EA Operational Awareness Record	Report Number: OAR-EA-DUF6-2016-10-17	
Site: Paducah, Kentucky (DUF6)	**Subject:**	Follow-up Assessment of the Paducah Fire Protection Program at the Depleted Uranium Hexafluoride (DUF6) Conversion Facility and the Assessment of Repairs to Historical Fire System Impairments at the Paducah Gaseous Diffusion Plant (PGDP)
Dates of Activity: 10/17/2016 – 10/21/2016	**Report Preparer:** Rosemary B. Reeves and Barry L. Snook	

Activity Description/Purpose:
The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the Office of Enterprise Assessments (EA), performed a follow-up assessment to evaluate the corrective actions taken to address findings identified by EA in the September 2015 *Office of Enterprise Assessments Targeted Review of the Paducah Depleted Uranium Hexafluoride Conversion Facility Fire Protection Program* report. This 2016 follow-up assessment evaluated the effectiveness of Babcock and Wilcox Conversion Services, Inc. (BWCS), the management and operating contractor for DUF6, in managing the findings and subsequent corrective actions associated with fire protection at the Depleted Uranium Hexafluoride (DUF6) site. Independent of the fire protection program follow-up assessment, EA also evaluated the repairs of 13 historical fire system impairments at the Paducah Gaseous Diffusion Plant (PGDP), which were completed by Fluor Federal Services, Inc. (FFS), the deactivation and stabilization contractor for PGDP, as identified in FPAD-16-1148, *Task Order DE-DT0007774: Fluor Federal Services, Inc., Paducah Deactivation Project – Submittal of Revised Correction Plan for Long-Standing Fire Protection Impairments*, December 8, 2015.

The DOE Portsmouth/Paducah Project Office (PPPO), headquartered in Lexington, Kentucky, oversees the management and operation of Paducah and is responsible for administrating the performance-based contract, executing assigned programs, and conducting oversight of work performed at Paducah in support of DOE requirements and priorities. FFS is also responsible for performing the inspection, testing, and maintenance of the DUF6 sanitary/fire water distribution system and fire suppression systems.

ATTACHMENTS:
None

Results:
EA observed the following results during this follow-up assessment.

Previous Finding F-BWCS-01: The Baseline Needs Assessment (BNA) for the DUF6 Conversion Facility (DUF6-C-RGN-014, September 2010) is outdated and does not address all elements specified in DOE Order 420.1C.
DOE Order 420.1C requires tri-annual reviews of the BNA. The BNA inadequately addresses elements specified in the current DOE orders and standards, fire protection statutory requirements, and national consensus codes and standards (e.g., fire department/brigade mission responsibilities, minimum staffing requirements to fulfill DOE expectations, fire apparatus and equipment life-time cycle replacement program).

BWCS appropriately tracked this finding in the Single Integrated Electronic Issues Management System (SIEIMS) under ID #15-00548-005, which includes one action item: "Complete BNA for the DUF6 Project or accept the BNA completed by the DOE-contractor providing fire and emergency response to the entire site." EA verified that the action was appropriate and that BWCS completed the action to resolve the finding to the extent that the BNA is current and addresses the required elements.

EA reviewed BWCS Management Assessment Report C-MA-16-NS-001, *Nuclear Safety (Fire Protection) Update of the Status of the Paducah Baseline Needs Assessment (BNA)*, February 9, 2016. Attachment A of the report provides documentation from the BWCS fire protection engineer and Safeguards, Security, & Emergency Preparedness Manager indicating that the FFS BNA covers emergency response needs for the DUF6 Conversion Project and that there is no further need for BWCS to maintain and update a separate BNA. EA also reviewed the FFS Emergency Management and Fire Protection BNA. The BNA addresses site facility hazards, response capabilities, response time requirements,

staffing levels and training, apparatus and equipment, mutual aid agreements, and procedures as required by DOE Order 420.1C. The BNA identified six findings, five recommendations, and noted in the conclusion that the onsite fire department is not fully capable of providing emergency services consistent with DOE and National Fire Protection Association (NFPA) guidelines. EA discussed the status of the BNA findings with the Pro2Serve PPPO fire protection subject matter experts, who indicated that PPPO and FFS are working on a path forward to address the BNA findings and recommendations.

Although BWCS adequately closed this finding, the FFS BNA included a finding on the Advanced Life Support (ALS) coverage provided by the onsite fire department, which fell short of DOE expectations. FFS established a modified version of ALS and was directed by DOE to submit justification for this change to the AHJ for approval. Documents pertaining to the finding on ALS coverage were not provided during EA's assessment. EA is planning to review the next revision of the BNA (anticipated to be October 2017) as a follow-up item.

Previous Finding F-BWCS-02: The freeze protection sub-system and its electric power supply for the DUF6 fire water supply are not classified as safety significant, and there is no specific administrative control to ensure that freezing does not occur during cold weather conditions. *The water supply to the DUF6 Conversion Facility safety significant suppression system is provided through two underground pipes equipped with above ground backflow preventers and electric heat tracing for freeze protection. Additionally, sprinkler piping in two riser rooms that protect the DUF6 Conversion Facility are provided with electric heaters for freeze protection. The electric heat tracing and the electric heaters are supplied by non-safety significant electric power. DOE-STD-3009, section 4.4 (and DOE-STD-1021, section 2.3 (a) (b) (c)) requires that any safety significant structures, systems or components (SSC) needed to ensure the availability of a preventative or mitigative feature of safety significant SSC shall be likewise classified. While surveillance rounds currently include verification of temperatures, without a safety significant power supply for freeze protection, there is no assurance that the surveillance frequency is sufficient to prevent freezing.*

BWCS appropriately tracked this finding in SIEIMS under ID #15-00548-006, which includes one action: "Review consequences of failed heat and, if required, for SSC operation." EA evaluated the proposed action and determined that it was appropriate for resolving the finding. However, BWCS has not adequately implemented the action for evaluating the sub-systems failure consequences or the safety significant classification requirements for the freeze protection sub-systems and their electric power supply. For example, BWCS engineering has taken the following actions:

- Verified that the underground piping is installed at least three feet below the frost line depth.
- Confirmed that the heat tracing is installed around fire water system (FWS) backflow preventers, which are contained within a temperature-controlled valve house.
- Verified that operators perform visual inspections of the FWS valve house and heat trace devices during cold weather months on each shift and when conducting weekly inspection rounds in accordance with BWCS-C-OPS-4501.

Additionally, BWCS engineering concludes that the FWS piping does not rely solely on the heat trace to perform its safety function, therefore, taking the position that there is no reason to classify the heat tracing as a safety significant SSC. DOE-STD-3009, which is invoked by DOE Order 420.1C, requires any SSC needed to ensure the availability of a preventive or mitigative feature of a safety class or safety significant SSC shall be likewise classified. The FWS for DUF6 is referred in the documented safety analysis as a credited safety significant control. However, safety components of the FWS, such as heated valve houses and heat tracing that do not have a safety significant power supply, are not classified as safety significant. The fire water piping depends on the freeze protection sub-systems for its intended safety function under certain conditions, such as cold weather, to prevent the freezing of water that supplies DUF6 fire protection systems. Additionally, cold weather visual inspections performed on FWS valve houses and heat trace devices are not established as Specific Administrative Controls in the technical safety requirement (TSR) surveillance schedule to reduce the risk of freezing. Furthermore, BWCS has not performed a quantitative calculation to determine the freeze time of the fire water piping to support the selected frequencies of the operator-performed inspections.

EA concluded that the BWCS engineering evaluation and resolution of issues identified in Finding F-BWCS-02 are incomplete and that BWCS inadequately closed ID #15-00548-006. EA identified this issue as a follow-up item.

Previous Finding F-BWCS-03: Contrary to the requirements of 10 CFR Part 830, *Nuclear Safety Management, Subpart B, Safety Basis Requirements*, there is no analytical basis to substantiate the TSR requirement for the minimum required FWS static riser pressure of 65 psig (pounds per square inch gage). *The DUF6 Conversion Facility TSR requires a static pressure equal to or greater than 65 psig for the automatic wet pipe sprinkler control valve. The TSR Bases, DUF6-C-TSR-002, Appendix A, state that these readings provide an indication of operability for the wet pipe sprinkler system(s); however, an analytical basis to determine the required riser pressure at the system flowrate is not provided. Consideration is necessary in the analysis for instrument inaccuracies and required pressure margin. The current hydraulic analysis for the DUF6 Conversion Facility (previously referenced) uses a fire loop static pressure of 75 psig. Contrary to this calculation input, the sanitary water pumps have no auto-start set points and are manually started by operations personnel in the Building 611 to maintain 70 to 73 psig system static pressure.*

BWCS appropriately tracked this finding in SIEIMS under ID #15-00548-007, which includes one action: "Provide better supporting documentation for the adequacy of the 65 psig basis fire water system (FWS) static riser pressure." At the time of this follow-up assessment, BWCS had not completed the resolution to this finding. EA identified this issue as a follow-up item.

Previous Finding F-DOE-PPPO-01: The absence of a structured inspection, test, and maintenance (ITM) program commensurate with American Water Works Association (AWWA) M31 and NFPA 25 requirements, and the general condition of the aged above-ground and underground piping infrastructure do not ensure an adequate and reliable water supply to the DUF6 Conversion Facility. In addition, there is no documented system health report for the underground piping/infrastructure to track performance, maintenance and the frequency of failures, as required by DOE Order 420.1C, Attachment 2, Chapter 5. *Pump and valve ITM are not performed in accordance with the requirements of NFPA 25 or the AWWA M31, but rather on an "as needed basis", based on vendor recommendations and as deemed necessary by operations staff. For example, USEC was not maintaining the isolation valves for the sanitary water system and was not testing the curb box valves for fire hydrants.*

At the time of the previous review, the PGDP had not transitioned from USEC to FFS. For this reason, and the fact that USEC-operated PGDP facilities and significant portions of the sanitary/FWS were under the regulatory authority of the Nuclear Regulatory Commission, this finding was issued to PPPO. Finding F-DOE-PPPO-01 was not entered in an appropriate tracking system(s), and an adequate, comprehensive corrective action plan to resolve the finding was not developed. EA identified this issue as a follow-up item.

PPPO indicated that although this finding is not being tracked, several issues identified in the finding were delegated to BWCS and FFS through meetings. Although formal documentation of the meetings could not be provided, BWCS and FFS have acted on the following issues:

- System Health Report Issue- BWCS engineering completed a system health report for the DUF6 sanitary/FWS underground piping and infrastructure. The action taken was appropriate for resolving the system health report issue. Sections 2.1 and 2.3 of the system health report identify two sanitary/FWS isolation valves (FWS-VA-027 and FWS-VA-028) as safety significant and vital equipment/components. These safety significant/critical valves control tie-in points for the sanitary/fire water supply from the PGDP to the DUF6 site. However, the system health report does not assess the position of these valves (open/closed) or verify that FFS, owner of the valves, has operated and maintained these valves in accordance with NFPA 25 requirements. Per a November 8, 2016, email from the FFS Work Control Manager, these valves have not been operated or had maintenance performed since the transition. Additionally, these safety significant/critical component isolation valves are not identified in the TSR inspection and testing schedule. These administrative controls are intended to ensure an adequate and reliable fire water supply to the DUF6 Conversion Facility. Furthermore, the system health report does not provide an evaluation or conclusion on the status of the fire system underground piping and infrastructure. Although BWCS completed a system health report, the assessment is inadequate and/or incomplete in evaluating safety significant and critical components of the DUF6 sanitary/fire water supply.

FFS System Engineering completed a system health report for the PGDP plant Utilities Systems. The report identifies the sanitary water system as a function for fire water use, but the assessment does not document the vulnerabilities of the age and condition of the C-611 pumps or the deterioration of the aboveground and underground piping. Furthermore, the system health report does not assess the position (open/closed) of the two safety-significant/critical isolation tie-in valves from the PGDP to DUF6, nor does it verify that FFS utilities have operated and maintained these valves. EA concluded that the FFS system health report is incomplete in evaluating safety significant and critical components that supply sanitary/fire water to the DUF6 Conversion site. EA identified the BWCS and FFS system health report issues as a follow-up item.

- Fire Hydrant Curb Box Valves Issue- FFS inspected and tested the DUF6 Conversion Facility fire hydrant curb box valves in August 2015, with the exception of hydrants 2, 6, and 8 which were out of service due to maintenance issues. EA reviewed the August 2015 *Summary of Hydrant Curb Box Valve Inspection & Testing* record and concluded that the action taken to resolve this issue was appropriate and complete.
- Pump and Valve ITM Issue - PPPO and FFS actions have not resolved this issue. Although PMIDs (013442, 013443, 013444, 013445, 013446, and 013447) for the six sanitary/fire water pumps have been entered in SOMAX, all six PMIDs are listed as inactive. Per a November 8, 2016, email from the FFS Work Control Manager, preventive maintenance on the sanitary/fire water pumps has not been performed since the transition, and the sanitary/fire water control valves have not been cycled for several years as a result of a valve breaking two different times while performing an operational test.
- PGDP Sanitary Water System ITM Issue - No action has been taken to address the ITM of the PGDP sanitary water system aged aboveground and underground piping infrastructure, including pump house C-611, as required by NFPA 25. EA identified this issue as a follow-up item.

EA concluded that Finding F-DOE-PPPO-01 remains "open".

FFS Historical Fire System Repairs:
EA's assessment of the FFS historical fire system repairs was independent of the 2016 fire protection follow-up assessment and is not part of maintenance of the fire water supply infrastructure that is of concern to EA in Finding F-DOE-PPPO-01. FFS completed repairs to 13 PGDP historical fire system impairments as described in FPAD-16-1148. The repairs consisted of replacing six fire hydrants, two post indicator valves, and ruptured underground pipe at four locations. One impairment was deleted from the schedule when it was determined that the heat detector system wiring was broken rather than an inoperative detector. EA reviewed work submittals, activity descriptions, drawings, photographs, and conducted walkdowns of all repairs. EA concluded that fire hydrants, post indicator valves, thrust blocks, restrained joint systems, clamps and tie rods, corrosion retarding materials, and backfill methods were compliant to NFPA Standard 24. Although each repair involved a visual leak test, replaced pipe and attached appurtenances were not subjected to hydrostatic tests as prescribed by NFPA 24, Section 10.10.2.2. Hydrostatic testing verifies that each joint has become stable, particularly to movement of the gaskets, and involves observations that include such items as protrusion or extrusion of the gasket, leakage, or other factors that can affect the continued use of a pipe in service. EA concludes that the installations were performed in accordance with the prescribed task order. However, PPPO and FFS should consider requiring hydrostatic testing after future FWS repairs involving piping and attached appurtenances.

Conclusion:
PPPO appropriately communicated the three BWCS findings to BWCS via letter PPPO-01-3166915-15 on September 22, 2015. BWCS completed a Preliminary Noncompliance Condition Report 15-0054, *The Office of Enterprise Assessments Targeted Review Paducah Fire Protection*, 12/17/2015, that determined that the findings did not represent a degradation of the SSC such that the SSC is inoperable and cannot meet its function. BWCS conducted follow-up assessments for the findings that were appropriately entered in the SIEIMS and adequately monitored and facilitated closure of Finding F-1.

However, BWCS management attention is necessary to ensure that:

- Finding F-BWCS-02 is re-evaluated to effectively address the safety significant classification of the sanitary/fire water sub-system freeze protection systems, TSR administrative controls, and quantitative calculation to support the selected inspection frequencies for freeze protection systems.
- Finding F-BWCS-03 is appropriately addressed to substantiate the TSR required static riser pressure.

EA concluded that Finding F-DOE-PPPO-01 remains open and that PPPO management attention is required to ensure that:

- The PPPO finding and an associated corrective action plan are tracked in a formal manner.
- The ITM of the PGDP sanitary/FWS aged piping and infrastructure is addressed.
- BWCS and FFS system health reports assess the safety significant and critical components of the sanitary/fire water supply to ensure an adequate and reliable water supply to DUF6.

Finally, PPPO and FFS should consider requiring that hydrostatic testing be performed on future fire system repairs involving piping and attached appurtenances.

Were there any items for EA follow up? ☒Yes ☐No

EA Follow-up Items	

1. BWCS Finding F-1: Although this finding is closed, EA plans to review the 2017 BNA during a future follow-up visit.
2. BWCS Finding F-2: BWCS has not adequately evaluated the safety significant SSC classification of the fire water sub-system freeze protection systems.
3. BWCS Finding F-3: BWCS has not completed actions to address this finding yet. When completed, evaluate supporting documentation for the adequacy of the 65 psig basis FWS static riser pressure.
4. PPPO Finding F-DOE-PPPO-01: Verify that the PPPO finding is entered in the appropriate tracking system(s) and that a corrective action plan is developed; BNA issues are adequately resolved; BWCS and FFS system health reports assess the safety significant and critical components of the sanitary/fire water supply to DUF6; and FFS action is taken to address the ITM of the PGDP sanitary water system aged piping and infrastructure.

EA Participants:	**References (Key Documents, Interviews, and Observations):**
1. Rosemary Reeves (lead) 2. Barry Snook	1. PPPO-01-3166915-15, *Contract NO. DE-AC30-11CC40015, DUF6 Conversion Project: Forwarding of Paducah Fire Protection Program Review Report For Action*, September 22, 2015 2. DUF6-C-RGN-014, *Emergency Services Baseline Needs Assessment UDS Paducah Conversion Facility*, 9/23/10 3. CP5-FP-0001, *Emergency Management and Fire Protection Baseline Needs Assessment*, October 3, 2014 4. ASH-C-FWS-1300-008-14, Rev. 4, *Basis for Assessing System Health*, 8/19/14 5. CR-15-548 (Resolution), Legacy Number 15-00548-005, Address Finding F-BWCS-01 6. CR-15-548 (Resolution), Legacy Number 15-00548-006, Address Finding F-BWCS-02 7. CR-15-548 (Resolution), Legacy Number 15-00548-007, Address Finding F-BWCS-03 8. C-MA-16-NS-001, *Management Assessment – Update of the Status of the Paducah Baseline Needs Assessment (BNA)*, 2/19/2016 9. Condition Report 15-00548, *Compliance Determination Report for Nuclear Safety and WSHP Noncompliance's*, 12/17/2015

10. U-ACE-15-030, *Apparent Cause Evaluation/Analysis (ACE)-Cause Analysis to Corrective Actions Crosswalk*, 12/17/2015
11. Summary of Hydrant & Curb Box Valve Inspection & Testing, 8/21/2015
12. PMIDs 013442, 013443, 013444, 013445, 013446, and 013447
13. FPAD-16-1148, *Task Order DE-DT0007774: Fluor Federal Services, Inc., Paducah Deactivation Project – Submittal of Revised Correction Plan for Long-Standing Fire Protection Impairments*, December 8, 2015
14. Submittal 0003683-050-05, Rev. 2, *Inspection & Test Reports w/ Documentation (PSWP Item #6)*, 8/8/2016
15. Submittal 0003683-050-02, Rev. 0, *Inspection & Test Reports w/ Documentation (PSWP Item #3)*, 7/25/2016
16. Submittal 0003683-050-08, Rev. 0, *Inspection & Test Reports w/ Documentation (PSWP Item #18)*, 7/25/2016
17. Submittal 0003683-050-09, Rev. 0, *Inspection & Test Reports w/ Documentation (PSWP Item #25)*, 7/25/2016
18. Submittal 0003683-024-01, Rev. 1, *PSWP (HPFW-2)*, 6/9/2016
19. Submittal 0003683-024-01, Rev. 0, *PSWP)*, 5/4/16
20. Fire Protection System Impairment CAP, 12/8/2015
21. Fire Protection System Impairments Spreadsheet, 8/29/2016
22. Paducah (FPDP) Fire Impairment Summary Table, 8/29/2016
23. Drawing M5E-ZA9340-A01, Rev. 0, *Fire Protection Valve, Hydrant, & Cooling Tower Vault Repair Plan & Detail*, 11/12/10
24. Drawing C-UG 8-7016, Rev. 4, *Details Underground Fire Water System*, 11/10/69
25. Drawing E3-26-M, Rev. FA1, *Fire Protection Plans & Details*, 9/6/16
26. Drawing P-U-2.0-4M, Rev. 45, *Sanitary & Fire Water*, 2/29/14
27. CP4-FP-2018-F04, Rev. 2, *Wet Pipe Sprinkler System Test Report*, 6/7/16 through 9/29/16
28. CP4-FP-2014-F01, Rev. 0, *Fire Hydrant Inspection Data Sheet*, 7/18//16 through 9/29/16
29. CP4-FP-2010 F03 (10-28-14), *Dry Pipe Sprinkler System Test Report*, 9/30/16
30. CP-10862A (10-23-13), *C-531, C535 & Pumphouse Annual Sprinkler System Inspection Sheet*, 9/12/16 through 10/3/16
31. Installation photographs of fire hydrants, thrust blocks, base support blocks, tie rods, thread coating, and poly wrap

Interviews:

1. Pro2Serve DOE Oversight Fire Protection Subject Matter Experts
2. FFS Project Manager
3. FFS Construction Manager
4. FFS System Engineer
5. FFS Quality Assurance Manager

Observations:

1. Annual Emergency Management Drill
2. Walkdown of historical fire system repairs