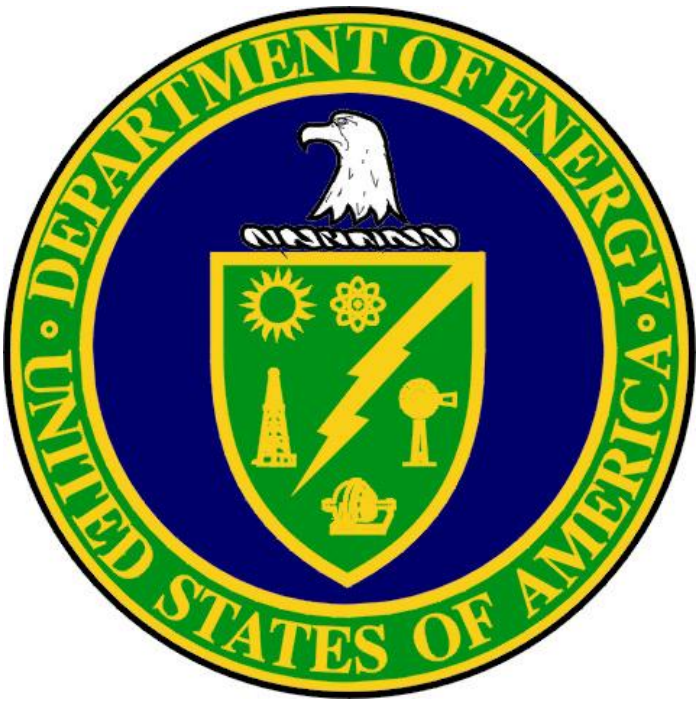
Independent Oversight Review of the Fire Protection Program and Fire Protection Systems at the Transuranic Waste Processing Center



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Acronyms

AED	Automated External Defibrillator
AHA	Activity Hazard Analysis
AHJ	Authority Having Jurisdiction
AWWA	American Water Works Association
BNA	Baseline Needs Assessment
CFR	Code of Federal Regulations
CHMB	Contact Handling Marshaling Building
CM	Configuration Management
CRAD	Criteria, Review, and Approach Document
CSE	Cognizant System Engineer
DBA	Design Basis Accident
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EM	Office of Environmental Management
FD	Fire Department
FHA	Fire Hazards Analysis
FPE	Fire Protection Engineer
FPP	Fire Protection Program
FSS	Fire Suppression System
GPM	Gallons per Minute
HFIR	High Flux Isotope Reactor
HPR	Highly Protected Risk
HSS	Office of Health, Safety and Security
HVAC	Heating, Ventilation, and Air Conditioning
ISMS	Integrated Safety Management System
ITM	Inspection, Testing, and Maintenance
LOI	Line of Inquiry
MA	Management Assessment
MPFL	Maximum Possible Fire Loss
MVST	Melton Valley Storage Tanks
NFPA	National Fire Protection Association
OFI	Opportunity for Improvement
OREM	Oak Ridge Environmental Management
ORNL	Oak Ridge National Laboratory
PB	Process Building
P&ID	Piping and Instrumentation Diagram
PIV	Post Indicator Valve
psig	Pounds per Square Inch Gauge
SH&Q	Safety, Health, and Quality
SME	Subject Matter Expert
SAC	Specific Administrative Control
SSC	Structures, Systems, and Components
SS	Safety Significant
SSO	System Safety Officer
TCC	Telecommunications Center
TRU	Transuranic
TSR	Technical Safety Requirement
TWPC	Transuranic Waste Processing Center
WAI	Wastren Advantage, Incorporated
WIPP	Waste Isolation Pilot Plant
Y-12	Y-12 National Security Complex

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security (HSS), conducted an independent review of the fire protection program (FPP) at the Oak Ridge Transuranic Waste Processing Center (TWPC). The review was one part of a targeted assessment of fire protection at nuclear facilities across the DOE complex.

The purpose of the Independent Oversight targeted assessment was to evaluate implementation of program requirements that are intended to ensure that adequate controls have been implemented to reduce the risk resulting from a fire or explosion at nuclear facilities. Existing HSS criteria, review, and approach documents (CRADs) were adapted to establish a focused set of inspection criteria, activities, and lines of inquiry (LOIs) for the targeted assessment. The independent review of TWPC is designed to evaluate the core fire protection elements and provide the site and responsible DOE Office of Environmental Management (EM) line management organizations with information for benchmarking their programs' effectiveness. This independent review also provides data for an ongoing HSS effectiveness review of the Department's implementation of Commitment #16 of the DOE implementation plan for Defense Nuclear Facilities Safety Board Recommendation 2004-1 regarding verification of Federal nuclear safety assurance capability.

This independent review was performed concurrently with the Oak Ridge Environmental Management (OREM) Site Office surveillance at the TWPC facility on July 15-19, 2013. This report discusses the background, scope, methodology, results, and conclusions of the review, as well as findings and opportunities for improvement (OFIs) identified during the review.

2.0 BACKGROUND

The Oak Ridge Environmental Management (OREM) Site Office was created in October 2012 and reports directly to EM at DOE Headquarters. Before OREM's formation, DOE line management of OREM projects was the responsibility of the Oak Ridge Operations Office. OREM serves as DOE line management for EM projects at the East Tennessee Technology Park (formerly the K-25 Gaseous Diffusion Plant), Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12), and the TWPC, which is managed and operated for DOE by Wastren Advantage, Incorporated (WAI). The purpose of the TWPC is to sort, treat, package, and ship transuranic (TRU) waste for disposal. The mission of the facility is to treat specific tank and solid debris TRU wastes currently stored at various facilities on the Oak Ridge Reservation to satisfy transportation and disposal criteria for the applicable DOE waste repositories: the Waste Isolation Pilot Plant (WIPP) in New Mexico for TRU waste, and the Nevada National Security Site for low-level waste.

The Independent Oversight program is designed to enhance DOE safety and security programs by providing DOE and contractor managers, Congress, and other stakeholders with 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 program is described in and governed by DOE Order 227.1, *Independent Oversight Program*, and a comprehensive set of internal protocols, inspection guides, and process guides.

Fire protection was identified as an Independent Oversight targeted review area for 2013 in an HSS memorandum from the Chief Health, Safety and Security Officer to DOE senior line management, *Independent Oversight of Nuclear Safety – Targeted Review Areas Starting in FY 2013*, dated November 6, 2012. This review is further described in the *Plan for the Independent Oversight Targeted Review of the Fire Protection Program and Fire Protection Systems at Transuranic Waste Processing Center*, dated May 10, 2013, which defines the specific focus at TWPC for this targeted review area.

3.0 SCOPE

Independent Oversight reviewed and assessed the effectiveness and implementation of the TWPC FPP and OREM oversight of the FPP. The assessment evaluated each organization to ensure that the necessary and appropriate policies and procedures are implemented to minimize the fire risk. The review evaluated key FPP elements, including the baseline needs assessments (BNA), pre-fire plans, the exemption and equivalency process, the fire impairment and hot work permit processes, the combustible control program, ignition control programs, fire hazards analysis (FHA), and the National Fire Protection Association (NFPA) inspection, testing, and maintenance (ITM) program. The key facility documents that were reviewed included the FHA/documented safety analysis (DSA) and their integration, technical safety requirement (TSR) surveillance and testing at TWPC, and TWPC and OREM self-assessments.

4.0 METHODOLOGY

The Independent Oversight review of the TWPC FPP included reviews of documents, walk downs of selected portions of the facility and the fire suppression safety systems, and observation of the Site Office Safety System Officer (SSO)/Subject Mater Expert (SME) performing a triennial fire protection review for the TWPC facility. The review considered the requirements of 10 CFR 851, *Worker Safety and Health Program*; DOE Order 420.1B, *Facility Safety*; and NFPA codes and standards. Independent Oversight noted during the review that DOE Order 420.1C was not yet applicable to the facility contract but that reviews for its implementation as appropriate are under way.

The following sections of HSS CRAD 45-34, Revision 1, were used for the targeted assessment:

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

5.0 RESULTS

5.1 Program Documentation

This portion of the review was to determine whether the following inspection criteria were satisfied:

- *A documented fire safety program exists as required by applicable safety criteria. (DOE Order 420.1B, DOE-STD-1066-99)*

- *A baseline needs assessment (BNA) of the fire protection emergency response organization has been documented and updated every 3 years. The plan should describe in sufficient detail fire-fighting operations for the respective facilities. (10 CFR 851, DOE Order 420.1B, DOE-STD-1066-99)*

The TWPC has a documented fire safety program as required by applicable DOE Order 420.1B criteria. The General Manager for the TWPC has overall responsibility for implementing and managing the risks related to fire during the operation of the facility. Various aspects of this responsibility are delegated to the functional organizations (engineering, operations, maintenance, safety and health, etc). Each functional organization manager is responsible for ensuring that their personnel receive appropriate fire prevention training, in accordance to the roles and responsibilities defined in the Fire Protection Program (FPP). The Technical Services Organization includes the Fire Protection Engineer (FPE) who is responsible for developing and maintaining the Fire FPP and implementing procedures. The FPE serves as the cognizant system engineer (CSE) for the fire suppression, detection, and alarm systems. FPE responsibilities also include conducting periodic assessments of the facilities and operations; assisting with the integration of the FHA and DSA; supporting the configuration management (CM) program related to fire protection systems; serving as the subject matter expert (SME) for the FPP; developing and issuing the DOE Annual Fire Protection Summary in accordance with DOE Order 231.1B; inspection and review of the elements of the FPP; performing triennial self-assessments of the FPP; and serving as the contractor's Authority Having Jurisdiction (AHJ) for fire protection issues. The Operations Manager is responsible for ensuring that key aspects of the TSRs and site procedures are properly implemented as documented in the Fire Prevention procedure (ref. CM-P-FP-001, R17, 11-19-2012); coordinating with the ORNL Fire Department (FD) and Local Emergency Supervisor; and communicating with the General Manager regarding the compliance and effectiveness of the FPP. The Safety, Health, and Quality (SH&Q) organization is responsible for verifying that fire extinguishers are available and in operating order, and coordinating the inspection and recharging of equipment.

TWPC Fire Protection Program

The FPP documents the mission, policies, and procedures necessary to meet DOE Order 420.1B requirements. The FPP indicates it is TWPC policy to implement 10 CFR 851, DOE Order 420.1B, and all other DOE-prescribed fire protection codes and standards that are applicable to OREM managed facilities , including the mandatory NFPA standards identified in list A and list B of the WAI contract (DE-EM0000323) with DOE OREM. The FPP describes the process for promulgating these program elements down to the facility. At the time of the assessment, TWPC had issued its implementation plan for complying with DOE Order 420.1C, noting that most of the requirements are already implemented and that the remaining actions to achieve full implementation will not impact TWPC's ability to continue operations in a safe and compliant manner.

The FPP provides an overview of the program requirements, documents the key roles and responsibilities, and identifies the fire protection administrative controls that are intended to minimize the risk and consequence of fire while maintaining a Highly Protected Risk (HPR) status. The program relies on the conclusions and commitments in the FHA, and DSA. The Operations and Maintenance Departments are responsible for implementing most of the fire prevention controls through the TSRs or TWPC Fire Prevention procedures, which include housekeeping, material storage handling and use, flammable and combustible material handling and control, ignition source control, emergency response portable fire extinguishing equipment, emergency lighting, fire doors and exit doors, access to fire protection and alarm system components, and fire blankets. Several administrative fire procedures address unique hazards as they relate to facility operations that complement the TWPC Fire Prevention procedure. The Independent Oversight team observed that the Fire Prevention procedure is appropriate for the facility hazards and adequately documented as part of a comprehensive FPP.

The FPE serves as the CSE for the TWPC process building safety significant sprinkler system and has overall responsibility for the other non-SS fire suppression and detection systems. He is responsible for maintaining the FHA and ensuring that the supporting technical baseline documentation for the TWPC fire systems is periodically reviewed and updated. The TWPC FPP defines a "system" to ensure that the requirements and objectives are documented and incorporated in the plans and specifications for all significant modifications of existing facilities. This system includes a documented review by the CSE of plans, specifications, procedures, and acceptance/commissioning tests per DOE Order 420.1B, Chapter II, paragraphs 3.b(3), 3.b(4). Physical changes to the facility are controlled by a configuration management program. The FPE performs periodic facility assessments and walk downs to ensure no unauthorized modifications are made to systems or structures under his purview. The FPE also serves as the fire protection SME and provides necessary guidance to the facility departments, including Operations, Maintenance, and SH&Q, to ensure that the applicable requirements are implemented.

The ORNL Fire Department (FD) response is conducted through deployment of emergency response personnel and apparatus from the fire station located on the west end of the ORNL site. The FD's responsibilities include response to manage, mitigate, and/or support mitigation of fire, hazardous material, emergency medical, and rescue events. Additional functions of the FD under a facility use agreement include ITM to ensure operability of certain fire alarm and suppression infrastructure external to the TWPC facility structures, and participation in training activities to ensure proficiency and facility awareness during a response.

The ORNL FD response is initiated either by contact from TWPC personnel or by an automatic fire alarm signal. The response time is generally between seven to eight minutes, with a distance from the fire station of approximately five miles over primary roadways. Additional resources are available as specified by the "Oak Ridge Reservation Common Response Plan to Fire/Rescue, Ambulance, and Hazardous Materials Release Emergencies." When requested, supplemental resources from Y-12 and the City of Oak Ridge fire station located at East Tennessee Technology Park can respond to the TWPC within approximately 20 minutes. Additional resources are also available from other stations within the City of Oak Ridge FD as documented in a mutual aid agreement.

Baseline Needs Assessment

DOE Order 420.1B requires each site to establish and document its needs and capabilities to provide timely and effective firefighting response with sufficient staffing, apparatus, facilities, and equipment, and to document these capabilities in a BNA that reflects applicable NFPA codes and standards. The BNA is to be updated every three years. In response to this DOE requirement, the ORNL FD prepares and maintains a BNA. The ORNL FD is responsible for understanding the facility fire hazards and risks posed by each facility it covers. The "drivers" for the ORNL FD BNA are for facilities managed by UT-Battelle under contracts to the DOE Office of Science. The TWPC FHA indicates that the total deployment for an initial full assignment to an actual emergency would be one Type 1 engine, one medium duty rescue, an Advanced Life Support equipped ambulance, and one command vehicle. A total of seven personnel would support this response. This level of deployment is generally within the capabilities supported by the ORNL FD BNA. However during a previous review of responses and the BNA, TWPC recognized the medical First Unit response and Basic Life Support response could not meet the four-minute response time requirement in accordance with the NFPA 1710. TWPC management has implemented appropriate internal compensatory measures that include:

- First aid training
- Cardiopulmonary resuscitation (CPR) training
- Automated external defibrillator (AED) training

- AEDs located throughout TWPC.

WAI should consider formalizing these compensatory measures as equivalencies to the NFPA 1710 (see **OFI-WAI-01**).

Procedures and Practices for Implementing Elements of the Fire Protection Program

A comprehensive FPP depends upon implementation of key processes and administrative controls that reduce the risk and minimize the consequences of a fire. The Independent Oversight team reviewed the following processes of the FPP: Ignition Source Controls, life safety evaluations, pre-fire plans, the system impairment process, inspections testing and maintenance, and control of combustibles.

Ignition Source Controls

Although the TWPC FPP and the Fire Prevention procedure document a comprehensive FPP, the Independent Oversight team observed areas for improvement. For example, the specific procedure for ensuring ignition source control for fuel receipt at the Foam Storage Enclosure is adequate, and other procedures address aspects of refueling specific portable equipment (forklifts and generators) such as use of PPE, but stand-off distances, bonding and grounding, and other appropriate ignition source controls for dispensing fuel to vehicles used on site are not clearly and consistently defined in the Fire Prevention Procedure (see **OFI-WAI-02**).

Life Safety Evaluations

The Fire Prevention procedure identifies several specific controls, including the frequency for performing emergency light testing. The procedure requires functional testing of the emergency lights once a quarter. This requirement was not consistent with the Life Safety Code requirement for monthly testing. Interviews with the TWPC FPE and review of testing documentation revealed that the testing is in fact performed monthly, thereby satisfying the Life Safety Code requirements. At the time of the review there existed an inconsistency with the frequency specified in the procedure. The procedure has since been revised (see **OFI-WAI-03**).

In evaluating the documentation of planned actions for responding to fires in the TWPC glove box, the Independent Oversight team found that the activity hazard analysis (AHA), *Glove Box Operations, OAHA-05-006, rev 18 dated 7-09-2013* still references fire equipment (such as pull stations) that had been removed as part of a fire suppression modification that replaced the pre-action system with a wet pipe sprinkler system (see **OFI-WAI-04**).

Pre-Fire Plans

TWPC conducts limited-scope performance exercises in accordance with NFPA 1710. These exercises, with the participation of the ORNL FD, are intended to benchmark the response time for securing a water supply, augmenting the TWPC Process Building (PB) sprinkler system, and advancing attack lines. The most recent exercise, in August 2012, met all of the drill objectives. The Independent Oversight team observed that the FD staffing, equipment and response are sufficient to support most of the needs identified in the TWPC FHA, however, at the time of the review there was no formal agreement or written process requirement to ensure that the ORNL FD receives the TWPC FHA and reviews it as part of the BNA update process. The ORNL Fire Chief has since been added to the controlled distribution of the TWPC FHA (see **OFI-WAI-05**).

The ORNL FD, working under the Emergency Management Division, is responsible for the

implementation of pre-fire plans for ORNL. The Pre-fire Plan procedure, LPD-FD-ADM-020104, rev 7 describes how ORNL implements and oversees the development and maintenance of these documents. Independent Oversight interviewed the fire captain responsible for implementing this program to gain an understanding of the program requirements, verify roles and responsibilities, and discuss the response planning for the TWPC PB (Building 7880). The procedure outlines the information that is required to be included in a pre-fire plan to support a safe and timely response. However, the TWPC PB pre-fire plan lacks several key pieces of information, including the location of fire walls, fire alarm panels, fire detection systems, and flammable liquid storage cabinets (see **Finding OREM-F-01**). Since the current alarm transmittal system for notifying the ORNL FD of an incident is a single node notification, it does not send facility specific alarm location information. Thus pre-fire plan information is even more important for a safe and efficient response. A TWPC emergency event (EM-ORO-WAI-TWPC-2013-0005) on June 26, 2013, that resulted in a sprinkler actuation revealed that the emergency response time and coordination with facility personnel program were generally effective and adequately implemented. However, during this event, the ORNL FD did not utilize an existing fire alarm control panel located in the Contact Handling Marshaling Building (CHMB) that would have identified the specific device and location of the alarm inside the facility, possibly reducing both the overall response time and the risk to the investigating first responders. This highlighted the deficiencies in the existing TWPC PB pre-fire plan. Additionally, this event highlighted some issues in facility-specific radiation hazard support and water runoff control, as discussed in Section 5.2.

Fire System Impairment Process

The TWPC fire impairment process provides direction for implementing compensatory measures and impairment documentation in support of maintenance on fire suppression systems (FSSs) at TWPC. The Fire Impairment procedure identifies the Operations Manager and the TWPC FPE as responsible for approving compensatory measures. Because the FPE's contract allows for a long-distance tele-work arrangement with monthly onsite inspections, compensatory measures can be approved either in writing or via verbal telecommunications. The Independent Oversight team's review of several completed impairment records indicated that the impairment approvals performed via telecommunications were not always effectively documented. On several of the reviewed Impairment Notification Forms, the Waste Operations Lead, who typically initiates an impairment, did not include the name of the person who approved the impairment or compensatory measures when completing the "FPE Authorization" step on Attachment B (see **OFI-WAI-06**).

Inspection, Testing, and Maintenance

Necessary and appropriate policies, procedures, requirements, and criteria should exist for design, installation, operability, inspection, maintenance, and testing of fire protection and life safety systems. Fire protection and life safety structures, systems, and components (SSCs) are subject to ITM requirements consistent with applicable codes and standards, such as NFPA 25 and American Water Works Association (AWWA) standards. A 10-inch ORNL water supply is located east of the PB. The water main has two post indicator valves (PIVs) for isolation purposes and three fire hydrants located within the TWPC facility. All of this equipment is installed for ready access by the FD during an emergency response. The ORNL FD is responsible for testing and maintaining these fire systems. The Independent Oversight team observed that the hydrant isolation valves and PIVs were not being tested as required by NFPA codes and standards (see **Finding OREM-F-02**).

Control of Combustibles

DOE Order 420.1B requires an FPP to include comprehensive, written fire protection criteria or procedures that address use and storage of combustible, flammable, radioactive, and hazardous materials

to minimize risk from fire. DOE-STD-1066-99 reinforces this requirement; stating that a combustible control program is a required FPP element and that general housekeeping practices, control of transient combustibles, and control of flammable and combustible liquids and gases must be documented. DOE Guide 420.1-3 further states that the quantity and associated hazards of flammable and combustible materials that are often found within the fire area should be factored into FHAs. NFPA 801 requires that the fire protection plan establish administrative controls governing general fire prevention activities, such as control of combustibles and ignition sources. The quantity and associated hazards of flammable and combustible materials that are expected within the fire area should be factored into the hazard analyses and considered when selecting fire accident control strategies. The presence of transient combustibles associated with storage and maintenance activities should also be considered. If a facility is fully protected as required by fire codes and standards, combustibles may be limited and controlled through normal housekeeping programs.

The TWPC FPP, CM-A-FP-002, R6, Section 4.1 acknowledges that a significant control for fire prevention is to limit the amount of combustible materials that may be exposed to a fire. The DSA accident analysis credits the combustible control program specific administrative control (SAC) for various safety basis accident scenarios that may occur in PB Room 231. The SAC (DSA Table 5-2) requires that PMDI container(s) shall have an attendant unless no transient combustibles are within 15 feet of the containers in excess of 80 PE-Ci. Procedure CM-P-FP-001, R17, *Fire Prevention*, appropriately characterizes and quantifies acceptable limits of combustibles and the corresponding facility locations required for safe operation, and relies on facility housekeeping to keep combustibles at an acceptable level. Independent Oversight performed a walk down of the facility and observed that combustibles were generally at an acceptable level. However, in one location the team observed excessive transient combustibles located under heating, ventilation, and air conditioning (HVAC) mechanical equipment. When notified of this observation, facility personnel responded promptly to remove the combustibles. Based on interviews with staff and review of the procedure, and in light of this observation, Independent Oversight concluded that controls for combustibles have been implemented by an informal process within the limits of typical housekeeping practices. Considering the observations the existing training and guidance for housekeeping were not sufficient to fully satisfy the criteria cited in Section 4.3 of the Fire Protection procedure (see **OFI-WAI-07**).

5.2 Fire and Related Safety Hazards Analysis

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *Fire Hazard Analyses (FHA) have been prepared for each nuclear facility and the results coordinated and integrated into the Documented Safety Analysis as required. (DOE Order 420.1B, DOE STD-1066-99, DOE-HDBK-1163, NFPA 801)*

- *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 420.1B)*

- *The FHA and self-assessments address all essential elements for a complete analysis as delineated in DOE Order 420.1 and its implementation guide. (DOE Order 420.1B and DOE Guide 420.1-3)*

- *The information contained in the FHA and assessment is accurate, as required by applicable fire safety criteria. (DOE Order 420.1B)*

A comprehensive FHA has been developed that generally satisfies the inspection criteria. However some deficiencies were identified for specific elements required for the FHA resulting in a finding.

An FHA is intended to comprehensively and qualitatively assess the risk from fire within individual fire areas to meet DOE Order 420.1B, *Facility Safety*. It is required for all hazard category 1, 2, and 3 nuclear facilities that store or process significant quantities of hazardous materials. The FHA is required to document the facility building construction, important process equipment and operations, the fire hazards, high value equipment, and the maximum possible fire loss (MPFL) related to the worst-case design basis fire scenario. The content of the FHA is a primary source of input to the safety analysis for determination of fire hazards and available preventive and mitigative controls.

Because the TWPC PB has been evaluated to be a hazard category 2 facility, the TWPC FPP document recognizes the FHA report as the source document that establishes the design basis for the fire protection features of the facility. The TWPC consists of multiple buildings and structures, each of which is described in the FHA in terms of construction type, occupancy, function and activities, and potential hazards. The facility TWPC FPE is the primary author of the FHA and maintains continuous communication with safety basis personnel with regard to facility changes and facility process evolutions. This informal process is not governed by a specific procedure; however, interviews with key parties confirmed the effectiveness of this communication stream and noted that it is reinforced by the Configuration Management Program (see Section 5.3). Additionally, the FHA is revised annually to ensure accuracy, and Independent Oversight considers this to be a programmatic strength.

Independent Oversight determined that the TWPC FHA generally contains the necessary attributes prescribed by DOE Order 420.1B and DOE Guide 420.1-3. However, the TWPC FHA was deficient in some areas (see **OFI-WAI-08**):

- FHA Section 2 lists, in part, consensus NFPA standards that provide the bases for the conduct of the FHA and for the defense-in-depth design features. In some cases, the listed codes of record are not consistent with the facility contract or the codes that are used for facility design modifications or found in other documents. Interviews with the FPE indicated that design modifications use the latest issue of the code or standard. Documenting specific codes of record in the facility FHA would help ensure facility-specific compliance, facilitate conformance of SSC design modifications, and ensure compliance with ITM requirements. Similarly, codes of record with issue dates are not always clearly documented in the facility DSA or the FSS design description documents.
- FHA Section 5.13 addresses fire protection water runoff. The analysis states that the most credible discharge is from an extended coverage head that would deliver 60 gpm for 10 minutes, contrary to NFPA 801, Section 5.10.2, which requires control of a discharge for 30 minutes.
- The Maximum Possible Fire Loss (MPFL) documented in TWPC FHA Section 7.4.2.1 does not consider mission interruption costs (lost time). DOE Order 420.1B (5.3.1.1) suggests that facility assessment be performed to include impact of potential mission interruption. To that end DOE Guideline 420.1-3 states that mission interruption costs be included in determining the MPFL.
- DOE Guide 420.1-3 states that MPFL should be determined based on the damage potential MPFL as defined in DOE-STD-1066-99 and the DSA design basis fire scenario. The FHA determines the MPFL based on a fire in the hot cell (DSA DBA TRU FIRE-1) and states that the remote handling process train was chosen for analysis because the equipment repair replacement costs are highest in the process area. However, this DSA DBA also covers a glove box fire. Analysis T-CM-FW-C-FP-00, *Maximum Possible Fire Loss Estimates*, which determines the cleanup costs component of the MPFL for a PB second-floor fire, is far greater than the total MPFL for a PB hot cell fire as documented in the FHA. The FHA MPFL determination does not appear to consider the fire scenario that results in the maximum damage potential. Reassessment of the fire loss scenario is needed to ensure that it represents the MPFL consistent with the referenced analysis.

- The Telecommunications Center (TCC) includes the TWPC servers and is protected by a clean agent FSS. The TCC houses the servers, storage devices, switches, and security devices that comprise the Central Server Complex. The TCC is a modular structure with a reinforced concrete shell that is insulated on the interior. It is designed to withstand winds of Category 5 hurricane force and is equipped with a redundant 5-ton HVAC system. Backup electrical power is provided by a dedicated 40 kW diesel generator with auto-start capabilities. The Information Technology Contingency Plan (CM-A-BO-003, R0, 3-19-2013) includes a detailed evaluation of the probable threats for the TCC. All of this reflects the importance of the TCC building and the information technology infrastructure for continued TWPC operations. However the FHA does not fully assess the impacts to the facility operations that could result from a fire that impacts the TCC. The potential risk and impact of a fire associated with the adjacent diesel generator has not been evaluated.

Other inconsistencies exist in the FHA that should be addressed (see **OFI-WAI-09**):

- FHA Section 6.2.1.1, Fire Suppression, states that hydraulic calculations show that the current sprinkler system demand in the PB of 368 gpm on the third floor provides a flow pressure of 86.2 psig. However, the hydraulic calculation shows that the 86.2 psig pressure occurs at the base of the riser at the pressure gauge downstream of the check valve, not at the most remote heads on the third floor. The FHA should be clarified to state the 86.2 psig flow pressure occurs at the base of the riser.

5.3 Fire Prevention and Protection SSCs and Controls

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *A complete spectrum of fire prevention controls and procedures are in existence and have been implemented as required by applicable fire safety criteria. (DOE Order 420.1B, Site & Facility DSA)*

- *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. (DOE Order 420.1B, Site & Facility DSA)*

- *A process exists to assure that all fire prevention and protection features are reviewed and approved by a qualified fire protection engineer. (DOE Order 420.1B)*

Independent Oversight found that the TWPC facility includes a complete spectrum of installed fire suppression and detection capabilities and supporting procedures and testing to assure functionality with appropriate management by a qualified fire protection engineer. Although some engineering deficiencies were identified as findings or OFIs the inspection criteria were generally satisfied within the facility. Recognizing that the fire protection systems within the facility are dependent on infrastructure water supplies from outside the facility, Independent Oversight identified weaknesses in the ORNL water distribution system ITM and configuration management resulting in a finding in this report.

Infrastructure Water Supply

Independent Oversight reviewed the fire protection water supply for the TWPC site. The ORNL potable water system supplies fire protection water to the TWPC. Reliability and availability of the ORNL firewater supply is addressed via a documented agreement between ORNL and TWPC. The documented agreement includes the requirement for ORNL to notify the TWPC upon discovery of, or prior to, any conditions that may compromise the reliability or availability of the water supply.

The ORNL distribution system is a combination system used for potable, process, and fire protection needs. Water is supplied to ORNL by a supply main from a water treatment plant north of Y-12. This main supplies a 3 million gallon reservoir on Chestnut Ridge that flows through two water mains to the ORNL water distribution system. Water is also supplied to the ORNL grid by a water main from two 1.5 million gallon reservoirs on Haw Ridge. An emergency reserve is administratively maintained in these reservoirs for fire protection purposes. The two reservoirs on Haw Ridge serve the Melton Valley, and the TWPC. The grid infrastructure throughout the ORNL site includes numerous zone sectional valves to facilitate piping isolation for routine or emergency maintenance and to exhibit system control to service areas, as well as PIVs serving individual facilities. Pipe mains from the ORNL grid serve the High Flux Isotope Reactor (HFIR) and then continue on to TWPC, through two pipe mains, a 12 inch and 6 inch. These pipe mains are concrete, cast iron, or ductile iron material, with mechanical or caulked joints. Most portions of these lines are 40 to 50 years old.

Independent Oversight interviewed ORNL Utilities Department personnel regarding general water supply characteristics, operation, emergency operations, and ITM. The system physical description, operation, and ITM are described in the *ORNL Water Distribution System Description, Revision 0*, and dated March 20, 2008. An Emergency Operations Plan (*UT-T-MECH-068, Revision 2, 9-2011*) identifies potential emergency situations and requirements to alert users of impacts to the water supply. The system description document requires tailored compliance (a graded approach) to NFPA 24, *Installation of Private Fire Service Mains and Appurtenances*, and requires that the ORNL water distribution system mains and associated components be inspected, tested, and maintained in accordance with NFPA 25 to provide at least the same level of performance and protection as designed.

Independent Oversight identified a number of observations, based on review of available documentation and interviews with the Utilities Department, that place in question whether the water supply satisfies a classification as an HPR type system (see **Finding OREM-F-02**):

- Neither the ORNL FD nor the Utilities Department performs adequate ITM on infrastructure underground piping and sectional valves. The ORNL FD performs annual ITM on fire hydrants, PIVs, and FD connections. However NFPA 25, Section 13.3.3.1 requires that each sectional control valve shall be operated annually through its full range and returned to its normal position. This requirement is also consistent with AWWA Manual M31, Distribution Requirements for Fire Protection, and Manual M44, Distribution Valves ITM. When testing a non-indicating gate valve, such as an underground sectional valve, the number of turns needed to fully close and open the valve should be noted and compared to the number of turns needed to open and close as noted in the manufacturer's literature. Contrary to these requirements, it does not appear that either the FD or Utilities performs this ITM on underground sectional zone valves. It is important that these normally open sectional control valves can be closed if necessary to facilitate isolation of water branch mains for routine or emergency maintenance and to verify effective system control to service areas.
- The TWPC water supply pressure is susceptible to fluctuations based on activities at other facilities such as HFIR, which periodically requires a high process water demand (significantly higher than TWPC) and draws its water supply from the same source and supply main, upstream from TWPC. Although system pressure is routinely monitored and to date has not necessitated entering into an LCO, this vulnerability is important because of the limited available pressure margin at the hydraulically most limiting area at TWPC as depicted in the hydraulic calculation.
- A fire main ring does not currently exist for TWPC. Instead, a single 10-inch supply line is provided to the TWPC PB from the adjacent Melton Valley Storage Tanks (MVST) Area directly east of TWPC. This arrangement is contrary to DOE-STD-1066-99, which states that water distribution systems should be of the looped grid type providing two-way flow with sectional valving arranged to provide alternate water flow paths to any point in the system.
- ORNL Facilities Services does not have a proactive system of monitoring, testing, maintenance and

planned replacement. The existing infrastructure buried piping is largely cast iron, ductile iron, or steel. Buried aged pipe can, over time, undergo gradual degradation in the form of corrosion that can lead to reduction in effective cross-section and loss of mechanical strength. Accordingly, as the water distribution system ages, the number of pipe failures will increase with time. A proactive process of monitoring, testing, maintenance, and planned replacement is necessary to satisfy the Highly Protected Risk (HPR) classification. Based on interviews and document reviews, it appears that established priorities for repairing or replacing valves that are known to be non-functional are not being addressed in a timely manner. The ORNL Utilities Division maintains a list of deficient valves. This list revealed eleven valves that did not operate and seven valves that were known to be leaking. While emergency replacement of broken pipe sections is performed quickly once discovered, this situation appears to represent a de-facto practice of run to failure rather than an active process of monitoring and testing.

- Independent Oversight observed inconsistent information regarding pipe sizing, reservoir volumes, and the location and numbers of pipes and valves on various drawings used by Facilities Services and other organizations that depend on the water supply system. This inconsistency calls into question the adequacy of ORNL facility services' configuration control processes.

Fire Protection Engineered Design Features within TWPC

The TWPC DSA credits the PB wet pipe FSS as a safety significant (SS) control to prevent small fires from becoming large fires by limiting fire propagation. This FSS is an automatically actuated wet-pipe sprinkler system that is maintained as a SS SSC. The water that supplies the SS suppression system in the PB enters the building from a single feed 4-inch feed line through a backflow preventer that is housed in an enclosed hot box enclosure outside the PB. The FSS is in general compliance with NFPA-13 and has the appropriate discharge density, sufficient water supply, and appropriate sprinkler spatial layout to fulfill its safety function. System ITM inside the TWPC facility is in accordance with NFPA 25 and ensures the availability and reliability of the FSS. Surveillances of the firewater isolation valves verify that the water path to the sprinkler system is open. The sprinkler system design takes into account the pressure drop in the piping, fittings, and sprinklers. A failure mode for the sprinkler system is an inadequate supply pressure.

Based on review of FSS documentation and performance of a system walk down, Independent Oversight identified a number of deficiencies (see **Finding WAI-F-03**):

- *T-CM-FW-P-AD-035, Rev 3, Design Features Hydraulic Bounding Calculation*, results in a minimal pressure margin of 2.833 psi between supply curve and system requirements. Although satisfying the NFPA requirements, this is less than the 10 percent margin expected by DOE-STD-1066-99. Reduction in margin may be a critical concern because of other facility supply diversions (e.g., at HFIR). Additionally, some sections of piping are undersized and thus exhibit high velocities (24 ft/sec) that result in higher pressure losses. It should be noted that a minimal replacement of approximately 10 feet of 2 inch pipe with new 2 ½ inch pipe could provide the required margin. Additionally, it appears that the hose stream allowance of 350 GPM used in the calculation could be reduced to 250 GPM helping to alleviate the margin shortfall.
- The PB third-floor design basis bounding hydraulic calculation uses hydrant flow test data as an input that is not verifiable based on the flow test data reviewed by Independent Oversight. Flow test data should be attached to the calculation, along with a piping node diagram used to develop the analysis.
- The electric heater in the backflow preventer hot box enclosure is provided with non-safety electric power. The heater is required for freeze protection of the 4-inch backflow preventer and piping. DOE-STD-3009 section 4.4 (and DOE-STD-1021 section 2.3 (a) (b) (c)) expect that any SSC needed to ensure the availability of a preventive or mitigative features of safety class or Safety Significant S SSC shall be likewise classified. While surveillance rounds currently include verification of

temperatures, in the absence of a SS power supply for the freeze protection heater, TWPC should verify by documented calculation and analysis that this surveillance frequency is sufficient to protect the system operation and assure the commitment is identified in the DSA and TSRs as a SAC.

- Based on a facility walk down and discussion with the FPE, Independent Oversight concluded that areas of the PB have inadequate curbing or controlled drainage holdup to contain potentially contaminated water discharged from the suppression system. This inadequacy could expose emergency responders and emergency equipment to contaminated water and is contrary to the intention of requirements found in NFPA 801 section 5.10. While this issue was self-identified by the contractor, at the time of the review, corrective actions and/or design features had not yet been implemented or installed.

Configuration Management

Independent Oversight's review of configuration management (CM) included the CM process required by DOE Order 420.1B, *Facility Safety*, and also included review of the USQ screening process required by 10 CFR 830 Subpart B, which ensures control of the analyzed and documented safety basis of a nuclear facility. The team reviewed various facility configuration products, such as drawings, calculations, and modification change packages, which were in turn evaluated against configuration control procedures to ensure conformance. The facility CM procedures were also reviewed to ensure compliance with DOE requirements and guidelines.

The CM program at TWPC is defined in the program document *T-CM-FW-A-AD-011, Revision 1 Configuration Management Program,* which provides a programmatic roadmap of the change control process, related to work control and change control. An integral part of the program is control of the processes for the preparation, review, and approval of TWPC documents. Procedure CM-P-AD-061, Revision 10, *Document Preparation, Review, and Approval*, provides for an interdisciplinary review and input process for the preparation of all documents and changes. This process ensures that annual changes to the FHA and DSA remain consistent and that the facility configuration is maintained. Review of a design modification package, drawings, calculations, and ITM documentation confirmed that the CM program process is followed. Although the CM program is formal and comprehensive, Independent Oversight identified a number of observations that should be addressed (see **OFI-WAI-09**):

- The SS boundaries of the FSS are not defined either on the system piping and instrumentation diagrams (P&IDs) or by physical identification plates. System boundaries are required to be located at an isolatable device. Facility personnel were uncertain about the precise location of the safety system boundary (at flanges before or after the isolation valve). This uncertainty could result in confusion in the classification of system components, including the isolation valves.
- Drawings depicting the underground water supply system to TWPC located in the MVST Area located just east of TWPC are inconsistent and show conflicting information on piping sizes.
- The Independent Oversight team evaluated the response actions resulting from a fire in the TWPC glove box and found that the AHA still referenced fire equipment, including pull stations, that had been removed as part of a fire suppression modification that replaced the pre-action system with a wet pipe sprinkler system (see **OFI-WAI-03**).

5.4 FHA/DSA Integration

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *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.

- *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.*

In accordance with DOE Order 420.1B, 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. The FHA for TWPC, CM-R-AD-002, Revision 18, was reviewed for consistency with the facility's DSA to determine the adequacy of the fire protection selected control set for the identified hazards. The determination of MPFL was also reviewed. In determining the value of the MPFL, which is used to assess the need for fire protection systems, an expected basic assumption should be that there is no automatic or manual fire suppression. The FHA appropriately assumes the failure of both automatic fire suppression and manual fire-fighting efforts. The FHA documents the MPFL based on a fire event in the hot cell. The DBA analysis includes a glove box fire, but the FHA MPFL determination does not appear to consider whether the glove box fire would have more damage potential. Clarification is necessary, as discussed in Section 5.2 of this report (see **OFI-WAI-08**).

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. Where fire areas are defined, they are bounded by fire rated construction with openings protected by equivalently rated fire doors and penetration seals. Where penetrations are made in the structure, fire retardant material approved by Underwriters Laboratories (UL) is installed to preserve the fire resistance rating of the structure consistent with the DSA. The facility DSA 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. Independent Oversight determined that for TWPC, the hazards identified in the FHA and the associated controls are consistent with those evaluated in the DSA.

5.5 TSR Surveillance and Testing

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *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.*

- *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.*

- *The acceptance criteria from the surveillance tests used to confirm system operability are consistent with the safety basis.*

- *Instrumentation and test equipment for the system are calibrated and maintained.*

Although certain ITM issues were apparent with the infrastructure water system provided by ORNL to the TWPC facility (see **Finding OREM-F-02**), within the operations performed by WAI at TWPC, a document review showed that TSR safety system surveillance testing generally confirms the adequacy of safety SSC credited controls performance requirements. Surveillance and testing of the FSS demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria. All 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 standard operating limits, and the acceptance criteria from the surveillance tests used to confirm system operability are consistent with the safety basis. At TWPC, the required NFPA ITM is integrated into the facility TSR surveillance testing procedures. Specifically, these include the ITM requirements of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* and NFPA 72, *National Fire Alarm Code*. Independent Oversight observed performance of the surveillance test procedures and confirmed that the safety basis attributes of the testing were not adversely influenced by preconditioning in order to accomplish the NFPA-required ITM.

5.6 Fire Protection Self-Assessment Program

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *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 420.1B)*

- *Proper controls are incorporated to prioritize and monitor the status of the fire protection assessments and associated findings until final resolution.*

Independent Oversight reviews of previous TWPC and site office assessment reports and observation of the site office performance of the triennial review indicate that the inspection criteria were generally satisfied. Opportunities for Improvement could be realized by enhancing the scope and qualitative aspects of the assessment beyond the immediate facility and verification of compliance. Additionally expanded scope could assist in long term follow-up on infrastructure issues identified by previous assessments.

TWPC

Independent Oversight reviewed documentation of a selection of eight management assessments (MAs) performed by TWPC between 2010 and 2013. Of these, one was a crosswalk of the written FPP's conformance to DOE Order 420.1 B, one was a verification of a required review and update of the FHA. Most documents were verifications or audits of the performance of TSR surveillances or ITM of various program or system components. All were prepared by the facility FPE and signed by the "Responsible Functional Manager," who would typically be the Operations Manager, Maintenance Manager, or Engineering Manager. With few exceptions, the MAs noted no deficiencies or necessary corrective actions. However, in one instance, lack of attention to detail by outside contractor test personnel resulted in deficiencies in testing of fire detection equipment. The TWPC FPE identified this deficiency and required a repeat of the contractor services with other personnel.

It was noted that WAI operations at TWPC place significant reliance on the FPE. He serves as, the credited suppression system CSE, lead reviewer of designs for the FP systems as part of the IDR process, and oversees the specification, modification, and testing of the detection and alarm systems. He serves as the FPP manager; approves impairments and compensatory measures; writes or approves most of the FPP

documents, ranging from the FHA to the implementing surveillance and test procedures; sometimes performs functionality tests; reviews and approves ITM and TSR test data; and serves as the contractors AHJ. Additionally he prepares the MAs for the systems he oversees. This individual has cultivated a network of colleagues; maintains full awareness of emerging fire protection engineering issues, standards, and regulations; and has demonstrated competence in performing his assigned duties. However, considering the organization's significant reliance on one individual, it is essential that the site office oversight processes provide adequate independence and detailed critical review.

OREM

Independent Oversight reviewed documentation of Site Office (OREM or precursor organizations) oversight assessments of TWPC, including the 2007 triennial environment, safety, and health and quality assurance (QA) program assessment that incorporated the elements of a triennial FPP assessment; the 2010 integrated safety management system (ISMS) assessment that incorporated the elements of a triennial FPP assessment; and the 2012 SSO assessment of the FSS.

The 2007 assessment noted three findings and three observations related to the FPP. Two of the findings and one of the observations were closed by the time the report was finalized. The remaining issues were principally related to lapses or insufficiencies in contracts and memoranda of understanding for interaction with outside support organizations. These were addressed with renewals or internal compensatory actions in a timely manner. The 2010 assessment appeared to be a comprehensive review of the significant elements of the program internal to TWPC. No findings were identified, and the report indicated that all review criteria had been met. The SSO review of the PB FSS was relatively limited in scope. It included a walk down of the existing system, observation of performance and reviews of the ITM, preventive maintenance (PvM), and TSR surveillance data internal to the TWPC facility and organization. The report indicated no issues of degradation or deficiency were identified.

Independent Oversight observed there was relatively little documentation in the 2010 assessment report of inquiries into the external issues identified in the 2007 facility triennial report. The 2010 assessment report did not specifically address issues with the external infrastructure interfaces with TWPC's fire protection suppression or alarm systems such as the ORNL provided water supply. However, in 2010, the SME/SSO prepared a separate white paper report on the status of the ORNL water distribution system, documenting the configuration of the distribution system, daily water usage, and adequacy of the system to support existing facilities. The report described a variety of facility water infrastructure modifications that had been undertaken in support of new facility construction at ORNL. While it was determined that the infrastructure was sufficient to support many of the existing facilities, in six facilities the adequacy was listed as "unknown." The report also documented notable cases of failures of major water mains. The author noted that the white paper review was relatively limited in scope, but provided a total of six observations that "DOE should consider directing the contractor to":

- Perform an evaluation of the total water demand at significant points throughout the water distribution system to determine whether the water supply is adequate.
- Replace existing pipe mains.
- Install a pressure monitoring capability on the water distribution system.
- Install redundant feeds to address single feeds.
- Modify water system testing protocols (i.e., ITM).
- Contract a civil engineering firm to perform a more detailed analysis.

The follow up actions recommended in this white paper are outside of the scope of this Independent Oversight review of the TWPC facility, and cross over organizational lines of responsibility. As such it is

unclear to the Independent Oversight team what follow up actions have been taken based on this white paper. Some of the issues identified in this white paper have similarities to the issues that resulted in Finding **OREM-F-02** of this report. The sections of the TWPC contract regarding government furnished supplies, facilities, or services do not appear to include the level of detailed specifications for quantity, quality, reliability, or timeliness of services typically necessary to define the expectations or requirements (see **OFI-OREM-11**). Further review may be necessary.

Since the reorganization, OREM relies on technical support from the Oak Ridge Service Center. The OREM 2013 triennial assessment of the TWPC FPP was conducted by an SSO/SME assigned by the service center, who is the same individual involved with prior assessments at TWPC and author of the white paper on the status of the ORNL water distribution system. Independent Oversight observed interviews conducted in support of the 2013 triennial assessment, which was conducted in accordance with a written plan, *Assessment of the Transuranic Waste Processing Center Fire Protection Program*, dated July 2013. As in previous reviews, the scope was defined in relation to FPP requirements as identified in Occupational Safety and Health Administration regulations; DOE regulations, guidance, and standards; and NFPA codes and standards. The plan included verification of: a documented program, an up-to-date FHA, implementation of procedures and systems, qualifications and training, emergency services capabilities, and the facility's application of a lessons learned and feedback and improvement process applicable to the fire safety community. The plan was supported by a comprehensive set of LOIs, including some covering issues related to external emergency response identified in the 2007 review, that were not directly controlled only by WAI personnel or facilities. Independent Oversight found that the service center fire protection SSO/SME's interviews with the TWPC FPE comprehensively covered the LOIs, and the open and positive exchanges between the SSO/SME and TWPC FPE indicated a good working relationship between knowledgeable professionals. It should be noted that many of these LOIs could be satisfied with a simple yes or no answer, but required significant additional document review or assessment to verify. As such, additional document review and observations were necessary to verify the responses; the SSO/SME could not complete this verification during the time available while Independent Oversight was observing. The final report prepared by the support center SSO/SME appears to have adequately addressed this verification and concluded that there were no findings or deficiencies. The report did identify five issues where parts of the Fire Suppression System were not in verbatim compliances with NFPA 13 or 24. These included the following: some underground valves were not "post indicating", some valves lacked indicating supervisory switches, sprinkler heads in some areas were obstructed and sprinkler piping was supported in some areas by the same hardware supporting lighting systems. In each of these cases compensatory measures were in place to assure appropriate functionality, such as placing locks on valves in the open positions, increasing the density of sprinkler heads to compensate for obstructed heads, or strengthening the support hardware to handle the excess load. In each case, justifications and compensatory measures for the non-compliance were discussed and deemed to be acceptable by the SSO/SME. Some of these issues identified by the SSO/SME were also noted by the Independent Oversight team and the compensatory actions are generally recognized as sufficient. The report also noted a positive observation in that the TWPC had proactively addressed augmentation of emergency medical services as compensation for response time concerns for the ORNL FD first response for medical issues.

Additional OFIs and Findings were identified by the Independent Oversight team based on a broader set of LOIs and wider scope of this review. Independent Oversight observed that most of the LOIs used by the SSO/SME for the triennial review were compliance-driven and concentrated on the existing systems or processes within the TWPC facility. They were not generally directed toward a qualitative assessment of the technical adequacy or effectiveness of a given system or process. In general, they did not address underlying assumptions of the FHA or DSA. They did not comprehensively address infrastructure or external support issues. The effectiveness of future reviews may be enhanced by augmenting the LOIs with additional qualitative technical performance measures, verification of supporting design or hazard

assessment calculations or assumptions, or inquiries into the condition of the supporting infrastructure, such as a follow-up on the observations and recommendations from the 2010 white paper (see **OFI-OREM-012**).

6.0 CONCLUSIONS

Overall, the WAI TWPC FPP processes reviewed are well-defined and implemented. Facility personnel responsible for the implementation of the FPP, including the FPE and the Operations Manager, understand the program requirements and were observed to be 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 FHA and the DSA, both of which were observed to be updated and integrated. The facility has been proactive in reducing the risk associated with certain ignition controls, including designating smoking areas and mandating standoff distances for combustibles and limitations for flammable compressed gas. However, implementation of the combustible control program currently managed through housekeeping practices would benefit from improved formality. Additionally some specific issues related to ignitions source controls during refueling operations need to be addressed in procedures.

Although most aspects of the WAI TWPC FPP are effective, some FPP procedures and standards that flow down and implement FPP requirements need to be strengthened. Increased management attention is warranted to improve the implementation of some FPP program elements, such as dispensing of fuels and clearly established boundaries for SS equipment, as well as with cross organizational coordination for pre-fire plans and ITM for isolation valves. Of particular importance were the noted vulnerabilities in the water supply distribution system related to inadequate implementation of ITM requirements and the resulting concern about the reliability of the ORNL supply system. Increased emphasis on ITM for supporting groups, including site Utilities and the FD, should be addressed. Due to cross organizational responsibilities many of these issues may require review and modification of existing contracts and MOUs governing the quality, quantity, timeliness, and reliability of provided services and materials.

7.0 FINDINGS

Findings are significant deficiencies or safety issues that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. Findings may identify aspects of a program that do not meet the intent of DOE policy and requirements. In some of these findings, the connection between the deficiency, the responsibility for corrective action, and the organizational authority to perform the necessary corrective actions are clearly linked. However some of these issues cross organizational lines. Coordination and clarification of Roles, Responsibilities, Authorities and Accountabilities within contracts and MOUs may be required to address the deficiencies.

Finding OREM-F-01: Contrary to the requirements of the Pre-Fire Plan Procedure, LPD-FD-ADM-020104, the TWPC PB pre-fire plan, prepared by the ORNL FD, does not contain all the specified information necessary to support the safe and efficient response of the ORNL FD. Specifically, the locations of fire walls, fire alarm panels, fire detection systems, and locations of flammable liquid storage cabinets are absent from the TWPC PB pre-fire plan.

Finding OREM-F-02: Contrary to NFPA 25, AWWA Manual M44, and DOE-STD-1066-99 requirements, and commitments in the *ORNL Water Distribution System Description, Revision 0*, the water supply infrastructure to TWPC from ORNL has ITM deficiencies, inherent design deficiencies,

and errors and inconsistencies in system drawings that indicate failures in management of configuration control.

Finding WAI-F-03: Various attributes of the TWPC FSS engineered design features are deficient with respect to conformance to contract requirements as specified in list A. Specifically these include insufficient FSS pressure margin at the most remote sprinkler head in conformance to DOE-STD-1066-99 section 7.2, and non-safety power for the hot box enclosure freeze protection in conformance to DOE STD-3009-94 section 4.4, or a specified SAC necessary to assure the SS fire suppression system can perform its designated function during freeze conditions.

8.0 OPPORTUNITIES FOR IMPROVEMENT

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

OFI-WAI-01: WAI should consider formalizing the compensatory measures for medical response time (AED training etc.) as equivalencies to the NFPA 1710.

OFI-WAI-02: TWPC procedures do not clearly and consistently address ignition source controls for dispensing gasoline to vehicles used on site, including such risks as bonding, grounding, and standoff distances for vehicles and other potential ignition sources. WAI should assure ignition source controls for vehicle refueling are consistently defined in the fire prevention procedures.

OFI-WAI-03: Verify revision of the TWPC emergency light test procedure and communicate to those responsible for implementing the procedure to ensure that the testing is consistently performed with the expected monthly frequency.

OFI-WAI-04: Revise the TWPC AHA and associated training for the glove box operators to ensure appropriate response actions during emergency events, such as a glove box fire.

OFI-WAI-05: Consider developing a formal method to ensure that the FD integrates TWPC into the BNA process. Information that could impact the BNA analysis, such as revisions to the TWPC FHA, should be communicated to the FD. Similarly, communication of conditions that impact the pre-fire plans should be improved. Ensure communications expectations and processes are adequately addressed in the MOUs and contracts.

OFI-WAI-06: Ensure appropriate documentation and attribution of authorization for impairments and compensatory measures at TWPC.

OFI-WAI-07: Consider clarifying expectations for transient fire loading limitations and providing training on those limitations as part of the “housekeeping” observations process.

OFI-WAI-08: The TWPC FHA does not fully conform to DOE Guide 420.1-3 intended to be the safe harbor method to demonstrate compliance with DOE Order 420.1 B. Various deficiencies, omissions and inconsistent with supporting documentation or consensus standards are identified in the text of this report. These should be addressed in the next revision of the FHA

OFI-WAI-09: FHA Section 6.2.1.1, Fire Suppression. The FHA should be clarified to state the 86.2 psig flow pressure occurs at the base of the riser.

OFI-WAI-10: Consider revising the TWPC FSS system P&IDs to ensure that they accurately reflect current as-built conditions and identify appropriate safety system boundary locations.

OFI-OREM-11: OREM with technical support from WAI should consider reviewing and if needed modifying contracts and MOUs to improve specification of requirements for government supplied materials and services. These should include aspects such as quantity, quality, timeliness, and reliability as well as conformance to any appropriate standards, codes, or regulations. Specifically, the DOE should consider follow-up on the issues and recommendations in the 2010 white paper on status of the water supply infrastructure.

OFI-OREM-012: OREM should consider augmenting the compliance based LOIs with additional qualitative technical performance measures including review of supporting analysis and assumptions, and supporting system infrastructure inputs, resulting in enhanced effectiveness of the review process and improved performance and reliability of the programs or systems being assessed.

9.0 ITEMS FOR FOLLOW-UP

Through the site lead program, Independent Oversight will continue to follow up periodically on actions taken to address the findings identified in this report.

Additional fire protection program reviews shall be performed at other Oak Ridge Reservation facilities to assess potential extent of condition issues raised by this report.

Appendix A
Supplemental Information

Dates of Review

Onsite Review: May 20-23, 2013
July 15-19, 2013

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William A. Eckroade
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Independent Oversight Site Lead

Timothy Mengers

Independent Oversight Reviewers

Timothy Mengers – Lead
Jeff Robinson
Joseph Panchison

Appendix B
Documents Reviewed and Interviews

Documents Reviewed:

TRU Waste Processing Center, Fire Protection Program, CM-A-FP-002, R6, 7-16-2012
TRU Waste Processing Center, Fire Impairment procedure, UT-P-OP-519, R1, 09-15-2011
TRU Waste Processing Center, Fire Prevention procedure, CM-P-FP-001, R17, 11-19-2012
Fuel Receipt procedure, CH-UET-IP-037, RO, 7-01-2012
Fire Pre-Plan procedure, LPD-FD-ADM-020104, R7, 8-13-2012
Oak Ridge National Laboratory, Fire Department Baseline Needs Assessment, 8-17-2012
Oak Ridge National Laboratory Fire Department Pre-Fire Plan Building 7880, 9-21-2012
TRU Waste Processing Center, Emergency Events, CM-P-EM-100, R7, 07-01-2012
TRU Waste Processing Center, Equivalency Request: Non-Sprinklered Areas in TRU Waste Process Building 7880, CM-X-FP-002, R0, 9-24-2007
TRU Waste Processing Center, VESDA Fire Detection System, UT-REF-OP-518, R0, 4-3-2013
TRU Waste Processing Center, Compressed Gases, CM-P-IS-005, R6, 09-19-2011
TRU Waste Processing Center, Operations Training Program Description, Attachment B-19: TWPC Operations OJT Guide Process CH Waste in Glove Box, CM-A-OP-005, R2
TRU Waste Processing Center, Activity Hazard Analysis, CM-P-IS-007, R8, Attachment B, Glove Box Operations, 6-4-2013
TRU Waste Processing Center, Fire Suppression System Maintenance, CM-UET-MT-512, R1, 6-13-2013
TRU Waste Processing Center - Incident Report IR-2013-009, Activation of Fire Suppression System
TRU Waste Processing Center, Management Assessment Record, MA-2011-046
TRU Waste Processing Center, Management Assessment Record, MA-2011-148
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