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7. Abstract

A fire hazards analysis (FHA) was performed for Project W-211, Initial Tank Retrieval System (ITRS), at the Department of Energy (DOE) Hanford site. The analysis was conducted in accordance with DOE Order 5480.7A, Fire Protection [DOE Order 5480.7A, 2/17/93] and addressed each of the fifteen principle elements outlined in paragraph 9.a.(3) of the Order. The elements were addressed in terms of the fire protection objectives stated in paragraph 4 of DOE 5480.7A.

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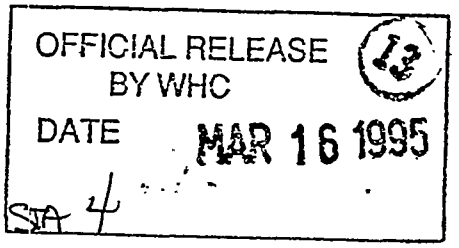

PRELIMINARY FIRE HAZARDS ANALYSIS

FOR

W-211, INITIAL TANK RETRIEVAL SYSTEMS

Westinghouse Hanford Company

March, 1994

Prepared by

R. A. Huckfeldt

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1.0 INTRODUCTION

1.1 Scope and Objectives

A fire hazards analysis (FHA) was performed for Project W-211, Initial Tank Retrieval System (ITRS), at the Department of Energy (DOE) Hanford site. The analysis was conducted in accordance with DOE Order 5480.7A, Fire Protection [DOE Order 5480.7A, 2/17/93] and addressed each of the fifteen principle elements outlined in paragraph 9.a.(3) of the Order. The elements were addressed in terms of the fire protection objectives stated in paragraph 4 of DOE 5480.7A.

The objectives of this FHA was to determine (1) the fire hazards that expose the Initial Tank Retrieval System or are inherent in the process, (2) the adequacy of the firesafety features planned, and (3) the degree of compliance of the project with specific firesafety provisions in DOE orders and related engineering codes and standards.

The scope included the construction, the process hazards, building fire protection, and site wide fire protection. The results are presented in terms of the fire hazards present, the potential extent of fire damage, and the impact on employees and public safety. This study evaluated the ITRS with respect to its use at Tank 241-SY-101 only.

1.2 Approach

The approach included several tasks. Project documents were reviewed to document the building, process, and fire protection features as well as to obtain general site information.

An analysis was then performed to establish candidate design basis fires (DBF), evaluated the damage potential associated with these fires, and determined compliance with DOE fire protection requirements. This analysis involved review of the existing requirements, and analytical analysis in order to quantify the potential impact of plausible fire scenarios on process operations, facility operations, and safety. Attention was directed at the potential for environmental damage or inadequate life safety.

1.3 Assumptions and Limitations

Project W-211 is currently at the 30% Definitive Design Phase. As the design progresses changes can be expected that could result in the need to revise this document. The results of this study are

predicated on assumptions of the types and quantities of combustibles. In the event that significantly greater quantities of Class A and B combustibles are allowed, the basis for determining the candidate DBFs and the potential impact presented in this study may no longer be valid.

In keeping with sound engineering practice in the absence of technical information, conservative "worst case" assumptions are made regarding fuel loading, fuel package burning rates, fire spread, and thermophysical effects. In the event that such an analysis demonstrated minimal or no impact on fire hazard potential, no further analysis is performed.

1.4 DOE FHA Basis

Each of the FHA elements identified in DOE 5480.7A were addressed in this FHA. They are included in the report as listed below.

Requirements in DOE Order 6430.1A, General Design Criteria, applicable NFPA standards, Factory Mutual Data Sheets, and the Uniform Building Code were addressed in the context of the FHA elements. The scenarios were based on an engineering analysis of the facility and the process.

FHA Elements

Element	FHA Report Section
• Description of Construction	3.0
• Fire Protection Features	4.0
• Fire Hazards	5.0
• Protection of Essential Safety Class Equipment	6.0
• Life Safety Considerations	7.0
• Critical Process Equipment	8.0
• High Value Property	9.0
• Damage Potential MCFL MPFL	10.0 10.1 10.2
• Fire Department/Brigade Response	11.0
• Recovery Potential	12.0
• Potential for Toxic, Biological, Radiological Incident	13.0

Element	FHA Report Section
• Emergency Planning	14.0
• Security and Safeguard Considerations Related to Fire Protection	15.0
• Natural Hazards Impact on Fire Safety	16.0
• Exposure Fire Potential	17.0

1.5 General Description

The Initial Tank Retrieval System will be located inside the Hanford Site 200 East Area at the Department of Energy (DOE) facility at Richland, WA. It will provide systems for the retrieval of radioactive wastes stored in ten underground double-shell tanks (DSTs). The contents of the tanks consist of supernatant liquids suspended over layers of solids that have settled to the bottom of the tanks. To retrieve the wastes, it is necessary to mix the solid and liquid contents prior to transfer to alternative storage, evaporation, pretreatment, or disposal facilities. The ITRS will provide systems to mobilize the settled solids and to transfer the wastes out of the tanks. The DSTs have existing equipment in place that will require removal to allow installation of the new mixing and retrieval systems. The ITRS scope of work includes the design, procurement, and installation and/or use of the following items as required for each particular tank:

- Mixer pumps for sludge mobilization
- Pump(s) for transferring the waste out of the tanks
- An operator station that includes functions to monitor, alarm, and control the retrieval systems for each tank.
- Instrumentation required to measure the effects and results of mixer pump operation, and the instrumentation that must be replaced to withstand the mixer pump forces.
- Instrumentation to measure the physical characteristics of the wastes prior to transfer.
- Interface with existing instrumentation that is critical to the mixing or transfer process in order to monitor the tank waste, shell and vapor space temperatures, and waste levels within the tank.

- Equipment and containers for removal, cleaning decontamination, transport, storage, and burial of contaminated components and soil.
- Utilities for retrieval operations (electrical power, water, telecommunications etc.)
- Site preparation and tank modifications for the installation of equipment.
- A system to maintain temperatures within the tank to acceptable levels, if required.
- Dilution capability to bring waste properties into compliance with transfer line specifications.
- Flush capability to both the transfer pump and the transfer piping.
- A camera system to monitor the mixing operation.
- An existing Run-in Test Facility will be used for Project W-211 mixer and transfer pump testing.
- An existing Cold Test Facility will be used for Project W-211 equipment installation and removal demonstrations.

This study evaluated the ITRS with respect to its use at Tank 241-SY-101 only. The remainder of the tanks will be addressed in future revisions of this document.

2.0 SUMMARY AND CONCLUSIONS

The ICE (Instrumentation/Control/Electrical) Building will be a non-combustible building. It will be completely sprinklered and provided with a complete fire alarm system to transmit all alarms to the fire department. The sprinkler systems and the fire alarm system will be designed per the applicable codes and adequate to control the hazards present.

The 15 elements of an FHA per DOE Order 5480.7A have been assessed. The provided building features and protection systems were adequate to satisfy all 15 elements. There is one recommendation included in Section 18.0 of this report that would further enhance the reliability of the fire protection system and reduce project and life cycle costs.

3.0 DESCRIPTION OF CONSTRUCTION

The ICE Building will be located 15 feet from the north face of the existing 241-SY-271 Instrument Building. The ICE Building will be a 24 ft. by 32 ft. preengineered, rigid-frame metal building. The eave height will be 10 ft. above the ground. The foundation will consist of individual footings and piers with a continuous perimeter wall. Footings will be placed at a depth not to exceed that of the existing instrument house turn-down slab and will be tied together by the 8 in. perimeter wall. The exterior building surface will be constructed of a galvanized sheet metal skin system attached to a self-framing metal structure. The ceiling/roof support structure will have exposed purlins, rafters, and beams. The building will be insulated. The interior surfaces will be covered with a vapor barrier. The lower eight feet will be covered with a prefinished metal liner.

4.0 FIRE PROTECTION FEATURES

Automatic fire alarms and a preaction automatic sprinkler system will be installed in the ICE Building. The fire alarm system will include manual pull stations at the exits, smoke detection, sprinkler system waterflow alarms, sprinkler system control valve tamper supervision, and audible and visual alarm warning devices. Fire alarms will be connected to the radio fire alarm reporter box to transmit the alarms to the Hanford Fire Department.

The preaction automatic sprinkler system will be supplied from a existing raw water system. The supply line lead-in will include a post indicator valve. A strainer will be installed at the base of the system riser.

There is an existing raw water fire hydrant within 300 feet of the ICE Building. A second hydrant will be installed for compliance with DOE Order 6430.1A. The 200-W Area raw water system is currently supplied by a single 3,000,000 gallon reservoir. Project B-604 will upgrade the 200-W and 200-E Areas by providing a second independent water supply in compliance with 6430.1A.

5.0 DESCRIPTION OF FIRE HAZARDS

The fire hazards associated with 241-SY Tank Farm are discussed in depth in WHC-SD-WM-TI-537, Fire Hazards Analysis for Double Shell Waste Storage Tanks. No new types of activities or processes are being introduced by this project. All new equipment installed within the 241-SY-101 Tank will meet the hazard classifications delineated in WHC-SD-WM-HC-010, Hazard Classification Study for the SY-101

Tank and Vicinity. The only significant new building is the ICE Building. The building will house adjustable frequency controllers for the pumps in the transfer system, various electrical equipment, the Programmable Logic Controller, and operator control stations.

Range fires are always a concern on the Hanford Site, however the physical location of this facility has adequate fire breaks which in conjunction with a well qualified fire department provides adequate protection.

6.0 PROTECTION OF ESSENTIAL SAFETY CLASS SYSTEMS

A Preliminary Safety Evaluation was prepared for the ITRS during the conceptual design phase of the project. This document included preliminary Safety Class assignments. It has been determined that a Safety Assessment will be developed in lieu of a PSAR because the ITRS involves upgrades of existing facilities as opposed to construction of a new facility. Plans are to submit this document to DOE approximately August 1, 1995. Although this effort is not complete, it appears that the highest safety class will be Westinghouse SC-2, which includes pit cover blocks, pump support systems etc.

7.0 LIFE SAFETY CONSIDERATIONS

For life safety design purposes, NFPA 101, Life Safety Code, General Purpose Industrial Occupancy classification is being applied. The facility meets all requirements with the classification, such as, travel distances, number of exits, and alarm requirements. No life safety concerns are anticipated.

8.0 CRITICAL PROCESS EQUIPMENT

Critical process equipment is that equipment whose continued integrity is essential to ensure the operability of safety class items in the event of a design basis fire. There is no critical process equipment in this project.

9.0 HIGH VALUE PROPERTY

There is no high value equipment (over $500,000) in this project.

10.0 DAMAGE POTENTIAL

10.1 MAXIMUM CREDIBLE FIRE LOSS (MCFL)

The MCFL, by definition in DOE Order 5480.7A, is:

> "The value of property within a fire area, unless a fire hazard analysis demonstrates a lessor (or greater) loss potential. This assumes that all installed fire protection systems function as designed, and the effect of emergency response is omitted except for post-fire actions."

The maximum credible fire (MCF) will be from electrical equipment in the ICE Building shorting thereby causing combustibles materials to ignite and spread throughout the piece of equipment generating substantial smoke and heat. Since the facility is provided with an automatic suppression system, it is anticipated that this fire will naturally transpire until enough heat is generated to fuse sprinklers in the area. It is anticipated that the sprinklers will control and probably extinguish the fire resulting in a loss of one piece of equipment and causing smoke damage to much of the facility, but is not expected to result in a total loss of the facility.

Due to the limited amount of combustibles and the installation of an automatic sprinkler system, the fire is not expected to breach the building. The MCFL for this fire as described above including clean-up and replacement of equipment is expected to be approximately $100,000.

10.2 MAXIMUM POSSIBLE FIRE LOSS (MPFL)

The MPFL, by definition in DOE Order 5480.7A, is:

> "The value of property within a fire area, unless a fire hazard analysis demonstrates a lessor (or greater) loss potential, assuming the failure of both automatic fire suppression systems and manual fire fighting efforts."

The fire loss estimate is to include the replacement cost of equipment and property and any applicable decontamination and cleanup costs.

The maximum possible fire (MPF) will be the same fire scenario as that described for the MCF, except that the automatic sprinklers do not operate and the fire naturally transpires and spreads to all areas of the building resulting in a total loss of the facility and its contents. There are no radiological or hazardous materials in this building minimizing clean-up costs. The estimated MPFL for this facility given this fire scenario is $1,400,000.

The fire protection systems required by the DOE Order 5480.7A criteria based on the MPFL are satisfied.

11.0 FIRE DEPARTMENT/BRIGADE RESPONSE

The Hanford Fire Department provides an approximate 5 minute response time to this area. Fire department response is adequate.

12.0 RECOVERY POTENTIAL

The anticipated recovery from the MCFL would include equipment and facility washdown, water clean-up, and equipment replacement. It is estimated that complete service could be restored within six months.

The ICE Building is not designated as vital by the Department of Energy, therefore the potential program delays are serious but not in conflict with any mandated requirements.

13.0 POTENTIAL FOR TOXIC, BIOLOGICAL, AND/OR RADIATION INCIDENT DUE TO FIRE

The potential for toxic, biological, or radiation incident due to a fire in the ICE Building is minimal because this facility will be located outside the tank farm fenced area where the environment should be free of these hazards. An exposure fire from within the tank farm could deposit radiological and chemical contamination on and within the ICE Building. In order for this to occur, administrative controls such as keeping the area free of transient combustibles most likely have failed.

14.0 EMERGENCY PLANNING

WHC-IP-0842, Waste Tanks Project Administration for Tank Waste Remediation Operations provides a system of planned responses to minimize risks to personnel, equipment, buildings, and the environment in the event of emergencies including fire.

15.0 SECURITY AND SAFEGUARD CONSIDERATIONS RELATED TO FIRE PROTECTION

Project W-211, Initial Tank Retrieval System located near the 242-S Building in 200 West Area. Access to 200 West Area is through the 200 West Main Gate. There are no additional security barriers or special coordination requirements that would hinder the fire department access. Previous fire department responses to the 200 West Area has shown that the existing procedures are adequate.

16.0 NATURAL HAZARDS IMPACT ON FIRE SAFETY

16.1 FLOODS

The 200 Areas are situated on a plateau, and because of the elevation, the structures are not susceptible to catastrophic flooding even by the "probable maximum flood" postulated by the U.S. Army Corps of Engineers (ERDA 1975) for the Columbia River Basin. The maximum 24 hour precipitation expected to occur once in 1,000 years is 6.8 cm (Stone et al. 1983).

16.2 TORNADOES

The Pacific Northwest is one of the areas of the country with the lowest frequency of tornadoes. The entire state of Washington has an average tornado frequency of less than one per year. An analysis of the Hanford Site concludes that the probability of a tornado hitting any particular onsite facility is six chances in a million during any one year.

16.3 EARTHQUAKES

Eastern Washington is a region of low-to-moderate seismicity. Based on the seismic history since 1840, the U.S. Coast and Geodetic Survey has designated Eastern Washington as Zone 2 seismic probability, implying a potential for moderate damage from earthquakes.

17.0 EXPOSURE FIRE POTENTIAL

The existing 241-SY-271 will be separated from the ICE Building by 15 feet. This meets the exposure separation criteria established in NFPA 80A, Recommended Practice for Protection of Buildings from Exterior Fire Exposures and is supported by the following calculations:

DESCRIPTION	241-SY-271	ICE BUILDING
Dimensions:		
Width (E/W)	24' - 0"	24' - 0"
Height (Sidewall)	10' - 0"	11"
Height (Peak)	12' - 6"	12"
Length (N/S)	16' - 0"	32' - 0"
Width of exposing fire (W)	24' - 0"	24' - 0"
Height of exposing fire (H)	12' - 0"	12' - 6"
% of opening in exposing wall area	0%	0%
Severity	Light	Light
Width/Height Ratio	24/12=2	24/12.5=1.92
Guide Number from NFPA 80A; Table 2.3: (Assume 100% openings-nonrated wall) ref. 2-2.3	1.93	1.93
Guide Number x lesser dimension +5'	1.93x12+5	1.93x12.5+5
Required minimum separation	28.16 ft.	29.13 ft.
Adjust per 4-2.3(b) (reduce 50%)	14.08 ft.	14.56 ft.

18.0 RECOMMENDATIONS

1. Based on the results of this analysis, it is recommended that the planned preaction sprinkler system is replaced with standard wet pipe automatic sprinkler protection. The hazards do not warrant a system of this sophistication nor are the life cycle maintenance and testing costs justified.

2. All new equipment installed under this project needs to meet the hazards classifications delineated in WHC-SD-WM-HC-010, Rev. 1. This will assure that frequency and severity of potential accidents associated with fire are within existing safety documentation limits.