CRWMS/M&O

Design Analysis Cover Sheet

Complete only applicable items.

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2. DESIGN ANALYSIS TITLE			
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1. PURPOSE

1.1 The purpose of the fire hazards analysis is to comprehensively assess the risk from fire within individual fire areas in accordance with U.S. Department of Energy (DOE) Order 5480.7A (Reference 4.4.7.4). This document will assess the fire hazard risk within the Exploratory Studies Facility (ESF) fuel supply system, Package 1E, and evaluate whether the following objectives are met:

1.1.1 Ensure that property damage from fire and related perils do not exceed an acceptable level.

1.1.2 Provide input to the facility Safety Analysis Report (SAR).

2. QUALITY ASSURANCE

2.1 Work performed by this analysis shall be quality assurance classified as "NONE."

2.2 The fuel supply system is considered a temporary utility. Determination of Importance Evaluation for the ESF North Portal Pad (Reference 5.17) has established that there are no quality assurance (QA) controls that pertain to this analysis.

3. METIIOD

As required by DOE Order 5480.7A (Reference 4.4.7.4), a fire hazard analysis includes a detailed narrative description and fire safety review of the facility, its location, fire areas, processes, occupancy, construction, fire and life safety features and hazards. This fire hazard analysis is performed under the direction of a qualified fire protection engineer. The following subsections detail the steps necessary to perform this analysis.

3.1 FACILITY DESCRIPTION, PROCESSES, AND CLASSIFICATION

3.1.1 Provide a general description and location.

3.1.2 Provide a short narrative description of the facility, including its location within the site area, and its intended use and occupancy.

3.1.3 Provide a detailed summary of the operations, processes, and activities that take place within the facility or are planned for new facilities. Provide product and process information concerning the raw materials, products, waste streams, production sequence, essential safety related equipment, and other information required to assess the fire and life safety risks within the facility or individual fire areas.

3.2 FIRE AREA DESCRIPTIONS AND FEATURES

3.2.1 Provide a detailed description of the facility by fire area, including information on the following applicable elements from Section 9.a.(3) of DOE 5480.7A (Reference 4.4.7.4):

- Fire protection features
- Description of fire hazards
- Life safety considerations
- Damage potential according to maximum credible fire loss (MCFL) and maximum possible fire loss (MPFL)
- Fire department/Reynolds Electrical and Engineering Co., Inc. (REECo) fire protection services response
- Potential for a toxic, biological, and/or radiation incident due to fire
- Emergency planning
- Impact of natural hazards (earthquake, flood, wind) on fire safety
- Exposure fire potential, including the potential for fire spread between fire areas.

3.2.2 Fire area boundaries and physical separation shall be analyzed based on the requirements of the applicable building codes (Uniform Building Code [UBC, Reference 4.4.5], Uniform Fire Code [UFC, Reference 4.4.6], DOE Order 6430.1A [Reference 4.4.7.7]); the monetary values and limits set for DOE Orders; national codes and standards (National Fire Protection Association [NFPA], Factory Mutual, etc.); and hazard inventory in each fire area.

3.2.3 The hazard inventories shall identify the combustibles in each fire area.

3.3 SPECIAL CONSIDERATIONS

3.3.1 Assess the potential impact on fire safety from natural hazards such as earthquake, flood, lightning, windstorm, etc.

3.3.2 Provide a description of the REECo fire protection services response to a fire incident, including anticipated response times, apparatus available to respond, appliance and equipment condition and availability, accessibility of the facility or fire areas, water supply available for fire fighting operations, fire pre-plan adequacy, and emergency planning (including non-fire events). Response time shall include all of the following events: alarm receipt, turn-out time, travel time, and fire scene set up.

3.4 FIRE EFFECTS AND DAMAGE POTENTIAL

Fire effects and damage potential scenarios and costs must be reviewed with facility personnel prior to being finalized to ensure that the scenario and loss figures are reasonable and justified.

3.5 MAXIMUM POSSIBLE FIRE LOSS

The MPFL is the single worst case fire scenario for a facility with no mitigating actions to suppress the fire. The MPFL will be the highest value fire area in the facility, including building, contents, equipment, decontamination and cleanup, and consequent effects of fire fighting.

3.5.1 Describe the fire scenario, the fire area involved, and any exposures or consequent effects anticipated in adjacent fire areas.

3.5.2 Provide the fire loss amount for building, contents, and equipment. Provide an estimated cost, with appropriate details and assumptions, for the fire fighting, decontamination and cleanup, and any ancillary costs (inflation, engineering design, overheads, etc.).

3.6 MAXIMUM CREDIBLE FIRE LOSS

The MCFL is the fire scenario that would cause the largest single fire loss controllable by the installed automatic fire protection systems. The MCFL can be assumed to be the single highest cost piece of equipment or process in the facility (from MCFL) that will burn. The installed automatic fire protection systems are assumed to control the fire and limit damage to the involved piece of equipment.

3.6.1 Describe the fire scenario, the equipment and fire area involved, and any exposures or consequent effects to adjacent equipment or contents of the fire area.

3.6.2 Provide the fire loss amount for building, contents, and equipment. Provide an estimated cost, with appropriate details and assumptions, for fire fighting, decontamination and cleanup, and any ancillary costs (inflation, engineering design, overheads, etc.).

3.7 TERMS AND DEFINITIONS

Terms and definitions are established based upon the DOE Orders, the UBC, and applicable national standards.

3.7.1 **Acceptable** - When applied to fire safety, "acceptable" is a level of protection which the authority having jurisdiction (AHJ), after consultation with the cognizant DOE fire protection engineer(s), considers sufficient to achieve the

objectives defined above. In some instances, it is a level of protection that deviates (plus or minus) from a code or standard as necessary and yet adequately protects against the inherent fire hazards. (Reference 4.4.7.4)

3.7.2 **Authority Having Jurisdiction** - The decision-making authority in matters concerning fire protection. Except as directed by the program secretarial officers, the heads of field organizations or designee is the AHJ. Decisions impacting fire safety shall be made by the AHJ only after consultation with the cognizant DOE fire protection engineer(s). Where an area office or site office exists within the DOE organization, a formal, clearly-defined delegation of fire protection responsibility shall be established regarding the AHJ. (Reference 4.4.7.4)

3.7.3 **DOE Fire Protection Program** - Those fire protection requirements, hardware, administrative controls, procedures, guidelines, plans, personnel, analyses, and technical criteria that comprehensively ensure that DOE objectives relating to fire safety are achieved. (Reference 4.4.7.4)

3.7.4 **Equivalency** - The approved alternate means of satisfying the technical provisions of a fire protection code or standard. (Deviations from specific requirements of occupational safety and health standards, as delineated in the Code of Federal Regulations (CFR), are treated as variances, as defined in the DOE's Occupational Safety and Health Program.) (Reference 4.4.7.4)

3.7.5 **Exemption** - The approved deviation from a nonstatutory code, standard, or DOE Order. (Deviations from specific requirements of occupational safety and health standards, as delineated in the CFR, are treated as variances as defined in DOE's Occupational Safety and Health Program.) (Reference 4.4.7.4)

3.7.6 **Fire Area** - A location bounded by construction having a minimum fire resistance rating of two hours with openings protected by appropriate fire-rated doors, dampers, or penetration seals. The boundaries of exterior fire areas (yard areas) shall be as determined by the AHJ. (Reference 4.4.7.4)

3.7.7 **Fire Loss** - The dollar cost of restoring damaged property to its pre-fire condition (refer to DOE Order 5484.1). In determining loss, the estimated damage to the facility and contents shall include replacement costs, less salvage value. Losses will exclude the cost of restoring: (Reference 4.4.7.4, Reference 4.4.7.6)

- Property that is scheduled for demolition
- Property that is decommissioned and not carried on books as a value
- Property with no loss potential.

Include the cost of decontamination and cleanup, the loss of production or program continuity, the indirect costs of fire extinguishment (such as damaged fire department equipment), and consequent effects on related areas in all property loss amounts.

3.7.8 **Fire Protection** - A broad term which encompasses all aspects of fire safety, including: (Reference 4.4.7.4)

- Building construction and fixed building fire features
- Fire suppression and detection systems
- Fire water systems
- Emergency process safety control systems
- Emergency fire fighting organizations (fire departments, fire brigades, etc.)
- Fire protection engineering
- Fire prevention.

Fire protection is concerned with preventing or minimizing the direct and indirect consequences of fire. It also includes aspects of the following perils as they relate to fire protection: explosion, natural phenomena, smoke and water damage from fire.

3.7.9 **Fire Protection System** - Any system designed to detect, extinguish, and limit the extent of fire damage or enhance life safety. Where redundant fire protection systems are required, any two of the following will satisfy that requirement: (Reference 4.4.7.4)

- Automatic suppression systems, such as fire sprinklers, foam, gaseous, explosion suppression, or other specialized extinguishing systems, plus appropriate alarms. An adequate supply, storage, and distribution system is an essential element.

- Automatic fire detection, occupant warning, manual fire alarm, and fire alarm reporting systems combined with properly equipped and adequately trained fire departments.

- Fire barrier systems or combinations of physical separation and barriers for outdoor locations.

- Other systems, such as alternate process control systems, as approved by the AHJ.

3.7.10 **Maximum Credible Fire Loss** - The property damage that would be expected from a fire, assuming that all installed fire protection systems function as designed, and the effect of emergency response is omitted except for post-fire actions such as salvage work, shutting down water systems, and restoring operation. (Reference 4.4.7.4)

3.7.11 **Maximum Possible Fire Loss** - The value of property (excluding land) within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential. This assumes the failure of both automatic fire suppression systems and manual fire fighting efforts. (Reference 4.4.7.4)

3.7.12 Property - All Federal-Government-owned or leased structures and contents for which DOE has responsibility, including: (Reference 4.4.7.4)

- All DOE land, structures, and contents
- All leased locations
- All other Federal Government property on DOE land or in DOE structures
- Other property that occupies DOE land or DOE structures.

3.7.13 Qualified Fire Protection Engineer - A graduate of an accredited engineering curriculum who has completed not less than four years of engineering practice, three of which shall have been in responsible charge of diverse fire protection engineering work. If not a graduate, then a qualified engineer shall: demonstrate a knowledge of the principles of engineering and have completed not less than six years engineering practice, three of which shall have been in responsible charge of diverse fire protection engineering projects; be a registered professional engineer in fire protection; or meet the requirements for a Grade 11 or higher fire protection engineer as defined by the U.S. Office of Personnel Management. (Reference 4.4.7.4)

3.7.14 Related Perils - Aspects of the following as they relate to fire protection: explosion, natural phenomena, smoke, and water damage. (Reference 4.4.7.4)

3.7.15 Risk - A term used to describe the overall potential for loss (refer to DOE Order 5481.1B). (Reference 4.4.7.5)

3.7.16 Safety Class Equipment - Systems, structures, or components including primary environmental monitors and portions of process systems, whose failure could adversely affect the environment or the safety and health of the public. (Reference 4.4.7.4)

For nuclear reactors and nonreactor nuclear facilities, Class A Equipment includes those systems, structures, or components with the following characteristics:

- Those whose failure would produce exposure consequences that would exceed DOE-established guidelines at the site boundary or nearest point of uncontrolled, public access.

- Those required to maintain operating parameters within the safety limits specified in Technical Safety Requirements (Technical Specification or Operational Safety Requirements) during normal operations and anticipated operational occurrences.

- Those required for nuclear criticality safety.

- Those required to monitor the release of radioactive materials to the environment during and after a design basis accident.

- Those required to monitor and maintain the facility in a safe shutdown condition.

- Those that control the safety class items described above.

3.7.17 **Vital Program** - A DOE program so defined by the program secretarial officers. (Reference 4.4.7.4)

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

4.1.1 Design parameters from the ESF Basis for Design document (BFD): (Reference 5.2) The following lists the design parameters from the mechanical section of the BFD (Section 7.2.4.1 D)

4.1.1.1 The Standby Generator Fuel System (SGFS) shall support subsurface tunneling and testing operations by providing diesel fuel at the quantity, quality, and pressure required. Provisions are to be made for present and future needs. [ESFDR 3.2.1.5] [ESFDR 3.2.1.5 B] [ESFDR 3.2.1.9.4 A] [ESFDR 3.2.6.2 A] [ESFDR 3.2.6.2.1 H1] [ESFDR 3.2.6.5 A] [ESFDR 3.2.6.5 B]

4.1.1.2 An automatic electronic control system shall minimize the energy usage, enhance maintenance, and provide alarms for malfunction. Maintenance shall be enhanced through the use of built-in automatic self-test and diagnostics. [DOE 6430.1A, 1640-2.5] [ESFDR 3.2.1.9.3 F] [ESFDR 3.2.1.9.3 G1(b)] [ESFDR 3.2.1.9.3 G1(c)] [ESFDR 3.2.1.9.3 E2] [ESFDR 3.2.1.23 A]

4.1.1.3 Fuel tanks shall be above-ground modular, skid-mounted units and employ lifting lugs for maintainability. [ESFDR 3.2.1.9.3 C1(c)] [ESFDR 3.2.1.9.3 E] [ESFDR 3.2.1.9.3 E1] [ESFDR 3.2.1.9.3 E2] [ESFDR 3.2.1.9.3 E3]

4.1.1.4 The SGFS shall be capable of supporting ESF standby operations for a total of 24 hours to support subsurface testing, construction and electrical load requirements. Standby systems include electrical power generation and compressed air production. [ESFDR 3.2.1 I1] [ESFDR 3.2.1.9.1 B] [ESFDR 3.2.6.2.1 H2] [REFERENCE 5]

4.1.1.5 To ensure subsurface operational reliability and availability, the SGFS shall be designed with excess capacity. [ESFDR 3.2.1 E] [ESFDR 3.2.1 I1] [ESFDR 3.2.1.9] [ESFDR 3.2.1.9.1 A] [REFERENCE 13]

4.1.1.6 The SGFS will be designed to withstand the natural conditions and hazards at the ESF. Natural hazards must not interfere with provisions within the SFGS for worker safety. Operation of the SFGS must not be affected by natural hazards. [ESFDR 3.2.1G] [ESFDR 3.2.1 I1] [ESFDR 3.2.1.10.1] [ESFDR 3.2.1.10.1 A] [ESFDR 3.2.6.2.1 G]

a) Combinations: The SFGS must be capable of withstanding a combination of natural hazards present at the ESF as described in 7.2.4.1IV.D.7b through e. [ESFDR 3.2.1.10.1 B]

b) Temperature: The SFGS must be capable of operating in ambient temperatures from -14°F to 108°F. Piping must be insulated to protect the product from extreme temperatures and heat traced to prevent the product from freezing. [ESFDR 3.2.1.10.1]

c) Earthquake: The SFGS equipment, piping, and appurtenances must be capable of withstanding a seismic event associated with UBC seismic zone 3 criteria. [ESFDR 3.2.1.10.1 E] [ESFDR APPENDIX A5]

d) Winds: The SGFS enclosures, skids, piping, electrical components, and panels will be designed and constructed to withstand a wind loading of 30 psf. [ESFDR 3.2.1.10.1 C]

e) Rain: The SGFS equipment, piping, and appurtenances must be capable of withstanding rain and light snow loads expected at the ESF. The maximum design rainfall intensity is 1.5 inches per hour. [ESFDR 3.2.1.10.1 A]

4.1.1.7 The Fuel Storage and Transfer System shall have a maintainable design service life of 25 years. [ESFDR 3.2.1.9.4 A]

4.1.1.8 All equipment shall be permanently affixed with appropriate labels and markings for unambiguous identification of specific hazard information. The SGFS piping shall be identified in accordance with American Society of Mechanical Engineers (ASME) A13.1. Accident prevention signs and tags shall adorn equipment and accessories presenting potential hazards according to 29 CFR 1926.200. [ESFDR 3.2.1.16 A] [ESFDR 3.2.1.16 B] [ESFDR 3.2.1.16 C] [ESFDR 3.2.1.16 D] [ESFDR 3.2.1.16 E] [ESFDR 3.2.1.16 F] [ESFDR 3.2.1.17 B] [ESFDR 3.2.1.19.1 B] [ESFDR 3.2.1.19.5 A] [ESFDR 3.2.1.19.5 B]

4.1.1.9 SGFS accessories shall be installed to allow the provision of a piped bypass to allow on-line maintenance without interrupting service if necessary. [ESFDR 3.2.1.9.3 G1(a)] [ESFDR 3.2.1.9.3 G1(b)]

4.1.1.10 The SGFS will be designed to use standard conventional tools, cleaners, lubricants, and test equipment for use in construction and maintenance procedures to the maximum extent possible. [ESFDR 3.2.1.9.3 G1(a)] [ESFDR 3.2.1.9.3 G1(b)] [ESFDR 3.2.1.26.1 B1]

4.1.1.11 The SGFS will be designed to use industry standard piping materials and appurtenances. Schedule 40 carbon steel piping will be utilized in accordance with ASME/ANSI B31.1. Pipe fittings will be flanged in accordance with ASME/ANSI B16.5-A. Screwed fittings will be in accordance with ASME/ANSI B1.20. All pressure vessels will be designed in accordance with ASME Section VIII. [ESFDR 3.2.1.26.1 B2]

4.1.1.12 To the extent practicable, all mechanical materials and equipment used in the design and construction of the SGFS will be commercial quality and commonly available in the industry. The intent is to minimize equipment breakdowns during construction and operations and to avoid situations that will adversely affect schedule and/or budget. Additionally, provisions for ease and economy of maintenance shall be integrated into the SGFS design. [ESFDR 3.2.1 Q] [ESFDR 3.2.1.9] [ESFDR 3.2.1.9.3 C1] [ESFDR 3.2.1.9.3 C1(b)] [ESFDR 3.2.1.9.3 G] [ESFDR 3.2.1.21 A4] [ESFDR 3.2.1.26.1 B1] [ESFDR 3.2.1.26.1 B2] [ESFDR 3.2.6.2.1 H3] [DOE Order 6430.1a, Section 0110-7]

4.1.1.13 To the extent practicable, all mechanical materials and equipment used in the design and construction of the SGFS will be modular. Skid mounted equipment will be utilized featuring commercially available modular components. Skids and components will be removable to enhance maintenance, construction, and decommissioning. To the extent practicable, all equipment skid types will be identical. Allow space for flexible expansion utilizing similar skid configurations. [ESFDR 3.2.1.7] [ESFDR 3.2.1.12] [ESFDR 3.2.1.7 C] [ESFDR 3.2.1.18]

4.1.1.14 An Electronic Control System (ECS) shall utilize panels mounted on each skid to control and monitor SGFS operations. The ECS shall interface with the IDCS facility management system for remote monitoring, setup and control. Manual switching and indication will be provided for local control of the panel. Control panels will be NEMA rated, UL listed, and installed in accordance with NFPA-70. [ESFDR 3.2.1.9.3 F] [ESFDR 3.2.1.19.7 B] **[ESFDR 3.2.1.19.9 A] [ESFDR 3.2.1.19.9 C]**

4.1.1.15 To the extent practicable, the SGFS will be designed, constructed, operated, and decommissioned in a manner to limit and monitor noise levels in accordance with 29 CFR 1926.52. Where limits are exceeded, hearing protection will be prescribed according to 29 CFR 1926.101 and

warning signs posted in accordance with 29 CFR 1926.200. [ESFDR 3.2.1 U] [ESFDR 3.2.1 W] [ESFDR 3.2.1.19.4 B] [ESFDR 3.2.1.19.5 A] [ESFDR 3.2.1.28 C2] [ESFDR APPENDIX J]

4.1.1.16 The SGFS shall utilize excess equipment available at the Nevada Test Site, as practicable. [REFERENCE 13]

4.1.1.17 Provide sufficient spacing of SGFS equipment for maintenance, and for fire prevention measures in accordance with DOE Order 5480.7A and a Fire Hazards Analysis (FHA). The FHA shall address the life safety issues presented in NFPA 101, NFPA 30, 29 CFR 1910 UFC and the UBC. **[ESFDR 3.2.1.10.2 A1] [ESFDR 3.2.1.10.2 A1(a)] [ESFDR 3.2.1.10.2 A1(b)] [ESFDR 3.2.1.10.2 A1(c)] [ESFDR 3.2.1.10.2 A1(d)] [ESFDR 3.2.1.10.2 A2] [ESFDR 3.2.1.10.2 B]** [ESFDR 3.2.1.19.2 A] [ESFDR 3.2.1.19.3] [ESFDR 3.2.2.2 C] [REFERENCE 4]

4.1.1.18 Precautions to avoid and control spills of diesel fuel shall be integral to the design of the Diesel Fuel Storage System. [ESFDR 3.2.1 M5] [ESFDR 3.2.1.1 A] [10 CFR 60.15(c)(1)] [ESFDR 3.2.1.1 B] [ESFDR 3.2.2.2 D] [REFERENCE 2, REQUIREMENT 3]

4.1.1.19 TFMs used in the construction or operation of the Fuel Storage System shall be managed and controlled in accordance with an approved TFM Management Plan. [ESFDR 3.2.1.1 B] [10 CFR 60.15(c)(1)] [ESFDR 3.2.2.2 D] [REFERENCE 2, REQUIREMENT 5]

4.1.1.20 Lockout/Tagout Protection as required by 29 CFR 1910.147 shall be integrated into the standby generator fuel system equipment controls. [ESFDR 3.2.1 W] [ESFDR 3.2.1.9.3 F] [ESFDR 3.2.1.19.7 B]

NOTE: All bold references above are in addition to the BFD verbatim.

4.1.2 DOE Order 5480.7A Requirements (Reference 4.4.7.4):

A DOE facility shall be characterized by a level of fire protection sufficient to fulfill the requirements for the best protected class of industrial risks (Highly Protected Risk/Improved Risk). This program is characterized by the inclusion of a continuing, sincere interest on the part of management and employees in minimizing losses from fire and related perils and the inclusion of preventive features necessary to ensure the satisfaction of safety objectives.

The DOE fire protection program shall meet or exceed the minimum requirements established by the NFPA as directed by the program secretarial officer. Basic requirements shall include a reliable water supply of acceptable capacity for fire suppression; noncombustible construction of an acceptable nature for the occupancy of the facility; automatic fire extinguishing systems; a fully staffed, trained, and equipped emergency response force; a means to summon the

emergency response force in the event of a fire; and a means to notify the building occupants to evacuate in the event of a fire. For areas subject to significant life safety risks, serious property damage, program interruption, or loss of safety class equipment as defined in the relevant facility SAR, additional protection measures may be deemed necessary as determined by the AHJ.

4.1.3 **Seismic Design** - The equipment shall be designed for UBC Seismic Zone 3 requirements. (Reference 4.4.5)

4.1.4 **Wind Design** - The equipment shall be designed for an 80 mile per hour basic wind speed, Exposure "C," in accordance with the UBC. (Reference 4.4.5 derived from 4.1.1.6 d)

4.2 CRITERIA

This document describes the methodology, structure, and responsibilities for performing fire hazard analysis to meet the requirements of DOE Orders 5480.7A, Section 9; 6430.1A, Sections 0110-6.2, 0111-99.0.1, 1300-1.3, and 1530; and 4700.1. A fire hazard analysis shall review the facility fire protection and life safety features by fire area to assess compliance with DOE Orders, national standards, and local site requirements. (References 4.4.7.4, 4.4.7.7) [ESFDR 3.2.1.10.2 A1] [ESFDR 3.2.1.10.2 A1(a)] [ESFDR 3.2.1.10.2 A1(b)] [ESFDR 3.2.1.10.2 A1(c)]

4.2.1 A fire hazard analysis shall be performed to comprehensively assess the risks from fire within individual fire areas in the ESF project to verify that the objectives of DOE Order 5480.7A are met. (Reference 4.4.7.4) [ESFDR 3.2.1.10.2 A1(a)]

4.2.2 A fire hazard analysis shall be performed for all new facilities as directed by DOE Order 6430.1A and the AHJ. (Reference 4.4.7.7) [ESFDR 3.2.1.10.2 A1]

4.3 ASSUMPTIONS

4.3.1 The level of protection includes administrative procedures encompassing controls for hazardous substances/processes; inspection, maintenance, and testing of fire protection features; and other programmatic fire safety activities as defined below:

4.3.1.1 **Fire Department** - A fully staffed, trained, and equipped fire department/REECo fire protection services shall service all DOE facilities, except as determined by the program secretarial officer. (Refer to the fire protection positions on minimum staffing levels in the DOE Fire Protection Resource Manual, Reference 5.10) used throughout - no verification required.

4.3.1.2 **Fire Department Water Supply** - An automatic water supply for fire protection having a minimum two hours stored water capacity shall be maintained. Water supply is provided from the ESF construction/fire

water tank. Well water at Area 25 of the Nevada Test Site is pumped to the ESF construction/fire water tank. Facilities having an MPFL in excess of $50 million shall be provided with an additional, independent source of fire protection water. Used throughout - no verification required.

4.3.1.2.1 A water supply dedicated to fire protection may be necessary as determined by the program secretarial officer. A dedicated system shall be able to meet hose stream and sprinkler system demands. Used throughout - no verification required.

4.3.1.2.2 A combined fire and process/domestic system shall be able to deliver the fire demand plus the maximum daily domestic demand for the required duration. Used throughout - no verification required.

4.3.1.3 Underground Piping - Mains shall be sized for the largest fire flows anticipated but in no case shall they be less than eight-inch diameter. Supply piping to individual fire sprinkler systems shall be at least as large as the fire sprinkler system riser. Used throughout - no verification required.

4.3.1.4 Fire Alarm Systems - Where fire suppression or fire alarm systems are provided, local alarms in the protected area and alarm transmission to an acceptable remote attended location shall be provided. Used throughout - no verification required.

4.3.1.5 Impairment Control - A fire protection system impairment program shall be provided for control of operations and tracking of impairments during periods when fire protection systems are out of service. Used throughout - no verification required.

4.4. CODES AND STANDARDS

4.4.1 Code of Federal Regulations (CFR):

4.4.1.1	29 CFR 1910-93	Occupational Safety and Health Administration (OSHA) Regulations
4.4.1.2	29 CFR 1910-93	Subpart L - OSHA Regulations, Fire Protection
4.4.1.3	29 CFR 1926-94	Safety and Health Regulations for Construction (OSHA)

4.4.2 Factory Mutual Engineering Corporation (FM):

4.4.2.1 Loss Prevention Data Sheets

4.4.2.2 Approval Guide - 1994 Edition

4.4.3 National Fire Protection Association (NFPA):

4.4.3.1 Fire Protection Handbook-1994 Edition

4.4.3.2 NFPA 10-90 Portable Fire Extinguishers

4.4.3.3 NFPA 24-92 Private Fire Service Mains and Their Appurtenances

4.4.3.4 NFPA 30-93 Flammable and Combustible Liquids Code

4.4.3.5 NFPA 70-93 National Electrical Code

4.4.3.6 NFPA 72-93 National Fire Alarm Code

4.4.3.7 NFPA 80A-89 Recommended Practice for Protection of Buildings from Exterior Fire Exposures

4.4.3.8 NFPA 101 Life Safety Code

4.4.3.9 NFPA 220-89 Standards on Types of Building Construction

4.4.3.10 NFPA 37-1994 Stationary Combustion Engines and Gas Turbines

4.4.3.11 NFPA 850-1992 Electric Generating Plants

4.4.4 Underwriters Laboratories Inc. (UL):

4.4.4.1 UL Fire Protection Equipment Directory - 1994 Edition

4.4.4.2 UL Fire Resistance Directory - 1994 Edition

4.4.4.3 UL Building Materials Directory - 1994 Edition

4.4.5 Uniform Building Code (UBC):

UBC - 1991 Edition

4.4.6 Uniform Fire Code (UFC):

UFC - 1990 Edition

4.4.7 U.S. Department of Energy (DOE):

4.4.7.1 DOE Order 4700.1 - 1987 Project Management System

4.4.7.2	DOE Order 5480.4 - 1984	Environmental Protection, Safety, and Health Protection Standards
4.4.7.3	DOE Order 5480.5 - 1984	Safety of Nuclear Facilities
4.4.7.4	DOE Order 5480.7A - 1993	Fire Protection
4.4.7.5	DOE Order 5481.1B - 1986	Safety Analysis and Review System
4.4.7.6	DOE Order 5484.1 - 1981	Environmental Protection, Safety and Health Protection Information Reporting Requirements
4.4.7.7	DOE Order 6430.1A - 1989	General Design Criteria
4.4.7.8	DOE/EP-0108 - 1984	Standard for Fire Protection of DOE Electronic Computer/Data Processing Systems

4.4.8 American Society of Mechanical Engineers:

ASME B31.3-1987 Chemical Plant and Petroleum Refinery Piping

5. REFERENCES

5.1 Yucca Mountain Site Characterization Project Exploratory Studies Facility Design Requirements Document, (ESFDR) YMP/CM-0019, Rev. 1, ICN 01, November 1994.

5.2 ESF BFD document BAB000000-01717-6300-00002 Rev. 05, November 28, 1994.

5.3 Mechanical Engineering Drawings for ESF Package 1E

- BABBDA000-01717-2100-29050-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply Equipment Schedule
- BABBDA000-01717-2100-29051-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System Location Plan
- BABBDA000-01717-2100-29052-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply Enlarged Plan Sheet 1
- BABBDA000-01717-2100-29053-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System Enlarged Plan Sheet 2
- BABBDA000-01717-2100-29055-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System Sections

- BABBDA000-01717-2100-29056-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System Sections and Details
- BABBDA000-01717-2100-29057-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System P&ID Sheet 1
- BABBDA000-01717-2100-29058-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System P&ID Sheet 2
- BABBDA000-01717-2100-29059-0A, Exploratory Studies Facility Package 1E, Mechanical Fuel Supply System P&ID Sheet 3

5.4 Electrical Engineering Drawings for ESF Package 1E

- YMP-025-1-7007-EL102 Rev 02, Exposed Conduit Power Plan
- YMP-025-1-7007-EL104 Rev 03, Grounding Plan
- YMP-025-1-7007-EL109 Rev 04, Embedded Conduit Plan
- BABB00000-01717-2100-24012 Rev 01, Electrical Cable Schedules Sheet 2
- BABB00000-01717-2100-24037 Rev 01, Electrical Standby Power System One Line Diagram
- BABB00000-01717-2100-24041 Rev 04, Electrical Site Grounding Plan Sheet 2
- BABB00000-01717-2100-24051 Rev 02, Electrical Lighting Plan Sheet 2
- BABB00000-01717-2100-24060 Rev 04, Electrical Incoming Power Plan
- BABB00000-01717-2100-24072 Rev 04, Electrical Underground Dist Plan Sheet 2
- BABB00000-01717-2100-24200 Rev 03, Electrical Ductbank Sections Sheet 3

5.5 ESF Design Package 1E Cost Estimate, Attachment I (TBV-058)

5.6 Specification Section 15483, Fuel Supply System, REV 00A

5.7 Specification Section 16622, Packaged Engine Generator Systems, REV 01, October 17, 1994

5.8 Specification Section 16623, Standby Power Generators, REV 00A

5.9 Specification Section 16950, Integrated Data and Control System, REV 00, February 2, 1995

5.10 DOE Fire Protection Resource Manual, transmitted October 18, 1991

5.11 North Portal Fire Hazard Analysis ESF Surface Design Package 1C, BABBDF000-01717-0200-00024, REV 00, April 24, 1994

5.12 North Portal Fuel Storage System Fire Hazard Analysis - ESF Surface Design Package 1D, BABBD0000-01717-0200-00003, REV 00, January 18, 1995

5.13. Analysis: Fuel Supply System Analysis for ESF Package 1E BABBDA000-01717-0200-00008, REV 0B, Fuel Supply System Requirements

5.14 Specification: Packaged Mechanical Equipment, BAB000000-01717-6300-16152, REV 03, February 1, 1995, UL Listings on Electrical Equipment

5.15 Specification: NEMA Frame Induction Motors (small), BAB000000-01717-6300-16405, REV 01, October 17, 1994, UL Listings on Motors

5.16 Analysis: Standby Generators for North Portal Electrical Loads, BAB000000-01717-0200-00145 REV 00, Physical Data and Characteristics for Standby Generators

5.17 DIE for ESF North Portal Pad, BABB00000-01717-2200-00001, REV 05

6. USE OF COMPUTER SOFTWARE

Not applicable.

7. DESIGN ANALYSIS

7.1 DIESEL FUEL OIL SYSTEM DESCRIPTION

7.1.1 General

7.1.1.1 The fuel supply system provides diesel fuel to the standby generators (Section 4.1.1).

7.1.1.2 The fuel supply system for Package 1E is similar to Package 1D, diesel fuel oil system which is approved and has been issued for construction (Reference 5.13).

7.1.1.3 All electrical equipment is UL listed and shall bear the UL label. Electrical components, controls, constructions, and design are in accordance with Specification Sections 16152 and 16405 (References 5.14 and 5.15).

7.1.1.4 All components of the system are restrained to meet UBC Seismic Zone 3 requirements (Section 4.1.1.6 c).

7.1.1.5 All components of the system are suitable for outdoor installation (Section 4.1.1.6 e)

7.1.2 Main Fuel Oil Storage Tank

7.1.2.1 One horizontal 6,500-gallon (nominal) carbon steel tank for above ground installation is provided as shown on the drawings. The tank has secondary containment construction (Type II), or equivalent, and is fabricated in accordance with the requirements of UL 142 and NFPA 30. The tank is self-contained and is designed to satisfy all requirements of NFPA 30, Paragraph 2-3.4.1, Exception No. 2. (References 5.6 and 5.13)

7.1.2.2 The fuel supply tank is provided with the following connections (References 5.6 and 5.13):

- Two, 2-inch diameter by 8-foot long vent stacks (primary and secondary tanks)
- 4-inch brass and iron lockable fill cap with overspill protection
- 8-inch emergency relief vent
- 2-inch liquid level port
- 2-inch secondary tank leakage monitoring port
- 4-inch supply and return
- 2-inch relief valve return
- 4-inch primary drain
- 2-inch secondary drain
- 8-inch secondary tank emergency relief vent
- 24-inch manhole access.

7.2 DIESEL FUEL PUMPS

A total of three diesel fuel pumps are employed; rated 1/2 horsepower, 120 volts, single-phase, 60 Hertz, 5 gallons-per-minute (gpm), and a head pressure of 50 psig. All pumps are supplied with standby power. One pump is in reserve. (References 5.6 and 5.13)

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7.3 STANDBY GENERATOR DESCRIPTION

7.3.1 General

7.3.1.1 Engine generator sets shall provide source of standby power to air compressors and other loads as shown on the drawings (References 5.2, 5.13, 5.16).

7.3.1.2 There are four packaged engine generator sets originally manufactured in 1969 by Stewart & Stevenson Services, Inc., Houston Branch. These four sets of packaged engine generators are included in Design Package 1C. (References 5.7 and 5.16)

The rating of the existing engine generator set is 500 kW, 4160/2400 volt, 60 Hertz, 0.8 power factor, 3 phase, 4 wire. The physical dimensions are 240 inches long, 72 inches wide, and 108 inches high, and the weight is approximately 30,000 pounds. The ratings and dimensions of all four sets are the same. (References 5.7 and 5.16)

7.3.1.3 Two new packaged engine generator sets will be procured by Specification Section 01600. The rating will be 1100 kw, 4160/2400 V, 60 Hertz, 0.8 power factor, 3-phase 4-wire. The physical dimensions will be approximately 240 inches long, 72 inches wide and 94 inches high, and weight approximately 30,000 pounds. (References 5.8 and 5.16)

7.3.2 Engine

7.3.2.1 Each engine generator set included in Design Package 1C contains two water cooled, 336 HP, Detroit Diesel engines (References 5.7 and 5.16).

7.3.2.2 Each engine generator set included in Design Package 1E contains a single engine water cooled HP diesel engines (References 5.8 and 5.16).

7.3.2.3 Components include fuel filters, lube oil filters, intake air filters, water cooling and heating systems, gauges, hoses, DC battery starting system, etc. (References 5.6-5.9, 5.14-16)

7.3.3 Engine Generator Instrument Panel

7.3.3.1 The engine generator instrument panel consists of meters, indicating lights, control devices, selector switches, and protective relays (References 5.8 and 5.9).

7.3.3.2 Provisions to automatically start all four engine generator sets from a remote location and automatically synchronize them are provided (References 5.8 and 5.9).

7.3.4 Instrument, Control, and Protective Relay Wiring

7.3.4.1 The instrument, control, and protective relay wiring, including all electrical interlocks and intercompartment wiring, is in accordance with the ASTM B3 and ASTM B8 (References 5.8 and 5.9).

7.3.4.2 Each engine generator set is equipped with a General Electric, solenoid-operated circuit breaker (References 5.8 and 5.9).

7.4 FIRE AREA DESCRIPTIONS AND FEATURES

7.4.1 The fuel supply tank pad is located approximately 30 feet north of the standby generator pad; only 15 feet is required by NFPA 30. The pump pads are immediately west of the storage tank. (Reference 4.4.3.4)

7.4.1.1 The fuel storage tank is constructed with secondary containment and is listed by UL in accordance with UL 142 and is installed in accordance with the requirements of NFPA 30 (References 4.4.3.4 and 5.6).

7.4.1.2 The tank contains a diesel fuel classified as a combustible liquid in accordance with the definitions of NFPA 30 (References 4.4.3.4 and 5.6).

7.4.1.3 No special extinguishing systems are required to protect either the tanks or any adjacent exposure (References 4.4.3.4 and 4.4.3.7).

7.4.1.4 The tank is separated to limit exposure damage in case of a fire. The tank pad is separated from adjacent structure to prevent exposure from fire-related incidents, in accordance with NFPA 80A, Uniform Fire Code Tables 79.503A and 79.503F, and BFD Section 7.2.4.1.IV.18 for maintenance. (References 4.4.3.7, 4.4.3.8, 4.4.3.9, 4.4.6 and 5.2)

7.4.2 The engine generator pad is located approximately 100 feet east of the Switchgear Building. The pads are in fenced areas at the southeast corner of the North Portal Facility. The engine generators are separated from each other by 10 feet to limit exposure from fire in an adjacent unit (five feet is required per NFPA 37). The engine generators do not protect essential safety class equipment, and no special fire protection features are required. (References 4.4.3.10, 5.3 and 5.4).

7.4.2.1 The standby generators do not contain materials with unusual fire characteristics or in quantities judged to exceed normal amounts permitted for their use and operation.

7.4.2.2 Adjacent units are separated from each other to limit exposure damage in case of a fire in one unit. The generator pads are separated from adjacent structure to prevent exposure from fire-related incidents, in accordance with NFPA 850 (30 feet). (Reference 4.4.3.11)

7.4.2.3 The water supply for the permanent fire protection installation is provided by a dedicated source with sufficient capacity (based on maximum demand) for fire fighting until other sources become available.

7.4.3 Yard Hydrants

Yard hydrants are provided at a minimum space of 400 feet. Locations of the hydrants consider the possible locations of fires outside. Hydrant demands comply with DOE Order 6430.1A, Section 1530-3.3.3. (References 4.4.7.7)

7.4.4 Portable Fire Extinguishers

Two portable fire extinguishers are provided as required and comply with NFPA 10 (Reference 4.4.3.2).

7.4.5 Water System

A separate firewater and construction water system supplies water for fire protection. Lines or subsystems handling water for fire protection have a minimum earth cover of three feet. (Reference 4.4.3.3)

7.4.6 Identification of Existing Fire Hazards

Fire protection techniques for the ESF Facilities incorporate requirements for handling fires involving normal fire hazards. Fire hazards include:

- Air compressors
- Lube oil
- Electrical supply panels and switchgear.

7.5 FIRE HAZARDS

7.5.1 Description

The fuel supply tank is designed in accordance with NFPA 30 and American Society of Mechanical Engineers (ASME) codes and standards. Combustible liquids are in suitably listed containers with spill protection, and electrical equipment is suitably listed and classified. The tank spacing is based on compliance with UFC Tables 79.503A and 79.503F. The tank construction and spacing are the same for either a Type I or Type II flammable or combustible liquid. (References 4.4.3.4, 4.4.6 and 4.4.8)

The standby generators are designed in accordance with applicable NFPA and ASME codes and standards. Combustible liquids are in suitably listed containers with spill protection, and electrical equipment is suitably listed and classified. Engine generators are suitably spaced from each other to limit fire damage to the individual unit.

7.5.2 Mitigation

Yard hydrants and portable fire extinguishers are provided. Two fire extinguishers are rated minimum 4A40B:C in accordance with NFPA 10. The pads for the engine generators are approximately 400 feet from the tunnel entrance and do not endanger the portal entrance. (Reference 4.4.3.2)

7.5.3 Line Safety Considerations

The units are located in an open area.

7.5.4 Essential Safety Class Systems

The standby generators and fuel supply system do not supply any essential safety class systems.

7.6 DAMAGE POTENTIAL

The leading scenario for a large loss fire would be failure of switchgear causing a generator fire. If the fire scenario is undetected or unmitigated for any length of time, the effect of the damage to the generator set could be expected to escalate rapidly. While due diligence is taken providing equipment which had been listed by nationally-recognized testing facilities, such as UL and FM, failures may still occur. (References 4.4.2.1, 4.4.2.2, 4.4.4.1, 4.4.4.2 and 4.4.4.3).

The design of the fuel supply system incorporated the fire safety requirements and the installation standards of the NFPA. Shutdowns are provided, along with local alarms and fire extinguishers, to assist at all levels of reasonable protection based on the identified hazards.

Administrative controls for the facility will limit the amount of transient combustible materials and limit potential ignition sources (e.g., No Smoking signs). As such, the facility does not pose an unreasonable fire hazard.

7.6.1 Maximum Possible Fire Loss

The MPFL, as defined by DOE Order 5480.7A, is the value of the property, excluding land, within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential. This assumes a failure of manual fire fighting efforts. The value of equipment is approximately $300,000. The losses would include fire damage, smoke and heat damage, water damage, salvage, and cleanup. The fire department would not respond in time to aid in suppression. The fire could result in loss of power to underground operations and result in a delay of greater than six months. (Reference 4.4.7.4)

7.6.2 Largest Possible Fire Loss

The largest possible fire loss can be expected to be the same as the maximum possible fire loss because the facility does not include materials or processes that would add significant costs for cleanup or decontamination.

7.6.3 Maximum Credible Fire Loss

The maximum credible fire loss for the standby generators would be the loss of a single unit plus cleanup costs or $320,000.

The maximum credible fire loss for the diesel fuel supply tank would be the loss of the tank and accessories plus cleanup costs or $115,000.

7.6.4 Fire Department Response

The fire department can be expected to respond from Area 6 with three fire fighters in half an hour with a 1,000-gallon tanker and 750 gpm pump. The Mercury Fire Department response would be approximately one hour with three fire fighters, a 1,500-gallon tanker, and a 1,250 gpm pump.

7.6.5 Critical Process Equipment

The fuel supply system does not contain any critical process equipment.

7.6.6 Special Considerations

The fuel supply system is designed to provide reasonable mitigation from natural hazards, such as earthquake, flood, lightning, windstorm, etc., as can be expected for the area.

7.6.7 Vital Facilities

The criteria documents do not identify the fuel supply system as a vital facility.

8. CONCLUSIONS

8.1 The fuel supply system does not exhibit any unusual hazards or unmitigated loss potential exceeding the guidelines of an "improved risk" as defined by DOE Order 5480.7A (Reference 4.4.7.4).

8.2 Consideration of applying "vital" criteria needs to be addressed by the program secretarial officer for loss causing delays which may exceed six months (Section 7.6.7).

8.3 LOSSES DUE TO FIRE:

8.3.1 The MCFL for the diesel generator system includes the loss of one generator unit combined with cleanup costs estimated at $320,000 (Section 7.6.3).

8.3.2 The MCFL for the fuel storage system would be the loss of one tank, all accessories, and cleanup costs estimated at $115,000 (Section 7.6.3).

8.3.3 The maximum possible loss is estimated at $300,000 (Section 7.6.1)

8.4 MITIGATING MEASURES:

8.4.1 Yard hydrants are provided (Section 7.5.2)

8.4.2 Two (2) fire extinguishers are required. The minimum rating of the extinguishers are 4A40B:C (Section 7.5.2).

9. ATTACHMENTS

ATTACHMENT	TITLE
I	Fuel Supply System - ESF Design Package 1E Cost Estimate (TBV-058-DD)

FUEL SUPPLY SYSTEM - ESF DESIGN PACKAGE 1E COST ESTIMATE

(TBV-058-DD)