Private Fuel Storage, L.L.C.

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ERRATA TO CORRECT PAGES OF
LICENSE APPLICATION AMENDMENT #13
DOCKET NO. 72-22 / TAC NO. L22462
PRIVATE FUEL STORAGE FACILITY
PRIVATE FUEL STORAGE L.L.C.

Reference: 1. PFS Letter, Parkyn to U.S. NRC Document Control Desk, License Application Amendment No. 13, dated June 23, 2000

Reference: 2. PFS Letter, Donnell to U.S. NRC Document Control Desk, Commitment Resolution Letter #34, dated June 2, 2000

Amendment #13 to the Private Fuel Storage Facility (PFSF) License Application, submitted to the NRC with Reference 1, contained an omission and several items requiring clarification which are corrected in the revised pages enclosed with this letter. Information discussing the height of flames associated with postulated fires in the Canister Transfer Building, submitted to the NRC in Reference 2, was inadvertently omitted from Safety Analysis Report (SAR) page 8.2-29m. SAR page 2.6-83, which discusses the bearing capacity of soils underlying the Security and Health Physics Building, Operations and Maintenance Building, and Administration Building, referred to the soils' total stress strength instead of undrained strength parameters. In addition, a sentence on SAR page 2.6-36 addressing the soils underlying the cask storage pads required clarification. The enclosed errata pages to PFSF License Application Amendment #13 provide the necessary corrections. Revised pages of the SAR document control list are included. A copy of this letter is being sent to all persons on the PFSF License Application distribution.

We apologize for any inconvenience caused by these items requiring correction. If you have any questions, please contact me at 303-741-7009.

J L Cooper

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Private Fuel Storage L.L.C.

Enclosure

NMSS01 Public

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reflect the increase in strength measured for the deeper-lying soils in the cone penetration testing.

Table 6 of Calculation 05996.02-G(B)-05 (SWEC, 2000a) summarizes the results of the triaxial tests that were performed within depths of ~10 ft at the site. The undrained shear strengths measured in these tests are plotted vs confining pressure in Figure 11 of that calculation. This figure is annotated to indicate the vertical stresses existing prior to construction and following completion of construction. As indicated, the undrained strength of the soils within ~10 ft of grade was assumed to be 2.2 ksf. This value is the lowest strength measured in the UU tests, which were performed at confining stresses of 1.3 ksf. This confining stress corresponds to the in situ vertical stress existing near the middle of the upper layer prior to construction of these structures. It is much less than the final stresses that will exist under the cask storage pads and the Canister Transfer Building following completion of construction. Figure 11 of Calculation 05996.02-G(B)-05 (SWEC, 2000a) illustrates that the undrained strength of these soils increases as the loadings of the structures are applied; therefore, 2.2 ksf is a very conservative, lower- bound value for use in the dynamic bearing capacity analyses of these structures.

Effective-stress strength parameters are estimated to be c = 0 ksf, even though these soils may be somewhat cemented, and $\phi = 30°$. This value of ϕ is based on the average PI value for these soils, which equaled 14%, as shown in the table presented above, and the relationship between ϕ and PI presented in Figure 18.1 of Terzaghi & Peck (1967).

Therefore, static bearing capacity analyses of the cask storage pads were performed using the following soil strengths:

Case IA Static using undrained strength: $\phi = 0°$ & c = 2.2 ksf.

Case IB Static using effective-stress strength: $\phi = 30°$ & c = 0.

The pads will be constructed on and within soil cement, as illustrated in Figure 4.2-7 and described in Sections 2.6.1.7 and 2.6.4.11. The unit weight of the soil cement is assumed to be 100 pcf in the bearing capacity analyses. The strength of the soil cement was conservatively ignored in the bearing capacity analyses.

Direct shear tests were performed on undisturbed specimens of the silty clay/clayey silt obtained at a depth of 5.7 ft to 6 ft in Boring C-2. These tests were performed at normal stresses that were essentially equal to the normal stresses expected:

- under the fully loaded pads before the earthquake,
- with all of the vertical forces due to the earthquake acting upward, and
- with all of the vertical forces due to the earthquake acting downward.

The results of these tests are presented in Attachment 7 of the Appendix 2A and they are plotted in Figure 7 of Calculation 05996.02-G(B)-05 (SWEC, 2000a). Because of the fine grained nature of these soils, they will not drain completely during the rapid cycling of loadings associated with the design basis ground motion. Therefore, sliding stability analyses of the cask storage pads constructed directly on the silty clay are performed using the shear strength measured in these direct shear tests for the normal stress that equals the vertical stress under the fully loaded cask storage pads prior to imposition of the dynamic loading due to the earthquake. As shown in Figure 7 of Calculation 05996.02-G(B)-05 (SWEC, 2000a), this shear strength is 2.1 ksf and the friction angle is set equal to 0° for the clayey soils underlying the cask storage pads.

2.6.1.11.2 Canister Transfer Building Area

The results of the tests of the silty clay/clayey silts obtained from the upper 25 to 30 ft layer in the Canister Transfer Building area are as follows:

movements of this small amount as a result of the earthquake, such postulated, minute movements do not adversely affect the performance of the Canister Transfer Building.

2.6.1.12.3 Allowable Bearing Capacity—Other Structures

Other structures at the PFSF include the Administration Building, Operating and Maintenance Building, and Security and Health Physics Building. These structures will be founded on strip and spread footings. The allowable bearing capacity of these footings is limited by shear failure of the soil underlying the footing and by footing settlement.

Bearing capacity analyses were performed for a variety of footing widths and depths for both strip footings and square footings, for vertical loads, and for loads inclined 10 and 20 degrees from the vertical. These analyses were performed using effective-stress strength parameters to investigate long-term conditions, which are applicable for static loads. For these analyses, the allowable bearing pressure was determined using a factor of safety of 3. Bearing capacity analyses were also performed using the undrained strength parameters ($\phi = 0°$ & $c = 2.2$ ksf), which are applicable for earthquake loads. The static analyses yielded the minimum allowable bearing pressures, primarily due to the higher factor of safety required for static loadings.

To limit the expected differential settlements to tolerable values, wall footings of all structures should be designed such that the maximum estimated settlement at the center of the wall along the minimum width of the building is less than or equal to 2 inches. Spread footings supporting column loads spaced approximately 16 ft to 24 ft should be designed such that the maximum estimated settlement at the center of the footing is less than or equal to 1.5 inches. These criteria are based on Table 14.1, "Allowable Settlement," of Lambe & Whitman (1969).

The gross allowable bearing pressure of these footings is presented as a function of the minimum effective footing width and depth in Figure 2.6-10 for strip footings and Figure 2.6-11 for square footings. In these figures, the straight lines represent the allowable bearing pressure that will provide the required factor of safety against a shear failure and the curves represent the bearing pressure that will result in a given amount of settlement. As indicated, the bearing pressure based on shear failure increases with increasing depth (and, typically, increasing width) of footing. Footing settlement increases as the load increases; therefore, for a given bearing pressure, as the width of the footing increases, there comes a point at which the amount of settlement exceeds the allowable settlement. Thus, as the footing width increases beyond this point, the allowable bearing pressure must decrease as shown by the curves in Figures 2.6-10 and 2.6-11, in order to limit the settlement to a tolerable value.

The design curves in these figures are for vertical loads applied at the center of the footings. For inclined or eccentrically applied loads, the allowable bearing pressures must be reduced. For loadings inclined at 10 degrees from the vertical, these allowables must be reduced by 25%, and for loadings inclined at 20 degrees from the vertical, these allowables must be reduced by 50%. Eccentric loads are addressed using the concept of "effective footing width", where the effective width (and length, if appropriate) of the footing is determined as shown in Figures 2.6-10 and 2.6-11.

in NFPA standards (such as NFPA #72, NFPA #204 and NFPA #92B). While these formulas do not provide the detail or spatial variations of computational fluid dynamics or other field models, they provide conservative bounding information, and are widely accepted for this type of bounding analysis. For the plume calculations, the area of the load/unload bay (10,200 sq. ft.) was used as the area limit, and 30 ft was used as the ceiling height. For the hot layer temperature calculations, the concrete walls and ceiling heat loss area of the high bay area (80,545 sq. ft.) were used. Since the hot layer calculations require a vent, a vent to the low bay area was assumed with a height of 30 feet and a width of 20 feet (the actual door is 22 feet high at the end of the low bay.) No credit was taken for roof level ventilation, which will be provided for normal ventilation and which would reduce both the temperature and the depth of the hot layer. Additionally, no credit was taken for the automatic fire suppression system or for manual actions to extinguish the fire.

The results of these analyses (included in Calculation No. 05996.02-P-006, Reference 66) are summarized in the following table.

FIRE SCENARIO	HEAT RELEASE RATE	PLUME TEMP., LOW BAY	HOT LAYER TEMP., HIGH BAY
30 min diesel fuel pool	21,100 kW	834 F	324 F
16 min diesel fuel pool	38,000 kW	1200 F	408 F
30 min tire	9,000 kW	503 F	214 F
Combined 16 min diesel fuel pool and 30 min tire	47,000/9,000 kW *	1372 F	459 F

* The 47,000 kw heat release rate (combined diesel pool and tire fire) lasts 16 minutes, and the 9,000 kw heat release rate (tire fire) continues for an additional 14 minutes.

The bounding fire for building structural considerations is the 300 gallon diesel fuel spill that burns for 16 minutes, combined with the 30 minute tire fire. Ceiling temperatures in the low bay area of the cask load/unload bay were calculated for each of the above fire scenarios, to verify exposures to the reinforced concrete ceiling were acceptable (no structural collapse). The range of plume temperatures at the 30 foot ceiling for the various scenarios did not exceed the exposure conditions of an ASTM E-119 (Reference 68) fire resistance test. The furnace temperatures to which a concrete slab is exposed to in a test furnace reaches 1399 F in 15 minutes and continues to climb to 1925 F at 180 minutes. The 12 inch concrete slab is capable of withstanding longer exposures to such temperatures without experiencing failure. The Concrete Reinforcing Steel Institute (Reference 69) reports that a slab of only 6 inch thickness exceeds a fire resistance rating of three hours. A flame height of 3.74 m was calculated from the tire fire (Reference 70). Based on Figure 3-11.2 of the SFPE Handbook, 2nd edition (Reference 71), the flame height for the diesel fuel fire would be 5.1 m. The low bay ceiling is 9.1 m (30 ft). With this ceiling height, the estimated flame heights and the worst-case plume temperatures calculated, it is unlikely that there would be any flame impingement on the ceiling, even directly above the pool fire. The crane is more than 16.7 m above the floor and at least 5 m horizontally from the worst case fire scenario. Therefore, no flame or plume impingement should effect the structural integrity of the crane or its supports.

As can be seen from the results of the four scenarios evaluated above, these fires will not threaten the structural integrity of the Canister Transfer Building and it will continue to perform its safety functions.

The upper layer temperatures are relatively low (459°F from the bounding fire scenario) and will not have any adverse impact on the Canister Transfer Building structure. In addition, the overhead bridge crane, semi-gantry crane, and HI-TRAC canister downloader structural components would be unaffected by these upper layer temperatures. While components associated with electrical power supplies and the crane and canister downloader motors could possibly fail at these temperatures, causing these lifting devices to discontinue operation and require repair, the cranes and canister downloader are designed to safely retain their loads upon loss of electrical power (Section 8.1.1). The bounding fire scenario in the load/unload bay will not cause a load drop and will not pose a threat to nuclear safety, even with no credit for the automatic fire suppression system or for manual actions to extinguish the fire.

Canister transfer operations are permitted to take place while the heavy haul vehicle is in the cask load/unload bay. The presence of the vehicle in the cask load/unload bay does not create an unacceptable exposure to the transfer casks. The 30 foot high reinforced concrete barrier walls of the transfer cells prevent radiant heat exposure to equipment in the cells from a fire in the load/unload bay.

Because of the 90 foot high ceiling in the high bay area and the large heat loss surface area of the reinforced concrete walls and ceiling, smoke layer temperatures over the transfer cells from the bounding building fire (the combined fuel spill and tire fire in the cask load/unload bay assessed above) would not create significant exposure to important to safety equipment in the canister transfer cells. The highest calculated upper layer temperature of 459°F for the bounding fire scenario for building structural considerations represents an average temperature of the upper layer for this scenario, with somewhat higher temperatures near the ceiling and lower temperatures near the 30 ft elevation at the bottom of the upper layer. This temperature would pose no threat to the structural integrity of the steel canisters or transfer casks. As shown in Table 4.7-2, the short term temperature limits are 700°F for the transfer cask outer shell, and 775°F for the canister shell. Section 11.2.4.2.2 of the HI-STORM Storage Cask TSAR analyzes the effects on the HI-TRAC transfer cask of a fire fueled by 50 gallons of diesel fuel surrounding the cask which burns for 4.775 minutes. The analysis determined that the transfer cask and canister would retain their structural integrity and continue to perform their safety functions. For this severe fire, there was some loss of transfer cask shield water due to boiloff, with resultant higher dose rates from the cask. This condition could be addressed by the use of temporary neutron shielding until the shield tubes are refilled with water, and does not pose a threat to worker safety. This HI-TRAC fire analysis is bounding for the Canister Transfer Building fire scenarios, and effects on the transfer cask from the bounding fire in the cask load/unload bay would be less severe than those evaluated in the HI-TRAC fire analysis in the HI-STORM Storage Cask TSAR.

Shipping Cask Assessment

The tires on the heavy haul vehicle would require a substantial ignition source to create a self-sustaining fire. The analysis considered a diesel fuel spill igniting the rear set of tires on the tractor axles. Since the floor is sloped away from the vehicle to a sump, and the sump is sloped away from the shipping cask, it is not considered possible for a spill from the tractor, with a maximum fuel tank capacity of 300 gallons, to spread to the cask located more than 20 m away from the fuel tank. The calculations also demonstrate that it is highly unlikely that a tire fire involving one pair of axles could propagate to an adjacent pair of axles in which the closest edges of the tires are separated by more than 12 feet (3.7 m). The peak radiant heat flux to the adjacent axle was calculated (Calculation No.05996.02-P-007, Reference 70) to be 8.0 kW/m^2 which is less than the minimum flux necessary to ignite vulcanized rubber (values of minimum critical heat flux for ignition are reported by Tewarson in Section 3/Chapter 4 of the SFPE Handbook, 2nd edition (Reference 71) for ethylene/propylene rubber power cables as 20-23 kW/m^2, and for chloroprene rubber conveyor belts as 20 kW/m^2). Therefore, a fire involving a set of tires near the fuel tanks on the tractor would not be expected to propagate to the next set of tires.

As a worst case fire for the shipping cask, even though demonstrated to be not practical, the tires on the double axle closest to the shipping cask (16 tires) were assumed to burn (Calculation No.05996.02-P-007, Reference 70). The peak radiant heat flux at mid flame on the cask was calculated to be 10.7 kW/m^2. This is a higher heat flux at the shipping cask than would be produced from the bounding fire for building structural considerations, the 300 gallon diesel fuel spill that burns for 16 minutes combined with the 30 minute tire fire, located near the tractor approximately 20 meters from the cask. Therefore, this postulated fire involving 16 tires nearest the cask is the bounding fire for the shipping cask. However, the 10.7 kW/m^2 generated by the bounding cask fire is well below the radiant heat flux from the fire for which the cask is qualified. The shipping casks are required to be demonstrated capable of safely withstanding the effects of an exposure fire that burns at 1475°F for 30 minutes per 10 CFR 71.73(c)(4). This flame yields a radiant heat flux of 68 kW/m^2.

Fire in a Canister Transfer Cell Involving the Cask Transporter

Another postulated fire scenario in the Canister Transfer Building is assumed to involve 50 gallons of diesel fuel from ruptured fuel tanks of the cask transporter in one of the three canister transfer cells. A fire involving up to 50 gallons of diesel fuel could burn for up to 3.6 minutes duration (as discussed previously), consuming the entire fuel inventory. The cask transporter enters a transfer cell for the purposes of moving an empty storage cask into the cell, and moving a loaded storage cask out of the cell and out to the storage pad. During canister transfer operations, the cask transporter is prevented from entering a transfer cell by shield doors on either side of the transfer cell. PFSF procedures will require that the shield doors remain closed when a canister transfer operation is in progress. Building design measures assure that any diesel fuel spilled in the cask transporter bay outside of a transfer cell will not run into a transfer cell. A cask transporter could enter a transfer cell when the canister is in the shipping cask and its lid bolted in place, or when the canister is in the storage cask and the storage cask lid has been bolted in place. As noted above, the shipping casks are required by regulation to be demonstrated capable of safely withstanding the effects of an exposure fire that burns at 1475°F for 30 minutes, with spent fuel remaining within temperature limits and no breach of the confinement barrier. Therefore, short duration fires in a transfer cell resulting from postulated rupture of the cask transporter's diesel fuel tanks and ignition of the pool of fuel would not result in breach of the shipping cask confinement and there would be no release of radioactivity. Fires involving shipping casks can result in reduction of neutron shielding, as discussed in Chapter 5 of both vendors' shipping cask SARs (References 5 and 20). Storage casks are relatively impervious to the effects of fires, as discussed above, and there would be no damage to the canister confinement or the spent fuel for fires in the vicinity of a loaded storage cask. The occurrence of a fire in a transfer cell while a canister is in a transfer cask is precluded, since the cask transporter can not enter a transfer cell during the canister transfer operation and the cask transporter represents the only significant combustible loading in a transfer cell.

Based on the above, the canister storage and transfer systems meet the general design criteria of 10 CFR 72.122(c), which states that structures, systems, and components Important to Safety must be designed and located so that they can continue to perform their safety functions effectively under credible fire exposure conditions. A fire at the PFSF (or a wildfire adjacent to the PFSF Restricted Area) would not cause a radioactive release, even if no credit were taken for firefighting by personnel or for automatic fire detection/suppression systems.

8.2.5.3 Accident Dose Calculations

The temperature of the canister would not significantly change in the event of a credible fire near a storage cask or in the Canister Transfer Building. Therefore, canister integrity would be retained in the event of fires and no activity released.