Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

02-ESD-0051

APR 25 2002

Mr. E. K. Thomson, President
Fluor Hanford, Inc.
Richland, Washington 99352

Dear Mr. Thomson:

CONTRACT NO. DE-AC06-96RL13200 – REPORT ON THE DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB) RECOMMENDATION 2000-2 PHASE II ASSESSMENT OF THE FIRE PROTECTION SYSTEMS AT THE CENTRAL WASTE COMPLEX (CWC)

During February 2002, the RL Engineering Support Division performed a DNFSB Recommendation 2000-2 Phase II Assessment of the Fire Protection Systems at the CWC. The purpose of the assessment was to determine the functionality, reliability, and operation of the fixed fire protection systems and their support systems contained within the CWC waste storage facilities.

To assist in the conduct of this assessment, RL developed an implementation plan to perform the CWC assessment and formed a multidisciplinary assessment team of experts from the Hanford site with knowledge and experience in fire protection engineering, nuclear safety, testing and maintenance, conduct of operations, configuration management, and assessment process methodology. Executing the implementation plan, the assessment team developed a draft assessment report, that underwent a factual accuracy review by CWC and fire department personnel. Following the factual accuracy review, the assessment team dispositioned all comments, and where appropriate, incorporated changes to the report. The factual accuracy comments, the assessment report and the team comment dispositions also underwent an independent third party technical review. The attached final assessment report is the result of these efforts.

Overall the assessment concluded that the Configuration Management Criteria and Review Approach Document (CRAD) was not met due to significant deficiencies with the fire sprinkler systems in a number of the CWC facility buildings. In addition, the Safety Function Definition CRAD was not met because there were issues with the interim safety basis accident analysis, which resulted in a positive Unreviewed Safety Question determination.

Following the assessment immediate actions were taken by the facility to address these deficiencies, including the additional administrative controls, enhancement of access control and work release processes, and a management review of each waste handling activity to limit ignition sources and prevent increase of material at risk. Facility Management also committed to preparation of a Justification for Continued Operations (JCO) that will be submitted to DOE Richland for review and approval. Additional mitigative actions are being evaluated by the facility including a revised fire hazard analysis and a rule compliant Documented Safety Analysis by April 2003.

Please provide a written response to each identified issue in the assessment report to Shirley Olinger, Assistant Manager for Safety and Engineering, within 45 days from the date of this letter, and a copy to Lee J. Voigt, ATLII, for making RL entries in the Deficiency Tracking System. No formal response is required for the observations found in the assessment report.

If you have any questions you may call Craig Christenson, Engineering Support Division, on (509) 376-5367.

Sincerely,

Michael H Schlender

Michael H. Schlender, Deputy Manager
for Site Transition

ESD: CPC
Attachment

cc w/attach:
D. D. Greenwell, FH
S. L. Johnson, EM-5
L. J. Olguin, FH
M. T. Sautman, DNFSB
J. A. Van Vliet, FH
M. J. Weis, EM-40

Attachment

Report on the DNFSB Recommendation 2000-2 Phase II Assessment of the Fire Protection Systems at the Central Waste Complex

Department of Energy

Richland Operations Office

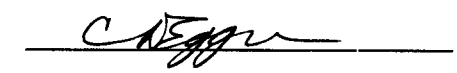
March 2002

ESD-PH2-CWC-02-001

Team Members Approval

I, by signature here, acknowledge that I concur with the contents and conclusions of this report.

C. D. Eggen
Fluor Federal Services



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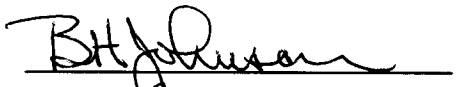
B. H. Johnson
Fluor Federal Services



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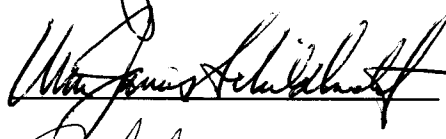
Fluor Hanford, Inc.



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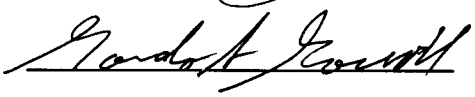
L. C. Lansing
Fluor Hanford, Inc.

Date: 4/5/02

G. A. Gossell
Assistant Team Leader
Enercon



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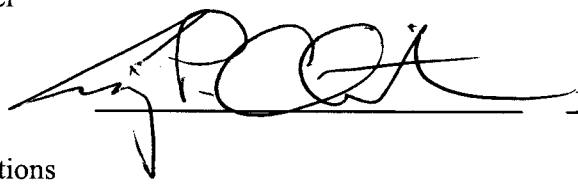
C. P. Christenson
Team Leader
DOE Richland Operations
Office



Date: 4/4/02

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ACRONYMS

CRAD	Criteria and Review Approach Document
CWC	Central Waste Complex
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
FACP	Fire Alarm Control Panel
FFS	Fluor Federal Services
FSM	Fire System Maintenance
FST&M	Fire System Testing and Maintenance
FH	Fluor Hanford
FHA	Fire Hazard Analysis
FM	Factory Mutual Research Corporation
GPM	Gallons per Minute
HFD	Hanford Fire Department
HNF	Hanford
ISB	Interim Safety Basis
M&TE	Measuring and Test Equipment
NFPA	National Fire Protection Association
NICET	National Institute for Certification in Engineering Technology
OH	Ordinary Hazard
PSI	Pounds per Square Inch
RFAR	Radio Fire Alarm Repeater
RPBP	Reduce Pressure Backflow Preventer
RL	Richland Operations Office
SNM	Special Nuclear Material
SSC	Structures, Systems, and Components
SWSD	Solid Waste Storage and Disposal
TRU	Transuranic Waste
UL	Underwriters Laboratories
VSS	Vital Safety System
WMP	Waste Management Project

EXECUTIVE SUMMARY

This section provides a summary of the Assessment Team's conclusions concerning the functionality, reliability, and operation of the fixed fire protection systems and their support systems contained within the Hanford Central Waste Complex (CWC) waste storage facilities as required by *Implementation Plan for the DNFSB Recommendation 2000-2 Phase II Assessment of the Fire Protection Systems at the Central Waste Complex*. The overall results of this assessment are presented in the *Assessment Results* section of this report, and the detailed results are presented in the *Detailed Results* section. A listing of the overall issues can be found in *Issues and Observations* report section.

The Assessment Team performed detail and critical reviews in all areas addressed within the Assessment Implementation Plan to address the following fire protection and support systems at CWC:

- Fire Protection Alarm and Detection Systems (VSS)
- Fire Protection Suppression Systems, including sprinklers (VSS)
- Electrical Power Distribution to Fire Protection Systems (Ancillary System)
- Water Supply System providing water to Fire Protection System (Ancillary System)

At CWC, there are fire protection systems in the 2401W building, 2402 Series (12 buildings), 2403 Series (4 buildings) and 2404 Series (3 buildings) structures. Recognizing that each of the fire protection systems in each series CWC building is nearly identical in design and operation, the assessment team initially choose one building in each of the 2402, 2403 and 2404 series to review the VSS in detail.

Following the criteria review assessment document process contained in Assessment Implementation Plan, the Assessment Team was initially divided up into four assessment topical areas, Safety Function Definition, Configuration Management, System Surveillance and Testing, and System Maintenance. For the ease and facilitation of this team assessment, the objectives and criteria contained in the implementation plan for the two similar Criteria and Review Approach Document (CRADs) for the system surveillance and testing and system maintenance were combined into a single set of criteria called "System Maintenance, Surveillance and Testing".

The Assessment Team determined that there were a number of shortcomings related to the fire protection systems in the CWC Facilities. Overall the Team concluded that the Configuration Management and Safety Function Definition CRADs were not met due to some serious fire sprinkler design related deficiencies and the lack of controls in protecting the role of the fire protection systems in the authorization basis document. The System Maintenance, Surveillance and Testing Definition CRAD was satisfied.

The Assessment Team determined that sprinkler design deficiencies were limited to the fire sprinkler systems in the 2402 and 2403 series buildings. These systems were not designed to protect the commodities of materials in these drums and the storage height of these drums in these facilities in accordance with NFPA standards. At the CWC facilities, the Assessment

Team observed storage in these facilities consisting of drum storage on pallets, three pallets high. The drums contain various combustible and non-combustible waste materials and they are classified as a Class IV commodity, as noted in the safety bases document, and as determined by container content when compared to the NFPA sprinkler standards. Since a fire involving the materials stored on three pallets high would be more hydraulically challenging than the installed sprinklers could deliver, a fire in the 2402 and 2403 series buildings could grow in an uncontrolled manner and could lead to failure and collapse of the facilities structural steel.

The Assessment Team concluded that the design of the fire sprinklers systems in the 2404 series buildings considered the high piled drum storage as characterized by the larger size overhead sprinkler piping. These systems were designed to control a fire involving the three tier palletized drums and a water supply test that was conducted for this assessment demonstrated that the water supply delivery system is capable of supplying the quantity and pressure of water necessary to control such fire.

The facility authorization basis was reviewed to determine the role of the fire protection systems. The CWC authorization basis analyzed a truck impact and fire scenario assuming a 26-gallon diesel fuel fire. While not assumed to be functional in the truck impact fire scenario, the fire sprinkler system reliability was credited in the facilities interim safety basis (ISB) in determining the probability of an uncontrolled fire. Significant degradation of the fire suppression system could result in an increase of the probability of an uncontrolled fire, hence increasing the risk beyond that authorized in the safety evaluation report. The conditions, assumptions, requirements, and performance criteria, under which taking a probability reduction for an uncontrolled fire is appropriate, are not presented within the ISB, nor does the ISB reflect the limitations of the supporting fire hazard analysis.

In addition, the Assessment Team observed facility conditions (i.e., quantity of fuel available, type of fuel available, slope of the floor in the 2403 and 2404 series buildings, or potential for structural damage from the fire) that do not appear to be consistent with the assumptions contained in the ISB accident analysis, limitations of the supporting FHA that are not reflected in the ISB, and the lack of coordination of the fire hazard analysis with the ISB that could affect how fire systems are operated at the facility level.

The Assessment Team identified these deficiencies to the CWC Facility Management on February 7, 2002 and the Solid Waste Storage and Disposal (SWSD) Management reported these issues as an off-normal occurrence on February 8, 2002 (RL—PHMC-SOLIDWASTE-2002-0002) due to a Potential Inadequacy in the Safety Analysis. Three unreviewed safety question (USQ) evaluations were performed resulting in a positive USQ determination and the occurrence report was upgraded to an unusual occurrence. SWSD Management issued a standing order limiting the amount of liquid fuel to 26 gallons or less within the CWC. In addition, SWSD Management took immediate actions to enhance access control and work release processes, as well as implemented a management review of each waste handling activities to limit ignition sources and prevent increase of material at risk. Management also committed to preparation of a Justification for Continued Operations (JCO) that will be submitted to DOE Richland for review and approval. Additional mitigative actions are being evaluated by SWSD. SWSD also plans to

revised the CWC fire hazard analysis and complete a rule compliant Documented Safety Analysis by April 2003.

These immediate actions to these major identified issues should allow for the continued operation of these facilities within the risks already accepted by the Department of Energy.

The Assessment Team also surfaced other less significant issues affecting the functionality, reliability, and operation of the fixed fire protection systems and their support systems within the CWC facilities. The water supply to the fire sprinkler systems was determined to be looped, gridded, provided with two supplies as required by DOE and a review determined that the underground piping has not been subject to major underground main breaks or significant deterioration. However, the water supply for the CWC complex may have reduced reliability as both supply main feeds are located in the same trench (2-feet apart) and cross over each other. The rupture of one main feed may effect the other main feed and it is possible that both lines would out of service at the same time, rendering all of the fire sprinkler systems at CWC inoperable.

The Assessment Team noted various sprinkler problems with incorrect sway bracing in the 2402 Series Buildings, a lack of piping obstruction investigation not being conducted in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*, sway bracing not connected to structure in West end of 2404WB, and drawings for 2404 series facilities that had incorrect information on the drawings.

The Assessment Team confirmed that inspection, testing, and maintenance of the fire protection systems is consistent with National Fire Protection Association (NFPA) Standards and DOE expectations and on site fire department support personnel are qualified to perform testing and maintenance work on these systems.

Fire alarm systems in CWC facilities are connected to sprinkler systems as required and they are capable of transmitting alarms and supervisory signals to the fire department. There are also a number of features, which keep the fire alarm systems reliable as well. The Hanford Fire Department remotely monitors building fire alarm system signals and should primary power fail the systems have the appropriate battery backup. If both primary and battery backup fail the radio fire alarm transmitted will cease to perform it's daily required test and the fire department will be sent to a CWC facility on site to investigate. Therefore, alarm and supervisory signals are maintained for the CWC facilities and they are reliable and capable of transmitting alarms to the on site fire department.

And finally, the Assessment Team observed a number of work package evolutions involving fire system testing and maintenance on CWC fire protection and support equipment. The Team concluded that CWC Operations understands their obligations to maintaining the Fire Protection Systems. However, CWC "operational control" of "outside" resources or service groups doing work within their facility areas or buildings should be improved. The facility can improve on the overall control of outside workers by assuring that work is formally released and controlled, to include raising the level of attention and participation by their own Operators during the conduct of these work evolutions.

There were four observations identified during this assessment that are considered noteworthy conditions or commendable practices that require no corrective action. However, there were eleven issues identified by this assessment that have been documented as non-compliant with an established requirement, quality problem, or recommendation/opportunity for process improvement that require management attention and corrective action.

To address the issues identified by this assessment, CWC Management implemented a number of immediate actions and they committed to the preparation of a Justification for Continued Operations. Additional issues will be addressed by a revised CWC fire hazard analysis and a new rule compliant Documented Safety Analysis scheduled for completion by April 2003. SWSD is also evaluating additional mitigative actions and this report will be forwarded to the contractor for the development of a written corrective action plan that will be tracked by the site's Deficiency Tracking System.

INTRODUCTION

On March 8, 2000, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2000-2, *Configuration Management, Vital Safety Systems,* concerning the degrading conditions of vital safety systems (VSS). VSS was addressed in the October 31, 2000 DOE Implementation Plan for DNFSB 2000-2 and defined as safety-class systems, safety-significant systems, and systems that perform an important defense in depth safety function. Specifically, the Recommendation identified possible degradation in VSS and recommended that the Department of Energy (DOE) take action to assess the condition of its VSS, develop programs for contractor and federal technical personnel that strengthen safety system expertise, and improve self-assessment processes that evaluate the condition of VSS.

In October 2000, the DOE issued the approved *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2000-2.* After the initial Phase I reviews of "facilities of interest" this Implementation Plan calls for Phase II assessments of VSS of facilities as designated by the field office. DOE Richland Operations Office (RL) selected the Central Wastes Complex (CWC) fire protection systems and supporting systems in their project plan as one of their stand-alone Phase II assessments.

To assist in the conduct of this assessment, DOE Richland Operations Office developed an implementation plan on January 24, 2002 and formed a multidisciplinary team of experts from the Hanford site with knowledge and experience in fire protection engineering, nuclear safety, testing and maintenance, conduct of operations, configuration management, and assessment process methodology.

The implementation plan was executed following an operational readiness type of approach and the process utilized a systematic execution of the Criteria and Review Approach documents (CRADs) included in the implementation plan. Team members were assigned individual assessment areas based on their area of expertise to address the four vital safety system areas listed in the Executive Summary section of this report. As many of the CWC facilities and fire protection systems are exactly similar, the team was not required to review every individual vital safety system in each CWC structure. The team utilized a graded approach in the course of this assessment to gain a representative sample of each type of vital safety system to thoroughly address each specific assessment criteria.

SCOPE OF ASSESSMENT

The purpose of this assessment was to determine the functionality, reliability, and operation of the fixed fire protection systems and their support systems contained within the Hanford Central Waste Complex (CWC) waste storage facilities. Facilities and structures associated with the Waste Receiving and Processing Facility were not included in the scope of this review (including, but not limited to the 2740W and 2336W facilities). Fixed fire protection systems are included in the 2401W building, 2402 Series (12 buildings), 2403 Series (4 buildings) and 2404 Series (3 buildings) structures. Other storage modules and burial grounds associated within the CWC were not assessed because they do not include fixed fire protection systems. Using a graded approach, the following systems were included in this assessment:

- Fire Protection Alarm and Detection Systems (VSS)
- Fire Protection Suppression Systems, including sprinklers (VSS)
- Electrical Power Distribution to Fire Protection Systems (Ancillary System)
- Water Supply System providing water to Fire Protection System (Ancillary System)

It was not the intent of this assessment to review every individual CWC fire protection system. As CWC facility fire protection systems are very similar from one series building to the next a graded approach was applied. Recognizing that each of the fire protection systems in each series CWC building is nearly identical in design and operation the team initial choose one of each building in a series to review the VSS in detail. As the assessment continued additional series facilities were walked down and included and assessment team members toured most all of the CWC facilities.

The assessment requirements provided in the CRADs provided consistent overall framework for assessments of VSSs and support systems. For completeness, the scope of this assessment includes electrical and mechanical components within these system boundaries.

The assessment did not reanalyze the authorization basis, fire hazard analysis, or the fire protection facility assessments. However, during the course of the assessment, where these documents made assumptions that affected how the fire protection systems were operated, the team documented areas that were considered inadequate for safety purposes.

BACKGROUND

Central Waste Complex (CWC)

The mission of the CWC is to receive and store radioactive waste in a safe and environmentally compliant manner. The storage facilities, located in the Hanford 200-West Area, include 13 small mixed waste storage buildings (the 2401 building and the 2402 series buildings) and seven large storage buildings (the 2403 and 2404 series buildings). In addition there are 27 small modules for storing low- flash point mixed waste, 12 modules for storing alkali metals, and the 2420-W Cask Storage Pad for interim storage of vitrified remote handled transuranic waste. The 27 low-flash point mixed waste modules, the alkali metal modules and the 2420-W Cask Storage Pad do not have fix fire protection systems. DOE-RL's Waste Management Division has programmatic responsibility for the facility; the operating contractor is Fluor Hanford.

CWC provides interim storage for mixed low-level waste, transuranic waste, and a small amount of low- level waste, awaiting treatment and final disposal. The design storage capacity is approximately 80,000 55-gallon drum equivalents; the operational capacity is 64,000 drum equivalents. The stored waste types are presently 84% mixed low- level, 13% transuranic, and 3% low- level. This percentage is expected to change with more inventory of transuranic waste generated by decommission and demolition activities from the Plutonium Finishing Plant and other Hazard Category 2 Hanford facilities.

CWC receives waste from both onsite and offsite waste generators. Receipt of transuranic waste drums retrieved from the Low Level Burial Grounds began in 1994. All newly generated waste must meet acceptance criteria set by the Hanford Site Solid Waste Acceptance Program. Waste is generally packaged in 55-gallon drums unless alternate packages are dictated by size, shape or other form of waste. Each drum is handled individually using a hand truck, forklift or crane. Drums are placed on wooden pallets with a maximum of four drums banded together; the pallets then are stacked three-high, or 12 drums per stack. The storage buildings or pads have physical features that provide for segregated storage areas to maintain appropriate separation between groups of incompatible waste.

Fire Suppression Systems

Automatic fire sprinkler systems designed per National Fire Protection Association (NFPA) Standard 13 are provided in the 2402 Series (12 buildings), 2403 Series (4 buildings) and 2404 Series (3 buildings) structures at CWC. It is important to note that the fire sprinkler systems in the 2402 and 2403 Series buildings were not designed to meet NFPA 231, Standard for General Storage, even though all of the NFPA standards were included in the contract at the time of design and installation. NFPA 231 was the standard for palletized storage of materials at the time the sprinklers were installed. While the fire sprinkler systems in 2402 and 2403 buildings were installed as ordinary hazard pipe schedule systems under NFPA 13 for general warehousing, the sprinklers were not designed to protect the three drum high palletized storage in accordance with NFPA 231. Because the buildings are not heated, the fire sprinkler systems at CWC are dry pipe systems, employing automatic sprinklers that are attached to a piping

system containing air under pressure. When the air in the piping is released (as from the opening of a sprinkler head) water pressure opens a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers. The air pressure in the piping is supervised so that a drop in pressure will relay a supervisory trouble signal to the fire alarm systems. In addition, all of the sprinkler systems at CWC utilize a water flow pressure switch so when water is released by the dry pipe valve switch contacts relay water flow alarm to the fire alarm system. All of the dry pipe sprinkler risers are appropriately located in a heated enclosure to prevent freeze up of the "wet side" of the dry system and the heated enclosures have low temperature monitors connected to the fire alarm system to send a supervisory signal to the fire department in the event the temperature reaches 40 degrees F. Control valves, such as post indicating valves and outside stem and yoke valves (for the reduced pressure principle backflow preventers) are provided with tamper switches so when the valves are moved a tamper switch send a supervisory signal to the fire alarm system. Sprinkler heads in the 2402 series buildings are 165 degrees F rated and sprinkler heads in the 2403 series and 2404 series buildings are 286 degrees F rated.

Fire Alarm Systems

Fire alarm systems at the CWC are composed of primarily two major hardware components, the fire alarm control panel (FACP), and the radio fire alarm repeater (RFAR). Pyrotronics manufactured the FACPs and they were installed under NFPA 72, National Fire Alarm Code. The panels are not multiplex style panels and therefore have no microprocessor software operating system. FACPs are only located in the 2403 and 2404 series buildings at CWC. 2402 series building fire alarm devices are connected directly to the RFAR panels for alarm and supervisory purposes. The RFAR panels are part of a site wide Factory Mutual approved radio fire alarm system, manufacturer by the GH Harlow Company, installed under NFPA 1221, Standard for Public Fire Communication Systems. The FACP collects supervisory and alarm signals from alarm initiating devices in the CWC facilities and transmits these signals to the RFAR. The RFAR then transmits the individual supervisory or alarm signal to the Hanford Fire Department for response. The CWC buildings fire alarm system alarm initiating devices consist of pull stations and water flow pressure switches. There is no automatic heat or smoke detection in these facilities as none are required by DOE requirements. The facility fire alarm systems also monitor a number of supervisory signals for the sprinkler systems, including sprinkler riser room temperature, valve tamper, and supervisory low air pressure. Although not required by the life safety code, the 2404 and 2403 series buildings also have auditable signaling devices connected to the FACPs. And finally, as required by NFPA 1221, the RFAR panels automatically send a daily test message to the Hanford Fire Department. If the panel does not report to the fire department on a daily basis, personnel are dispatched to the RFAR box that failed to report in for investigation and correction.

Electrical Power supply for Fire Alarm Systems

The FACP and RFAR panels at CWC buildings have independently supplied primary power via 120 VAC breakers. In addition, the FACPs and the RFAR panels are provided with gel cell battery backup designed to support these systems on battery for up to 60 hours in the event primary power is lost. The primary power supplies of the FACP and RFAR panels are also

supervised. In the event of primary power loss of either, these panels automatically switch over to battery power and transmit a supervisory signal to the Hanford Fire Department. In addition, both panels monitor the battery backup. When batteries fall below a predetermined capacity or they are disconnected the panels send a supervisory signal to the fire department.

Water Supply for Fire Suppression Systems

The water supply system at the Hanford Site consists of two underground main systems, raw and sanitary water. Water for fire protection purposes is provided to the CWC through the sanitary water system. The water is provided by the export water system to CWC through one 12 inch feed line and one 10 inch feed line which loop around the CWC facilities through 12 inch, 10 inch and 8 inch underground lines. The water supply underground piping is primarily cast ductile iron and polyvinyl chloride (PVC).

The sanitary water supply (WHC-SD-SQA-ANAL-30001, Rev. 0, 1995) serving the CWC fire protection systems consists of two supply sources, including a primary sanitary clear well system with a water storage capacity of 400,000 gallons and a secondary system with a 1,100,000 gallons reservoir for the 200 West Area. Sanitary water system pumping capabilities include the following:

200 West primary system:

- Four electric pumps @ 1,000 GPM

200 West secondary system:

- One electric pump @ 4,000 GPM

ISSUES AND OBSERVATIONS

The following is a brief summary of the issue and observations. For explicit requirements and examples developed by the assessment team to support these issues see the Assessment Results and Detailed Results sections of this report. Issues identified in this assessment are items that have been documented as non-compliant with an established requirement, quality problem, or recommendation/opportunity for process improvement that require management attention and corrective action. The term "observations" mentioned in this assessment are noteworthy conditions or commendable practices observed during this assessment that require no corrective action. The issue and observations listed below are ordered chronologically as they appear in the detailed results section of this report.

ISSUES

I-01

The role of the fire protection system in reducing the probability of an uncontrolled fire is not addressed by the body of the ISB, SEL, fire protection program, or implementing procedures. Consequently, the conditions, assumptions, requirements, and performance criteria, for taking a 5E-2 probability reduction (for an uncontrolled fire) is not identified.

I-02

The role of the fire protection system in reducing the probability of an uncontrolled fire was not recognized by those interviewed currently performing USQs for the facility. Past modifications of the water supply system could have had the potential to affect the reliability of the fire protection system.

I-03

Conditions observed do not appear to be consistent with the assumptions contained in the ISB accident analysis (i.e., quantity of fuel available, type of fuel available, the slope of the floor in the 2403 and 2404 series buildings, or potential for structural damage from the fire).

I-04

The dry sprinkler systems in the 2402W and 2403W type buildings may not be adequate to protect the palletized storage against fire.

I-05

The sprinkler system in the 2402W type buildings need to be inspected and brought up to the current NFPA13 requirements for earthquake sway bracing.

I-06

The fire alarm drawings for the 2404W type buildings need to be revised and updated to show the as-constructed condition. The high/low air pressure switches need to be added to the drawing and the extra tamper switches need to be removed from the drawings.

I-07

NFPA 25 requires that the sprinkler system be investigated on a regular frequency to determine if any obstructions are present. This is especially important for systems that were constructed with black steel piping. Dry systems are also inherently prone to condensation and condensation on black steel piping creates corrosion produces and crud that will plug small diameter sprinkler piping. Since there is a condition that exists that could cause obstruction in this piping and a physical internal inspection has never been done on these systems an internal obstructions investigation should be conducted. There is no evidence that this inspection has ever been done.

I-8

The following CWC Fire Hazard Analysis and/or Interim Safety Basis issue have been identified:

- The FHA does not analyze the storage of combustible lab-packs with plastic absorbent in CWC facilities and fire modeling has not been completed to date to justify the storage of the lab-packs. However, lab-packs with plastic absorbent have been observed in storage in building 2404 WA.

- The ISB does not reflect the limitation of the supporting FHA. Therefore, committed actions and limitations of the FHA have not always been implemented (i.e., lab-packs were added to 2404 building without revisiting the FHA).

- WHC-SD-W112-FHA-001, Revision 1, does not contain an accurate description of the water supply to CWC. The water supply upgrades done as part of the Project B-604 are not included in this FHA.

- The propane tank for forklift 40-75-4995 lacks protection of the propane tank as required in the FHA.

- There are multiple FHA documents that have not been formally reviewed and approved by DOE RL. As required by RLID 420.1, Section 8.11 facilities shall have only one fire hazard analysis document and they must be reviewed and approved by RL.

- There are multiple FHAs not referenced by the ISB and there are fire event described in the FHAs, which are not analyzed in the ISB. This could affect how the fire systems are operated. The FHA and ISB development were not coordinated in fire hazard analysis in accordance with procedures.

I-9

The reliability of the underground water supply to CWC may have been reduced as the location of mains are in the same trench and crossing over each other. It is possible that one piping rupture in this vicinity could take both lines out of service at the same time and render all of the fire sprinkler systems at CWC inoperable.

I-10

Facility Operations do not ensure that all work is adequately released and controlled for work performed by "outside" organizations.

I-11

Work package procedures are not clearly identified for "procedure use" type in accordance with procedures.

OBSERVATIONS

O-01

The CWC water supply system is reliable and meets DOE requirements. This water supply is looped, gridded, with two water supplies and can provide adequate capacity and pressure demands for CWC sprinkler systems that have been correctly designed (2404 Series Buildings). In addition, a review of the underground piping that provides water to the sprinkler systems determined that the underground has not been subject to major main breaks or significant deterioration

O-02

Alarm and supervisory signals are provided in the CWC facilities and they are reliable and capable of transmitting alarms to the on site fire department. In addition, fire alarm and radio fire alarm repeaters have appropriate battery backup.

O-03

The CWC Operations organization adequately maintains, tests and inspects facility Fire Protection Systems, assuring that these programs meet the requirements of DOE Orders, NFPA, other regulations, and internal policies (HNF-RD-7899). Maintenance, test and inspection criteria are carefully reviewed against requirements, established in working-level procedures and recall systems, and results are evaluated to assure that fire protection system integrity is sustained.

O-04

Hanford Fire Department and Fire Systems Maintenance and Test personnel are well qualified and exhibit very good abilities, knowledge and skills in performing maintenance and tests on complex fire protection components and systems. These personnel take pride in their work, demonstrate highly effective communication skills during work tasks, and are concerned when quality is compromised for any reason.

ASSESSMENT RESULTS

This section of the report presents the overall result of the DNFSB Recommendation 2000-2 Phase II Assessment of the Fire Protection Systems at the Central Waste Complex. The following VSSs were addressed in this assessment using the Criteria Review Assessment Document as a guide:

- Fire Protection Alarm and Detection Systems (VSS)
- Fire Protection Suppression Systems, including sprinklers (VSS)
- Electrical Power Distribution to Fire Protection Systems (Ancillary System)
- Water Supply System providing water to Fire Protection System (Ancillary System)

The overall purpose of this assessment was to assess the functionality, reliability, and operability of the CWC fire protection systems using the safety function definition criteria contained in the assessment implementation plan.

The details surrounding the results, including how the review was conducted, documents reviewed and personnel interviewed are provided in the Detailed Assessment Results section of this report.

Safety Function Definition:

The purpose of the safety function definition area was to determine if the safety basis for the fire protection VSS in CWC are identified and defined in the safety documentation.

During the course of the Safety Functional Definition area review, more than forty documents and procedures were reviewed, four engineering staff were interviewed, and a tour of the 2402, 2403, and 2404 series buildings was conducted.

The following issues were identified during the assessment:

- The role of the fire protection system in reducing the probability of an uncontrolled fire is not addressed by the body of the ISB, SEL, fire protection program, or implementing procedures. Consequently, the conditions, assumptions, requirements, and performance criteria, under which taking a 5E-2 probability reduction (for an uncontrolled fire) is not identified.

- The role of the fire protection system in reducing the probability of an uncontrolled fire was not recognized by those interviewed currently performing USQs for the facility. Past modifications of the water supply system could have had the potential to affect the reliability of the fire protection system.

- Conditions observed do not appear to be consistent with the assumptions contained in the ISB accident analysis (i.e., quantity of fuel available, type of fuel available, the slope of

the floor in the 2403 and 2404 series buildings, or potential for structural damage from the fire).

- The ISB does not reflect the limitation of the supporting FHA. Therefore, committed actions have not been taken (i.e., lab-packs were added to 2404 building without revisiting the FHA).

- There are multiple FHAs not referenced by the ISB and there are fire events described in the FHAs, which are not analyzed in the ISB. This could affect how the fire systems are operated. The FHA and ISB development were not coordinated in fire hazard analysis in accordance with procedures.

Based on these issues, it is concluded that the safety basis, supporting documents, and procedures do not clearly present and protect:

- The specific role of the system in detecting, preventing, or mitigating analyzed events

- The associated conditions and assumptions concerning system performance

- Requirements and performance criteria for the system and its active components, including essential supporting systems, for normal, abnormal, and accident conditions relied upon in the hazard or accident analysis.

Configuration Management:

The purpose of the configuration management area was to determine if the requirements, documents and installed fire protection VSS components and their support systems in CWC are identified are appropriately controlled.

The assessment of the CWC Complex included a detailed reviewed of over twenty-five documents, including fire protection drawings, assessments, fire hazard analyses and procedures, field review of the actual the installed fire suppression systems, fire alarm systems, electrical supplies to fire alarm systems, and water supply for Buildings numbers 2402WF, 2403WC, 2404WB, and 2404WC. A walk down of the fire alarm and suppression systems was completed. Storage in the building was reviewed to determine occupancy classification and storage arrangement. In addition, the water supply for the sprinklers and electrical supply to the fire alarm systems for the CWC group of building were reviewed.

During this assessment the following people were contacted and interviewed, the Fire Protection Engineer for the CWC Complex, a CWC Shift Operator, Hanford Fire Department Fire System Testing and Inspection Manager and Fire System Maintenance Mechanical Systems, and the FFS Project Manager and Project Engineer for Project L-339, Main Upgrades.

The assessment team established that the sprinkler systems in the 2402W and 2403W buildings were designed per NFPA 13 and 2404 Series buildings were designed per NFPA 231. This was shown on the sprinkler system as-built drawings and design specification. However, ALL of the

NFPA standards were included in the contract at the time these facilities were constructed. The standard that the sprinkler systems in 2402W and 2403W should have been designed under was NFPA 231, which was in the contract at the time of design and construction for these buildings. The wrong standard was used in the design of the sprinklers for the use of these facilities. Later NFPA 231 content was put into NFPA 13. The Team recognized this and evaluated these buildings under both standards that were in place at the time of design and construction and under the current standards that exist today and determined that under any scenario the sprinkler systems are deficient for the storage they are presently being used for.

Concerns that were noted during this assessment include an inadequate fire sprinkler design in the 2402 and 2403 Series Buildings (the sprinkler systems were not designed to protect the three high palletized storage), lack of NFPA 13 required earthquake sway bracing (for 2402 buildings), fire alarm drawings for 2404 series buildings show a couple of components that do not exist in the as-constructed condition, and the NFPA 25 internal piping obstruction investigation requirements are not being met.

The water supply is looped, gridded, with two water supplies and can provide adequate capacity and pressure demands for CWC sprinkler systems that have been correctly designed (2404 Series Buildings). However, the water flow test that was conducted for this assessment demonstrates that pressure demands for the under designed sprinkler systems in the 2402 and 2403 series facilities is only about half than what is available in the supply. Although the CWC fire hazard analysis identified this as a water supply problem, the correct identification of this issue is that the sprinkler systems in the 2402 and 2403 series buildings do not have large enough size piping in the overhead sprinkler systems to carry the needed flow capacity at the required pressure to control a design basis fire. Since the water supply can support the 2404 series building sprinkler systems due to their larger size overhead sprinkler piping this is clearly a deficiency with the 2402 and 2403 series building sprinkler piping sizes and not the underground supply.

A review of the underground piping that provides water to the sprinkler systems determined that the underground has not been subject to major main breaks or significant deterioration. A major portion of the underground mains that serve CWC may have a reduced reliability due to the location of mains in the same trench and crossing over each other. It is possible that one piping rupture in this vicinity could take both lines out of service at the same time, rendering all of the fire sprinkler systems at CWC inoperable.

Fire alarm systems at the CWC are composed of primarily two major hardware components, the fire alarm control panel (FACP), and the radio fire alarm repeater (RFAR). Fire alarm system initiating devices consist of pull stations and water flow pressure switches. There is no automatic heat or smoke detection in these facilities. The facility fire alarm systems also monitor a number of supervisory signals for the sprinkler systems, including sprinkler riser room temperature, valve tamper, and supervisory low air pressure. Alarm and supervisory signals are provided in the CWC facilities and they are reliable and capable of transmitting alarms to the on site fire department.

During the CWC document review it was noted that there are concerns in the FHA documents including, the storage of lab packs with plastic absorbent in facilities that are not analyzed by the

FHA, inaccurately described water supplies in the FHA, a propane tank for forklift 40-75-4995 that lacks protection of the propane tank as required in the FHA, and multiple FHA documents that have not been formally reviewed or approved by DOE RL. Additionally, drawings for the 2404 series of buildings showed tamper switches that were not installed in the field.

Based on the identified issues and deficiencies, the criteria, review and approach elements of the configuration management area have not been met.

System Surveillance, Testing, and Maintenance:

The purpose of the system surveillance, testing, and maintenance definition area was to determine if fire protection systems are being tested and maintained to meet system requirements and performance criteria necessary of performing their intended safety function.

The assessment of the CWC Fire Protection System maintenance, surveillance and test program included a review of over twenty applicable Hanford Fire Department (HFD), Fluor Hanford Waste Management Project (WMP) and Central Waste Complex (CWC) policies, processes, procedures, practices, and a sampling of the applicable NFPA 25 and NFPA 72, inspecting, testing, and maintenance requirements as mandated by DOE. This included reviews of activity-level maintenance and test procedures and work packages related to work on RFARs, fire alarm control panels (FACPs), fire system dry risers, reduced pressure backflow preventers, and cold weather protection. Maintenance and testing activity recall reports and working level procedure lists were reviewed against CWC Facility and Fire Department policies to assure that requirements for maintenance and testing were accomplished with the appropriate level of detail and at the proper frequencies. Technical procedure and work control process procedures and policies were reviewed to assure that procedures and work documents were properly prepared, reviewed, validated, released and used. Facility walkdowns were conducted to ascertain the general condition of fire protection system components and equipment.

Many interviews were conducted with employees of the HFD, the FSM group, and the CWC facility to determine worker knowledge and understanding of their work assignments, responsibilities, work processes, fire system maintenance/test requirements, system condition and status, etc. Interviews were conducted with the following personnel: FSM Work Control Coordinator, FSM Planner/Scheduler, FSM Maintenance Manager, FSM Mechanical Supervisor, FSM Electrical Engineer, two FSM Electricians, FSM Procedure Writer, WMP/Solid Waste Maintenance Engineer, WMP/CWC Operations Manager, WMP/CWC Operations Planner, WMP/CWC Maintenance Planner/Scheduler, and two HFD Firefighters.

Field observations were used to evaluate the performance of HFD, FSM and CWC personnel as they conducted maintenance and testing of Fire Systems at the 2403-WA, -WB,-WC and –WD facilities. This fieldwork was focused on the maintenance and testing of RFARs, FACPs, Dry Fire Risers, and a backflow preventer (RPBP). Two different pre-job briefings were observed, as well as work crews staging through the CWC dispatch office.

The identification, planning and performance of maintenance, surveillance and testing of CWC Fire Protection Systems satisfy applicable DOE and NFPA requirements with the exception of

the five year internal inspection of the sprinkler system piping as required by NFPA 25 as identified in the Configuration Management section. The HFD firefighters and FSM craft that perform work on these systems are well qualified, highly skilled and professional, and they take great pride in their work. Policies are established and procedures are in place to facilitate and sustain an effective maintenance, test and surveillance program.

CWC Operations exhibited a less than satisfactory level of control of outside resources by allowing some fieldwork to proceed without appropriate release (authorization), and one assigned Operator on a maintenance task evolution demonstrated low interest and inadequate support of the job. Management expectations for "procedure use" need to be reinforced to preclude the reoccurrence of procedures or packages that do not clearly state the "procedure use" requirements.

The criteria, review and approach elements of this Fire Protection Systems assessment have been met by the HFD and the FH CWC Operations in regard to maintenance, test and surveillance programs.

DETAILED RESULTS

This section of the report presents a detailed discussion of the assessment and results for each topical area.

Safety Function Definition

OBJECTIVE:
Safety basis-related technical, functional, and performance requirements for the system are identified/defined in appropriate safety documents.

Criterion:
Safety/Authorization Basis documents identify and describe:

1) The system safety functions and the safety functions of any essential supporting systems, and

2) The system requirements and performance criteria that the system must meet to accomplish its safety functions.

Approach:

Records Review:

Review the appropriate safety/authorization basis documents, such as safety analysis reports, basis for interim operations, technical safety requirements, safety evaluation reports, and fire hazards and accident analyses, to determine if the definition/description of the system safety functions includes:

- The specific role of the system in detecting, preventing, or mitigating analyzed events
- The associated conditions and assumptions concerning system performance
- Requirements and performance criteria for the system and its active components, including essential supporting systems, for normal, abnormal, and accident conditions relied upon in the hazard or accident analysis.

Interviews:

N/A

Observations:

N/A

PROCESS:
Records Reviewed:

Safety Basis Documents:

- HNF-SD-WM-ISB-007, *Central Waste Complex Interim Safety Basis*, Rev. 1
- ECN-637359, *Central Waste Complex Interim Safety Basis*, Rev. 1-A
- ECN-637364, *Central Waste Complex Interim Safety Basis*, Rev. 1-B
- ECN-637496, *Central Waste Complex Interim Safety Basis*, Rev. 1-C
- ECN-659119, *Central Waste Complex Interim Safety Basis*, Rev. 1-D
- ECN-659122, *Central Waste Complex Interim Safety Basis*, Rev. 1-E
- HNF-SD-WM-TSR-005, *Central Waste Complex Interim Operational Safety Requirements*, Rev. 0
- 01-ABD-038, *Removal of Steel Waste Disposal Boxes from 324 Bldg to CWC*
- 01-ABD-053, *Annual Summary of the Solid Waste Storage and Disposal Unreviewed Safety Question Evaluations and Submittal of Annual Safety Analysis Updates*

Safety Basis Supporting Documents:

- WHC-SD-WM-SEL-009, *Central Waste Complex Safety Equipment List*, Rev. 5
- WHC-SD-W112-FHA-001, *Fire Hazard Analysis for the Enhanced Radioactive and Mixed Waste Storage Phase V - Project W-112*, Rev. 0
- WHC-SD-WM-FHA-008, *Fire Hazards Analysis of Central Waste Complex*, Rev. 0

Other Fire Hazard Analyses:

- WHC-SD-W241-HIE-001, *Preliminary Fire Hazard Analysis for Alkali Metal Wastes Storage Modules at the Central Waste Complex*, Rev. 0
- WHC-SD-W312-HIE-001, *Preliminary Fire Hazard Analysis for the Central Waste Complex Reactive Mixed Waste Storage Modules*, Rev. 0
- WHC-SD-W461-FHA-001, *Fire Hazard Analysis for Project W-461*, Rev. 0.
- WHC-SD-WM-FHA-008, Appendix E *Fire Hazard Analysis for the FRG Sealed Isotopic Heat Source Project C-229 at the Central Waste Complex*, Rev. 0

Unreviewed Safety Questions (USQ) Procedure and Associated USQs:

- WMP-200, *Unreviewed Safety Questions*, Section 4.3, Rev. 17
- SW-USQ-01-055, *Hanford Fire Department Procedures FS0012, Rev. 0-C, FS0029, Rev. 0-O, and FS0004, Rev. 0-C*
- SW-USQ-01-012, *Hanford Fire Department Work Package 2G-01-22409/X Reset/Drain & Blowdown/Restore Dry Riser 2404-WB Building*
- SW-USQ-00-073, *Post Fire Reclamation, FY2000*
- SW-USQ-02-008, *Hanford Fire Department Procedures FS0049, Rev. 1-B, FS00010, Rev. 1-A*
- SW-USQ-01-010, *Auditable Safety Analysis for 2727-W Sodium Storage Facility, HNF-7529, Rev. 0*
- SW-USQ-00-014, *Hanford Fire Department Ignitable/Reactive Waste Fire Inspection of CWC, November 17, 1999; and DSI to R. J. Giroir from J. R. Keene, dated September 1, 1998, entitled "CWC Fire Protection Facility Assessment: Resolution of Findings"*

Fire Protection Program and Implementing Procedures:

- WMP-200, *Fire Protection*, Section 4.6, Rev. 3
- SW-100-143, *Cold Weather Protection Plan*, Rev./Change C-4
- SW-020-028, *Utility Disconnect*, Rev./Change A-0
- SW-040-043, *Inspect Central Waste Complex and Sodium Storage Building*, Rev./Change D-7
- Hanford Fire Department PM work orders (8 reviewed)
- Hanford Fire Department site-wide activity instructions (2 reviewed)
- HNF-PRO-350, *Fire Hazard Analysis Requirements*, Rev. 3
- HNF-PRO-700, *Safety Basis Development*, Rev. 3

RL Fire Protection Requirements:

- RLID 420.1, RL Implementing Procedure for Fire Protection, dated June 18, 1999.

Other Documents:

- FEB-FY02-01, *Facility Evaluation Board Report*
- RL-PHMC-SOLIDWASTE-2002-0002, *Potential Inadequacy in Safety Analysis (USQ)*, February 9, 2002

Personnel/ Positions Interviewed:

- Safety Basis Team Lead
- Design Authority (USQ evaluator)
- Fire Protection Engineer
- Engineering Lead (USQ evaluator)

Evolutions/Operations/Shift Performance Observed:

- Toured 2402, 2403, 2404 series buildings

RESULTS:

Discussion of Results:

1. **Tour**. To gain familiarization of CWC, the team participated in a site tour on January 30th. The team entered the 2402WF, 2403WA, and 2404WA Buildings, observed fire protection systems (i.e., detection/alarm and suppression) and layout of waste storage.

2. **Safety Basis Review**. The Interim Safety Basis (ISB) was reviewed to determine the role of the fire protection system and supporting ancillary systems (i.e., electrical power distribution and water supply system).

   The original purpose of the ISB was to provide the CWC facilities with a basis for interim operation during the upgrade process until a DOE O 5480.23 compliant document could be prepared and approved.

   Chapter 2 provides a brief description of the fire protection systems within each building (no system performance expectations are provided within these descriptions).

   Accidents selected for detailed analysis in Chapter 5 of the ISB are as follows:

   - Mechanical release from a drum handling accident
   - Fire resulting from a drum handling accident
   - Flammable gas explosion (and nonradiological flammable gas explosion)
   - Truck impact and fire (and nonradiological truck impact and fire scenario)
   - Earthquake scenarios

   Each scenario was reviewed; of these analyzed scenarios, only one scenario (truck impact and fire) was determined to involve the fire protection system. Section 5.6.4, "Truck Impact and Fire Scenario," presents an uncontrolled fire in which an out of control truck, collides with and penetrates a CWC building, impacting an outer row of stacked drums. As a result of the truck crash, 26 gallons of diesel fuel is assumed to spill and ignite; several drums are involved in the preceding fire. Per the ISB, “The fire protection system (i.e., detection/alarm and suppression) is assumed to fail and no credit is taken for manual fire suppression by facility workers or the Hanford Fire Department.” However, the ISB refers to Appendix B for further discussion of the event probability. Upon reviewing the event-tree analysis contained in Appendix B it was discovered that the ISB credits the CWC fire suppression system reliability in determining the probability of an uncontrolled fire. Per Appendix B, the probability of the fire suppression system failing is 5.0×10^{-2}, based on Reference Table 2 of *Fire Induced Vulnerability Evaluation Methodology (five) Plant Screening Guide* (EPRI 1991). The ISB does not define what constitutes failure (i.e., failure to actuate and/or failure to control the fire) nor does it present a controlled fire.

   The analyses within the ISB utilize the initial assumption that inventory available for release is limited and controlled administratively (via source strength control). Utilizing this initial source term assumption, the ISB concludes that based on the probabilities and consequences as presented, the five accidents analyzed have dose estimates below the risk comparison guidelines. Chapter 6 of the ISB concludes that no credit for any safety-class or safety-significant SSCs has been assumed in the accident analysis for the prevention or mitigation of any accident that could exceed recommended guidelines.

   Chapter 6 of the ISB carries the following administrative controls forward into IOSRs: Organization, Nuclear Criticality Safety, and Accident Analysis Source Strength Control.

Per the ISB, specific details of programs for which credit is taken in the ISB analysis are identified in the IOSRs.

Section 6.3, Institutional Safety Programs, states, "Programs for ensuring worker safety and minimization of the impact from releases have been committed to for the Hanford Site...SWD has implemented these programs for ensuring worker safety and minimization of the impact from releases in WMH-5-34, WMH-200, and the HNF-PROs. The institutional programs controlled by these documents include, but are not limited to, the following:…Fire Protection. The purpose of these programs is to implement the DOE orders and regulations as they become contractual obligations. Changes to these programs are made by SWD per the change control procedures of WMH-5-34, WMH-200, and the HNF-PROs, as necessary, to ensure compliance.

Appendix H of the ISB contains the SER delivered under DOE-RL-97-SWT-047. The SER concludes, "…DOE accepts the risks from the CWC operations as presented in Table 2-1 as the authorization basis against which future USQ determinations are to be made…"

Summary: The reliability of the fire suppression system is credited in supporting appendices for reducing the probability of an uncontrolled fire. This safety function served by the fire suppression system is not defined in the body of the ISB; it is not presented in the facility description, accident analysis, or hazard controls chapters. In addition, the conditions, assumptions, requirements, and performance criteria, under which taking a 5E-2 probability reduction for an uncontrolled fire is appropriate are not presented within the ISB.

3. **USQs Related to Fire Protection System**. The following USQs were reviewed to determine if the safety function of the fire protection system (as identified within the appendices of the safety basis) was recognized by the USQ process:

    - SW-USQ-01-055, *Hanford Fire Department Procedures FS0012, Rev. 0-C, FS0029, Rev. 0-O, and FS0004, Rev. 0-C,*
    - SW-USQ-01-012, *Hanford Fire Department Work Package 2G-01-22409/X Reset/Drain & Blowdown/Restore Dry Riser 2404-WB Building,*
    - SW-USQ-00-073, *Post Fire Reclamation, FY2000*, and
    - SW-USQ-02-008, *Hanford Fire Department Procedures FS0049, Rev. 1-B, FS00010, Rev. 1-A.*

    All of the USQs reviewed stated that the fire protection system is not depended upon for any of the CWC accident analyses.

    Summary: The role of the fire protection system in reducing the probability of an uncontrolled fire does not appear to be recognized.

4. **Fire hazard analysis reviewed.** *The Assessment Team Leader made the following review and observations.* The fire hazard analysis was reviewed to determine what fire protection systems exist within CWC facilities and how important to safety those systems are. A number of fire hazard analyses exists for facilities covered in the Central Waste Complex as follows:

   - WHC-SD-W112-FHA-001, *Fire Hazard Analysis for the Enhanced Radioactive and Mixed Waste Storage Phase V - Project W-112,* Rev. 0
   - WHC-SD-WM-FHA-008, *Fire Hazards Analysis of Central Waste Complex*, Rev. 0
   - WHC-SD-W241-HIE-001, *Preliminary Fire Hazard Analysis for Alkali Metal Wastes Storage Modules at the Central Waste Complex*, Rev. 0
   - WHC-SD-W312-HIE-001, *Preliminary Fire Hazard Analysis for the Central Waste Complex Reactive Mixed Waste Storage Modules*, Rev. 0
   - WHC-SD-W461-FHA-001, *Fire Hazard Analysis for Project W-461*, Rev. 0.
   - WHC-SD-WM-FHA-008, Appendix E *Fire Hazard Analysis for the FRG Sealed Isotopic Heat Source Project C-229 at the Central Waste Complex*, Rev. 0

   The ISB only references the *Fire Hazard Analysis for the Enhanced Radioactive and Mixed Waste Storage Phase V - Project W-112* as the bounding fire scenario. However other fire initiating event, scenarios and fire risks are described in the other Central Waste fire hazard analysis documents, which are not carried forth in the ISB. Fluor Hanford *Fire Hazard Analysis Requirements* procedure (HNF-PRO-350) and the *Safety Basis Development* procedure (HNF-PRO-700) require that accident analyses for fire events be "consistent in both the fire hazard analysis and the safety basis" and that the FHA must be referenced in the safety basis (note: At the time the FHA and ISB were originally was developed integration and consistency of the FHA with the safety analysis was required by WHC-CM-4-41, Section 3.4, Rev. 2, Fire Hazard Analysis Requirements, dated November 10, 1994 and WHC-SD-GN-FHA-30001, Rev. 0, Integration of Fire Hazards Analysis and Safety Hazard Analysis Report Requirements). Additionally, RLID 420.1, Section 8.11a states that a facility will not have multiple fire hazard analysis documents.

   Issues:

   - There are multiple FHAs not referenced by the ISB and there are fire event described in the FHAs, which are not analyzed in the ISB. This could affect how the fire systems are operated.

   - The FHA and ISB development were not coordinated in accordance with procedures.

5. **Personnel Interviews**.

   Authorization Basis Lead. The Authorization Basis (AB) Lead was interviewed to verify the role of the fire suppression system as read in the ISB. Some of the questions asked of the AB Lead included the following:

- Can you give me a brief description of the analyzed accidents within the safety basis, the conclusion, and the controls?

- What is the safety function of the fire suppression system?

- How is the functionality of the fire suppression system protected?

The AB Lead described the main accidents analyzed (i.e., mechanical release from drum-handling, fire resulting from drum handling, flammable gas explosion, truck impact fire, design basis earthquake), the conclusion (risk evaluation guidelines are not exceeded), and described the controls (i.e., criticality program and source strength AC) in place at CWC. When questioned about the safety function of the fire suppression system, he explained that the fire suppression system was not identified as a safety system, he explained that the analysis assumes the fire suppression fails to operate but that the reliability of the fire suppression system is included in determining the frequency of the uncontrolled fire. He stated that the consequences of the truck impact fire scenario are controlled using a source strength administrative control. When asked about protection of the functionality of the fire suppression system, the AB Lead felt that the engineers responsible for performing USQs to support changes would protect the fire suppression system. When a specific USQ (SQ-USQ-00-073) was discussed where the evaluator concluded that the fire protection was not credited in the accident analysis and therefore modifications to these systems was not a USQ concern, he suggested he probably would have handled the USQ a little differently. He proposed that the evaluators probably looked more at the surface of the accident analysis (i.e., sprinkler system is not credited for reduction of the fire consequences), and probably didn't focus on the supporting details (i.e., credit for the reliability of the fire suppression system in determining probability of an uncontrolled fire). The AB Lead described reliance upon the fire protection program to control combustibles and maintain the fire suppression systems. The program was believed to identify any large deviations which might affect the assumptions of the safety basis (e.g., removal of a fire suppression system would cause a red flag).

Design Authority. The Design Authority was interviewed to determine his knowledge and understanding of the safety basis and the role of the fire protection system. Some of the questions asked of the Design Authority included the following:

- Can you give me a brief description of the analyzed accidents within the safety basis, the conclusion, and the controls?

- What is the safety function of the fire suppression system?

- How is the functionality of the fire suppression system protected?

The Design Authority listed the main accidents analyzed (i.e., mechanical release from drum-handling, fire resulting from drum handling, flammable gas explosion, truck impact

fire, design basis earthquake). The Design Authority had a good general understanding of the truck impact fire scenario and the use of the source strength AC to stay below the risk evaluation guidelines but was unfamiliar with the role of the fire suppression system in reducing the probability of the analyzed uncontrolled fire. When asked about how the functionality of the fire suppression system is protected, he stated the fire department is responsible for maintaining the fire suppression system operable. He suggested that in the past, modifications had been made to the water supply without the design authority's knowledge. The Design Authority explained that CWC is now very diligent in performing USQs for all modifications. The approach of the design authorities is that they maintain the fire suppression system primarily for the purpose of personnel safety. When asked if the diversion of water authorized in SW-USQ-00-073 would affect reliability he said it would most definitely affect reliability and that was why they reviewed it.

Lead Engineer. The Lead Engineer was interviewed to determine his knowledge and understanding of the safety basis and the role of the fire protection system. The Lead Engineer explained that while USQ qualified he was not the facility ISB expert and relied upon the expertise of his other USQ evaluators. When asked, he too did not realize the role of the fire suppression system in reducing the probability of the analyzed uncontrolled fire. He was familiar with the text of the event and the fact that the ISB states multiple times that the suppression is not credited for putting out the fire but had not seen the event-tree. He quickly recognized the impact of the probability assumption and suggested that he would need to meet with his AB Lead and USQ evaluators and discuss the implications. He shared that while the fire suppression system was maintained, it was maintained for purposes outside of the scope of the safety basis and that CWC was not actively protecting the fire suppression systems reliability for purposes of staying within the safety basis.

Fire Protection Engineer. The Fire Protection Engineer was interviewed to find out more about the fire suppression system reliability and actions taken if reliability is questioned. Some of the questions asked of the design authority included the following:

- What is the role of the sprinklers as defined by the safety basis?
- How closely do you work with the safety basis team?
- Where can I find the fire protection program?
- Are there any individual facility procedures which implement this program?
- How are the fire protection program requirements incorporated at a facility level?
- How is an impairment handled?
- Is there a limit on how long a system is allowed to be down?
- What kind of compensatory actions would be implemented?
- How reliable is the fire suppression system?
- How long was the reliability impacted during the yard watering described by SW-USQ-00-073, and was the reliability of the fire suppression system affected?

The Fire Protection Engineer stated that he was not intimately familiar with the CWC ISB but indicated it was his experience that typical WMP accident analysis does not

credit the fire suppression system for putting out facility fires. The Fire Protection Engineer explained that previous safety basis / FHA efforts were performed prior to the recognition of the importance of joint scenario development. He is currently working on a new FHA for CWC, but had not yet involved the safety basis team, as scenario development has not begun.

The Fire Protection Engineer identified the fire protection program as being described in WMP-200, Section 4.6. He explained that the current intention is to replace this program with the HNF-PROs and S/RIDs. He stated that there were no individual procedures which implemented the fire protection program for each facility, but rather that elements of the fire protection program were implemented within the facilities operational procedures (i.e., housekeeping, cold protections, etc.). Per the Fire Protection Engineer, when a restriction is encountered; the HFD puts together the work package to remedy the restriction and WMP develops the compensatory measures. While the facilities are allowed up to two weeks to fix a restriction, the engineer stated that rarely had he seen a restriction in place for more than one week. Typical responses to emergency impairments include placement of an hourly fire watch for as many days as it takes to remedy the emergency impairment. The Fire Protection Engineer was confident in the overall reliability of the fire suppression system (provided human intervention was not involved).

Per the engineer's recollection the yard watering authorized by SW-USQ-00-073 diverted flow from the fire suppression system for three months (July - September), the engineer stated that during that time period he believes the reliability of the fire suppression system was impacted.

Issue: The role of the fire protection system in reducing the probability of an uncontrolled fire is not recognized by those interviewed currently performing USQs for the facility. Past modifications were discussed which could have had the potential to affect system reliability.

Follow-Up: Following the conversations held with the AB Team lead and the USQ evaluators, a discussion was held between the AB Team lead and the USQ evaluators to discuss the importance of protecting the assumed fire suppression system reliability in future evaluations.

6. **Review of Safety Equipment List**. The SEL was reviewed to determine if conditions and assumptions concerning system performance, and/or requirements and performance criteria for the system were identified. The purpose of the SEL as given is to provide a list of SSCs that are essential to the continuing safe operation of the CWC, as designated by the applicable facility management and the cognizant engineer. The SEL describes the fire protection system and the confinement system, concluding that there are no SSCs which meet the criteria for defining safety significant or safety class SSCs. The SEL justifies the non-classification of fire protection as follows, "The fire protection SSCs are controlled through an institutional safety program. Fire Maintenance performs preventative maintenance on the fire system components to ensure its operability."

Administrative Note: The SEL states that the CWC is provided with an early warning detection system using ionization type smoke detectors. This statement is inaccurate as there are no early warning detection systems within the CWC storage buildings.

Issue: The SEL does not identify the role of the fire protection system in reducing the probability of an uncontrolled fire.

7. **Review of Fire Protection Program**. The fire protection program (WMP-200, Section 4.6) was reviewed to determine how the program protected the reliability of the fire suppression system. The procedure's purpose as stated is to implement the fire protection program of Waste Management Project facilities and operations and demonstrates compliance with applicable fire protection criteria. The program provides fire protection in some of the following ways:

   - Describes the personnel responsibilities as well as facility inspection/testing responsibilities.

   - Provides direction to ensure fire protection deficiencies are corrected and that compensatory measures are in place and maintained until the deficiency is corrected.

   - Coordinates with the Hanford Fire Department (HFD) to ensure there is a clear understanding of terms and conditions of the Interface Agreement between WMP and HFD. (Note: Responsibilities for maintaining the fire protection systems are split between the HFD and WMP.)

   Issue: As was indicated by those interviewed, the program provides for important aspects of fire protection. The program states that it is implemented to ensure life safety of personnel and protection of facility resources. The Fire Protection Program does not identify the role of the fire protection system in reducing the probability of an uncontrolled fire.

8. **Review of Fire Protection Program Implementing Procedures**. The following implementing procedures were reviewed to determine how the procedures protected the reliability of the fire suppression system.

   - SW-100-143 provides instructions to establish a freezing weather surveillance for CWC.

   - SW-020-028 gives directions for disconnecting the utilities in CWC.

   - SW-040-043 provides instructions for inspecting CWC to allow for prompt identification and correction of safety hazards, maintenance, and general housekeeping programs.

- 8 HFD PM work orders were reviewed – providing for both regular testing and maintenance as well as for repair of impairments

- 2 HFD site-wide activity instructions – providing for regular testing and maintenance

Issue: The reviewed procedures / work orders provide an additional level of fire protection but do not identify the role of the fire protection system in reducing the probability of an uncontrolled fire.

9. **Items Not Directly Related to Function of Fire Suppression System**. Per the direction of the implementation plan, no specific effort was made to judge the adequacy of the safety basis. However, the following adequacy issues were observed during the review, which were pursued on the basis that they were believed to have the potential to affect safety.

   - **2727-W.** Tour leader (Fire Protection Engineer) stated during the site tour that 2727-W is included within the scope of CWC. However, 2727-W is not identified in the ISB. SW-USQ-01-010, *Auditable Safety Analysis for 2727-W Sodium Storage Facility, HNF-7529, Rev. 0*, was reviewed to follow up on 2727-W. The USQ states that the ASA contains the safety basis for establishing 2727-W as a low-hazard non-nuclear facility. Concluding that 2727-W does not need to be analyzed in the ISB since it is a non-nuclear facility, not even in the near vicinity of the CWC.

   - **Lab Packs within 2404 Building**. During the site tour lab-packs were observed to be stored within 2404-WA. WHC-SD-W112-FHA-001 prepared to address the 2404 series buildings states, "If the storage in the drums in the LTDS buildings includes "Lab-Packs" that contain Class I, II, or IIIA liquids, the FHA shall be revisited since they may significantly increase the hazard."

     The ISB allows for storage of low level waste, low level mixed wastes, PCBs, TRU waste, suspect TRU waste, and TRU mixed waste and does not prohibit the inclusion of lab-packs within the 2404 series buildings. However, the ISB utilizes the analysis within WHC-SD-W112-FHA-001 to support the bounding fire accident analyzed in the ISB.

     SW-USQ-00-014 was reviewed (per the suggestion of those interviewed) to determine what consideration was given to inclusion of the lab-packs within the 2404 building. SW-USQ-00-014 addresses storage of lab packs within 2402 (not within 2404) and notes that the conclusions reached in the FHA considered the inclusion of lab packs. This USQ does not appear to resolve the issue at hand.

     Interviews indicated the lab-packs were moved into the 2404 building because the sprinkler system in 2404 was better. A fire permit was obtained and the lab-packs were moved. No USQ was made available that specifically addressed the movement of the lab-packs into the 2404-WA building.

No attempt has been made by the assessment team to determine if inclusion of these lab-packs in the FHA would change the consequences as analyzed. However, the text provided in the FHA, "the FHA shall be revisited since they may significantly increase the hazard," leads one to believe this might be a concern. The USQ screenings reviewed do not provide justification as to why the results of WHC-SD-W112-FHA-001, and the resulting bounding truck impact fire scenario presented in the ISB, would be unaffected by introduction of lab-packs.

Issue: ISB does not reflect the limitations of the supporting FHA. Therefore, committed actions have not been taken.

- **Protection of other assumptions within the safety basis**. *The Assessment Team Assistant made the following observation.* The truck impact and fire scenario assumes 80 kg (176 lb) [approximately 26 gal per the fire hazard analysis] of diesel fuel is spilled and catches fire. No structural damage to the building is accounted for in this analysis. No basis for the assumptions on the amount or type of fuel used or building structural integrity is provided in the ISB. No basis for the assumption of the fuel pool size. The floor of the 2403 and 2404 series buildings slopes and the slope of the floor in the 2403 and 2404 series buildings is not discussed.

  In discussions with the Fire Protection Engineer, Design Authority, and AB Lead, all stated that vehicles of larger capacity fuel systems and/or with gasoline engines serve the CWC.

  In discussion with the Fire Protection Engineer and DOE Fire Protection Engineer both stated that the fire could affect the structural integrity of the building.

  Note: Similar observations were made during the 2002 Facility Evaluation Board assessment as documented in FEB-FY02-01. The FEB concluded the following:

  - "Waste storage practices at the CWC may result in an unanalyzed fire hazard…WHC-SD-WM-FHA-008 states large metal boxes are stacked directly on top of each other with no combustible material, like wooden pallets, in between. Inspection of the CWC buildings (2403WB and 2403WD) revealed wooden planks and/or pallets between stacked metal boxes."

  - "An analyzed CWC waste configuration was not identified as a configuration requirement in the IOSR…The FHA and its supporting documents showed that fire propagation was not anticipated if there was adequate spacing between rows. HNF-SD-WM-ISB-007 concluded that a pool fire would not propagate from the row where it is started to other rows and spread throughout a building. There were no spacing requirements for fire protection purposes in the CWC TSRs or operating procedures."

Issue: Conditions observed do not appear to be consistent with the assumptions contained in the ISB accident analysis. The team has not assessed the impact of these inconsistencies.

Follow-up: In response to the concerns raised during the DNFSB Recommendation 2000-2 assessment, CWC declared a potential inadequacy of the documented safety analysis to determine if the existing analysis is bounding and adequate. (Reference: RL-PHMC-SOLIDWASTE-2002-0002).

Conclusion:

The assessment in the Safety Functional Definition area was performed against requirements established in the Implementation Plan For Defense Facilities Safety Board Recommendation 2000-2 Phase II Assessment of the Fire Protection Systems at Central Waste Complex. The safety basis, supporting documents, and procedures were reviewed and engineering staff interviewed, to evaluate the following (as related to the fire protection system):

- The specific role of the system in detecting, preventing, or mitigating analyzed events
- The associated conditions and assumptions concerning system performance
- Requirements and performance criteria for the system and its active components, including essential supporting systems, for normal, abnormal, and accident conditions relied upon in the hazard or accident analysis.

During the course of the Safety Functional Definition area review, more than forty documents and procedures were reviewed, four engineering staff were interviewed, and a tour of the 2402, 2403, and 2404 series buildings was conducted.

Through the review of the documentation and interviews, it was determined that:

- While not assumed to be functional in the truck impact fire scenario, the fire suppression system reliability is credited in determining the probability of an uncontrolled fire (reduces probability by 5E-2). Significant degradation of the fire suppression system could result in an increase of the probability of an uncontrolled fire, hence increasing the risk beyond that authorized in the SER. The conditions, assumptions, requirements, and performance criteria, under which taking a 5E-2 probability reduction for an uncontrolled fire is appropriate, are not presented within the ISB, nor does the ISB reflect the limitations of the supporting FHA.
- The fire suppression system is not given as a safety SSC nor is it protected by an OSR control. The fire suppression system is maintained under the fire protection program for the purposes of ensuring life safety of personnel and protection of facility resources. The role of the fire suppression system in reducing the probability of an uncontrolled fire is not described in the system description within the body of the ISB, SEL, fire protection program, or implementing procedures. USQs reviewed have demonstrated that the

function of the fire suppression system in reducing the probability of an uncontrolled fire is not considered when modifications are made affecting the system. Conditions observed do not appear to be within the assumptions contained in the ISB accident analysis.

- There are multiple FHAs not referenced by the ISB and there are other fire events described in the FHAs, which are not analyzed in the ISB. This could affect how the fire systems are operated.

Issues:

- The role of the fire protection system in reducing the probability of an uncontrolled fire is not addressed by the body of the ISB, SEL, fire protection program, or implementing procedures. Consequently, the conditions, assumptions, requirements, and performance criteria, under which taking a 5E-2 probability reduction (for an uncontrolled fire) is not identified.

- Past modifications of the water supply system could have had the potential to affect the reliability of the fire protection system. The role of the fire protection system in reducing the probability of an uncontrolled fire was not recognized by those interviewed currently performing USQs for the facility.

- Conditions observed do not appear to be consistent with the assumptions contained in the ISB accident analysis (i.e., quantity of fuel available, type of fuel available, the slope of the floor in the 2403 and 2404 series buildings, or potential for structural damage from the fire).

- The ISB does not reflect the limitation of the supporting FHA. Therefore, committed actions have not been taken (i.e., lab-packs were added to 2404 building without revisiting the FHA). Furthermore, the fire hazard analyses and ISB development were not coordinated in fire hazard analysis in accordance with procedures and this could affect how fire systems are operated at the facility level.

Configuration Management

OBJECTIVE:
Changes to safety basis-related requirements, documents, and installed components are controlled.

Criterion:

1. Changes to system safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested, and documented in accordance with controlled procedures. Consistency is maintained among system requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.

2. Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.

3. Changes to system safety basis requirements, documents, and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change approval authority is determined using the Unreviewed Safety Question (USQ) process.

4. Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.

5. Software used in system instrumentation and control (I&C) components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

APPROACH:

Records Review:

1-1 On a sample basis, review and evaluate the change control process and procedures and associated design change packages and work packages to determine whether the change control process and procedures are adequate and effectively implemented. Determine whether:

- SSCs and documents affected by the change are identified
- Changes are accurately described, reviewed and approved as appropriate
- Installation instructions, post-modification testing instructions and acceptance criteria for turnover to facility operations are specified, and
- Important documents affected by the change (e.g., operating and test procedures, Master Equipment List, etc.) are revised in a timely manner.

3-1 Review documentation, such as change travelers and changes packages, and interview individuals responsible for processing selected changes made to the system requirements, installed equipment, and associated documents. Determine whether:

- Changes to the system are reviewed to ensure that system requirements and performance criteria are not affected in a manner that adversely impacts the ability of the system to perform its safety functions
- The USQ process (i.e., USQ screens and USQ safety evaluations/ determinations) is being appropriately used

5-1 For software used by safety system I&C components, request the facility staff to identify:

- The applicable software quality assurance requirements,
- The software quality assurance standards/controls applied to software development, procurement, acceptance, and testing
- The basis for acceptance of these standards/controls as providing adequate assurance that the software is acceptable for performing its associated safety functions

5-2 Review software quality assurance requirements, procedures, and records. Determine whether:

- Software quality assurance documentation exists for software in use
- Configuration management procedures exist for updates, changes, and version control of software and related documentation such as software design documents and a list of software configuration items installed on computer-based components
- An appropriate degree of independence exists between those responsible for software development and quality assurance functions
- A process is in place and used to identify, evaluate, and resolve operational problems that are attributable to software

Interviews:

1-2 Interview a sample of cognizant line, engineering, QA managers and other personnel to verify their understanding of the change control process and commitment to manage changes affecting design and safety basis in a formal, disciplined and auditable manner.

4-1 Determine whether engineering (including the design authority and technical disciplines for process control, fire protection, electrical, mechanical, chemical, HVAC, nuclear, criticality, structural, etc.), operations, and maintenance organizations are made aware of system changes that affect them, and are appropriately involved in the change process. Verify integration and coordination with other organizations that could logically be affected by the change such as facility training, document control, construction, radiological control, OSHA occupational safety, industrial hygiene, occupational medicine, hazard analysis/safety basis, safeguards and security, and fire protection.

5-3 Interview facility engineering and operations staff to determine their awareness of software quality assurance requirements for system software under their cognizance.

Observations:

2-1 Walkdown selected system components and compare the actual physical configuration of these components to system documents such as design basis and safety/authorization basis documents, system design descriptions, and system drawings such as piping and instrumentation diagrams. Identify any temporary changes, or configuration discrepancies that call into question (1) the operability or reliability of the system or (2) the adequacy of the change control or document control processes, including drawing revision, applied to the system.

PROCESS:

Records Reviewed:

- Drawing: H-2-80608, Sheet 1 of 1, *Fire Protection Fire Alarm Plans, EL, DET, & DIAG,* Revision 4
- Drawing: H-2-80740, Sheet 1 of 2, *Fire Protection Fire Alarm System Plans & Sections,* Revision 5
- Drawing: H-2-80740, Sheet 2 of 2, *Fire Protection Fire Alarm System Plans & Sections,* Revision 4
- Drawing: H-2-80741, Sheets 1-2, *Fire Protection Fire Alarm System Wiring Diagram,* and Revision 4
- Drawing: H-2-131542, Sheet 1 of 1, *Fire Protection Plan, Sections & Details,* Revision 5
- Drawing: H-2-131543, Sheet 1 of 1, *Fire Protection Alarm System Wiring Diagram,* Revision 5
- Drawing: H-2-821885, Sheets 1-2, *Fire Protection Sprinkler System,* Revision 1
- Drawing: H-2-821893, Sheet 8, *Fire Protection System Sections & Details,* Revision 0
- Drawing: H-2-821893, Sheets 1 - 7, *Fire Protection System Details & Sections,* Revision 0
- Drawing: H-2-823231, Sheet 1 of 1, *Fire Protection Floor Plans, Sect., Details, & Notes,* Revision 1
- Drawing: H-2-823236, Sheet 1 of 1, *Fire Protection, Fire Alarm Plan & Details,* Revision 0
- Drawing: H-2-823237, Sheet 1 of 1, *Fire Protection, Fire Alarm Wiring Details,* Revision 0
- Drawing: H-2-830083, Sheet 1, 3, *Civil Potable Water System Plans & Profiles,* Revision 0
- Drawing: H-2-830462, Sheet 8, *Site Map Potable Water System 200 West Enlarged Plan,* Revision 0
- JR Keene, DSI, *Fire Protection Facility Assessment for Central Waste Complex,* September 20, 2001
- JR Keene, DSI, *CWC Fire Protection Facility Assessment: Resolution of Findings,* September 1, 1998
- FEB-FY01-02, *Facility Evaluation Board Report of Waste Management Project*
- FEB-FY02-01, *Facility Evaluation Board Report of Waste Management Project*
- FEB-FY00-02, *Facility Evaluation Board Report of Solid Waste Projects*
- G Meade, Internal Memo, WMH-31300-98-117, *Facility Fire Protection Assessment,* August 18, 1998
- DJ Hart, Internal Memo, 97JRK002, *Fire Protection Facility Assessment*, June 5, 1997
- DJ Hart, Internal Memo, 31A00-96-001, *Central Waste Complex Fire Protection Facility Assessment,* January 2, 1996

- WHC-SD-W112-FHA-001, *Fire Hazard Analysis for the Enhanced Radioactive and Mixed Waste Storage Phase V - Project W-112*, Rev. 1
- WHC-SD-WM-FHA-008, *Fire Hazards Analysis of Central Waste Complex*, Rev. 0
- WHC-SD-W241-HIE-001, *Preliminary Fire Hazard Analysis for Alkali Metal Wastes Storage Modules at the Central Waste Complex*, Rev. 0
- WHC-SD-W312-HIE-001, *Preliminary Fire Hazard Analysis for the Central Waste Complex Reactive Mixed Waste Storage Modules*, Rev. 0
- SD-W016-FDC-001, Rev. 1, *Functional Design Criteria, Radioactive Mixed Waste Storage Facility, Project W-016*, June 1989.
- Various CWC Construction Specifications relative to fire protection for 2402-W (W-032-C1 and W-033-C2) and 2403-W (W-016H-C1).
- WHC-SD-W461-FHA-001, *Fire Hazard Analysis for Project W-461*, Rev. 0.
- WHC-SD-WM-FHA-008, Appendix E *Fire Hazard Analysis for the FRG Sealed Isotopic Heat Source Project C-229 at the Central Waste Complex*, Rev. 0
- Hanford Site Water System Master Plan, September 2000
- HNF-PRO-350, *Fire Hazard Analysis Requirements*, Rev. 3
- HNF-PRO-700, *Safety Basis Development*, Rev. 3
- WHC-SD-WM-TRP-246, *Solid Waste Drum Array Fire Performance*, September 1995.
- RLID 420.1, RL Implementing Procedure for Fire Protection, dated June 18, 1999.
- DOE O 420.1, Facility Safety
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
- NFPA 72, National Fire Alarm Code ®

Personnel/ Positions Interviewed:
CWC Fire Protection Engineer
FFS Project Manager L-339 Main Upgrades
FFS Project Engineer L-339 Main Upgrades
HFD, Fire System Testing and Inspection Manager
FSM, Manager Mechanical Systems
CWC Shift Operator

Evolutions/Operations/Shift Performance Observed:
Complete walk downs and inspections of fire sprinkler systems and fire alarm systems in the 2402WF, 2403WA, and 2404WB and 2404WC buildings.

RESULTS:

Discussion of Results:
The fire sprinkler and fire alarm system drawings for Buildings 2403 WA, 2404 WA, 2402 WF (19 drawings) were reviewed. This was done to determine the density that the sprinkler system could provide. The buildings were known to contain palletized drum storage of waste from the Hanford site. Palletized drum storage to three pallets high could be found in the buildings. Automatic sprinkler density requirement for indoor general storage is now contained in NFPA 13 – 1999 Edition. The fire protection requirements for this storage were previously found in NFPA

231. The NFPA 231 Standard was incorporated into NFPA 13 during the 1999 update to the NFPA Standards. Class refers to the commodity of material being stored and is noted in NFPA 13 as noted in Chapter 2 and Appendix A. OH (ordinary hazard) 1 and OH 2 refer to the sprinkler design density as noted in NFPA 13 Figure 7-2.3.1.2. Based on NFPA 13 Table 7-2.3.2.2, the following are the design density requirements for the sprinkler system:

Class I	12 ft or less in height	OH1
Class II	8 to 12 ft (or less in height)	OH2
Class III	12 ft or less in height	OH2
Class IV	up to 10 ft in height	OH2

The density for OH2 per Figure 7-2.3.1.2 ranges from a density of 0.2 gpm per sq ft density over the most remote 1500 sq. ft area to 0.15 gpm per sq ft density over the most remote 4000 sq. ft area.

Underground drawings (3) from the recently completed water main upgrade to the CWC were reviewed. This review was done to determine the Water Supply Reliability. The main upgrades were not connected to the CWC but were done in a separate project upgrading the inter-structure of the 200 West Area. The review was done to determine if the water supply meets the highly protected risk water supply reliability that is used by DOE. This review concluded that the water supply to the CWC meets required fire flows in sprinkler systems designed correctly in the 2404 series buildings but not in the 2403 and 2402 Series buildings. The underground water supplies are looped and gridded around CWC and two sources of water are provided for redundancy as required by DOE. A review of the Hanford Site Water System Master Plan determined that the underground piping has not been subject to major underground main breaks or significant deterioration. However, a portion of the underground serving CWC may have a lower reliability because a portion of the underground mains are in the same trench (2-feet apart) and cross over each other. It is possible that one accident or break in a main at this location could take both supply lines out of service at the same time.

During the review of documents that are related to the CWC, the following concerns were noted. The documents reviewed are as previously listed.

- WHC-SD-W112-FHA-001, Rev. 1, applies to Building 2404 WA. Paragraph 6.3 states “The three LTDS buildings will be used to store drums of solid combustible and noncombustible waste. Flammable and combustible liquids will not be stored in these buildings. If the storage of drums in the LTDS buildings includes “Lab-Packs” that contain Class I, II, or IIIA liquids, the FHA shall be revisited since they may significantly increase the hazard.”

- The resolution of CWC Fire Protection Assessment Recommendation CWC-98-01 (see JR Keene, September 1, 1998) involves fire modeling to justify leaving lab pack containers in place in other CWC buildings (2402 W-series buildings) and storage of new lab-packs in the 2404 W-series buildings. Presently, lab-packs have been observed in storage in building 2404 WA in violation of the FHA.

- WHC-SD-W112-FHA-001, Revision 1, is not accurate in its description of the water supply to CWC. The work done as part of Project B-604 needs to be included in the FHA.

- There appear to be many "project" FHAs that were written for the CWC. WHC-SD-WM-FHA-008, Revision 0, should be revised to incorporate these "project" FHAs so that CWC has one fire protection basis document.

- WHC-SD-W112-FHA-001, Revision 1, and WHC-SD-WM-FHA-008, Revision 0, are released documents but they have not been approved by DOE as required by DOE Orders 5480.7A and RLID 420.1 (Fire Protection).

- Fire protection assessments for buildings 2402-WF and 2403-WA indicate that the sprinkler systems in these buildings are "pipe schedule for ordinary hazard" and give a design density and flow of "about" 0.12 gpm per sq. ft. over an area of 4000 sq. ft. This analysis is not documented.

2402W Type Buildings

An inspection visit was made to Building 2402 WF. This building is provided with a sprinkler system and a radio fire alarm repeater transmitter with fire alarm devices.

The following sprinkler system items were reviewed or confirmed:

Dry Pipe system
Ordinary hazard schedule system
Black steel pipe
Head spacing - 10 ft. between heads
Line spacing – 12-ft 6-in between lines
Sprinkler heads - 165º F rated heads
Hangers and earthquake sway bracing
Conformance to drawings and standards

The following fire alarm items were reviewed or confirmed:

Radio Fire Alarm Repeater transmitter
Battery back up
Dedicated electrical panel breaker
Supervisory air pressure switch on sprinkler system
Supervisory tamper switches on all sprinkler water supply valves
Manual Pull stations
Sprinkler riser room temperature detector

The sprinkler system riser and valve rooms was checked for the following:

Arrangement of riser

Arrangement of the air supply for the dry pipe valve – “in house” air compressor
Arrangement of the fire department connection and drain
Valve room provided with baseboard heaters – adequate heat provided
Arrangement of fire alarm components

The following concerns were noted with the sprinkler system;

Trapeze pipe hangers are consistent with the details noted on the drawings. However, the design does not meet the usual design standards. Allowable loading for Unistrut: #P5500 T may not meet requirements in later editions of NFPA 13.

Later editions of NFPA 13 require restraint straps and/or locknuts on beam clamps and other hanger devices. Restraining straps and/or locknuts were not observed in the field.

A longitudinal sway brace is not installed on the end of the feed/cross main leading to the last branch line. Lateral sway braces are installed, it would make sense that a longitudinal brace would have been required at this location as well.

The lateral sway brace installed on the end of the feed/cross main leading to the last branch line is anchored to the trapeze hanger (Unistrut #P5500 T). This brace should be attached to a substantial building structural member.

Other sway braces on this sprinkler system were installed in accordance with the drawing detail.

The fire alarm system was reviewed and the fire alarm system devices (flow switches, tamper switches, high/low pressure switches, low temperature switches, manual pull stations, alarm bells, fire alarm panel and RFAR box) are consistent with the field installation. All of the fire alarm systems are hardwired with wiring in conduit. The panels are not multiplex style panels and therefore have no microprocessor software operating system subject to quality assurance requirements.

Storage arrangement in the 2402 WF Building consisted of drum storage on pallets. The storage is three pallets high. The drum and pallet are 44 inches in height for a total of 132 in (11 ft) high. The drums contain various solid waste materials from the site and are characterized as a Class IV commodity per the NFPA based upon drum contents (see the following Conclusion discussion on the standard load drum found in the Solid Waste Drum Array Fire Performance fire tests).

An area of concern was noted that relates to the storage in the 2402-WF Building as follows:

The dry sprinkler systems can’t provide adequate building fire protection when the storage in the building when the storage of palletized waste is three drum high.

This concern has been noted for several years (from the FHA and Fire Assessments). However, action has not been taken to correct this problem.

2403W Type Buildings

An inspection visit was made to Building 2403WA. This building is provided with two sprinkler systems, a fire alarm control panel with fire alarm initiating and signaling devices and a radio fire alarm repeater transmitter.

The following sprinkler items were reviewed or confirmed:

Dry Pipe system
Ordinary hazard schedule system
Black steel pipe
Head spacing - 10 ft. between heads
Line spacing – 12-ft 6-in between lines
Sprinkler heads - 286º F rated heads
Hangers and earthquake sway bracing
Conformance to drawings and standards

The following fire alarm items were reviewed or confirmed:

Fire alarm control panel
Radio Fire Alarm Repeater transmitter panel
Battery back up for both panels
Dedicated electrical panel breakers for both panels
Supervisory air pressure switch on sprinkler system
Supervisory tamper switches on all sprinkler water supply valves
Manual Pull stations
Auditable signaling gongs
Sprinkler riser room temperature detector

The sprinkler system risers and valve rooms were checked for the following:

Arrangement of riser
Arrangement of the air supply for the dry pipe valve – “in house” air compressor
Arrangement of the fire department connection and drain
Valve room provided with baseboard heaters – adequate heat provided
Arrangement of fire alarm components

There were no concerns were noted during the sprinkler systems drawing review.

The fire alarm system was reviewed and the fire alarm system devices (flow switches, tamper switches, high/low pressure switches, low temperature switches, manual pull stations, alarm bells, fire alarm panel and RFAR box) are consistent with the field installation.

Storage arrangement in the 2403WA Building consisted of drum storage on pallets. Most of the storage was 3 pallets high, (44 in. per pallet, a total of 132 in [11 ft]) high. Box storage was noted in the building to about 10 ft. high. The building contained some over packs drums that

were 3 pallets high (46 in. per pallet or a total of 138 in. [11 ½ft]). However the majority of building is being used for "normal" pallets storage. The drums contain various solid waste materials from the site and are characterized as a Class IV commodity per the NFPA based upon drum contents (see the following Conclusion discussion on the standard load drum found in the Solid Waste Drum Array Fire Performance fire tests).

An area of concern was noted that relates to the storage in the 2403-W series of buildings as follows:

> The dry sprinkler systems may not provide adequate building fire protection when the storage in the building when the storage of palletized waste is three drum high. This concern has been noted for several years (from the FHA and Fire Assessments). However, action has not been taken to correct this problem.
>
> The sprinkler system drawings for the 2403 series buildings as noted on Drawing H-2-821896, Sheet 1 states in Note 2 that all piping is Schedule 40. However, Schedule 10 (thin wall) piping may have been installed rather than Schedule 40 as noted on the drawings. The use of thin wall piping could allow the sprinkler system to provide adequate fire protection. This issue should be resolved, the drawings changes made if appropriate, and new hydraulic calculation performed.

2404W Type of Buildings

An inspection visit was made to 2404-WC Building. The 2404 Series Buildings are provided with calculated sprinkler system, a fire alarm control panel with fire alarm initiating and signaling devices and a radio fire alarm repeater transmitter.

The following sprinkler items were reviewed or confirmed:

> Dry Pipe system
> Calculated system
> Galvanized pipe, inside and out
> Head spacing - 10-ft between heads
> Line spacing – 10-ft between lines
> Sprinkler heads - 286º F rated heads
> Hangers and earthquake sway bracing
> Conformance to drawings and standards

The following fire alarm items were reviewed or confirmed:

> Fire alarm control panel
> Radio Fire Alarm Repeater transmitter panel
> Battery back up for both panels
> Dedicated electrical panel breakers for both panels
> Supervisory air pressure switch on sprinkler system
> Supervisory tamper switches on all sprinkler water supply valves

Manual Pull stations
Auditable signaling gongs
Sprinkler riser room temperature detector

The sprinkler system risers and valve rooms were checked for the following:

Arrangement of riser
Arrangement of the air supply for the dry pipe valve – "in house" air compressor
Arrangement of the fire department connection and drain
Valve room provided with baseboard heaters – adequate heat provided
Arrangement of fire alarm components

The following concerns were noted with the sprinkler systems and the fire alarm systems:

The 4-way earthquake sway bracing on the west end of the 2404-WB Building is not attached to structure.

The drawings for the fire alarm systems for 2404-WA, WB, WC shows three (3) system isolation valves with tamper switches (Device Nos. 5-1, 5-2, 5-3). However, in the field, two (2) isolation valves are actually installed with two (2) associated tamper switches (Device Nos. 5-2, 5-3). High/Low Air Pressure switches are provided for each of the risers but these switches are not shown fire alarm system drawing that shows the wiring/device riser for fire sprinkler riser room.

An insulated ground wire clamped to fire department connection pipe in all of riser rooms. This is a poor ground due to rubber gaskets in pipe couplings and poor contact between FD connection piping and penetration through building exterior wall.

High/Low Air Pressure switches are located on the risers but they are not shown fire alarm system wiring/device riser for fire sprinkler riser room.

Storage arrangement in the 2404WA Building consisted of drum storage on pallets. Most of the storage was 3 pallets high, (44 in. per pallet, a total of 132 in [11 ft]) high. Box storage was noted in the building to about 11 ft. high. The majority of building floor space is being used for "normal" pallets storage, but much of the area is only one pallet high. The drums contain various solid waste materials from the site and are characterized as a Class IV commodity per the NFPA based upon drum contents (see the following Conclusion discussion on the standard load drum found in the Solid Waste Drum Array Fire Performance fire tests).

Water Supply and underground piping

Water for fire protection purposes is provided to the CWC through the sanitary water system. The water is provided by the 200 Area water system to CWC through two new12 inch feed lines located to the north of PFP. The mains are in the same trench and located 2-feet apart. They are supplied by connections to the existing water sysem to the northeast of PFP. The 12 inch main are separate on the west side of PFP and are routed on opposite sides 16th Street to Dayton Ave.

to 19th Street. At this point one feed goes into the south end of the CWC Complex and the other to the north end. The water supply underground piping is primarily cast ductile iron and polyvinyl chloride (PVC) deemed to be in fair condition with appropriate valuing and hydrants as required by NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances. The underground water supplies are looped and gridded around CWC and two sources of water are provided for redundancy as required by DOE. However, during the review, it was noted that the two feed mains to the CWC are located close to each other and in fact cross over each other, which may affect the reliability of the system. A piping rupture may possible take out both feeds.

The sanitary water supply serving the CWC fire protection systems consists of two supply sources, including a primary sanitary clear well system with a water storage capacity of 400,000 gallons and a secondary system with a 1,100,000 gallons reservoir for the 200 West Area. Sanitary water system pumping capabilities include four electric pumps @ 1,000 GPM each and one electric pump @ 4,000 GPM.

A water flow test at hydrant 2-WF (inside the CWC Complex) was conducted by the Hanford Fire Department on January 25, 2002 to support this assessment. The following are the results of this test:

Residual Hydrant 1-WF	
Static Pressure	100 PSI
Residual Pressure	65 PSI
Residual Hydrant 9-WF	
Static Pressure	102 PSI
Residual Pressure	68 PSI
Flow Hydrant 2-WF	
Test Flow:	1187 GPM

Fire hazard analysis

There are six FHA documents for the CWC facilities. The two major FHA documents are WHC-SD-W112-FHA-001, Revision 1, and WHC-SD-WM-FHA-008, Revision 0.

First, WHC-SD-W112-FHA-001, Rev. 1, applies to Building 2404 WA. Paragraph 6.3 of the FHA states that "The three LTDS [Long Term Drum Storage] buildings will be used to store drums of solid combustible and noncombustible waste. Flammable and combustible liquids will not be stored in these buildings. If the storage of drums in the LTDS buildings includes "Lab-Packs" that contain Class I, II, or IIIA liquids, the FHA shall be revisited since they may significantly increase the hazard." However, lab-packs were noted inside the 2404WA building.

The resolution of CWC Fire Protection Assessment Recommendation CWC-98-01 (see JR Keene, September 1, 1998) involves fire modeling to justify leaving lab pack containers in place in other CWC buildings (2402 W-series buildings) and storage of new lab-packs in the 2404 W-series buildings. Presently, lab-packs have been observed in storage in building 2404 WA that is not analyzed by the FHA.

WHC-SD-W112-FHA-001, Revision 1, is also not accurate in its description of the water supply to CWC. The water supply upgrades done as part of the Project B-604 are not included in this FHA. In addition, the propane tank for forklift 40-75-4995 lacks protection of the propane tank as required in the FHA.

The WHC-SD-WM-FHA-008, Rev. 0, FHA covers the 2402 and 2403 Series buildings plus the low flash point mixed waste and alkali metal waste storage modules. This FHA, written in 1996, identified sprinkler hydraulic concerns for the sprinkler systems in these buildings (even though the FHA underestimated density design requirements per the NFPA) but unfortunately corrective actions have not been implemented by the facility.

USQ Process:

The USQ process is discussed in the safety function area definition.

CONCLUSION:

Fire Protection water supply for CWC is supplied from the 200 West Area sanitary water system. This is a pumped system and interconnected with the 200 East Area water system that is equal in reliability of that of a municipal system.

Project L-339 that was just completed modified the water supply that directly feeds the CWC Complex. The L-339 Project eliminated the 10-inch supply through the PFP Complex and provided two new feeds to the CWC Complex. These two feeds are 12-inches in size and are located north of the PFP complex. Water is supplied from the 200 West Area water system with the connection to this system northeast of PFP. One of the new mains is supplied by an 8-inch supply main. In addition, the new mains were installed for most of their length in the same trench and are located 2-feet apart and cross over each other. The arrangement may affect reliability of the system in the event of a piping rupture that could take out both feeds. The underground water supplies are looped and gridded around CWC and two sources of water are provided for redundancy as required by DOE.

There were also no indications of water main breaks and significant deterioration of the underground piping to CWC that would affect system reliability.

The automatic sprinkler systems in the three different types of buildings were reviewed. The 2402W and 2403 W type building have dry pipe valve sprinkler system. The systems are ordinary hazard pipe schedule with 125 sq ft spacing per head. These system provided fire protection for the palletized drum storage waste up to three drums high. The drums contain various solid waste materials and classified as a Class IV commodity as noted in the safety bases document, HNF-SD-WM-ISB-007, Revision 1-C.

Class IV commodity is defined by NFPA as a product, with or without pallets, that is constructed partially or totally of Group B plastics, or consists of free-flowing Group A plastic materials, or contains within itself or its packaging an appreciable amount (5 percent to 15 percent by weight

or 5 percent to 25 percent by volume) of Group A plastics. The remaining materials shall be permitted to be metal, wood, paper, natural or synthetic fibers, or Group B or Group C plastics.

A review of the Solid Waste Information Tracking System for selected containers found in CWC facilities included a number of containers with packing components of materials of polyurethane plastics, rubber, paper, and other waste component constituents. Additional evidence on the content of materials stored in the CWC facilities was found in WHC-SD-WM-TRP-246, Solid Waste Drum Array Fire Performance. The Solid Waste Drum Array Fire Performance was done to predict the performance of drums in fire at Hanford solid waste storage facilities. In order to evaluate fire a "standard load drum" was agreed on by Solid Waste Management and Fire Protection Engineering in 1995 as being representative of drums used in Hanford solid waste storage facilities. The "standard load drum" consists of appreciable amounts of rubber, plastic, paper, and cotton, which was consistent with the generated waste of DOE complex nuclear material production. Finally, the assessment team obtained container data on the pipe overpack containers (POC) used in CWC. The POC consist of a stainless steel pipe and lid sealed with butyl rubber or ethylene propylene O-ring centered in a 55-gallon steel drum. The steel pipe is surrounded inside the drum by cane fiberboard plywood packing and a polyethylene line. The POC was evaluated by fire test for transportation purposes by Sandia National Laboratories. The fire tests showed that internal pressure from fire can create enough pressure on the drums to result in a violent lid loss, polyethylene drum liners being destroyed by the fire, and portions of the fiberboard being burned.

Based on the NFPA definition of Class IV commodity it is evident to the assessment team that most all of the packaging and contents of drum stored at CWC are considered a Class IV. Polyethylene and polyurethane plastics and rubber are considered Class A and B plastics. Containers containing this material coupled with wood, paper, and natural or synthetic fiber materials meet the definition of NFPA as a Class IV commodity. This indicates that the sprinkler systems for CWC should be designed for a Class IV commodity. While a Class IV commodity was taken into consideration into the design of the sprinkler system in the 2404 series buildings, Class IV commodities were not considered in the design of the sprinkler systems for the 2403 and 2402 series buildings.

Finally, while the solid waste procedures (e.g. SW-100-143) have inventory controls based on radionuclide content and physical limitations (based aisle widths and storage heights no greater than 3 drums for structural considerations) there are no controls on the container contents relative to commodity classification that could be counted on to protect the design assumptions of the sprinklers for a NFPA commodity Class less than IV.

Fire tests conducted by Sandia National Laboratories and by the Solid Waste Drum Array Fire Performance protocols demonstrated that drum content lid loss in a fire is anticipated. With propane fired fork trucks and wooden pallets in the CWC facilities there is enough energy available to initiate a fire in CWC facilities to result in drum container lid loss of container contents and involvement and fire extension into upper tier drums. Such a fire could easily over come the design capacity of the sprinkler systems in 2402 and 2403 series buildings because they were not designed for this sort of a fire.

In accordance with NFPA 13, palletized storage a Class IV commodity requires a sprinkler system designed to need Ordinary Hazard (OH) 2 design criteria.

Additional reviews and calculation were done for the sprinkler systems in the 2402W type buildings. The sprinkler systems are four-inch dry pipe systems using ordinary hazard pipe schedule, about 125 sq ft head spacing per head using 165 degree F rated heads. The storage is drummed waste (a Class IV commodity per the Facility FHA) three drums high, 11 feet. This type of storage requires a sprinkler system that can provide a sprinkler density of Ordinary Hazard (OH) group 2 as defined by NFPA 13, 1999 Edition. This requires a sprinkler density of 0.20 gpm per sq ft over the most remote 1500 sq area. In addition, a 30% increase in design area is required for the dry systems which gives an area of 1950 sq ft. Hydraulic calculations using the HASS program were done at this density. HASS determined that the required flow at the base of the riser is 560 gpm at 123.4 psi and 1060 gpm at 134 psi at the loop. This latter flow includes 500-gpm allowances for fire department hose streams. In addition, hand hydraulic sprinkler calculations were done at this density to verify this information. The required flow at the base of the riser from this calculation was determined to be 562 gpm at 119.73 psi and 1062 gpm at 129 psi at the loop. This latter flow includes 500-gpm allowances for fire department hose streams. This is within the tolerance differences expected by both calculations.

If the 1990 Edition of NFPA 231, Standard for General Storage, is used to determine the required automatic sprinkler density, the required flow is much greater than the above flow. Using Table 6-2.1a, the required density to protect a Class IV commodity is 0.385 gpm per sq ft over the most remote 2000 sq ft area. In addition, a 30% increase in design area is required for the dry systems. However, the density can be reduced in accordance with Figure 6-2.2. For storage 12 ft or less in height, there is a reduction of 60% allowed in the density. The required density is 0.23 gpm per sq ft over the most remote 2000 sq ft area for wet system or 2600 sq ft for the dry systems. The required flow at the base of the riser for a dry system is 823.9 gpm at 134.7 psi and 1329 gpm at 155 psi at the loop. This latter flow includes 500-gpm allowances for fire department hose streams.

The water supply cannot provide the required flows. The water supply has a static pressure of 100 psi with a residual pressure of 65 psi at a flow of 1187 gpm based HFD test done January 25, 2002. See Figure 1.

The sprinkler systems as installed can only provide about half of the required sprinkler system density. With this reduced density, a fire starting in the palletized storage may not be controlled. This could lead to failure of the building steel and the building could fall to the ground. The fire could continue to burn in an uncontrolled manner.

The water flow test shows that only about half of the needed water is available for the underdesigned systems in the 2402 and 2403 facilities. Thus the sprinkler system can’t be counted on to protect the building and its contents for a total loss. This type of a destructive fire could allow for the release of any radioactive materials that is contained in the drums.

The dry sprinkler systems in the 2404W type buildings are hydraulically calculated and will provide a 0.30 gpm per sq ft density over the most remote 3000 sq ft using high temperature

rated heads. This density will provide adequate fire protection for storage up to 4 pallets high. The current storage is only three pallets high therefore the fire sprinklers are adequate.

The fire alarm system for the three types of buildings was reviewed. The fire alarm system includes the fire alarm control panel; the input devices (flow switches, pressure switches, etc), local alarms, and manual pull stations. Alarms and troubles are transmitted through the radio fire alarm repeater (RFAR) to the Hanford Fire Department. The fire alarm systems were found to be installed in accordance with the drawing except for two minor items. The drawings for the 2404W type buildings showed four tamper switches but only three are installed, as there are only three valves that are required to be tampered. The same drawings did not show the high/low air pressure switches that were installed in each valve room.

Both the fire alarm control panels and the radio fire alarm repeater panels have dedicated primary power supplies and battery backup of sufficient capacity. Should primary power fail on any panel the panels automatically switch over to battery backup and a supervisory signal is transmitted to the Hanford Fire Department for investigation and correction. The panel's batteries are also supervised so that if a battery is removed or falls below a predetermined capacity a supervisory signal will also transmit to the Hanford Fire Department. In addition, if both primary power and battery back up is removed the radio fire alarm repeater will not be able to automatically transmit it's daily test message to the fire department. When a daily test message is not reported automatically the fire department dispatches personnel to the facility panel to determine why the panel is not reporting. Therefore alarm and supervisory signals are maintained for the CWC facilities and they are reliable and capable of transmitting alarms to the on site fire department.

Issues:
The dry sprinkler systems in the 2402W and 2403W type buildings are not adequate to protect the palletized storage. Upgrades to the systems are needed

The sprinkler system in the 2402W type buildings need to be inspected and brought up to the current NFPA13 requirements for earthquake sway bracing.

The fire alarm drawings for the 2404W type buildings need to be updated to show the as-constructed condition, (need high/low air pressure switches and tamper switches).

NFPA 25 requires that the sprinkler system be investigated on a regular frequency to determine if any obstructions are present. This is especially important for systems that were constructed with black steel piping (2402 and 2403 series buildings). There is no evidence that this inspection is being doing on a 5-year schedule. NFPA 25, Section 1-2.2 emphatically states, "Systems shall be examined internally for obstructions where conditions exist that could cause obstructed piping." Dry systems are inherently prone to condensation and condensation on black steel piping creates corrosion produces and crud that will plug small diameter sprinkler piping. Since there is a condition that exists that could cause obstruction in this piping and a physical internal inspection has never been done on these systems an internal obstructions investigation should be conducted.

During the CWC document review, the following concerns in the FHA were noted and need to be addressed:

> WHC-SD-W112-FHA-001, Rev. 1, applies to Building 2404 WA. Paragraph 6.3 states "The three LTDS buildings will be used to store drums of solid combustible and noncombustible waste. Flammable and combustible liquids will not be stored in these buildings. If the storage of drums in the LTDS buildings includes "Lab-Packs" that contain Class I, II, or IIIA liquids, the FHA shall be revisited since they may significantly increase the hazard."
>
> The resolution of CWC Fire Protection Assessment Recommendation CWC-98-01 (see JR Keene, September 1, 1998) involves fire modeling to justify leaving lab pack containers in place in other CWC buildings (2402 W-series buildings) and storage of new lab-packs in the 2404 W-series buildings. Presently, lab-packs have been observed in storage in building 2404 WA in contradiction of the FHA.
>
> WHC-SD-W112-FHA-001, Revision 1, is also not accurate in its description of the water supply to CWC. The water supply upgrades done as part of the Project B-604 are not included in this FHA. In addition, the propane tank for forklift 40-75-4995 lacks protection of the propane tank as required in the FHA.

There are multiple FHA documents that have not been formally reviewed and approved by DOE RL. As required by RLID 420.1, Section 8.11 facilities shall have only one fire hazard analysis document and they must be reviewed and approved by RL.

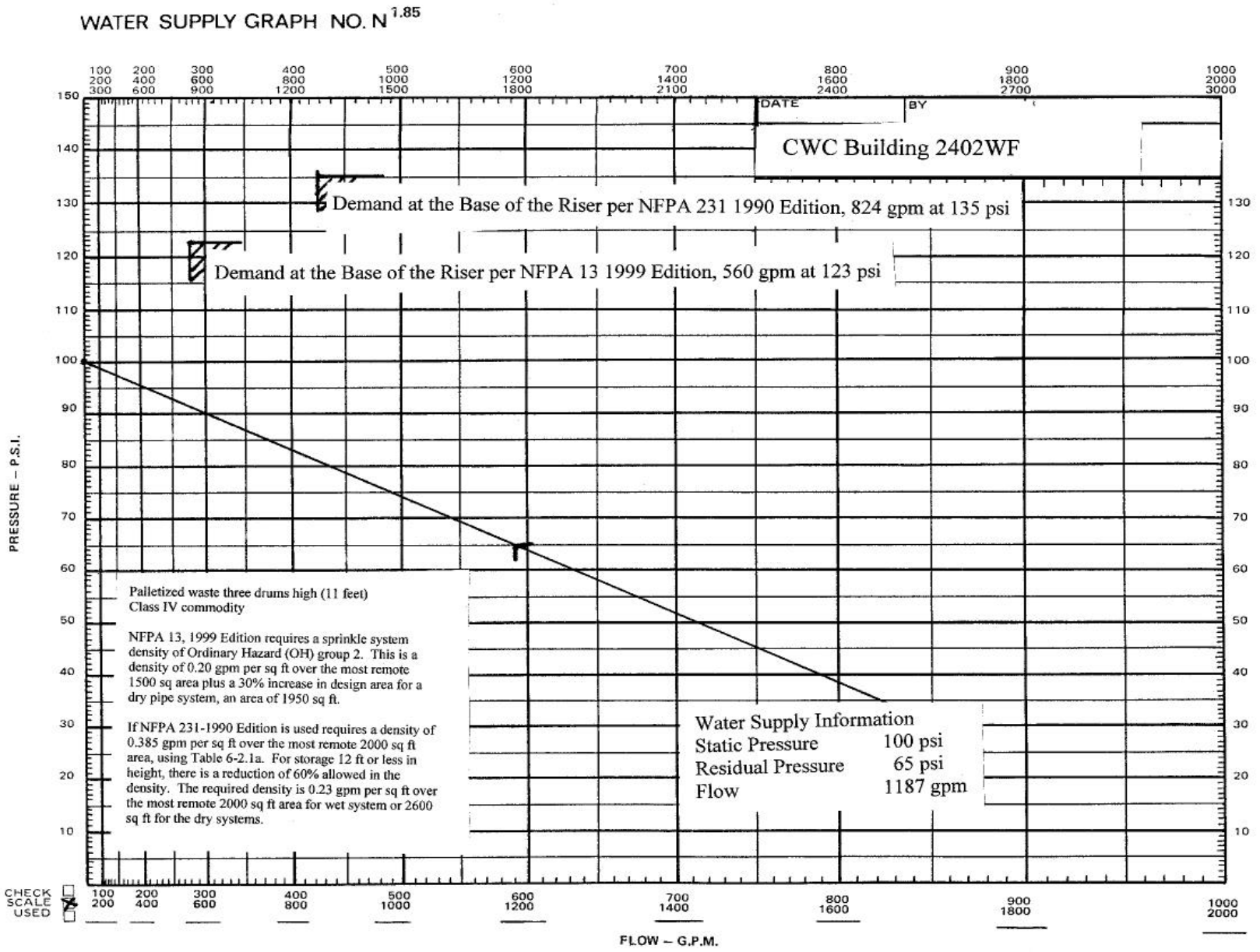

Figure 1: CWC Building 2402WF Water Supply and Sprinkler Demand Curve

System Surveillance, Testing and Maintenance

(Note: The System Surveillance and Testing and Maintenance Criteria Requirements Assessment Criteria were combined in this review due to their similarity)

OBJECTIVE:

Maintenance, Surveillance and Testing of the Fire Protection systems at the CWC demonstrate that systems are operable, reliable, capable of accomplishing their safety functions, and continue to meet applicable system requirements and performance criteria.

Criterion:

1. Requirements for maintenance, surveillance and testing are adequate for demonstrating overall system reliability and operability, are linked to the technical safety basis, the processes for preventive, corrective and predictive are in place and effective, and the backlog is managed.

2. Maintenance, surveillance and test procedures confirm that key operating parameters for the overall system and its major components are maintained within operating limits, and systems are reviewed and walked-down to assess material condition.

3. Instrumentation and measurement and test equipment (M&TE) for the system are calibrated and maintained.

APPROACH:

Records Review:

1-1 Identify the acceptance criteria from the maintenance, surveillance and test procedures used to verify that the system is capable of performing its safety functions, and acceptance criteria are capable of confirming that safety/operability requirements are satisfied.

1-2 Evaluate Maintenance of aging Fire Systems equipment and components

1-3 Determine that maintenance source documents, industry standards DOE Orders are used as technical bases for Fire System work packages

2-1 Review maintenance, surveillance and testing processes, as well as the procedures for the system's major components. Review a sample of the maintenance and test procedure results to assure that they are accurate:

- Validity of test data
- System performance meets requirements
- Performance criteria are appropriate for current facility mission life-cycle
- Parameters that demonstrate compliance with the safety requirements can be measured
- Test personnel are knowledgeable and able to satisfactorily perform the test
- The procedures reflect applicable safe operating conditions
- Limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria are included
- Appropriate data recording provisions are included or referenced and are used to record results
- The procedure includes provisions for listing discrepancies

- The procedure requires timely notification of facility management about any failure or discrepancy that could impact operability
- Appropriate personnel reviewed the test results and took appropriate action

3-1 For the maintenance, surveillance and test procedures and records reviewed, determine whether the test equipment used for testing was calibrated.

3-2 Perform a walkthrough of the maintenance, surveillance and test procedure with appropriate facility personnel and verify:

- Material condition
- Validity of test results
- System performance meets system requirements
- Performance criteria are appropriate for current facility mission life-cycle
- Parameters that demonstrate compliance with the safety requirements can be measured
- Test personnel are knowledgeable and able to satisfactorily perform the test
- The procedure cites applicable Technical Safety Requirements/Limiting Conditions for Operation
- Limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria are included
- Appropriate data recording provisions are included or referenced and are used to record results
- The procedure includes provisions for listing discrepancies
- Observed deficiencies are identified, prioritized and corrected in a timely manner
- The procedure requires timely notification of facility management about any failure or discrepancy that could impact operability
- Appropriate personnel reviewed the test results and took appropriate action

PROCESS:

<u>Administrative note</u>: for the purpose of this VSS assessment report on the CWC Fire Protection Systems, the objectives/criteria for two separate CRADs (System Maintenance/System Surveillance & Testing) have been combined into a single set; now called "System Maintenance, Surveillance and Testing".

Records Reviewed:

- HNF-PRO-340, *Fire Protection Program Overview & Responsibilities*
- HNF-RD-9188, *Fire Protection Design/Operations Criteria*
- HNF-RD-7899, *Fire Protection System Testing/Inspection/Maintenance/Deficiencies* (establishes periodical and frequent activities to be performed on Fire System equipment, as requirements from NFPA 25 and NFPA 72)
- NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*
- NFPA 72, *National Fire Alarm Code*
- HNF-IP-0939, *HFD Internal Policy, Fire System Maintenance and Testing Policy, Section 17.10, Rev. 5, Maintenance and Testing Procedure Administration*
- WMP Project Procedure Manual (PPM), Table of Contents (TOC)

- WMP/CWC Operations Daily Release Sheet (DRS), and the CWC Plan of the Week Schedule (week of 2/4/02)
- WMP/CWC USQ Screening Memo, Engineering (Whitlock) to Operations (J. Mitchell)
- FSM "Impairment" History Report for WMP/CWC (6-month run date, 2/6/02)
- FSM Work Packages 2X-01-26143/J through 26145/J: Fire Alarm Control Panels (FACP) testing, RFAR tests, Dry Fire System Risers testing at 2403-WA, 2403-WB, etc., and Annual test of the 286W-1 Reduced Pressure Backflow Preventer
- FH Utilities Reduced Pressure Backflow Preventer (RPBP) Test Procedure S-CC-0044, Rev. 4
- Maintenance Work Packages: 2G-02-26335/P; *2403-WC Fire Alarm Control Panel (FACP)/Battery Test/Replace*; and 2G-02-26336/P; *2403-WD Fire Alarm Control Panel (FACP)/Battery Test/Replace*
- HFD PM Work Order 2G-02-26384/P, 286-W, Febco, Annual Backflow Preventer Test/Maintenance PM; Equip. Descr. BFPV-10169 (Model 825YD)
- FSM Procedures FS-049, Rev. 1A, Replace FACP Batteries, and FS-010, Rev. 1A, Test and Maintenance of Fire Alarm Control Panel (FACP)
- Maximo (CMMS) report - *Recalled FSM PM/Surveillance Activities*
- Maximo (CMMS) report - *FSM North/South Area Maint & Testing Weekly Schedule*
- FSM Procedure Group *Facility Reviewer Checklist* (new process tool)
- HFD/FSM Report – *Active Testing and Maintenance Procedure Index*
- WMP Manual, WMP-200, Section 3.14, *Cold Weather Protection*
- FSM-MIP-001, Rev 0/Chg 0, HFD/FSM, Maintenance Implementation Plan (MIP)
- Certificates of Calibration (Energy NW Standards Lab); Fluke Digital Multimeter, and the Backflow Test Kit – Midwest Model 830

Personnel/ Positions Interviewed:
FSM Work Control Coordinator
FSM Planner/Scheduler
Manager, Fire Systems Maintenance
FSM Electrician
FSM Procedure Writer, Maximo CMMS Specialist
WMP/Solid Waste Maintenance Engineer, PIC
WMP/CWC Operations Manage
WMP/CWC Operations Planner/Scheduler
WMP/CWC Maintenance Planner/Scheduler
FSM Supervisor, Mechanical Team
Fire Department, Firefighter
FSM Electrical Engr., PIC

Evolutions/Operations/Shift Performance Observed:

- HFD and FSM Prejob for maintenance and tests of RFARs, Fire Alarm Control Panels (FACP), Fire System Dry Risers, and a RBPB at/near Central Waste Complex (CWC) buildings 2403-WA and 2403-WB

- HFD and FSM Prejob for conducting inspection and testing of the FACPs at CWC buildings 2403-WC and 2403-WD
- Critique of CWC management pertaining to failure to adequately release field work of outside craft (related to the FACP work)

RESULTS:
Discussion of Results:

1. **In the Field**: To gain familiarization of CWC, the team participated in a site tour on January 30, 2002. The team entered the 2402WF, 2403WA, and 2404WA Buildings, observed fire protection systems (i.e., detection/alarm and suppression) and layout of waste storage. On February 5-7, 2002, observed the Hanford Fire Department (HFD) and Fire Systems Maintenance (FSM) at CWC buildings facilities conducting fire system work packages as follows:

   - On February 5, 2002, observed the HFD and FSM pre-job meeting in preparation for workers to conduct maintenance and tests of Radio Fire Alarm Repeaters (RFARs), Fire Alarm Control Panels (FACP), Fire System Dry Risers, and a Reduced Pressure Principle Backflow Preventer (RPPB) at/near Central Waste Complex (CWC) buildings 2403-WA and 2403-WB. The pre-job meeting was held at MO-720, and was attended by Fire Fighters and Fire System Maintenance craft that would be conducting the work. HFD work documents (test reports) 2X-01-26143/J through 26145 were reviewed. The pre-job briefing was led by the Electrical Engineer/Person-in-Charge from the Fire Systems Maintenance group. An Operator from the CWC facility was in attendance, as was an Operations management representative. The pre-job leader covered a number of topics regarding the work, to include job scope, location, facility status, significant work steps, special safety precautions, and notifications. The packages were released (signature) by the Operations staff prior to the work team departing for the work location. All workers and observers checked in at the CWC Dispatch office (MO-288) prior to initiating work activities in the affected buildings. The work at the facilities was conducted in accordance with work packages and procedures. Workers followed test and maintenance procedures as directed by procedure "use" expectations. The test procedure S-CC-044, RPBP, was used in step by step (continuous use) fashion by the pipefitters even though the procedure did not contain a procedure use type direction. All inspection and test data recording was completed as instructed. Systems were properly restored following applicable work.

   - On February 6, 2002, attended and observed a morning pre-job briefing at MO-720 to prepare HFD and FSM personnel for conducting inspection and testing of the FACPs at CWC buildings 2403-WC and 2403-WD. Work Packages 2G-02-26335/P and 2G-02-26336/P were reviewed and discussed by the pre-job facilitator (PIC) and the workers, covering work scope, special precautions, facility status, and notifications. A CWC Operator also attended the meeting, who advised that care be taken to avoid slips/falls due to ground frost. Without obtaining an Operations release of the work, the work team(s) departed for the Dispatch office, where they signed in prior to moving to the affected work areas at 2403-WC/WD. The dispatcher observes sign in, but did not review issues such as destination, documents, or other pertinent matters. Just as the FSM

electricians began to do alarm and battery tests within the control panel, after gaining panel access by the lead Fireman, they were told by the Fireman that the work packages had not been released by Operations and the work was to stop. The control panel was cleared and restored to original configuration, and the Fireman returned the ventilation system to normal from a by-pass configuration. The CWC Operator was unable to identify the personnel that would provide official work release, but the fireman requested that an electrician return to the Dispatch office or the CWC Operations offices to get the packages released. Approximately 20 minutes elapsed before the electrician returned with appropriate clearance to proceed with work. Work activities were continued, and procedures were used as directed by the instructions. When questioned, one electrician seemed momentarily surprised that the procedure for conducting the battery test on the FACP was directed to be used in "continuous" fashion, but following brief discussion with co-workers, continued to conduct the test. Prior to conducting the test, one electrician noticed that the Fluke multimeter in hand had an expired calibration sticker. This unit was exchanged for a like instrument that had an acceptable calibration status, and the task was resumed. During the battery replacement and test at 2403-WC, the electricians noticed an intermittent "supervisory" alarm condition. Through simple troubleshooting they were able to determine that the condition was caused by a bad "lug" on the battery end. The lug was replaced as part of the PM activity. When the work activities were completed, the systems were restored and Operations was notified that tests were finished. HFD personnel restored the RFAR system that had been isolated prior to the maintenance and test.

- On February 7, 2002, as invited, observed the performance of a CWC management "critique" session pertaining to the matter of "failure to adequately release field work of outside craft" (related to the FACP work conducted on the previous day, February 6, 2002). The critique was facilitated by a CWC Operations manager, and attended by personnel from CWC, the HFD, and FSM. The critique covered discussion of the occurrence, used a time-line for determining event sequences, discussed immediate actions taken, potential causes, and longer-term commitment actions and responsibilities. The plant manager attended the entire critique session

- Many interviews were conducted with employees of the HFD, the FSM group, and the CWC facility to determine worker knowledge and understanding of their work assignments, responsibilities, work processes, fire system maintenance/test requirements, system condition and status, etc. Interviews were conducted with the following personnel: FSM Work Control Coordinator, FSM Planner/Scheduler, FSM Maintenance Manager, FSM Mechanical Supervisor, FSM Electrical Engineer, two FSM Electricians, FSM Procedure Writer, WMP/Solid Waste Maintenance Engineer, WMP/CWC Operations Manager, WMP/CWC Operations Planner, WMP/CWC Maintenance Planner/Scheduler, and two HFD Firefighters.

Summary:

Hanford Fire Department, Fire Systems Maintenance and CWC Operations organizations and staff had mature management systems and processes in place for identifying, establishing,

conducting and controlling activities for maintenance, testing and inspection of fire systems. Hanford Fire Department and Fire System Maintenance have qualified personnel to address these systems. Fire fighters, pipe fitters and electricians assigned to perform tasks on these systems have gained system competency through special training on fire systems equipment, such as state of the art control panels, and on-the-job training using mock-ups or mentoring. In addition, some of maintenance staff actually hold a National Institute for Certification in Engineering Technology (NICET) certification and hold a Washington State Fire Sprinkler Certificate of Competency. NICET is awarded to individuals who have appropriate engineering technician work experience or appropriate engineering technologist work experience in fire protection systems and State Fire Sprinkler Certificate of Competency is awarded to persons who have satisfactorily passed an examination administered by the State demonstrating knowledge and competency of fire sprinkler systems.

Fire Protection Engineers in WMP/CWC and in the Hanford fire Department understood their requirements and translated them into effective program procedures and systems. Fire Protection Engineers and personnel involved in work management processes were aware of backlogged work inventories, and kept a list of system impairments, to include the time that it took to repair those failures. Work instructions, work packages and working level procedures, including data sheets, were developed, recalled and controlled through formal work management systems and procedure management policies. Adequate involvement of subject matter experts, to include the review of fieldwork tasks for Un-reviewed Safety Questions (USQ), was conducted. There were good communication and feedback processes in place between the owning organization and the service organizations to assure that changing requirements or conditions were adequately addressed.

Procedures and work packages were developed using information and criteria from manufacturer vendor data, and include specific system parameters established by engineers from safety bases documents.

Procedures for maintenance and testing of fire systems were reviewed by applicable subject matter experts prior to being issued or released. Fire Department personnel (firefighters) and Fire System Maintenance craft were allowed to review and validate procedures before they were used in the field. Working level procedures included adequate guidance on how to use procedures, actions to take if the procedure was incorrect, where steps might be “not applicable”, and where to enter measurement data. Measuring and Test Equipment (M&TE) was adequately identified, stored and maintained. Workers were observed reviewing and verifying that M&TE were properly calibrated before using to conduct tests or other related measurements. Each work package or procedure contained a section (work record) for workers to report any unusual issues or findings, needed procedure corrections, or other deficiencies or recommendations. Following the completion of fieldwork, engineers and craft management reviewed work documents to assure that any data discrepancies were addressed, and that worker feedback was acted upon.

Pre-job briefings were conducted before each fieldwork evolution, and covered such topics as safety, system status, notifications, and how to recover from abnormal events. Fieldwork

observed was conducted using technically adequate procedures and data sheets. Workers used procedures and work packages as directed.

Summary: In one instance, work was allowed to be performed without achieving formal Operations work release as required by policy. In that case, once identified, the workers stopped work and restored the system, then notified appropriate personnel.

2. **Related Document Reviews:** Reviewed over 20 documents related to the inspection, testing, and maintenance of fire protection systems (sprinklers, fire alarms, and related electrical and water supply) to validate whether or not CWC fire protection and support systems are operable, reliable, capable of accomplishing their safety functions, and continue to meet applicable system requirements and performance criteria. Reviewed the applicable NFPA Codes and Standards (NFPA 25 and 72), fire protection system inspection, testing and maintenance procedures, and several work packages to determine if systems are capable of performing their functions and if NFPA Codes and Standards and DOE Orders are used as technical bases for the work packages.

   Summary:

   - Procedures and requirements for the inspection, testing, and maintenance of fire protection systems at CWC, with the exception of inspection of the sprinkler system obstruction investigation per NFPA 25, is consistent with NFPA requirements and DOE expectations.

   - Only one procedure, the site standard for testing the reduced pressure principle backflow preventors (RPBPs), did not clearly state the expectation for "procedure use". The procedure was used in "continuous" type use by the workers, or "step-by-step"

Conclusion:
The CWC Operations organization adequately maintains, tests and inspects facility Fire Protection Systems, assuring that these programs meet the requirements of DOE Orders, NFPA, other regulations, and internal policies (HNF-RD-7899) with the exception of inspection of the sprinkler system obstruction investigation per NFPA 25. Maintenance, test and inspection criteria are carefully reviewed against requirements, established in working-level procedures and recall systems, and results are evaluated to assure that fire protection system integrity is sustained.

Fire Department and Fire Systems Maintenance and Test personnel are well qualified and exhibit very good abilities, knowledge and skills in performing maintenance and tests on complex fire protection components and systems. These personnel take pride in their work, demonstrate highly effective communication skills during work tasks, and are concerned when quality is compromised for any reason. The concept of "procedure use" is an important part of conducting good "formality of operations", and frequent improvements or changes in this particular policy area at Fluor Hanford may mean that workers don't always fully understand related processes. Management needs to continually remind or re-train workers to be certain that there is no confusion.

The CWC Operations understands their obligations to maintaining the Fire Protection Systems. CWC "operational control" of "outside" resources or service groups doing work within their facility areas or buildings should be improved. The facility can improve on the overall control of outside workers by assuring that work is formally released and controlled, to include raising the level of attention and participation by their own Operators during the conduct of these work evolutions.

Issues:

- Facility Operations must assure that all work is adequately released and controlled, especially for work performed by "outside" organizations. Fire Department and Fire Systems Maintenance work activities on February 6, 2002 were allowed to progress without obtaining formal release as required by FH/WMP policy and DOE Conduct of Operations requirements. Additionally, the actions (or lack thereof) by the CWC dispatch office and by the CWC Operator on the job failed to protect the facility from this process failure.

- A work package was prepared by FSM, and released by CWC Operations, that contained a working level procedure (S-CC-044, RPBP Testing) without necessary reference to "procedure use" type. Under questioning, and in the process of doing work, some workers were unclear in their answers regarding the basis for developing and then implementing "procedure use" expectations (reference vs. continuous). There has been much action recently at the FH "company" level with regard to "procedure use" applications. Subsequently, HFD, FSM and CWC organizations may need to revisit the matter with their workforce to prevent potential violations in the future.

BIOGRAPHIES OF TEAM MEMBERS

Craig P. Christenson, P.E.
U.S. Department of Energy

EDUCATION:

Bachelor of Science - Fire Protection Engineering,
University of Maryland, College Park, Maryland (May 1985)

CERTIFICATION AND LICENSES:

Registered Professional Engineer (P.E.): Fire Protection Engineering, CA State License No. FP-1186
Fire Protection Engineering, WA State License No. 25863

SUMMARY:

A multidisciplinary principal fire protection engineer with over 15 years professional experience in the broad and comprehensive field of reducing consequences, loss of life and property impacts of fire by applied engineering fundamentals, research, fire hazard analysis, design of fire protection systems for commercial buildings, industrial, and nuclear complexes and processes, research and development of fire propagation, detection and suppression, public and industrial fire department organizations, fire department incident command systems, emergency medical requirements, fire ground tactics, confined space requirements, and hazardous material responses.

A partial list of experience includes:

- Evaluation and recommendation concerning the content of fire protection programs at Department of Energy (DOE) Hanford Nuclear Reservation. Provides direction to DOE and contractors to assure achievement of fire protection objectives and produce a level of fire protection, health, and safety performance, which is better than the national average.
- Design and engineering of fire protection systems for all types of commercial and industrial buildings, structures, and hazards for compliance with Department of Defense fire protection engineering criteria.
- Conducted fire protection surveys, inspections, and audits of large facilities and complexes of Marine Corps, Navy, Air Force, and Air National Guard shore facilities including field facility walk downs, facility water supplies, adequacy of fire department responses, fire prevention services, and fire system maintenance.
- Conducts fire hazard analysis reviews, nuclear safety hazard analysis reviews, operational readiness reviews and field level inspections and assessments for complex industrial and nuclear facilities.
- Authored the DOE filter plenum fire protection criteria, which is included in the DOE Fire Protection Design Criteria Standard, DOE-STD-1066-99, March 1997.
- Team Leader for the development of the DOE Fire Protection Engineering Functional Area Qualification Standard, DOE-STD-1137-2000, July 2000.

RELATED PROFESSIONAL MEMBERSHIP

Committee Member - Department of Energy's National Fire Safety Committee.
Member - National Fire Protection Association (NFPA), Quincy, Massachusetts.

Gordon A. Gossell, GSSC – DOE/RL

Summary of Technical Qualifications:

U.S. Navy Nuclear Power Program 20 years
DOE operations and maintenance representative for Waste Management division 3 years
Developed the original DOE Operational Readiness Review program.
Provided support to DOE Operational Readiness Review program manager when assigned.
NQA-1 Lead Assessor.

Summary of Assessments/ORR/Inspection Qualifications

TRU Retrieval Operational Readiness Review as assistant team leader reviewed operations and safety analysis.
N Basin DOE readiness assessments as assistant team leader reviewed operations, maintenance and safety analysis.
N Basin DOE Operational Readiness Review as assistant team leader reviewed operations, maintenance and safety analysis.
PFP DOE restart Operational Readiness Review as Operations Reviewer
CWC DOE Operational Readiness Review as assistant team leader reviewed operations and safety analysis
233-S Contractor Management Assessment assistant team lead
PFP Contractor startup Operational Readiness Review assistant team leader reviewed operations.
101-SY Operational Readiness Review as operations reviewer
T Plant Operational Readiness Review as assistant team leader reviewed operations, maintenance, and management systems
PFP Operational Readiness Review reviewed operations

Basis for Acceptable Independence:

Mr. Gossell is Government Support Services Contractor assisting the ESD in development of the DOE ORR/RA RIMS process, assisting the DOE DNFSB recommendation 2000-2 coordinator.

Clarence D. (Dale) Eggen

Title: Professional Fire Protection Engineer

Education: B.S., Civil Engineering, Montana State University, 1972

Professional Credentials: Registered Fire Protection Engineer, Oregon, License No. 11,074
Registered Fire Protection Engineer, Washington, License No. 20,480

GENERAL EXPERIENCE

Mr. Eggen has more than 28 years of progressively responsible experience in commercial and government environments, which include all phases of fire protection engineering work. This includes work for a major fire insurance company; a government-owned utility plant, and Department of Energy. In addition, he has eight years of experience in the construction industry.

Mr. Eggen is responsible for the Fire Protection Engineering work done by A&E for the DOE Richland Operations, Richland, Washington. Work involves the consideration of the many rules, regulation and guidelines on Fire Protection between various groups such as engineers, architects, project managers, and end users to assure the needed fire protection is provided. This process is used in the conceptual design, definite design, and construction.

Mr. Eggen served as the District Chief Engineer in a company that is involved with preventing loss in industrial properties through proper engineering. I was responsible for the technical accuracy of work done this office. This included Loss Prevention Reports, reviews of Fire Protection Plans, and assisting in the training of new personnel and upgrading qualifications of other personnel.

Mr. Eggen is a Registered Fire Protection Engineer in the states of Washington and Oregon and holds Member Grade in the Society of Fire Protection Engineers. He served for three years on the State of Washington Fire Sprinkler Advisor Board. This board, working with the State Fire Marshal's Office, wrote the Washington Administrative Code for licensing of contractors installing automatic sprinkler system in the State of Washington. Mr. Eggen is on the Technical Committee for NFPA 241 "Safeguarding Construction, Alteration, and Demolition Operations."

RELEVANT EXPERIENCE

Mr. Eggen served as the Principal Fire Protection Engineer for a Nuclear Power Plant. He was responsible for assuring that the Fire Protection programs were kept at the highest possible standards. This included the Nuclear Regulatory Commission (NRC), interface with NRC personnel, Insurance Company personnel and other regulatory agencies. A review of Fire Protection commitments made versus the Fire Protection Program was done. Problems areas noted were assigned corrective actions, solved, and changes implemented. Fire Protection inspections were conducted at other facilities with recommendations for Fire Protection improvements using good engineering practices. Fire Protection programs and procedures were developed at the nuclear power plant that meets the requirements of the NRC and operational needs. This included the day-to-day plant operations. Additionally, a program was established to update the Fire Hazard Analysis with any Engineering Design Changes.

Bennett H. Johnson

Title: Fire Protection Engineer

Education: M.B.A., University of Iowa, Iowa City, Iowa, 1991
B.S., Mechanical Engineering, University of Washington, 1979

Professional Credentials: Registered Mechanical Engineer, Washington, 32647
Registered Mechanical Engineer, Iowa, PE11852
Registered Fire Protection Engineer, Washington, 32647

GENERAL EXPERIENCE

Mr. Johnson has 21 years of experience in mechanical and fire protection engineering design and project management with extensive experience in engineering and operation of U.S. Navy, U.S. Department of Energy, and commercial nuclear facilities.

Mr. Johnson has served in key positions and has been responsible for all aspects of nuclear facility operation, maintenance, project engineering, nuclear regulatory engineering, mechanical and fire protection engineering. He was the lead fire protection engineer on T-Plant Secondary Containment Upgrades, CSB construction, and the Plutonium Stabilization and Handling Conceptual Design.

RELEVANT EXPERIENCE

Mr. Johnson was the engineering manager and fire protection engineer for the CSB construction phase. He was responsible for overseeing all Title III engineering activities, as well as, directly supporting the installation of fire protection systems and fire proofing barriers. Mr. Johnson is familiar with the CSB Fire Hazard Analysis (FHA) and associated fire modeling as applied to the fire protection posture at the CSB.

Mr. Johnson was the primary author of the Cold Vacuum Drying Facility (CVD) Fire Hazard Analysis including computer fire modeling and hydrogen gas hazard calculations. He developed innovative approaches for CVD facility compliance with the DOE Fire Protection Program.

Mr. Johnson was lead engineer for the fire protection conceptual design for upgrades to an existing plutonium storage and handling facility at the Hanford Site for accommodation of additional International Atomic Energy Agency plutonium storage and handling equipment on the W-460, Plutonium Stabilization and Handling Project.

Mr. Johnson was the project manager of activities leading to cost-effective resolution of fire protection issues at the 100 K Area of the Hanford Site, which included specifications for design and installation of sprinkler systems, fire alarm systems, life safety upgrades, and a fire pump and the fire hazard analysis for the Cold Vacuum Drying Facility on the W-405, K Basin Essential Systems Recovery.

Mr. Johnson was the lead engineer for the design of the fire protection system for a new tank storage facility, conversion of a dry type fire sprinkler system to a wet sprinkler system, installation of spray systems in a new filter plenum, and replacement of an obsolete fire alarm control panel with a supervised fire control panel on the W-259, T-Plant Secondary Containment Upgrades.

William J. (Jim) Schildknecht
Fluor Hanford/Hanford Site Operations/Project Maintenance Center

EXPERIENCE SUMMARY

24 years in commercial and government nuclear, chemical and industrial facility construction, operations, maintenance, work management, conduct of operations and safety management programs; having performed specific job assignments as cost engineer/estimator, construction engineer, maintenance engineer, technical team leader, program manager, project manager, and operations/maintenance consultant or technical specialist

EMPLOYMENT HISTORY

10/96 to Present **FLUOR HANFORD, INC.** (FH), Richland, Wa.
Consultant/Technical Specialist; Project Operations Center/Project Maintenance Center; Functional Area Manager, Interpretive Authority: Maintenance Management Programs;Technical Support to Conduct of Operations (ConOps) Programs; Technical Lead for FH ISM Implementation and Verification Project Teams; Co-Chairman, National Enhanced Work Planning (EWP) Committee

10/94 to10/96 **WESTINGHOUSE HANFORD COMPANY** (WHC),Richland, Wa.
Technical Team Leader**,** Operations and Maintenance Programs (OMP), Tank Waste Remediation Systems; Interpretive Authority/Technical Authority: Tank Farms and Site-Wide Operations and Maintenance Management Programs; Developed/Issued Standards for ConOps (DOE Order 5480.19), ConMaint (DOE Order 4330.4B), Conducted technical forums and training; established worker-based "champions" programs

8/89 to10/94 **WESTINGHOUSE HANFORD COMPANY**, Richland, Wa
Manager, Technical Procedure Development & Control Group, Maintenance Engineering, Ops Support Services; admin and technical guidance to multi-discipline engineering staff (35 + employees) responsible for development/control of site maintenance, operating, and test procedures; developed and implemented site processes and standards for technical procedure programs

5/83 to8/89 **WESTINGHOUSE HANFORD COMPANY**, Richland, Wa.
Senior Maintenance Engineer/Technical Team Lead, Chemical Processing Div., Ops. Support Services;
lead maintenance engineer for site chemical process facilities (UO_3 Plant, 222-S Lab, T Plant); cognizant engineer for mechanical systems and components; implemented corrective, predictive, preventive maintenance and instrument calibration programs; spare parts analysis, design reviews (maintainability), equipment failure analysis, readiness review and startup program support

12/78 to5/83 **J. A. JONES CONSTRUCTION COMPANY** (Energy Div.), WNP-1/4 Nuclear Power Plants, Richland
Construction Engineer**;** Mechanical/Piping; engineering support to install large-bore piping/hangers and rotating mechanical equipment; cognizant engineer for project to realign containment penetrations and associated piping; lead engineer for work package preparation, directing 3-4 engineers responsible for equipment and component supports (including NSSS)

4/78 to12/78 **GUY F. AKTKINSON AND WSH**, WNP-1/4 Nuclear Power Plants, Richland, Wa.

Cost Engineer/Estimator (Civil, Mechanical); cost estimates from contract drawings and specification revisions; prepared and submitted cost proposals for evaluation and baseline change control; assisted contract manager w/ presentation of claims and entitlement negotiations; field inspection and surveillance of work quality/schedule progress.

12/77 to 4/78 **BRAND INSULATIONS, INC**., WNP-2 Nuclear Power Plant, Richland, Wa.
Cost Engineer/Estimator; provided cost estimates for field and engineering change orders; prepared and submitted cost proposals; planned material requirements from drawings and specifications; solicited and evaluated quotes from material vendors, awarded purchase orders

MILITARY

4/67 – 6/71

United States Army; Commissioned Officer (First Lieutenant)- Graduate of Infantry Officer Candidate School (with honors); **Instructor/Supervisor** with U.S. Army Airborne School, (Fort Benning, Ga.); **Unit Commander**, 101st Airborne Division, 1/327th Infantry (Vietnam); **Training Operations Officer**, 3rd Training Brigade (Ft. Lewis, WA); assignments in training operations, administration

EDUCATION

9/71 – 6-75

Western Washington University – Industrial Arts Education
Univ. Of Washington – General Studies

Related Assessment Experience:

1. Numerous CONOPS and CONMAINT Field Performance Assessments and Technical Assists, all FH Projects (1995-2000)
2. Team Leader, Operations Function, Facility Vulnerability Assessment (FVA), following PFP TK-A109 Incident (1997/1998)
3. WRAP Phase 1 Contractor ORR team, Operations and Maintenance functions (1996)
4. PFP Mag. Hyd. Precip. Process Contractor ORR team, Maintenance Function (2001)
5. PTH Safeguards and Security Formality of Operations Assessment – Lead (1999)
6. FH MSAs for Phase 1 and Phase II ISM Verifications, Activity Level (1999/2000)
7. FH Enhanced Work Planning Performance Review (Work Control), Spent Nuclear Fuel Project (2000)

Lisa C. Lansing

Nuclear Safety

SUMMARY OF TECHNICAL QUALIFICATIONS:

- B.S. Mechanical Engineering, Washington State University
- Nuclear Safety Program Engineer, Fluor Hanford (1 yr)
- Safety Analysis Team, Project W-460 at Plutonium Finishing Plant (PFP)
- Safety Analyst, H&R Technical Associates (5 yrs)
- Criticality Program Student Engineer, WHC (5 yrs)

SUMMARY OF ASSESSMENT/ORR/INSPECTION QUALIFICATIONS:

- Readiness Assessment for PFP BTS Feed Shift to Oxide Startup
- Facility Hazards Analysis Walkdowns, various retired facilities, BHI

SUMMARY OF FACILITY FAMILIARIZATION:

- Readiness Assessment Team, BTS Feed Shift to Oxide Startup at PFP
- Safety Analysis Team, Project W-460 at PFP
- Completed orientation training