Battelle
Pacific Northwest National Laboratory Recertification

Report from the DOE
Voluntary Protection Program
Onsite Review
October 15-25, 2007

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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. DOE-VPP closely parallels the Occupational Safety and Health Administration (OSHA) VPP, which was established by OSHA in 1982 and has demonstrated that cooperative action among Government, industry, and labor can achieve excellence in worker health and safety. The Office of Health, Safety and Security (HSS) assumed responsibility for DOE-VPP in October 2006.

DOE-VPP outlines areas where DOE contractors and subcontractors can comply with DOE Orders and OSHA Standards while also "stretching for excellence." DOE-VPP emphasizes systematic and creative approaches involving cooperative efforts of everyone in the contractor or subcontractor workforce at DOE sites, including contractor managers and workers.

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 designed to apply to all contractors in the DOE complex and encompasses production facilities, research and development operations, and various subcontractors and support organizations.

DOE contractors are not required to apply for participation in DOE-VPP. In keeping with OSHA's VPP philosophy, participation is strictly voluntary. Additionally, participants may withdraw from the program at any time.

DOE-VPP consists of three programs, which are based on and similar to those in OSHA's VPP. These programs are Star, Merit, and Demonstration. The Star program is the core of DOE-VPP, and its achievement indicates truly outstanding protectors of employee safety and health. The Merit program is a steppingstone for contractors and subcontractors that have good safety and health programs, but need time and DOE guidance to achieve Star status. The Demonstration program is expected to be used rarely; it exists to allow DOE to recognize achievements in unusual situations about which DOE needs to learn more before determining approval requirements for the Star program.

By approving an applicant for participation in DOE-VPP, DOE recognizes that the applicant is meeting, at a minimum, the basic elements of ongoing, systematic protection of employees at the site. The symbols of this recognition are DOE-provided certificates of approval and the right to fly the VPP flags (e.g., VPP Star flag for sites with Star status). The participant may also choose to use the DOE-VPP logo on letterhead or on award items for employee incentive programs. Further, each approved site will have a designated DOE staff person to handle information and assistance requests from DOE contractors, and DOE will work cooperatively with the contractors to resolve health and safety problems.

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ABBREVIATIONS AND ACRONYMS

AED	Automated External Defibrillator
ALARA	As Low As Reasonably Achievable
AMH	Advance Med Hanford
CAP	Corrective Action Plan
CPP	Chemical Process Permit
CPR	Cardiopulmonary Resuscitation
CSM	Cognizant Space Manager
DART	Days Away, Restricted, or Transferred
DOE	U.S. Department of Energy
DZAC	Director Zero Accident Council
EJTA	Employee Job Task Analysis
EMSL	Environmental Molecular Sciences Laboratory
EPR	Electronic Prep & Risk
ES&H	Environment, Safety, and Health
F&O	Facilities and Operations Directorate
HAMMER	Hazardous Materials Management and Emergency Response
HAMTC	Hanford Atomic Metal Trades Council
HAS	Hazard Awareness Summary
HPI	Human Performance Improvement
HSS	Office of Health, Safety and Security
IOPS	Integrated Operations System
MRO	Marine Research Operations
MSL	Marine Science Laboratory
NMR	Nuclear Magnetic Resonance
OSHA	U.S. Department of Labor's Occupational Safety and Health Administration
PHLSC	PNNL/HAMTC Laboratory Safety Committee
PM	Preventive Maintenance
PNNL	Pacific Northwest National Laboratory
POD	Plan of the Day
PPE	Personal Protective Equipment
R&D	Research and Development
SBMS	Standards Based Management System
SHIMS	Safety and Health Information Management System
SOS	Safety, Operations, and Security
STOP	Safety Through Observation Program
TGM	Technical Group Manager
VPP	Voluntary Protection Program

EXECUTIVE SUMMARY

The Pacific Northwest National Laboratory (PNNL) submitted its application for U.S. Department of Energy (DOE) Voluntary Protection Program (VPP) consideration in October 2000. The project was awarded DOE-VPP Star status in 2001 and recertified in 2004.

Continuation of Star status in the DOE-VPP program requires an onsite review by the DOE Office of Health, Safety and Security (HSS) DOE-VPP team (Team) every 3 years. The Team conducted its review October 15-25, 2007, to determine whether PNNL continues to perform at a level deserving DOE-VPP Star recognition. This report documents the results of the Team review and provides the Chief Health, Safety and Security Officer with the necessary information to make the final decision about PNNL's DOE-VPP status.

All personnel who were interviewed at PNNL expressed a clear commitment to the safety and health of every worker at PNNL. Most personnel contacted by the Team have extensive experience at PNNL, many having been there for 20 years or more. PNNL has long fostered a strong procedural compliance culture, and this culture remains intact. Resources for health and safety incentives, while apparently available and adequate, have not been consistently used to reward desired behavior, particularly in the Research and Development (R&D) Directorates.

Generally, work continues to be performed safely in accordance with DOE Orders and Regulations. PNNL accident and injury rates are well below the average for their comparison industry. A notable decrease occurred between 2004 and 2005, when, following a Class B accident, aggressive actions were taken by the Facilities and Operations (F&O) Directorate to address shortfalls and change the safety culture. These actions have been particularly successful in the F&O Division and provide a model for the other Directorates to follow. The R&D Directorates, which represent approximately 90 percent of Laboratory personnel, have not been as successful in fostering increased safety awareness and encouraging workers to take an active role in recommending and developing safety improvements. Consequently, while accident and injury statistics for the R&D Directorates have remained low, they have shown little improvement. Additionally, a recent investigation by the Office of Enforcement resulted in a Preliminary Notice of Violation for eight violations of DOE Radiological Safety and Quality Assurance regulations, and a proposed fine of $288,750 that was statutorily waived. The events revealed some broader weaknesses in the Laboratory safety culture. Corrective actions for the events leading to the investigation were in progress.

The Team is recommending that PNNL be placed in a Conditional Star status while addressing the necessary improvements for the Management Leadership tenet of DOE-VPP. Opportunities for improvement are also identified in the other four tenets. As part of this recommendation, HSS is committed to providing assistance to PNNL in keeping with the partnership relationship established by DOE-VPP participation, as well as conducting another site visit within the next 12 months to gauge improvements.

TABLE 1
OPPORTUNITIES FOR IMPROVEMENT

Opportunity for Improvement	Page
PNNL should examine options to revitalize and/or enhance its safety awareness program to encourage workers across the Laboratory to participate in the safety program; actions might include a safety incentives program that rewards desired behaviors to promote safety improvement and a culture of safety excellence.	4
PNNL should consider revising the CSM processes and procedures to institutionalize more frequent meetings and forums, reestablish a CSM Steering Committee, encourage information exchange between work groups and R&D Directorates, and establish broader, more frequent recognition of CSMs for safety and work practice improvements.	5
PNNL should consider coordinating the efforts of the various safety committees/councils through a single point of contact and should encourage formal documentation of meeting minutes and dissemination across the Laboratory.	5
PNNL should reevaluate the availability of safety professionals and ensure adequate expertise is available at MRO.	6
PNNL senior managers should revisit the Quantum Leap initiative, disseminate the results to all levels of management across the Laboratory, and either pursue timely incorporation of the programs detailed therein or communicate detailed reasons for recommendations not adopted.	7
PNNL senior managers should use the current recordable injury case rate as the new benchmark from which to drive numbers to zero.	8
PNNL should consider modifying the Safety DiaLog to show both the date the suggestion was submitted and the response date. For open concerns, include an interim response with a target completion date to show that action is being taken.	10
PNNL should revisit the composition of the VPP Steering Committee and ensure that it better represents the composition of PNNL.	11
PNNL should ensure that the VPP Steering Committee has an active role in developing a safety improvement plan for the Laboratory.	11
PNNL should ensure that the contractor preliminary hazard assessments and the worker safety and health assessments are compared and cross-checked, and that affected parties, including CSM, communicate and fully understand the associated hazards.	14

PNNL senior managers and CSMs should ensure high expectations for hazard analyses associated with laboratory work are consistently understood and met.	16
PNNL should consider improving the safety and housekeeping assessment.	16
PNNL should provide incentives to encourage broader use of the ergonomics Web site for proper equipment positioning and encourage managers to discuss ergonomic issues with employees.	18
PNNL should emphasize the use and applicability of PPE when required. If the environment does not require PPE, the applicability in the area should be adjusted commensurate with the hazard.	22
PNNL should review, revise as required, approve, and implement the fire impairment procedure to ensure that all building occupants and users are aware of impairments and necessary actions.	22
PNNL should identify and implement an effective means of recognizing and communicating safety improvements throughout the Laboratory.	22
PNNL should review the training and controls associated with passive access to hazards and ensure that workers can protect themselves in the event of abnormal or upset conditions before they are granted unescorted access to spaces.	25

I. INTRODUCTION

The U.S. Department of Energy (DOE) Voluntary Protection Program (VPP) onsite review of Battelle Pacific Northwest National Laboratory (PNNL) at the Hanford Site was conducted October 15-25, 2007. Battelle Memorial Institute is the prime contractor for management and operation of the Laboratory. Battelle has operated PNNL for DOE and its predecessors since 1965. A unique feature of Battelle's contract with DOE allows PNNL staff to perform projects for private industry. The DOE Pacific Northwest Site Office provides oversight of Battelle.

Located in Richland, Washington, PNNL is one of DOE's 10 National Laboratories. Managed by DOE's Office of Science, PNNL also performs research for other DOE offices, as well as Government Agencies, universities, and industry to deliver breakthrough science and technology to meet today's key national needs. PNNL:

- Provides the facilities, unique scientific equipment, and world-renowned scientists/engineers to strengthen U.S. 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 U.S. energy capacity and reduces dependence on imported oil through research of hydrogen and biomass-based fuels; and
- Reduces the effects of energy generation and use on the environment.

PNNL currently has approximately 4,200 staff members and a business volume of $750 million. At the main campus in Richland, Washington, PNNL has a variety of laboratory facilities. For example, the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), a DOE Office of Science national scientific user facility, is located on PNNL's Richland campus. PNNL also operates a marine research facility in Sequim, Washington, and has satellite offices in Seattle and Tacoma, Washington; Portland, Oregon; and Washington, D.C. Additionally, PNNL has personnel deployed around the globe conducting a large variety of scientific and engineering missions.

Recognition in DOE-VPP requires an onsite review by the Office of Health, Safety and Security (HSS) DOE-VPP team (Team) to determine whether the applicant is performing at a level deserving DOE-VPP Star recognition. The Team evaluated PNNL safety programs against the provisions of DOE-VPP. During the site visit, the Team observed activities, evaluated relevant safety documents and procedures, and conducted interviews to assess the strength and effectiveness of PNNL health and safety programs.

The Team had contact with over 250 employees, managers, and supervisors, either formally or during observation of field activities. Hazards associated with PNNL activities include potential radiological contamination, potential chemical exposure associated with various activities, electrical hazards, elevated work, hoisting and rigging, and a multitude of other standard industrial hazards. Activities observed included plan-of-the–day (POD) meetings, pre-job briefings, dispatch work, planned work, construction activities, office work, research work, vendor operations, and maintenance work.

II. INJURY INCIDENCE/LOST WORKDAYS CASE RATE

The team conducted a review of the Occupational Safety and Health Administration (OSHA) 300 logs. The tables below summarize the OSHA reportable data both for PNNL employees and for subcontractors supporting PNNL.

Pacific Northwest National Laboratory (PNNL)
INJURY INCIDENCE / LOST WORKDAYS CASE RATE

Injury Incidence / Lost Workdays Case Rate (PNNL employees only)					
Calendar Year	Hours Worked	Total Recordable Cases	Total Recordable Case Incidence Rate	DART* Cases	DART Case Rate
2004	6,905,504	39	1.13	19	0.55
2005	7,083,350	40	1.13	15	0.42
2006	7,210,493	28	0.78	11	0.31
3-Year Total	21,199,347	107	1.01	45	0.42
Injury Incidence / Lost Workdays Case Rate (subcontractors only)					
Calendar Year	Hours Worked	Total Recordable Cases	Total Recordable Case Incidence Rate	DART Cases	DART Case Rate
2004	51,530	0	0.00	0	0.00
2005	53,951	0	0.00	0	0.00
2006	50,403	0	0.00	0	0.00
3-Year Total	155,884	0	0.00	0	0.00
Injury Incidence / Lost Workdays Case Rate (including subcontractors)					
Calendar Year	Hours Worked	Total Recordable Cases	Total Recordable Case Incidence Rate	DART Cases	DART Case Rate
2004	6,957,034	39	1.12	19	0.55
2005	7,137,301	40	1.12	15	0.42
2006	7,260,896	28	0.77	11	0.30
3-Year Total	21,355,231	107	1.00	45	0.42
Bureau of Labor Statistics (BLS-2005) average for NAICS Code # 5417			Total cases 3yr avg. >1,000 employees 1.3 All employers 1.7		Total cases 3yr avg. >1,000 employees 0.5 All employers 0.8

*Days Away, Restricted, or Transferred

Conclusions

PNNL injury rates are below the averages for the comparable industry and meet the criteria for continued participation in DOE-VPP at the Star level.

III. MANAGEMENT LEADERSHIP

Management leadership is a key element of obtaining and sustaining 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. 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. Elements of that management system must include clearly communicated policies and goals, clear definition and appropriate assignment of responsibility and authority, adequate resources, and accountability for both managers and workers. Finally, managers must be visible, accessible, and credible to employees.

PNNL is committed to safe, secure, environmentally conscious, and compliant operations. PNNL relies on well-integrated processes and tools to implement that policy, ensuring that hazards are identified and mitigated and work is performed safely. During interviews and discussions with the managers, from the Laboratory Director down through the directorates, all personnel expressed a clear commitment to the safety and health of every member of the organization.

PNNL uses web-based information technology to both catalogue the myriad of requirements and push them to the bench top. The Standards Based Management System (SBMS) contains the requirements, processes, procedures, and work practices necessary to safely and efficiently perform work throughout the Laboratory. This system is used by PNNL as a storefront for all Laboratory-level requirements. SBMS provides a method of both computerized information management and delivery. The Integrated Operations System (IOPS) is designed to provide bench-level risk management controls throughout the facility to ensure properly trained workers/researchers in spaces that have been adequately assessed with respect to environment, safety, and health (ES&H) hazards. The key IOPS processes identify and communicate hazards, control access, detail worker hazard interaction, specify tailored hazard controls, verify worker qualifications, provide for tailored self-assessment and corrective action management, and establish notification and reporting means for management oversight. The IOPS system interfaces with and links to SBMS. Other electronic tools are available to both research and development (R&D) and Facilities and Operations (F&O) managers to facilitate safe and comprehensive work planning.

Interviews throughout the workforce revealed a level of frustration with the information technology infrastructure (SBMS and IOPS) and its ability to push the requirements to the bench top and keep workers safe. Management has developed some additional electronic tools to address these concerns. The “How Do I” initiative is under way and is expected to field an umbrella information technology architecture within 3-5 years to fully automate the development of work practices and procedures documents. While personnel expect this initiative to address many of the concerns about using the existing systems, PNNL must ensure that responsibility and accountability for incorporating all of the requirements into work practices and procedures remain with the line managers and staff who perform work, and not transferred to the computer software.

Senior managers have recently undertaken several initiatives to improve operational excellence across the Laboratory. Examples include Human Performance Improvement (HPI) training for all F&O Division staff, including members of the bargaining unit, Dupont Safety Leadership training for all managers, the DuPont Safety Through Observation Program (STOP) training for managers of bargaining unit staff, and the Safety, Operations, and Security (SOS) refresher training for immediate managers. The Laboratory leadership recognizes the challenge and is committed to taking the steps necessary to achieve the intended improvements.

Managers have used other methods to gauge the work environment across PNNL. For example, the Gallup Q^{12} survey has been used to assess workplace engagement annually. A review of the results rolled up across the Laboratory since 2001 revealed that staff engagement at PNNL, while higher than the U.S. working population (39 percent compared to 28 percent), is average (in the 48^{th} percentile) compared to the Gallup database and has not significantly changed in the past 3 years. Managers were generally pleased that the survey did not show a decrease in workplace engagement, citing a number of organizational stressors, such as contract uncertainty and a recent major reorganization. Senior managers indicated they expected the survey results to be used at the work group level to generate discussions on how to improve in a specific area. A review of the data revealed that those groups that did use previous Gallup results recorded on average much higher levels of engagement during the latest survey. Other performance data is available in many subject areas within the PNNL data management systems. For example, information is collected with regard to hazard assessments, injuries and illnesses, at-risk behaviors (STOP program), ergonomics, electrical issues, contractor performance, VPP performance, accident investigations, occurrence reporting, vehicle accidents, beryllium sampling, and professional development.

Most managers indicated that safety was a key performance element in the staff development review program; however, with the exception of the F&O Directorate and the Marine Research Operations (MRO) in the Environment and Energy Directorate, managers did not provide specific information regarding the steps taken to influence employee behavior or encourage employees to pursue safety excellence. Even in the F&O Directorate, the incentives program is geared toward rewarding the final results; e.g., having a lunch provided when they have no first aid cases or recordable injuries within that quarter instead of rewarding the desired behaviors that would achieve those results. Most managers indicated that they talked with the employees and encouraged them to increase their awareness, but did not identify any specific actions that were implemented to improve that awareness.

Opportunity for Improvement: PNNL should examine options to revitalize and/or enhance its safety awareness program to encourage workers across the Laboratory to participate in the safety program; actions might include a safety incentives program that rewards desired behaviors to promote safety improvement and a culture of safety excellence.

In the F&O Directorate, weekly safety meetings, daily safety topics at POD meetings, and pre-job safety walkdowns are institutionalized methods that management uses to promote safety and exchange of information. R&D organizations used different approached. When asked to detail methods for exchange of information between work groups, including sharing good ideas with respect to work practices between lab spaces, R&D managers pointed to semiannual meetings of

cognizant space managers (CSMs). A CSM Steering Committee was used in the past but is no longer active. The CSM of the year award at the EMSL provides recognition for the most outstanding CSM. R&D managers did not point to any other specific instances of special recognition or reward given to a CSM for a safety improvement and/or incorporating a better work practice.

Opportunity for Improvement: PNNL should consider revising the CSM processes and procedures to institutionalize more frequent meetings and forums, reestablish a CSM Steering Committee, encourage information exchange between work groups and R&D Directorates, and establish broader, more frequent recognition of CSMs for safety and work practice improvements.

Currently, there are many committees in addition to the PNNL VPP Steering Committee that contribute to safety programs at PNNL. For example, the F&O Directorate has a Director Zero Accident Council (DZAC). There is also a PNNL/Hanford Atomic Metal Trades Council (HAMTC) Laboratory Safety Committee (PHLSC), and an IOPS Steering Committee. Additionally, there are Safety Committees for Management Systems, such as: as-low-as-reasonably-achievable (ALARA), electrical safety, and IOPS administrators, and Building-specific Safety Committees, such as IOPS Building Safety Committees and the Independent Review Committee. With the exception of DZAC, senior management participation in these committees has been infrequent. While not specifically required, senior manager participation in these committees on a regular basis could help senior managers better understand issues and recommendations raised by these committees, as well as better demonstrate managers' commitment to safety excellence. Additionally, senior managers may be able to better coordinate and identify redundant efforts being made by the different committees.

A monthly Safety Council, chaired by Worker Safety and Health with representation from the directorates at the division head level, is convened to address agenda items selected by the chairman. Although the Council does not keep formal records or minutes and does not report actions and decisions to any level of management, it has been responsible for some significant safety efforts at PNNL. For example, the Council recently identified and supported laboratory workers' participation in the Hazardous Materials Management and Emergency Response (HAMMER) training facility's driving safety class.

Opportunity for Improvement: PNNL should consider coordinating the efforts of the various safety committees/councils through a single point of contact and should encourage formal documentation of meeting minutes and dissemination across the Laboratory.

Interviews and observations of the workforce throughout the site indicate a particularly effective approach used by the F&O Directorate to promote the safety culture. F&O employs all the bargaining unit workers at PNNL, as well as a significant portion of exempt administrative, support, and engineering staff. This Directorate is responsible for all infrastructure, building maintenance and services, and operations. F&O was responsible for most of the accidents and injuries that occurred at PNNL in 2004. At that time, after a worker was injured when he fell from a cart and broke his leg, PNNL performed a Type B investigation of the accident that led to

major changes in the Directorate's processes. Since that time, F&O managers and workers have combined their efforts to proactively identify and remove safety hazards and risks. The F&O Director formed DZAC, which has representation from every work group within F&O and the radiological control organization. The council meets monthly in a scheduled 2-hour meeting that serves as a forum for raising and discussing safety issues and corrective action status, and provides valuable information that the representatives take back to their individual work groups. All managers within F&O are expected to attend the meeting. The interactions between F&O managers and their staff, the support for DZAC, and the overall proactive leadership style within F&O, with respect to safety, provide a model that other directorates within PNNL should consider emulating.

Resources for safety and health compliance are adequate across the Laboratory. CSMs uniformly state that they have access to their facility safety representatives or other safety subject matter experts. There is a staff of over 20 industrial hygienists and industrial safety experts, as well as a large staff of radiological control technicians and radiological engineers. An exception to this observation is the MRO in Sequim, Washington, which is located several hundred miles from the main Laboratory campus and does not have a resident safety professional or industrial hygienist permanently assigned. The MRO Radiation Safety Officer acts as the local worker safety and health resource, and there is a certified safety professional/certified industrial hygienist that travels from Richland to Sequim. That person is also available via phone or e-mail. Personnel interviewed at MRO believed an onsite safety professional would better support their needs. Although an onsite safety professional has been requested for the past 2 years, resources to provide this expertise locally for MRO have not been provided. All the safety experts encountered by the Team were experienced, well qualified, and dedicated to performing their jobs well and ensuring that workers are protected.

Opportunity for Improvement: PNNL should reevaluate the availability of safety professionals and ensure adequate expertise is available at MRO.

PNNL has a VPP Steering Committee that fulfills essential roles in assessing and guiding PNNL's safety program (see Section IV, Employee Involvement). This steering committee has primary responsibility for conducting PNNL's annual VPP self-assessment. The 2007 VPP Self-Assessment, published in February 2007, identified four key issues that the Laboratory needed to address:

- Management priorities and allocation of resources for safety culture improvements are not adequate across much of the Laboratory;
- Staff participation in the safety program is declining, and recognition of staff contributions to safety at PNNL is less than desired;
- Processes to assure subcontractor/vendor safety and compliance with safety requirements are not yet at the desired level; and
- The values and beliefs of some individuals (including managers) are not aligned with the safety values and standards of Battelle and PNNL, including the belief that "all accidents are preventable."

The 2006 VPP self-assessment identified similar (though not identical) issues. These issues were entered into the Laboratory Assessment Tracking System. The corrective actions detailed several items for managers, but the actions were not specific. For example, actions included:

- Encourage strong management support for employee participation in safety-related activities, management leading and supporting safety communications, and emphasis initiatives;
- Encourage managers to regularly visit the workplace and perform activity observations;
- Management must visibly create a "just" culture that values reporting of safety issues;
- PNNL managers and staff need to recognize, understand, and appreciate the importance of employee participation in activities related to improving safety culture; and
- Immediate managers need to provide rewards, recognition, and acknowledge the value of [staff] involvement.

The actions were closed on October 14, 2007, based on implementation of a new vision, model, and expectations for management. Most of the emphasis for that new model was based on strong expectations for performing activity observations by managers. The closure basis also identified that continuing attention on this matter was needed. All managers have been directed by senior management toward more activity-based assessments to replace conventional space-based assessments. The newer activity-based assessments by managers have the potential to provide a wealth of information that managers can use to more proactively identify risk reduction opportunities, but this process needs time and attention to realize that potential.

Senior F&O and Environment, Safety Health & Quality (ES&H) managers regularly attend and participate in the VPP Steering committee meetings; however, the Committee needs more support from senior R&D managers, who do not typically attend the VPP Steering Committee meetings. When asked to address the specific issues raised in the 2007 evaluation, some R&D managers either had not seen or heard the issues, or disagreed with the statements. Some R&D managers did not provide specific information on how these issues had been or were to be addressed. The Deputy Laboratory Director for Operations and the ES&H director developed a "Quantum Leap Safety Strategy" initiative to address desired safety improvements and the issues addressed in the 2007 VPP assessment. The Quantum Leap implementing committee began its work in February 2007 and submitted its report in early June 2007. Recommendations from the committee included the creation of a Lab-wide Zero Accident Council, continuing the 24/7 Safety Initiative and HPI, a wellness campaign, implementation of a safety rewards and incentive program, and development of a strategic communication plan. There has been some progress on most of these recommendations. The Lab-wide Zero Accident Council has not been formed, and the safety rewards and incentive program has not been initiated. Responsibility for continued implementation of these efforts has not been clearly assigned, and none of the managers interviewed mentioned the Quantum Leap initiative or its findings.

Opportunity for Improvement: PNNL senior managers should revisit the Quantum Leap initiative, disseminate the results to all levels of management across the Laboratory, and either pursue timely incorporation of the programs detailed therein or communicate detailed reasons for recommendations not adopted.

Most managers did not provide examples of specific instances where rewards or recognition was given to specific employees for safety culture improvement efforts. Similarly, employees contacted during the inspection could not identify rewards or recognition for safety culture improvements. Most managers who were interviewed indicated that their actions to encourage and lead safety improvement were by e-mail messages to their staff, safety topics at the beginning of meetings, and general encouragement to be aware of conditions.

PNNL has established specific, aggressive goals for days away from work and recordable injury case rates that are well below industry averages. Managers identified "situational awareness" as the primary contributor to the minor injuries that do occur, but did not identify any specific actions that were implemented to improve that awareness. Moreover, managers did not recognize that since 2004, when a Class B accident prompted the actions in the F&O Directorate that significantly reduced recordable cases, that there has been limited improvement in the statistics for R&D organizations.

Opportunity for Improvement: PNNL senior managers should use the current recordable injury case rate as the new benchmark from which to drive numbers to zero.

An event at the Radiochemical Processing Laboratory in December 2006 and a leaking sealed source that resulted in offsite contamination event in June 2007 prompted an investigation by the HSS Office of Enforcement. The investigation report identified a number of deficiencies in laboratory management and supervision that contributed to these events. Observations by the Team in laboratories throughout PNNL indicate that the behaviors and conditions preceding the radiological events exist elsewhere in the Laboratory. Other nonnuclear events have occurred in laboratories, such as small chemical explosions, chemical spills, and electrical safety violations that did not result in significant injuries. These nonnuclear conditions and associated behaviors are not covered by title 10, Code of Federal Regulations, part 830 (10 C.F.R. 30) and 10 C.F.R. 835 regulations. Therefore, these conditions were not highlighted by the Office of Enforcement report. The PNNL RPL/414 Corrective Action Plan (CAP) does, however, address all aspects of research work planning and control, including nonnuclear aspects of the causes and issues identified in the RPL/414 CAP Root Cause Analysis and Extent of Condition evaluation. PNNL intends to perform an Effectiveness Review during fiscal year 2008 to demonstrate that the actions have been deployed as intended and were effective across the Laboratory.

Conclusions

Injury and illness rates at PNNL are lower than industry averages. Management leadership in pursuit of safety excellence varies across PNNL Directorates; it is especially strong within the F&O Directorate, but additional emphasis is needed among R&D Directorates. Senior management has recognized the need to change the culture across the Laboratory and has put measures in place that, if coordinated and followed through, should instill the requisite commitment at all levels of management and should result in the necessary improvements.

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 participation is in addition to the individual right to notify appropriate managers of hazardous conditions and practices. Field observations and interviews indicate that PNNL workers remain committed to their personal safety, as well as the safety of their coworkers and plant visitors.

PNNL encourages staff to become involved in the safety and health programs at the Laboratory to the extent that they are motivated to do so. Involvement comes in many forms, from individuals taking personal responsibility for their own safety to leading major Laboratory-level safety initiatives. Staff members are routinely involved in the decision processes that affect their work, such as hazard analysis, accident investigation, safety and health training, self-assessments, program evaluations, and problem resolution.

Employees at all levels believe that a positive and safe work environment exists at PNNL, and they indicated that they are comfortable raising safety and health concerns to their supervisors and managers. Employees also indicated that they participate in the resolution of the concerns they raise. Employees in the bargaining unit feel that barriers to communication to and from management are minimal. Interviewed employees regarded communications as mostly effective. Workers were candid and showed no fear in talking with the Team during interviews. All employees indicated that they understood their rights and responsibilities and were very knowledgeable about their responsibilities regarding safety and health. Employees also indicated that they were responsible for their own safety.

Few employees contacted by the Team expressed their responsibility for looking out for their coworkers' safety. For example, some workers were observed not wearing appropriate personal protective equipment (PPE); i.e., safety glasses. Their coworkers did not remind them of the PPE requirements. Moreover, some researchers were either not involved in or were unaware of other workers' benchtop safety practices within their lab spaces. For example, a post-doctoral researcher who was interviewed at his workstation was not aware of a potential toxic gas hazard associated with another project being conducted at another workstation within the laboratory, and he did not know what actions to take if exposed to the hazard.

PNNL expects all CSMs to conduct self-assessments of their assigned spaces on a scheduled basis (typically quarterly). Additionally, senior managers indicated that they are expected to conduct activity-based assessments in each of their assigned spaces twice a year. Reports of those assessments showed that the managers and CSMs were satisfied that management expectations were being met in the labs. Contrary to these assessments, the Team found poor housekeeping in several lab spaces, indicating either that workers do not adequately maintain the laboratories or that managers do not set high expectations. For example, in one lab, several large tools were stacked atop a mechanic's toolcart directly in front of the glass door of the walk-in fume hood that houses the lab's hydrogen generator and assorted hoses. If the tools were knocked off the cart, they are large enough to break the glass door.

PNNL has implemented a computerized tool, the Safety DiaLog, to register and track safety concerns raised by employees and help staff members assist in resolving safety suggestions and improve the safety culture at the lab. Employees felt empowered to voice safety concerns and were generally aware of the tools available to raise and report safety concerns, suggestions, and issues. Not all employees are familiar with the Safety DiaLog initiative, although it works for those who elect to use it. Employees who were familiar with this initiative felt that it was easier and just as effective to raise concerns verbally and directly to their first line supervisor; they were clearly confident that their supervisors and managers would address concerns in a timely and acceptable manner. Although staff at the Marine Science Laboratory (MSL) facility were not familiar with the Safety DiaLog initiative, employee interviews clearly demonstrated that they were very comfortable bringing any safety and health issue, concern, or suggestion to their immediate supervisor, the safety representative, and the facility manager. Generally, employees feel that the safety culture at PNNL supports an open-door policy with managers. The Team noted that some of the issues reported through the Safety DiaLog had gone for at least 2 months with no response (PNNL personnel indicated that this situation was in part due to staffing constraints).

Opportunity for Improvement: PNNL should consider modifying the Safety DiaLog to show both the date the suggestion was submitted and the response date. For open concerns, include an interim response with a target completion date to show that action is being taken.

The Team observed or was briefed on a number of safety improvements that resulted from employee concerns or suggestions. For example, the F&O Directorate grounds maintenance crew has made many improvements in the way they conduct a variety of activities. Examples include improvements in cleaning methods for the "ponds," better use of high-visibility clothing, use of baling equipment to clean up and dispose of tumbleweeds, design and use of hose carts for fire hoses used in cleaning, and equipment handling improvements for river water screens at water intakes. In another case, employees had concerns regarding forklift attachments that had not been approved for use by the equipment manufacturer. In response, PNNL not only contacted the manufacturer, but also conducted engineering evaluations of the attachments.

PNNL has a VPP Steering Committee made up of both bargaining and exempt employees from across the PNNL organization. Due to the distance considerations identified earlier, MSL is not represented. Furthermore, the composition of the VPP Steering Committee does not reflect the composition of the workforce at PNNL. For example, bargaining unit representation is 50 percent of the committee, yet less than 10 percent of the employees. Some employees stated that because of the committee's composition, they felt that VPP was a program only for represented employees. HAMTC support for the VPP programs in the Richland area (including all DOE contractors under the Richland Operations Office, the Office of River Protection, and the Pacific Northwest Site Office) has been a primary driver for growth of DOE-VPP in that area. PNNL should continue to foster this support by the bargaining unit, but must also ensure that all employees are appropriately represented on the VPP Steering Committee.

Opportunity for Improvement: PNNL should revisit the composition of the VPP Steering Committee and ensure that it better represents the composition of PNNL.

The VPP Steering Committee has demonstrated continued efforts to improve the safety culture at PNNL by implementing several initiatives to enhance worker involvement and safety and health awareness. Some of these initiatives and events include:

- Annually evaluating the VPP program and PNNL safety operations;
- Championing the purchase and deployment of blood pressure monitors on the PNNL site;
- Championing the purchase and deployment of automated external defibrillators (AED) on site for quick response to cardiac arrests;
- Contributing to the Laboratory's established lessons learned/best practice program, as well as starting another "preventative-focused" series of articles;
- Participating in regional and national VPP conferences;
- Celebrating safety success and demonstrating safe practices at annual all-staff picnics;
- Promoting VPP and safety at Laboratory functions; and
- Distributing a monthly newsletter, fliers, and brochures highlighting safety and health issues (e.g., “Porcelain Press,” 24/7 safety tents, e-mails).

As discussed in Section III, Management Leadership, senior management support for the VPP Steering Committee has been limited. The VPP Steering Committee has not been encouraged to work with all members of the senior management team to identify and implement specific corrective actions or improvement plans that address recurring issues. The PNNL VPP effort could be significantly improved by fostering a greater degree of partnership between the VPP Steering Committee and the Laboratory Executive Committee. The VPP Steering Committee should be encouraged to make specific suggestions for improvement based on the annual VPP self-assessment and to work with senior managers to negotiate implementation of those suggestions.

Opportunity for Improvement: PNNL should ensure that the VPP Steering Committee has an active role in developing a safety improvement plan for the Laboratory.

PNNL has a variety of other safety-related committees, such as the Electrical Safety Committee, the Lock and Tag Committee, and the PHLSC. Nevertheless, most employees do not appear to be actively involved, either with these specialized safety committees or with VPP. According to employee feedback in the annual VPP evaluation, safety committees need to be better integrated into PNNL’s management infrastructure. These other safety committees have facilitated some integration by preparing charters for all major safety committees and have assumed more responsibility for contributing to the continuous improvement of PNNL safety programs. However, the information from these committees is not always shared with other committees or the VPP Steering Committee, and safety committee meeting minutes are not always posted or current on their Web sites.

The F&O Directorate DZAC was noted by the Team for demonstrating active involvement, participation, and leadership by both managers and employees in their common pursuit of continuous improvement and safety excellence. The F&O employees have a heightened awareness of the VPP process and how it works. Over a 15-month period, they were able to reduce their illness and injury rate substantially, primarily through cooperation between managers and employees working together and communicating effectively. Workers in other directorates indicated that their involvement with safety and health at the site generally consisted of reading widely distributed informational bulletins (i.e., the Porcelain Press) and e-mails sent to them by the VPP Steering Committee and their supervisors and managers.

F&O has provided training for all of their employees and managers in the HPI initiative. Employees and managers alike indicated that this initiative was key to improving human performance by helping employees focus on and reinforce the right behaviors during all phases of design, construction, operation, and maintenance, rather than focusing largely on results. F&O managers have encouraged their employees to identify weaknesses in their organizational process and listen to their concerns regarding those weaknesses. F&O managers have effectively cultivated an open line of communication within their organization.

The Team found that PNNL maintains adequate safety and health communication with employees. However, the Team noted that more attention is needed to communicate PNNL's high expectations for safety and health to new hires and to nonemployees, such as visiting researchers. Nonemployees at the Laboratory include foreign nationals, students, and short-term contractors. Interviews with many personnel in these categories demonstrated they were generally unfamiliar with safety programs or communication efforts beyond their individual laboratory bench. Additional efforts are needed to anticipate and support initial orientation to PNNL safety and health programs within the Laboratory operations.

PNNL also needs to continue efforts to extend invitations and incentives to employees who are not aware of VPP and its importance. Safety professionals are generally visible among the scientists and researchers, promote safety programs and initiatives, and foster a safety dialogue that promotes a stronger safety culture. More frequent walkthroughs by senior and mid-level managers will help convey top managers' commitment to safety and their expectations of being a leading example of excellence among DOE National Laboratories.

Conclusions

Craft employees in the F&O Directorate are actively involved in promoting and improving safety at PNNL. Some researchers and research directorate staff are also actively involved; however, broader participation is encouraged across all of the directorates. Managers need to be actively involved in encouraging workers to participate, and need to clearly demonstrate support for the VPP Steering Committee. Communications with employees are generally adequate, but more effective means need to be identified and implemented to ensure that nonemployees, such as visiting researchers, are oriented and integrated into the VPP culture.

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. There must be a systematic approach to identifying and analyzing all hazards encountered during the course of work, and 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 also involves implementing preventive and/or mitigative measures during work planning to anticipate and minimize the impact of such hazards.

PNNL has three primary types of work, and they are subject to different work control processes. The first process is work associated with maintenance and operation of the Laboratory property and facilities; the second is work performed by subcontractors; and the third is associated with control and authorization of research and development activities. These processes are discussed separately here for clarity.

Maintenance and Operations Activities

The F&O Maintenance Work Control Administrative Procedure and the Facility Design Manual provide the framework within which ES&H hazards are analyzed through formal processes. The review and analysis processes are incorporated in internal F&O administrative, maintenance, operating, and safety basis procedures, which, taken together, establish the analysis and compensatory measure development processes that are deployed. Specific work activity controls and facility controls are reconciled with the work scope and are included in activity planning, so that work within a facility is conducted consistent with the internal authorization agreement(s). Work managers (i.e., resource, facility project, or work control specialists) of the staff who perform the work are responsible for determining that the work conducted within the facility complies with Facility Use Agreement terms and conditions and is performed with an appropriate level of discipline. Facility operations and maintenance work activities are governed by administrative, maintenance, operating, and safety basis procedures; general craft work practices (i.e., skill of the craft); function-specific roles, responsibilities, authority, and accountability; the IOPS; and SBMS subject areas. The basic elements of work performance related to facility operations, maintenance and renewal activities are specified in the Facility Management System description and consist largely of supervised bargaining unit staff following approved administrative, operating, and maintenance procedures. Appropriate readiness review activities are performed prior to operation after significant facility modifications or major maintenance work.

Work Performed By Subcontractors

Work performed by subcontractors is required to conform to PNNL safety and health requirements, or the subcontractors must implement their own internal requirements that are at least equivalent to PNNL's requirements. Subcontractors/vendors (and all badged workers) are provided with a basic safety and health orientation that addresses emergency preparedness, the

need to comply with safety and health requirements, and stop-work authority. The subcontract technical administrator is responsible for ensuring that requirements are met and appropriate actions taken if requirements are not met.

To support subcontract work, PNNL has developed a Contractor ES&H Manual that provides the minimum requirements for contractors and subcontractors performing work in PNNL facilities. Contractors are required to comply with the requirements of this manual or supply an equivalent document for approval prior to work. For example, a contractor preliminary hazard assessment must be prepared by the contractor before commencing work. In supplying a standard/preferred document, PNNL has taken steps to establish a common culture for contract work performed at PNNL facilities by providing not only clear direction and expectations to the contractor but also consistency for the PNNL staff regarding safety performance when contractors are collocated with PNNL staff. Since the rules are consistent across the range of contractors, PNNL staff will be more likely to address concerns in the collocated spaces. Contract workers will also become more knowledgeable as the rules between contractors are normalized.

In response to self-identified weaknesses in the hazard analysis process regarding contract workers, PNNL has included an additional level of hazard analysis before work is approved within PNNL facilities. A worker safety and health assessment is conducted by the assigned field-deployed safety and health representative whenever contract workers are badged to perform hands-on work in lab spaces. The assigned field-deployed safety and health representative is made aware of the planned work via the badging system. When a badge is requested, a series of questions must be answered. When certain questions are positive, the system routes the request to the safety representative, thus initiating the hazard analysis review. However, the worker safety and health assessment (performed by the PNNL safety representative) and the contractor preliminary hazard assessment (performed by the contractor) do not necessarily indicate the same hazards and controls regarding the work to be performed. Also, the contractor preliminary hazard assessment is not currently routed to the CSM for review or approval. The CSM is an integral part of the hazard analysis process for the space he/she manages and needs to be aware of all hazards introduced, even if the project is limited in duration.

Opportunity for Improvement: PNNL should ensure that the contractor preliminary hazard assessments and the worker safety and health assessments are compared and cross-checked, and that affected parties, including CSM, communicate and fully understand the associated hazards.

R&D Activities

The process for R&D work planning and execution is described in the SBMS subject area of project management. The Electronic Prep & Risk (EPR) is a system with pertinent questions to help identify the major hazards of proposed R&D work. It is linked to the Laboratory-level requirements (e.g., SBMS) that are applicable to the work. The EPR form is completed when a project is proposed and is updated after the project is funded, when the scope of work or hazards change, or at least annually. The project manager completes the EPR form, and the product line manager approves it. Other staff may be enlisted to review and approve the EPR form, including the technical group manager (TGM) ES&H support staff and technical reviewers. It is used to distribute relevant risk management information needed to authorize initiation of project work

and safely manage the Laboratory. Identified risks are linked to applicable procedures and processes designed to mitigate those risks via the EPR Risk Mitigation Permit. These actions are intended to ensure that projects are properly analyzed and hazards adequately mitigated. After installation or modification of equipment, the project is evaluated to ensure that the technical requirements of the project have been met.

PNNL procedures require new and modified equipment to meet PNNL requirements for safety (e.g., guarding, electrical safety). Consensus and regulatory standards (such as the American National Standards Institute, National Electrical Code, etc.) are specified where appropriate. Complex or safety-significant systems require a level of readiness review and/or acceptance testing specified by the cognizant line or project manager.

Under the SBMS umbrella for worksite analysis, the researcher or CSM uses the IOPS process for identifying hazards, controls, and mitigative functions through the use of smart questioning. The system walks the user through a comprehensive set of questions that are linked to more detailed analysis. Embedded within the process are areas for discussion related to specific hazards that may be encountered, such as chemicals, bio-hazards, electrical, lasers, and radio frequencies.

The Chemical Management System is a separate system for chemical inventory management that researchers utilize to keep track of their chemical inventories. The management of chemical inventories and hazards dovetails into the IOPS process for hazard identification and control. Chemicals are inventoried into the lab space upon receipt. When completely used or no longer needed they are removed from the lab space and the inventory adjusted accordingly.

If the CSM identifies that a Biological Level 2 hazard issue is applicable to a space, the system alerts the CSM that no permit exists for the space as required. This prompts the CSM to take further action. However, the system could be improved if the reverse scenario were also covered in the program for example, if the CSM does not identify any Biological Level 2 hazard when a permit for the hazard exists. Currently, the system is not set up to provide a prompt in this case.

Managers and CSMs are not consistently ensuring the high expectations established in SBMS are met for performing detailed hazard analysis in laboratory spaces. For example, some labs use generic Chemical Process Permits (CPP) while other labs are specific and very detailed with respect to the chemical processes covered (see discussion under PNNL Wide Processes). The quality and detail of Hazard Awareness Summaries (HAS) varies significantly between lab spaces as well. For example, after some labs removed hazards from the research space, HAS indicated that the hazards were still present. With one exception, the Team did not identify any situations where a new hazard had been introduced into the laboratory without appropriate controls. The exception was a researcher that modified a process from regeneration of sodium to regeneration of lithium without modifying CPP. The process change was not noticed for approximately 8 months, until the Team's review. The researcher was aware of the more stringent controls for lithium regeneration, but did not follow the process to ensure that those controls were documented and included in an approved CPP. Because CPP was not revised, the process change was not included in the HAS for the space.

Opportunity for Improvement: PNNL senior managers and CSMs should ensure high expectations for hazard analyses associated with laboratory work are consistently understood and met.

PNNL Wide Processes

Self-inspections are performed by a variety of roles within the organization (CSM, TGM, subject matter expert). Tailored self-assessment checklists are created for IOPS spaces that mirror the hazards identified in HAS. Recently, managers have started to perform activity-based assessments, allowing the assessor to observe not only the conditions in the workplace, but also the behaviors of individuals performing the work. Results of the assessments are reviewed and corrective actions tracked via the corrective action management process.

Documents indicated that over 300 hazard evaluations have been performed in the fiscal year. Over 100 construction contractor reviews/inspections have also been performed with an average zero finding rate of over 90 percent. Over 600 spaces have been reviewed by the safety and health staff, and over 100 spaces by the electrical safety representative. Although there appears to be an abundance of self-inspections, field walkdowns by the Team identified many spaces with poor housekeeping.

A PNNL process for conducting routine, general hazard assessments that follow written procedures or guidance and result in written reports of findings and tracking of hazard correction has not been implemented with sufficient rigor to eliminate or significantly limit general hazards in the workplace. This insufficient rigor was evident in the Research areas and to a lesser degree in the F&O areas. Also, while some hazard assessments (facility safety and housekeeping walkdowns) are performed by CSM and the building manager, these assessments are not conducted frequently enough to ensure that housekeeping is maintained appropriately. Unsatisfactory housekeeping conditions were observed during walkdowns in several areas. Laboratories, loading docks, storage rooms, offices, and shop areas were among the areas found to have deficiencies, such as electrical disconnects not labeled, grinder wheels/rests with excessive gaps, photoluminescent exit signs not illuminated by external source as required, tripping hazards, gas cylinders not properly secured, gas cylinders stored horizontally, fire extinguishers not inspected, tripping hazards, safety showers and eyewash stations blocked, egress blocked by chairs or equipment, oil on the floor, and various signs not meeting the site standard for color code. The lack of good housekeeping in some areas also indicates that managers do not regularly walk through their spaces or provide expectations (with consequences) to the workforce with regard to keeping the workplace free of hazards. A robust safety and housekeeping assessment program would help reduce the number of hazards in these areas.

Opportunity for Improvement: PNNL should consider improving the safety and housekeeping assessment program.

In the Research facilities, IOPS is used to facilitate routine assessments. Given a scope of work to be performed, CSM is charged with evaluating both the facility hazards and the hazards associated with the actual work to be performed in a specific space. Because CSM is considered a senior position that requires a high degree of competence in the affected lab, the quality of the hazard assessments is generally good, and they are documented on the HASs. As part of assessment duties, CSM is expected to validate the currency of HAS. However, some summary sheets were outdated; e.g., one sheet in EMSL did not identify the pertinent hazards, and, as noted, one HAS described a sodium regeneration process in detail that had been discontinued approximately 8 months earlier.

In some cases, HAS does not effectively identify the hazards and controls for all, including passive users (e.g., craft workers). Some workers could not adequately identify the hazards listed on HAS for the spaces they were working in. For example, workers assigned to replace light bulbs in EMSL workspaces are listed as passive users for the applicable spaces, and HAS for those spaces identifies potential hazards, such as toxic gases, chemicals, and high gauss magnets. However, as users, the electrical workers are not included in the "training required" section of HAS; only workers actually associated with "working" with the hazard are given the hazard training. Nevertheless, the electrical workers are allowed unescorted access to the space. Although these users do not intentionally work with the hazards listed, accidental contact could put them at risk, and the worksite analysis process must cover not only the intended work scope but, as practical, hazards that could be encountered due to common errors (inattention, ladder tip-over, etc.). The same is true of researchers whose activities are conducted in a lab space that contains other research-related hazards for which they are considered passive users. For example, as noted earlier, a postdoctoral researcher was adjacent to a worksite where toxic gases were listed as a potential hazard, but could not say what the hazards might be or what to do if exposed to them.

Given the prevalence of chemical hazards across PNNL, the Team reviewed a broad range of CPPs. Many of them give sufficient detail about the specific process or processes being described, accurately identify how often the process is used, quantify the chemicals being used, and clearly identify any hazards or special concerns about use of the chemical. For example, one permit analyzed the hazard of peroxides and other chemicals, identified fume hood failure as a concern, and analyzed the consequences to the lab space. This is a conservative and commendable approach. However, some of the permits that were reviewed did not meet this standard. Some permits involving the same or similar chemicals simply identified that only small quantities would be used, and that, because all work was in the fume hood, the risk was acceptable. Because the fume hoods represent a single-point failure, the permit should discuss power failures and responses when working with hazardous chemicals. When CPPs lack sufficient detail, reviewers may not have enough information to determine whether the hazards have been adequately controlled. For example, a chemist's use of perchloric acid led to an event earlier this year. The hazards of forming an unstable/explosive precipitate had not been identified and analyzed, and there was an explosion in a fume hood. The chemist only received minor cuts, but the potential consequences were much greater.

PNNL has developed a Map Information Tool with a graphic user interface that allows the user to identify a building and obtain information about hazards, first aid responders, etc., down to the

individual room or space within the building. This tool is especially helpful in planning work and carrying out the hazard analysis process.

Accident investigations and reporting processes/procedures are in place at PNNL to ensure that accidents and injuries are appropriately reported and thoroughly investigated, and that necessary corrective actions are implemented. Written requirements are documented in ***"SHP- 4.02 Accident Investigation, Recordkeeping, and Reporting Requirements."*** Accident investigations are required to be performed for all injuries, and cases that are deemed to meet recordable criteria under the OSHA recordkeeping rules also require a formal critique. In all cases, the affected worker is required to be part of the accident investigation. Information regarding all injuries is documented in the Safety and Health Information Management System (SHIMS). Each injury is investigated to determine direct and contributing causes and root causes; those determinations are tracked in SHIMS. Recordable cases are also entered on the OSHA 300 Log as required by regulation. Corrective actions determined during the investigation are tracked in the Assessment Tracking System.

A documented "return-to-work" plan is required for staff members who have been restricted from performing their normal work activities or have lost time due to injury or illness. This document provides clear expectations and guidelines for the worker and the supervisor to reduce the risk of further injury as the injured worker re-enters the work environment.

PNNL has established a comprehensive exposure assessment program through workplace exposure assessments and employee job task analyses (EJTA). These programs provide relevant information about exposure hazards for spaces, job functions, and task assignments.

PNNL has a risk-based approach to require ergonomic evaluation for employees in "caution zone" jobs. Virtually all of those employees have had an ergonomic evaluation. Although PNNL has performed over 600 ergonomic evaluations in the last 3 years, many exposed workers have not had their workstations evaluated. Workers can request ergonomic evaluation from the applicable safety and health staff, and no one who has requested an evaluation has been refused. Many workers who have not yet requested an evaluation indicated that they do not see the benefit of being proactive in this process. Although small in number, ergonomic and repetitive trauma injuries represent a large percentage of PNNL's current injury statistics. A more proactive approach to ergonomic evaluations could assist PNNL in achieving its safety goals.

Opportunity for Improvement: PNNL should provide incentives to encourage broader use of the ergonomics Web site for proper equipment positioning and encourage managers to discuss ergonomic issues with employees.

Conclusion

The suite of hazard analysis processes in place at PNNL includes EPR, IOPS, HAS, EJTAs, Job Performance Plans, CPPs, confined space evaluation, energized electrical work permits, preliminary hazard assessments, worker safety and health assessments, worker exposure assessments, product hazard evaluations, and qualitative hazard assessments. PNNL has access, either through assigned onsite professionals or through matrixed organizations, to the necessary

subject matter expertise to evaluate the range of hazards encountered during work. Much of the work reviewed by the Team showed clear identification of hazards, documentation of controls, and a method of feedback after the work was completed. Improvement is needed by PNNL to ensure that the analysis of identified hazards is adequate for all work, including R&D, to ensure that the hazard controls are appropriate and that the affected workers are knowledgeable of the hazards and controls.

VI. HAZARD PREVENTION AND CONTROL

Once hazards have been identified and analyzed, they must be eliminated (by substitution or changing work methods) or addressed by the implementation of effective controls (engineered controls, administrative controls, and/or PPE). Equipment maintenance, PPE, processes to ensure compliance with requirements, and emergency preparedness must also be implemented where necessary. Safety rules and work procedures must be developed, communicated, and understood by supervisors and employees, and followed by everyone in the workplace to prevent mishaps or control their frequency and/or severity.

PNNL has processes in place, particularly for chemical hazards, to first attempt to minimize or eliminate the hazards. During the chemical procurement process, when a researcher identifies the need for a specific chemical, the system first attempts to identify possible less hazardous alternatives. If no alternative is available, the system then attempts to determine whether the chemical is already available elsewhere in the Laboratory and compares the requested chemical and quantity against the current inventory for the building. If the requested chemical is not already available, it is procured in the smallest quantity that will fit the need. The system also tracks whether any emergency preparedness planning thresholds are reached. Researchers are then supposed to return unused chemicals to the system when they are done with a particular process. The Laboratory encourages CSMs to regularly review their spaces for unused or unneeded chemicals, and the Laboratory sponsors a biennial cleanout to further reduce chemical storage.

PNNL has implemented extensive engineering controls. Laboratories are fitted with fume exhaust hoods (which are regularly checked for adequate airflow), emergency eyewash stations, chemical safety showers, fire extinguishers, toxic gas cabinets, and smoke and fire detectors. In EMSL, the facility was fitted with a toxic gas alarm system when it was initially built; the installed system is commonly used in the semiconductor industry to detect minute quantities of toxic gases before they reach levels that would be considered harmful. However, once the facility came into operation, it became apparent that the system was not appropriate for the R&D environment because small quantities of nonhazardous chemicals were often sufficient to provide false alarms. The responsible directorate elected to disable the installed alarm system, and the Laboratory developed a standard practice that any processes using toxic gases would require a portable toxic gas monitor at the point of use.

The F&O Directorate grounds maintenance crew has developed several engineered improvements to equipment used for snow clearing and maintenance. For example, PNNL has two “ponds” that are not only decorative, but also provide evaporative cooling for air conditioning. Each year, the ponds are drained and cleaned of debris. This effort typically requires extensive use of manual labor and tools. To avoid the excessive manual labor and associated risks of muscular-skeletal injuries, PNNL procured ramps that would allow light industrial equipment to enter the ponds for cleaning. They also modified the equipment to improve visibility for the driver and added flags to the spray risers in the pond to help drivers avoid them. In addition, they constructed a firehose cart and hose-reeling machines to reduce the risk of injuries while handling firehoses used for cleaning, and fabricated a pump cart to eliminate manual handling of heavy water pumps used in cleaning. These improvements not

only reduce the risk of injuries, but also significantly improve the quality of the final product (cleanliness of the ponds) and reduce the time needed to perform the cleaning.

Another engineered control adopted by the grounds maintenance crew involves the cleanup and disposal of tumbleweeds. Windstorms commonly deposit large numbers of these weeds across the Laboratory, requiring significant efforts to remove and dispose of them. In the past, workers typically just piled the weeds onto a truck and "stomped" them down, exposing the workers to risk of injury. The purchase of a baler to compact the weeds made handling them easier and quicker. Cleanup times following windstorms have been reduced from 3 weeks to 3 days, the volume of debris is greatly reduced, and the risk of injuries to workers is reduced.

As discussed throughout this report, PNNL has extensive administrative controls throughout the Laboratory from procedures and practices included in SBMS and IOPS to training requirements and extensive use of hazard postings. PNNL has a procedure that describes expectations for Danger, Warning, Caution, and Notice signs, including the conditions for which each is appropriate. The Team observed some postings that did not meet PNNL expectations (use of a Notice where Warning or Caution was more appropriate). In general, the use of and compliance with administrative controls are very good, although in some cases, administrative controls were not followed in R&D laboratories. For example, one laboratory had a toxic gas cabinet with four lecture bottles of gases that had not been used for at least 30 days, and were not expected to be used in the near future. The CPP for those gases requires that gases no longer in use are to be returned to a central storage location or the loading dock.

One set of controls observed in the EMSL was associated with access to the nuclear magnetic resonance (NMR) machines, which use some of the most powerful magnets in the world. Each machine is clearly marked with the 20-gauss line, which is a generally accepted standard for limited access. In some cases, access is further restricted by use of walls or other barriers. Additional controls include limited access to higher gauss areas, postings, and training.

Access to some spaces in the Laboratory is controlled by the use of electronic proximity cards. These cards are used to limit access to buildings and laboratories based on individual training and qualifications, as well as approval by the building and laboratory managers.

In addition to the engineered and administrative controls, PPE is often required for activities within the PNNL complex that pose hazards to personnel. Typically, these hazards include (but are not limited to) hazardous chemicals, radioactive material, heated surfaces, noise, energized circuitry, electromagnetic fields, sharp implements, cryogenic materials, suspended loads, and pinch points. Nearly all personnel observed by the Team were wearing the appropriate PPE for the task they were performing. The few contrary cases involved lack of PPE for eye protection, and generally related to workers not complying with specific postings. For example, most workers believed that eye protection was only required if actual work was being performed. The postings in some areas made that exception clear, while others simply stated that eye protection was required. Consequently, workers followed a generally accepted practice that was not in compliance with the postings. In another case, a pipefitter who was soldering with an oxyacetylene torch wore safety glasses, but no tinted eye protection even though the light from the torch was very bright. A Laboratory standard for this activity did not clearly establish a

minimum protection for the worker, and PNNL had not performed an adequate analysis of the hazards associated with this type of soldering. Consequently, PPE requirements for the job were not clearly communicated to or understood by the worker.

Opportunity for Improvement: PNNL should emphasize the use and applicability of PPE when required. If the environment does not require PPE, the applicability in the area should be adjusted commensurate with the hazard.

The controls associated with impaired fire protection/detection systems are not effectively communicated to building occupants. PNNL has developed a draft fire impairment procedure, but it has not been approved for use in the facilities. At this point in time, the fire protection engineer has to rely on e-mail notification to building occupants with regard to system outages and compensatory measures, which may include restrictions on specific work activities (e.g., hot work, working with flammables, welding). The lack of a robust impairment program places PNNL facilities at increased risk of property damage and personal injury in case of a fire while fire protection systems are impaired.

Opportunity for Improvement: PNNL should review, revise as required, approve, and implement the fire impairment procedure to ensure that all building occupants and users are aware of impairments and necessary actions.

In some cases, improvements in hazard controls in one laboratory were not translated into improvements in other laboratories. For example, in EMSL, the NMR magnets must be refilled weekly with the cryogenic liquids used to cool the magnets. This operation requires access to the top of the machine, which is typically elevated eight to ten feet above the floor and in some laboratories is accessed via step ladders. One laboratory substituted steel rolling platform ladders that include handrails, are more stable, and reduce the risk to workers. This improvement should be identified and communicated to other laboratories where elevated equipment is accessed regularly. It was not clear that there was an effective forum or mechanism for improvements to be communicated and spread throughout PNNL.

Opportunity for Improvement: PNNL should identify and implement an effective means of recognizing and communicating safety improvements throughout the Laboratory.

PNNL's radiation protection program is founded on the DOE radiological control program. The radiological control management system description and the radiological control program description provide the basis for PNNL's implementation of radiological control. The Team observed a radioactive waste shipment from Building 325 to the Hanford Site for which the pre-job briefing discussed the hazards of the activity, especially the dose rates of the containers, and engaged members of the workforce in discussing those hazards. The Team reviewed the radiological work permit and the procedure used in the evolution. All personnel observed wore required PPE, and the work proceeded without any issues. The Team made a suggestion relative to the loading sequence as an ALARA improvement, which was positively received by the person in charge.

The Team observed a good example of employee involvement resulting in improved hazard control at the 325 facility. The task involved the radiological surveying of boxes for shipments. Based on workforce input, a stand was researched and procured to stage the boxes so that the health physics technicians could safely survey the bottom of boxes without being subjected to suspended loads. The forklift driver would place the box on the stand that was engineered to support the box safely, and the technician could then smear and survey the underside of the box prior to shipment.

Advance Med Hanford (AMH) provides all medical services for PNNL (and other site contractors), including acting as the medical director, providing medical surveillance, maintaining medical records, and providing medical evaluation and other medical-related activities.

The site EJTA defines medical surveillance requirements for each staff member and subcontractor. The industrial hygienist implements the EJTA program and performs annual assessment of the status of EJTAs. Job activities requiring medical surveillance are scheduled for evaluation by AMH, which uses EJTA information to guide medical surveillance and monitoring. Use of the EJTA is a key way that PNNL coordinates with AMH medical monitoring and surveillance.

Workers with potential exposure or minor injury/illness are evaluated by AMH. Emergency medical response service is provided by the Hanford Fire Department, and serious cases can be transported directly to the local hospital.

Field workers are provided with first aid, cardiopulmonary resuscitation (CPR), and AED training when it is required by their job. First aid kits are provided in facilities and at key worksites/vehicles.

Site emergency preparedness activities are the primary driver for alarm testing and emergency drills. Site-wide alarm tests are conducted regularly, and each site area typically has two drills each year. Drills may include evacuation, take cover, or personal injury scenarios.

Inherent to the laboratory/research environment is researchers' awareness of the hazards particular to their area of research. In addition to that knowledge, PNNL has on-staff safety professionals who provide expertise in industrial safety, industrial hygiene, and radiation protection, as well as Certified Safety Professionals who assist researchers in their research planning. Qualified and trained craftsmen also assist researchers with electrical hazards, hoisting and rigging issues, and mechanical construction of research apparatus.

PNNL's preventive/predictive maintenance (PM) program describes the purpose, roles and responsibilities, and process for PM at the Laboratory. The process for performing PM is to be initiated through Maximo, the electronic service request system. PNNL has PM procedures for various pieces of equipment, including (but not limited to) safety showers, eyewash stations, and cranes and hoists. The PM schedule is administered by Facility Operations to ensure that PM is performed as required. The work team leader works with the building engineer to schedule and assign PM work, and the work control specialist works with the building engineer to plan

complex PM activities. For day-to-day service requests, the building engineer, building manager, or subject matter experts "triage" the initiators' requests to ensure that the requested work is clearly stated and defined. In addition, new work requests are screened to determine whether additional planning (or permits) will be required based on the nature and location of the requested work.

Conclusions

Hazards associated with operations and maintenance at PNNL are well controlled. Systems are in place to implement controls, beginning with elimination or substitution and use of engineered controls, then administrative controls, and finally PPE. There have been cases where workers identified process improvements that not only reduce worker risk, but make the process more efficient. The team noted some opportunities for improvement that should help improve communication of improvements, as well as ensure all workers are aware of PPE requirements and fire protection system impairments.

VII. SAFETY AND HEALTH TRAINING

Training is necessary to implement management's commitment to prevent exposure to hazards. Managers, supervisors, and employees must know and understand the policies, rules, and procedures established to prevent exposure to hazards. Managers, supervisors, and employees must understand their safety and health responsibilities and know how to effectively carry them out.

The PNNL training program continues to be comprehensive and well administered. SBMS describes training and qualification considerations for PNNL staff members and other onsite workers (e.g., contractors and visitors). It is intended to include all training considered to have an effect on the performance of work that presents a possible risk or consequence to PNNL staff, facilities, or business. An employee's job training plan is developed within 30 days of hiring and at least annually thereafter. Additional training may be assigned as applicable to address any project- or job-specific need. All managers and supervisors receive additional training, such as the SOS training course. Training is administered using various methods such as computer-based, classroom, and on-the-job training.

Job-specific training for work in IOPS facilities is administered and documented in the IOPS tool. Each worker who is granted unescorted access to an IOPS space has training designated by CSM based on their level of access and the specific work that they will be doing. The training includes applicable work practice documents and job-specific permits. The training for each worker is administered and documented in the IOPS tool. The specific training required for unescorted access is determined based upon whether a worker is considered active or passive with respect to the hazards within the space. For example, a craftsman would be considered passive with respect to chemical hazards in a lab space unless he was being detailed to work on the chemical system(s). This process does not require workers to be aware of, or trained in, emergency procedures for potential hazards for which they are considered passive.

Opportunity for Improvement: PNNL should review the training and controls associated with passive access to hazards and ensure that workers can protect themselves in the event of abnormal or upset conditions before they are granted unescorted access to spaces.

Employees who were interviewed were able to recognize hazards associated with their jobs and explain how to respond to different types of emergencies. Employees also feel that the level of safety and health training they receive is sufficient to conduct their work in a safe and productive manner. Although most interviewed employees indicated that training has improved, some feel that computer-based training is not an adequate replacement for traditional classroom training for some specific disciplines; several researchers expressed this view in the context that too much emphasis is placed on computer-based training and not enough on classroom and/or workspace orientation. Overall, employees feel that management fully supports safety and health training at PNNL.

Through observations during facility walkthroughs, the Team found that first aid kits, CPR, and AEDs (which are designed to be used without training) are provided in most PNNL facilities. Training documentation and interviews provide evidence that 281 employees are currently

trained for medic/first aid/CPR/and AED. E-mails, newsletters, POD meetings (where used), and pre-job briefings are thorough and effective and serve as informal training.

PNNL identified some unique safety training for laboratory personnel through the HAMMER training facility. After vehicle safety was identified as an area of emphasis, some personnel were allowed to attend the HAMMER driving safety course to evaluate its effectiveness and applicability to laboratory personnel. This training is not for basic driving skills, but is used to enhance driver awareness and skills when driving under hazardous conditions. PNNL has reserved 9 spots per month for the next 12 months to allow laboratory workers who must drive as part of their normal duties to take the course.

Conclusions

Workers at PNNL are very experienced. Training is appropriate for personnel entering laboratory spaces. All personnel encountered were aware of their responsibilities related to safe conduct of work. PNNL should continue identifying means of training in addition to computer-based training to ensure that personnel have opportunities to engage in more “hands-on” training.

VIII. CONCLUSIONS

Operations at PNNL are generally conducted in a safe manner. Systems and processes are in place to ensure that workers are aware of requirements and standards that apply to their work. The low accident and injury statistics reflect a workforce that is generally aware of hazards in their workspaces, establishes appropriate controls, and workers generally comply with safety requirements.

The F&O Directorate is noted as an example for the rest of the Laboratory in its pursuit of safety excellence. Managers, supervisors, and workers all actively participate and contribute to improved operations. Since the injury in 2004, the improvement in injury statistics across the Laboratory has been largely due to improvements in the F&O Directorate. Additional emphasis is needed among other Directorates where many personnel may only be peripherally involved in VPP-related efforts.

The VPP Steering Committee, although active, would be more effective with broad senior management support for its efforts. Some improvements or issues identified by the committee have not been accepted or acted on by management. Although senior managers are clearly committed to safety, their active involvement and leadership for safety improvements have not been consistent. They have not worked with the VPP Steering Committee to clarify or understand identified issues and identify potential improvements. The Laboratory Director is taking steps to improve that condition.

Based on the need for improvement in Management Leadership and ensuring that all personnel at the Laboratory are actively engaged in safety improvement, the Team recommends that PNNL continue as Star participant in a Conditional status. HSS will offer assistance in keeping with the partnering relationship established by DOE-VPP participation. In addition, HSS will conduct a followup review in 2009 gauge improvements.

Appendix A

Onsite VPP Audit Team Roster

Management

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Office of Health, Safety and Security

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Office of Health, Safety and Security

Patricia R. Worthington, PhD, Director, Office of Health and Safety
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Crystal Adolfson	Battelle Energy Alliance, Idaho National Laboratory	Safety and Health Training, Employee Involvement
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Barbara Key	Washington Savannah River Company	Safety and Health Training