Emergency Management Assessment at the Y-12 National Security Complex

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Acronyms

CAT	Consequence Assessment Team
CNS	Consolidated Nuclear Security, LLC
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
ECC	Emergency Control Center
ED	Emergency Director
EMInS	Emergency Management Information System
EOC	Emergency Operations Center
EOS	Emergency Operations System
EPHA	Emergency Planning Hazards Assessment
ERO	Emergency Response Organization
FE	Functional Exercise
FMT	Field Monitoring Team
FPE	Full-Participation Exercise
GIS	Geographical Information System
HAZMAT	Hazardous Material
IC	Incident Commander
ICP	Incident Command Post
IZ	Isolation Zone
JIC	Joint Information Center
LiOH	Lithium Hydroxide
MAR	Material At Risk
MJERP	State of Tennessee Multi-Jurisdictional Emergency Response Plan
NARAC	National Atmospheric Release Advisory Center
NPO	National Nuclear Security Administration Production Office
NSC	National Security Complex
OE	Operational Emergency
OFI	Opportunity for Improvement
PA	Protective Action
PAR	Protective Action Recommendation
PSS	Plant Shift Superintendent
TEMA	Tennessee Emergency Management Agency
TSC	Technical Support Center
Y-12	Y-12 National Security Complex
YAMS	Your Area Mapping System

Emergency Management Assessment at the Y-12 National Security Complex May – August 2019

Summary

Scope:
This assessment included evaluations of a full-participation exercise (FPE) and a follow-on functional exercise (FE) to ascertain the effectiveness of the Y-12 National Security Complex (Y-12) response to an emergency and ability to self-identify program weaknesses and make improvements. Using two exercises for data collection minimizes irregularities caused by individual anomalies or exercise artificialities. The assessment team compared decision-making performance from the two exercises; analyzed the observed exercise strengths and weaknesses; and identified best practices, findings, deficiencies, and opportunities for improvement.

Significant Results for Key Areas of Interest:

Overall, Consolidated Nuclear Security, LLC (CNS) has implemented an effective emergency operations system that mostly provides the emergency response organization (ERO) with exceptional situational awareness and a common operating picture. As reflected in this report, the number of best practices cited is indicative of a mature emergency management program at Y-12. However, during the exercises, CNS did not demonstrate that it had established and maintained adequate emergency response capabilities and responder proficiency at all venues and emergency response positions, respectively.

<u>Full-Participation Exercise</u>
The FPE validated the ability of the Y-12 emergency operations system to respond to an emergency incident involving both onsite and offsite consequences. The scenario simulated a severe weather-initiated incident affecting multiple hazardous material facilities, leading to elevated releases of uranium and lithium compound inventories and resulting in a General Emergency declaration. Additionally, the exercise incorporated 15 onsite injuries and numerous offsite injuries and contaminations.

The FPE was an extensive demonstration of U.S. Department of Energy, state, and local response capabilities. The National Nuclear Security Administration Production Office and CNS validated Y-12's concepts for responding to a severe event with onsite and offsite consequences. The exercise revealed some weaknesses in responder capability and proficiency in implementing response procedures. The assessment team concluded that these weaknesses were the consequence of the training, drill, and exercise programs that did not account for, and address, different levels of ERO member proficiency (the combination of skills and competency acquired from training and experience).

<u>Functional Exercise</u>
The FE validated the performance of key ERO decision-makers but did not include the participation of field response elements (fire, rescue, emergency medical, protective force, field monitoring teams, etc.). The scenario simulated a fire affecting a single hazardous material facility, resulting in the release of uranium and hydrogen fluoride and a General Emergency declaration. Additionally, CNS incorporated two onsite injuries into the exercise.

The FE effectively validated the ability of key ERO decision-makers to respond in accordance with established emergency plans and procedures to a Y-12 emergency incident with onsite and offsite

consequences. Overall, CNS demonstrated improved ERO performance during the FE when compared to the FPE.

Exercise Design and Conduct

CNS's design of both the FPE and the FE sufficiently challenged and validated most CNS emergency response capabilities, including field monitoring, emergency operation systems, and injured personnel tracking. However, whereas CNS effectively designed and conducted the FE, the design and conduct of the FPE did not adequately support the validation of all elements of the consequence assessment process.

Best Practices and Findings

The assessment team identified several best practices that include injured personnel tracking, automation and integration of technology into the response, and offsite planning.

The assessment team identified one finding as part of this assessment. Observations during the exercises revealed that CNS has not established and maintained some Y-12-specific emergency response capabilities that ensure responder proficiency.

Follow-up Actions:

No follow-up activities were identified.

Emergency Management Assessment
at the Y-12 National Security Complex

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), assessed the emergency management program at the Y-12 National Security Complex (Y-12). The assessment appraised the Y-12 emergency management program by evaluating its effectiveness in responding to emergencies. This assessment is part of a series of assessments of emergency management programs at DOE complex sites and was conducted in accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Emergency Management Program at the Y-12 National Security Complex, May – August 2019*. The assessment included both the June 2019 full-participation exercise (FPE) and July 2019 functional exercise (FE), and considered the performance of the emergency response organization (ERO) at key decision-making venues using scenarios that postulated potential offsite consequences.

2.0 METHODOLOGY

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

As identified in the assessment plan, this assessment considered requirements related to DOE Order 151.1D, *Comprehensive Emergency Management System*. The assessment team used the following sections of EA Criteria and Review Approach Document (CRAD) 33-09, *DOE O 151.1D Emergency Management Program*, Rev. 0: 4.3 Emergency Response Organization, 4.4 Emergency Operations System, 4.5 Training and Drills, 4.6 Offsite Response Interface, 4.7 Emergency Categorization, 4.8 Protective Actions, 4.9 Consequence Assessment, 4.11 Notifications and Communications, and 4.15 Exercises. The assessment team observed specific decision-making venues during the exercises using the CRAD's applicable ERO performance-based lines of inquiry. In addition, the assessment team used a response element matrix to integrate crosscutting performance observations relative to six response elements (Emergency Operations System (EOS), Notifications and Communications, Emergency Classification, Protective Actions, Consequence Assessment, and Offsite Interface) identified in DOE Order 151.1D, as well as Exercise Design and Conduct.

The FPE, Y-12's annual exercise, tested the ability of the ERO to respond to a severe emergency incident resulting in onsite and offsite consequences. The FPE provided an extensive demonstration of DOE response capabilities and interface with State of Tennessee capabilities that included 296 onsite and 324 offsite participants.

The FE also validated and compared the performance observed during the FPE of key ERO decision-making functions, without requiring the participation of field response elements (fire, rescue, emergency medical, protective force, field monitoring teams or FMTs, etc.). The FE included 175 (40% less than during the FPE) onsite participants and two offsite participants from the State of Tennessee.

Using two exercises for data collection minimized irregularities caused by individual anomalies or exercise artificialities, and allowed a comparative assessment of decision-making performance for similar hazardous material (HAZMAT) incidents. The assessment team followed up on issues identified during the exercise evaluations to determine possible causes, such as a lack of training, insufficient procedural guidance, or a lack of practice during drills.

The assessment team examined key documents, such as emergency plans and implementing procedures, the FPE and FE plans, emergency planning hazards assessments (EPHAs), manuals, job aids, policies, and training and qualification records. In addition, the assessment team reviewed all relevant programmatic documentation supporting the assessment of response elements. The assessment team interviewed key personnel responsible for developing and executing the associated programs and observed the FPE and FE planning, conduct, and evaluation activities, focusing on response processes and capabilities. The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in Appendix A.

3.0 RESULTS

3.1 Comparison of Exercise Observations

The FPE represented a complex and resource-intensive emergency that involved significant participation from onsite and offsite elements. Participation included local and state response agencies and operations centers, DOE Headquarters, local hospitals, and DOE national assets. The affected Y-12 general plant population validated onsite Protective Actions (PAs), which involved the evacuation of 600 personnel, 250 who sheltered in place, and 2,000 who implemented curfew (population control measure used during an emergency response situation in which there is a need to control movement throughout the site or portions thereof, but not requiring PAs).

The FPE scenario simulated a severe weather-initiating incident affecting multiple HAZMAT facilities and resulting in the release of uranium and lithium compounds. Consolidated Nuclear Security, LLC (CNS), the prime management and operating contractor, specifically designed the severe event exercise to stress response capabilities and test the interface with offsite mutual-aid partners and other organizations that supplement or support response efforts. Damage to Building 9204-2E from the weather incident caused a structural fire (subsequently referred to as the lithium fire) that resulted in a General Emergency declaration. Concurrently, a small amount of lithium spilled outside of Building 9811-01 (subsequently referred to as the lithium spill). The lithium spill by itself would have resulted in an Alert declaration, but because CNS had declared the General Emergency, another declaration was not necessary. Additionally, CNS incorporated 15 onsite injuries at multiple locations and numerous offsite injuries/contaminations into the FPE. Extensive offsite monitoring and assessment involved Y-12 FMTs, State FMTs, Region 2 Radiological Assistance Program teams, 45th Civil Support Team, National Atmospheric Release Advisory Center (NARAC), and Radiation Emergency Assistance Center/Training Site.

The National Nuclear Security Administration Production Office (NPO), CNS, and the Tennessee Emergency Management Agency (TEMA) successfully conducted the FPE on June 12, 2019. NPO and CNS validated Y-12's plans and procedures for responding to a severe incident that resulted in onsite and offsite consequences in accordance with EMPO-500, *Y-12 National Security Complex Emergency Plan*, and the *State of Tennessee Multi-Jurisdictional Emergency Response Plan (MJERP) for the United States Department of Energy Oak Ridge Reservation*.

CNS self-identified eight deficiencies (defined in DOE Order 151.1D as an inadequacy in the implementation of its applicable procedural requirements or performance standards) during the FPE as documented in EMPO-1090, *Emergency Preparedness Integrated Capability Exercise 2019 After-Action Report*. In addition, CNS identified 14 improvement items; that is, situations in which the performance of an evaluated capability could be improved or made more efficient if standard DOE or industry best practices were adopted. This EA report notes self-identified deficiencies, when appropriate.

Several ERO teams and individuals exhibited performance weaknesses in three of the six response elements observed by the assessment team during the FPE (Notifications and Communications, Protective Actions, and Consequence Assessment). With a few exceptions, CNS self-identified these weaknesses in its after-action report. Importantly, the ERO exhibited performance weaknesses at several key decision-making levels that resulted in untimely and incorrect information entering the EOS. The assessment team investigated contributing causes within other emergency management program elements, and the team's limited causal analysis attributed weaknesses in notifications and communications, PAs, and consequence assessment (further discussed in the following sections of this report) to inadequate training, drill, and exercise programs that did not maintain Y-12-specific emergency response capabilities to ensure responder proficiency.

At EA's request, CNS designed and conducted the FE to evaluate the capabilities and the multiple functions of key onsite ERO groups. Accordingly, the FE focused on the use of appropriate plans, policies, and procedures, as well as the actions of ERO members involved in management, direction, and command and control functions. CNS conducted the FE in a realistic, real-time environment in response facilities, but simulated the movement of response personnel and equipment in the field.

The FE scenario simulated a fire affecting Building 9212, resulting in the release of uranium and hydrogen fluoride. The postulated damage to Building 9212 resulted in a General Emergency declaration. Additionally, CNS incorporated two onsite injuries into the FE.

NPO and CNS successfully conducted the FE on July 31, 2019. Similar to the FPE, the FE effectively validated the ability of Y-12 to respond to an emergency incident that resulted in onsite and offsite consequences, in accordance with established emergency plans and procedures. The FE fulfilled the readiness assurance requirements of DOE Order 151.1D to validate emergency response capabilities to hazards identified in the Building 9212 EPHA.

Overall, CNS demonstrated improved ERO performance during the FE as compared to the FPE. The assessment team attributes this improvement to CNS capitalizing on the experience gained during the FPE and conducting focused training for select ERO teams that exhibited weaknesses during the FPE. CNS did not revise any response procedures between the two exercises, indicating that emergency management processes did not change between the FPE and FE. CNS has implemented an adequate qualification program for its ERO. However, performance in the FPE showed that the training, drill, and exercise programs have not established or maintained emergency response capabilities or proficiency for some ERO members. In addition, the level of ERO experience has significantly decreased in recent years. EA observed during the exercises, and reinforced during interviews, an association between lesser-experienced individuals and a lack of proficiency in the performance of their ERO tasks. The ERO training program (encompassing training, drills, and exercises) had not accounted for these different levels of ERO member's skills, knowledge and abilities, contributing to weaknesses in responder performance. (See **Finding F-CNS-1** and **OFI-CNS-1**.)

3.2 Emergency Operations System

The objective of this portion of the assessment was to determine whether the CNS EOS provided centralized collection, validation, analysis, and coordination of information related to an emergency, and supported on-scene response during an escalating incident by relieving the burden of site-level and external communication and securing additional resources needed for the response.

CNS implemented an effective EOS for the FPE and FE that supported on-scene response and provided both onsite and offsite EROs and facilities situational awareness and a common operating picture throughout responses to the postulated incidents. The Y-12 emergency plan, emergency public information plan, and MJERP provided a cohesive concept of operations that supported an effective EOS. During the FPE, CNS effectively demonstrated a significant effort in offsite planning through its integration of onsite plans with the MJERP. Additionally, the Emergency Management Information System (EMInS) provided efficient collection and dissemination of information through a network of workstations in Y-12 response facilities and offsite command centers, including TEMA EOC (Nashville), TEMA Field Coordination Center (Knoxville), and those for city, counties, and DOE Headquarters.

CNS has made significant improvements to EMInS (previously noted as a best practice by EA) and successfully demonstrated these improvements during the exercises. CNS has integrated computer databases, geographical information system (GIS) mapping, and video capabilities to gather, store, and display relevant information. CNS further organized the data into summary charts to provide succinct information to onsite and offsite responders. In addition, numerous EMInS databases are automatically integrated with graphical outputs using GIS maps, which CNS has designated Your Area Mapping System (YAMS). During the FPE and FE:

- CNS effectively implemented a newly developed injured personnel status process and database interface to identify, track, and validate injured personnel information (identification, health condition status, current location, supervisor, transport method, and next-of-kin if required). **(Best Practice)**

- CNS effectively demonstrated the usefulness of YAMS to support decision-making by quickly generating a list of affected buildings that required immediate employee PA announcements and potentially affected offsite sectors that required implementation of protective action recommendations (PARs) listed in the emergency action levels (EALs). **(Best Practice)**

- CNS effectively demonstrated its field monitoring process and tools to obtain and maintain the situational awareness of multiple onsite and offsite monitoring teams by integrating real-time field monitoring data among the EMInS database, YAMS, and GIS mapping. **(Best Practice)**

- NPO and CNS effectively managed emergency public information data and approvals for public release by the joint information center (JIC), through the automation of the initial press release, which was integrated with the initial notification form. The automated process permitted the prompt issuance of the pre-approved press release. Additionally, pre-approved, Y-12-specific factoids expedited the release of public information via social media. **(Best Practice)**

- CNS effectively managed the incidents by using emergency operations center (EOC) strategies and the technical support center (TSC) tactics status boards, which CNS used for status updates during scheduled teleconferences.

During the FPE:

- CNS successfully used its automated damage assessment process and tools to obtain and maintain situational awareness on multiple Y-12 building damage assessments and provided a response priority for each building based on strategic information, such as damage sustained, building stability, occupancy, and essential functions impacted. Real-time integration with Y-12's GIS provided a highly useful, color-coded, interactive graphical status map. **(Best Practice)**

- NPO and CNS effectively provided a significant amount of near real-time information in EMInS, which supported current situational awareness at onsite response facilities, TEMA facilities, the JIC, and the DOE Headquarters Watch Office and EOC.

Nevertheless, in some instances during the FPE, CNS entered erroneous information into its EOS that negatively affected the EOS' effectiveness and introduced some differences in situational awareness among the response venues. Most significantly, the EOC calculated and posted an unrealistic consequence assessment plume model with the PA distance extending to 31 kilometers, which was well beyond the EAL worst-case PA distance. Additionally, the emergency control center (ECC) provided inaccurate information in the offsite notifications, such as the lithium spill as a fire and the location of the spill as inside the facility. Finally, the initial notification form included some inaccurate information that was then transferred to the initial press release, resulting in the release of inaccurate information to the public.

Overall, CNS has implemented an effective EOS through plans, procedures, and information management tools that mostly provided the ERO with exceptional situational awareness and a common operating picture. Additionally, during the FPE, CNS validated effective integration of onsite plans with the MJERP, which was the result of a noteworthy effort in offsite planning. Finally, CNS demonstrated several notable tools and processes supporting injured personnel identification, status, and tracking; prompt PA decision-making; field monitoring data presentation; the initial press release and public information approval process; and building damage assessment and resource prioritization.

3.3 Notifications and Communications

The objective of this portion of the assessment was to determine whether CNS made initial notifications promptly, accurately, and effectively to all appropriate stakeholders, including the ERO recall and safe routing and employee PAs, and maintained effective communications throughout the emergency response.

3.3.1 Notifications

CNS has established adequate processes in its plans, procedures, and supporting systems for notifying stakeholders during emergencies. During the exercises, Y-12's ringdown phone system simplified verbal offsite notifications and enabled simultaneous participation with all organizations. In addition, CNS has automated the initial press release issuance process by integrating it with the initial notification process, which permits the prompt issuance of a preapproved press release. Nevertheless, the ERO exhibited several performance weaknesses related to notification processes during the exercises.

During the FPE and FE, the ECC did not complete onsite employee PA notifications within 10 minutes, contrary to DOE Order 151.1D. The ECC identified the affected buildings (where affected employees were located) using YAMS in less than one minute, which is the starting point for completing the PA notifications. The PA notification process requires two additional steps: emergency director (ED) approval of the announcement and issuing the PAs to employees via site announcement systems. The ECC completed the PA notifications in 12 minutes during the FPE and 15 minutes during the FE. Historically, issuing the announcements took the majority of time to complete, and CNS has begun a project to improve the announcement system portion of the notification process. However, CNS has proficiency issues in the ECC related to obtaining ED approval. During the FPE, CNS took 4 minutes to complete the approval, which extended completion of employee PA notifications beyond 10 minutes. Consequently, some employees remained in a potentially unsafe location, increasing the risk of health and safety impacts. (See **Deficiency D-CNS-01** and **OFI-CNS-2**.)

During the FPE, the CNS ERO did not provide a complete and accurate account of known information in a timely manner. Initial offsite notifications consist of the same information provided both verbally and electronically with receipt confirmation. The ECC initiated verbal notifications within 15 minutes after classifying the event; however, the verbal notification contained errors on the affected offsite sectors and did not provide the implemented onsite PAs. Additionally, the ECC did not provide complete and accurate information on the electronic notification form. The ECC sent an initial notification form 41 minutes after classification, and when TEMA called and asked about some conflicting information, the ECC sent an updated form 10 minutes later that corrected some information. Of significance, both the initial and updated electronic notification forms included inaccurate/incomplete information, including the time of discovery, description of the emergency, onsite PAs, and PAR sectors (initial only). Consequently, CNS did not provide TEMA complete and accurate information to support the prompt development of offsite PA decisions and issuance of the Emergency Alerting System message. The inaccurate description of the incident on the notification form also resulted in the consequence assessment team (CAT) not reviewing the lithium spill event. CNS self-identified the inaccurate notification form but did not identify the weakness in responder performance related to the delay and repeated submission of the initial notification form. The assessment team attributes the lack of responder proficiency as the primary contributing factor for this weakness. (See **Finding F-CNS-1**, **OFI-CNS-1**, and **OFI-CNS-2**.)

3.3.2 Communications

With some exceptions, CNS demonstrated effective use of communication systems and processes during both exercises. The ERO effectively used radio communications for primary fire department response tasks and maintained dedicated incident commander (IC) mobile phones for communicating detailed information. In addition, the TSC shared event scene information with the ERO in a timely and accurate manner. The EOC and TSC frequently used teleconference capabilities between the two facilities to maintain situational awareness. Further, the TEMA representative, dispatched from the TEMA East office to the EOC, assisted with communications to the state. Finally, during the FPE, the ERO had offsite FMT captains stationed at the TEMA Field Coordination Center and the EOC to facilitate FMT communications.

However, during both exercises, the TSC did not effectively communicate incident-based HAZMAT inventories to the CAT. CNS self-identified this weakness in the FPE after-action report. The TSC objective is to provide the latest known inventory of each material in the incident area to the CAT. However, during the FE the TSC did not provide the worst-case material quantities and unnecessarily spent time considering ways to produce a smaller HAZMAT inventory. This lack of appropriate information delayed the CAT in developing a timely incident-based plume dispersion model. The assessment team attributes the lack of effectiveness to responder proficiency in performing emergency response duties. (See **Finding F-CNS-1**, **OFI-CNS-1**, and **OFI-CNS-3**.)

Similarly, CNS did not demonstrate effectiveness with other communications. During the FPE, the ECC did not inform the IC about the HAZMAT spill until 45 minutes after receiving the report of the incident and did not direct the emergency medical response team to activate, delaying their response. Additionally, the ECC/Fire Department Alarm Room did not communicate safe route instructions to the fire department second alarm response, which resulted in the responders traversing the isolation zone (IZ) around Building 9204-2E, potentially exposing the responders to HAZMAT. CNS self-identified both weaknesses in the FPE after-action report. During the FE, the ECC incorrectly directed the IC support team to report to the incident command post (ICP), which was similar to a corrected past CNS-identified deficiency. Finally, the ECC did not initially inform the IC of the initial IZ, potentially resulting in the IC establishing the ICP and staging area in an unsafe location. The assessment team's limited causal analysis identified the primary contributing factor for these weaknesses to the lack of responder proficiency in performing emergency response duties. (See **Finding F-CNS-1**, **OFI-CNS-1**, and **OFI-CNS-2**.)

Overall, CNS has established effective processes and systems for notifications and communications, but did not always execute them effectively. CNS promptly made verbal notification to offsite organizations of the classified emergency. In addition, field responders maintained adequate communications with the ERO. The inclusion of an onsite TEMA representative, and FMT captains at TEMA East and in the EOC, facilitates effective communications. However, some weaknesses in ERO proficiency adversely affected implementation of employee PAs and offsite notification processes, as well as some communication processes in the ECC and TSC.

3.4 Emergency Classification

The objective of this portion of the assessment was to determine whether CNS correctly categorized operational emergencies (OEs) as promptly as possible, but no later than 15 minutes after identification by the predetermined decision-maker, and further classified the OE for incidents involving the airborne release of HAZMAT.

CNS effectively and appropriately classified the OEs as General Emergencies; during the FPE, CNS used the severe event EAL for the classification decision and during the FE, CNS used the building-specific EAL. Subsequently, the TSC and EOC validated the classifications of the incidents. Additionally, during the FPE and FE, the CAT immediately verified the General Emergency classification using the building-specific EALs.

3.5 Protective Actions

The objective of this portion of the assessment was to determine whether CNS has the capability to identify and implement predetermined onsite PAs and offsite PARs.

CNS has developed PA processes and implementation procedures to provide an appropriate combination of PAs and PARs to protect workers and the public. Importantly, onsite PA decision-making requires implementation of an initial IZ and a PA zone. CNS defines the initial IZ as the area surrounding an incident where the potential exists for exposure to dangerous and life-threatening concentrations of material, and the PA zone as the area downwind from the incident locations in which persons may become incapacitated and unable to take PA and/or incur serious or irreversible health consequences. CNS developed YAMS to support the prompt identification of onsite PAs and offsite PARs based on meteorological conditions and EAL-defined PA criteria distances.

During the FPE and FE, the ECC used these tools, and evacuated workers inside the initial IZ and sheltered workers outside the IZ. Furthermore, the ECC adequately communicated shelter-in-place PARs to offsite authorities during the initial notification and appropriately implemented protocols for activating the public warning siren system, which alerts residents to tune to the Emergency Alert System for PA instructions.

Nevertheless, during the FPE, the ECC entered incorrect PA distances in YAMS, which resulted in incorrect PA decision-making. The assessment team's limited causal analysis identified the plant shift superintendent's (PSS's) unfamiliarity with and misapplication of guidance in OA-PSS-102, *Downwind Distances for Site Area Emergencies Involving Multiple Buildings*, and EMPO-560/EAL-087, *Emergency Action Levels for Events Involving Multiple Buildings and Severe Events at Y-12 NSC*, for the resulting incorrect PA distances. Specifically, the PSS inappropriately determined the General Emergency distance

(26,400 feet) for the lithium spill instead of the Alert distance (328 feet). (See **F-CNS-1**, **OFI-CNS-1**, and **OFI-CNS-4**.)

While consistent with ECC YAMS procedures, the PSS determined a release location and resultant PA distances based on selecting either a single point (inside) or the exterior of the building leading to a non-conservative result. During the FE, by selecting a single point, assembly station 17 was outside the IZ, but would have been inside the IZ had the building exterior been selected (for larger buildings, the decision of a release point could have an even greater impact on PA distances). Additionally, during the FE, the EAL specified different sectors for PARs than generated by YAMS. The EAL specified a shelter-in-place PAR for only sector Y, whereas YAMS output resulted in PARs for sectors Y and H. Unlike most other Y-12 General Emergency EALs, this EAL did not include the statement to include "downwind affected sectors" in determining PARs; however, the YAMS output correctly included the downwind sector H. Lastly, although during the FPE, CNS demonstrated an effective personnel accountability system for several hundred evacuees from 13 buildings, accountability took 84 minutes to complete. (See **OFI-CNS-5**, **OFI-CNS-6**, and **OFI-CNS-7**.)

Overall, CNS demonstrated adequate capabilities to determine and implement appropriate PAs and PARs for the hazards presented in the exercises. CNS effectively integrated the use of YAMS and EMInS for determining affected populations requiring protective measures, and during the exercises, the ECC identified appropriate PA instructions to onsite workers. Additionally, CNS efficiently activated the public warning system immediately after the declaration of the General Emergencies and provided PARs to offsite authorities. However, mistakes in implementing some PA decision-making processes adversely affected the determination of PA distances and sectors

3.6 Consequence Assessment

The objective of this portion of the assessment was to determine whether CNS consequence assessment activities provide a conservative, timely initial assessment; accurate projections using incident conditions; and supportive assessments throughout an emergency.

3.6.1 CAT Verifications and Projections

CNS has effective capabilities to conduct consequence assessments throughout an emergency and communicate results to key response personnel and offsite authorities. During both exercises, the CAT used three dispersion modeling programs, EALs, EPHAs, a survey map, GIS, EMInS, video conferencing, a secure line, and telephones to verify, develop, and distribute consequence assessment results.

During the FPE, the CAT's effectiveness in performing timely initial assessments varied. The CAT immediately reviewed the appropriate EAL for the lithium fire incident and verified incident classification and areas under PAs, but did not perform a similar review for the lithium spill because of an error on the notification form describing the spill location. CNS identified the incorrect entry on the notification form as a deficiency in its after-action report.

The CAT was not successful in providing a timely, accurate, and complete incident-based assessment of the HAZMAT dispersion by fire. The CAT was unable to obtain a complete record of the material-at-risk (MAR) inventory from the TSC before a controller instructed the CAT to post an earlier plume plot (developed using the worst-case scenario) in EMInS. The CAT had developed the worst-case plume plot using an inaccurate source term calculated using an overly conservative release fraction; this error went unnoticed during the review and approval process. The erroneous calculation projected lithium hydroxide (LiOH) concentrations above the PA criterion as far away as 31 kilometers (101,706 feet) from the building, whereas the applicable EAL bounded PAs at 15,000 feet. Further, although the CAT completed an accurate radiological dose plot for the enriched uranium component of the MAR, it did not perform a uranium toxicity assessment for the substantial amount of depleted uranium in the MAR. In its after-action report, CNS identified the inaccurate source term calculation as a deficiency and the development of a better process for transferring MAR information to the CAT as an improvement item. (See **Finding F-CNS-1** and **OFI-CNS-1**, **OFI-CNS-8**, and **OFI-CNS-9**.)

CAT personnel did not provide informative briefings about the consequence assessment results. Once posted, the consequence assessment manager did not fully explain the unexpectedly large LiOH plume plot to the EOC cadre and offered no recommendations for expanding, or rationale for keeping, the PAs as they were, as required by Y40-510, *Emergency Management Consequence Assessment Manual*. Further, when TEMA inquired about the cause of such an extended PA distance, the CAT could not readily provide an answer. This uncertainty prompted an additional EOC manager to assist the CAT in identifying the cause of the extended projection and to make the necessary correction. The EOC manager identified an error in the airborne release fraction used in the source term calculation, and then a modeler developed a correct plume plot for posting in EMInS. (See **Finding F-CNS-1** and **OFI-CNS-1**.)

Near the conclusion of the exercise, the CAT adequately supported ongoing assessments to address TEMA inquiries about relaxing offsite PAs and the FMT coordinator's request for a revised radiological deposition plot. To develop a predictive analysis, the CAT coordinated with NARAC personnel for current time projections of LiOH airborne concentrations. The NARAC results concluded that no airborne hazards existed at that time. The CAT also developed an adequate radiological deposition plot based on limits used by FMTs and provided the plot to the FMT coordinator.

During the FE, the CAT accurately calculated the estimates of onsite and offsite consequences from the postulated release of HAZMAT and informed the ERO of the results. The CAT made results available for placement into EMInS for authorized ERO members to view. The projections showed that PA criteria were not exceeded for any HAZMAT, although potentially contaminated areas extended off site.

3.6.2 Field Monitoring

During the FPE, CNS demonstrated effective field monitoring planning and adequate habitability monitoring at the ICP. CNS developed sound plans for use by onsite and offsite monitoring teams, using plume and deposition plots and a preplanned sampling survey map. Further, CNS deployed radiological control technicians to the ICP to monitor for radioactive material. The FE scope did not include a similar level of participation. CNS recognized a performance weakness during the FPE, involving onsite monitoring planners who took four hours to develop a survey plan. (See **Finding F-CNS-1** and **OFI-CNS-1**.)

3.6.3 Performance Weakness Causations

The assessment team's limited causal analysis identified multiple contributors to weaknesses in the performance of consequence assessment tasks. Contributors include weaknesses in execution, procedures, the EPHA, and exercise planning. Execution areas of weaknesses included: communicating MAR and spill incident information; selecting an appropriate release fraction for performing a source term calculation; approving and briefing the consequences shown by the LiOH plume plot; making assumptions about uranium toxicity; and clarifying and verifying inquiries about incident conditions, particularly for those at Building 9811-01. Procedure rigor areas of weaknesses included source term calculations, transmittal of MAR information, requirements for conducting uranium toxicity assessments, and EPHA descriptors. The most significant contributor to weaknesses in the performance of consequence assessment tasks is the process for calculating the source term; performed as a "skill-of-thecraft" task, the calculation is not documented and included in the review and approval process for the plume plot. Complicating the source term calculation, the EPHA does not clearly reflect the use of fire and explosive airborne release fractions for expedient modeler replication, leading the modeler to select the most conservative fraction used in the EPHA. To a lesser extent, and at the request of offsite organizations to use elevated contamination levels, exercise planners contributed to these performance issues using a MAR that was well beyond the technical planning basis and not preparing plausible, incident-based MAR quantities for ERO use. The implausible MAR and instructions provided by controllers created a mindset among responders that the inaccurate plume plot was part of the scenario, which contributed to curtailing follow-up inquiries. (See **OFI-CNS-10**.)

CAT plans and procedures remained the same for both exercises, so the assessment team attributes the performance differences to variabilities in scenario complexities, CAT membership, and application of lessons learned from the FPE. Compared to the FE scenario, the FPE scenario was more complex, with more in-depth testing and higher exposure to errors. As a result, a second HAZMAT release at Building 9811-01 and depleted uranium release at Building 9204-02E were not analyzed. Likewise, the potential for fire and explosion conditions at Building 9204-02E complicated airborne release fraction decision-making, and the increased number of players introduced the potential for more communication errors, as witnessed in communication of the situation at Building 9811-01. In contrast, CAT membership during the FE included a veteran EPHA author. In addition, CNS provided all personnel qualified for CAT membership with lessons learned from the FPE to avoid similar errors during the FE.

Overall, the CAT accurately and adequately provided consequence assessments throughout the FE. During the FPE, consequence assessments were effective for field activities and accurate for radiological dose projections; however, the CAT did not provide timely, accurate, and complete reviews and reports for LiOH and uranium toxicity. The CAT could not readily obtain MAR inventory information for calculating a source term, and an error in the LiOH source term calculation went unnoticed during the plume plot approval reviews. The CAT also did not perform an assessment of the uranium toxicity hazard or inquire about the lithium spill presented in the FPE. CNS identified most of these weaknesses in its after-action report.

3.7 Offsite Interface

The objective of this portion of the assessment was to evaluate the effectiveness of NPO and CNS in establishing and maintaining interfaces with local, state, and Federal organizations responsible for emergency response or who may be used to supplement response capabilities based on threats/hazards identified in the all-hazards planning basis, including planning for severe incidents.

NPO and CNS effectively coordinated and integrated with the State of Tennessee and local response agencies in accordance with established, prearranged, and documented plans and protocols found in the MJERP; the MJERP requires Y-12 to coordinate emergency response with TEMA, which coordinates information and response actions with local governments. During the FPE, TEMA activated the State EOC in Nashville, and its field coordination center and environmental monitoring coordination center in Knoxville, and provided a representative in the Y-12 EOC to facilitate communication with local governments and to coordinate the offsite response to the Y-12 emergency, including support for mutual aid requests. Likewise, TEMA provided a representative in the Y-12 EOC during the FE, which enabled adequate testing of key offsite interface criteria.

Once the Y-12 EOC was operational, offsite interface and responses effectively transitioned to the EOC and included activation and deployment of offsite assets (e.g., JIC and offsite FMTs) during the FPE. NPO and CNS successfully demonstrated MJERP provisions with state and local agencies and organizations for coordinating the release of information about the emergency to the public. Importantly, state, county, and city public affairs agency participation in the FPE enabled the demonstration and validation of emergency public information and social media activities.

Notably, the integration of onsite Y-12 plans with the MJERP represented a significant effort in offsite planning that NPO and CNS effectively demonstrated during the FPE and FE. Most importantly, through EMInS, CNS concurrently provided a significant amount of information to support situational awareness at all onsite response facilities, TEMA command centers, the JIC, and the DOE Headquarters Watch Office and EOC. Real-time EMInS data adequately supported continuous ongoing assessment and reassessment of public PA measures, including the State's process for lifting PAs, which is based entirely on field monitoring or sampling data that shows that potentially affected areas are safe. **(Best Practice)**

Likewise, NPO and CNS effectively established communications with DOE Headquarters during the FPE and provided numerous written status updates once the EOC became operational. EMInS access via DOENet, a dedicated communication network within the DOE firewall, provided real-time information to DOE Headquarters as Y-12 personnel entered data into the system. In addition, EMInS provided access to the consequence assessment and field monitoring plots, which were useful in following the progress of the surveys. Overall, EMInS made a significant amount of timely information available for use at DOE Headquarters.

Overall, NPO and CNS effectively demonstrated Y-12 capabilities to establish and maintain interfaces with local, state, and Federal organizations responsible for emergency response or who may be used to supplement response capabilities based on threats/hazards identified in the all-hazards planning basis, including planning for severe incidents.

3.8 Exercise Design and Conduct

The objective of this portion of the assessment was to evaluate the ability of the CNS exercise program to demonstrate integration of local, state, and Federal agencies, and to validate emergency response capabilities to the hazards identified in the EPHAs.

During the FPE, numerous local, state, and Federal agencies fully participated, and CNS worked closely with offsite agencies in developing objectives. A joint exercise committee, including offsite agencies, developed the exercise plan, which included a comprehensive set of objectives for every participating onsite and offsite organization. The FPE was particularly challenging with two incident scenes; 15 onsite injuries requiring tracking; significant offsite consequences; full participation of the JIC; and extensive offsite planning with Headquarters, state, and local agencies.

Nonetheless, the simulated HAZMAT inventory in the FPE (significantly above the material allowed in the room at the facility) partially contributed to an inaccurate consequence assessment. At the request of the State of Tennessee to drive significant offsite consequences, CNS simulated an exaggerated HAZMAT inventory rather than using other methods for fulfilling the request, such as changing release fractions. This action, combined with modeling errors, produced an inaccurate consequence assessment that required PARs beyond 31 kilometers, significantly greater than the worst case EPHA analysis. During the FPE, when players questioned the assessment, a controller inappropriately stated that the large distance was part of the exercise and curtailed appropriate pushback by the players. The aggregate of these actions resulted in the FPE's inability to validate all aspects of CNS's consequence assessment capability during the FPE. (See **OFI-CNS-11**.)

During the FE, CNS simulated most local, state, and Federal agencies with role players and based the exercise on the EPHA material in Building 9212. No significant exercise design or conduct issues occurred during the FE.

Generally, CNS designed and conducted the FE effectively. The FPE fully demonstrated the integration of local, state, and Federal agencies, and the simulation of the offsite agencies was adequate during the FE. Additionally, both the FPE and the FE were sufficiently challenging and designed to validate important emergency response capabilities, such as field monitoring, emergency operation systems, and injured personnel tracking. However, the FPE design and conduct were not adequate to validate some elements of consequence assessment.

4.0 BEST PRACTICES

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

- CNS developed and implemented an automated process to track onsite injured personnel status, including a database interface that supports identification, tracking, and validation of injured personnel information.
- CNS developed and implemented a YAMS tool that supports timely decision-making for affected buildings that require immediate employee PA announcements and potentially affected offsite sectors that require PARs.
- CNS developed and coordinated an effective field monitoring process and tools to obtain and maintain situational awareness of multiple onsite and offsite monitoring teams by integrating real-time field monitoring data among the EMInS database, YAMS, and GIS mapping.
- CNS developed and implemented an effective emergency public information process that provides timely data and approvals of information for public release by the JIC, including the automated integration of the initial press release with the initial notification form.
- CNS developed an automated damage assessment process and supporting tools to obtain and maintain situational awareness on multiple building damage assessments and provide a response priority for each building based on strategic information.
- NPO and CNS developed and coordinated extensive offsite planning for acquiring and maintaining situational awareness, as validated during the FPE with Headquarters, state, and local agencies.

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.

Finding F-CNS-1: CNS has not ensured that the training, drill, and exercise programs collectively establish and maintain Y-12-specific emergency response capabilities and responder proficiency. (DOE Order 151.1D, Attachment 3, Paragraph 5.b and DOE Order 151.1D, Attachment 4, Paragraph 15.a.(4))

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.

Deficiency D-CNS-1: CNS did not provide notification and PAs to affected employees within 10 minutes after identifying the PAs. (DOE Order 151.1D, Attachment 3, Paragraph 11.a.(3))

7.0 OPPORTUNITIES FOR IMPROVEMENT

The assessment team identified 11 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.

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OFI-CNS-1: Consider enhancing the training/drill/exercise programs to improve responder proficiency needed to perform emergency response capabilities by:

- Assessing the collective training, drill, and exercise program for individuals and ERO teams to account for the different levels of ERO member's skills, knowledge and abilities.
- Reviewing ERO qualification/requalification requirements, with an emphasis on demonstrating proficiency rather than simple participation.
- Assessing failure modes relative to approval hierarchies, such as in the CAT through the EOC director, to ensure that higher-level approval authorities detect lower-level errors, e.g., posting an unrealistic plume model.
- Conducting additional drills in order to supplement exercises as a means to increase responder proficiency, which is demonstrated skill and competency acquired from training and experience.
- Conducting additional exercises and evaluated drills as a means to validate responder proficiency.
- Directing less-experienced responders to participate in more than the minimal requirement of one exercise or performance drill annually.
- Ensuring responders participate in drills and exercises involving scenarios associated with a spectrum of HAZMAT facilities.
- Conducting exercises focused on response processes to ensure effective communications and role proficiency (e.g., consequence assessment that includes all organizational elements involved, such as the CAT, TSC technical team, FMT, and on-site monitoring team).
- Ensuring rigorous/critical proficiency assessments for key, high-impact ERO positions: PSS, EOC/TSC team leads and directors.
- Revising the PSS employee PA notification evaluation criteria to start the clock with the YAMS output in order to document the proficiency of the ED in approving the announcement for the control center specialist to initiate notifications.
- Assessing whether newly qualified personnel require additional training, drill, and exercise opportunities to become fully proficient, and adjusting the program requirements accordingly.

OFI-CNS-2: Consider improving the notification process to ensure timely, accurate, and complete notifications to stakeholders by:

- Conducting an analysis of the ECC information flow dynamics to define the critical paths of key information, with the objective to reduce health and safety risks to stakeholders.
- Ensuring clear and accurate information is captured and communicated during incidents by requiring the ECC to implement more rigorous conduct-of-operations protocols with respect to written and verbal communications.
- Completing the electronic notification form prior to telephonically contacting DOE Headquarters in order to expedite the information transfer and obtain receipt confirmation.
- Completing the consolidation of onsite employee PA emergency notification systems (emergency notification, public address, radio systems) to facilitate one announcement versus three separate announcements.
- Updating the YAMS employee PA announcement to automatically complete some of the known information from YAMS (assembly stations, shelter in place) and including an ED sign-off block.
- Including onsite PAs implemented as part of the mandatory 15-minute information on the initial notification form.

OFI-CNS-3: Consider improving the prompt communication of the incident-based material inventories to the CAT by:

- Revising the ERO procedure to reflect the specific inventory information initially needed by the CAT within an expected timeframe.
- Conducting a joint CAT and TSC technical meeting for reviewing the processes and information needs within each team supporting the consequence assessment effort.
- Incorporating "For exercise purpose only" practice classified information to practice the proper protocols for transferring classified information.

OFI-CNS-4: To aid the PSS in applying appropriate PA criteria distances during multiple building incidents, consider providing additional guidance in OA-PSS-102 and EMPO-560/EAL-087 to ensure that only the appropriate PA distances are applied.

OFI-CNS-5: To aid the PSS in the use of YAMS, consider providing clarity in procedures, especially for larger buildings, detailing when to select a single point or the building exterior for determining onsite PAs and assembly stations.

OFI-CNS-6: To ensure consistency in EAL-identified PARs and YAMS PAR output, consider reviewing General Emergency EALS to ensure that "and downwind affected sectors" are included in the PAR statement, if required.

OFI-CNS-7: To improve accountability efficiency, consider expanding the electronic accountability system or developing an alternate system for use at other assembly stations during relocation situations.

OFI-CNS-8: Consider developing a calculation worksheet for the source term and including the worksheet as part of the plume plot review and approval process.

OFI-CNS-9: Consider revising the CAT checklists to provide guidance for determining when uranium toxicity analysis is needed.

OFI-CNS-10: To enable dispersion modelers to easily replicate the calculations, consider reviewing, and updating accordingly, EPHA descriptors for calculating worst-case scenario results during the next EPHA review cycle.

OFI-CNS-11: In order to improve exercise design and conduct, consider:

- Using only HAZMAT quantities contained in the EPHA.
- Ensuring that all appropriate exercise controllers understand the expected protective action criteria distances and the modeling results that should be questioned by players.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: May – August 2019

Office of Enterprise Assessments (EA) Management

Nathan H. Martin, Director, Office of Enterprise Assessments
April G. Stephenson, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
Kevin G. Kilp, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments
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