# Independent Assessment of Work Planning and Control at the Pacific Northwest National Laboratory

**August 2024**

Office of Enterprise Assessments
U.S. Department of Energy

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## Acronyms

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| BMI | Battelle Memorial Institute, Pacific Northwest Division |
| CFR | Code of Federal Regulations |
| CRAD | Criteria and Review Approach Document |
| CSM | Cognizant Site Manager |
| DOE | U.S. Department of Energy |
| EA | Office of Enterprise Assessments |
| ECP | Employee Concerns Program |
| EDM | Electrical Discharge Machining |
| EHSS | Office of Environment, Health, Safety and Security |
| EMSL | Environmental Molecular Sciences Laboratory |
| ESF&IO | Facilities and Infrastructure Operations |
| FR | Facility Representative |
| HDI | How Do I |
| HSS | Office of Health, Safety and Security |
| ISMS | Integrated Safety Management System |
| LOTO | Lockout/Tagout |
| MHTLS | Modular Hydrothermal Liquefaction System |
| MIP | Mission Integration and Projects |
| OFI | Opportunity for Improvement |
| OPEX | Operating Experience |
| PAR | Performance Assurance Reporting |
| PLD | Pulsed Laser Deposition |
| PNNL | Pacific Northwest National Laboratory |
| PNSO | Pacific Northwest Site Office |
| PPE | Personal Protective Equipment |
| PSF | Physical Sciences Facilities |
| PSL | Physical Sciences Laboratory |
| R&D | Research and Development |
| RPL | Radiochemical Processing Laboratory |
| SC | Office of Science |
| SCMS | Office of Science Management System |
| SME | Subject Matter Expert |
| SOP | Standard Operating Procedure |
| TQP | Technical Qualification Program |
| WP&C | Work Planning and Control |
| WS&H | Worker Safety and Health |

# INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE PACIFIC NORTHWEST NATIONAL LABORATORY

## Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of work planning and control (WP&C) for work involving lockout/tagout and machine guarding at the Pacific Northwest National Laboratory (PNNL) from March to May 2024. Specifically, this assessment evaluated Battelle Memorial Institute, Pacific Northwest Division (BMI) WP&C processes and implementation of the integrated safety management system core functions: define the scope of work, identify and analyze hazards, develop and implement hazard controls, perform work safely within controls, and provide feedback and make improvements. The assessment also included the evaluation of Federal oversight conducted by the Pacific Northwest Site Office (PNSO).

EA identified the following strengths:

- BMI has developed an adequate and well-documented WP&C framework to support the implementation of the integrated safety management system core functions for work involving lockout/tagout and machine guarding.
- BMI appropriately staffs WP&C and worker safety and health programs for hazardous energy control and machine guarding with an adequate number of well qualified and experienced subject matter experts.
- BMI adequately performed observed hazardous energy control and machining work within defined work controls by effectively implementing work planning, stop work authority, and the safe use of equipment with appropriate subject matter expert engagement.
- PNSO provides effective oversight of BMI's lockout/tagout and machine guarding programs, with Facility Representatives and subject matter experts collaborating to communicate information on contractor programs.

EA also identified several weaknesses, as summarized below:

- BMI does not apply lockout/tagout requirements in some cases to eliminate the potential for exposure to hazardous energy wherever feasible.
- BMI has not ensured that all machine tools are adequately guarded and in safe operating condition as required.
- PNSO has not completed some required self-assessments of site office programs, some oversight staff have not been assigned required qualifications, and some implementing procedure documents require updates.

In summary, BMI has developed and implemented an appropriate WP&C framework for most lockout/tagout and machine guarding activities at PNNL, and PNSO provides effective Federal oversight. However, in some instances BMI does not eliminate hazardous energy and machine operation hazards wherever feasible. Additionally, PNSO has not completed required self-assessments of the site office programs, and some oversight staff lack required qualifications. Resolution of the weaknesses identified in this report will further enhance BMI's worker safety and health program and PNSO oversight.

# INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE PACIFIC NORTHWEST NATIONAL LABORATORY

## 1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Worker Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of work planning and control (WP&C) with a focus on lockout/tagout (LOTO) and machine guarding at the Pacific Northwest National Laboratory (PNNL), which is managed and operated by Battelle Memorial Institute, Pacific Northwest Division (BMI). This assessment was conducted from March to May 2024.

Consistent with the *Plan for the Independent Assessment of Lockout/Tagout and Machine Guarding at the Pacific Northwest National Laboratory, May 2024*, this assessment evaluated the effectiveness of the implementation of BMI's integrated safety management system (ISMS). The five ISMS core functions are: define the scope of work, identify and analyze hazards, develop and implement hazard controls, perform work safely within controls, and provide feedback and make improvements. The assessment evaluated activity-level work involving LOTO and machine operation activities. This assessment also evaluated the Federal oversight conducted by the Pacific Northwest Site Office (PNSO).

## 2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement (OFIs)" as defined in the order.

EA evaluated the adequacy of PNNL's implementation of ISMS guiding principles and core functions in accordance with DOE Order 450.2, *Integrated Safety Management*, and DOE Guide 450.4-1C, *Integrated Safety Management System Guide*. Additionally, as identified in the assessment plan, this assessment considered objectives and criteria from DOE Guide 226.1-2A, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*, appendix D, *Activity Level Work Planning and Control Criterion Review and Approach Documents with Lines of Inquiry*. EA also used elements of EA criteria and review approach document (CRAD) EA-30-07, Revision 0, *Federal Line Management Oversight Processes*, to collect and analyze data on PNSO oversight activities related to WP&C. In addition, EA used selected objectives and criteria from CRAD EA-32-11, Revision 0, *Control of Hazardous Energy (Lockout/Tagout)*, and CRAD EA-32-13, Revision 1, *Electrical Safety*.

EA reviewed local site office procedures to evaluate the adequacy of the PNSO oversight program as it applies to ISMS. The Office of Science (SC) uses their Science Management System (SCMS) and local site office procedures as foundational implementing procedures for its oversight model.

EA observed the planning and execution of 40 onsite work activities at PNNL. EA examined key activity-level work control documents, such as research activities planned in Lab Assist (BMI's online laboratory WP&C software application), work permits, standard operating procedures (SOPs), work orders, hazard analysis documents, and other relevant WP&C documentation. EA also interviewed key personnel responsible for developing and executing the associated programs and walked down relevant portions of specific facilities. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

There were no previous findings for follow-up addressed during this assessment.

## 3.0 RESULTS

### 3.1 Work Planning and Control Processes

This portion of the assessment evaluated BMI's WP&C processes to enable the safe performance of work involving LOTO and machine guarding in accordance with DOE's ISMS requirements.

BMI has developed an adequate and well-documented WP&C framework to support the implementation of the ISMS core functions for work involving LOTO and machine guarding. BMI uses a comprehensive set of electronic "How Do I?" (HDI) procedures and instructions. HDI work control procedure *Basic Laboratory and Operations Practices* and ADM-016, *Work Control*, serve as valuable tools in defining the scope of proposed work and ensuring that hazards are analyzed, documented, and controlled for Facilities and Infrastructure Operations (F&IO) (e.g., craft trades) and research activities. Collectively, these two procedures define WP&C processes that are effective in the control of hazardous energy and machine guarding. BMI adequately flows down worker safety and health requirements into Lab Assist documents, SOPs, and work packages. Additionally, WP&C processes appropriately require collaboration among workers; supervisors; engineering personnel; Worker Safety and Health (WS&H) subject matter experts (SMEs); and work planners (for F&IO work packages) for identifying hazards. WP&C processes also appropriately include the selection of hazard cards, which are identification checklists that effectively address relevant hazards, including physical hazards associated with the control of hazardous energy and machine operation.

BMI appropriately staffs WP&C and worker safety and health programs for hazardous energy control (i.e., LOTO) and machine guarding with an adequate number of well qualified and experienced SMEs. BMI WS&H managers and their staff have extensive experience and knowledge in their respective areas. For example, SMEs were able to provide detailed demonstrations and clearly explain the process of controlling hazardous energy and machine operation hazards.

#### Work Planning and Control Processes Conclusions

BMI has developed an adequate and well-documented WP&C framework to support the implementation of the ISMS core functions for work involving LOTO and machine guarding. BMI appropriately staffs WP&C and worker safety and health programs for hazardous energy control (i.e., LOTO) and machine guarding with an adequate number of well qualified and experienced SMEs.

### 3.2 Work Planning and Control Implementation

This portion of the assessment evaluated BMI's implementation of its WP&C institutional processes for ongoing LOTO and machine operation work through the proper implementation of the ISMS core functions.

#### Defining the Scope of Work

Procedure ADM-016 and the Lab Assist processes provide adequate instructions for preparing and screening work scopes. Most reviewed F&IO and research activity-level work control documents for LOTO and machining activities provided sufficiently detailed work scopes to permit the analysis of hazards and specification of necessary controls.

*Lockout/Tagout*

The work scopes in three of the five reviewed SOPs and associated Lab Assist packages adequately defined expected work practices that involved potential exposure to hazardous energy. LOTO requirements were appropriately incorporated into the work scopes of these three packages, which covered the maintenance and servicing of the Hockmeyer immersion mill, the modular hydrothermal liquefaction system (MHTLS), and the Stanat rolling mill. However, the following weaknesses were identified in two reviewed packages:

- The specificity of some work activities defined in the package for the pulsed laser deposition (PLD) system for the periodic maintenance of the excimer laser and target exchanges in the deposition chamber was not sufficient for hazardous energy control purposes (see section 3.2, *Developing and Implementing Hazard Controls*, for additional information).
- The operational instructions for the cable motor test bed were ambiguous and did not clearly define the process for hazardous energy control. (See **OFI-BMI-1**.) SOP-2410-ARENA, *ARENA Cable Motor Test Bed*, and associated Lab Assist ID 4524, *ARENA Cable Motor Test Bed*, outline the scope of activities for the experimental set-up, including the use of cord and plug control for hazardous electrical energy control. However, the scope did not define which system (i.e., 110 volt or 480 volt outlet) this activity covered, the sequence of steps related to the plug and breaker, or other steps necessary to perform this activity.

*Machine Guarding*

The work scopes of reviewed research and development (R&D) work activities (conducted by either F&IO or R&D staff) using machine guarding were sufficiently detailed to specify the work to be performed and to allow subsequent identification of associated hazards. For major tasks with higher risks, the reviewed documents demonstrated that the scope of work was appropriately documented in the Lab Assist online tool for the respective activity. Additionally, F&IO and the R&D community are supported by HDIs that comprehensively address tools and machinery: WSH-OS-03, *Occupational Health Procedure Tools and Machinery Work Control*; and WSH-OS-09, *WS&H Program Description Occupational Safety*, which in combination sufficiently address machine guarding work scopes.

**Identifying and Analyzing Hazards**

Observed work and reviewed documents generally demonstrated that energy sources and machining hazards were identified and analyzed by the appropriate personnel.

*Lockout/Tagout*

The HDI work control procedure *Lockout and Tagout* (LOTO HDI) provides generally adequate direction for personnel to identify site LOTO requirements to control hazardous energy. This HDI provides site-established thresholds for various energy sources and useful examples. In addition, the HDI work control procedures *Pressure and Vacuum Systems*, *Electrical Work Practices*, and *Compressed Gas Supply Systems* provide additional direction related to LOTO requirements. However, the HDIs do not provide explicit direction to address other hazards potentially created by an energy source (e.g., pneumatically driven mechanical hazards). Also, contrary to 10 CFR 851.21(a)(2), *Hazard identification and assessment,* BMI does not have a documented basis for thresholds and exclusions established to exempt pressurized systems from the LOTO requirements of 29 CFR 1910.147, *The control of hazardous energy (lockout/tagout)*. (See **Deficiency D-BMI-1**.) Not having a documented basis for such thresholds and exclusions could result in worker exposure to inadequately controlled hazardous energy. For example, the LOTO HDI excludes the changeout of compressed gas cylinders from LOTO without a

documented assessment of the hazards. The DOE Office of Environment, Health, Safety and Security (EHSS) issued a policy clarification in early 2022 stating that the changeout of compressed gas cylinders, including when the cylinder valve is under the control and within the line-of-sight of the person performing the changeout, may be subject to LOTO based upon the results of the hazard identification and assessment required by 10 CFR 851, *Worker Safety and Health Program*.

In addition, the LOTO HDI establishes various system pressure thresholds below which BMI does not require LOTO. However, the basis for these thresholds for pressurized systems is not documented. An interview with the BMI pressure safety SME provided additional information on safety features incorporated into the design and operation of pressurized systems at PNNL, but those considerations primarily focused on features and controls to ensure the safety of an intact pressurized system. Hazards associated with intentional breaching of a system for service or maintenance prior to the system being fully de-energized were not adequately addressed by those features.

*Machine Guarding*

BMI has established a combination of processes to effectively identify most machine-related hazards associated with research and F&IO work. The Lab Assist development and approval processes establish general activity-level requirements and hazard categories for the initial activity proposal safety review process. These processes help ensure a hazard analysis that is tailored to the laboratory spaces where a proposed activity will take place. Additionally, safety representatives, peer researchers, and SMEs are appropriately required to review and analyze proposed activities in Lab Assist, as well as the hazards related to laboratory-specific activities.

The potential hazards associated with electrical discharge machining (EDM) and potential impacts of electric fields on workers with pacemakers have not been analyzed. Interviewed WS&H staff have confirmed that manufacturers' documentation contains warnings pertaining to the potential electric fields generated during EDM operation and risk to workers with pacemakers; however, no documented exposure assessments were available. Additionally, Lab Assist hazard awareness summaries posted at locations where EDM machines are in use (or are available for use) do not identify potential electric field hazards. Examples of such locations include the Physical Sciences Facilities (PSF) shop, Building 3420 Radiation Detection Laboratory, 1604 Radiation Detection Sciences machine shop, the Environmental Molecular Sciences Laboratory (EMSL), Radiochemical Processing Laboratory (RPL), and Building 350 machine shops. BMI initiated prompt actions to assess this concern, including SME measurement of potential electric fields generated during EDM activities. (See section 3.2, *Developing and Implementing Hazard Controls*, for additional information)

**Developing and Implementing Hazard Controls**

BMI's HDIs provide adequate direction for integrating hazards and controls from job-specific hazard analyses and manufacturers' instructions into work instructions and SOPs. Hazard controls were effectively developed and implemented for most reviewed LOTO and machining activities and work performed under hazard-specific permits (energized work, hot work, etc.).

*Lockout/Tagout*

BMI has established adequate training courses to ensure that the purpose and function of the hazardous energy control program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of energy control devices are communicated and practiced. All workers listed on six reviewed LOTO permits were current with training requirements.

BMI personnel adequately identified energy sources and lockout parameters (e.g., circuits, valves, devices) to prevent worker exposure to hazardous energy for observed LOTO activities and demonstrations. Ten observed permitted LOTO activities demonstrated proper work practices for de-energizing the system, applying lockout devices (including the use of cables to lock out multiple breakers), using a spacer to reduce the potential for accidental dislodgement of lockout devices, verifying the absence of energy, and re-energizing the system. In addition, a researcher adequately described LOTO requirements for various unit operations of the MHTLS and properly demonstrated locking out electrical and potential energy sources of Hockmeyer equipment for cleaning and maintenance activities, including applying a site-specific 3-D printed lockout accessory device to protect interlock wire lines when used in combination with a safety block to lock out the mill head in the raised position.[1] However, the following weaknesses were identified.

- Contrary to the signage requirements in section 5 of HDI work control procedure *Warnings and Barriers for Hazards*, four instances of signage usage that conflicted with this HDI or provided direction that was contrary to the LOTO HDI were observed. (See **Deficiency D-BMI-2**.) A miscommunication of hazardous conditions could result in inadequate worker protection, leading to injury or death. BMI implemented HDI work control procedure *Warnings and Barriers for Hazards* to specify the use of hazard awareness signs to indicate conditions that have a potential safety impact to workers. This HDI defines the use of specific signal words that are intended to capture the immediate attention of workers. For example, "WARNING" indicates a hazardous situation that, if not avoided, could result in death or serious injury, and "NOTICE" indicates information considered important but not hazard-related (i.e., messages relating to property damage, security, sanitation, and housekeeping). The following observed signage did not adequately communicate hazards:
    - At the cable motor test bed research area, WARNING is used on signage near the undamaged, insulated "control" loop, even though no hazardous condition is present. The area's limited approach boundary also has WARNING signage posted, which appropriately communicates the potential hazard. Using the same signal word for both scenarios may result in workers misinterpreting the actual risks.
    - The service corridor entrance of the 1401 laboratory in EMSL is posted as a class IV laser area. NOTICE signage is used to inform personnel that the entry door interlock, an engineering control for reducing risk, is inoperable; this is in contrast to the HDI requirement for hazard-related (e.g., WARNING or DANGER) signage.
    - In the Building 350 machine shop, an area near a mechanical shear that has a hazard area boundary delineated by a waist-high cable is inappropriately posted with signage communicating that either using LOTO or turning off equipment are options for entry; activity-level expectations for work conducted in this demarcated area are not defined elsewhere, such as in an SOP.
    - Several EDM machines were available for use at the F&IO shops without warnings for potential electric field hazards. (One machine in the Building 350 machine shop and one room at PSF were posted with pacemaker warnings.)
- Contrary to 10 CFR 851.22(b) and 29 CFR 1910.147(c)(2), Lab Assist 8087, *Excimer laser and PLD alignment, maintenance*, does not apply LOTO requirements to eliminate the potential for exposure to hazardous energy wherever feasible. (See **Deficiency D-BMI-3**.) Not applying LOTO requirements wherever feasible exposes workers to hazardous energy. Requirements for LOTO of laser systems are less stringent than site requirements for other hazardous energy sources (e.g., electrical, mechanical, thermal). Specifically, hazardous energy controls in HDI work control procedure *Laser Systems* rely on engineering controls, administrative controls, and personal protective equipment

[1] The SOP identified the interlock wire as a hydraulic line in the SOP. BMI stated that this error will be corrected in the next revision.

(PPE) instead of hazard elimination through LOTO where feasible. For example, the work package for Lab Assist 8087 instructs workers to perform maintenance on the vacuum side of the PLD chamber and exchange PLD targets during scenarios where the laser is permitted to continue operating. This includes scenarios where the laser is used for beam alignment or performing depositions in a second PLD, rather than isolating power using LOTO. Additionally, while the work package specifies cord and plug control for troubleshooting activities, this control does not adequately address stored energy in high voltage capacitors, which can cause spontaneous emission of a laser pulse.

- The hazardous energy controls for the cable motor test bed were not adequately developed. (See **OFI-BMI-1**.) SOP-2410-ARENA requires the plug to the cabinet to be under the exclusive control of the worker, within line of sight, unplugged, and in arm's reach of the worker during set-up. However, the size and layout of the experimental set-up is too large to maintain control of the plug in that manner. In addition, there are discrepancies between the SOP, observations during a walkdown of the project, and worker interviews. For example, the administrative barrier (i.e., approach boundary) is set at 10 feet in the laboratory, with workers stating that was chosen based on the design of the experimental setup. This is inconsistent with the 1-meter (3.28 feet) administrative barrier identified in the SOP.

*Machine Guarding*

Observed machine guarding hazard controls were generally well developed and implemented to protect workers. Controls were observed to be generally effectively implemented for approximately 100 machines, either in use or through area walkdowns, at locations under the control of F&IO, such as Building 350 central shops, the EMSL machine shop, PSF, Physical Sciences Laboratory (PSL) machine shop, and RPL machine shop, as well as four divisional laboratory/machine shop areas. Specifically:

- Most point-of-operation guards were provided and in place.
- Most emergency stop buttons or bars were provided.
- Guards were firmly secured and not easily removeable.
- Most warning and hazard labels were affixed to the machines.
- Most chip shields were installed or available when the risk of debris hitting an operator was present.
- Most gears, sprockets, pulleys, and flywheels were guarded.
- Most belts and chain drives were guarded.
- Exposed set screws, keyways, and collars were guarded.
- Doors and access panels to the machine electrical switches were securely closed.
- Electrical cords or connectors were in good condition.
- Machine controls were within easy reach of operators.
- Most on/off and start/stop switches were distinct (red coloration for stop) and easy to identify.
- Machine bases were securely anchored to the ground or work surface.

While observed machine guarding hazard controls were generally adequate, contrary to HDI work control procedure *Tools and Machinery*, section 5, some observed machines were either in use or available for use in machine shops without the required protective guarding devices. (See **Deficiency D-BMI-4**.) Not using required protective guarding devices could place workers at risk of injury. HDI work control

procedure *Tools and Machinery HDI*, section 5, requires that "tools are adequately guarded, awareness barriers, gates, or shields are in place…and tools are in safe operating condition." Additionally, section 5 of the HDI addresses requirements for emergency stop controls and anti-restart capabilities. In contrast, the following conditions were observed:

- Several pieces of equipment (primarily milling machines in Building 350, EMSL, RPL, and PSF) did not have emergency stop controls.
- Equipment in most machine shops did not have the required anti-restart capability to prevent automatic restarts during power interruptions.
- A vertical belt sander in the Building 350 carpenter shop did not have distinctly colored on/off switching.
- An abrasive cut-off (Pistorius) saw at PSL did not have guarding devices to protect workers against chip, liquid, or debris spatter, or potential access to unguarded abrasive surfaces. This issue was immediately corrected by taking the saw out of service.

**Performing Work Within Controls**

BMI adequately performed observed hazardous energy control (LOTO) and machining work within defined work controls by effectively implementing work planning, stop work authority, and the safe use of equipment with appropriate SME engagement. Observed pre-job briefings were comprehensive and addressed the work scope, tasks, and hazard controls.

*Lockout/Tagout*

BMI's implementation of procedures and processes is adequate for the control of potentially hazardous energy when employees are engaged in the servicing or maintenance on a machine or equipment. Four observed plan-of-the-day meetings were effective in communicating the status of ongoing projects, planned work to be performed, the need for LOTO for specific activities, and verification that the facility status was appropriate for the work to be performed. The two observed pre-job briefings (one for a LOTO-covered activity) were comprehensive and effective in communicating the scope of activities, potential hazards associated with the work (including co-located activities), PPE requirements, and pause and stop work authorities. Workers were attentive and engaged, with frequent two-way discussions on scope, hazards, and controls.

Overall, observed LOTO work activities were performed in accordance with the governing HDI and LOTO permit requirements. LOTO devices were installed in a manner to minimize the potential for dislodgement. Activities to de-energize and re-energize systems were performed with appropriate PPE and work practices to minimize the potential for injury.

For observed systems not actively undergoing LOTO, interviews and demonstrations were consistent with HDI requirements. LOTO demonstrations for the Hockmeyer immersion mill illustrated work practices and worker knowledge adequate to control both hazardous energy sources for this equipment. Similarly, during a walkdown, an interviewed researcher demonstrated adequate knowledge and understanding of the hazardous energy sources in the MHTLS and LOTO requirements associated with servicing various components (e.g., nitrogen supply system, filters, heaters). In addition, LOTO requirements are specified in the SOP for routine reconfiguration activities for the Stanat rolling mill.

*Machine Guarding*

Observed work was conducted in accordance with established controls (HDIs and worker safety and health procedures). Researchers, technicians, and F&IO machinists performed observed work safely using appropriate machine guarding practices. Reviewed procedures associated with several observed projects contained instructions to address specific hazard controls, including machine guarding. Interviewed cognizant site managers (CSMs) were knowledgeable of the hazards and have considerable experience within their areas of expertise.

**Feedback and Improvement**

*Lockout/Tagout*

An observed post-job briefing was effective in providing feedback on the completed activity. The briefing was held after the completion of LOTO to permit the safe removal of water, sand, and debris from a high-pressure water jet in RPL. Workers were attentive and engaged, with frequent two-way discussions covering what went well and areas where improvements in planning and supplies could be pursued.

In addition, for five previous event responses reviewed, BMI effectively evaluated events involving potential exposure to hazardous energy, implemented corrective actions to address both event-specific issues and broader systemic weaknesses, and developed and shared lessons learned. Causal analyses of previous MHTLS and melt spinner hazardous energy events, and roll-up of three LOTO-related Occurrence Reporting and Processing System (ORPS) events adequately considered a variety of factors contributing to those events. Based on factors identified through recent events, the LOTO SME has appropriately initiated action to compile a list of Lab Assist activities where similar systems might be in use to evaluate those activities on a prioritized basis.

*Machine Guarding*

Feedback (a fact-finding report and interviews) associated with the discovery of the Blue M Furnace with unguarded chain/gear drives was inadequate. (See **OFI-BMI-2**.) The fact-finding report did not specify the time duration that researchers worked in proximity to the unguarded equipment without reporting the condition, or record the R&D workers' awareness level of the potential hazard (the actual hazard was identified by F&IO staff members). Interviewed WS&H and F&IO staff expressed concern about the time duration (potentially weeks or months) that the equipment may have been left in disrepair (i.e., unguarded) and the lack of any reports of these conditions by researchers or the laboratory CSMs.

**Work Planning and Control Implementation Conclusions**

BMI is generally effective in managing work associated with hazardous energy control (LOTO) and machine guarding by defining the scope of work, identifying and analyzing hazards, developing and implementing hazard controls, and performing work within controls. Additionally, BMI has effectively evaluated events involving potential exposure to hazardous energy and machine guarding and has generated and shared lessons learned. However, weaknesses were identified in the areas of signage, exempting pressurized systems from LOTO, ensuring LOTO requirements are applied in all cases where feasible, and machine guarding on some observed machines. Also, the feedback associated with the discovery of the Blue M Furnace with unguarded chain/gear drive was inadequate.

## 3.3 Federal Oversight

This portion of the assessment evaluated PNSO's oversight of the BMI LOTO and machine guarding programs, as well as PNSO's management of safety issues, Facility Representative (FR) program, oversight staff technical qualification program (TQP), lessons learned and operating experience (OPEX) program, and employee concerns program (ECP).

### Oversight

PNSO has developed an effective oversight program that is implemented through PNSO-PCDR-02, *PNSO Oversight Program Procedure,* for the BMI LOTO and machine guarding programs. Open lines of communication are maintained and documented issues are transmitted from PNSO oversight staff to appropriate staff at BMI. These issues are communicated using formal and informal methods based on a graded approach. The Operations Division, safety and health SMEs, and FRs from the Mission Integration and Projects (MIP) Division conduct assessments, surveillances, operational awareness activities, and transactional reviews. PNSO staff conducted oversight assessments of BMI's LOTO program and prepared formal, thoroughly written reports with evidence supporting identified issues and performance conclusions in 2020 and 2024. Operational awareness activities of LOTO and machine guarding, including document reviews, walkthroughs, informal communications, meetings, work observations, and FR weekly reports, are documented in the Performance Assurance Reporting (PAR) tool; however, the information entered into the PAR tool is not used to track and trend lower-level issues to assist future oversight planning. (See **OFI-PNSO-1**.) Interviews with SMEs and FRs reflected strong engagement between the two groups, and staff were observed working collaboratively to share information on contractor programs, implementation, field observations, and events.

### Issues Management

PNSO is effective in providing management oversight of BMI's management of safety issues. Oversight staff have unrestricted access to BMI's Issue Tracking System and Noncompliance Tracking System where they can verify the screening level, any actions developed or taken to address the issue, and supporting evidence for issue closure. Interviews revealed that issue follow-up occurs effectively, and if needed, productive discussions and formal processes are used to effectively resolve any disputes that arise. Regular monthly issues management meetings are held with BMI to review higher risk category issue (level 2 and 3) corrective action plans, corrective actions taken, and effectiveness reviews.

### Facility Representative Program

PNSO completed an FR staffing analysis in April 2024 showing that PNNL operations require 3.85 full-time FRs. At the time of this assessment, there were four qualified FRs. However, contrary to PNSO-PCDR-24, *PNSO Facility Representative Oversight Program*, section 3.2.8, and DOE-STD-1063-2021, *Facility Representatives*, section 5.6.2 and appendix B, PNSO has not conducted a triennial self-assessment of its FR program since July 2016. (See **Deficiency D-PNSO-1**.) A lack of periodic self-assessments could enable program weaknesses to endure and impact the effectiveness of the PNSO FR program.

### Technical Qualification Program

PNSO has established and implemented a TQP that generally meets DOE Order 426.1B, *Department of Energy Federal Technical Capabilities*. PNSO-PLAN-03, *PNSO Training & Qualification Management Plan*, describes how the organization will implement the TQP qualification process. However, contrary to DOE Order 426.1B, section 4.f.(4)(c), the plan does not include the current requirement for completing

80 hours of continuing training activities in a nominal 5-year cycle. (See **Deficiency D-PNSO-2**.) Not completing the required continuing training could limit the effectiveness of the participant's oversight.

Currently, oversight staff complete and document continuing training in an ad hoc manner. Managers are notified by email when their assigned staff make continuing training entries in the electronic technical qualification program (eTQP) system. A review of the MIP Division revealed that all four FRs are fully qualified. However, contrary to DOE Order 426.1B, section 4.c.(4)(a), a review of the Operations Division qualification records revealed that half of the safety management staff are qualified, and the other half have not been assigned TQP qualifications within 90 days of onboarding. (See **Deficiency D-PNSO-3**.) Delaying the assignment of required qualifications could result in inadequate oversight. Additionally, contrary to DOE Order 426.1B, section 4.c.(6), PNSO-PLAN-03 does not establish expectations for the frequency of self-assessments; PNSO last assessed the TQP program in August 2020. (See **Deficiency D-PNSO-4**.) Without self-assessments that identify the strengths and weaknesses in the TQP program, the PNSO Manager may not have all necessary information for its effective administration.

**Lessons Learned and Operating Experience Program**

PNSO has a generally effective lessons learned and OPEX program. PNSO staff members are familiar with the principles of EHSS's *Charter for the Operating Experience Committee*. The PNSO OPEX Coordinator appropriately participates in monthly calls with DOE Headquarters. Appropriate staff members have obtained access to the OPEX system and use information to promote and facilitate continued learning about DOE complex-wide operating experience. However, the PNSO Manager has not formally appointed the OPEX Coordinator with a designation letter.

**Employee Concerns Program**

PNSO has a generally effective ECP. Local administration of the program is performed by the ECP Coordinator with support from the ECP Manager in SC's Office of Safety and Security, who conducts a monthly employee concerns network call for all SC site office coordinators. The ECP is advertised to PNSO and BMI staff on bulletin boards across the PNNL campus and in various links on the SC website. The local ECP Coordinator provides a briefing to new PNSO employees and assists with delivering semi-annual briefings to BMI staff. The PNSO Manager distributes an annual ECP notice that endorses the program and describes how Federal, contractor and subcontractor employees can access information and submit concerns. The ECP Coordinator administers the program using the SCMS *Employee Concerns Program Description*. The ECP system description appropriately requires the ECP Coordinator to receive, secure, process, and properly resolve cases. The last biennial self-assessment was completed using a questionnaire format that was solicited by the SC ECP Manager and submitted by PNSO on March 16, 2022. Consequently, contrary to DOE Order 442.1B, *Department of Energy Employee Concerns Program*, appendix A, section 6.b.(1), PNSO has not conducted a biennial self-assessment of its ECP. (See **Deficiency D-PNSO-5**.) Self-assessments that are not conducted regularly could result in unidentified program weaknesses.

**Federal Oversight Conclusions**

PNSO conducts effective oversight of BMI's LOTO and machine guarding programs. FRs and SMEs work collaboratively to conduct oversight and communicate information on contractor programs and implementation. Identified issues are documented and transmitted to BMI through formal and informal channels using a graded approach. Oversight staffing levels are stable at the time of this assessment. However, PNSO has not completed required self-assessments of its FR and ECP programs, and has not prescribed the frequency of self-assessments of the TQP program in the implementing procedure; some oversight staff have not been assigned required qualifications.

## 4.0 BEST PRACTICES

No best practices were identified during this assessment.

## 5.0 FINDINGS

No findings were identified during this assessment.

## 6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

**Battelle Memorial Institute, Pacific Northwest Division**

**Deficiency D-BMI-1**: BMI does not have a documented basis for thresholds or exclusions established to exempt pressurized systems from the LOTO requirements of 29 CFR 1910.147. (10 CFR 851.21(a)(2))

**Deficiency D-BMI-2**: BMI does not ensure that all signage is in accordance with the HDI work control procedure *Warnings and Barriers for Hazards*. (HDI work control procedure *Warnings and Barriers for Hazards*, sec. 5)

**Deficiency D-BMI-3**: BMI does not apply LOTO requirements in laser operations to eliminate the potential for exposure to hazardous energy. (10 CFR 851.22(b) and 29 CFR 1910.147(c)(2))

**Deficiency D-BMI-4**: BMI did not ensure that all equipment was in a safe operating condition and that one abrasive cut off saw was adequately guarded. (HDI work control procedure *Tools and Machinery*, sec. 5, and 29 CFR 1910.212(a)(2))

**Pacific Northwest Site Office**

**Deficiency D-PNSO-1**: PNSO did not conduct a triennial self-assessment of its FR program. (PNSO-PCDR-24, sec. 3.2.8, and DOE-STD-1063-2021, sec. 5.6.2 and app. B)

**Deficiency D-PNSO-2**: PNSO does not include the requirement for staff to complete 80 hours of continuing training activities in a nominal 5-year cycle in PNSO-PLAN-03. (DOE Order 426.1B, sec. 4.f.(4)(c))

**Deficiency D-PNSO-3**: PNSO has not assigned required TQP qualification standards to all Operations Division safety management staff within 90 days. (DOE Order 426.1B, sec. 4.c.(4)(a))

**Deficiency D-PNSO-4**: PNSO has not established expectations for the frequency of self-assessments of its TQP in procedure PNSO-PLAN-03. (DOE Order 426.1B, sec. 4.c.(6))

**Deficiency D-PNSO-5**: PNSO has not conducted a biennial self-assessment of its ECP. (DOE Order 442.1B, app. A, sec. 6.b.(1))

## 7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFIs shown below to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

**Battelle Memorial Institute, Pacific Northwest Division**

**OFI-BMI-1**: Consider reevaluating SOP 2410-ARENA to ensure that the hazardous energy controls are adequately defined, feasible, and consistent throughout.

**OFI-BMI-2**: Consider conducting a root cause analysis to preclude recurrence of unguarded chain/gear drives.

**Pacific Northwest Site Office**

**OFI-PNSO-1**: Consider adding categorizing and trending capabilities to the PAR tool to assist PNSO staff in developing risk-informed annual assessment plans.

# Appendix A
# Supplemental Information

**Dates of Assessment**

March 27 to May 24, 2024

**Office of Enterprise Assessments (EA) Management**

John E. Dupuy, Director, Office of Enterprise Assessments
William F. West, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
David A. Young, Deputy Director, Office of Environment, Safety and Health Assessments
Thomas E. Sowinski, Director, Office of Nuclear Safety and Environmental Assessments
Kimberly G. Nelson, Director, Office of Worker Safety and Health Assessments
Jack E. Winston, Director, Office of Emergency Management Assessments
Brent L. Jones, Director, Office of Nuclear Engineering and Safety Basis Assessments

**Quality Review Board**

William F. West, Advisor
Kevin G. Kilp, Chair
Sarah C. R. Gately
Thomas E. Sowinski
William A. Eckroade

**EA Assessment Team**

Thomas M. Wirgau, Lead
Lawrence J. Denicola
Joseph Lischinsky
David Olah