Dispatch: Work performed by PNNL. The work hazards are identified and mitigated by utilizing controls found in HDI or IOPS. Controls include skill-of-the-craft, hot work permits, zero energy checks, Lock-Out/Tag-Out (LOTO), etc.; or

2. Planned work: Work that does not meet dispatch criteria and where two or more hazard controls must complement each other (interdependent) or be sequenced to safely mitigate the hazard of the work. It requires a job planning package (JPP) assembled by the planner, building engineer, or construction engineer with a clear scope, hazards and controls, details to perform the work, and supporting documentation.

All F&O goods and services initiate with a service request in the Electronic Service Request in Maximo®. The Sequim Campus utilizes an alternate process approved for use by the Plant Operations Manager. A Triage Manager performs an initial risk-based screen. Using a graded approach consistent with the risk from the work type and scope, service requests are categorized as Dispatch or Planned work. Both dispatched and planned work activities consider the effect of the work on the functionality and effectiveness of facility safety systems, alarms, and equipment. The work planning process recognizes that maintenance work can impact or negatively affect facilities' S&H systems and require actions to adequately mitigate these impacts. For instance, alternate means of notification must be utilized if alarms are disabled or are inaudible due to high noise from work activities. Similarly, when facility eyewash stations are in maintenance mode, temporary portable eyewash stations are required by the work planning procedure.

For dispatched work, the Person-in-Charge (PIC) reviews the activity description and scope of work to ensure adequate information has been provided to perform the work and obtains any

necessary permits. The PIC also verifies that the staff has completed necessary training and decides on the level of prejob briefings required. Complex, mixed-hazard work can use this less rigorous dispatch work process to perform subtasks to support more hazardous planned work described below.

Planned work uses the more rigorous process documented in ADM-016. Like the PIC for dispatch work, a trained planner triages work and prepares a JPP. Planners use a combination of review checklists, experience, knowledge, and training to create a JPP. Following the extensive guidance from ADM-016, Attachment 3, planners prepare a JPP using input from the Facility Core Team staff. The planner selects a review team using a *JPP Review Checklist* and a procedural table based on the Safety-Significant Structures, Systems, and Components equipment category designation, when applicable. Depending on the type and hazards of the work, the review team can include craft workers, work team leads, SMEs, building engineers, system engineers, and building managers. SMEs are available and engaged in helping define hazards and identify controls. The planner and review team members conduct job walkdowns for planned work. Approximately 20,000 dispatch and planned jobs are conducted annually.

At the time of this review, a Facility Management Improvement Initiative was in progress. The initiative includes a review and revision to ADM-016, including the planning screening criteria. A new category of lower hazard "skill-of-the-craft" work has been proposed to be included in this initiative. Preventative Maintenance procedures, Standard Operating Procedures, and Standard Maintenance Procedures are used for some repetitive and routine maintenance work.

The injury and illness case manager, a registered nurse by profession and being new to OSHA injury and illness recordkeeping, formed a Recordkeeping Community of Practice group to build a case review network and improve recordablity decisionmaking consistency. To date, 15 DOE sites/facilities participate in monthly meetings, including the Idaho National Laboratory, Los Alamos National Laboratory, and contractors at the Hanford Site.

Conclusion

PNNL continues to improve its work control process. While some implementation problems are anticipated as PNNL transitions from IOPS to LA, the proposed intentional and methodical approach will facilitate a successful outcome. The PNNL Exposure Assessment Process is well documented in the industrial hygiene procedures. Formation of the Recordkeeping Community of Practice represents the spirit of community and outreach expected within DOE-VPP. PNNL continues to improve the analysis of its hazards to meet the expectations of Worksite Analysis for continued participation in DOE-VPP.

VI. HAZARD PREVENTION AND CONTROL

The third and fourth core functions of an 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 controlled using engineered controls, administrative controls, or PPE. Equipment maintenance processes must comply with requirements and emergency preparedness. 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, reduce the frequency of, and lower the severity of mishaps.

In 2015, PNNL was pursuing improvements that strengthened its hazard controls and invested in those controls. The emergency management and the occupational medicine programs had been adapted and improved to better support PNNL employees.

PNNL continues to invest in and support the implementation of engineering controls throughout its facilities. Engineered controls, such as ventilated fumehoods and gloveboxes, are commonly used for hazardous work. SMEs work with laboratory researchers to perform ergonomic workplace evaluations. As a result, laboratory workstation ergonomics have been improved by the use of floor mats to reduce worker fatigue, computer workstation desks and keyboards, as well as ergonomic chairs and benches.

Workplace walkdowns identified numerous examples of the use of engineered controls. For example, one F&O machine shop uses large sheet metal stock material. The material is stored flat on horizontal storage racks. Currently, two workers climb ladders and manually slide the sheets out of the elevated racks. While attending a metalworking conference offsite, the shop supervisor identified a vendor that had a sheet metal storage and retrieval system. The equipment eliminated the need for workers to manually handle the materials while standing on ladders. The storage rack design uses removable storage shelves with forklift tine pockets. As a result of the supervisor's recommendation, workers will use a forklift to access the material by lowering removable storage racks. Once on the ground, a vacuum-lifting fixture will lift and move the material using the same forklift. This equipment eliminates the hazards from falling off a ladder while manually handling the large, awkward sheet material and the hazard from manually handling metal stock. PNNL has approved the purchase of the necessary equipment and expects to complete the project in the next few months.

The same machine shop recognized a hazard associated with one of its belt sanders. The 5-inch-wide belt on a vertical belt sander was exposed for approximately 20 inches. Only a small section of the belt was needed for normal work. A custom adjustable sanding belt guard was designed, fabricated, and installed over the unused part of the belt. A safety professional reviewed and accepted the equipment modification to ensure it did not introduce any additional hazards and adequately protected workers. The guard protects workers from inadvertent contact with the exposed portion of the belt.

Another engineered control was used to mitigate lifting hazards. Workers and their supervisor collaborated to identify a commercially available lifting table to use during high efficiency particulate air (HEPA) filter change outs. Workers were susceptible to injury from manually lifting and moving 100-pound HEPA filters. The lifting table allows the filters to be pulled from their frames directly on to the tables and moved, eliminating the need for manual lifting.

Other examples of engineered controls include the use of laboratory door access locks to prevent unauthorized entry by untrained personnel and auto-dialers to alert researchers when unattended experiments have excursions outside of established parameters. In addition, equipment has double start switches. There is also secondary containment for liquid waste storage areas, and the shipping and receiving warehouse.

PNNL implemented a unique approach to safety in a laser laboratory. Laser equipment in the laser laboratory is installed at waist height and there is only one chair for the scientist. By having no additional chairs present, personnel cannot sit and be at the same height as the laser equipment. This precaution helps prevent any eye damage from lasers.

Workers were observed demonstrating their support of the PNNL safety program. During a routine interview with an SME, the Team witnessed two employees outside that were obviously not F&O employees specifically assigned to spread ice melt. The employees took the initiative to spread ice melt on sidewalks and crosswalks to address icing conditions.

PNNL uses administrative controls and PPE to protect workers. Administrative controls include the use of permits, such as LOTO, chemical, energized work permits, and a work control system that tracks who are trained to perform work in specific laboratories. PPE is required and described in the various analysis processes and identified in the workers' training. Workers were aware of and complied with PPE requirements. In one laboratory, workers described that their previous laboratory coats were not suited for a wet-chemistry environment. At the time the concern was expressed, the S&H representative was new to the facility and was unsure of the process to resolve employee safety concerns through the established channels, but that has changed with experience. Laboratory workers were not hesitant to raise the issue and were persistent until the issue was resolved adequately.

The PNNL Emergency Management Plan provides an overview of the emergency management program for laboratory-managed facilities at the PNNL site, the Hanford site, Sequim, and Richland. PNNL established the program to meet DOE Order 151.1D, *Comprehensive Emergency Management System,* as well as Federal and State regulations. PNNL performs multiple drills each year ranging from tabletop exercises, fire drills, and evacuations, to full participation exercises. Interviews with emergency management personnel demonstrated a proactive approach to the emergency management program and the methods used to meet the program's expectations.

In accordance with PNNL internal procedures, the emergency management program performed several drills of various types in 2018, based on the facility and its emergency management requirements. For any building containing greater than 11 occupants, a tabletop drill has to be conducted. In addition, every building conducts an evacuation drill, and the entire campus participates in an annual exercise.

In previous years, PNNL has been successful in communicating various emergency and nonemergency events with the Communicator Notification System (CNS). The system sends different notification types based on the user's request, which can include e-mail, smart device, and desktop computer. This program has been successful in notifying personnel for any changing conditions. However, the CNS program was only beneficial to PNNL staff. To fix this issue, PNNL has created a CNS system for visitors, who now can receive the same notifications

while visiting campus. This will be beneficial to both the visitors, staff, and responding agencies.

Due to the physical location of the PNNL campus, the City of Richland's Fire Department and Police Department responds in an emergency. The departments are physically located off campus, which can lead to them being uninformed of the hazards, chemicals, or any other facility issue. The PNNL emergency management program works closely with the Richland Fire Department to ensure the department's familiarity with PNNL emergency management program requirements and potential facility hazards. PNNL has delivered facility maps, hazardous facility information documents, and other background information to both departments to keep them aware of the any changes. In addition, PNNL will be creating Quick Reference Guides, which will further communicate information that would be valuable and beneficial for both departments.

In 2015, the Team highlighted the emergency management program's implementation of several new and innovative plans to address the continual challenges associated with government operations and ensure hazards at PNNL remain appropriately controlled during a government shutdown. PNNL's *Government Shutdown Plan* outlines a detailed "process" (not checklist) for addressing the challenges with a government shutdown. The plan provides a method to evaluate the current rules and regulations so that PNNL managers have the necessary information available to make informed decisions. The plan addresses the steps associated with facility shutdowns and personnel who are essential to operate facilities with radiological significance that cannot be "turned off."

PNNL continues to fund, maintain, and use the 10-year-old travel emergency team (TET) program. The TET provides emergency response support to any PNNL staff on official travel who are involved in an emergency or disaster experience. The TET includes SMEs in specialties that equip them to effectively evaluate and address emerging situations. TET SMEs are prepared to arrange for personnel extractions, medical treatment, language translations, financial difficulties, and to ensure clients' intellectual and physical property are protected in challenging travel situations. In addition, PNNL continues to use the commercial program/service *Stabilitas Ventures* that provides real-time tracking of personnel across the globe, systematically analyzes developing geographical, political, and disaster issues, and synchronizes that information with the location of employees to alert and maintain communications with those employees to ensure their safety. This service allows PNNL TET SMEs to communicate directly with foreign-based or on-travel employees to alert them of global upset situations. The service enhances PNNL staff member' safety and, if necessary, provides a "geo-fence" that identifies safe and "no go" zones in and around an employee's specific location. For example, the TET was recently notified of travelers near the vicinity of an explosion in Paris. The names of the workers were relayed to the manager, who contacted the travelers to see if they were okay. Although all of them were unaffected, this program is beneficial to personnel that are travelling.

As in 2015, the Team interviewed the radiation protection manager, observed technicians performing routine surveys, and toured radiation facilities at PNNL. Most of PNNL's radiochemistry work is in the Radiochemical Processing Laboratory. The Team observed good housekeeping practices, suitable radiation contamination control procedures, and laboratory access controls that satisfy the intent of title 10, Code of Federal Regulations (CFR), part 835, *Occupational Radiation Protection (10 CFR 835)*. The *Radiological Control Program Description*, and the DOE-approved *Radiation Protection Program Description –*

Implementation Plan for 10 CFR 835 document the PNNL radiation protection program. Certified health physics professionals support the program. The PNNL radiation control program establishes annual goals. The Radiation Control manager provides quarterly Metric Performance Reports to senior management and the PNSO. This report provides a review of radiological performance metrics and indicators at PNNL over the past calendar quarter. The report includes evaluation of the Radiation Protection Program Risk Profile, completed 10 CFR 835 functional element assessments, including identified critical controls, radiological problem report tracking/trending data, As Low As Reasonably Achievable performance indicators, and other metric data. It also provides an opportunity to identify any radiological performance issues and respective trends across a broad spectrum within PNNL. The program metrics are used to support decision about the program's effectiveness and establish a current risk/performance profile.

The comprehensive PNNL Occupational Medicine Program is documented in *PNNL Occupational Medical Program Description.* By contract, AnovaWorks, PLLC (AnovaWorks) provides occupational medical services. AnovaWorks tailors its services to the needs of the PNNL workforce and provides all occupational medical exams, foreign travel consultations, injury/illness care, work restriction reviews, return-to-work evaluations, and seasonal flu shots. AnovaWorks continues to provide personal health services to all PNNL employees. These services include: free wellness checks, health education and counseling, immunizations, treatment for minor injuries and skin conditions, acute/minor illness checks, and self-limited illnesses and conditions. These clinic visits are free-of-charge for all PNNL staff. AnovaWorks also provides foreign travel employees the prescriptions for any medicine required during foreign travel and any required immunizations. Occupational medicine professionals regularly attend safety meeting and visit workplaces. A 33 percent increase in procurement of automated external defibrillators is one indication that the occupational medicine is well supported.

Conclusion

PNNL continues to identify and mitigate hazards by the proactive use of the hierarchy of controls. PNNL is continuing its efforts to monitor and protect workers deployed to remote locations and recently had to test its plans to respond to challenges during government shutdowns. The emergency management and the occupational medicine programs serve the needs of PNNL workers and facilities. PNNL continues to meet the Hazard Prevention and Control expectations for continued participation in DOE-VPP.

VII. SAFETY AND HEALTH TRAINING

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

In 2015, PNNL's training function had moved to the EHSS Division from the Human Resources Division to align with the organization's health and safety core. A review of the training material eliminated redundancies, improved course material, and saved over $500,000. The Training Division tracked training, and administered Web-based training courses. ELM interfaced with several other PNNL systems to efficiently manage PNNL training requirements. PNNL provided specialized training, such as Laboratory Operations Leadership Academy and LOSA, to expand manager skills. They were also developing a new course, Research Operations Supervisors Academy, to focus on research operations.

In 2015 the Training Division used the PeopleSoft® ELM system to track training, administer Web-based training courses, and interface with several other PNNL systems, including the Access Control Enterprise System, Identity Credential and Access Management, Computer Access Request System, Job Evaluation and Training System, Medical Surveillance Tool, and IOPS. The course catalog function of ELM provided course details, such as course abstract, creation date, minor update date, major revision date, duration, retrain requirements, prerequisites and mandate document, target audience, delivery method, as well as schedules for upcoming classroom courses for training that was administered through the department.

In 2016-17, Oracle informed PNNL that they would no longer support the heavily customized version of PeopleSoft® ELM in use by the PNNL training organization and recommended PNNL convert to the latest PeopleSoft® ELM version 9.2. While assured that the transition would be smooth, the training organization experienced multiple complications in the training program's database. Some of the issues involved errors with personnel training records, indications of training not performed, and personnel-completed training not registering in the system as performed. The training organization recognized the errors immediately and took steps to ensure the errors were immediately resolved. The training group informed the Directorates of the potential for errors and they assigned additional schedulers to the F&O group to ensure workers' training profiles were corrected in a timely manner to ensure workers were not prevented from performing work they were qualified to perform. The training group leaders believe the bulk of the system errors have been corrected and the system will function as designed within the next year with less intervention required.

The newly hired PNNL Training Division Manager is dedicated to improve training by eliminating redundant training, improving quality of training, and focusing on incorporating the values and expectations of training into the training course during development. The team provided the training manager with points-of-contact at the Volpentest Hazardous Materials Management and Emergency Response (HAMMER) Federal Training Center facility that recently developed an innovative program that evaluates training inefficiencies automatically and recommends alternatives. The Training Division Manager intends to evaluate the program to determine if it would improve the PNNL training program. In addition, the Training Division Manager is considering creating a "hybrid" training program that includes using experienced craftspeople as part-time instructors to save money and add experience to classroom lectures.

As in 2015, staff who perform, supervise, or manage activities at PNNL are qualified to perform their assigned responsibilities based on education, experience, and training. PNNL identifies training requirements for each staff member, combining required courses with other job-specific, project-specific, staff development and agreed-upon training. Training occurs in several formats: classroom, computer-based training (CBT), Web-based, and on-the-job training. In addition, the Training Division has established space for practicals for radiation worker training, a CBT training room, and a new LOTO (electric and pressure) training room in the Research Operations Building. A Virtual Reality (VR) GERT simulation project was developed (from the QuickStarter program) and is in the pilot stage. The pilot training class is informative and has the potential for greater retention of the course information through the innovative technology. By using VR, the training is learned through visual memory versus conventional CBT. Staff developed and proposed the project and won approval from the QuickStarter review board, which funded the development of the pilot.

On the 1st and 15th of each month, the ELM system sends notifications to all staff for past due and currently due (due by the end of the month or not yet taken) classes. Upcoming classroom training notifications are sent up to 60 days prior to the retrain date. The system also sends notifications to all managers when individuals have past-due training.

PNNL added the Researcher Supervisor program to improve newly hired researchers' understanding of expectations of proper laboratory safety and work conduct at PNNL. Newly hired researchers are assigned a research supervisor who mentors and guides them through PNNL safety values and expectations. PNNL has established roles, responsibilities, authorities, and accountabilities for research supervisors and has a process in place to ensure the new researchers are properly indoctrinated prior to graduation from the process.

Conclusion

The Training Division continues to meet its expectation to provide a cadre of training courses that ensure workers are properly trained to work safely, identify hazards, and to schedule and track training progress of PNNL staff. In 2016-17, PNNL upgraded from its highly customized ELM system to the latest ELM revision and experienced implementation issues that the training group immediately recognized and took steps to correct. PNNL added the Researcher Supervisor program to improve newly hired researchers' understanding of expectations of proper laboratory safety and work conduct at the PNNL. PNNL meets the DOE-VPP expectations for the Safety and Health tenet.

VIII. CONCLUSIONS

Since the last DOE-VPP assessment in 2015, PNNL has made significant improvement in its S&H performance. It has experienced almost a 50 percent reduction in TRC rates, but only a 20 percent decline in DART case rates. This anomaly warrants investigation for additional improvement opportunities. In 2016, PNNL began a major shift in how it plans and authorizes research work, which is in the early stages of implementation. Preliminary feedback has been positive. Combined with the effect the SCoR focus has had since it began prior to the 2015 assessment, these efforts are changing the culture of PNNL for the better. Researchers are working with S&H personnel to ensure safety processes enhance the research and are not viewed by researchers as barriers to good science. Rather than fostering a culture that is risk-averse, PNNL is fostering a culture that is risk-aware, and ensuring risks are understood and controlled. PNNL uses events and incidents as learning opportunities, and expects all laboratory personnel to report incidents, accidents, and injuries. Personnel that stop work, ask questions, and identify potential concerns are recognized and rewarded for preventing incidents and accidents. The opportunities for improvement identified in this report should help PNNL continue its improvement trend. The Team recommends that PNNL continue participating in DOE-VPP as a Star site.

Appendix A: Onsite VPP Assessment Team Roster

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