

**Office of Enterprise Assessments Targeted Review
of the Paducah Depleted Uranium Hexafluoride
Conversion Facility Fire Protection Program**



September 2015

**Office of Nuclear Safety and Environmental Assessments
Office of Environment, Safety and Health Assessments
Office of Enterprise Assessments
U.S. Department of Energy**

Table of Contents

Acronyms	ii
Executive Summary.....	iii
1.0 Purpose	1
2.0 Scope	1
3.0 Background.....	2
4.0 Methodology	3
5.0 Results	4
5.1 Program Documentation.....	4
5.2 Fire and Related Safety Hazards Analysis.....	8
5.3 Fire Prevention and Protection SSCs and Controls	9
5.4 FHA/DSA Integration.....	11
5.5 TSR Surveillance and Testing	12
5.6 Fire Protection Self-Assessment Program	14
5.7 DOE PPPO Oversight.....	15
6.0 Conclusions	19
7.0 Findings	20
8.0 Opportunities for Improvement	21
9.0 Items for Follow-up.....	23
Appendix A: Supplemental Information	A-1
Appendix B: Documents Reviewed and Interviews.....	B-1

Acronyms

AHJ	Authority Having Jurisdiction
AWWA	American Water Works Association
BNA	Baseline Needs Assessment
BWCS	Babcock & Wilcox Conversion Services, LLC
CFR	Code of Federal Regulations
CR	Condition Report
CRAD	Criteria, Review, and Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
DUF6	Depleted Uranium Hexafluoride
EA	Office of Enterprise Assessments
EMCBC	Office of Environmental Management Consolidated Business Center
FHA	Fire Hazards Analysis
FIR	Field Inspection Report
FPE	Fire Protection Engineer
FPP	Fire Protection Program
FR	Facility Representative
FSS	Fire Suppression System
FWS	Fire Water System
FY	Fiscal Year
GFS&I	Government Furnished Services and Items
GPM	Gallons per Minute
HAZMAT	Hazardous Materials
ITM	Inspection, Testing, and Maintenance
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
LCO	Limiting Condition for Operation
MTS	Management Tracking System
NFPA	National Fire Protection Association
NRC	U.S. Nuclear Regulatory Commission
OPI	Opportunity for Improvement
PGDP	Paducah Gaseous Diffusion Plant
PPPO	Portsmouth/Paducah Project Office
Pro2Serve	Professional Project Services, Inc.
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gauge
PSS	Plant Shift Superintendent
SITM	Surveillance, Inspection, Testing, and Maintenance
SME	Subject Matter Expert
SMSI	Strategic Management Solutions, LLC
SSC	Structure, System, and Component
SSO	Safety System Oversight
SST	Swift and Staley Mechanical Contractors Team
SWS	Sanitary Water System
TP	Tie Point
TSR	Technical Safety Requirement
UDS	Uranium Disposition Services
USEC	United States Enrichment Corporation

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted a targeted review of the fire protection program at the Paducah Depleted Uranium Hexafluoride Conversion Facility in Paducah, Kentucky. The conversion facility is on the Paducah Gaseous Diffusion Plant site but is operated under a separate contract to DOE by Babcock and Wilcox Conversion Services (BWCS). This review was one part of a targeted assessment of fire protection at nuclear facilities across the DOE complex. The purpose of this review was to evaluate the selected fire protection elements and provide information to the site and responsible DOE line management organizations for benchmarking their program's effectiveness. EA performed the onsite portions of this targeted review from July 7 to 10, 2014, and July 21 to 25, 2014.

At the time of this review, the Paducah Gaseous Diffusion Plant was in a transitional state in preparation for the near-term turnover of United States Enrichment Corporation-leased facilities to the Portsmouth/Paducah Project Office (PPPO), who is the responsible DOE field element at Paducah. Subsequent to this review, Fluor Federal Services has taken over responsibility for monitoring and operating the Paducah Gaseous Diffusion Plant facilities, including infrastructure for the fire water supply and onsite fire department response capabilities. The impact of these changes was not part of the review, but will be evaluated by EA in a future assessment.

Overall, the BWCS fire protection program was well-defined and most program elements were adequately implemented. Personnel responsible for the implementation of the fire protection program, including the BWCS fire protection engineer and the operations manager, were knowledgeable about the program requirements and effective in their roles. The facility risks associated with fire are well defined, and appropriate controls have been identified. These controls are adequately documented in the technical baseline documents, including the fire hazards analyses for both the Conversion Facility and the cylinder storage yards, and the documented safety analysis. Although the fire hazards analyses were sufficiently integrated into the documented safety analysis, both fire hazards analyses are outdated.

The EA team identified four findings, three for BWCS and one for PPPO relating to the BWCS fire protection program and the site's fire protection infrastructure. The BWCS Baseline Needs Assessment for the Conversion Facility has not been updated to comply with the current requirements. Also, the freeze protection system for the DUF6 fire water supply is not classified as safety significant. Lastly, there is no analytical basis for the TSR required minimum pressure of the static riser. Increased management attention is warranted to improve the implementation of some fire protection program elements. At the time of the review, implementation of the DOE Order 420.1C, *Facility Safety*, and DOE-STD-1066-2012, *Fire Protection*, both issued in Dec 2012, was still underway at Paducah, and many procedures still referenced the earlier requirements.

Of particular importance were the vulnerabilities related to the aged pumps, pipes, and valves of the water supply system and inadequate implementation of inspection, testing, and maintenance requirements. Based on EA's observations of the infrastructure, the water supply for the fire suppression system in the DUF6 Conversion Facility cannot be considered reliable.

The PPPO oversight program includes written plans and schedules for planned assessments and surveillances, focus areas for operational oversight, and reviews of the contractor's self-assessments. PPPO also periodically evaluates the contractor assurance system and verifies corrective actions are satisfactorily completed. The oversight program implemented at the conversion facility is generally adequate, although some weaknesses were identified. PPPO should emphasize the need for inspection, testing and maintenance of the site fire water supply and improvements in the emergency response capabilities with the new contractor (Fluor Federal Services, Inc.). PPPO is understaffed, particularly with Facility Representatives. Review of the conversion facility by a qualified fire protection engineer is not being routinely performed. In several cases, PPPO oversight documentation and procedures do not reflect current DOE requirements.

**Office of Enterprise Assessments Targeted Review
of the Paducah Depleted Uranium Hexafluoride Conversion Facility
Fire Protection Program**

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the Office of Enterprise Assessments (EA), conducted an independent review of the fire protection program (FPP) at the Paducah Depleted Uranium Hexafluoride (DUF6) Conversion Facility in Paducah, Kentucky. The review was one part of a series of targeted reviews of fire protection at nuclear facilities across the DOE complex.

The purpose of this EA targeted review was to evaluate the implementation of program requirements and the adequacy of controls to reduce the risk or severity of a fire or explosion in the select facilities. Existing criteria, review, and approach documents (CRADs) were adapted to establish a focused set of inspection criteria, activities, and lines of inquiry for the targeted review. This independent review of the FPP at the Paducah DUF6 Conversion Facility was designed to evaluate the selected core fire protection elements and to provide information to the site and responsible DOE line management organization for benchmarking their program's effectiveness.

EA's oversight program is designed to enhance DOE safety and security programs by providing an independent evaluation of the adequacy of DOE policy and requirements and the effectiveness of DOE and contractor line management performance in safety and security and other critical functions, as directed by the Secretary of Energy. The Independent Oversight Program is described in and governed by DOE Order 227.1, *Independent Oversight Program*, and a comprehensive set of internal protocols and CRADs.

Fire protection was identified as an independent oversight program targeted review area for 2013 in a memorandum from the Chief Health, Safety and Security Officer to DOE senior line management, entitled *Independent Oversight of Nuclear Safety – Targeted Review Areas Starting in FY 2013*, dated November 6, 2012. This targeted review was performed at Paducah from July 7 to 10, 2014, and July 21 to 25, 2014. This report discusses the scope, background, methodology, results, and conclusions of the review; findings and opportunities for improvement (OFIs); and items identified for further follow-up by EA.

2.0 SCOPE

The scope of this review of fire protection at the Paducah site was limited to the Paducah DUF6 Conversion Facility. EA reviewed selected elements of the FPP at the Paducah DUF6 Conversion Facility and independently assessed the effectiveness of the program and its implementation by the facility operations contractor, Babcock & Wilcox Conversion Services, LLC (BWCS). The review included evaluation of the FPP program documentation; the exemption and equivalency process; baseline needs assessments (BNAs); life safety assessments; pre-incident plans; control of combustibles; and the fire system impairment process. The review also evaluated the integration of the fire hazards analysis (FHA) results in the documented safety analysis (DSA). EA also considered the performance of self-assessments by BWCS and the DOE field office assessments of the FPP. The review selectively evaluated the program and documentation at the institutional level and its implementation at the DUF6 Conversion Facility.

At the time of the review, the Paducah Gaseous Diffusion Plant (PGDP) was certified by the U. S. Nuclear Regulatory Commission (NRC) and subject to inspection and enforcement by NRC. Therefore, EA limited the scope of the review to the Paducah DUF6 Conversion Facility, and only those PGDP facilities or systems that support the fire protection system, such as the fire water supply and alarm monitoring and response. The results of this review are based on a sampling of data and work that was ongoing at the time of the review and are not intended to represent a full programmatic review of the site FPP.

3.0 BACKGROUND

The PGDP began producing enriched uranium in 1952 for further processing at the Oak Ridge and Portsmouth plants and for reactor fuel. The plant operated for roughly 60 years, the majority of the time under U.S. Government agencies. In 1992, the United States Enrichment Corporation (USEC) was established to take over operations under a lease agreement with DOE. The enrichment operations at PGDP are regulated by the NRC under Title 10 of the Code of Federal Regulations (CFR) Part 76. In May 2013, USEC ceased the enrichment of uranium at PGDP and at the time of this review had initiated deactivation work to stabilize the plant in preparation for future decontamination and decommissioning. USEC has since terminated their NRC certificate and de-leased all PGDP facilities, returning them to DOE control on October 21, 2014. In preparation for this transition, the DOE Portsmouth/Paducah Project Office (PPPO) awarded a 3-year contract task order with Fluor Federal Services, Inc. for deactivation and stabilization of the PGDP facilities. Prior to the transition from USEC operation to Fluor Federal Services, Inc. operation, significant aspects of the Paducah site (including portions of the FPP) were in a transitional state. For this reason, and the fact that USEC-operated PGDP facilities were under the regulatory authority of the NRC at the time of this review, the scope of this fire protection review was limited to the DUF6 Conversion Facility.

The DUF6 Conversion Facility at Paducah began operation in September 2010. Uranium Disposition Services (UDS) performed start-up and initial operations, but current operations are conducted by BWCS under a DOE contract through January 2016. The DUF6 Conversion Facility converts cylinders of solidified DUF6 into a stable form of uranium oxide, which is stored on site for eventual disposal or possible reuse. The conversion process generates hydrofluoric acid as a byproduct, which is commercially sold for industrial applications. Based on the material in process, the DUF6 Conversion Facility is designated a Hazard Category 3 nuclear facility. The DUF6 Conversion Facility is expected to operate for 25 years to convert approximately 38,000 steel cylinders of DUF6 resulting from decades of enrichment operations. BWCS also provides surveillance and maintenance of the inventory of DUF6 cylinders and maintains the cylinder database for both sites. The 10 cylinder storage yards are collectively designated as a Hazard Category 2 nuclear facility, based on the total quantity of radioactive material present.

In addition to BWCS, other contractors at the Paducah site that interface with the DUF6 Conversion Facility include:

- LATA Environmental Services of Kentucky, LLC (LATA Kentucky) conducts environmental activities, such as compliance sampling and low-level waste monitoring. They also perform testing of portable high efficiency particulate air ventilation systems.
- Swift and Staley Mechanical Contractors Team (SST) performs infrastructure services for the DUF6 Conversion Facility including maintenance of cylinder hauling vehicles, site roads and grounds, and snow removal. SST supports the FPP by performing inspections and system testing (sprinklers, alarms, flow testing, etc.).

- Fluor Federal Services, Inc. is the incoming deactivation contractor and will provide emergency response and fire department support to the DUF6 Conversion Facility after the transition.

PPPO, headquartered in Lexington, KY, oversees the operations at Paducah and is responsible for administering the performance-based contract, executing assigned DOE programs, and conducting oversight of work performed at Paducah in support of DOE requirements and priorities. PPPO is responsible for similar functions related to the Portsmouth Gaseous Diffusion Plant in Piketon, OH. To support the PPPO in conducting oversight at Paducah, several support service contracts are in place. Strategic Management Solutions, LLC (SMSI) technical staff conduct independent assessments and audits for BWCS activities, while Professional Project Services, Inc. (Pro2Serve) conducts safety oversight and assessments of activities done by LATA Kentucky, SST, and USEC.

4.0 METHODOLOGY

This EA review included detailed reviews of documents, interviews with personnel responsible for program implementation, observation of inspection and testing activities, and site walkdowns of DUF6 fire suppression safety systems and supporting infrastructure on the Paducah site. The review considered the requirements of 10 CFR 851, *Worker Safety and Health Program*; DOE Order 420.1C, *Facility Safety*; DOE Standard DOE-STD-1066-2012, *Fire Protection*; and National Fire Protection Association (NFPA) codes and standards.

The FPP at the DUF6 Conversion Facility was assessed using selected objectives and criteria from the CRADs identified below. These criteria are based on program elements from DOE Orders 420.1C and 226.1B and were grouped together by similarity under an overall objective.

EA used selected applicable sections of CRAD 45-34, *Fire Protection*, Revision 1, with particular emphasis on the following elements:

- Section I Programmatic Elements
 - FP-1, Program Documentation
 - FP-2, Program Implementation - Fire and Related Safety Hazards and Self Assessments
 - FP-3, Program Implementation - Fire Prevention and Protection
- Section II FHA/DSA Integration, FP-4
- Section II FHA/DSA Integration, FP-4
- Section III Engineered Design Features, FP-5
- Section IV TSR [Technical Safety Requirement] Surveillance and Testing, FP-6
- Section V Configuration Management, FP-7.

EA also used selected elements of CRAD 45-21, *Feedback and Continuous Improvement Inspection Criteria and Approach – DOE Field Element*, Revision 1, to assess the PPPO field office oversight activities for the FPP.

The members of the EA team and EA management responsible for this review are listed in Appendix A. Appendix B provides a detailed list of the key documents that were reviewed and interviews that were conducted relevant to the findings and conclusions of this review.

5.0 RESULTS

The EA review team reviewed the effectiveness of the FPP at the Paducah DUF6 Conversion Facility and its implementation by site contractors. Results of this review are organized around seven main areas: BWCS FPP; engineering and design features; fire prevention and protection structures, systems, and components (SSCs) and controls; FHA/DSA integration; TSR surveillance and testing; fire protection self-assessment program; and PPPO oversight.

5.1 Program Documentation

Inspection Criteria: A documented fire protection program (FPP) that includes elements and requirements ... for design, operations, emergency response, fire analysis and assessments, wildland fire, and specific fire protection criteria must be developed, implemented, and maintained by the contractor. The FPP shall include requirements for life safety and means of egress for building occupants. (DOE Order 420.1C, DOE-STD-1066-12)

Inspection Criteria: A baseline needs assessment (BNA) of the fire protection and emergency response organization must be conducted and reviewed at least every three years and updated as appropriate. (Note: If no update is necessary, this result must be documented following the review.) The BNA should describe in sufficient detail fire-fighting operations for the respective facilities. (10 CFR 851, DOE Order 420.1C, DOE-STD-1066-12)

Inspection Criteria: Pre-incident strategies, plans and standard operating procedures must be established to enhance the effectiveness of manual fire suppression activities. (DOE Order 420.1C)

Inspection Criteria: A process must be established for developing and requesting approval from the DOE [Authority Having Jurisdiction] AHJ for equivalencies and exemptions to fire protection requirements. (DOE Order 420.1C)

Inspection Criteria: Comprehensive, written fire protection criteria and procedures must be established and include use and storage of combustible, flammable, radioactive and hazardous materials. (DOE Order 420.1C)

BWCS Fire Protection Program

BWCS-POL-003, *BWCS Fire Protection Policy*, establishes the goals and objectives for implementing a FPP. The FPP for the DUF6 Conversion Facility is documented in DUF6-BWCS-PLN-024, *Fire Protection Program Description for the DUF₆ Conversion Project*. The program generally reflects both defense-in-depth and a “Highly Protected Risk” level of fire protection, as required by DOE Order 420.1C, *Facility Safety*. The FPP also implements the fire protection and emergency services criteria necessary to comply with 10 CFR 851, *Worker Safety and Health Program*.

BWCS manages the FPP in accordance with their contract, which includes reliance on government furnished services and items (GFS&I) provided by other contractors. The BWCS Nuclear Safety Manager is responsible for providing oversight and appointing a fire protection subject matter expert (SME). The fire protection SME ensures that the BWCS FPP incorporates the appropriate project and site-specific procedures necessary to ensure compliance with facility fire protection and safety basis documents (e.g., DSA, TSRs, FHA). The fire protection SME works with BWCS management to ensure that the program elements are implemented, oversight activities of the FPP are appropriately executed, and FPP requirements are integrated into all subcontracted work. This integrated approach to fire protection management is further implemented at various levels of work activity and project phases and

ensures that all work complies with applicable Federal, state, and local laws and the DOE/BWCS contract.

The BWCS Fire Protection SME has the overall responsibility for administering and enforcing the FPP while serving as the BWCS point of contact within the company and with external organizations. The SME's responsibilities include developing the FPP; supporting implementation by performing operational requirements to meet the objectives of the fire protection policy; assisting with DOE orders, standards, and codes affecting fire protection; reviewing and approving all fire protection related SSC modifications; and presenting fire protection determination requests (e.g., equivalencies and exemptions) to the DOE AHJ representatives. BWCS has documented and implemented a FPP for the DUF6 Conversion Facility. However, the FPP does not incorporate DOE Order 420.1C (contractually added in April 2014) and DOE-STD-1066-2012 and references to DOE Guide 420-1.3 have not been removed. (See **OFI-BWCS-01**.)

The inspection, testing, and maintenance (ITM) of fixed protection systems, fire water supplies, and other program elements are required to be performed in accordance with criteria contained in NFPA 25, NFPA 72, and NFPA 80. The responsibility for the surveillance, inspection, testing, and maintenance (SITM) of the BWCS Fire Protection Systems is a shared responsibility between BWCS maintenance and the site Fire Service Provider(s), which at the time of this review was USEC. The site Fire Service Provider responsibilities are invoked through the application of a third-party contract with SST and the facility owner, DOE (i.e., GFS&I).

Currently, SST maintains the DUF6 Conversion Facility safety-significant fire protection system. EA reviewed the procedure BWCS-C-FPP-3110, *Quarterly and Annual TSR Tests and Inspection of the Wet Pipe Sprinkler System*, and witnessed the quarterly test of the sprinkler system. The procedure references USEC as the Fire Service Provider, but SST performed the work. The test procedures have not been updated to reflect the appropriate contractor responsible for performing the work. Roles and responsibilities for SITM being performed between the various contractors (SST and USEC) are not adequately specified in the FPP. (See **OFI-BWCS-02**.)

Emergency response for the BWCS DUF6 Conversion Facilities is provided by a DOE-Contractor fire department located on the PGDP site. At the time of the review, USEC was in the process of turning the PGDP back to DOE. During the review, a new contractor was announced to manage the PGDP, which also included the fire department and their services. EA was unable to review emergency response capabilities of the new contractor. Results of the review of USEC capabilities are provided below. (See Section 9.0, Items for Follow-up.)

The PGDP fire department provides emergency fire, hazardous materials (HAZMAT), and medical response to the BWCS DUF6 Conversion Facility. At the time of the EA review, these services were defined through the provisions of a Work Authorization agreement between DOE and USEC (Work Authorization #29573, *Paducah Fire, Emergency and Plant Shift Supervisor (PSS)*). The USEC fire department had the following apparatus available: one 1987 1500 gallons per minute (GPM) pumper, one 1982 100 foot aerial truck with a 1500 GPM pump, one 1991 HAZMAT unit, one 1997 Ambulance, and one 2010 Equipment Truck. Reserve apparatus consists of one 2005 wildland unit, one HAZMAT cart, and one 1990 ambulance. This reserve apparatus is sufficient to provide the (water) pumping capability, emergency medical/ambulatory capability, and command vehicle for all credible fires and related events per DOE criteria. Basic Life Support was provided by USEC with limited Advanced Life Support provided from the onsite medical department. The USEC fire department was a full time, paid, professional fire department. The USEC minimum staffing consisted of three fire fighters, one shift commander, one PSS Incident Commander, one safety officer, and six USEC Emergency Squad members. The staffing to be provided by the new contractor is assumed to be similar; however, the Emergency Squad may be smaller under the new contractor.

Fire department access to the BWCS DUF6 Conversion Facility is adequate. Based on prior run times and drills, response time is less than five minutes. Once on scene, the fire department is trained to search the facility for injured workers, and use hose streams to suppress and/or extinguish any fires. The adequacy of the response capability to the spectrum of credible site emergencies is described in the BNA report, DUF6-C-RGN-014, *Emergency Services Baseline Needs Assessment UDS Paducah Conversion Facility*. This document was prepared in September 2010 when the fire department was operated by USEC.

At the time of the review, USEC fire department response services were below normal staffing levels and did not meet OSHA 29 CFR 1910.134 (g) (4) (i) Two-in Two-out rule and NFPA's Rapid Intervention Crew policy that specifies where two or more firefighters enter a building, at least two firefighters remain outside, near the entrance, ready to respond and fully equipped with bunker gear, self-contained breathing apparatus, and rescue equipment if the inside team becomes endangered. Title 29 CFR, Part 1910, "*Occupational Safety and Health Standards*," is invoked through 10 CFR 851.22.

During the transition, the capabilities of the on-site fire department will be evaluated for the new contract. At the time of this EA review, the USEC fire department was not fully equipped or trained for all potential site emergencies (e.g., high angle rescue, demolition search and rescue). (See **OFI-PPPO-01**.)

Exemption and Equivalency Process

The DOE AHJ for the BWCS contract is the PPPO Manager, who has delegated this authority to the PPPO Nuclear Safety Oversight Lead. DOE also assigns advice and consultation authorities to technical representatives who are knowledgeable experts that provide advice on fire protection issues requiring AHJ involvement. The DOE procedure PPPO-PRO-420.1-2, *Authority Having Jurisdiction Fire Protection Program Equivalencies and Exemptions*, expands on AHJ approval authorities for FPP equivalencies and exemptions. A request for an exemption or equivalency must document the reasons why strict compliance with mandatory fire protection requirements cannot be met and document the measures taken to ensure life safety and to prevent damage to property or to the environment. Overall, PPPO was effectively managing the equivalency and exemption process.

Baseline Needs Assessment

DOE Order 420.1C requires that each site establish capabilities to provide timely and effective firefighting response with sufficient staffing, apparatus, facilities, and equipment. These capabilities must be documented in a BNA that reflects applicable NFPA codes and standards and is updated every three years. To meet this requirement, UDS completed and approved a BNA prior to startup of the DUF6 Conversion Facility in 2010. The document DUF6-C-RGN-014, *Emergency Services Baseline Needs Assessment UDS Paducah Conversion Facility*, evaluated the fire department capabilities and was based on requirements established in NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Emergency Services Requirements* and DOE Guide 420.1-3.

The current BNA for the DUF6 Conversion Facility, DUF6-C-RGN-014, *Emergency Services Baseline Needs Assessment UDS Paducah Conversion Facility*, was issued in September 2010 and is outdated. 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). (See **Finding F-BWCS-01**.)

The Work Authorization specifying contractual agreements between USEC and DOE does not address response times for Advanced Life Support or include an obligation to satisfy governing emergency response criteria such as 10 CFR Part 851, 29 CFR Part 1910, and DOE 420.1C. In addition, the lifetime service for key fire protection equipment is not addressed, and recent findings from the *Tri-Annual Self-Assessment BWCS Fire Protection Program Paducah KY and Piketon OH* (ref. U-MA-14-NS-001) have not been incorporated. (See **OFI-PPPO-01**.)

Tri-annual reviews of the BNA are not being performed as required by DOE Order 420.1C. (See **Finding F-BWCS-01**.) This issue was identified during the BWCS Tri-Annual Self-Assessment conducted in June 2014, but was defined as a recommendation rather than a finding.

Life Safety Evaluations

NFPA 101, *Life Safety Code*, requires that equipment, such as emergency lights, be maintained and tested. Procedure BWCS-C-FPP-3101, *Emergency Lights and Exit Signs*, provides instructions for testing and inspecting emergency lighting units and battery operated exit signs for all areas at the DUF6 Conversion Facility.

The BWCS emergency lighting systems procedure does not include an annual functional test as required by the Life Safety Code. The BWCS Fire Protection Engineer (FPE) indicated the 90 minute test had been performed, but the documentation for the test was not provided to EA for review. (See **OFI-BWCS-03**.)

Pre-Incident Plans

The pre-incident fire plan KY/D-5276, *DUF6 (UDS Conversion Building C-1300) Fire Incident Plan*, identifies the majority of the fire risks and exposures to the facility. Overall, the plan meets the requirement to communicate pertinent information in a short period of time for the responding USEC fire department. Pre-Incident plans should indicate equipment and building features that would assist with the fire department initial size up of the fire and response as recommended by NFPA 1620, *Standard for Pre-Incident Planning*. Contrary to the recommendations of this standard, the Pre-Incident plan does not show the passive fire systems for the building or their ratings. (See **OFI-BWCS-04**.)

Control of Combustibles

DOE Order 420.1C requires that a FPP include comprehensive, written fire protection criteria and procedures that include use and storage of combustible, flammable, radioactive, and hazardous materials to minimize risk from fire. DOE-STD-1066 reinforces the DOE Order 420.1C requirement, stating that a combustible control program is a required element for all FPPs and that a description of the general housekeeping practices, control of transient combustibles, and control of flammable and combustible liquids and gases must be documented. With respect to fire safety, these controls typically revolve around combustible materials. Procedure BWCS-U-FPP-0810, *Conversion Facility Control of Combustibles*, specifies the controls imposed on combustible material configurations in the Conversion Facility. Procedure BWCS-U-CYP-0002, *DOE UF₆ Cylinder Storage Yards Combustible Material Control Program*, specifies the controls imposed on combustible material configurations in the Cylinder Storage Yards. These controls require one or more of the following parameters to be maintained and incorporated into work orders as necessary to prevent serious unmitigated fires: 1) limits or prohibitions on combustible material quantities and configurations by fire area; 2) separation of combustibles from targets of concern; 3) accompanying or attending bulk flammables/combustibles movements; and 4) accompanying or attending movement and select placement of targets (i.e., cylinders). Overall, EA determined that the implemented controls for managing combustible loading were effective.

Issues Management – Corrective Actions

BWCS tracks findings relating to fire protection by writing a condition report (CR). BWCS then evaluates the CRs and develops corrective action plans. CRs are discussed at the Daily Communication and Teamwork meeting. CRs are tracked to closure and documented evidence of closure is filed in the corrective action data base.

This process does not evaluate risk in terms of fire protection but considers critical factors such as life safety, unacceptable program interruption, fire loss potential in excess of limits defined by DOE-STD-1066-2012, and potential damage to process control and safety systems. All of these risk factors significantly impact frequency and consequence. (See **OFI-BWCS-05**.)

System Impairment Process

BWCS has implemented an impairment procedure BWCS-U-FPP-0811, *Conversion Facility Fire Protection Impairment*, for use at the DUF6 project. This procedure is used in conjunction with the respective site fire department, as applicable.

5.2 Fire and Related Safety Hazards Analysis

Inspection Criteria: Fire Hazard Analyses (FHA), using a graded approach, must be conducted for all hazard category 1, 2, and 3 nuclear facilities and modifications thereto. The FHAs must be integrated into the safety basis documentation (i.e. Documented Safety Analysis). (DOE Order 420.1C, DOE-STD-1066-2012, NFPA 801)

Inspection Criteria: Fire Hazard Analyses must be reviewed every 3 years by a Fire Protection Engineer and revised as appropriate. (Note: If no revision is necessary, this result must be documented following the review.) (DOE Order 420.1C)

Inspection Criteria: Fire and related safety hazards on site (or within the facility) have been identified and evaluated in conjunction with a current and comprehensive FHA. (DOE Order 420.1C)

Inspection Criteria: The FHA and self-assessments address all essential elements for a complete analysis as delineated in DOE-STD-1066-2012. (DOE Order 420.1C)

Inspection Criteria: The information contained in the FHA and assessment is accurate, as required by applicable fire safety criteria. (DOE Order 420.1C, DOE-STD-1066-2012)

The comprehensive FPP required by DOE Order 420.1C must include the preparation of an FHA using a graded approach for all hazard category 1, 2, and 3 nuclear facilities, significant new facilities, and facilities that represent unique fire safety risks. EA reviewed the FHAs for both the cylinder storage yards and the conversion facility, namely DUF6-C-F-FHA-001, *Paducah DUF6 Conversion Facility Fire Hazards Analysis*, and DUF6-C-F-FHA-002, *Paducah DOE C-745 Cylinder Storage Yards Fire Hazards Analysis*, and identified the following deficiencies:

- Both FHAs are 2010 versions, which have not been updated at the required 3-year frequency. These FHAs are outdated and do not incorporate all essential elements/topics specified in DOE-STD-1066-2012. (See **OFI-BWCS-01**.)
- The DUF6 Conversion Facility FHA specifies that every fire area is separated by the appropriate required fire separation per criteria in the Uniform Building Code and DOE standards. Specifically,

the FHA identifies the DUF6 construction type as Type IIA-222 consistent with NFPA 101 and NFPA 220. NFPA 220, Table 4.1.1 indicates a requirement for 2 hour fire rating for exterior bearing walls. However, life safety drawings (D-C-1300-GEN-0190-A) show two cylinder air lock doors that are not designated as fire rated doors. It is unclear what rating these doors have, or if there should be an equivalency or exemption from the AHJ for this requirement. (See **OFI-BWCS-06.**)

5.3 Fire Prevention and Protection SSCs and Controls

Inspection Criteria: A complete spectrum of fire prevention controls and procedures are in existence and have been implemented as required by applicable fire safety criteria. (DOE-STD-1066-2012, Site & Facility DSA)

Inspection Criteria: All fixed fire protection features (appropriate construction types, fire barriers, fire alarm and signaling systems, manual and automatic fire suppression systems, etc.), that are required by authorization basis documents and fire hazards analyses, have been installed and are tested and maintained, as required by applicable fire safety criteria. (NFPA Standards, Site & Facility DSA)

Inspection Criteria: A reliable and adequate water supply and distribution system must be provided for fire suppression, as documented through appropriate analysis. (DOE Order 420.1C)

Inspection Criteria: A means for collecting and containing a credible quantity of fire suppression water for a minimum of 30 minutes is provided to avoid the spread or release of radioactive material during a fire. (DOE-STD-1066-2012, NFPA 801)

Infrastructure Water Supply

As described in the DUF6 DSA, DUF6-C-DSA-001, Rev 5, and shown on drawing P-U-2.0-4M, *Sanitary and Fire Water*, the fire water supply for the DUF6 Conversion Facility comes from the PGDP site sanitary water system (SWS). PGDP Building 611 houses five sanitary water pumps that take suction from a 500,000 gallon clear well and discharge into two sanitary water mains supplying PGDP. A pumping station from the Ohio River provides makeup water to the clear well. The sanitary water pumps discharge into an elevated storage tank. The water in the tank is maintained at a sufficient level to provide a steady water supply between 68 and 78 pounds per square inch gauge (psig) in the sanitary water mains. The water mains are interconnected so that either line can be removed from service for repairs with a minimum of service disruption. Two of the five sanitary water pumps are provided with diesel engine drives to maintain sanitary system pressure in the event of a loss of offsite power.

The DUF6 Conversion Facility Fire Water System (FWS) is supplied by the PGDP SWS via two independent feed main interconnections to the SWS gridded yard loop. Since the SWS also provides potable water service for the rest of the PGDP site, the two supply mains are equipped with reduced pressure backflow preventers. These backflow preventers are located at the DUF6 north site boundary and are heat traced for freeze protection. Originally, a weather enclosure was provided for the back flow preventers, but the enclosure was damaged in a tornado and has since been removed. The FWS is constructed in a loop fashion around the facility in accordance with DOE-STD-1066 to ensure that all systems can be supplied.

The SWS underground piping is cast iron which is heavily degraded due to age and has a record of repeated failures. The DUF6 supply loop piping is 14-inch diameter, Class 200, high-density polyethylene. Building lead-ins transition into ductile iron spool pieces and risers as they enter individual buildings or supply individual hydrants and are in overall good condition.

Based on a walkdown of Building 611; observations of the pumps, valves, and exposed transfer piping; and interviews with the SWS operations staff, the SWS cannot be considered a reliable and adequate water supply to DUF6. SWS operations personnel were very knowledgeable and have a strong sense of ownership of the SWS system. However, the PDGP SWS is largely operated and maintained based on the “skill of the craft.” Furthermore there is no system health report for the underground piping/infrastructure to document frequency of failures, or track and trend replacement of critical equipment, based on system performance metrics. EA noted several deficiencies and inconsistencies:

- The NFPA requirement for a two-hour fire water supply duration is loosely enforced; the sanitary water pumps have no auto-start set points and are manually started by operators in Building 611 to maintain system pressure between 70 to 73 pounds per square inch (psi).
- Due to the high costs involved, the replacement of aged underground piping is largely reactive rather than proactive.
- Pump and valve inspection, testing, and preventive maintenance are not performed in accordance with the requirements of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* or the American Water Works Association (AWWA) M31, *Distribution System Requirements for Fire Protection*, 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 SWS and were not testing the curb valve boxes for the hydrants. (See **Finding F-PPPO-01.**)

EA reviewed testing records for a system flow test performed in May 2004 and another more recent system flow test performed in September 2010. These tests measured flow at tie point (TP) locations TP-4 and TP-5, which are the two DUF6 water supply tie-in points that provide water to the FWS through the backflow preventers. Based on flow testing performed in May 2004, the SWS exhibited sufficient capacity (2964 GPM at 70 psi residual at TP-4; 2068 GPM at 70 psi residual at TP-5) to meet all Conversion Facility fire protection water supply demands. The subsequent system flow testing (FPP-3005, *Fire Water System Loop Flow Test*; Work Order C-WO-1002436, dated September 9, 2010) indicates that certain sprinkler systems will have inadequate pressure if a loop sectional control valve is closed and one of the feeds to the loop from the PGDP is unavailable. During normal operation, the loop sectional control valves are locked open. See Section 5.5 of this report for further discussion.

Fire Protection Controls Implementation

EA reviewed fire protection systems at the DUF6 facilities to confirm, in part, that they are appropriate for the facility fire scenarios identified in the FHA. EA also verified the safety basis of the fire protection systems and ensured the systems were designed and installed in compliance with the required codes and standards and that an appropriate ITM program for fire protection features is in place and being conducted. The FWS consists of a water supply system, wet pipe sprinkler systems, manual wet standpipe system, and a private hydrant system. The FWS for DUF6 is a credited safety significant control and therefore bound by TSR surveillance requirements. Additionally, the requirements of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*; NFPA 72, *National Fire Alarm Code*; and other applicable NFPA standards and code ITM requirements apply and have been incorporated in the BWCS FPP. Based on this review, the following comments and issues apply:

- EA reviewed the DUF6 Conversion Facility’s compliance to the NFPA 801 requirement to contain potentially contaminated fire suppression water runoff. Based on DUF6-C-F-FHA-001, Paducah

DUF6 Conversion Facility Fire Hazards Analysis, if a large fire develops and numerous sprinkler heads (more than ten) operate, the liquid containment capacity of the building is likely to be exceeded. Hydraulic analyses, DUF6 calculation E11341-C-S041-CDS-204, Revision 2 dated 4/27/2010, postulates fire design areas model actuation of greater than ten sprinklers. Based on review of these documents, areas of the DUF6 Conversion Facility have inadequate curbing or controlled drainage holdup to contain potentially contaminated water discharged from the suppression system. This inadequacy has been addressed and a letter from the AHJ approving an equivalency is on file.

- Previously referenced hydraulic calculations of record, dated April 27, 2010, use water supply flow test data based on flow testing performed in May 2004, during which time the SWS exhibited sufficient capacity (i.e., 2964 GPM at 70 psi residual at TP-4 and 2068 GPM at 70 psi residual at TP-5); the residual pressures were based on a static pressure of 75 psi. Hydrant flow tests performed on September 2, 2010, at more appropriate hydrant locations in the SWS loop, indicate a static pressure of 70 psi and the best residual pressure, with both sanitary water feeds from the PGDP system open and available, of 65 psi at a flowrate of 1838 GPM. DOE-STD-1066-2012 requires the supply pressure for hydraulically designed sprinkler systems to be within 10 percent, but not less than 10 psi below the water supply curve. Based on the results from the 2010 flow tests, this requirement may be unattainable. The pressure margin is required to accommodate minor system modifications or degradation of the water supply and sprinkler systems that may occur over time. The hydraulic calculations have not been revised to use the latest flow test results. (See **OFI-BWCS-07.**)
- The FWS is an automatically actuated wet-pipe sprinkler system that is maintained as a safety significant SSC. The water supply to the DUF6 Conversion Facility safety significant suppression system is provided through two underground pipelines equipped with above ground backflow preventers and electric heat tracing for freeze protection. Additionally, sprinkler piping in two riser rooms that support 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 SSC needed to ensure the availability of a preventive or mitigative feature of safety class or 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. (See **Finding F-BWCS-02.**)

5.4 FHA/DSA Integration

Inspection Criteria: Within the scope of the review, the FHA conclusions shall be incorporated into the safety authorization (preliminary safety design review, preliminary DSA, or DSA, as appropriate) and demonstrate the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards, and define the process for maintaining the controls and controlling their use. (DOE Order 420.1C, DOE-STD-1066-12)

Inspection Criteria: The safety authorization basis is consistent with the fire hazards analysis; demonstrates the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards; and defines the processes for maintaining the controls current at all times and controlling their use. (DOE-STD-1066-12, Site and Facility DSA)

In accordance with DOE Order 420.1C, the conclusions of the FHA are to be incorporated in the DSA for hazard category 1, 2, or 3 nuclear facilities to provide consistency between the fire accidents analyzed in the DSA and the actual fire hazards analyzed in the facility. EA reviewed DUF6-C-F-FHA-001, *Paducah*

DUF6 Conversion Facility Fire Hazards Analysis, and DUF6-C-F-FHA-002, *Paducah DOE C-745 Cylinder Storage Yards Fire Hazards Analysis*, for consistency with the facility's DSA to determine the adequacy of the fire protection selected control set for the identified hazards. The facility FHA comprehensively and qualitatively identifies the fire hazards and assesses the risk from fire within individual fire areas in the facility. A concise description of building construction is provided as required, and fire rated area separations are identified. As identified previously in this report, some exterior doors of the DUF6 Conversion Facility are not rated as 2-hour fire barriers. (Refer to **OFI-BWCS-06**.) EA also reviewed DUF6-C-DSA-001, *Paducah DUF Conversion Facility Documented Safety Analysis*, which defines the scope of work that is performed in the facility, identifies and analyzes the hazards associated with the work, and establishes the hazard controls on which the contractor relies to ensure adequate protection of workers, the public, and the environment. For the DUF6 Conversion Facility, the hazards identified in the FHAs and the associated controls are generally consistent with those evaluated in the DSA. However, EA noted two deficiencies:

- BWCS does not have an integrated wildland fire management plan as required by DOE Order 420.1C or DOE-STD-1066-2012. The BWCS FPE stated in an interview that a wildland fire plan is unnecessary for the DUF6 Conversion Facility, but no exemption from the DOE AHJ officially dismisses the requirement. Furthermore, the DUF6 Conversion Facility DSA Section 1.5.3 states that the FHA concludes that wildland fires pose no significant risk directly to the DUF6 Conversion Facility operations as long as wildland fuels in the vicinity (e.g., grass, low-growing vegetation) are controlled. The FHA for the DUF6 Conversion Facility states, "Wildfires are a low hazard and pose no risk to the conversion building as evaluated based on NFPA 1144." The cylinder storage yard FHA states, "No risk from wildfires as evaluated to NFPA 299." Neither FHA mentions a requirement for control of vegetation. (See **OFI-BWCS-08** and **OFI-DOE-PPPO-02**.)
- Support systems for the safety significant fire suppression system (FSS) including electrical power for heat tracing and heaters are not discussed either in the FHA for the DUF6 Conversion Facility or the DSA. As noted in Finding **F-BWCS-02**, the safety classification of freeze protection sub-system and its power source are not classified consistent with DOE-STD-3009. DOE-STD-3009 requires that any SSC needed to ensure the availability of a preventive or mitigative safety class or safety significant SSC shall be likewise classified.

5.5 TSR Surveillance and Testing

Inspection Criteria: Surveillance and testing of the system demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria. (DOE-STD-3009-94 CN 2, Site and Facility DSA, NFPA Codes and Standards)

Inspection Criteria: Surveillance and test procedures confirm that key operating parameters for the overall system and its major components remain within safety basis, NFPA, and applicable consensus standards operating limits. (DOE-STD-3009-94 CN 2, Site and Facility DSA, NFPA Codes and Standards)

Inspection Criteria: The acceptance criteria from the surveillance tests used to confirm system operability are consistent with the safety basis. (DOE-STD-3009-94 CN 2, Site and Facility DSA)

Inspection Criteria: Instrumentation and test equipment for the system are calibrated and maintained. (NFPA 25)

The DUF6 Conversion Facility has only one safety-significant sprinkler system; namely, the portions of

the system that cover the Vaporization Room, the Cylinder Evacuation Room, and the Scrubber Room are safety significant. For safety-significant fire protection SSCs, DUF6-C-TSR-002, *Technical Safety Requirements for DUF6*, provides the specific criteria and surveillances needed to determine and maintain operability and actions to be taken should a system or component become inoperable. TSR surveillances are conducted in accordance with procedures to verify system and component operability to meet their intended safety functions and performance requirements. Should surveillance activities for equipment related to Limiting Condition(s) for Operation (LCO) indicate potential inoperability of a system or component(s), prescribed actions are taken in accordance with the TSR until operability status is confirmed or operable status restored. Various procedures address provisions for testing, calibration, and control of test equipment; performer qualification; and trending of surveillance results (as applicable).

EA identified a discrepancy in the documentation that supports FWS LCO 3.5.1 statement, i.e., the FSS is considered operable if one flow path of the fire water supply to the DUF6 Conversion Facility is available. The flow testing performed in 2010 (reference Loop Flow Test Work Order 1002436), has not been integrated as a design input to DUF6 hydraulic calculation E11341-C-S041-CDS-204. Integration of these two documents would represent a more accurate basis of the FSS performance capability and the LCO 3.5.1 statement. (See **OFI-BWCS-09**.)

Work control is provided for all fire protection tasks and procedures that govern safe work practices, initiation, performance, and close-out of a given work package. The work package procedure for Paducah operations is BWCS-U-GFP-0108. Documentation of all performed SITMs is required by this procedure. The fire protection SME reviews completed procedure data to ensure compliance with standards and also monitor for trends. Fire protection SITM is performed in accordance with this program as well as the BWCS maintenance program. SITM procedures are initiated in accordance with schedules generated by the electronic work control system.

While overall the fire protection surveillance tests are adequate, EA identified a weakness in the TSRs and their technical bases. For operability, 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 psi. Contrary to this calculation input, the sanitary water pumps have no auto-start setpoints and are manually started by operations personnel in Building 611 to maintain 70 to 73 psi system static pressure. Therefore, there is no analytical basis for the surveillance test acceptance criteria of 65 psig. (See **Finding F-BWCS-03**.)

In addition, the BWCS/SST inspection and test procedures do not define an “inoperable” condition, provide acceptance criteria, or identify and list the applicable TSR requirement.

The TSRs require a fire watch as an immediate action for LCO 3.5.1 when the FSS for the DUF6 Conversion Facility has been declared inoperable. Action A.4 requires the fire watch to be completed once every 12 hours. This fire watch frequency does not provide an equivalent level of protection to address the risk of fire. (See **OFI-BWCS-10**.)

5.6 Fire Protection Self-Assessment Program

Inspection Criteria: A documented comprehensive self-assessment of the fire protection program is performed by the DOE site office and the facility contractor at least every 3 years, or at a frequency with appropriate justification approved by the DOE head of field element. (DOE Order 420.1C)

Inspection Criteria: An Issues Management Process is developed and implemented that prioritizes and monitors the status of fire protection assessment findings, recommendations, and corrective actions until final resolution. (DOE Order 226.1B)

Inspection Criteria: Program deficiencies identified during previous assessments or program reviews are documented and tracked until timely corrective actions are identified and implemented.

Effectiveness of the corrective actions shall be reviewed to prevent recurrences. (DOE Order 226.1B)

BWCS Assessment Program

BWCS has implemented a regular process of program oversight. The BWCS assessment program procedure, BWCW-U-QAP-0012, *Independent Assessments* requires that an annual schedule of assessments be developed and managed by the Site Quality Assurance manager. EA found that although the assessment procedure is outdated (it references DOE Order 5480.7A, which was cancelled in 1995 and superseded by DOE Order 420.1) the BWCS assessment schedule was acceptable.

The assessment report U-MA-14-NS-001, *Tri-Annual Self-Assessment BWCS Fire Protection Program*, conducted by BWCS in June 2014 identified numerous existing issues. There may have been fewer issues if the self-assessment program for the FPP was conducted on an annual basis (a recognized “best practice” at numerous DOE sites), rather than waiting until the tri-annual review was performed.

However, several of the issues identified during the tri-annual self-assessment (ref. U-MA-14-NS-001) as “recommendations” met the BWCS assessment criteria for findings, but were not identified as such, including:

- Lightning Protection Systems on BWCS buildings are not being inspected or maintained (recommendation 2014-3).
- Procedure for 5-year valve inspections does not include examination of the pipe interior or identify actions necessary if excessive pipe obstruction is discovered. The inspection interval should also be reduced to 3 years based on the known zinc hydroxide issue (recommendation 2014-4).
- The required frequency for test and inspection of fire standpipe systems needs to be clarified in the procedure (recommendation 2014-15).

Overall, the BWCS assessment program has been marginally effective in assessing the fire protection program as implemented in the DUF6 Conversion Facility. The BWCS self-assessment of the fire protection program was only conducted once, roughly 3 years after start-up of the DUF6 Conversion Facility, rather than as a continuous review of specific areas as they relate to the FPP. Furthermore, the program does not include adequate guidance for defining issues of noncompliance. (See **OFI-BWCS-11.**)

5.7 DOE PPPO Oversight

Inspection Criteria: DOE field element line management has established and implemented oversight processes that evaluate contractor and DOE programs, including contractor's assurance systems, for effectiveness of performance (including compliance with requirements). (DOE Order 226.1B 4b (1))

Inspection Criteria: DOE field element line oversight program includes written plans and schedules for planned assessments, focus areas for operational oversight, and reviews of the contractor's self-assessment of processes and systems. (DOE Order 226.1B 4b (2))

Inspection Criteria: Oversight processes are tailored according to the effectiveness of the contractor's assurance system, the hazards at the site/activity, and the degree of risk, giving additional emphasis to potentially high consequence activities. (DOE Order 226.1.B 4b (5))

Inspection Criteria: DOE field element staff are adequately trained and qualified to perform assigned oversight activities. (DOE Order 226.1B, DOE Order 360.1C, and DOE Order 426.1 chg 1)

The results of this EA review are organized to address the following aspects of the DOE-PPPO oversight processes and procedures for ensuring the effectiveness of the FPP:

- Oversight Programs and Processes
- Planning, Scheduling and Conducting Assessments
- Qualifications of PPPO Oversight Staff
- Trending and Reporting Contractor Performance.

Oversight Programs and Processes

PPPO performs the DOE oversight of fire protection at the DUF6 Conversion Facility. Onsite Facility Representatives (FRs) and support services contractors who augment the PPPO oversight staff at Paducah perform the majority of the oversight. The PPPO headquarters office supports the field PPPO organization and provides SMEs for programmatic assessments in specialized areas that require unique expertise not available within the field office.

PPPO has documented and implemented processes and procedures to oversee the BWCS FPP. The plan PPPO-M-226.1-2, *Oversight Program Plan*, describes the PPPO implementation of DOE Order 226.1B for conducting oversight including the methods to be used, areas to be reviewed, and the frequency of the reviews. This plan also describes how the results of various oversight methods are integrated and considered in developing an accurate assessment of the contractor's performance.

The plan PPPO-M-413.1-1, *Management Plan*, describes the DOE-PPPO organization and identifies the functions, responsibilities, and authorities of PPPO management and staff for DOE technical oversight. Table 8.2-3 of this plan lists the PPPO Programmatic Functional Lead for each major programmatic area, but fire protection is not included. In addition, the list of programmatic areas in the plan does not match the programmatic areas in the current annual schedule for assessments and surveillances. EA noted that the signature page for this plan states that it will be updated annually. However, the plan has not been updated since January 2007 and contains several deficiencies. (See **OFI-DOE-PPPO-03**.)

The program plan PPPO-M-420.1-3, *Safety Systems Oversight Program Plan*, establishes the framework for the PPPO SSO program and defines the roles and responsibilities for implementing the program. This program plan describes the role of the SSO Engineer in conducting routine oversight of the contractor and

also describes the selection, training, and qualification requirements for SSO Engineers. However, because of a recent staff resignation, PPPO does not have a qualified SSO engineer at Paducah.

PPPO also has a documented plan specifically for performing oversight of BWCS at the DUF6 Conversion Facility, namely PMP-5-08, *DUF6 Conversion Project Oversight Plan – Operations and Maintenance*. PPPO management issued this plan in March 2012 and was revising it at the time of this review.

Although PPPO conducts oversight for both Paducah and Portsmouth, PPPO staff stated that they use different methods and formats for performing and documenting oversight at each site, based on historical site preferences. This lack of consistency makes it harder to locate information and requires additional time and effort to review results. (See **OFI-DOE-PPPO-04**.) PPPO management is considering standardization of their inspection format.

Planning, Scheduling and Conducting Assessments

Assessments and surveillances are scheduled, conducted, and reported in accordance with procedure PPPO-M-414.1-2, *Assessment and Surveillance Process*. EA reviewed the PPPO assessment planning schedule, *DUF6 Conversion Project Assessment Schedule FY-14 Planned*, which is developed annually before the start of the new fiscal year (FY). The scope and frequency of oversight is based on past contractor performance, with consideration to resource limitations. The specific assessments for the DUF6 Conversion Facility are established based on past weaknesses in BWCS's safety performance, specific hazards at the facility, the degree of risk in the operations, and the potential consequences. PPPO also considers upcoming contract changes or transitions to prioritize resources. The assessment plan covers a broad range of subjects, including the annual contractor building assessment and the triennial comprehensive assessment of the FPP and update to the FHA as required in DOE 420.1C. The PPPO assessment schedule indicates an effective oversight plan for the BWCS conversion operations.

PPPO tracks each assessment it conducts to ensure the contractor responds to the assessment findings and completes appropriate corrective actions. For deficiencies that fall within PPPO responsibility, procedure PPPO-M-414.1-1, *Corrective Action Program*, establishes responsibilities and methods for initiating measures to correct conditions adverse to quality that are generated by surveillances, assessments, and other oversight activities conducted by PPPO or technical support contractors and DOE Headquarters staff. The assessment findings at Paducah and Portsmouth are tracked in a computer-based Management Tracking System (MTS), developed by PPPO staff. The procedure for use of the MTS is still in draft form. The FR for the DUF6 Conversion Facility also ensures that issues are added to the BWCS corrective action program for appropriate follow-up.

Recent PPPO Assessments of Fire Protection

A PPPO assessment of fire protection at the DUF6 Conversion Facility was actually a shadow assessment of the BWCS Tri-annual self-assessment of the FPP for the DUF6 Conversion Facility conducted in June 2014. The shadow assessment was performed by a qualified FPE from the DOE Office of Environmental Management (EM-42). At the time of this EA review, the report for the Office of Environmental Management shadow assessment had not been issued.

A PPPO assessment of the LATA Kentucky Fire Protection and Prevention Program was conducted in April 2012. The assessment resulted in no findings, but two observations. The first observation was that the LATA Kentucky fire program did not actively manage and communicate fire system impairments and repair schedules. The second observation regarded the failure to ensure and document the submittal of the Annual Fire Protection Summary information to the DOE Office of Health, Safety and Security Fire

Protection database, as required by DOE Manual 231.1-1, *Environment, Safety, and Health Reporting Manual*.

Earlier, PPPO conducted an assessment of fire protection at Paducah entitled “Quality Assessment of the Fire Protection Services Provided by the United States Enrichment Corporation Under Work Authorization #25973,” dated June 2008. This assessment resulted in one finding that in all but one case, USEC could not provide documentation to prove that the emergency lights were being tested monthly.

Additional recent PPPO assessments involving the DUF6 Conversion Facility, but not specifically fire protection, included:

- An assessment of the BWCS Conduct of Operations Program at the DUF6 Conversion Facility conducted in April 2013, which identified 9 findings, 6 observations and 4 recommendations
- An assessment of the BWCS Quality Assurance Program at the DUF6 Conversion Facility conducted in November 2013, which identified 14 findings, 27 observations, and 1 proficiency within the Quality Assurance program.
- An assessment of the BWCS Cognizant System Engineer Program, including Configuration Management, Design Change Request, and Unreviewed Safety Question Determination at the DUF6 Conversion Facility conducted in February 2014, which identified 12 findings, 23 observations, and 9 proficiencies.

The results of these recent assessments indicate that the PPPO assessment program is functioning as intended in these programmatic areas to identify weaknesses and deficiencies in the contractor’s program as a means for evaluating the performance of the contractor. However, the PPPO assessment program did not adequately identify any substantial weaknesses in the area of fire protection.

Qualifications of PPPO Oversight Staff

The PPPO *Annual Workforce Analysis and Staffing Plan Report*, dated December 31, 2013, summarizes the combined technical staff needs for Paducah and Portsmouth. This report indicates that the PPPO office is short on qualified staff in several key areas including SSO personnel, FRs, Quality Assurance, Radiation Protection, and Security. For these five capabilities, the report indicates “planning to recruit in FY 14.” PPPO management stated that they are aware of the shortage in technical capabilities and are taking steps to address it.

PPPO has 52 Federal employees who provide oversight for multiple facilities and contractors at both Paducah and Portsmouth. The Paducah Operations Oversight Group currently has 12 Federal staff in Paducah, augmented with multiple support contractors to oversee the various operations and decontamination and decommissioning efforts on site. Of the support contractors, SMSI performs safety system oversight (SSO) of the DUF6 Conversion Facility and operations conducted by BWCS. Pro2Serve conducts oversight for other site facilities, including operations performed by LATA Kentucky, SST, and USEC (prior to the transition). PPPO recently experienced staff transitions and is understaffed. The DUF6 Federal Project Director resigned in June 2014, and one of the qualified FRs left the project in April 2014. In addition, with the increased DOE responsibility following the transition from USEC to Fluor, the DOE oversight organization will be further stretched. (See **OFI-DOE-PPPO-05**.)

PPPO currently has a number of staff openings and is planning to hire two new FRs for Paducah: one as a replacement and one as an addition to support the upcoming USEC de-lease. In areas where they are

short-handed, PPPO uses technical support contractors to assist with oversight. SMSI personnel function essentially as FRs, but without the same authority. They report their observations to the FRs, not directly to BWCS or other contractors. Certain technical specialists are often assigned to perform oversight duties at both sites.

The use of support service contractors to augment the oversight program is common within the DOE complex. However, the qualifications of the support contractor staff are not always explicitly stated contractual requirements and are often unknown until the contractor is selected and hires additional staff. The support contractors do not have the same authority as qualified Federal staff. (See **OFI-DOE-PPPO-05**.)

Fire Protection Engineer

Since there are no Federal FPEs in the PPPO staff, DOE-PPPO obtains the services of a FPE for oversight of the Paducah DUF6 Conversion Facility through a support contract or from the DOE Office of Environmental Management Consolidated Business Center (EMCBC). As observed during this review, the contractor FPE is qualified by education and demonstrated appropriate technical competence. The contractor FPE has over 20 years of experience in fire protection at DOE facilities and has supported the PPPO for 7 years. The contractor FPE demonstrated the ability to assess the performance of BWCS and other contractors in matters related to fire protection. However, the contractor FPE had not conducted an assessment at the Paducah DUF6 Conversion Facility since 2011. EA did not interview the FPE from the EMCBC office during this review. EA found that there is only sporadic, part-time FPE support for DOE oversight at the Paducah DUF6 Conversion Facility. This infrequent level of DOE FPE oversight may result in missed opportunities for improvement, reduced efficiency, and increased risks at the facility. (See **OFI-DOE-PPPO-06**.)

The procedure PPPO-PRO-420.1-2, *Authority Having Jurisdiction Fire Protection Program Equivalencies and Exemptions*, specifies the process for handling deviations from applicable DOE requirements (as specified in DOE Orders, Standards, Notices, etc.) and fire protection codes and standards and clarifies the approval authority for such deviations. The role of the PPPO AHJ at Paducah has been delegated to the DOE Nuclear Safety Oversight Lead. In accordance with this procedure, the PPPO AHJ solicits advice from a “qualified person” (i.e., an FPE with the requisite knowledge and abilities to provide such advice) when responding to a request for an equivalency or exemption from DOE requirements related to fire protection. The FPE then provides a documented evaluation and recommendation which is submitted for review and concurrence. To date, there have been a handful of equivalencies granted by the DOE AHJ, but no exemptions.

Facility Representatives

There are currently two qualified FRs at Paducah. The roles, responsibilities, and performance requirements for the FRs, as well as their relationships with other PPPO staff and with the site contractors, are defined in PPPO-1063, *Facility Representative Program Plan*. The FRs perform inspections of the DUF6 Conversion Facility and the other Paducah facilities in accordance with PPPO-1063, *Facility Representative Program Plan*. The responsibilities are divided up so that one FR is the lead for the Paducah DUF6 Conversion Facility, while the other FR is the lead for the PGDP and balance of plant. As previously mentioned, PPPO management recognizes there is a staff shortage and is planning to hire two more FRs for Paducah. At this time, the FRs rely heavily on the support service contractors to assist them with daily oversight at Paducah.

With over 100 buildings at the Paducah Site, the current workload for the two FRs is unmanageable. Three SMSI contractors who augment the PPPO staff provide additional oversight support at the DUF6

Conversion Facility. This arrangement helps enhance safety at the Paducah DUF6 Conversion Facility, but does not replace the need for qualified FRs. (See **OFI-DOE-PPPO-05**.)

EA examined the qualification records, interviewed the FRs, and accompanied each of them on walkthroughs of several Paducah facilities. Both FRs are fully qualified under PPPO-1063 and have many years of experience in conducting DOE oversight. The FRs possess sufficient knowledge of the facilities and systems they are assigned to, the status of operations, and the key projects underway in those facilities.

Trending and Reporting Contractor Performance

The FRs and DOE oversight support contractors perform oversight of the various operations at Paducah through regular daily activities and interactions with the contractor (e.g., BWCS). The FRs perform walkthroughs of the job site, attend work planning meetings, conduct surveillances, and perform many other routine tasks that interface with the contractor. The FRs review all occurrence reports and produce a quarterly analysis of the recurring events to identify trends in contractor performance.

In addition to formal surveillances and assessments, the PPPO support services contractors document their observations in Field Inspection Reports (FIRs). The FIRs follow a specified format, are assigned a tracking number, and provide documented evidence of contractor activities and system conditions. EA reviewed several FIRs and found that they are a useful tool for evaluating and communicating contractor performance.

The FRs review the contractor's proposed corrective actions to determine whether the proposed action will resolve the deficiency. After the corrective action is completed, the FR or DOE support contractor verifies that the problem is resolved. If unsatisfied with the resolution, the FR or DOE support contractor will create a new open item. The FRs periodically meet with BWCS and the other operations contractors to review the status of corrective action items.

The Paducah FRs conduct weekly internal teleconference meetings with the Portsmouth FRs and PPPO management. In addition to keeping DOE management informed, these informal meetings allow the FRs a chance to share emerging issues and solicit input on potential resolutions.

Summary

Overall, the DOE-PPPO assessment program and its implementation was generally effective, although the program lacks adequate Federal staff to function efficiently, particularly in the area of qualified FRs and technical specialists for some disciplines. There is no FPE on the PPPO staff, and there is insufficient regular oversight in the area of fire protection. A number of the PPPO procedures and programs reviewed have not been revised or updated to incorporate new DOE orders and the current requirements for field organizations. For example, the PPPO assessment schedule for the DUF6 Conversion Facility includes more programmatic areas for assessment than the outdated PPPO Management Plan issued in 2007. In many cases, references in oversight plans do not specify DOE Order 420.1C. Finally, the MTS for tracking assessment findings is being used at both Paducah and Portsmouth, but the procedure describing how to use the system is still in draft form.

6.0 CONCLUSIONS

Most elements of the BWCS FPP for the DUF6 Conversion Facility were well defined and implemented. Facility personnel responsible for the implementation of the FPP, including the BWCS FPE and the

Operations Manager, understand the program requirements and were effective in their roles. The facility risks associated with fire are well defined, and appropriate controls have been identified. These controls are adequately documented in the technical baseline documents including the FHAs for both the DUF6 Conversion Facility and the DUF6 cylinder storage yards and the DSA. Although the FHAs were sufficiently integrated into the DSA, both FHAs are outdated.

Increased management attention is warranted to improve the implementation of some FPP program elements. At the time of this review, implementation of the DOE Order 420.1C and DOE-STD-1066-2012 was still underway at Paducah, and many procedures still referenced earlier requirements.

The EA team identified a number of findings relating to the BWCS FPP and one that relates to the site's fire protection infrastructure, which is not specifically a BWCS responsibility. The BWCS BNA for the DUF6 Conversion Facility has not been updated to comply with the current requirements. Also, the freeze protection system for the DUF6 fire water supply is not classified as safety significant. Lastly, there is no analytical basis for the TSR required minimum pressure of the static riser.

Of particular importance were the noted vulnerabilities in the water supply to the DUF6 Conversion Facility FSS related to the age and condition of the pumps, pipes, valves, and other components and the inadequate implementation of ITM requirements, which raise questions about the system's reliability. Coupled with a USEC backlog of deferred maintenance and a "run to fail" mentality, this could lead to system failures.

ITM for supporting groups, including site utilities and the fire department, have not been adequately addressed. Because of cross organizational responsibilities, many of these issues may require review and modification of existing contracts and memorandums of understanding that govern the quality, quantity, timeliness, and reliability of provided services and materials.

The water supply and the electric power supply for the heat tracing for the safety-significant fire protection system have not been designated as safety significant. The correct classification of these systems will provide additional impetus for ensuring their availability.

The PPPO assessment program and its implementation is effective, although PPPO is short on qualified Federal staff and routine review of the FPP by a qualified FPE is not being performed. Additionally, PPPO has not standardized the processes and procedures for conducting oversight at Paducah and Portsmouth to maximize efficiency. In many cases, documentation and procedures do not reflect the current DOE requirements.

7.0 FINDINGS

As defined in DOE Order 227.1, *Independent Oversight Program*, findings indicate significant deficiencies or safety issues that warrant a high level of management attention. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers or the public, or national security. Findings may identify aspects of a program that do not meet the intent of DOE policy or Federal regulation. Corrective action plans must be developed and implemented for findings identified by EA. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 227.1 to manage these corrective action plans and track them to completion.

BWCS

Finding F-BWCS-01: DOE Order 420.1C requires tri-annual reviews of the BNA. The BNA for the DUF6 Conversion Facility (DUF6-C-RGN-014, dated September 2010) is outdated and does not address all elements specified in DOE Order 420.1C.

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. DOE-STD-3009 Section 4.4 (and DOE-STD-1021 section 2.3 (a) (b) (c)) requires that any SSC needed to ensure the availability of a preventive or mitigative feature of safety class or safety significant SSC shall be likewise classified.

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.

PPPO

Finding F-DOE-PPPO-01: The absence of a structured ITM program commensurate with 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.

8.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the following OFIs. These recommendations are not intended to be mandatory. Rather, they are suggestions offered by the EA team that may assist site management in implementing best practices or provide potential solutions to minor issues identified during the review. It is anticipated that these OFIs will be reviewed and evaluated by the responsible line management organization and accepted, rejected, or modified as appropriate in accordance with site-specific program objectives and priorities.

BWCS

OFI-BWCS-01: Consider revising and updating the FPP and FHA documents to incorporate DOE Order 420.1C, remove references to DOE Guide 420-1.3, and incorporate DOE-STD-1066-2012.

OFI-BWCS-02: Consider updating the SITM test procedures to reflect the responsible contractors and revising the fire protection plan to reflect the appropriate procedures.

OFI-BWCS-03: Consider revising the BWCS emergency lighting systems program to include an annual functional test as required by the Life Safety Code. The BWCS FPE indicated the 90 minute test had been performed, but the documentation for the test was not on file and as a result could not be reviewed by EA.

OFI-BWCS-04: Consider revising the pre-incident fire plan to show the passive fire systems for the building and their ratings as recommended by NFPA 1620.

OFI-BWCS-05: Consider improving the BWCS process for evaluating risk when performing corrective actions. Items should be evaluated in terms of fire protection because of critical factors such as life safety, unacceptable program interruption, fire loss potential in excess of limits defined by DOE-STD-1066-2012, potential damage to process control and safety systems, etc. All of these risk factors significantly impact frequency and consequence.

OFI-BWCS-06: Consider revising the FHA and drawing D-C-1300-GEN-0190-A to more clearly define fire barrier ratings. The FHA identifies the DUF6 construction type as Type IIA-222 consistent with NFPA 101 and NFPA 220. NFPA 220, Table 4.1.1 indicates a requirement for 2 hour fire rating for exterior bearing walls. Furthermore, FHA Section 4.2 states that fire area boundary barriers are 2-hour rated per DOE criteria. According to the life safety drawing, exterior doors in the cylinder airlock are not 2-hour rated.

OFI-BWCS-07: Consider revising the FSS calculations to use the latest flow test data performed at more representative hydrant locations.

OFI-BWCS-08: As part of the integrated wildland fire management plan required by DOE Order 420.1C, consider adding the requirement for control of vegetation.

OFI-BWCS-09: Consider revising hydraulic calculation E11341-C-S041-CDS-204 to incorporate DUF6 Loop Flow Test data covered by Work Order 1002436. The Test 2 flow test data that depicts one flow path supply to the DUF6 underground fire loop should be used to support the LCO 3.5.1 operability statement with only one flow path to the Conversion Building.

OFI-BWCS-10: Consider evaluating and reducing the fire watch frequency of once every 12 hours in LCO Action A.4 to reflect a level of protection similar to an installed automatic FSS.

OFI-BWCS-11: Consider revising the BWCS self-assessment program to include a continuous review of specific areas as they relate to the FPP and include adequate guidance for defining issues of noncompliance.

PPPO

OFI-DOE-PPPO-01: Consider ensuring the current contractor has an obligation to satisfy governing emergency response criteria such as 10 CFR Part 851, 29 CFR Part 1910, and DOE 420.1C (ref F-BNA-2010-1). This includes, but is not limited to, ensuring minimum staffing levels in the fire department, and ensuring adequate equipment and training for potential site emergencies, such as high angle rescue and demolition search and rescue. In addition, address the lifetime service for key fire protection equipment.

OFI-DOE-PPPO-02: Ensure that the various contractors' wildland fire management plans are integrated into a site-wide wildland fire management plan as required by DOE Order 420.1C and that vegetation is controlled as needed to reduce any potential for a wildland fire.

OFI-DOE-PPPO-03: Consider revising the PPPO Management Plan (PPPO-M-413.1-1) to identify the current Programmatic Functional Lead for each major programmatic area and to add Fire Protection as a programmatic area. Also update references and requirements throughout the plan. This plan was issued in 2007 and was intended to be updated annually.

OFI-DOE-PPPO-04: Consider implementing a standard set of assessment procedures and methods based on the best practices from the DOE complex and ensure the support contractors use them. PPPO staff at Paducah and Portsmouth use different methods and formats for performing and documenting

oversight, based on historical site preferences. Furthermore, the support services contractors typically use their own corporate format for reporting surveillance and assessment results. PPPO recognizes this lack of standardization is inefficient and is working to standardize their inspection format. This lack of consistency at each site and between the sites requires extra effort and results in a missed opportunity.

OFI-DOE-PPPO-05: Consider prioritizing the current staffing deficiencies and expedite the process for hiring additional staff, particularly the two new FRs and the SSO engineer.

OFI-DOE-PPPO-06: Consider increasing FPE support for DOE oversight at the Paducah DUF6 Conversion Facility. The current infrequent level of DOE FPE oversight is contrary to DOE best practices and may result in missed opportunities for improvement, reduced efficiency, and increased risks at the facility.

9.0 ITEMS FOR FOLLOW-UP

EA will monitor ongoing corrective actions to ensure the findings are resolved as the transition at Paducah is finalized. The areas of most concern include the aging infrastructure, the gaps identified with the analytical basis for the credited FSSs, and the portions of the BNA that need to be updated to reflect how the fire department will operate and maintain minimum staffing with the departure of USEC.

EA will conduct a review of the FPP for all other portions of the Paducah site that were not addressed during this review due to the impending contract transition and the NRC regulatory oversight responsibilities.

APPENDIX A
Supplemental Information

Review Dates

July 7-10, 2014, and July 21-25, 2014

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments

Quality Review Board

William A. Eckroade
T. Clay Messer
Karen L. Boardman
Thomas R. Staker
William E. Miller
Patricia Williams
Michael A. Kilpatrick

EA Site Lead for Paducah

Rosemary Reeves

EA Team Members

Rosemary Reeves – Lead
Jeffrey L. Robinson
Joseph J. Panchison

APPENDIX B
Documents Reviewed and Interviews

BWCS Documents Reviewed

- DUF6-BWCS-PLN-024, Fire Protection Program Description for the DUF6 Conversion Project, Rev 0, October 2013
- DUF6-C-DSA-001, Paducah DUF Conversion Facility Documented Safety Analysis, Rev. 5, December 2011
- DUF6-C-DSA-003, Paducah Cylinder Storage Yards Documented Safety Analysis, Rev. 6, August 2012
- DUF6-C-TSR-002, Technical Safety Requirements for the DUF6 Conversion Facility, Paducah, Kentucky, Rev. 7, December 2013
- DUF6-C-TSR-004, Technical Safety Requirements for the DOE C-745 UF6 Cylinder Storage Yards, Paducah, Kentucky, Rev. 5a, August 2012
- BWCS-POL-003, Fire Protection Statement, Rev 0, 09/28/2012
- BWCS-C-FPP-3003, Cyber Cat 254 Fire Alarm Panel Test Procedure, Rev. 0, 9/28/2012
- BWCS-C-FPP-3004, Siemens MXL Fire Alarm Control Panel Test, Rev. 0, 9/28/2012
- BWCS-C-FPP-3005, Fire Water System Loop Flow Test, Rev. 0, 9/28/2012
- BWCS-C-FPP-3100, Fire Barrier Inspections, Rev. 0, 9/28/2012
- BWCS-C-FPP-3101, Test and Inspection of Emergency Lighting Units, Rev. 0, 9/28/2012
- BWCS-C-FPP-3102, Annual Testing of Fire Alarm Initiating Devices and Notification Appliances, Rev. 0, 10/3/2012
- BWCS-C-FPP-3103, Fire Alarm Control Panel Battery Test Procedure, Rev. 0, 9/28/2012
- BWCS-C-FPP-3104, Test and Inspection of Fire Dampers, Rev. 0, 9/28/2012
- BWCS-C-FPP-3105, 5-Year Valve Inspection and Sprinkler System Obstruction Test, Rev. 1, April 2014
- BWCS-C-FPP-3106, Test and Inspection of Fire Standpipe Systems, Rev. 1, 4/12/2013
- BWCS-C-FPP-3108, Vehicle Fire Extinguisher Inspection and Maintenance, Rev. 0, 9/28/2012
- BWCS-C-FPP-3110, Quarterly and Annual TSR Tests and Inspections of the Wet Pipe Sprinkler System, Rev. 0, 7/23/2012
- BWCS-C-FPP-3111, Test and Inspection of Non-TSR (GSN) Wet Pipe Sprinkler System, Rev. 0, 9/28/2012
- BWCS-C-FPP-3112, Monthly Inspection of TSR and Non-TSR Wet Pipe Sprinkler Systems, Rev. 0, 7/23/2012
- BWCS-C-FPP-3115, Inspection and Testing of Fire Hydrants and Curb Box Valves, Rev. 0, 9/28/2012
- BWCS-C-FPP-3117, Fire Door Inspection, Testing, and Maintenance, Rev. 0, 9/28/2012
- BWCS-C-FPP-3501, Non-TSR Sprinkler Riser Rooms Monthly Inspection, 0, 7/23/2012
- BWCS-C-FPP-0610, Conversion Facility Fire Alarm Response, Rev. 0, 9/28/2012
- U-MA-14-NS-001, Tri-Annual Self-Assessment BWCS Fire Protection Program Paducah KY and Picketon, OH, 6-20-14
- BWCS-U-FPP-0803, Fire Prevention and Good Housekeeping Practices, Rev. 1, 9/28/2012
- BWCS-U-FPP-0810, Conversion Facility Control of Combustibles, Rev. 0, 7/23/2012
- BWCS-U-FPP-0811, Conversion Facility Fire Protection Impairment, Rev. 0, 7/23/2012
- BWCS-U-QAP-0012, Independent Assessments, Rev 1, 8-8-2013
- BWCS-U-CYP-0002, DOE UF6 Cylinder Storage Yards Combustible Material Control Program, Rev. 1, December 2012

- BWCS-U-GFP-0108 Work Package Procedure for Paducah
- D-C-1300-GEN-0190-A, Paducah DUF6 Conversion Building, Life Safety Ground Floor Plan, Rev 5

SST Documents Reviewed

- (SST) ASMT-2011-010, 2011 SST Fire Protection Program Assessment, QA Checklist, 8-10-11
- (SST) ASMT-2011-010, Corrective Action Tracking Log, and closure attachments: Fire Protection Policy Statement; Fire Protection Program Description; Emergency management MOU; Site Emergency Plan, Various Dates
- (SST) ASMT-2012-019, Swift & Staley Team (SST) Internal Assessment Report – 2012 SST Fire Protection Program Assessment, Corrective Actions, 5-8-12
- (SST) ASMT-2013-21, SST Fire Protection Program Annual Assessment, 8-2-13, and Corrective Actions/Closure, Various Dates
- SST FY 2014 Integrated Oversight Schedule, 9-26-13
- SST.FP-0001, Fire Protection Assessment for the Fuel Dispensing Facility C-752B PGDP, Rev. 0, 7-24-14
- SST.EM-0001, Site Emergency Plan, Rev. 7, 2-11-14
- SST-AHA-023, General Work Activity SST Activity Hazard Assessment, 7-24-14
- SST-13-0345, DE-AC30-10CC40021: Deliverable 20, Directives Review, 6-28-13
- SST-14-0641, DE-AC30-10CC40021: Revised Fire Protection Gap Analysis for the Gaseous Diffusion Plant Transition, 7-7-14
- SST WO#-14-General Fire Services – Work Control Document, 3-25-14

UDS Documents Reviewed

- DUF6-UDS-LEX-10-00177, Contract No.: DE-AC05-020R22717, DUF6 Conversion Project Request for Authority Having Jurisdiction Approval of Equivalency Request for Portsmouth and Paducah Conversion Facilities, 3-4-2010
- DUF6-UDS-LEX-10-00275, PPPO-01-865-10 Contract No. DE-AC05-020R22717, DUF6 Conversion Project: Authority Having Jurisdiction Approval of Equivalency Requests 2010-001 for Spill Control and Secondary Containment Limitations at the DUF6 Conversion Facilities in Portsmouth, Ohio and Paducah, Kentucky
- DUF6-C-F-FHA-001, Paducah DUF6 Conversion Facility Fire Hazards Analysis, Rev. 2, August 2010
- DUF6-C-F-FHA-002 Paducah DOE C-745 Cylinder Storage Yards Fire Hazards Analysis, Rev. 0, February 2010
- DUF6-C-RGN-014, Emergency Services Baseline Needs Assessment UDS Paducah Conversion Facility, Rev. 1, 9-23-10
- DUF6-UDS-LEX-10-00822, Contract No.: DE-AC05-020R22717, DUF6 Conversion Project Fire Suppression System Change Packages for Paducah Conversion Facility DSA and TSR, 9-20-10
- DUF6-UDS-LEX-10-00836, Contract No.: DE-AC05-020R22717, DUF6 Conversion Project Request for Authority Having Jurisdiction Approval of the Emergency Services Baseline Needs Assessment for the Paducah Conversion Facility, 9-23-10
- DUF6-C-F-STU-001, Paducah Sanitary Water Supply/UDS Fire Water Supply Analysis, Rev. 0, March 2005
- DUF6-C-M-SDD-FWS, System Design Description for Fire Protection and Detection System, Rev. 1, December 2009
- C-WO-1002436, Uranium Disposition Services Work Order, FPP-3005 Fire Water System Loop Flow Test, 9-8-10

- UDS E11341-C-S041-CDS-204, As Built Sprinkler Calculations, Rev 2, 3-30-2010
- UDS-U-SHP-0801, Hot Work, Rev. 0, December, 2008
- UDS-C-FPEA-10-001, FPEA for the DUF6 Paducah Conversion Building, Rev. 0, June 2010
- UDS-C-FPEA-10-002, FPEA for the DUF6 Paducah Cylinder Storage Yards, Rev. 0, June 2010
- UDS-C-FPEA-10-003, FPEA for the DUF6 Paducah Administration Building, Rev. 0, June 2010
- UDS-C-FPEA-10-004, FPEA for the DUF6 Paducah Warehouse/Maintenance Building, Rev. 0, May 2010
- UDS-C-FPEA-10-005, FPEA for the DUF6 Paducah KOH Regeneration Building and Service Water Pump House, Rev. 0, June 2010
- UDS-C-FPEA-10-006, FPEA for the DUF6 Paducah Exterior Process Areas, Rev. 0, June 2010

USEC Documents Reviewed

- CP4-CU-UW2040, Isolating and Returning to Service a Section of The Sanitary Water Distribution System, Rev. 4, 6-4-10
- CP4-CU-UW2402, Operating Sanitary Water System With Diesel Engine Drive Pumps at C-611, Rev. 7, 4-25-11
- CP4-CU-UW2430, Operation of Raw, Plant and Sanitary Water Pumps for C-611 Flow Control, Rev. 8, 6-4-10
- CP4-CU-UW3040, Sanitary Water Distribution System Failure, Rev. 3, 1-27-05
- CP4-CU-UW3400, Power Failure at C-611, Rev. 4, 1-10-14
- CP4-SS-FS6117, Fire Protection
- DIVS – ZA6100 – M001, DUF6 Conversion Utility Tie-Ins, Rev. 0, 1-27-06
- DIVS – ZA6100 – M003, DUF6 Conversion Utility Tie-Ins, Rev. 0, 6-4-07
- E-PU-4.0-84M, Treated Water System, Rev. 0
- P-U-20-4M, PGDP Sanitary and Fire Water Drawing
- KY/D-5276, USEC Fire Services DUF6 [UDS Conversion Building C-1300] Fire Incident Plan, Rev. 0, 5-26-10
- Work Order 1302637, Task Performance History for Master #013442-Perform preventative maintenance on motor/pump, 5-20-13
- Work Order 1305611, Task Performance History for Master #017430-Manually Cycle Sanitary System Valves on Annual Basis, 1-31-14
- Work Requests – Plant Information System - CMMS Tasks Under 611 SWS

DOE PPPO Documents Reviewed

- PPPO-M-226.1-2, Oversight Program Plan, Rev 1, March 2010
- PPPO-M-413.1-1, Management Plan, Rev. 2, January 2007
- PPPO-M-414.1, Corrective Action Program, Rev. 1, March 2010
- PPPO-M-420.1-3, Safety Systems Oversight Program Plan, Rev. 0, October 2009
- PPPO-1063, Facility Representatives Program Plan, Rev 1, March 2010
- (PPPO) PMP-5-08, DUF6 Conversion Project Oversight Plan – Operations and Maintenance, Rev 3, 3-5-12
- PPPO-01-1901082-13, Contract No. DE-AC30-11 CC40015, DUF 6 Conversion Project: Forwarding of DUF6 Conversion Project Assessment Report of BWCS CONOPS Program PADU-13-MA-100597, Rev 1, 4-22-13
- PPPO-01-2020717-13, Contract No. DE-AC30-11 CC40015, DUF 6 Conversion Project: BWCS Reporting and Learning Culture Issues, 7-31-13
- PPPO-01-2168144-14, Contract No. DE-AC30-11 CC40015, DUF 6 Conversion Project:

Independent Assessment Report for the BWCS Quality Assurance Program (PPPO-13-IA-100629), 11-20-13

- PPPO-01-2230605-14, Contract No. DE-AC30-11 CC40015, DUF 6 Conversion Project: Independent Assessment Report for the BWCS Cognizant System Engineer Program to Include - Configuration Management - Design Change Request - and Unreviewed Safety Question Determination (PPPO-14-IA-100661), 2- 21-14
- PPPO-01-2308633-14, Contract No. DE-AC30-11 CC40015, DUF 6 Conversion Project: Request for Action for Prompt Short Term Corrective Actions for Hazard Analysis Weaknesses, 4-24-14
- PPPO-01-2378884-14, Assessment of BWCS Fire Protection, 6-16-14
- PPPO-02-1425740-12, Contract No. DE-AC30-10CC40020: Final Report for the (LATA Kentucky) Fire Protection and Prevention Program (PADU-12-IA-100412), 4-9-12
- PPPO-02-558-08, DOE Assessment of the United States Enrichment Corporation Fire Protection Services Under Work Authorization #25973, 7-15-08
- (PPPO) DUF6 Conversion Project Assessment Schedule FY14 Planned, Rev 1, 10-13-13
- FY14 (10/1/2013 – 9/30/2014) PPPO Assessment & Surveillance Plan (from MTS), 7-10-14
- FY14 (10/1/2013 – 9/30/2014) PADU Assessment & Surveillance Plan (from MTS), 7-10-14
- PPPO Observation Custom Report (Sample of MTS Data - Third Quarter FY2014), 7-8-14
- (PPPO) DOE Fire Protection and DOE Oversight Assessment, (Sample of Paducah Facility Representative Weekly Report, week of 8-13 to 8-19-2012), provided 7-10-14
- (PPPO) FIR #C-201307-015, Field Inspection Report: July 1, 2013 HF Release, 7-8-13
- (PPPO) FIR #C-201402-004, Field Inspection Report: Closure of Corrective Actions (CAs) to ORPS Reports, 2-11 to 2-14-14
- PPPO Slides: Paducah Gaseous Diffusion Plant: Plant Overview for HQ Fire Protection, 7-7-14
- PPPO Press Release: Energy Department Selects Deactivation Contractor for Paducah Gaseous Diffusion Plant, 7-22-2014
- Work Authorization #29573 - Paducah Fire, Emergency and PSS

Interviews

- PPPO, Nuclear Safety Oversight Lead and AHJ
- PPPO, Subject Matter Expert and FPE (Support Subcontractor)
- PPPO, Facility Representatives
- BWCS, Nuclear Safety Manager
- BWCS, Fire Protection SME
- BWCS, Fire Protection and Fire Water System Engineer
- BWCS, Fire Protection and Fire Water System Engineer; Shift Technical Engineer
- BWCS, Production Support Facility Manager, Cylinder Yards
- USEC, Operations & Maintenance Manager
- USEC, Supervisor for Utilities
- USEC, Fire Chief
- USEC, Engineering Manager (Acting)
- LATA Kentucky, Engineering and Technical Services Manager
- LATA Kentucky, Fire Protection Engineer
- SST, Operations & Maintenance Manager/Deputy Program Manager
- SST, Environmental, Safety and Health Manager