6 THERMAL EVALUATION

6.1 Conduct of Review

Review of the thermal evaluation included Sections 3.3.6, Fire and Explosion Protection, and 3.3.7, Materials Handling and Storage, of the SAR. The design of the proposed Facility is based on the use of the HI-STORM 100 Cask System as certified by the NRC (Nuclear Regulatory Commission, 2000a) and as described in the FSAR for the HI-STORM Cask System (Holtec International, 2000).

6.1.1 Decay Heat Removal Systems

The HI-STORM 100 Cask System is designed to remove decay heat primarily by convective heat transfer. No active cooling systems are used. The storage cask is equipped with four inlet vents at the bottom and four inlet vents on top. Cool air is drawn into the annulus between the canister and storage cask through the bottom inlet vents. The buoyancy created by the heating of the air creates a chimney effect and the air flows back into the environment through the outlet vents at the top of the cask. The Technical Specifications include surveillance requirements for ensuring that the cask heat removal system is operational during storage (i.e., the air ducts are inspected or the outlet temperature is measured every 24 hours to ensure that the ducts are free of blockages). The cask system design and heat removal capability are described and evaluated in the HI-STORM 100 FSAR. As documented in the NRC's HI-STORM 100 SER (Nuclear Regulatory Commission, 2000b), the staff has previously determined that the HI-STORM 100 Cask System provides adequate heat removal capacity.

6.1.2 Material Temperature Limits

The material temperature limits for the HI-STORM 100 Cask System are given in the HI-STORM 100 FSAR, which has been reviewed and found to be acceptable by the staff.

6.1.3 Thermal Loads and Environmental Conditions

The staff has reviewed the information presented in Section 2.3, Meteorology, and Section 3.2.6, Thermal Loads, of the SAR. The staff reviewed the discussion on thermal loads and environmental conditions with respect to the following regulatory requirements

- 10 CFR 72.92(a) requires that the natural phenomena that may exist or that can occur in the region of a proposed site be identified and assessed according to their potential effects on the safe operation of the ISFSI. The important natural phenomena that affect the ISFSI design must be identified.

- 10 CFR 72.122(b) requires that (1) structures, systems, and components important to safety be designed to accommodate the effects of, and to be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing of the ISFSI and to withstand postulated accidents. (2) Structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions. The design bases for these structures, systems, and components must reflect: (i) Appropriate consideration of the most severe of the natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated, and (ii) Appropriate combinations of the effects of normal and accident conditions and the effects of natural phenomena. The ISFSI should also be designed to prevent massive collapse of building structures or the dropping of heavy objects as a result of building structural failure on the spent fuel or high-level radioactive waste or on to structures, systems, and components important to safety. (3) Capability must be provided for determining the intensity of natural phenomena that may occur for comparison with design bases of structures, systems, and components important to safety.

The temperatures recorded at different sites are summarized in Table 2-1 of this SER. This table has been developed from Table 2.3-4 of the SAR and data presented in Ashcroft et al. (1992). The data availability period for Salt Lake City in Table 2.3-4 of the SAR is 1951–1980. Similarly, 1950–1992 and 1951–1958 information was available for Dugway and Iosepa South Ranch, respectively. Ashcroft et al. (1992) reported meteorological data for 1950–1992 and 1948–1992 for Dugway and Salt Lake City, respectively. The maximum recorded annual average temperature at the site (average of temperatures recorded both day and night throughout the year) is 49 °F. At Dugway, 12 mi south of the proposed site, the annual average temperature is 51 °F. The average daily maximum temperature is defined as the average of peak temperatures throughout the hottest month, July. The highest average daily temperature is 95 °F, recorded at Iosepa Ranch, 8 mi northwest of the proposed site. Based on information from the National Oceanic and Atmospheric Administration, the lowest ambient temperature recorded near the site is -30 °F, at Salt Lake City. The HI-STORM 100 Cask System was evaluated for an average annual temperature of 80 °F and temperature extremes of -40 °F and 125 °F. The temperatures at and around the PFS Facility site are bounded by the temperatures for which the HI-STORM 100 Cask System was evaluated.

The maximum solar insolation recorded at the site is 685 W/m^2 during a 12-hr period. Also, the maximum solar insolation recorded at Salt Lake City is 730 W/m^2 during a 12-hr period. The HI-STORM 100 Cask System has been evaluated for a bounding solar insolation value of 775 W/m^2 during a 12-hr period, per 10 CFR Part 71.

The staff reviewed the local meteorological data and discussions presented in the SAR and found these acceptable because reliable data sources, such as the National Weather Service, were used, and the data are appropriately summarized. The applicant adequately presented information regarding temperatures recorded during the onsite measurement program and at other nearby sites, and, therefore, satisfied the requirement of 10 CFR 72.92(a). The staff confirmed that temperatures and solar loads at the site are bounded by the HI-STORM 100 Cask System design parameters.

6.1.4 Analytical Methods, Models, and Calculations

The analytical methods, models, and calculations for the thermal evaluation of the HI-STORM 100 Cask System are described in detail in the HI-STORM 100 FSAR. As documented in the NRC's HI-STORM 100 SER, the staff has previously reviewed these methods, models, and calculations and found them acceptable.

6.1.5 Fire and Explosion Protection

6.1.5.1 Fire

The information presented in Section 3.3.6, Fire and Explosion Protection; Section 3.2.12, Lightning; Section 4.3.8, Fire Protection System; Section 4.3.12, Gas Utilities; and Section 8.2.5, Fire; in connection with the protection against potential onsite fire and wildfire has been reviewed for conformance with the following regulatory requirement.

- 10 CFR 72.122(c) requires that structures, systems, and components important to safety be designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions. Noncombustible and heat-resistant materials must be used wherever practical throughout the ISFSI, particularly in locations vital to the control of radioactive materials and to the maintenance of safety control functions. Explosion and fire detection, alarm, and suppression systems shall be designed and provided with sufficient capacity and capability to minimize the adverse effects of fires and explosions on structures, systems, and components important to safety. The design of the ISFSI must include provisions to protect against adverse effects that might result from either the operation or the failure of the fire suppression system.

Facility Restricted Area

The proposed Facility is located on an open gravel surface. Figure 1.2-1 of the SAR gives the layout of the restricted area of the Facility. Concrete storage pads will be separated from the inner fence of the Facility surrounding the restricted area by a minimum distance of 150 ft. The restricted area not covered by the storage pads will have 12-in.-deep crushed rock (Cooper, 1999). The outer fence is separated from the inner fence by 20 ft. The isolation zone (the region between the fences) will also be covered with 12-in.-deep crushed rock. The 20-ft-wide perimeter road, located 10 ft from the outer fence, will also be covered by 12 in.-deep crushed rock. The 10-ft wide zone between the perimeter road and the outer fence will also have a 12-in.-deep crushed rock surface. A maintenance program will control any significant growth of vegetation through the crushed rock. Therefore, the surface of the restricted area, including the region up to the perimeter road, will be noncombustible. Additionally, there will be a 300-ft-wide barrier of crested wheat grass around the restricted area to protect the Facility from wildfires. This barrier would remain in place with little maintenance after the wheat grass has been planted. Crested wheat grass is fire resistant and will greatly reduce the effects of any wildfire approaching the Facility. The staff finds that the width of the fire barrier is sufficient to protect important to safety structures, systems, and components from the effects of wildfires. It may be noted that the U.S. Fire Administration (1993) recommends a 100-ft-wide fire barrier for protecting houses in a pine forest.

Canister Transfer Building

The Canister Transfer Building is made of concrete walls 2 ft thick, a concrete roof 1 ft thick and a 5-ft-thick concrete foundation (Stone & Webster Engineering Corporation, 1998a,b). In SAR Section 4.3.8.1, PFS characterized the Canister Transfer Building as multiple purpose occupancy and classified it as a Type II Fire Rated construction following the UBC (International Conference of Building Officials, 1997) and a construction Type II structure in accordance with NFPA 220, Standard Types of Building Construction (National Fire Protection Association, 1999a), as referenced in NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Material (National Fire Protection Association, 1998a). UBC provides the minimum standards to safeguard life, health, property, and public welfare by regulating and controlling the design, construction, occupancy, and quality of materials of a building. NFPA 220 provides definitions for standard types of building construction based on the combustibility and the fire resistance rating of a building's structural elements. NFPA 801 addresses the requirements for fire protection at facilities handling radioactive materials to reduce the risk of fires and explosions. Because nuclear materials will be handled in the Canister Transfer Building, the fire protection systems will be designed in accordance with NFPA 801. To meet any fire insurance requirements, however, PFS will design the Canister Transfer Building to envelope UBC requirements if found to be more stringent. The building is designed to limit the potential effects from a diesel fire by providing curbs and sloped floors to contain spilled diesel away from the structures, systems, and components important to nuclear safety.

The Canister Transfer Building, including the cask load/unload bay and cask transfer cells, and other buildings in the Facility will be constructed with automatic fire detection systems. Photosensitive smoke detectors will be placed in all buildings to detect any fire. The smoke detectors will be interconnected within each building and connected to a central alarm panel located in the Security and Health Physics Building. A trip of the fire detection system over the cask load/unload bay will automatically engage the foam-water sprinkler system. The fire-suppression systems and equipment consist of sprinkler systems in the Canister Transfer Building and the Security and Health Physics Building, portable fire extinguishers, hose reels, fire hydrants, fire truck, fire pumps, and water supply tanks. The Canister Transfer Building is divided into three fire zones, based on specific occupant classifications following NFPA 101, Life Safety Code (National Fire Protection Association 1997a). NFPA 101 addresses life safety from fire and similar emergencies. The code provides requirements for construction, protection, and occupancy features necessary to minimize danger to life from fire, including smoke, fumes, and panic. Fire Zone 1 is classified as a Special Purpose Industrial Occupancy and consists of the transfer cells, crane bay, cask load/unload bay, and the cask transporter bay. The low-level waste storage room is included in Fire Zone 2 and classified as a Storage Occupancy, based on NFPA 101. Fire Zone 3 consists of the office and services areas of the building and is classified as a Business Occupancy. Figure 4.3-1 of the SAR illustrates these zones in the Canister Transfer Building. The fire zones will be separated by 1-hr fire rated barrier walls and fire doors, as recommended by UBC.

The transfer cells and crane bay in Fire Zone 1 will not store any combustible liquid. The cask transporter bay could have up to 50 gal. of diesel (Class II combustible liquid) in the cask transporter. However, during transfer operations, the cask transporter will be prevented from entering a transfer cell by the shield doors at either side of the cell. The shield doors will remain closed when canister transfer is in progress by PFS Facility administrative procedures. A cask transporter can only enter a transfer cell when the canister is either in the shipping cask or in the storage cask with the lid bolted in place. The cask load/unload bay will have the combustible fuel load of 300 gal. of diesel in the heavy haul tractor/trailer. The heavy haul vehicles will enter and exit the cask load/unload bay at the south end of the Canister Transfer Building and will not approach a cask transfer cell. By Facility administrative procedure, train locomotives are required to stay out of the Canister Transfer Building. The Canister Transfer Building and its surroundings are designed in such a way that any fuel spilled outside the building will not flow into the building.

A foam-water sprinkler system will be installed in the cask load/unload bay in accordance with NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems (National Fire Protection Association, 1999b). NFPA 16 provides the minimum requirements for the design, installation, and maintenance of foam-water sprinkler and spray systems. Water will flow into the piping system when the foam-water sprinkler system is activated. Foam will be injected into the water resulting in a foam solution being discharged through special sprinkler heads. Foam-water discharge will continue until manually shut off.

Total floor area of the cask load/unload bays is approximately 10,250 sq ft. NFPA 16 allows a maximum of 5,000 sq ft per zone. PFS has selected three foam-water sprinkler zones for the Canister Transfer Building. One zone includes the low bay section of the east half of both bays. A second zone covers the low bay section of the west half of both bays. The high bay section in the middle of the building is the third zone. The area of each low bay zone is approximately 3,500 sq ft. The high bay has an area of 3,250 sq ft. Additionally, the floor of the bay area will be sloped toward one of two sumps located at the center of each low bay zone.

The depth of each sump will be 6 ft. Each sump will be 60 ft long and 6 ft wide with floors that slope downward at a rate of 0.25 in./ft for 24 ft toward a deep end of the bays. The sumps would be away from the locations where a shipping cask and the crane lifting cables will be located. Dimensions of the sump will be adequate to accommodate 300 gal. of diesel fuel spill and 30 min of discharge of the sprinkler system at the discharge rate allowed. The threshold between the crane bay and load/unload bay will be 1 in. high to retain any spilled diesel. The rise of the threshold will be gradual for a 2 ft wide area to avoid personnel tripping hazards.

The walls of the transfer cells will be 2-hr fire rated and the sliding doors will be 2-hr fire rated to prevent any fire in the transporter bay from affecting an exposed canister during transfer operation. No sprinklers will be located in the transfer cells to avoid inadvertently spraying down the canister and dislodging any contamination on the canister. The transfer cells will primarily contain the storage or shipping cask. The only ignition source that can enter the transfer cell is the cask transporter which can contain up 50 gal of diesel fuel. This situation will only arise after the canister is contained in the concrete storage cask. The HI-STORM 100 FSAR has demonstrated that this configuration can adequately withstand a 50-gal fire.

Additionally, the floor of the transfer cells will slope away from the cells to ensure that any spill of diesel in the transporter bay does not flow into the cells. Moreover, PFS will install 100-ft-long hose reels adjacent to the crane bay and the cask transporter bay exit locations to ensure that all areas within the transfer cells are accessible by water in case of a fire.

Fire Zone 2 is a low-level waste (low-level waste) storage area and will store health physics survey samples and dry wipes to be used for removing radioactive contamination of the storage casks in 55 gal. sealed drums. The holding cell is designed to maintain radiation levels ALARA and will store a few low-level waste containers before they are shipped offsite. Further evaluation of the low-level waste holding cell is given in Chapter 14 of this SER. This zone does not require a fire sprinkler system and will only have fire extinguishers for fire protection.

Fire Zone 3 will have smoke detection and fire extinguishers for fire protection.

The fire detection system is designed in accordance with NFPA 72, National Fire Alarm Code (National Fire Protection Association, 1999c). NFPA 72 includes the application, installation, location, performance, and maintenance of fire alarm systems and their components. This code defines the means of signal initiation, transmission, notification, and annunciation; the levels of performance; and the reliability of the various types of fire alarm systems.

Portable fire extinguishers are provided throughout the Canister Transfer Building in accordance with NFPA 10, Standard for Portable Fire Extinguishers (National Fire Protection Association, 1998b). NFPA 10 provides the requirements for selection, installation, inspection, maintenance, and testing of portable extinguishing equipment. Requirements in NFPA 10 are minimum and fire extinguishers are intended to cope with fires of limited size.

Fire pumps located outside the restricted area will supply water to the sprinkler system, fire hydrants, and hose reels. Water is supplied by a primary and backup water tanks. Water for the foam-water sprinkler system will be fed from one of two fire pumps placed in a pump house outside the restricted area near the Security and Health Physics Building. The foam supply will be connected to the water lines outside the Canister Transfer Building. One pump will be powered by an electrical motor and the other by a diesel engine in case of loss of electric power. The fire pumps and water supply tanks are provided in accordance with NFPA 20, Standard for the Installation of Centrifugal Fire Pumps (National Fire Protection Association, 1999d) and NFPA 22, Standard for Water Tanks for Private Fire Protection (National Fire Protection Association, 1998c), respectively. NFPA 20 gives the requirements for selection and installation of pumps supplying water for fire protection. Requirements have been established for design and installation of these pumps, pump drivers, and associated equipment. NFPA 22 provides the minimum requirements for design, construction, installation, and maintenance of tanks and accessory equipment that supply water for fire protection. Fire hydrants are located near the buildings to support fire suppression. At least one fire truck will be located at the Facility site, and one truck will be at the Goshute Village, 3.5 mi from the site. Smoke from a fire in the Canister Transfer Building will be removed by the exhaust fans.

Section 8.2.5.2 of the SAR states that a fire involving 300 gal. of diesel would not threaten the integrity of a canister in a shipping cask. The shipping casks are required to safely withstand the effects of a fire burning at 1,475 °F for 30 min, as per 10 CFR 71.73(c)(4). A fire involving 50 gal. of diesel from a cask transporter would burn a maximum of 5 min without any assistance from the sprinkler system to extinguish it.

Security and Health Physics Building

The fire protection systems of the Security and Health Physics Building will be designed in accordance with the requirements of UBC and NFPA 101, as applicable. The building has been classified as Group B for business related functions, with an occupancy of less than 50 persons and floor area of less than 12,000 sq ft. The building construction is classified as Type II-N (i.e., non-combustible) based on UBC guidelines. No automatic fire-suppression systems are required by UBC for this building.

A double-wall sub-base diesel tank, designed according to NFPA 37, Standard for the Installation and Use of Stationary Combustible Engines and Gas Turbines (National Fire Protection Association, 1998d), will be located in the Security and Health Physics Building to provide fuel for the backup diesel generator. NFPA 37 specifies the design and spill control requirements for storage tanks. The capacity of the diesel generator will not be more than 150 kW with maximum fuel consumption at the rate of approximately 12 gal./hr. To provide a minimum of 24-hr backup power plus the required 30-min monthly tests, PFS estimates 350 gal. of diesel need to be stored in the tank. More discussion on the diesel storage tanks is given in the following section.

The anticipated capacity of the diesel tank in the Security and Health Physics Building for providing fuel for the backup diesel generator is 350 gal. and exceeds the exempt amount of 120 gal. for Class II combustible liquid prescribed by UBC. Therefore, a water sprinkler will be installed in the diesel generator room in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems (National Fire Protection Association, 1999e). NFPA 13 provides the minimum requirements for the design and installation of automatic water sprinkler systems and exposure protection sprinkler systems, including the character and adequacy of water supplies and the selection of sprinklers, fittings, pipings, valves, and all materials and accessories, together with the installation of private fire service mains. The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through standardization of design, installation, and testing requirements for sprinkler systems, and private fire service mains, based on sound engineering principles, test data, and field experience. The diesel generator room will be separated from all other adjacent interior spaces by a 1-hr rated fire barrier in accordance with UBC.

Diesel Storage Tanks

A diesel fuel oil storage tank will be located within the restricted area for refueling onsite vehicles including the cask transporters. This tank will have a capacity of approximately 1,000 gal. of low-grade sulfur No. 2-D diesel fuel. This tank will be placed approximately 200 ft from the Canister Transfer Building and approximately 700 ft from any storage cask. This above ground tank will have a double wall for primary and secondary spill containment requirements, fill and venting requirements, and fire prevention requirements in accordance with NFPA 30, Flammable and Combustible Liquids Code, (National Fire Protection Association, 1996). The tank will be surrounded with dikes to contain fuel in the event of a leak or spillage. NFPA 30 applies to the storage, handling, and use of flammable and combustible liquids. The code also includes strategies for the protection against flammable liquid hazards (e.g., storage limits and sprinkler designs). The tank will be designed in accordance with the requirements of UL-142, Steel Aboveground Tanks for Flammable and Combustible Liquids (Underwriters Laboratories Inc., 1993) and UL–2085, UL Insulated Aboveground Tanks for Flammable and Combustible Liquids (Underwriters Laboratories Inc., 1997). UL–2085 requires tanks be constructed to limit the heat transferred to the primary tank when exposed to a 2-hr hydrocarbon pool fire. The primary tank should also be provided with additional protection against impact from projectiles and vehicles. A regional bulk fueling service will deliver diesel to the Facility approximately every two weeks with a tanker truck.

The diesel storage tanks will be located at least 50 ft inside the inner fence of the restricted area. Consequently, there will be approximately 100 ft of firebreak between the outer edge of the perimeter road and the tank. An additional firebreak of approximately 300 ft will be provided by the crested wheatgrass barrier. This barrier will run around the restricted area. The Security and Health Physics Building will be approximately 50 ft inside the crested wheat barrier. Therefore, the emergency diesel generator tank located inside this concrete building would be approximately 350 ft from a potential wildfire. Based on these distances from the potential wildfire, availability of firebreaks, and construction of the storage tanks, the staff concludes that the potential impact of wildfires will be negligible on the diesel storage tank and the emergency generator tank.

Locomotives

A fire associated with the diesel fuel spill from locomotives is not likely given the low travel speed and difficulty in igniting spilled diesel fuel. In addition, PFS will engineer the slope of the terrain to retain a spill of 6,400 gallons of diesel fuel near the rail line, as discussed in Section 15.1.2.4 of this SER. Two coupled main line locomotives on the north rail line can come within 100 ft of the nearest cask storage pads. These railroad locomotives, manufactured by General Motors Electro-Motive Division, are assumed to be model SD–40–2, Type C-C. Each of these locomotives is rated at 3,000 continuous horsepower and carries 3,200 gal. of diesel in two tanks located underneath the locomotive. The locomotives will be fueled outside the restricted area by a regional bulk fueling service. The fuel service must comply with the U.S. Environmental Protection Agency and Occupational Safety and Health Administration regulations and will be responsible for containment and clean up of any spills in accordance with the applicable regulations.

By Facility administrative procedures, the locomotives will not enter the Canister Transfer Building. PFS proposes to use railroad switching locomotive model MP–15AC to push the 150-ton depressed center flat car carrying the spent fuel shipping cask inside the Canister Transfer Building. The locomotive, manufactured by General Motors Electro-Motive Division, has 1,500 hp with an 1100 gal. diesel fuel tank. The shipping cask car has a coupled length of approximately 74 to 105 ft. A spacer car of coupled length of approximately 66 ft will be placed in between the shipping cask car and the locomotive. The rail cars will enter the Canister Transfer Building through the west doorway of the cask load/unload bay. The distance from the west doorway to the location where the shipping cask would be positioned for hoisting is approximately 103 ft. The nearest end of the locomotive fuel tank will be approximately 20 ft outside the Canister Transfer Building. By Facility administrative procedures, the locomotive engineers would be instructed to keep the locomotives outside the Canister Transfer Building. Additionally, PFS proposes to install wheel stops onto the rails in the cask load/unload bay east of the bay centerline to physically prevent locomotives from entering into the Canister Transfer Building.

Propane Storage Tanks

Propane for heating the Canister Transfer Building and the Security and Health Physics Building will be stored in a group of four centralized tanks. Each tank will have a capacity of 5,000 gal. or less so that the combined capacity of all four tanks will be not more than 20,000 gal. The four storage tanks will be separated by missile walls to ensure that a single tornado missile cannot rupture more than one tank. The tanks will be located outside the restricted area and at least 1,800 ft away from the nearest cask storage pads and the Canister Transfer Building and approximately 1,000 ft west of the Operations and Maintenance Building. Additionally, propane for heating the Operations and Maintenance Building and the Administration Building will be stored in relatively small propane tanks located near these structures. PFS specifies that a crushed rock surface devoid of vegetation will be placed a minimum of 100 ft radially outward from the propane tanks to stop propagation of wildfires. Evaluation of potential detonation of the propane in Chapter 15, Accident Analysis, of this SER shows that the generated air overpressure at a distance of 1,800 ft will be less than 1 psi, the recommended safe limit for structural damage by Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978). These above ground storage tanks will be designed in accordance with the requirements of NFPA 58, Liquified Petroleum Gas Code (National Fire Protection Association, 1998e). NFPA 58 provides the requirements for construction of liquefied petroleum gas storage tanks. It also requires a minimum distance of 50 ft from any nearby building for propane tanks having capacity 2,001–30,000 gal. Heating systems will be designed following NFPA requirements. Additionally, all outdoor pipes between the tanks and the buildings will be located below ground.

Inspection, Testing and Maintenance

The fire protection systems including the foam-water sprinkler system at the Canister Transfer Building, the sprinklers in the diesel generator room at the Security and Health Physics Building, yard hydrants, fire pumps, water storage tank, service mains, and all associated components will be maintained in accordance with NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems (National Fire Protection Association, 1998f). NFPA 25 establishes the minimum requirements for the periodic inspection, testing, and maintenance of water-based fire protection systems. The types of systems addressed by this standard include, but are not limited to, sprinkler, standpipe and hose, fixed water spray, and foam water. The standard also includes the water supplies that are part of these systems, such as fire service mains and appurtenances, fire pumps and water storage tanks, and valves that control system flow. PFS is committed to use the latest code in effect at the time to design the fire protection systems.

Water Tanks for Fire Suppression System

PFS plans to construct a water system to provide water for the fixed fire suppression systems, hose lines, and hydrants. The capacity of the primary tank meets the requirement to specify the largest fixed fire suppression system demand and hose stream allowances, per NFPA 13. PFS has calculated this demand and has specified that two, 100,000 gallon water tanks will be provided for a primary and secondary water supply. The largest fixed fire suppression system is the foam-water deluge system installed to protect the Canister Transfer Building load/unload bay area. This system should be adequate to suppress the bounding fire scenario for the load/unload bay area, involving the heavy haul vehicle. The primary water tank capacity is also within the norms for an industrial facility. Since NFPA 801 requires an 8-hour refill time, PFS plans to provide a secondary tank of equal capacity.

NFPA 16 requires a flow not less than 0.16 gpm/ sq ft for a duration of 60 min. A density of 110 percent of the average density was assumed by the staff to satisfy the maximum change in density across the area of coverage. The high bay of the Canister Transfer Building has a cross-section of 3,250 sq ft. Each low bay has a cross-sectional area of 3,500 sq ft. The design flow time of the hose line is 90 min at a flow rate of 250 gpm. As a worst case scenario, it may be expected that the sprinklers in the high bay area will operate simultaneously with one of the low bay area. Based on the above parameters, the staff has estimated that the minimum capacity of the water tank for fire safety is approximately 94,000 gal. Therefore, a water tank with a capacity of 100,000 gal. would be adequate to fight the fire in the Canister Transfer Building. The second tank with a capacity of 100,000 gal. would be adequate to satisfy the 8-hour refill time requirement.

PFS has also stated that it will obtain water from one or more wells drilled onsite, from the reservation's existing supply, or from additional wells drilled on reservation property. The staff is satisfied with this design and concludes that PFS will have an adequate water supply for fire fighting.

The Facility design must provide accessibility to onsite and offsite emergency equipment and services such as fire departments. In this regard, standpipes and hose systems will be provided throughout the Canister Transfer Building, in accordance with NFPA 14, Standard for the Installation of Standpipes and Hose Systems (National Fire Protection Association, 1996a). In addition, portable extinguishers will be located throughout the Facility per industry standards (NFPA 10). The NRC has accepted these industry standards as adequate for facility fire safety.

Fire Fighting Brigade

The PFS Emergency Plan (Private Fuel Storage, 2000b) indicates that emergency response equipment will be located in the Security and Health Physics Building away from the Canister Transfer Building. One fire truck will be located onsite, one will be located at the Goshute village 3.5 miles away, and additional fire fighting assets will also be available from Tooele County. This dispersion of assets provides adequate accessability of fire fighting equipment and gear for use by response personnel in the event of an emergency at the Facility.

The PFS Emergency Plan indicates that a fire brigade will be available during the normal 40-hour work week and on-call after hours. A manual response from the fire brigade has been determined not to be necessary during off-hours when transfer operations are not being conducted. The brigade will receive training and equipment in accordance with industry standard NFPA 600 (National Fire Protection Association, 2000) and additional training will be provided for fire truck operations. Training to familiarize offsite responders will be offered annually. The staff considers this description of the applicant's fire protection training program to be adequate.

In the Emergency Plan, PFS has committed to have fire fighting equipment and gear stocked, inventoried, and maintained in accordance with NFPA 600. This standard requires equipment to be maintained in accordance with manufacturers' instructions. PFS also committed to conduct inventories of emergency response equipment and supplies quarterly and after each use. The staff concludes that PFS's commitment to maintain fire fighting equipment in accordance with industry standards is acceptable and will provide adequate maintenance of its fire fighting equipment.

Summary of Review

The staff reviewed the information provided by the applicant regarding protection against potential wildfire, onsite fire, and onsite explosion at the proposed Facility. The staff found the information acceptable because:

- The restricted area with designed fire barriers has been adequately described.

- Adequate information has been presented regarding the fire design of the Facility along with the fire detection, alarm, and suppression systems to be installed. These systems will be designed following acceptable codes and standards. Moreover, these systems have sufficient capacity and capability to minimize the adverse effects of a postulated fire on structures, systems, and components important to safety.

- Noncombustible and heat-resistant materials will be used wherever practical.

- Through design of the Canister Transfer Building and administrative procedures, combustible material (e.g., spill of diesel fuel from cask transporters) will be kept out of the canister transfer cells, especially when the canisters are outside the protections of either a transfer cask or a storage cask during a canister transfer operation.

- By administrative procedures and installation of wheel stops on the rails, the locomotives will remain outside the Canister Transfer Building.

- Fire pumps designed with acceptable codes and standards will be supplied with water by primary and backup water tanks. One pump will be powered by an electrical motor and the other by a diesel engine, in case of loss of electric power.

- PFS's Emergency Plan provides for the availability of a fire brigade and fire fighting equipment and gear. The fire brigade will be organized, operated, trained, and equipped in accordance with NFPA 600. The equipment and gear will be stocked and maintained in accordance with NFPA 600.

This information is also acceptable for use in other sections of the SAR to develop the design bases of the Facility and perform additional safety analyses. Based on the previous information, there is reasonable assurance that the design requirements of 10 CFR 72.122(c) have been met. The information presented is sufficient to conclude with reasonable assurance that the Facility is adequately designed to protect structures, systems, and components important to safety from any postulated onsite fires and wildfires.

The HI-STORM 100 Cask System has been evaluated for a bounding, hypothetical fire caused by 50 gallons of spilled diesel fuel. This evaluation is described in detail in the HI-STORM 100 FSAR and has been reviewed and found to be acceptable by the staff (as documented in the NRC's HI-STORM 100 SER). PFS proposes to use the HI-STORM 100 storage casks with a reduced compressive strength from that of 3,000 psi of the concrete overpack (Private Fuel Storage Limited Liability Company, 2001a). This is a reduction from 4,200 psi identified in the HI-STORM 100 FSAR. Concrete compressive strength is controlled primarily by the water-cement ratio. The density of the concrete is inconsequentially affected by variation of the ratio of these two materials (Holtec International, 2001). The thermal conductivity of the concrete is governed by the concrete density. Therefore, use of lower strength concrete will not have any effect on the thermal performance of the overpack concrete since the material density remains essentially the same. Based on the assessment of the potential fire hazards and the fire protection measures at the Facility, there is reasonable assurance that the cask system will not be exposed to fires that exceed the design basis fire.

6.1.5.2 Explosion

The information presented in Section 2.2.1, Hazards from Facilities and Ground Transportation; Section 3.3.6, Fire and Explosion Protection; Section 4.3.12, Gas Utilities; and Section 8.2.4, Explosion, in connection with the protection against potential onsite and offsite explosions has been reviewed for conformance with the following regulatory requirements.

- 10 CFR 72.122(c) requires that structures, systems, and components important to safety be designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions. Noncombustible and heat-resistant materials must be used wherever practical throughout the ISFSI, particularly in locations vital to the control of radioactive materials and to the maintenance of safety control functions. Explosion and fire detection, alarm, and suppression systems shall be designed and provided with sufficient capacity and capability to minimize the adverse effects of fires and explosions on structures, systems, and components important to safety. The design of the ISFSI must include provisions to protect against adverse effects that might result from either the operation or the failure of the fire suppression system.

The site is approximately 1.9 mi from the nearest highway (Skull Valley Road) or a public railroad. The only rail line close to the proposed Facility is controlled by PFS Facility management. Consequently, consideration of explosive cargo using the railway line is not necessary. There is no river nearby. Therefore, a river vessel carrying explosives need not be considered for design of the Facility. Based on Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978), the maximum probable hazardous solid cargo for a single highway truck is 50,000 lb. Regulatory Guide 1.91 recommends an air overpressure of 1 psi, below which no damage to structures, systems, and components will occur. An evaluation of potential hazards from accidental explosions at Skull Valley Road and other nearby facilities is presented in Section 15.1.2.10, Accidents at Nearby Sites, of this SER. Based on that evaluation, there is reasonable assurance that any credible explosion outside the Facility will not pose any significant hazard to the Facility.

It is possible that the outdoor tank may rupture from a collision or a tornado-driven missile impact resulting in spillage of diesel fuel. However, rupture of the storage tank and spillage of diesel fuel oil do not create a credible potential for an explosion because the diesel fuel is a Class II combustible liquid with a flash point of 126 °F.

Propane is classified as a flammable liquid. Propane will be stored as a liquified petroleum gas with the tank pressurized to the vapor pressure of the propane liquid, whose temperature will be close to the average ambient daily temperature. Based on the Fire Protection Handbook (National Fire Protection Association, 1997b), the vapor pressure of commercial propane is 132 psig at 70 °F and 216 psig at 105 °F. Relief valves on the tanks will be set at approximately 275 psig. A group of four centralized tanks, with individual capacities of maximum 5,000 gal. each will store a maximum 20,000 gal. of propane for heating the Canister Transfer Building and the Security and Health Physics Building. The storage tanks will be located outside the restricted area. The distances between the storage tanks and nearest storage casks and the Canister Transfer Building will be at least 1,800 ft. The tanks will be separated by missile walls to ensure that rupture of more than one tank at any given time is not credible. A fire barrier (minimum of 100 ft wide radially) will be placed around the tanks to protect them from wildfires.

The Canister Transfer Building is designed to withstand a pressure differential of 1.5 psi from a design basis tornado. Moreover, the design and evaluation of the HI-STORM 100 Cask System show that at least 5 psi pressure differential is needed before any damage takes place. Table 3.6-1 of the SAR specifies an air overpressure criterion of 1 psi. Any structures, systems, and components important to safety will not be subjected to more than 1 psi air overpressure.

Accidental offsite explosions may occur at the Tekoi Rocket Engine Test Facility, Dugway Proving Ground, or in the Tooele Army Depot. Additionally, a rocket engine on transit to the Tekoi Rocket Engine Test Facility through the access road or on Skull Valley Road may explode. In addition, an aircraft and/or ordnance crash in the vicinity of the site could result in overpressurization. An evaluation of these potential offsite explosion hazards has been presented in Chapter 15, Accident Analysis, of this SER. This evaluation concluded that these potential offsite explosions do not pose a credible hazard to the proposed Facility.

Summary of Review

The staff reviewed the information provided regarding onsite and offsite explosion potential. The staff found it acceptable because:

- Descriptions of potential explosion sources are adequate.

- As determined in Chapter 15 of this SER, the potential explosion sources are at sufficient distances away to produce air overpressure insufficient to cause any damage to important to safety structures, systems, and components, including the storage cask.

The information presented is also acceptable for use in other sections of the SAR to perform additional safety analysis. Based on the information presented, the staff concludes with reasonable assurance that the requirements of 10 CFR 72.122(c) for explosion protection design of the proposed Facility have been satisfied.

6.2 Evaluation Findings

Thermal evaluation of the PFS Facility, as presented in the SAR, is based on the assumption that the HI-STORM 100 Cask System will be used for storage and only casks approved under 10 CFR Part 72 will be used for transporting the spent fuel to the Facility. Findings based on this review follow.

Reliable data sources have been used to present temperatures and solar insolation at nearby sites. Data recorded during the onsite measurement program have also been presented. These short-term data correlate well with data recorded at nearby sites for a significantly longer duration. Therefore, the SAR shows that information on temperatures and solar insolation at the proposed site is acceptable and in compliance with 10 CFR 72.92(a). The temperatures and solar loads at the site are bounded by the HI-STORM 100 Cask System design parameters.

The SAR adequately describes the design of the Facility for fire detection, alarm, and suppression systems to be installed. These systems will be designed based on acceptable codes and standards. Through design and Facility administrative procedures, sources of ignition will be kept out of the canister transfer cells when a canister is outside a storage or transfer cask. Locomotives will be kept out of the Canister Transfer Building through Facility administrative procedures. Fire barriers with adequate width will be placed around the restricted area of the Facility to prevent any fire hazard from wildfires. Adequate descriptions of potential sources of accidental onsite and offsite explosions have been presented. Consequently, the SAR shows that the fire and explosion hazards at the site are acceptable and in compliance with the requirements of 10 CFR 72.122(c). Based on the assessment of the fire protection measures and the potential fire and explosion hazards at the site, there is reasonable assurance that the HI-STORM 100 Cask System will not be exposed to fires or explosions that are beyond the design basis for the cask system.

6.3 References

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