Office of Health, Safety and Security
Office of Enforcement and Oversight

Independent Review of the Occupational Radiation Protection Program as Implemented and Recently Enhanced at the Idaho National Laboratory

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Office of Safety and Emergency Management Evaluations
Office of Health, Safety and Security
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Acronyms

ALARA	As Low As Reasonably Achievable
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE-ID	DOE Idaho Site Office
DOELAP	DOE Laboratory Accreditation Program
dpm	Disintegrations per Minute
DRMS	Digital Radiation Monitoring System
HPIL	Health Physics Instrument Laboratory
HRA	High Radiation Area
HSS	Office of Health, Safety and Security
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
PPE	Personal Protective Equipment
RCT	Radiological Control Technician
RPP	Radiation Protection Program
RWP	Radiological Work Permit
VHRA	Very High Radiation Area

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1.0 PURPOSE

At the request of the Office of Nuclear Energy, and in accordance with Independent Oversight priorities, the Office of Safety and Emergency Management Evaluations within the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS) performed an initial independent assessment of the Battelle Energy Alliance, LLC (BEA) occupational radiation protection program at the Idaho National Laboratory (INL). The HSS Office of Worker Safety and Health Policy provided a subject matter expert to support this independent review. HSS examined the effectiveness and current condition of the INL program as related to the management of occupational radiological hazards to the safety and health of site personnel, commensurate with the requirements of 10 CFR Part 835.

This report discusses the background, scope, results, and conclusions of the review, as well as items for further follow-up by HSS. The review was conducted July 25-28, 2011.

2.0 BACKGROUND

In January 2011, BEA, the primary contractor responsible for the management and operation of INL, instituted a voluntary suspension of radiological work, beginning with the Materials and Fuels Complex (MFC). This action followed a history of poor performance with regard to radiological controls, dating back to March 2009. Between 2009 and early 2011, the DOE Idaho Operations Office (DOE-ID) and BEA both identified that changes to, and management of, the INL occupational radiation protection program were ineffective. BEA suspended radiological work to reassess the condition of the program, identify the major shortcomings, and develop a plan for corrective action. During this cessation of radiological work at INL, BEA identified weaknesses in key management positions and conducted independent reviews of its radiological work planning process, overall work control process, and radiological control program. Those reviews revealed additional weaknesses in access control for high radiation areas, instrumentation, and radiological worker training and qualification program effectiveness, among other things.

In addition to conducting those reviews, BEA replaced key management personnel at INL. BEA also began to develop a formal "Get Well" plan for its occupational radiological protection program, with the intention of addressing all the identified programmatic deficiencies. Among other activities, this plan initiates efforts to address human resource issues, update and upgrade training and procedures, upgrade the INL bioassay program, and more clearly define the roles and responsibilities of key radiological control personnel (e.g., radiological control supervisor, radiological control engineer). Currently, the plan indicates completion of all actions by mid-2012.

3.0 SCOPE

HSS conducted this review using an independent team to examine the occupational radiation protection program. Additionally, the HSS team evaluated the changes and potential improvements that BEA had made, and plans to make, to enhance the program going forward. The HSS team examined a variety of INL facilities to provide a broad perspective on the status and progress.

Before arriving on site, the HSS team reviewed Occurrence Reporting and Processing System (ORPS) data to clearly identify the nature of the reported radiation control noncompliances. With assistance from DOE-ID, the HSS team was able to obtain various site procedures and assess their consistency with DOE requirements and with the INL radiation protection program (RPP) implemented by BEA. When on site, the HSS team reviewed radiological work permits (RWPs), observed activities, interviewed staff, and examined facilities. The HSS team focused first on the INL facilities that present the most significant radiological hazard to site personnel and on those facilities with the highest frequency of reported radiation control concerns: the Advanced Test Reactor (ATR) Complex, MFC, and the Central Facilities Area. In addition, the Health Physics Instrument Laboratory (HPIL) and the Portable Isotopic Neutron Spectroscopy facility were toured. The criteria review and approach document, HSS-CRAD-45-35, "Occupational Radiation Protection Program Inspection Criteria, Approach, and Lines of Inquiry," was used to help guide this review.

4.0 RESULTS

The following sections discuss the HSS team's observations during the assessment of the occupational radiation protection program, as implemented at key facilities of INL. The HSS team reviewed program effectiveness at each INL facility of interest in the context of the key areas discussed in the sections below.

DOE Laboratory Accreditation Program (DOELAP)

By providing copies of DOELAP certifications, BEA demonstrated that both the external dosimetry and indirect and direct radiobioassay programs at INL are accredited in accordance with DOELAP. Currently, BEA uses vendor services to perform whole-body counts at INL; however, BEA management indicated that BEA plans to install and implement its own whole-body counting program.

Procedures

The HSS team reviewed several INL radiation protection procedures. The HSS team noted that BEA has recently improved its process for updating procedures. However, review of several INL radiation protection procedures indicates that additional clarification and/or modification is needed in several areas. The follow are examples of procedural areas needing revision:

- LWP-15017, *Radiological Release Surveys*, Appendix C, Footnote 7, states that "Type A removal contamination limit specified is for alpha emitting radionuclides. Beta emitting radionuclides in Type A will be released if removable contamination is < 100 disintegrations per minute (dpm)/100 cm^2 beta above background. Instrumentation used must be capable of measuring at these levels." The Type A row in Appendix C of LWP-15017 is the same as the 10 CFR 835 Appendix D row that includes the transuranics. However, contrary to LWP-15017, 10 CFR 835 does not allow use of 100 dpm/100 cm^2 beta above background for this row of radionuclides. Also, the probe area correction factor (5) for an HP-210 probe, as listed in Appendix D of the LWP-15017 procedure, may be non-conservative; most other facilities use a larger correction factor.

- MCP-187, *Radiological Control Posting and Labeling,* specifies criteria for fixed contamination areas located outside controlled areas. Further, it specifies the use of controls similar to those discussed in 10 CFR 835.1101(c). However, because this procedure does not require routine monitoring and clear marking of these areas, as required by 10 CFR 835, posting practices are inconsistent. While these areas are listed to be annually surveyed per MCP-139, *Radiological Surveys*, MCP-187 could be improved by listing all of the related 10 CFR 835 requirements.

- LWP-15019, *Access Control for High and Very High Radiation Areas*, specifies key controls for high radiation areas (HRAs) and very high radiation areas (VHRAs). Sections 4.3.3 and 4.3.4 of this procedure were found to be unclear about issuing security personnel the keys to HRAs and VHRAs. The following statements from procedure LWP-15019 leave the status of security personnel accessing HRAs or VHRAs questionable:
    - LWP-15019, Section 4.3.3, states, "In addition to the controls in Section 4.3.1, additional measures shall be implemented to ensure individuals are not able to gain unauthorized or inadvertent access to VHRAs.
      NOTE: *Use of security keys to access HRA-ACR or VHRAs is prohibited, except for emergency or security conditions (for example: in cases of imminent danger that could result in injury or death of facility personnel).*"
    - LWP-15019, Section 4.3.4, states, "Security personnel should obtain permission to use security keys to access a HRA-ACR or VHRA from the Key Custodian or higher-level facility management and Facility Radiological Control Manager or designated alternate, prior to use."

- INL RPP, PLN-260, Rev. 9, Page 20, states that the regulatory provision discussed in 10 CFR Part 835.101(f) is addressed in Chapter 6 of the RPP. However, the RPP document does not appear to have a Chapter 6.

Pre-Job Briefings

The HSS team attended several pre-job briefings during the review. Overall, the HSS team found that the briefings were conducted well and provided sufficient information on radiological hazards and required controls. The HSS team observed radiological control technician (RCT) job coverage for several work evolutions and found it to be well implemented. However, the team noted some areas where documentation of controls could be enhanced:

- The HSS team attended the pre-job briefing for work in the MFC casting lab (Work Order 00156710, RWP MFC2011268). The RWP was not specific about required air monitoring, stating only that air sampling representative of work areas was required. The RCT explained the planned use of continuous air monitors and grab samples; however, this level of detail was not specified in any work control document. Contractor personnel stated that this information was specified in document MPC-356, *Routine and Job Specific Air Monitoring Program*. However, a review of MPC-356 indicated no additional level of specified air monitoring requirements. Better description of air monitoring requirements in work control documents would be beneficial.

  The RCT who presented the casting lab pre-job briefing gave explicit instructions on emergency actions, including where to relocate given various scenarios. Again, this information was not specified in any work control document. A better description of emergency action requirements in work control documents would be beneficial.

- The HSS team attended the pre-job briefing for work on the MFC scrubber line (Work Order 156656, RWP MFC2011300). Although several RCT hold points were specified in the work order over a relatively short time span, the RCT coverage was described as being "periodic." Contractor personnel stated that RCT coverage was not continuously needed during work setup, so "periodic" coverage was a convenient description. The HSS team believes that the RCT coverage that was needed would have better been described as periodic during setup and continuous during the work evolution.

  The scrubber line RWP specified neutron dosimetry for work in the glovebox; however, working in the glovebox was not within the scope of the work order.

  For the scrubber line work, radiological monitoring expectations were described differently in the work order, the RWP, the "as low as reasonably achievable" (ALARA) review, and the pre-job briefing.

Both the casting lab and the scrubber line work evolutions indicated a need to improve the method of ensuring that the workers have current training and qualifications for the activity. The HSS team noted that some individuals did not have the training or qualifications specified in the work order, and some work orders did not specify the required qualifications. For example, the work order for the casting lab job did not specify that the RCT needed RCT qualification. Supervisors' verification of training and qualification status of their workers ranged from determining current status via computer, to relying on workers' monthly qualification cards, to relying on personal knowledge of each worker's current status. The HSS team recommends implementation of a more structured method to verify the training and qualification status of the INL work force.

The HSS team also identified some general improvements for the INL pre-job briefing process:

- Pre-Job Briefing Form: The HSS team noted that the pre-job briefing form, Form 434.14, was not implemented consistently across all facilities and for all radiological work. The HSS team believes it would be a good practice to gain consistency in how, when, and by whom the form is completed. Also, the HSS team found that some pre-job briefing attendees did not sign the form.

- Reverse Briefing: The procedure that governs the conduct of a pre-job briefing, LWP-9201, *Briefing Procedure*, allows for and discusses various options for conducting an effective briefing. The HSS team observed that one such method, referred to as "reverse briefing," was particularly effective in identifying weaknesses in worker understanding and encouraging all personnel to become engaged in the design and conduct of the work activity. However, this or similar methods were not always used in the pre-job briefings that were observed. The HSS team recommends making more consistent use of this type of procedural tool to enhance the effectiveness of the briefing.

- Accident Discussion: Through observation of the pre-job briefings, the HSS team identified the periodic useful practice of discussing potential accidents with workers. By allowing radiological work personnel and job supervisors to collectively postulate potential accidents and briefly discuss the correct subsequent actions to take, the radiological workers are more prepared to address adverse conditions and avoid injury. The HSS team encourages BEA to consider having such discussions on a more frequent basis before or during the pre-job briefing.

Radiological Work Permits/Access Controls

The HSS team reviewed several RWPs and discussed their development and content with BEA personnel. All RWPs that were reviewed proved to be adequate, and the workers who were interviewed were knowledgeable of the RWP requirements and limits. The HSS team noted that INL takes a very conservative approach to using supplemental electronic dosimeters, often requiring them well-below the threshold for supplemental measures established in 10 CFR 835. This practice helps BEA track cumulative and individual exposures in a very timely manner and is considered a good practice. In addition, the RWPs that the HSS team reviewed also specified radiological evaluation points (i.e., provision for evaluating radiological conditions that are higher than expected but not high enough to warrant stopping work). Use of these evaluation points is considered a good practice.

INL RWPs specify alarm settings for electronic dosimeters; these settings are based on both total integrated dose to an individual and dose rates at the individual's location. INL workers and supervisors were clear that an integrated dose alarm on an electronic dosimeter was sufficient cause to stop the work activity. However, it was less clear what to do in case of a dose rate alarm (e.g., what type of evaluation would be needed and how to document the evaluation). The HSS team believes that a better description of actions to take if an electronic dosimeter alarms on dose rate would be beneficial.

Immediately upon resuming radiological work at INL after the suspension, BEA required all personnel performing radiological work to use a tool they refer to as an "RWP Cue Card." This is a pocket-sized form for documenting key information from the RWP, such as the ALARA goal, the current year-to-date dose of the worker, dose and dose rate alarm settings, and evaluation/hold points. The HSS team was informed that the RWP Cue Cards were required for only six months after radiological work resumed, but their use is still encouraged. However, the

RWP Cue Cards were not used for the vast majority of the activities that the HSS team observed. The use of RWP Cue Cards appears to be a logical, low-impact, high-reward practice that generally enhances the safe conduct of radiological work, and the HSS team encourages INL to enhance the RWP Cue Card and consider using it consistently throughout INL.

The HSS team noted that INL specifies various degrees of personal protective equipment (PPE) on the RWPs. INL defines 26 different combinations of PPE, designated A to Z. Although posters in the changing room specify what each PPE level requires, the HSS team believes that the sheer number of PPE combinations can confuse the work force. BEA management indicated that this issue is addressed in the “Get Well” plan for the occupational radiation protection program, and BEA intends to significantly reduce the number of PPE combinations.

BEA informed the HSS team that the computerized access control system is being updated to automatically track the status of individual participation in the INL bioassay program; this function is currently performed manually. Automation will free up the resources currently dedicated to this task, and the HSS team views this as another good initiative.

Postings

The HSS team toured various facilities that operate under the INL RPP. Postings and barriers were found to be generally compliant with requirements in 10 CFR 835; however, the following areas for improvement were noted:

- BEA has established "Radioactive Material Storage Areas," per LWP-15011, *Radioactive Material Areas and Radioactive Storage Areas*, defined as areas "that [have] been set aside for the exclusive storage of radioactive material or radioactive wastes.” Such areas are not recognized in 10 CFR 835, and it is unclear how BEA distinguishes between these areas and 10 CFR 835-defined "Radioactive Material Areas." Either eliminating or clearly defining the non-standard terminology would be beneficial.

- 10 CFR 835.501(c) requires radiological areas to have signs and barricades. The HSS team observed several contamination areas (10 CFR 835-defined radiological areas) in which the barricade consisted only of a piece of magenta and yellow rope a few inches off the floor. BEA personnel indicated that this practice evolved from an earlier practice of using Plexiglas to enclose areas that were contaminated with radioisotopes that had a tendency to migrate; the access points to these areas were marked by a piece of Plexiglas approximately one foot high, with radiation warning stickers affixed. The Plexiglas would be acceptable as a barricade. However, the use of rope, positioned just a few inches above the ground, is an ineffective barricade, as well as a tripping hazard.

- During a fuel element transfer activity in the ATR canal, the HSS team observed that individuals working in a buffer area established for contamination control routinely crossed over a clean zone to perform their work. The HSS team recommends that BEA review its work practices to prevent this practice at this and other locations.

Additionally, the HSS team noted that radiological areas with the same hazards were not always posted in the same way. Different color schemes and posting verbiage were used, and, as noted, the posting procedure, MCP-187, *Radiological Control Posting and Labeling*, is not clear on how to post various areas. Standardizing radiological posting practices would enhance safety.

Fixed and Portable Radiation Measurement Instruments

The HSS team verified the status of portable and fixed (e.g., counting room) radiation monitoring equipment with respect to current calibration and current instrument response checks. The HSS team reviewed the calibration records of several randomly selected portable radiation monitoring instruments recently used to conduct radiological surveys. No discrepancies were found. All portable radiation monitoring instruments observed in the field had response check and calibration stickers indicating that they were up to date and compliant in these areas.

The HSS team discussed BEA's process for evaluating radiological monitoring instruments in cases where "as found" readings are not within specifications, both when an instrument is returned to the HPIL for calibration and when the instrument's response is periodically checked. In both situations, BEA had a process for ensuring that radiological evaluations made with instruments failing an "as found" response check are appropriately evaluated. The HSS team found this process to be a strength at INL.

One area for improvement noted by the HSS team pertains to developing and using control charts for the counting room instruments. A recommended practice is to plot daily background and response check readings on a control chart to help identify adverse trends in results and initiate corrections before the instrument fails a daily check. INL does not currently plot these results on control charts but should evaluate the benefits of doing so.

Another opportunity for improvement was found in the Digital Radiation Monitoring System (DRMS) installed at the ATR Complex. The DRMS output is displayed on a computer terminal in the radiation protection office, presumably to inform ATR radiation protection personnel of radiological conditions throughout the ATR Complex and the status of the DRMS. The HSS team noted that the information provided on the DRMS displays is not fully useful, either for ascertaining the radiological conditions throughout the ATR Complex or for determining the status of the DRMS. For example, the DRMS display often indicated negative radiological readings, which (the HSS team was informed) indicated a negative trend over the short term; the trending chart also frequently indicated readings below zero. The DRMS system did not provide information that radiation protection personnel could to evaluate current radiological conditions at the ATR. A hardware and software-based radiation monitoring program could be implemented to provide useful and timely information on radiological conditions and trending of radiation levels at the ATR Complex.

Very High Radiation Area Controls

The HSS team toured the HPIL facility, and INL personnel explained the upgrades that were made to the HPIL calibration room access controls. These upgrades were initiated following an event that resulted in an unplanned exposure to the extremity of an individual who entered a calibration room when the high radiation sign was energized. The upgrades included the addition of an active mechanism to retract exposed sources and the installation of an audible alarm that sounds if anyone attempts to enter a calibration room when the high radiation sign is energized. The HSS team found this approach to be acceptable.

HPIL has one x-ray calibration room that could pose a sufficient radiological hazard to generate a VHRA when operating, i.e., an area in which radiation levels could result in an individual receiving an absorbed dose greater than 500 rads in an hour at 1 meter from the source. Title 10 CFR 835.502(c) requires that VHRAs have controls in addition to those specified for Radiation Areas, HRAs, and areas where an individual could exceed an equivalent dose to the whole body of 1 rem in an hour at 30 centimeters from a source. The INL RPP does not specify these additional controls for INL VHRAs, nor does LWP 15019, *Access Control for High and Very High Radiation Areas*. The INL Radiological Control Manual simply states in article 334.9:

> *In addition to the above requirements (Article 334.8), additional measures shall be implemented to ensure that individuals are not able to gain unauthorized or inadvertent access to very high radiation areas when dose rates are in excess of the posting requirements of Table 2-3 [see 10 CFR 835.502(c)].*

INL did not identify program documents (procedures, manuals, RPP, technical basis documents) that describe the additional controls for VHRAs.

The HSS team reviewed the additional controls for the HPIL x-ray calibration room. They include a circuit that de-energizes the x-ray power source when the access door is opened, in addition to the access door interlock system that keeps the x-ray power from being energized when the door is open. The HSS team found this to be a satisfactory control. INL personnel were able to explain the additional controls that have been implemented for other VHRAs, and although they were not physically walked down by the HSS team, what was described was appropriate. However, this type of information should be included in the INL RPP or another site document.

Safety Culture

Over the course of this review, all BEA and DOE-ID staff proactively facilitated the HSS team's execution of its review scope at INL by providing full access to the site and personnel. This cooperation played a key role in promoting the efficiency and productivity of this review.

The HSS team found that BEA management has embraced the safety improvement mission with regard to the overall safety culture of INL staff involved in radiological work. They have allocated resources and placed priority on enhancing safety in the conduct of radiological work. All personnel who interacted with the HSS team appear to be thoroughly engaged in the mission and the effort to correct the safety concerns associated with the occupational radiation protection program at INL. The broad observations of the HSS team indicate that key drivers for engagement – such as management leadership, commitment to continuous improvement, and training and development, are viewed in a generally favorable way by INL personnel. Nevertheless, considering the challenges that have inhibited the effectiveness of this program over the past two years, the HSS team recommends that progress in this area continue to be periodically reviewed.

5.0 CONCLUSIONS

Within the scope of this review, the HSS team found that BEA has implemented a radiological protection program at INL that is compliant with the key provisions of 10 CFR 835. The HSS team notes several good practices and planned improvements such as the very conservative use of electronic dosimeters, improvements in staffing, and the planned reduction in the various combinations of PPE specified in RWPs. Nevertheless, additional improvements are needed to enhance the content and implementation of radiation protection procedures. The HSS team notes that BEA has a very aggressive radiation protection improvement plan. If resolutions and improvements continue at the pace BEA has currently planned, the effort should prove effective.

6.0 OPPORTUNITIES FOR IMPROVEMENT & ITEMS FOR FOLLOW-UP

This HSS review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered for review and evaluation by responsible line management organizations and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

1. **Improve the work control process and procedures.**
   - Modify the current work control documents to improve the requirements description sections.
   - Develop a more structured method and procedure for pre-work training and qualification verification.
   - Enhance the consistency, completeness, and effectiveness of the pre-job briefing process.

2. **Improve various radiological control process and procedures.**
   - Consider improving the procedure description of the action for a dosimeter alarm and also encourage the use of operator aids/cue cards for this alarm.
   - Consider using standardized posting terminology in procedures and on signs.
   - Encourage the broader use of control charts for counting room instruments.
   - Consider replacing the ATR DRMS with a more reliable system for monitoring and trending data.
   - Consider providing more thorough discussion of VHRA controls in the INL RPP
   - Periodically review and encourage the continued development of a positive radiological safety culture.
   - Consider automating the tracking of bioassay participation.

3. **Improve DOE follow-up reviews.**
   - DOE should ensure that follow-up reviews be conducted to assess implementation of enhancements to the INL RPP, adherence to the schedule of corrective activities the Contractor has set forth (i.e., the Get Well Plan), and to verify that continuous improvements are being made. HSS intends to conduct such a follow-up review 6 months to a year from the date of this assessment.

Appendix A
Supplemental Information

Dates of Review

Onsite Data Collection: July 25-28, 2011

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