



# Independent Assessment of Emergency Management at the Argonne National Laboratory

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## Acronyms

AAR	After-action Report
ANL	Argonne National Laboratory
Argonne	UChicago, Argonne LLC
ASO	Argonne Site Office
CAT	Consequence Assessment Team
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
EEG	Exercise Evaluation Guide
EMG	Comprehensive Emergency Management System Guide
EOC	Emergency Operations Center
EOS	Emergency Operations System
EPHA	Emergency Planning Hazards Assessment
EPZ	Emergency Planning Zone
ERO	Emergency Response Organization
FPE	Full-participation Exercise
HAZMAT	Hazardous Material
HF	Hydrofluoric Acid
HP	Health Physics
HS	All-hazards Survey
IC	Incident Commander
NARAC	National Atmospheric Release Advisory Center
OE	Operational Emergency
OFI	Opportunity for Improvement
RAP	Radiological Assistance Program
REAC/TS	Radiation Emergency Assistance Center/Training Site
TEL	Threshold for Early Lethality

# INDEPENDENT ASSESSMENT OF EMERGENCY MANAGEMENT AT THE ARGONNE NATIONAL LABORATORY

## Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the emergency management program at the Argonne National Laboratory (ANL) from August to October 2022. The assessment, which was conducted virtually due to DOE COVID-19 restrictions, evaluated the technical planning basis, exercise planning, and exercise evaluation processes for the August 2, 2022, annual exercise. ANL emergency response was not observed but reconstructed through interviews and a review of participant and evaluator log notes and exercise documentation. This assessment evaluated the effectiveness of both the Argonne Site Office (ASO) and its management and operating contractor, UChicago Argonne, LLC (Argonne), in developing the all-hazards planning basis for the exercise, as well as the ability of Argonne and ASO to plan, execute, and evaluate ANL's five-year severe event full-participation exercise. The basis for EA's review criteria is DOE Order 151.1D, *Comprehensive Emergency Management System*.

EA identified the following strengths:

- All-hazards surveys are maintained using periodic facility walkdowns and reviews of purchasing and inventory databases.
- Emergency action levels (EALs) and protective action plans provide the type of information essential for supporting an effective response.
- The exercise was conducted safely using a well-prepared safety plan.
- Emergency Public Information staff provided effective social media and news monitoring during the exercise.
- Altered photos were used to help players visualize simulated tornado damage, and moulage was used on actors to make injuries appear realistic.
- Argonne used a team of former news reporters and broadcasters as mock media at the Joint Information Center to promote realism.

EA also identified several weaknesses, the most significant of which are summarized below:

- A timely initial assessment using worst-case source terms and actual weather conditions is not part of the laboratory's established response procedures. (Finding)
- The exercise plan did not include sufficient injects and contingency messages to ensure that all objectives were demonstrated, and the exercise evaluation guides were inadequate. (Finding)
- The after-action report did not identify some significant performance issues, impacting the ability of the laboratory to improve exercise planning and execution that results in program improvements. (Finding)
- Argonne implemented the revised EPHA before ASO provided its approval as allowed by the Argonne technical planning basis program plan.
- Inventory controls were not effective in keeping hazardous material out of a building before implementation of the EPHA revision.
- Non-conservative assumptions are incorporated into the EPHA calculations and average weather EALs were developed, reducing the area under protective actions.

In summary, Argonne has generally well-established emergency response plans and procedures to comply with DOE requirements and support an adequate response to postulated airborne releases of hazardous materials. Nevertheless, EA noted significant weaknesses in the program's technical planning basis, exercise planning, emergency response, and exercise evaluation. Until the weaknesses identified in this report are addressed, there is increased risk that the emergency management program at ANL will not exhibit the capabilities necessary to effectively respond to significant emergency events at ANL.

The Office of Science (SC) does not concur with the three findings and disagrees on two of the four deficiencies and four of the eight opportunities for improvement identified in the report. SC's response memorandum is provided as appendix B to this report in accordance with DOE Order 227.1A Change 1, *Independent Oversight Program*.

# INDEPENDENT ASSESSMENT OF EMERGENCY MANAGEMENT AT THE ARGONNE NATIONAL LABORATORY

## 1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the emergency management program at the Argonne National Laboratory (ANL) from August to October 2022. EA evaluated the planning and evaluation processes for ANL's five-year severe event full-participation exercise (FPE), conducted on August 2, 2022, and examined the technical basis used for planning a response to the selected exercise scenario to determine the effectiveness of the ANL emergency management program. This assessment evaluated the effectiveness of both the Argonne Site Office (ASO) and its management and operating contractor, UChicago Argonne, LLC (Argonne), in developing the all-hazards planning basis for the exercise, as well as the ability of Argonne and ASO to plan, execute, and evaluate the exercise. Due to COVID-19 travel restrictions, the assessment was conducted remotely. This assessment is part of a series of assessments of emergency management programs at sites throughout the DOE complex and was conducted in accordance with the *Plan for the Independent Assessment of the Emergency Management Program at Argonne National Laboratory, July – December 2022*.

The exercise scenario postulated an Operational Emergency (OE) from a large spill of hydrofluoric acid (HF) resulting from windborne debris from tornadic activity. The consequence from a spill of this size is bounded by the analysis in the emergency planning hazards assessment (EPHA) for a collapsed building scenario. The exercise scenario, which was designed to fulfill ANL's five-year severe event requirement, involved multiple tornadoes that directly impacted ANL, damaging facilities and causing partial power outages, resulting in chemical and radiological releases, as well as eight casualties. The postulated casualties included one fatality, one person injured and contaminated by radioactive material, and one person burned by HF. The emergency response included many decision-makers and responders from ANL, participation from offsite organizations, such as the Radiological Assistance Program (RAP), Radiation Emergency Assistance Center/Training Site (REAC/TS), the DOE watch office, state and county representatives, as well as simulations and role-players.

## 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.

As identified in the assessment plan, this assessment considered requirements related to DOE Order 151.1D, *Comprehensive Emergency Management System* (hereafter referred to as DOE requirements). EA used sections 4.2, *All Hazards Planning Basis*, and 4.15, *Exercises*, from EA's Criteria and Review Approach Document 33-09, *DOE Order 151.1D Emergency Management Program Criteria and Review Approach Document*. EA examined key documents, such as emergency plans and implementing procedures, the site all-hazards survey (HS), the applicable EPHA, the exercise plan, job aids, and other relevant programmatic documentation supporting program development and maintenance and ANL's assessment of response elements. EA primarily relied on program requirements, interviews of key personnel responsible for developing and executing the exercise and its technical planning basis, and records created during the exercise. Direct observation of activities was limited to the exercise critique meeting, by remote means, and a recorded video of the press conference. Before the exercise, ASO's

required approval of the building 208 EPHA was pending, although Argonne had implemented the EPHA, as discussed further in section 3.1 of this report. The members of the assessment team, the Quality Review Board, and 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 Technical Planning Basis Development and Use**

This portion of the assessment determined whether the technical planning basis used to analyze and prepare for the accident scenario that was the subject of the exercise was effectively built upon DOE requirements and the disciplined application of scientific and engineering principles, and supports an effective and reliable (conservative) response that protects responders, employees, the public, and the environment. The exercise scenario postulated a spill of HF at 48% concentration (hereafter referred to as HF, unless specifically noted otherwise). EA reviewed program documents used for the development and maintenance of the HS and EPHAs, as well as the HS for buildings 200 and 208, the EPHA for building 208 (building 200 is not an EPHA facility), and the emergency action levels (EALs) and protective action plans, as applicable to the exercise scenario. This section also discusses the effectiveness of users in implementing these documents during the exercise.

DOE has specific requirements for analyzing accident consequences related to software requirements, protective action criteria, and specific weather conditions. Additionally, DOE requires the conduct of a quantitative hazards analysis using “accepted assessment techniques” and “thresholds for early lethality” (TELs) without further definition. When performing dispersion modeling, many other attributes are needed, such as deposition velocity (terminal velocity of the contaminant towards earth), terrain roughness settings (contaminant removal by surface structures and dilution by air turbulence mixing), pool surface area (affecting evaporation rate), and contaminant vapor pressure at specific temperatures (affecting evaporation rate). Determination of the values for those attributes requires the application of professional judgement using scientific and engineering principles; guidance in DOE Guide 151.1-1B, *Comprehensive Emergency Management System Guide* (EMG), and the dispersion-modeling program user’s guides; and the availability of published information from published technical studies (internal and external to DOE). All analytical assumptions are required to be stated in an EPHA to support replication during a response. DOE site office personnel approve the use and application of the assumptions in the analysis for correct application of these attributes at their site via approval of the EPHA.

#### **Program Documents**

ANL has an adequate set of program documents for developing and maintaining a technically based emergency management program that meet all DOE requirements. Collectively, ANL’s OEM-PLAN-001, *Argonne Comprehensive Emergency Management Plan*; OEM-PLAN-004, *Technical Planning Basis Program*; OEM-EPHS-SITE, *Argonne Emergency Planning Hazards Survey*; and OEM-PLAN-005, *Emergency Planning Hazards Assessment Methodology*, implement the technical and administrative requirements for the development of EPHAs, EALs, pre-determined protective actions, and emergency planning zones (EPZs).

#### **All-Hazards Survey Program Plan**

OEM-PLAN-004 incorporates all the DOE requirements for conducting and documenting a qualitative assessment of site buildings to establish the core requirements of the ANL emergency management

program and to identify hazardous material (HAZMAT) for an additional quantitative assessment. The process identifies the types of natural phenomena events to plan for, including tornados. The process for identifying HAZMAT implements multiple methods, including reviews of purchasing and inventory databases and periodic facility walkdowns. Identified materials are then screened for a quantitative analysis using the accepted Globally Harmonized System screening criteria for chemicals, and the DOE required criteria for radioactive material, including screening for quantities below hazard category 3 nuclear facilities. The HS properly concludes with a set of event initiators to prepare for and identifies the HAZMAT needing a quantitative assessment in an EPHA. OEM-PLAN-004 also requires the HS to be updated at least every three years and be submitted to ASO for approval.

Nevertheless, the HS development and maintenance process does not produce a record of materials screened from a quantitative assessment and how they were eliminated. The EMG recommends that the use or storage of radioactive hazardous materials, chemical hazardous materials, or hazardous biological agents or toxins in the facility be noted and described in the HS. However, OEM-PLAN-004 only requires the identification of materials in need of a quantitative assessment. (See **OFI-Argonne-1**.)

### **EPHA Program Plans**

Collectively, OEM-PLAN-004 and OEM-PLAN-005 incorporate the DOE requirements for developing, maintaining, and submitting an EPHA and changes thereto to ASO for approval. The process requires the use of DOE-preferred protective action criteria, approved dispersion modeling programs, barrier analysis, calculated consequences for key receptors of interest, triennial reviews, and the use of the results for developing EALs, pre-determined protective actions, and facility EPZs. For EPHA development, the plan specifies the use of DOE-approved dispersion modeling programs - EPICode for chemical spills and HotSpot for radioactive material releases. OEM-PLAN-005 also stipulates the use of conservative surrogate materials when chemical and radioactive mixtures are involved. OEM-PLAN-005 adheres to DOE Order 151.1D, att. 4, par. 2.n for submitting the EPHA to ASO for approval. However, Argonne implemented the draft EPHA without ASO approval, as allowed by OEM-PLAN-004. (See **Deficiency D-Argonne-1**.) The draft EPHA used less conservative parameters than the previous revision, increasing the HAZMAT source term while decreasing the calculated consequences, thereby reducing the area under protective actions.

Further, OEM-PLAN-005 provides a set of modeling assumptions that stray from the conservative approaches expected by DOE Order 151.1D and the EMG. Important dispersion modeling input parameters include deposition velocities, terrain roughness settings, receptor height, and the altitude at the point of release. Of these parameters, the most significant ones affecting the revised EPHA calculations are the deposition velocity and terrain roughness settings. These parameters affect the accuracy and the conservative safety margins calculated by dispersion modeling software for estimating removal of airborne contaminants, the former principally by gravity and the latter by additional surface contact of buildings and trees and air turbulence as air moves around objects.

The deposition velocity is affected by the mass of the contaminant (by the pull of gravity), the aerodynamics of the contaminant (size and shape) in reaching a terminal velocity in air, the contaminant's buoyancy in air (relative molecular weights), and precipitation. Other factors can also apply to increase removal of contaminants from the air for specific gases such as chemical reactions in the atmosphere or radioactive decay. Lower deposition velocities are more conservative because they result in higher airborne concentrations, increasing the projected inhalation hazard. The deposition velocity assumptions implemented by OEM-PLAN-005 are 0.3 cm/sec for radiological particulates and a default of 0.01 cm/sec or, if available, a published deposition velocity for chemicals. For the radioactive particulate, the deposition velocity is higher than the recommendation of 0.1 cm/sec in DOE's Office of Health, Safety and Security Safety Bulletin 2011-02, *Accident Analysis Parameter Update*. For most gases, the



dispersion modeling default setting is zero, which is most commonly used in the DOE enterprise because it is most conservative and is the recommended value by the EPICode user guide when additional information is not available. Published deposition velocities are typically not available; therefore, conservative default values are more often used. The absence of the use of conservative modeling parameters reduces the assurance that the consequences from a HAZMAT release are bounded to ensure the protection of responders, site personnel, and the public, particularly early on when the incident is not well understood. (See **OFI-ASO-1.**)

The roughness setting in OEM-PLAN-005 for ground level releases is significantly non-conservative. The EPICode program has three selections for terrain roughness: standard (conservative option), city (large metropolitan area), and a custom input feature. Argonne changed its default selection from the standard setting to the city option since the last building 208 EPHA revision. The rationale for the change, provided in OEM-PLAN-005, is due to the number of structures and trees on site, which Argonne considers reflective of a large metropolitan area. The EPICode user guide suggests that the large metropolitan area setting be used for large buildings that create much turbulence in the vicinity of a release and that the standard setting represents the conservative option. (See **OFI-ASO-1.**)

Finally, OEM-PLAN-005 uses a 5-rem criterion for the radioactive TEL rather than the 100-rem criterion established in the EMG. DOE requirements do not provide a TEL for radioactive material, only that one be used for establishing pre-determined protective actions and the minimum size of an EPZ. A radiological dose of 5 rem is an annual worker's exposure limit under 10 CFR 835.202, *Occupational dose limits for general employees*, rather than a radiological exposure reflecting a TEL. The effect of the 5-rem TEL does not change the area under protective actions but does affect the type of pre-determined protective actions that are implemented. The 1-rem protective action criterion establishes the area under protective actions, bounding the area that exceeds the 5-rem criterion. The area within the protective action zone established by the TEL criterion is used by Argonne to establish the minimum size of the EPZ and help differentiate between the pre-determined protective action of shelter-in-place or evacuation. OEM-PLAN-005 requires evacuations within the area that is projected to exceed the 5-rem TEL criteria. Therefore, a 5-rem TEL increases the area for mandatory evacuations, and eliminates some shelter-in-place options, possibly sending people through a plume or contaminated area when the best option is to shelter while the plume disperses. (See **OFI-Argonne-2.**)

### **Buildings 200 and 208 Hazards Surveys**

The HSs for buildings 200 and 208, incorporated into OEM-EPHS-SITE, *Argonne Emergency Planning Hazards Survey*, were developed by Argonne in accordance with OEM-PLAN-004 and were consistent with the exercise scenario. OEM-EPHS-SITE identifies tornados as a potential initiator of an incident and concludes that building 200 does not require an EPHA while building 208 does require an EPHA for the HF solutions. The last walkdown record for building 200, documented in ANL OEM-JAID091A, *Building Walk-down*, conducted in October 2020, stated that there is no HAZMAT in the building requiring a bounding hazards analysis and that there were no identified maximum planning quantities expected to change in the following year. This was verified by interviews and verification that radiological inventories for building 200 are maintained below the screening criteria for an EPHA per LMS-PROC-45, *Managing Radioactive Material Inventories Laboratory*. For building 208, the HS identifies the need for an EPHA based on HF solution inventories. The latest walkdown record for building 208, conducted in October 2021, identified a 30-gallon drum of 48% HF in the building that was not analyzed in the EPHA at that time. The EPHA implemented before this discovery only analyzed HF solutions of 25% HF and 10% HF that are stored and used in the building. While the draft building 208 EPHA adds the new 30-gallon drum to the analysis, further actions for improving inventory controls were not implemented at the facility to prevent an unanalyzed condition to exist, as required by DOE Order 151.1D, att. 4, par. 2.o. (See **Deficiency D-Argonne-2** and **OFI-Argonne-3.**) Effective inventory

controls ensure that the worst-case consequences are established and properly planned for before the hazard is introduced into the facility.

### **Building 208 EPHA**

The exercise introduced four leaking drums of HF solutions: one outside the building and three inside the building. Separation of inside and outside drums is by an overhead roll-up door that was postulated to have damage from windborne debris that penetrated the door and damaged the inside drums. As many as seven drums of the three different types of HF solutions are allowed in building 208 per the draft EPHA. The draft EPHA analyzes drums containing HF that are stored in different fractions of solution and different drum volumes. One drum is 100% HF, filled at 30 gallons; two drums are 25% HF by volume, filled at 50 gallons; and four drums are 10% HF by volume, filled at 44 gallons. The latter two types of drums contain mixtures of HF and other acids to form solutions. The significant difference between the draft EPHA and the last ASO-approved EPHA is that the draft EPHA increases the number of drums analyzed in the spill scenario analysis from one to seven; despite the increased source term, the application of new non-conservative modeling parameters resulted in estimated incident consequences being lowered. This changed the incident classification EALs from a Site Area Emergency to an Alert (under severe weather conditions) or an OE not requiring further classification (under average weather conditions).

The draft EPHA improves the spectrum of spill consequences by establishing a worst-case source term represented by a single spill that totals all allowable drums inside the building. This represents the consequences from a collapsed building scenario that can be applied to incidents caused by tornados, earthquakes, and snow loading. The analysis includes all assumptions used for modeling the dispersion of HF except for the altitude parameter. (See **OFI-Argonne-2**.) The analysis provides calculated airborne concentrations for establishing incident classifications and projected concentration at key receptors of interest using the appropriate and current version of the EPICode dispersion-modeling program, the required severe and average weather conditions, and the preferred acute exposure guideline levels protective action criteria. The concentrations were calculated solely on the HF as the other acids in solution were properly screened out based on the vapor pressure screening criterion.

Nevertheless, while the draft EPHA increases the source term for HF, the calculated airborne concentrations were reduced because of non-conservative changes in modeling assumptions. (See **OFI-ASO-1**.) The most significant change is the use of a 2 cm/sec deposition velocity value (set at 0 cm/sec in the previous EPHA revision) that Argonne based on an assumption used in a European Union Risk Assessment report. The report referenced by Argonne did not establish an HF deposition velocity; 2 cm/sec was used in the report as an unfounded assumption used in one of the study calculations to bound HF concentrations in soil and water. For the purpose of that study, a high deposition rate is conservative when soil and water deposition are the concerns, however; the rate is non-conservative when airborne concentration is the concern. What the European Union considered as the actual HF deposition velocity is not stated in its report. HF is a buoyant gas; therefore, the use of the most conservative deposition velocity of zero, or the OEM-PLAN-005 value of 0.01 cm/sec is more appropriate in the absence of a study with a validated HF deposition velocity.

The second most significant change in the EPHA analysis that reduces calculated airborne concentrations is the change from the standard conservative roughness setting to the large metropolitan area roughness setting. This setting reflects the assumption that site buildings and trees will remove much of the airborne contaminants. This assumption is not consistent with the actual conditions shown in the building 208 protective action plan. An aerial photo shows the protective action zone having one building to the west of building 208 along with some smaller structures, and a copse of trees in the northerly and southerly sectors. These do not represent the type of large buildings in a large metropolitan area and there are

essentially no structures or trees to scrub out airborne contaminants in the protective action zone for westerly winds. The calculation for airborne concentrations is used for EAL development, including areas under protective actions, and the lack of structures in the easterly sectors do not accurately represent the assumptions used for selecting the large metropolitan area terrain setting to ensure accurate and conservative dispersion modeling results are obtained. (See **OFI-ASO-1**.)

The third most significant change in reducing calculated airborne concentrations is the use of lower vapor pressures for each of the HF mixtures. In 2021, Argonne had a study performed to obtain a more accurate vapor pressure for each of the three types of HF mixtures. While this approach is allowable, the results do not correlate to expected trends. Published gas laws, such as Raoult's law, predict lower vapor pressures with increased dilution. However, the study concluded that the lowest amount of HF in solution (10% HF by volume) has the highest vapor pressure of 20.8 torr. The second lowest HF solution (25% HF by volume) has the lowest vapor pressure of 10.3 torr, and the 100% HF has a vapor pressure of 20.2 torr. Without an explanation for this occurrence, there may be an error in the values or the vapor pressure may be correlated to the incorrect solutions. Correct correlation is important for the method Argonne used for determining airborne consequences from an HF release. The EPA analyst used these vapor pressures in calculating airborne concentrations by setting up custom files for each of the three different mixtures and volumes. The results from each are then manually added to arrive at airborne concentrations at receptors of interest. This methodology is not easily transferrable to consequence assessment personnel during a response and conflicts with the OEM-PLAN-005 that says that multiple hazardous chemicals used or stored in the same building will use an appropriately conservative surrogate chemical to model the potential consequences associated with the release and dispersal. (See **OFI-ASO-1** and **OFI-Argonne-2**.)

The collective non-conservative approach used in the draft building 208 EPHA significantly impacts the planning for the emergency response using EALs and pre-determined protective actions. The selection of dispersion modeling input parameters can change the results from an OE not requiring further classification in the draft EPHA under average weather conditions to classification as high as a General Emergency using conservative input parameters. Specifically, EA used EPICode to perform calculations with a surrogate vapor pressure of 20.8 torr, a deposition velocity of zero, the "standard" terrain setting, a receptor height of 1.5 meters, and an altitude of 231 meters (based on the DuPage County airport elevation) with all other settings the same as the draft EPHA calculations. EA's results showed that the protective action criterion was exceeded offsite and the distance in which TEL was exceeded significantly increased. By EA's calculation, protective action criterion (24 ppm) is exceeded out to 0.69 km from the release point (the site boundary is 0.353 km away), and TEL (44 ppm) is exceeded out to 0.48 km away. Conservative assumptions are of utmost importance in consideration of the ANL operational concepts for OEs, whereby the Argonne Fire Department is expected to use the EAL and EPHAs at the scene during a situational size-up evaluation for determining protective actions in consultation with the emergency management duty officer. In order for the Argonne Fire Department to observe the scene, first responders may be in higher-than-expected airborne concentrations due to the non-conservative assumptions used to calculate areas projected to exceed protective action criteria. (See **OFI-Argonne-2**.)

### **Emergency Action Levels and Pre-determined Protective Actions**

The exercise scenario applied to two ANL EALs, one for the HF release at building 208, with a 208-1 designator, and the other for sitewide facility damage and the potential for personnel injury or fatalities, named HS-3, *On-Site Facility Incident*.

EAL 208-1 is based on the results of the EPHA using the correct distances for an Alert and General Emergency and the required severe weather definition. The General Emergency did not apply to the spill scenario used in the exercise because it was developed from a malevolent act scenario involving

explosives. However, the EAL also identifies an OE not requiring further classification for an HF release during average weather conditions. The non-conservative use of average weather for EALs is strongly discouraged in the EMG. (See **OFI-Argonne-2.**)

EAL HS-3 includes three ways to classify an incident and only one of them uses the protective action criteria, as required by DOE Order 151.1D, att. 4, par. 8.a., for a HAZMAT emergency management program. HS-3 directs the user to a damaged EPHA facility EAL, as was the case in the exercise by applying EAL 208-1. If a HAZMAT facility was not involved, HS-3 directs the user to a targeted hazard assessment-based EAL to classify incidents based on unique ANL criteria when HAZMAT is not involved, such as radiant heat of a fire, overpressure distances, and range of missile fragments. If neither an EPHA nor a targeted hazard assessment facility is involved, HS-3 has the user classify the incident based on the size of the area the incident commander (IC) places under protective actions. The latter two methods also deviate from OEM-PLAN-001, par. 2.6 that stipulates that OEs resulting from natural weather phenomena, mass casualty incident, or security-related events and do not involve a release of hazardous materials are among those categorized as OEs, not further classified. For the exercise scenario, the classification would be a Site Area Emergency if a HAZMAT facility was not involved, rather than an Alert for the HF release declared in the exercise because the IC implemented protective actions at multiple facilities. (See **Deficiency D-Argonne-3.**) The use of DOE-required classification facilitates better understanding by the DOE watch office of the nature of the incident and the required site response centers that must be activated.

OEM-PLAN-009, *Emergency Action Levels and Protective Actions Plan*, appropriately links EALs to pre-determined protective actions. The building 208 pre-determined protective actions are based on the EPHA calculations and require evacuations where TEL is exceeded and shelter-in-place for areas beyond TEL where the protective action criterion is exceeded. The pre-determined protective actions also include suggested assembly areas for evacuees.

## **EPZ**

Argonne's development of the building 208 EPZ is consistent with DOE requirements and guidance. The facility EPZ is developed based on EPHA calculations that identify areas that may exceed protective action (24 ppm) and TEL (44 ppm) criteria for HF, although these calculations were non-conservative as previously discussed. Argonne uses the worst-case scenario as the basis for the facility EPZ with the proper exclusion of malevolent acts. Argonne submits the facility EPZ to ASO as part of the submittal for EPHA approval. Argonne properly uses the facility EPZ to develop the site EPZ.

## **Consequence Assessment**

The consequence assessment team (CAT) in the emergency operations center (EOC) has the necessary tools for conducting its functions. The CAT is provided with position checklists, EPHAs, EALs, protective action plans, the National Atmospheric Release Advisory Center (NARAC) Web dispersion-modeling program, weather data, and access to facility inventory databases. Source terms are provided within the EPHA and protective action plans for the worst-case (seven leaking drums of HF) and for each of the three types of drum solutions. A total solution volume is provided to calculate a pool size as input that supports evaporation rates for the worst-case scenario. For the exercise, no source term data were available for modeling the radioactive material release because the release did not come from a facility requiring an EPHA and the modeler stated during an interview that a review of the radioactive material inventory database indicated no radioactive material in the building. The modeler developed radioactive material dispersion plots based on a search of legacy material in building 200, rather than from building inventory records or an earned inject from a controller.

Nevertheless, the ANL program does not include a timely initial assessment, as required by DOE Order 151.1D, att. 4, par. 10, and errors that were made in dispersion modeling went unnoticed. (See **Finding F-Argonne-1.**) The timely initial assessment is used to bound the consequences of a release to confirm that implemented protective actions are adequate. DOE requirements are to model the dispersion of the worst-case source term using the actual weather data at the time of release to cover unknown conditions or misinformation from field reports. In the absence of that initial step, the modeler proceeded with modeling a 55-gallon drum release, based on a report from the IC. Modeling errors included:

- The HF temperature setting was left at the default setting of 190 K (-118 F) rather than adjusting it to 75 F, reflecting the known ambient temperature.
- The HF solution volumes did not make use of the volumes provided in the EPHA or protective action plan, as the source term was limited to one 55-gallon drum.
- The modeling was for pure HF rather than more closely to 48% HF (NARAC has a drop-down menu for selecting different concentration. A 50% concentration is the best fit for the exercise scenario).
- The modeler used the weather data at the time the modeling started rather than the weather data for the time of release. (The NARAC program uses an ANL meteorological weather tower for data based on the user specified time of release.)

Although checklists have provisions to verify correct input parameters, they were not effective in identifying these errors. Additionally, the ANL emergency plan stipulates that NARAC will approve plume plots before use and distribution. Although the position checklist contains NARAC contact information, a step to obtain NARAC approval is not included and the CAT did not seek NARAC approval during the exercise, as stated in ANL OEM-PLAN-001, par. 2.8.3.1. (See **Deficiency D-Argonne-4.**) NARAC personnel provide guidance to more accurately and conservatively model the dispersion from the postulated release when using its dispersion modeling program, such as temperature settings, available concentration settings, and the importance of the time of release that is modeled. The CAT used the modeling results to verify for themselves that protective actions were adequate and an entry was posted on the Vector system used by the emergency response organization (ERO) for information sharing during a response. No use was made of the plume plots for briefing the EOC cadre or for planning field monitoring activities. The EMG promotes the use of formal means of distribution and briefings in sharing the results of consequence assessment activities. Additionally, two subsequent dispersions were modeled – for 20- and 30-gallon spills – rather than considering “what if” more than one drum spilled. Finally, the CAT did not question the use of EAL 208-1 for a one-drum spill when the EPHA indicates that the HF protective action criterion is not exceeded for a one drum spill of any type. (See **OFI-Argonne-2.**)

### **Technical Planning Basis Conclusions**

The Argonne technical planning basis program documents implement the DOE requirements for developing a technically based emergency management program; however, the program does not adhere to the conservative approach expected by DOE Order 151.1D and the EMG. This issue has led to many deviations from the accepted assessment techniques used throughout the DOE enterprise that are governed by guides and engineering judgments. Argonne submitted a new revision to the building 208 EPHA but did not obtain ASO approval before its implementation. The recent revision expands the spectrum of analyzed events to the highest HF inventory; however, other new assumptions since the previous EPHA revision were made in modeling parameters that reduced the projected consequence of the release to less than the previously analyzed one-drum spill. Argonne also deviates from DOE approaches by classifying non-HAZMAT release events, having average weather EALs, and using 5-rem as a radiological TEL. EA identified other program weaknesses associated with implementing inadequate

building inventory controls and not performing timely initial assessments during a response. Further, CAT use of available technical data was lacking during the exercise and the plume plots were neither accurate, conservative, nor used by the ERO.

### 3.2 Exercise Planning and Design

This portion of the assessment evaluated the exercise program staff's ability to plan an exercise that tests individual capabilities, multiple functions and activities within a function, or interdependent groups of functions used to respond to hazards analyzed in EPHAs.

#### Program Documents

ANL has an adequate set of program documents for developing and maintaining an exercise program that complies with DOE order requirements, with some exceptions discussed below. Collectively, ANL's OEM-PLAN-006, *Emergency Management Exercise Program Plan*, and OEM-SCHD-004, *Exercise Matrix*, establish and implement the requirements of the ANL emergency management exercise program.

#### Exercise Planning and Design

Argonne selected an exercise planning team in accordance with OEM-PLAN-006 and designed the FPE to test the five-year requirement for a severe event, as well as numerous capabilities, response functions, and 11 program elements. The scenario, level of participation, evaluation criteria, and number of Argonne evaluators were adequate to test many aspects of the emergency operations system (EOS); affected facilities, site, and some aspects of the offsite organizational inter- and intra-relationships; and adequacy of many pre-selected response resources. The scenario met DOE requirements for a severe event, and the scenario, injects, and supporting data were designed to ensure that players had the opportunity to demonstrate many of the 142 objectives identified in the final exercise plan. The exercise appropriately included time warps that enabled demonstration of some objectives that occur in later response phases, such as termination and recovery planning. In addition, Argonne promoted realism by altering photos to simulate tornado damage, applying moulage to simulate injuries, and using a team of former reporters and broadcasters as mock media during the news conference.

While the scenario validated many ERO capabilities, the exercise did not fully validate Argonne's emergency response capability to respond to the hazards identified in the selected EPHA and did not provide sufficient information necessary for the required evaluation of ERO performance, as required by DOE Order 151.1D, att. 4, par. 15 and att. 3, par. 14. (See **Finding F-Argonne-2**.) Periodic validation of all emergency response capabilities is necessary to ensure that Argonne can adequately mitigate identified hazards, and evaluators understand expected response actions in order to evaluate performance sufficiently.

Planning issues associated with the validation of emergency capabilities included:

- EOC and fire department objectives to assess impacts from the HF release and make all required environmental notifications were not fully demonstrated because injects did not ensure that responders addressed the HF spilled inside of building 208.
- Three of four objectives for the environmental protection program were not demonstrated because the IC did not understand the full extent of the release and concluded that air and water samples were not needed.
- An objective for health physics personnel to conduct field surveys for radiological contamination was not demonstrated because no contingency messages were developed.

- Protective action objectives were not fully demonstrated because exercise controllers directed role-playing evacuees to report to building 213 after protective actions were implemented, without consideration of IC instructions. During the exercise, upon receiving a high-flow fire alarm, building 200 personnel self-evacuated to their rally point at building 208, the site of the HF release. Meanwhile, the IC directed personnel from buildings 206 and 208 to report to building 200, which had self-evacuated and was the source of a radioactive material release. Personnel pre-selected to represent building occupants were directed to building 213 by non-responders, without an inject, and the IC was not given the opportunity to interact with these role-player evacuees. Consequently, during interviews, the duty officer and several players from the EOC and incident command post said they did not know why evacuees went to building 213.

Planning and design issues related to evaluation included:

- The plan provided no indication of what emergency categorization and classification decisions were expected. During pre-exercise briefings, EA was informed that multiple categorization and classification decisions could occur, depending on decisions made by players, with no clarification of whether any of the various potential classification decisions were wrong.
- Exercise planners did not provide exercise controllers and evaluators with activity logs, a list of key times to track, or instructions to log the event times necessary for evaluation of time-sensitive objectives. Because many key times were not logged, a later analysis of time-sensitive actions was limited.
- The exercise plan did not contain information needed to evaluate the postulated radioactive material release. Because the release was postulated from a non-HAZMAT facility, there was no EPHA, EAL, or protective action plan to reference. Likewise, the HS and pre-fire plans identify no radioactive material in building 200. When the CAT tried to perform dispersion modeling, its review of the radiological material inventory database showed no radioactive material in the building. A review of the database should have earned a source term inject for use in modeling, but none was prepared.
- Exercise planners did not review exercise evaluation guides (EEGs) for adequacy, relying instead on subject matter experts from the venues scheduled for evaluation to develop lines of inquiry. Issues pertaining to EEGs are described in section 3.4 of this report.

Additional concerns related to exercise planning and design are described below:

- The focus area of emergency facilities and equipment did not include objectives for evaluation of emergency facilities.
- The exercise plan unrealistically had the RAP team arrive on scene approximately 30 minutes after it was requested to respond to the radioactive material release. A test of the Argonne field monitoring team's capability was more appropriate for this small onsite contamination incident.
- The severe event scenario was a missed opportunity to test backup power and alternate response facilities. Power was lost to the 200 area of the site, but not to any command centers.
- To meet the definition of a severe event, the scenario postulated a chemical and radioactive material release, but the radioactive material release did not come from an EPHA facility.
- The exercise scenario did not represent a test of a response to a high-consequence incident as expected by an FPE under severe event conditions. The last Argonne test of a response to a high-consequence incident with offsite impacts was in 2016. OEM-SCHD-004 gives no indication

whether a high-consequence event will be tested in the next five years, or what protective actions will be demonstrated in future exercises.

- OEM-SCHD-004 does not ensure that the exercise program fully demonstrates ERO capabilities or that a sufficient number of exercises are planned to test all capabilities. (See **OFI-Argonne-5**.) Although the exercise matrix properly ensures that scenarios rotate among major facilities and includes a list of onsite and offsite facilities to be tested, the alternate EOC has never been tested and is not currently scheduled for testing per OEM-SCHD-004. An Argonne representative said that planning to test the alternate EOC began prior to the pandemic but was halted when work restrictions were imposed. Argonne staff said that a test of the alternate EOC is now tentatively planned for fiscal year 2023.

### **Exercise Planning and Design Conclusions**

Overall, the exercise plan tested many of Argonne’s emergency response capabilities but did not fully validate response capabilities, did not include information needed for sufficient evaluation, and did not demonstrate the ability of the ERO to respond to a high-consequence scenario, as expected by a severe event FPE selected from EPHAs.

### **3.3 Exercise Conduct**

This portion of the assessment determined whether controllers and evaluators were appropriately briefed, maintained exercise confidentiality, and conducted the exercise safely and in accordance with the exercise plan.

#### **Controller/Evaluator Briefings**

EA did not participate in controller/evaluator briefings and relied on a review of controller/evaluator briefing/training materials used to prepare personnel, as well as documents referenced in the briefing materials, and interviews of key players, controllers, and evaluators, to draw conclusions about how well controllers and evaluators were prepared to perform their functions. The briefings, roles, expectations, and limitations of controllers, evaluators, and observers were appropriately described; safety controls and expectations were clear and adequate; and venues, participants, and exercise simulations/artificialities were properly explained. However, training for the scenario and the master sequence of events list were limited to two slides and were not sufficiently detailed. Additionally, expected actions for successful implementation of exercise objectives were not included in the exercise plan, nor were they discussed in controller briefing materials.

EEGs included a place to notate times of activities and document other relevant information and controllers were informed during briefings about notating times of anticipated responses on EEGs; however, many EEGs for time-sensitive objectives did not include the questions needed to prompt notation of important response times, as described in section 3.4. As a result, evaluators did not evaluate the timeliness in performing time-sensitive objectives established by DOE requirements, and records were unavailable for later analysis. Based on interviews with players and controllers, as well as a review of player, controller, and evaluator logs, EEGs, and the after-action report (AAR), EA concluded that evaluators were not adequately prepared to perform their functions, as discussed in section 3.4.

#### **Exercise Confidentiality**

A “trusted agent” slide was included in the controller/evaluator briefing materials but did not specify whether non-responder participants were required to sign the trusted agent form. OEM-PLAN-006 indicates that exercise planners are expected to sign a trusted agent form. In addition to exercise planners, Argonne required EA assessors to sign a trusted agent form in order to review the exercise plan, and a



total of 46 other controllers, evaluators, role-players, and observers also signed forms as trusted agents. However, 38 controllers, evaluators, role-players, and observers who participated in the exercise did not sign the form. (See **OFI-Argonne-5**.) In addition, even though objectives pertaining to initial categorization/classification of the event were included in the exercise package, the duty officer who played during the exercise was a member of the exercise development team. The evaluation of an objective for initial categorization/classification was omitted from the AAR, but another objective pertaining to initial response by the duty officer, to include categorization/classification activities, was evaluated. Argonne indicated that duty officers are typically involved in exercise scenario discussions because, as members of the emergency management staff, they are expected to support exercise planning efforts. (See **OFI-Argonne-5**.)

### **Safety Controls**

No significant safety issues were noted in the post-exercise materials. The safety information provided in the exercise plan was adequate, the exercise briefing provided to controllers, evaluators, role-players, and safety observers was appropriate, and the post-exercise comments submitted by safety observers were thorough and critical.

### **Exercise Control**

Based on exercise records and interviews, controllers did not contact the exercise director to discuss how or whether to get the exercise back on track with the planned scenario when responders did not earn the inject for three spilled HF drums in building 208. This caused a condition whereby some of the objectives were not demonstrated and no contingency messages were available to ensure players were able to perform the expected tasks. (See **OFI-Argonne-6**.)

### **Exercise Conduct Conclusions**

Overall, the exercise conduct was sufficient to ensure that many of the exercise objectives were demonstrated. Controllers implemented the exercise plan as designed, some steps were taken to keep the exercise scenario confidential, and all exercise activities were conducted safely. However, controllers did not take action to get the exercise back on track when they realized that multiple objectives would not be demonstrated because responders either did not earn injects or no prepared injects were available.

## **3.4 Exercise Evaluation**

This portion of the assessment determined whether Argonne effectively evaluated player performance and exercise planning and conduct, identifying strengths, findings, weaknesses, and opportunities for improvement, as appropriate.

Although Argonne evaluators self-identified one safety-significant issue, the exercise response was not critically evaluated to measure the effectiveness of the response for a planned incident, contrary to DOE Order 151.1D, att. 3, par. 14, which states that exercises must be sufficiently evaluated. Significant response issues were not self-identified by evaluators or included in the AAR, and some safety-significant issues were misclassified as OFIs. (See **Finding F-Argonne-3**.) Issues pertaining to evaluation are discussed in detail in the sections below.

## **Exercise Evaluation Guides**

ANL evaluated 124 of the 142 objectives in the exercise plan in the AAR. However, the EEGs used for the evaluation either did not contain observable and measurable criteria or they were not used. In addition, EEGs were not developed for 19 of the objectives in the final exercise plan, or for the two objectives added after the exercise plan was approved. Available EEG evaluation criteria were insufficient to enable an assessment by comparison of performance against predetermined and documented ANL program-specific plans and procedures. Therefore, responders were not evaluated with respect to their demonstrated proficiency in their respective responsibilities and functions, their communication and coordination with other responders, or their familiarity with and use of applicable procedures and equipment. (See **OFI-Argonne-7.**)

The following are examples of EEGs containing criteria that were either not measurable or that did not align with objectives:

- The EEG used to evaluate incident classification had a single line of inquiry: “Better information on event conditions causes incident to be escalated to a classifiable OE using OEM-PLAN-009 if incident was not initially classified.” No criteria were included to help evaluators determine whether the incident was classified using the appropriate EAL or whether the classification occurred promptly, within the DOE response time requirements.
- The EEG criteria for objective HEW.4 were inappropriate and did not align with the objective. The objective was designed to evaluate whether Health and Employee Wellness staff determined the level of contamination on arriving patients and conducted decontamination activities while avoiding cross-contamination. However, the EEG criteria pertained to: (1) rescheduling patients; (2) communicating schedule changes; (3) keeping patient information confidential; and (4) controlling who enters and leaves the clinic during the event.
- The criteria for two objectives pertaining to REAC/TS were not related to interactions with REAC/TS.

## **Controller/Evaluator Debriefing**

The controller/evaluator debriefing did not adequately integrate the ERO response to determine whether the response was effective. The 30-minute controller/evaluator debriefing contained little discussion of responder performance and did not establish a timeline of key events. Although a few strengths and weaknesses were mentioned, only two evaluators offered critical comments; most venues shared no information. Strengths and issues related to emergency public information were commendably discussed at length, but the evaluator was unaware that the briefing provided inaccurate and incomplete information during the simulated news conference. Program elements and core capabilities selected as focus areas for the exercise were not mentioned for vetting by the entire evaluator organization. Finally, there was no discussion of whether any objectives were not met. The debriefing did not include an analysis of the response, which would involve using data collected to reconstruct the timeline of events to identify the differences between what happened and what was supposed to happen and to ascertain the root causes for the differences. Collectively, the controller/evaluator debriefing and the EEG evaluation records identified only one significant issue requiring a corrective action plan. This contrasts to the number of issues that EA identified through exercise records reviews as described below. (See **OFI-Argonne-7.**)

## **After-Action Report**

Argonne evaluated some aspects of the response effectively. Most notably, the fire department and safety controllers identified responders inappropriately entering the scene’s hot zone. In addition, the

emergency public information evaluators provided critical evaluations, recognizing both strengths and weaknesses, although they missed the aforementioned press briefing content issues.

Argonne concluded that 121 of the 124 objectives evaluated in the AAR were met, largely without consideration of ERO performance. Significant examples of erroneous conclusions include:

- Objective HP.5 pertaining to the conduct of field surveys by HP personnel was graded as met with some challenges although the evaluator recorded that no field surveys were taken by HP personnel.
- Objective EOC.8 pertaining to consequence assessment was graded as superior although significant errors occurred in the plume plot development, the plume plots were not approved, and no briefings or distribution of results occurred.
- Objective EOC.26 pertaining to situational awareness in the EOC was graded as superior even though there were variances in understanding about whether a radiological release occurred. Additionally, the press briefing information, approved by Emergency Public Affairs managers and the ASO Communications Advisor, did not reflect the exercise scenario or the information that some EOC team members knew at the time of approval.

Additionally, significant response issues were not identified by evaluators or addressed in the AAR, as described below. A critical and thorough evaluation is necessary to ensure the ERO's response to an analyzed incident will be effective.

- Personnel evacuated from buildings 206 and 208 were directed to enter a building that had already self-evacuated due to a fire alarm, radiological release, loss of power, and structural damage.
- The ERO did not fully mitigate the hazardous releases. Responders did not realize that HF spilled into two different drainage systems, one inside the building and one outside the building. This information is available in the building 208 EPHA and protective action plan.
- The 15-minute notification requirement for emergency classification of the HF release was not met. In addition, the DuPage County sheriff and the ANL child development center were not notified of the HAZMAT release.
- Responders were not given safe route information to the EOC or to the incident command post.
- The EOS did not ensure that responders had a common operating picture. For example: (1) responders thought there was only one leaking HF drum; (2) the emergency director, safety manager, and public information staff did not know that a radiological release occurred; and (3) the EOC cadre only knew about three of the eight postulated injuries.
- Due to the power outage, personnel in the 200 area were released without performing accountability. Regulations, such as 29 CFR 1910.38, *Emergency action plans*, require that all employees be accounted for after an emergency evacuation has been completed. Although full-site accountability was completed after the tornado impacted the site, accountability of 200-area employees was not performed when the evacuation decision was made while the HAZMAT release was in progress.
- Inaccurate information was provided to the news media, including: (1) that no hazardous release occurred at building 200; (2) that no national assets had been requested; (3) that only two injuries were being treated; (4) that an injury was caused by hydrochloric acid; and (5) that the injury at building 200 was not caused by a HAZMAT release.
- The incident was terminated prior to mitigation of three spilled drums of HF, and an approved recovery plan did not include an objective to clean up inside building 208 or two impacted drainage systems.

- Miscommunication about the chemical release (i.e., hydrochloric acid versus HF) was corrected at the scene and in the EOC but was not corrected at the Joint Information Center and, consequently, was incorrectly briefed to the media.

Eighteen objectives included in the exercise plan were not evaluated in the AAR. (See **OFI-Argonne-7**.) In addition, response times in relation to categorization/classification, notifications, and implementation of protective actions are time-sensitive program elements that were not discussed in the AAR. Because evaluators did not log key response times related to incident categorization/classification, it could not be ascertained afterwards whether these time-sensitive objectives were met. (See **OFI-Argonne-7**.) Eleven program elements and 16 core capabilities were chosen for testing in the exercise plan, but performance evaluations for those elements are not included in the AAR. (See **OFI-Argonne-7**.) Players interviewed after the AAR was approved were still unaware that the exercise scenario included four spilt drums of HF, eight personnel injuries, and that a radiological release had been confirmed outside to the environment. Only one player understood why evacuees reported to building 213.

Finally, some of the 58 OFIs identified in the AAR were potentially safety-significant issues and warranted a more significant category for which a corrective action plan is required. For example:

- No field surveys were performed. (HP OFI 1)
- Responders could not access wind data needed to assess exposure. (EPP OFI 3)
- The EOC did not know what the RAP team was doing. (EOC OFI 1)
- No water or perimeter air samples were taken. (Fire OFIs 1&2, EPP OFI 2)
- Unified command vacated while nine companies were operating in two locations. (Fire OFI 11) A unified command at a single command post is essential for ensuring overall incident management, for achieving goals effectively, and for ensuring responders have a common operating picture.

Proper classification of safety-significant issues is necessary to ensure that the weaknesses are appropriately processed and corrected so that the ERO's responses to analyzed incidents are effective.

### **Exercise Evaluation Conclusions**

Although evaluators identified one safety-significant issue, the overall exercise evaluation was not thorough and, as a result, numerous significant response weaknesses were not identified or categorized as needing corrective action plans. Key attributes missing from the evaluation process included an evaluation of responder performance based on criteria developed from site plans and procedures and DOE requirements, as well as a reconstruction of what happened for a comparative analysis with what was supposed to happen. Players interviewed after the AAR was approved thought that the response was highly effective and did not understand that the release was not fully mitigated. Lack of adequate evaluation criteria in the EEGs and lack of sufficiently detailed controller/evaluator debriefings contributed to evaluation ineffectiveness.

## **4.0 BEST PRACTICES**

No best practices were identified during this assessment.

## 5.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1, *Implementation of Department of Energy Oversight Policy*, to manage the corrective actions and track them to completion.

### UChicago Argonne, LLC

**Finding F-Argonne-1:** Argonne did not implement a timely initial assessment that modeled the dispersion of the worst-case source term under actual weather conditions and did not develop an accurate plume plot during the exercise. (DOE Order 151.1D, att. 4, par. 10)

**Finding F-Argonne-2:** The Argonne exercise plan did not ensure emergency response capabilities to respond to the hazards identified in the EPHA were fully validated and did not provide sufficient information necessary for evaluation of ERO performance. (DOE Order 151.1D, att. 4, par. 15 and att. 3, par. 14)

**Finding F-Argonne-3:** Argonne did not critically evaluate the exercise to measure the effectiveness of the response for a planned incident. Some significant response issues were not self-identified by evaluators or included in the AAR, and other significant issues were misclassified as OFIs. (DOE Order 151.1D, att. 3, par. 14)

## 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.

### UChicago Argonne, LLC

**Deficiency D-Argonne-1:** Argonne implemented an EPHA without ASO approval. (DOE Order 151.1D, att. 4, par. 2.n)

**Deficiency D-Argonne-2:** Argonne inventory controls did not ensure that the EPHA was revised before a new form and quantity of HF was introduced into building 208. (DOE Order 151.1D, att. 4, par. 2.o)

**Deficiency D-Argonne-3:** Argonne used non-DOE protective action criteria to classify non-HAZMAT incidents and deviated from the Argonne emergency plan by not categorizing non-HAZMAT incidents as an OE not requiring further classification. (DOE Order 151.1D, att. 4, par. 8.a. and ANL OEM-PLAN-001, par. 2.6)

**Deficiency D-Argonne-4:** Argonne did not obtain NARAC approval of results, as specified in the Argonne emergency plan. (ANL OEM-PLAN-001, par. 2.8.3.1)

## 7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified eight OFIs 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.

### Argonne Site Office

**OFI-ASO-1:** During review and approval of the building 208 EPHA, consider whether:

- The deposition velocity values used in the analysis are consistent with published values and are appropriately conservative in accordance with site procedures, accepted techniques in user guides, and scientific and engineering principles.
- The building 208 protective action zone is accurately characterized as a large metropolitan area for a quantitative analysis.
- The vapor pressures for each of the three types of drum solutions are accurate and correlate to the correct type of solution.

### UChicago Argonne, LLC

**OFI-Argonne-1:** Consider revising OEM-PLAN-004 to have the HS include all materials subjected to screening criteria and the reason they were screened from a quantitative assessment or reference where the documentation can be found in OEM-PLAN-004 and/or the HS to ensure that all materials were considered and to avoid repeating the entire survey when personnel that performed the survey are replaced.

**OFI-Argonne-2:** Consider implementing the following conservative assumptions and methodologies for EPHA development, as well as consequence assessment activities and products:

- Revise OEM-PLAN-005 to change the 5-rem TEL value to 100-rem to align with the accepted assessment techniques provided in the EMG and to allow for more shelter-in-place options for short duration radiological releases.
- Record all assumptions in a quantitative assessment.
- Add the altitude parameter for ANL's elevation to OEM-PLAN-005 and the EPHAs.
- For ease of use by consequence assessment personnel, use the conservative surrogate drum for a quantitative assessment in the building 208 EPHA, as stipulated by OEM-PLAN-005.
- To avoid the selection of an incorrect EAL due to misjudgments in weather conditions, eliminate average weather-based EALs.
- Ensure that the vapor pressures used for modeling are correct or explain, in the EPHA, why they do not adhere to published gas laws, which predict lower vapor pressures with increased dilution.
- Communicate consequence assessment results by transmitting them to decision-makers in the ERO using formal, written worksheets and notification forms and briefings.
- Use dispersion plume plots and deposition plots as the basis for field monitoring team planning and source term validation with field monitoring survey data.
- Perform "what if" dispersion projections for changing conditions or conditions that may be worse than reported by field personnel, particularly for unknown conditions.

**OFI-Argonne-3:** When improving HAZMAT inventory controls within a building or room, consider establishing administrative limits with facility managers that can be used at the facility to ensure that incoming materials are analyzed in an EPHA before entry.

**OFI-Argonne-4:** To better protect first responders, consider having the duty emergency manager make use of field indicators and reports from witnesses to select an EAL and associated protective actions without depending on first responder observations. Responders from the fire department can rely on their pre-fire plans during a response.

**OFI-Argonne-5:** To improve exercise planning, consider:

- Including a comprehensive list of response capabilities and a testing frequency for each capability in OEM-SCHD-004; ensuring the matrix indicates what classification levels are proposed for future scenarios; listing the protective actions that will be demonstrated in future exercises to ensure that the 5-year exercise program includes high-consequence events with offsite impacts; and ensuring that one of the response capabilities tested regularly is the alternate EOC.
- Clarifying OEM-PLAN-006, *Emergency Management Exercise Program Plan*, to indicate whether all controllers, evaluators, and observers need to sign a trusted agent form.
- Ensuring that the duty officer scheduled for participation in the annual exercise is not a member of the exercise planning team and, as a member of the emergency management staff, not included in department-level exercise planning discussions.

**OFI-Argonne-6:** Consider revising exercise controller briefing and training materials to encourage controllers to verify that exercise objectives are being accomplished, and, if not, to ask the exercise director whether ad hoc injects should be developed to correct the trajectory of exercise play.

**OFI-Argonne-7:** To improve exercise evaluation, consider:

- Using ANL-specific plans and procedures to develop EEG criteria for objectives that will enable evaluators to measure responder proficiency in performing tasks related to their responsibilities and functions.
- Lengthening and revising the controller/evaluator debriefing process to include: (1) discussion of strengths and weaknesses by evaluators from all venues, with an explanation of performance issues related to objectives that were unable to be performed or performed with major challenges; (2) compilation of a timeline of significant events, and particularly events related to time-sensitive objectives; (3) discussion of player performance in relation to program elements and core capabilities being tested; and (4) discussion of conflicting information gathered by evaluators, if applicable.
- Evaluating all objectives included in the exercise plan in the AAR or, at a minimum, explaining in the AAR why objectives included in the exercise plan were not evaluated.
- Including log sheets in controller/evaluator materials, as well as encouraging evaluators to log key response times for significant events and for events related to time-sensitive exercise objectives.
- Discussing exercise performance for program elements and core capabilities selected for testing in the exercise plan.

## **Appendix A Supplemental Information**

### **Dates of Assessment**

Remote Assessment: August 1 – October 28, 2022

### **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  
Vacant, 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  
Christopher E. McFearin  
Shannon L. Holman  
Michael A. Kilpatrick

### **EA Assessment Team**

Brad J. Edler, Lead  
John L. Riley  
Thomas Rogers



**Appendix B**

**Office of Science Response Memorandum**

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Department of Energy  
Office of Science  
Washington, DC 20585

May 31, 2023

MEMORANDUM FOR JOHN DUPUY  
DIRECTOR  
OFFICE OF ENTERPRISE ASSESSMENTS

FROM: JUSTON K. FONTAINE *Juston Fontaine*  
DEPUTY DIRECTOR FOR OPERATIONS  
OFFICE OF SCIENCE

SUBJECT: Response to the Office of Enterprise Assessments Report  
*Independent Assessment of Emergency Management at the  
Argonne National Laboratory*

Thank you for the opportunity to review and comment on the Office of Enterprise Assessments Draft Report, *Independent Assessment of Emergency Management at Argonne National Laboratory*. The Office of Science (SC) has reviewed the draft report and concurs with three of the identified Deficiencies and specific Opportunities for Improvement (OFI). However, the Office of Science does not concur with the three Findings. In addition, there remains disagreement on two of the four Deficiencies and four of the eight OFIs identified in the report. Unfortunately, previous comment resolution efforts have not achieved a satisfactory level of agreement.

The Office of Science does not think that the report evaluates the “effectiveness of” emergency management as stated in the executive summary. The report cites requirements in a subjective manner, adding opinion on implementation and, at times, relies on opinion-based statements that are incorrect. While reviewers can have an opinion on a preferred way of business or best practice and SC will certainly take that into account, it is not the basis for a finding or deficiency.

The attachment to this memorandum provides a management response on the proposed findings and deficiencies in the report.

If you have any questions regarding this response, please contact me at 202-586-2086.  
Attachment

**Office of Science Response to the Office of Enterprise Assessments Report *Independent Assessment of Emergency Management at Argonne National Laboratory***

**Finding F-ARGONNE-1:** Argonne did not implement a timely initial assessment that modeled the dispersion of the worst-case source term under actual weather conditions and did not develop an accurate plume plot during the exercise. (DOE Order 151.1D, att. 4, par. 10)

**Management Response:** Non-concur – As specified in Argonne OEM-PLAN-001, *Comprehensive Emergency Management Plan*, the Argonne emergency management team has two individuals in the EOC who are assigned specifically to perform the functions of the timely initial assessment and ongoing consequence assessment. All DOE requirements are followed with Protective Action Coordinator (PAC) assessment steps provided in OEM-JAID-016, Protective Action Coordinator Job Aid. The report specifically highlights that the worst-case source term should be used; however, Argonne utilized the actual source term (or worst case per EAL) per DOE O 151.1D which states that sites must “Establish provisions to conduct a timely initial assessment with the worst-case source term from the EAL using current meteorological conditions or if information is available, the actual source term based on known incident conditions from observations and indicators using current meteorological conditions for onsite and offsite consequences.” This is the process Argonne follows.

**Finding F-ARGONNE-2:** The Argonne exercise plan did not ensure emergency response capabilities to respond to the hazards identified in the EPHA were fully validated and did not provide sufficient information necessary for evaluation of ERO performance. (DOE Order 151.1D, att. 4, par. 15 and att. 3, par. 14)

**Management Response:** Non-concur—The referenced DOE Order requirements are that “capabilities be validated” and the “exercises be evaluated sufficiently.” The annual exercise need not validate all capabilities and what constitutes “sufficient” evaluation is a matter of subjective opinion. As noted in the report Introduction, the initial planning for the assessment anticipated on-site evaluation during the Argonne full participation exercise, which occurred on August 2, 2022. However, due to changes in local COVID-19 conditions, the actual exercise was not observed, and the assessment report was reconstructed through interviews (some occurring over two months after the exercise date) as well from participant and evaluator logs and exercise documentation. The lack of first-person observations of the exercise conduct and after- action activities calls into question the accuracy of the evaluators’ determination of “sufficient.”

Additionally, the comments providing further detail on this finding seemed to focus on Argonne not providing additional injects to steer exercise participants to a pre-determined action. Argonne conducted this exercise as a participant driven exercise, i.e., we let the responders perform as they naturally would to the event scenario presented to them. This type of exercise provides a more realistic validation on how responders would actually perform rather than artificially guiding them. It also identifies opportunities for improvement that would not be available if participants were simply told by exercise staff what to do.

**Finding F-ARGONNE-3:** Argonne did not critically evaluate the exercise to measure the effectiveness of the response for a planned incident. Some significant response issues were not self-identified by evaluators or included in the AAR, and other significant issues were misclassified as OFIs. (DOE Order 151.1D, att.3, par 14)

**Management Response:** Non-concur—This finding again becomes one of subjective opinion on the part of the evaluators who were not directly present during the conduct of the exercise or the associated after-action activities.

**Deficiency D-ARGONNE-1:** Argonne implemented an EPHA without ASO approval. (DOE Order 151.1D, att. 4, par. 2.n)

**Management Response:** Concur

**Deficiency D-ARGONNE-2:** Argonne inventory controls did not ensure that the EPHA was revised before a new form and quantity of HF was introduced into building 208. (DOE Order 151.1D, att. 4, par. 2.o)

**Management Response:** Concur

**Deficiency D-ARGONNE-3:** Argonne uses non-DOE protective action criteria to classify non- HAZMAT incidents and deviates from the Argonne emergency plan by not categorizing non- HAZMAT incidents as an Operational Emergency not requiring further classification. (DOE Order 151.1D, para. 8.b.(b) and ANL OEM-PLAN-001, para. 2.6.)

**Management Response:** Non-concur—Argonne’s Technical Planning Basis and EALs are well documented and use DOE protective action criteria as contained in DOE O 151.1D to classify HazMat incidents. Only HazMat incidents are classifiable, and Argonne does not classify incidents that do not involve hazardous materials. Operational Emergencies that do not involve classifiable hazardous material releases are categorized as Operational Emergencies – Not Further Classified (OE-NFC). The exercise resulted in a spill of hazardous materials in an EPHA facility, thus a HazMat based EAL of Alert was appropriate.

**Deficiency D-ARGONNE-4:** Argonne did not obtain NARAC approval of results, as stated in the Argonne emergency plan. (ANL OEM-PLAN-001, para. 2.8.3.1.)

**Management Response:** Non-concur—During the exercise, the Protective Action Coordinator did contact NARAC and went through the reporting protocols with NARAC. However, based on prior Argonne exercise experience with NARAC, Argonne did not receive an “approval” from NARAC.