# Work Planning and Control Assessment at the Idaho National Laboratory

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Office of Enterprise Assessments
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## Table of Contents

## Acronyms

| | |
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| ALARA | As Low As Reasonably Achievable |
| ARA | Airborne Radioactivity Area |
| ATR | Advanced Test Reactor |
| BEA | Battelle Energy Alliance, LLC |
| CAM | Continuous Air Monitor |
| CAS | Contractor Assurance System |
| CFR | Code of Federal Regulations |
| DOE | U.S. Department of Energy |
| DOE-ID | DOE Idaho Operations Office |
| DOP | Detailed Operating Procedure |
| EA | Office of Enterprise Assessments |
| ECP | Employee Concerns Program |
| ES&H | Environment, Safety, and Health |
| FHPA | Fall Hazard Prevention Analysis |
| FR | Facility Representative |
| FY | Fiscal Year |
| HVAC | Heating, Ventilation, and Air Conditioning |
| I&C | Instrumentation and Control |
| IH | Industrial Hygiene |
| IMCL | Irradiated Material Characterization Laboratory |
| INL | Idaho National Laboratory |
| ISM | Integrated Safety Management |
| ISMS | Integrated Safety Management System |
| LI | Laboratory Instruction |
| LO/TO | Lockout/Tagout |
| MFC | Materials and Fuels Complex |
| NFPA | National Fire Protection Association |
| OFI | Opportunity for Improvement |
| OMM | Operating and Maintenance Manual |
| OPEX | Operating Experience Program |
| ORPS | Occurrence Reporting and Processing System |
| PDD | Program Description Document |
| POD | Plan of the Day |
| POW | Plan of the Week |
| PPE | Personal Protective Equipment |
| R&D | Research and Development |
| RADCON | Radiological Control |
| RCT | Radiological Control Technician |
| RWP | Radiological Work Permit |
| SME | Subject Matter Expert |
| TREAT | Transient Reactor Test Facility |
| WP&C | Work Planning and Control |

# Work Planning and Control Assessment at the Idaho National Laboratory June 24-27 and July 8-11, 2019

## Summary


**Scope:**
This assessment evaluated the work planning and control (WP&C) processes at the Idaho National Laboratory (INL), which is managed and operated by Battelle Energy Alliance, LLC (BEA). The assessment focused on the Materials and Fuels Complex and the Advanced Test Reactor, and observation of research and maintenance activities in multiple facilities. Other reviewed areas included electrical safety and the contractor assurance system. In addition, the DOE Idaho Operations Office (DOE-ID) oversight processes were assessed.

**Significant Results for Key Areas of Interest:**
Overall, BEA has developed and implemented a WP&C process that has been effective in implementing the Integrated Safety Management (ISM) Core Functions for both research and maintenance work activities, although a few deficiencies were identified in WP&C program development and implementation.

Work Planning and Control Institutional Programs
BEA has mature WP&C institutional programs and processes that generally result in the safe performance of research and maintenance work. However, the diversity of research at INL has resulted in overlapping and sometimes conflicting research WP&C procedures. One WP&C programmatic deficiency was identified in that BEA has not established clear guidance or provided the supporting training necessary to ensure that trained and qualified personnel perform work planning for skill-of-the-craft work.

Work Planning and Control Implementation
The workforce is experienced and qualified. The workers and researchers were effectively integrated into the WP&C processes and provided examples where they paused/stopped work as needed. Overall, the WP&C institutional programs are adequately implemented, but five deficiencies were identified in implementing WP&C programs with respect to research work scope definitions, administrative controls and documentation of controls, pre-job briefings, and job-specific radiological air sampling.

Electrical Safety
The BEA electrical safety program meets requirements, and BEA is diligently working to address potential shock hazards associated with multiwire (Edison) branch circuits and has installed arc flash warning labels on equipment. Observed electrical work was conducted in a safe manner by qualified electrical workers; however, there was one observed instance of a lockout/tagout violation.

Contractor Assurance System and DOE-ID Oversight
BEA has effectively developed and implemented procedures and processes that contribute to the improvement of WP&C processes. Overall, DOE-ID has established appropriate procedures for and effectively implemented Federal line oversight of WP&C.

Best Practices and Findings
The following three best practices were identified as part of this assessment.

- The ATR Maintenance Execution Walkdown Checklist “Ready Ready” process helps ensure that work is ready to be performed and includes a walkdown by the craft to ensure that conditions have not changed, tools are available, etc.
- BEA’s use of the small Landauer, Inc. nanoDot single chip dosimeter and Micro Star reader to supplement traditional finger rings during high extremity dose work allows for effective tracking, management, and prevention of possible overexposures.
- BEA has developed a comprehensive process to address the electrical shock hazard presented by multiwire (Edison) branch circuits.

There were no findings identified as part of this assessment.

**Follow-up Actions:**
No follow-up activities are planned.

**Work Planning and Control Assessment**
**at the Idaho 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) at the Idaho National Laboratory (INL), which is managed by Battelle Energy Alliance, LLC (BEA). This assessment, which was conducted on June 24-27 and July 8-11, 2019, evaluated the effectiveness of the implementation of the integrated safety management (ISM) core functions (define scope of work, identify and analyze hazards, identify and implement controls, perform work safely within controls, and feedback and improvement) for activity-level work. This assessment also evaluated elements of the contractor assurance system (CAS) and the oversight provided by the DOE Idaho Operations Office (DOE-ID).

In accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Work Planning and Control Program at Idaho National Laboratory, June 2019*, this assessment focused on facilities at the Materials and Fuels Complex (MFC) and the Advanced Test Reactor (ATR) Complex, but also included a few select work observations at the Idaho National Laboratory Research Center, and the Central Facilities Area. MFC is a testing center for nuclear reactor fuels, and ATR is a nuclear test reactor. The assessment included research and maintenance activities primarily at MFC and ATR, with a special emphasis on electrical safety.

## 2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented 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 DOE Order 227.1A.

As identified in the assessment plan, this assessment considered requirements related to WP&C and the CAS included in DOE Contract Number DE-AC07-05ID14517. The assessment team used sections of 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*; Criteria Review and Approach Document (CRAD) EA-32-03, Rev. 0, *Industrial Hygiene Criteria Review and Approach Document*; CRAD EA-45-35, Rev. 1, *Occupational Radiation Protection Criteria Review and Approach Document*; and CRAD EA-30-01, Rev. 1, *Contractor Assurance System*. The assessment team also used selected feedback and improvement criteria from within DOE Guide 226.1-2A.

The assessment team observed the planning and implementation of work activities in two primary areas:

- Activities associated with research, including research-related work in nuclear facilities
- Activities associated with maintenance.

The assessment team examined key documents, such as system descriptions, work packages, procedures, laboratory instructions (LIs), manuals, analyses, policies, and training and qualification records. The assessment team also interviewed key personnel responsible for developing and executing the associated programs, observed 35 work activities, and walked down significant portions of selected MFC and ATR facilities.  Appendix A lists the members of the assessment team, the Quality Review Board, and management responsible for this assessment.

EA has not conducted a recent assessment of WP&C at INL.  Therefore, there were no items for follow-up during this assessment.

## 3.0 RESULTS

The objective of this assessment was to verify that BEA manages and performs work in accordance with a documented Safety Management System that (1) defines the scope of work; (2) identifies and analyzes hazards associated with the work; (3) develops and implements hazard controls; (4) performs work within controls; and (5) provides feedback on the adequacy of controls and continues to improve safety management.  (48 CFR 970.5223-1(c), *Integration of environment, safety, and health into work planning and execution*, and DOE Contract Number DE-AC07-05ID14517, Clause I.22, *Integration of Environment, Safety, and Health into Work Planning and Execution*)

BEA has mature WP&C institutional programs and processes that generally result in the safe performance of research and maintenance work.  The workforce is experienced and qualified.  The workers and researchers were effectively integrated into the WP&C processes and provided examples where they paused/stopped work as needed.  Overall, the WP&C institutional programs are adequately implemented.

However, the diversity of research at INL has resulted in overlapping and sometimes conflicting research WP&C procedures.  One WP&C programmatic deficiency was identified in that BEA has not established clear guidance or provided the supporting training necessary to ensure that trained and qualified personnel perform work planning for skill-of-the-craft work.  Also, five deficiencies were identified in implementing WP&C programs with respect to research work scope definitions, administrative controls and documentation of controls, pre-job briefings, and job-specific radiological air sampling.

### 3.1 Work Planning and Control Institutional Programs

The objective of this portion of the assessment was to verify that BEA has established WP&C processes to enable the safe performance of work.

Overall, for all work observed, the INL Program Description Document (PDD) on the Integrated Safety Management System (ISMS) (PDD-1004) provides a useful structure for how environment, safety, and health (ES&H) requirements and the DOE ISMS core functions and guiding principles are to be incorporated into WP&C at INL.

**Research Work Planning and Control Institutional Programs**

The WP&C process for research related work in nuclear facilities (i.e.., reactor and hot cell operations, fuel processing, fuel irradiation and testing, and other related radiological work) is well defined in the INL *Work Management* procedure (LWP-21220).  LWP-21220 effectively defines the INL requirements for implementing the ISM core functions, and for developing and implementing work control documents, including LIs, which are the principal work control documents.  Other technical work documents supplement the requirements of LWP-21220, such as detailed operating procedures (DOPs), operating and maintenance manuals (OMMs), and operating instructions.  These supplemental technical work documents are also effective in implementing the WP&C process as defined in LWP-21220.  Radiological hazards are inherent across MFC and ATR activities, and BEA has a mature radiation protection program supported by detailed implementing procedures and technical basis documents for radiological control (RADCON) functional areas, which supplement the WP&C process.

Research personnel in non-nuclear facilities are also required to follow LWP-21220 when planning and conducting research work. For example, staff at both MFC and ATR used LIs developed under LWP-21220 to perform many observed activity-level work evolutions. However, another WP&C process, the *Conduct of Research* procedure (LWP-20000), is also required to be followed for the planning and implementation of research activities. BEA classifies both procedures as "laboratory-wide procedures." Most MFC research organizations typically follow LWP-21220, whereas Science and Technology organizations, which also perform research within laboratories at MFC and ATR, follow LWP-20000, or both procedures. In some cases, the two procedures are similar (e.g., types of work control documents required for various risk categories), but in other areas (e.g., defining the work scope), the two procedures have different requirements. For example, only LWP-20000 includes a section devoted to "Scope Creep." Based on interviews with Laboratory managers, INL organizations have made a determination of which of these two research processes, or combination of processes, they will follow. INL does not have an overarching research work control structure that provides guidance in making such a determination. Experimental nuclear materials research performed in the INL reactors (e.g., ATR and the Transient Reactor Test Facility or TREAT) follows a separate and more robust work control process (i.e., neither the LWP-21220 or LWP-20000 WP&C process), which is defined in the *Nuclear Materials Experiments Execution Process* procedure (LWP-20700). (See Section 3.2.1, Performing Work Within Controls, and **OFI-BEA-R&D-1**.)

**Maintenance Work Planning and Control Institutional Program**

Procedure LWP-6200, *Maintenance Integrated Work Control Process*, adequately defines maintenance WP&C processes. INL bins maintenance work into two categories – planned work and skill-of-the-craft work. The maintenance WP&C procedures, including GDE-6200, *Planners Guide*, provide an appropriate framework for creating detailed technical work packages for planned work. The WP&C process ensures worker involvement in the work planning process by requiring workers to participate on the planning team, participate in a planning walkdown, and provide feedback after the completion of the job. Both ATR and MFC have implemented appropriate processes to facilitate the completion of work packages and reduce work order changes. ATR has implemented a Maintenance Execution Walkdown Checklist "Ready Ready" process, which requires a walkdown by the craft when a package is ready but before the work is started. This **Best Practice** helps ensure that work is ready to be performed and includes a walkdown by the craft to ensure that, for example, conditions have not changed and tools are available. This practice has the dual benefit of ensuring that workers are involved in the WP&C process as well as verifying readiness to perform work. At MFC, the job foremen are included in the review and approval of planned work packages.

The assessment team noted issues with work planning for skill-of-the-craft work. Procedure LWP-6200 allows work expediters to perform the initial screening of work requests to determine whether the work should be skill-of-the-craft or planned work. This screening function requires an understanding of the potential hazards and controls for the work requested. The work expediters are not qualified to perform the screening function and have not been trained on hazard identification and controls selection. Additionally, LWP-6200 does not provide instructions for hazards identification/mitigating controls for minor maintenance. This lack of instruction is contrary to LRD-14700, *Worker Safety and Health: General Program Requirements*, which states that INL must "provide training and information to workers who have worker safety and health program responsibilities that is necessary for them to carry out those responsibilities" and "evaluate operations, procedures, and facilities to identify workplace hazards and perform workplace and routine job activity-level hazard analyses." (See **Deficiency D-BEA-MNT-1**.)

**Work Planning and Control Institutional Programs Conclusions**

BEA has mature WP&C institutional programs and processes that generally result in the safe performance of work. PDD-1004 provides a useful structure for how ES&H requirements, and the DOE ISMS core functions and guiding principles, are to be incorporated into WP&C at INL. The WP&C process for research activities is well defined in LWP-21220; however, there is duplication and the potential for conflict with the similar LWP-20000 procedure. Procedure LWP-6200 adequately defines the maintenance WP&C processes, but BEA has not established clear guidance or provided the supporting training necessary to ensure that trained and qualified personnel perform work planning for skill-of-the-craft work.

## 3.2 Work Planning and Control Implementation

### 3.2.1 Research

The objective of this portion of the assessment was to assess BEA's implementation of its institutional WP&C program for research-related activities. The assessment team observed 7 experimental activities and 13 research-related activities, primarily at ATR and MFC facilities.

**Defining the Scope of Work**

With two exceptions (discussed under *Performing Work Within Controls* in this section), experimental work scopes were generally described in sufficient detail such that the hazards could be identified and the appropriate hazard controls and work schedules could be developed. Work scopes were prepared in accordance with the work scope requirements of either LWP-21220 or LWP-20000. Work scopes for observed nuclear materials experiments, such as those observed at ATR and TREAT, were extensive and consistent with the requirements of LWP-20700.

**Identifying and Analyzing Hazards Associated with the Work**

Hazards for all observed work activities were identified, documented, and analyzed for significance. All observed work activities were appropriately deemed as greater than low risk and were performed using LIs. For observed activities, the requirements of LRD-14005, *Activity Level Hazard Identification, Analysis and Control*, were followed. The computer-based Hazard and Risk Planning System produces a detailed and effective Risks and Controls table embedded within each research LI. For nuclear materials experiments at ATR and TREAT, an experimental safety analysis is prepared to demonstrate that the experiment can be safely received, irradiated, and handled in the reactor facility. Of the seven experimental activities observed by the assessment team, only one did not identify and sufficiently analyze the hazard (i.e., the air compressor noise identified at the ATR Safety and Tritium Applied Research (STAR) laboratory).

For experimental research and research-related work, analysis of radiation hazards is accomplished through the As Low As Reasonably Achievable (ALARA) review process defined in LWP-15021, *ALARA Program and Implementation*. The assessment team observed 13 work evolutions at MFC and ATR and found that, with the one exception noted below, radiological hazards were effectively analyzed and documented. ALARA reviews were thorough and provided detailed information on the work area, allowable work scope and tasks, the associated technical work documents, radiological hazards including source term composition, expected dose rates, contamination levels, airborne levels, worker dose estimates, and methods to reduce exposures. Information from the ALARA reviews was also appropriately flowed into the specific RWPs covering the work.

At ATR, one radiological hazard analysis concern was identified. The DOPs and RWP associated with Reactor Top activities where workers access (i.e., reach/look into) the reactor shield ring "donut" do not include an evaluation of the potential for a beta dose to the lens of the eye. Standard personal protective equipment (PPE) did not include wearing safety glasses, and workers were observed working above the donut in an unshielded configuration, leaning over and looking down into the chamber while manipulating long-handled tooling. ATR RADCON management agreed that this concern should be evaluated and committed to having a subject matter expert (SME) conduct a study to determine whether the dose potential warrants additional controls.

**Developing and Implementing Hazard Controls**

Administrative controls associated with observed research activities were generally sufficient and consistent with INL procedural requirements, with the following two exceptions (see **Deficiency D-BEA-R&D-1**):

- Hazard communications postings on observed MFC laboratory doors do not accurately identify and communicate to workers which laboratories use and/or store highly hazardous chemicals (e.g., reproductive toxins) as required by LWP-14109, *Posting Safety Signs*. Identification of such chemicals in a laboratory room is not readily available because MFC chemical inventories are maintained on a building, not a laboratory room, basis, in contrast to IRC laboratories.

- The chemical use survey form 420.07 is used in conjunction with most LIs involving chemicals to identify and control chemical usage. The form is prepared by the research staff and is modified independent of the LI review and approval process, which requires an IH review. There are no requirements for an IH review of form 420.07 when new chemicals are introduced into a work activity as required by LRD-14005 and Section 3.3.2.3 of the INL *Chemical Hygiene Plan* (LWP-14620). The MFC Occupational Safety and Health Group identified the need to develop work instructions and/or procedures for this form as a goal in fiscal year 2019.

Most work observed within MFC and ATR was conducted in nuclear and radiological facilities utilizing engineering controls, which were effective in minimizing worker exposures to both chemical and radiological hazards. These engineered controls, including hot cells, gloveboxes, laboratory hoods, ventilation systems, and shielding, are used extensively and serve as the principal controls for hazard mitigation. Radiological administrative controls appropriately supplemented engineered controls, including the use of RWPs, postings, access restrictions, radiological surveys and sampling, and dose tracking to aid in controlling contamination and external radiation exposures.

Some operations, such as the observed Fuel Conditioning Facility manipulator repair group glovebox work to repair hot cell manipulators, have the potential for very high extremity doses to the hands and arms that are more limiting than whole body exposure. Permanent record of extremity dose is tracked using finger rings with laboratory analysis on a monthly basis. BEA has also proactively undertaken supplemental extremity dose tracking through use of the small Landauer, Inc. nanoDot single chip dosimeter and Micro Star reader, which allows for frequent onsite readout of extremity exposures following individual work evolutions. The assessment team considers this approach a **Best Practice** for managing potentially high extremity exposures and avoiding possible overexposures.

Internal exposure to airborne radioactive materials, such as transuranic isotopes processed at MFC, is a significant potential hazard in the event of a failure or breach of an engineered control or respirator. At the facility level, MFC processing facilities with potential airborne hazards have a comprehensive network of fixed location air samplers and/or continuous air monitors (CAMs) in radiological processing areas. The need for facility CAMs and fixed air samplers is evaluated and well documented in Technical

Evaluations and/or Engineering Calculations and Analysis documents, a sampling of which were reviewed by the assessment team.

In addition to CAMs and fixed air samplers, job-specific air sampling is also required for those work evolutions with an actual or potential risk of generating airborne radioactivity. The assessment team observed two such jobs at MFC, including work in an area requiring respiratory protection and several glovebox glove changes. In both cases, job-specific air sampling was required by the RWPs. However, during these evolutions, sampler placement was not sufficient to detect the potential presence of airborne radioactivity at the locations of interest, as required by the RWPs, associated ALARA reviews, and MCP-352, *Radiological Air Monitoring Requirements,* and LI-598, *Performing Radiological air Monitoring.* (See **Deficiency D-BEA-OPS-1**.)

- During the Hot Fuel Examination Facility Hot Repair Area entry, a job-specific air sampler was positioned upstream of the documented room airflow pattern data and was not located "between the potential release point and workers based on airflow patterns present and as close to the source as possible" as required by the ALARA review. In addition, there was no evidence that small-scale smoke tests were performed to support the sampler placement as required by the ALARA review. Radiological survey reports for similar work the day before and several months prior indicate that the same sampler placement was used during those evolutions.

- During the Waste Form Glovebox glove change work in the Analytical Chemistry facility, job-specific air sampling was required by the RWP and ALARA review. However, according to an airflow pattern data form, the sampler was positioned on the southeast end of the glovebox, which was not representative of the glove port locations being worked; these glove port locations were on the diagonally opposite side of the glovebox with airflow patterns that differ from those on the southeast end of the glovebox. There was also no documented evidence of small-scale smoke test results to support sampler placement as required by the RWP and ALARA review.

At ATR, two of the five observed research-related work activities under DOPs or OMMs were conducted with inadequate documentation of controls, contrary to the requirements of LRD-14005. (See **Deficiency D-BEA-OPS-2**.)

- The two DOPs associated with reactor top activities and the two procedures (one DOP and one OMM) associated with the reactor canal did not include the specific work step(s) applicable to the hazard control, as required by LRD-14005. The instruction sections of the procedures, which contain the actual work steps, identify precautions but not the applicable hazards or controls as required by LRD-14005.

- When working on the reactor top while shield blocks are rolled back, DOP-4.10.1.33, *Insertion of an Unirradiated AGR Experiment in the NE Flux Trap,* requires "*appropriate safety measures to protect from drowning while working over dangerous equipment*," with no further information related to specific controls to be used. During an experiment extraction, the assessment team observed a worker seated above an opening into the reactor top, with the shield block rolled back, without a fall restraint or a flotation device.

**Performing Work Within Controls**

Work authorization processes for research activities observed, in both nuclear and non-nuclear facilities, were robust. For nuclear facilities, research authorization and work release is accomplished through plan of the week (POW), plan of the day (POD), and shift supervisor work release. For research in non-nuclear facilities, department managers, laboratory managers, laboratory space coordinators, and principal investigators/researchers are actively involved in approving, authorizing, and releasing work.

Most observed pre-job briefings were comprehensive and adequately addressed the work scope, tasks, and hazards and controls. Briefings were interactive and employed good use of reverse briefing techniques and discussion of error precursors, “what if,” and emergency scenarios.

Most observed research work was performed within the work scope boundaries documented in LIs. However, in two examples (one identified by the assessment team during a work observation and another that was self- identified by INL during the same period), research work was performed outside the boundaries of the work control documents (i.e., LI and/or RWP). The second example resulted in an Occurrence Reporting and Processing System (ORPS) reportable radiological contamination of the researcher. (See **Deficiency D-BEA-R&D-2** and **OFI-BEA-R&D-2**.)

- In the first example, the assessment team observed activity-level research being performed under a broad-scope LI in which some of the work scope, hazards, and/or controls were not included in the LI. The assessment team observed a parts decontamination activity involving the removal of alpha radiation contamination from stainless steel rod segments in a glovebox using one or more chemicals and an ultrasonic bath. The research activity was being performed in the Irradiated Material Characterization Laboratory (IMCL) using the *Sampling Handling Activity* procedure, LI.1730-13-IMCL. This LI envelopes a wide variety of sample preparation activities, but it does not include a work scope for decontaminating parts and does not identify the hazards and controls associated with parts decontamination in the Risks and Controls table or link those hazards and controls to the work scope, as required by Appendix D of LWP-21220.

- In the second example, which was self-identified by INL, on July 9, 2019 in IMCL a researcher and vendor were troubleshooting an electron microscope, which involved inspecting the internal sample chamber. Upon opening the chamber, the radiological control technician (RCT) detected unexpected surface contamination above the levels allowed by the RWP and appropriately stopped the work with no personnel contamination detected. The researcher later returned to the area to wipe down the external surfaces of the microscope without understanding that the RWP was no longer valid, resulting in a reportable personnel radiological contamination of the researcher. Entry back to the area and performing decontamination of the microscope was an activity that was not defined or authorized in the work scope of the LI or the associated RWP. The BEA Critique Report for this event concluded that “no work control was present for the second entry” and identified several causal factors and draft corrective actions.

Both of these work scope creep events were performed using LIs prepared under LWP-21220 for work management, which, unlike LWP-20000 for conduct of research, does not include a section that discusses work scope creep. LWP-20000, Section 4.1.2, *Scope Creep*, states that “it is imperative that researchers fully understand the research and development (R&D) scope and boundaries of an assigned activity and perform within these limits.” See Section 3.1 for additional discussion.

During an observed pre-job briefing for DOP-4.10.1.33, there was no discussion of the collocated workers on the ATR Reactor Top or the potential need for coordinating activities, which raised a concern about ensuring readiness to perform work. The lack of pre-planning for groups working simultaneously in this area resulted in delays of work conduct for both groups and also resulted in relocation of individuals from the canal work group to other areas away from the experiment retrieval, due to increased radiation levels in the area. Additionally, the use of two cranes and the coordination of hoisting flight paths were not addressed in the pre-job briefing, or prior to encountering the condition during the work conduct. The pre-job briefing did not sufficiently cover changing conditions and was not a complete task preview as required by LWP-9201, *Briefings*. (See **Deficiency D-BEA-OPS-3**.)

A few radiological contamination control weaknesses were also observed involving potential for contamination of facial hair (beards) that was in contact with PPE, failure to follow posted instructions when doffing radiological PPE, and not frisking arms and the front of lab coats after exiting hood areas. These observations were brought to the attention of MFC and ATR RADCON management, and were subsequently discussed in RADCON daily turnover meetings and/or PODs. Subsequently, the assessment team learned that while at the site, a facial hair contamination occurred at ATR. As a result, site RADCON management was implementing additional measures to require that facial hair be properly secured under PPE.

### 3.2.2 Maintenance

The objective of this portion of the assessment was to assess INL's implementation of its institutional WP&C program for maintenance activities. The assessment team observed 15 maintenance work activities – 8 at MFC (2 at TREAT, 2 at the Fuel Conditioning Facility, 1 at the Analytical Laboratory, 2 at building 710, and 1 at Zero Power Physics Reactor), 1 at the Central Facilities Area, and 6 at ATR. Maintenance activities included skill-of-the-craft work (minor maintenance and documented minor maintenance), corrective maintenance, preventive maintenance, and planned work.

**Defining the Scope of Work**

The assessment team reviewed seven work control documents. The scope of work was adequately addressed in all of them. The work order packages for MFC and TREAT included sufficient detail to determine the location of the work (e.g., facility, equipment) and an appropriate description of the work to be accomplished. Model work orders are used to accomplish repetitive tasks and include a scope of work that is appropriately augmented by more specific information on the work order request as needed (e.g., location of scaffolding). A complex work activity at ATR involving a cask insertion was supported by a DOP (DOP-4.10.1.17, *Insertion of an Experiment*), which included a sufficient work scope description. During discussions with workers (e.g., heating, ventilation, and air conditioning, or HVAC, and Instrumentation and Control (I&C) technicians, electricians), the assessment team found that the workers were appropriately involved in the work planning process, including planning walkdowns.

**Identifying and Analyzing Hazards Associated with the Work**

For all observed work activities, the associated hazards were appropriately identified and communicated to the workers. Documented hazards analyses have been performed for the day-to-day maintenance activities at MFC (M-LI-113, *Maintenance Work Performed at MFC*) and ATR (LI-295, *General Maintenance/Operations Performed Daily*). Tailoring of the hazards and controls to the work activity is performed by the foreman during the pre-job briefing. Planned work appropriately involves a more rigorous hazards analysis process, including a planning team.

An example of worker involvement and the use of walkdowns in the identification of hazards was observed during a job to install floodlights on the roof of Experimental Breeder Reactor-II. Electricians stated that when they walked down the job, they realized that the work would require them to be within 15 feet of the edge of the roof and, as such, would require a specific Fall Hazard Prevention Analysis (FHPA). The safety SME was then involved in the analysis of the fall hazard and the subsequent development of the FHPA. As observed during the work evolutions and confirmed during interviews with workers, the RCTs and other safety SMEs are appropriately involved in the identification of workplace hazards.

**Developing and Implementing Hazard Controls**

The hierarchy of controls is considered in the development of the hazard control selection set for maintenance activities – engineered controls (e.g., machine guards, local exhaust ventilation) are used extensively in the craft shops, and engineered radiological controls (discussed in section 3.2.1 under Developing and Implementing Hazard Controls) provide protection to the maintenance workers. The controls for the day-to-day general maintenance activities are primarily administrative controls and PPE.

Job foremen use pre-job briefings to reinforce the control set for the anticipated job hazards. Controls were adequately addressed in the 10 pre-job briefings observed. For example, the pre-job briefing for an HVAC job included a discussion of the appropriate controls, including a lift plan, the hot work permit and welder PPE; the RWP; a confined space permit; lockout/tagout (LO/TO); and controls associated with the chemical hazards (e.g., safety glasses, gloves). The need to barricade the area due to the crane and lift work was identified, and equipment operators were required to wear high visibility clothes.

The assessment team observed SMEs provide briefings on permitted activities, including a briefing by the RADCON SME on the RWP for an ATR job. He distributed RADCON "cue cards" that highlighted important controls from the RWP and could be carried to the job site. The assessment team also observed the fall protection SME provide a briefing on the specific FHPA for the MFC job to install floodlights on the roof of Experimental Breeder Reactor-II. These briefings were effective in highlighting important controls to the workers.

Appropriate controls were identified for all hazards associated with the observed maintenance work activities. The minor maintenance work orders included appropriate control references (e.g., FHPAs and associated PPE, LO/TO, LIs). DOP-4.10.1.17 includes a table of activity-based hazards and controls, and appropriately includes cautions and warnings in the procedure steps. Model work orders for repetitive work include an adequate activity/hazards/hazard control set table – for example, the scaffolding erection and dismantling routine work order includes specific hazards and controls for fire loading and elevated work.

**Performing Work Within Controls**

The workers performed the job tasks in a safe and controlled manner. Workers wore appropriate PPE and demonstrated excellent communication techniques and proper adherence to the work instructions. For example, the I&C instrument technicians performing a differential pressure gauge calibration preventive maintenance activity wore appropriate anti-contamination clothing, used three-way communication with the control room, and used the circle/slash method of place-keeping with the instructions in hand. Because the system was potentially contaminated, an RCT checked smears of the breached system and provided feedback to the I&C instrument technicians. Another observed job (documented minor maintenance) involved the replacement of a 70A electrical circuit breaker. There was effective integration between the shift supervisor and maintenance workers. The shift supervisor confirmed that the work order was on the POD and that he was responsible for work release. One electrician discussed the LO/TO procedure with the shift supervisor, who authorized the electricians to perform the simple LO/TO (the electrician had the MFC LO/TO standard practice procedure in hand). The electricians wore appropriate PPE, conducted zero energy checks, and performed the work in an efficient and safe manner.

Observed work was appropriately scheduled, integrated, and authorized. The assessment team attended six PODs and reviewed the POW reports for the MFC, the POD meeting report for TREAT, and the ATR outage schedule. BEA appropriately scheduled work on the POW, and confirmed and authorized during the POD meetings. The maintenance, facility, and research organizations demonstrated effective coordination and communication during the PODs. The assessment team observed maintenance workers checking in with the shift supervisor prior to performing work and after completion of the work at MFC and ATR.

The assessment team observed 10 pre-job briefings and tailgate meetings that effectively outlined each job and the requirements for performing that job efficiently and safely. The pre-job briefings were tailored to the complexity and formality of the work, with verbal pre-job briefings provided for skill-of-the-craft work and formal documented pre-job briefings for planned work. The pre-job briefings were adequately conducted in accordance with LWP-9201, and Form 434.14, *INL Briefings*, was used for planned work to document the briefing subject matter. The job foremen effectively used Human Performance Improvement techniques, including reverse briefings and worst case scenarios, during the pre-job briefings.

MFC and ATR maintenance managers, work planning staff, craft foremen, and workers have substantial experience, and the workers demonstrated proficiency with their craft during work observations. All interviewed managers and workers stated that they were aware of the right to pause or stop work, and workers provided examples where they recently paused work (e.g., pipefitters could not get a zero energy check; electricians realized their work would be within 15 feet of the edge of the roof). Elements of effective communication were consistently demonstrated by MFC and ATR personnel while performing work during this assessment. BEA has implemented several Human Performance Improvement tools to improve the safe execution of work, such as the HUPERT trainer (mockup of gauges and actuator devices, with intentionally confusing labeling) to improve procedure compliance and communication skills; reverse briefing, worst case scenario, and "what if" techniques during pre-job briefings; and the use of three-way communication and placeholder techniques during the conduct of work.

### 3.2.3 Work Planning and Control Implementation Conclusions

Overall, the WP&C institutional programs are adequately implemented at the MFC and ATR facilities. Most observed work at ATR, MFC, and other facilities was performed under appropriate activity-level work documents, and the work scopes were adequately described, sufficient to permit hazard analyses, and in accordance with LWP-20000, LWP-20700, LWP-21220, or LWP-6200 requirements. For most observed work, the hazards were appropriately identified and analyzed. Engineered controls (e.g., hot cells, gloveboxes) are used extensively within MFC and ATR, minimizing worker exposures to both chemical and radiological hazards. Observed work was appropriately scheduled and integrated, and work authorization processes and most pre-job briefings were robust.

However, some research work scopes in broad LIs were not sufficiently defined (e.g., chemical use at MFC) and hazards and/or controls were not linked to individual research work scopes. Two research-related work examples involved scope creep (e.g., decontamination of parts and equipment at IMCL) and resulted in work being performed outside the boundaries of the work control documents. Additionally, two research-related work examples involving reactor top activities were conducted with inadequate documentation of controls, and a third reactor top activity lacked an adequate pre-job brief. Also, while most required radiological air sampling was appropriate, job-specific air sampling was not effectively performed according to requirements for two observed jobs.

## 3.3 Electrical Safety

The objective of this portion of the assessment was to assess INL's implementation of its electrical safety program, including the process for identifying multiwire (Edison) branch circuits and the installation of arc flash warning labels on certain pieces of equipment. The assessment team observed six electrical maintenance work activities – four at MFC and two at ATR (included in the maintenance activities identified in section 3.2.2).

INL's electrical safety program (PDD-14101, *Electrical Safety Program*) effectively implements 10 CFR 851, *Worker Safety and Health Program*, and National Fire Protection Association (NFPA) 70E, Section 110.1, *Electrical Safety Program*. INL accomplished five of the six observed electrical maintenance work activities safely in accordance with PDD-14101 (one LO/TO violation was observed as discussed below); these work activities included only qualified electrical workers using maintenance procedures, applying safe work practices, and wearing appropriate PPE.

Five of the six observed electrical maintenance work activities were performed on de-energized electrical equipment in accordance with LWP-9400, *Lockouts and Tagouts*. The one exception was an observed work activity that involved a worker signing in on the wrong LO/TO, resulting in the worker being potentially exposed to an uncontrolled electrical energy source. BEA held a comprehensive fact finding and issued an occurrence report for this event. Additionally, work performed at MFC included the use of SP-94.0.0, *MFC Lockouts and Tagouts Supplement to LWP-9400*. Procedures LWP-9400 and SP-94.0.0 effectively implement 10 CFR 851 and NFPA 70E.

INL maintenance and engineering organizations developed and implemented an effective process for identifying all multiwire (Edison) branch circuits fed from 120- and 277-volt, single-phase, lighting panels. The INL plans (i.e., EXH-14102, *Multiwire Branch Circuits*, and PLN-5557, *MFC Implementation Plan for Identifying and Mitigating Multi-wire Branch (Edison) Circuits*) ensure that all multiwire (Edison) branch circuits are identified, circuit breaker handle-ties are installed, and panels and circuit breakers are labeled, or the panels and circuits are rewired to eliminate this condition. The cited process for addressing multiwire (Edison) branch circuits is a **Best Practice**, and effectively implements the requirements of 10 CFR 851; NFPA 70, Section 210.4, *Multiwire Branch Circuits*; and 29 CFR 1910, Subpart S, *Electrical*.

All observed 208-volt and greater, three-phase, electrical panels, disconnect switches, motor control centers, and switchgear have a current arc flash warning label installed, as required by 10 CFR 851 and NFPA 70E. These labels provide warnings and guidance for maintenance and research personnel of the potential arc flash hazard, arc flash boundary, and the required PPE for anyone working on or operating equipment within the arc flash boundary.

**Electrical Safety Conclusions**

The INL electrical safety program is consistent with 10 CFR 851 and NFPA 70E, Section 110.1, and effectively implements recommended criteria. A **Best Practice** is noted for the process to correct the potential shock hazards associated with multiwire (Edison) branch circuits. All electrical equipment observed had a current arc flash warning label installed as required by 10 CFR 851 and NFPA 70E. Most observed electrical work was conducted in a safe manner by qualified electrical workers; however, one instance of an LO/TO violation was observed where an RCT was potentially exposed to an electrical hazard due to signing in on the wrong LO/TO.

### 3.4 Contractor Assurance System

The objective of this portion of the assessment was to ensure that BEA systematically identifies issues, concerns, and OFIs resulting in improvement in the WP&C program, and that feedback and lessons learned are factored into ongoing and future WP&C activities.

The BEA CAS effectively manages safety and health-related issues from their discovery to their resolution through corrective action. BEA uses the LabWay software application system to track issues management activities such as causal analyses, corrective actions, and trend data analysis. The assessment team looked at how effectively INL used its CAS for two ORPS-reportable events. One event was the discovery of an uncontrolled electrical energy source while performing a safe-to-work check in support of a remodeling activity at MFC. The uncontrolled energy source was determined to be the result of a disconnected neutral wire in a multiwire (Edison) branch circuit. The causal analysis triggered by INL's issues management program was effective in determining the apparent cause and generated a comprehensive corrective action plan that included determining the extent of condition of this issue and updating the LO/TO training to include an exhibit on how to effectively isolate the electrical energy of multiwire (Edison) branch circuits.

The other ORPS-reportable event involved the tipping of a mill at MFC that resulted in a serious near miss. A three-ton mill was being moved using three Hillman casters. During the move, one of the casters became misaligned due to the weight of the load. While attention was focused on this caster, an adjacent caster flipped from under the mill, causing the load to shift and the mill to tip over. This material handling event was entered into LabWay, and an apparent causal analysis was conducted. BEA disseminated lessons learned from this event throughout all onsite organizations.

Lessons learned from other sources are being leveraged by INL to improve performance. The Operating Experience Program (OPEX) provides DOE sites with examples of lessons learned from events involving safety and health issues. The searchable database in OPEX allows a site to look for information from specific types of events with specific hazard characteristics (e.g., fall protection, electrical safety, material handling). BEA tracks OPEX use by its personnel by tracking the number of downloads from the OPEX website by INL personnel over time.

LWP-13730, *Performance Assurance and Assessment*, establishes performance expectations for activities that support the INL mission. Quarterly reports are generated by the Operations Performance Analysis Committee to review research and contractor assurance data sources for the purpose of trend identification and elevation. The fiscal year 2019 Q2 CAS Quarterly Report focused on the issues surrounding the recent mill tip-over event and included high-level managerial attention and a recommendation to conduct a common cause evaluation by an independent and experienced SME.

**Contractor Assurance System Conclusions**

BEA has effectively developed and implemented procedures and processes that contribute to the improvement of WP&C processes, including managing issues from their initial identification to the closeout of corrective action plans. Feedback is solicited from workers, and lessons learned from both external (OPEX) and internal sources are incorporated into work packages and procedures. BEA demonstrates the qualities of a learning organization in its approach to safety and health issues, and has a solid programmatic approach for continuous improvement activities.

## 3.5 DOE Idaho Operations Office Oversight

The objective of this portion of the assessment was to assess DOE-ID's implementation of oversight processes to oversee and evaluate INL operations managed by BEA and the implementation of selected DOE programs.

Procedure 01.OD.03, *Integrated Safety Management System Document*, *Revision 5,* adequately describes the safety mechanisms for implementing ISM to ensure that work is performed safely in accordance with the ISMS core functions and guiding principles. DOE-ID added an eighth guiding principle, "Worker Involvement," to its ISMS in order to emphasize the necessary involvement of workers at all levels to achieve safety excellence. The assessment team observed Facility Representatives (FRs) and SMEs engaging the BEA employees in the safety-related issues discovered during oversight activities. The DOE-ID management system integrates all the elements of quality assurance, security, environment, safety, and health into an integrated management system, which promotes the full inclusion and integration of ES&H and quality assurance into the entirety of work.

Procedure 01.OD.02, *Quality Assurance Manual (QAM)*, *Revision 14*, adequately describes the DOE-ID quality assurance program purpose, policy, organizational structure and functional responsibilities, and implementation process. Attachment B to the QAM is a useful cross-reference tool and demonstrates compliance with the American Society of Mechanical Engineers Nuclear Quality Assurance NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, and applicable DOE Order 414.1D, *Quality Assurance*, criterion, and maps them to DOE-ID implementing documents. DOE-ID rated BEA's performance on "management and operation of the laboratory" and "worker health and safety program" in the Performance Evaluation and Measurement Plan (PEMP) reports collectively based on metrics from sources such as operational oversight activities, weekly reports, quarterly evaluation reports, semiannual tracking and trending reports, Computerized Accident Incident Reporting System data, ORPS data, performance-related meetings, and CAS reports. The PEMP process is effectively used as a management tool to rate and provide feedback on BEA's contract performance.

DOE-ID has implemented an effective FR program. Procedure 03.OD.03, *Facility Representative Program*, is consistent with DOE-STD-1063-2017, *Facility Representatives*, and adequately describes FR duties, responsibilities, and authorities. DOE-ID performed its FR program assessment and FR Staffing Analysis in 2018, which provided self-critical and actionable information that led to a request to create two additional FR positions.

The employee concerns program (ECP) is adequately described in 02.OD.04, *Idaho Operations Office Employee Concerns Program Procedure*. DOE-ID ECP posters containing the process for submitting a concern and other information, such as the 24-hour hotline number and whom to contact, are displayed on bulletin boards in the Willow Creek Building, Idaho Falls, and MFC building 759, but they were not displayed at ATR. All ECP cases have been investigated and closed.

The ECP procedure references an archived DOE Order 442.1A, *Department of Energy Employee Concerns Program*, and does not identify the requirements under the current DOE Order 442.1B for handling contractor employee concerns through the appropriate DOE-ID Contracting Officer. Though the procedure was not updated, the ECP manager is aware of this current requirement. DOE-ID has not conducted a self-assessment of the ECP annually, as required by 02.OD.04, in the last three years; however, a self-assessment is scheduled for this fiscal year by the ECP manager.

**DOE Idaho Operations Office Oversight Conclusions**

Overall, DOE-ID has established appropriate processes and procedures for Federal line oversight, including assessment planning and performance, operational awareness activities, issues management, and performance assurance analysis. The staff is well qualified and technically competent. Through the oversight mechanisms, DOE-ID effectively communicates oversight issues to BEA during field activities and formally through the issues management and performance evaluation processes. The current FR staffing shortage is being managed by the FRs, who are taking additional responsibilities to ensure coverage of oversight.

## 4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practices were identified as part of this assessment.

- The ATR Maintenance Execution Walkdown Checklist "Ready Ready" process helps ensure that work is ready to be performed and includes a walkdown by the craft to ensure that conditions have not changed, tools are available, etc. This has the double benefit of ensuring that workers are involved in the WP&C process and that readiness to perform work is verified.

- BEA's use of the small Landauer, Inc. nanoDot single chip dosimeter and Micro Star reader to supplement traditional finger rings during high extremity dose work allows for effective tracking, management, and prevention of possible overexposures. This is not possible with finger rings alone, which must be read on a set periodicity (monthly) by an accredited offsite laboratory and used as the permanent record of extremity exposure.

- BEA has developed a comprehensive process to address the electrical shock hazard presented by multiwire (Edison) branch circuits, including the development of training and operating procedures by the engineering and maintenance organizations, and ensures that all multiwire (Edison) branch circuits are identified, circuit breaker handle-ties installed, and panels and circuit breakers labeled, or panels and circuits are rewired to eliminate this condition.

## 5.0 FINDINGS

There were no findings identified as part of 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 Energy Alliance, LLC**

**Deficiency D-BEA-R&D-1:** Two observed BEA research activities had administrative controls that were not in compliance with INL procedures LWP-14109, LWP-14005, and LWP-14620.

- Hazard communications postings on MFC laboratory doors do not accurately identify and communicate to workers which laboratories use and/or store highly hazardous chemicals (e.g., reproductive toxins). (LWP-14109)

- The chemical exposure survey form 420.07 does not have instructions or a procedure to ensure a review by IH when new chemicals are introduced into a work activity. (LRD-14005 Section 9.9 and LWP-14620, Section 3.3.2.3)

**Deficiency D-BEA-R&D-2:** In one work observation, and one INL self-identified ORPs event, BEA research work was performed outside the boundaries of the research work documents (i.e., LI and/or RWP), which in one case resulted in a radiological contamination of the researcher. LWP-20000, Section 4.1.2, *Scope Creep*, states that "R&D activities must remain within the scope of existing work control."

**Deficiency D-BEA-OPS-1:** For two observed work evolutions that required job-specific radiological air sampling, RCTs did not ensure that air samplers were placed in close proximity to workers' breathing zones and specific locations where airborne radioactivity could be generated, as required by the associated RWPs, ALARA reviews, and MCP-352 and LI-598.

**Deficiency D-BEA-OPS-2:** BEA conducted some research work activities at ATR using procedures with inadequate documentation of controls. (LRD-14005, Sections 3.E and F)

**Deficiency D-BEA-OPS-3:** For observed ATR Reactor Top work, the pre-job briefing provided by the field work supervisor insufficiently covered changing conditions (collocated workers and activities) and did not include a complete task preview. (LWP-9201)

**Deficiency D-BEA-MNT-1:** BEA work expediters are not qualified to perform the initial screening of work requests and have not been trained to identify hazards. LWP-6200 does not provide instructions for hazards identification/mitigating controls for minor maintenance. (LRD-14700)

## 7.0 OPPORTUNITIES FOR IMPROVEMENT

The assessment team identified two OFIs to assist cognizant managers in improving programs and research 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 Energy Alliance, LLC**

**OFI-BEA-R&D-1:** Consider streamlining, integrating and strengthening the Conduct of Research work management processes:

1. Consider consolidating the research WP&C requirements from LWP-21220 and LWP-20000 into a single Conduct of Research LWP to minimize the overlap and potential conflicts that currently exist between these two documents;
2. Consider expanding the scope of this new procedure to encompass all types of INL research WP&C requirements and processes, including nuclear materials experiments
3. Consider the establishment of a Conduct of Research Board (like SRNL) to provide ownership and oversight of the INL research WP&C processes.

**OFI-BEA-R&D-2:** Consider including a section within each broad-scoped research LI that defines the work scope boundaries and, limitations. One example is the Lawrence Livermore National Laboratory *Hazard Control Plan* concept, which requires the inclusion of work scope "boundary conditions" in each hazard control plan. Another consideration for broad-scoped research LIs is to require the development of an abbreviated activity based hazard analysis (ABHA) for each experiment enveloped by the LI. The ABHA process has been used effectively at the Oak Ridge National Laboratory as a mechanism to tailor work scopes, hazards, and controls for each experiment bounded by a broad-scoped work document.

## Appendix A
## Supplemental Information

**Dates of Assessment**

Onsite Assessment: June 24-27 and July 8-11, 2019

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

Nathan H. Martin, Director, Office of Enterprise Assessments
April G. Stephenson, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
Kevin G. Kilp, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments
Charles C. Kreager, Acting Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

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