to determine dose rates at various distances, including the RA fence and the OCA boundary from the PFSF array of 4,000 casks. The following paragraphs summarize the methodology used and results of dose rate projections from the PFSF array, assuming the PFSF is filled with HI-STORM storage casks containing 40 GWd/MTU, 10-year cooled fuel.

Holtec used the dose rate vs. distance data from a single HI-STORM storage cask, shown in Table 7.3-5, to project dose rates at various distances from the PFSF array, assumed to be filled with 4,000 HI-STORM storage casks containing 40 GWd/MTU, 10-year cooled fuel (Reference 13). The dose rate contributions from the tops and sides of the casks were separately analyzed using the MCNP code. The total dose rate from the tops of casks is a summation of the gamma and neutron top doses from all 4,000 casks, where the actual distance from each cask to the dose receptor is accounted for.

The total dose from the sides of the casks is a summation of side doses from all 4,000 casks where the distances within the facility and self-shielding of one row of casks by another row are accounted for. The fraction of radiation blocked by a cask directly in front of another cask was calculated by MCNP and used in the determination of total side dose rates. Self-shielding effects are different along the north/south faces than along the east/west faces because of the different geometries, as seen in Figure 1.2-1.

It was impractical to model the entire facility in MCNP, therefore, numerous smaller calculations were performed for configurations of several casks and combined in a conservative fashion to accurately estimate dose rates from the sides of the casks at various distances from the PFSF array. Modeling of configurations of casks determined the fractional increases in dose rates when a row of casks is added directly behind another row along the east/west and north/south faces at various distances. Different configurations were analyzed to account for the different cask and pad spacing within the array in both the east/west and north/south directions.

The results of the dose rate vs. distance analysis for the PFSF array full of HI-STORM storage casks are given in Table 7.3-7 (Reference 13). Total dose rates at the RA fence (150 ft from the nearest storage pads) at the north side of the array are 1.69 mrem/hr. The RA fence south of the array is 265 ft from the nearest storage pads, so will have lower dose rates. Total dose rates at the RA fence on the east and west sides of the array (also 150 ft from the nearest storage pads) are 1.43 mrem/hr. It is considered that dose rates calculated by this analysis are very conservative, since PWR fuel having 40 GWd/MTU burnup and 10-year cooling time represents relatively "hot" fuel, which will produce substantially higher array dose rates than PFSF average fuel. Spent PWR fuel having 35 GWd/MTU burnup and 20-year cooling time is considered to be representative of typical fuel expected to be received at the PFSF, as explained in Section 7.4. Applying scaling factors to calculate dose rates assuming all 4,000 HI-STORM casks contain this typical fuel, the highest dose rate at the RA fence for this typical fuel is 0.60 mrem/hr (Reference 23).These dose rates are less than the 2 mrem/hour criteria for unrestricted areas specified in 10 CFR 20.1301 and are therefore acceptable. Assuming all 4,000 casks contain the relatively hot PWR fuel having 40 GWd/MTU burnup and 10-year cooling time, the total dose rates at the OCA boundary were calculated to be 5.85 mrem/yr at a point on the boundary 1,969 ft (600 meters) north of the RA fence, and 4.35 mrem/yr at a point on the boundary 600 meters west of the RA fence (Reference 13), assuming a hypothetical individual spends 2,000 hours per year at the OCA boundary. Dose rates will be lower at points along the south and east sides of the OCA boundary, since these points are further from the storage casks than the north and west OCA boundaries. The maximum annual dose at the OCA boundary assuming typical fuel expected to be received at the PFSF (scaling the dose rates to be representative of PWR fuel having 35 GWd/MTU burnup, 20-year cooling time) is 2.10 mrem (Reference 23). These dose rates are less than the 25 mrem criteria specified in 10 CFR 72.104 for maximum permissible annual whole body dose to any real individual located beyond the controlled area boundary and are therefore acceptable.

Dose at Nearest Residence

The approximate distance to the nearest residence is 2 miles east-southeast of the PFSF. At distances greater than several thousand feet, the accuracy of computer code calculational techniques becomes questionable. The error bands in statistical codes like MCNP become large and for deterministic codes like Skyshine, the conditions may be beyond the range of the codes data. However, dose rates were estimated that could occur at long distances from the PFSF, assuming the PFSF array of 4,000 HI-STORM storage casks loaded with 40 GWd/MTU, 10-year cooled PWR fuel, and conservatively taking no credit for any intervening shielding from berms, natural terrain or buildings at the PFSF. Holtec estimated the dose rate at 2.0 miles from the PFSF by extrapolating the maximum dose rate at the OCA boundary (5.85 mrem/yr) out to a distance of 2.0 miles using a power curve (Reference 13). The result was an annual dose of 8.12 E-3 mrem at a distance of 2.0 miles from the OCA boundary for a 2,000 hour assumed annual occupancy. This equates to an annual dose of 3.56 E-2 mrem, assuming a person is continually present (8,760 hrs/yr) at this location.

7.3.4 Ventilation

10 CFR 72.122(h)(3) requires that ventilation systems and off-gas systems be provided where necessary to ensure the confinement of airborne radioactive particulate materials during normal or off-normal conditions. However, there are no special ventilation systems installed in the PFSF facilities. There are no credible scenarios that would require installation of ventilation systems to protect against off-gas or particulate filtration.

7.3.5 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

10 CFR 72.122(h)(4) requires the capability for continuous monitoring of the storage system to enable the licensee to determine when corrective action needs to be taken to maintain safe storage conditions. This is not applicable to the PFSF because the canisters are sealed by welding and with the canisters in storage casks and the casks on the storage pads, there are no credible events that could result in releases of radioactive material from within the canisters or unacceptable increases in direct radiation levels. Area radiation and airborne radioactivity monitors are therefore not needed at the storage pads. However, TLDs will be used to record dose rates in the RA and along the OCA boundary fence. TLDs provide a passive means for continuous monitoring of radiation levels and provide a basis for assessing the potential impact on the environment.

TLDs will be located along the RA and OCA boundary fence such that each side of the boundary has one TLD at each corner, one on the N-S or E-W centerlines of the storage cask array, and one equidistant between each corner and the N-S or E-W centerlines. This provides a total of 16 TLD locations for each boundary. These TLDs will be used to record dose rates along the RA and OCA boundary fence and will provide documentation that radiation levels at these boundaries are within regulatory limits. TLDs will also be placed on the outside of several buildings as follows: NW corner of the Administration Building, NW corner of the Operations and Maintenance Building, NW corner of the Canister Transfer Building, and at three locations along the West wall of the Security and Health Physics Building. Additionally, TLDs will be located at strategic locations inside the Canister Transfer Building and the Security and Health Physics Building where personnel will normally be working. These TLDs will serve as a backup for monitoring personnel radiation exposure and maintaining this exposure ALARA. For redundancy, each TLD location mentioned above will house a

7.4 ESTIMATED ONSITE COLLECTIVE DOSE ASSESSMENT

The shipping, transfer and storage casks are designed to limit dose rates to ALARA levels for operators, inspectors, maintenance, and radiation protection personnel when the canisters are being transferred from the shipping to the storage casks, when the storage casks are being moved to the storage pads, and while the storage casks are being stored on the pads.

Table 7.4-1 shows the estimated occupational exposures to PFSF personnel during receipt of the HI-STAR shipping cask, transfer of the canister from the shipping cask to the HI-STORM storage cask using the HI-TRAC transfer cask, movement of the storage cask to the pad, and emplacement on the pad. The estimated occupational exposures were calculated in Reference 20. The operational sequence for these operations is also described in Chapter 5.

Dose rate values include both gamma and neutron flux components, and are based on PWR fuel with 35 GWd/MTU burnup and 20-year cooling time. Fuel with these characteristics is considered to be representative of typical fuel that will be contained in canisters handled at the PFSF, and dose estimates based on fuel with these characteristics are considered to be realistic and reflect expected personnel exposures. Evaluation of weighted average burnups and cooling times of the nations' PWR and BWR spent fuel inventory in existence at the end of 1994, as discussed in Section 7.3.3.5, indicates an overall weighted average burnup (weighted by metric tons uranium) of approximately 32.4 GWd/MTU for PWR fuel and approximately 23.8 GWd/MTU for BWR fuel, with a weighted average cooling time for both types of fuel of approximately 23.0 years (assuming 30,000 MTU of spent fuel is received during the first 15 years of PFSF operation). Based on this evaluation, the 35 GWd/MTU burnup and 20-year cooling time characteristics for spent fuel assumed in the onsite dose assessment are considered to be representative of typical fuel expected to be received at the PFSF.

From Table 7.4-1, the total dose from receipt of a loaded shipping cask, transfer of the canister into a storage cask, movement of the storage cask to the pad, and performance of initial surveillances is estimated to be about 247 person-mrem for the HI-STORM system. Assuming a storage cask loading rate of 200 casks per year, the total annual dose to operations and Radiation Protection personnel involved in these operations is estimated to be approximately 49 person-rem, assuming all storage casks are HI-STORM casks. Occupational doses to individuals will be administratively controlled to ensure that they are maintained below 10 CFR 20.1201 limits and ALARA.

Temporarily positioned shielding will be used during transfer operations to reduce dose rates from streaming paths or relatively high radiation areas where its use will result in a net reduction in worker exposures. The effects of temporarily positioned shielding, calculated in Reference 20, are considered in the Table 7.4-1 dose estimates for canister transfer operations.

Occupational exposures are also estimated to security personnel and PFSF personnel that conduct inspections, surveillances, and maintain the storage systems. These estimates are based on the assumption that the PFSF is at its 4,000 storage cask capacity. It is estimated that security personnel that conduct security inspections will accrue approximately 0.66 person-rem annually, based on one 1 hour inspection per shift (3 shifts per day, 365 days per year) along the RA fence, using the 0.60 mrem/hr dose rate at the fence discussed in Section 7.3.3.5. It is considered that dose rates inside the Security and Health Physics Building are negligible due to shielding provided by the building structure. One visual inspection per quarter is required to be performed for each storage cask to check for the buildup of debris at the inlet ducts and to inspect the cask exterior. Assuming one person spends 1.0 minute inspecting each cask, in an average dose field of 12.4 mrem/hr during the inspection, this surveillance will result in approximately 0.83 person-rem per quarter to PFSF personnel conducting the inspections, for a total of 3.3 person-rem annually. The 12.4 mrem/hr average dose field estimate near a cask inside the cask array is based on the Reference 21 calculation, which assumes that storage casks contain "typical" PFSF fuel, represented by PWR fuel with 35 GWd/MTU burnup and 20 year cooling time. Conservatively assuming that 5 percent of the 4,000 casks require clearing of debris from the inlet ducts once a year at 10 minutes each (Reference 21), in a dose field of 12.4 mrem/hr, an additional annual dose of 0.41 person-rem is estimated. Monitoring of temperatures representative of the thermal performance of the casks will be performed remotely with a data acquisition system and will not result in significant exposure. Based on the above, the total dose to personnel involved in security inspections, surveillance, and storage cask maintenance operations is estimated to be 4.4 person-rem annually, assuming all storage casks are HI-STORM casks.

PFS considers that the occupational exposures calculated and reported above are conservative (i.e., actual doses to individual workers at the PFSF will be a fraction of those calculated). Additionally, doses to workers will be closely monitored throughout operations involving loaded canisters at the PFSF. Based on actual doses received from the first few canister transfer operations, measures will be implemented to maintain occupational exposure ALARA. These may include additional shielding, optimizing handling operations to maximize distance to the source, and reducing time in the radiation field. PFS is committed not only to maintaining occupational exposures below federal guidelines but to maintaining exposures ALARA as well.

A combination of building location and shielding will minimize the dose to staff personnel working in the PFSF facilities. The west sides of the Canister Transfer Building and Security and Health Physics Building are approximately 425 ft (130 meters) and 948 ft (289 meters), respectively, from the nearest storage pad (see Figure 1.2-1). The building structures will provide shielding to reduce doses to workers in the buildings from the cask storage area to levels that are ALARA. The Operations and Maintenance Building and Administration Building will be located near the entrance gate to the OCA (see Figure 1.1-2). The Administration Building is further from the storage pads (2,580 ft) than the nearest distances to the OCA boundary (2,119 ft), and the Operations and Maintenance Building is nearly as far away (1,960 ft). Dose rates at these buildings will be less than 25 mrem/yr (at a 2,000 hr/yr occupancy rate) without consideration for shielding provided by the building structures.

7.6 ESTIMATED OFFSITE COLLECTIVE DOSE ASSESSMENT

Figure 1.1-2 shows the PFSF OCA fence, which serves as the site boundary. Areas at and beyond the OCA fence are considered to be offsite. A maximum dose rate of 2.10 mrem/yr was calculated (Section 7.3.3.5) at the OCA boundary fence 1,969 ft (600 meters) from the RA fence at its closest points of approach. This dose rate is comprised of direct and scattered gamma and neutron radiation emanating from 4,000 storage casks and is based on the assumption that all 4,000 casks contain typical fuel expected to be received at the PFSF with 35 GWd/MTU burnup and 20-year cooling time. Operations inside the Canister Transfer Building would not contribute significantly to dose rates at the OCA fence as a result of shielding provided by the Canister Transfer Building walls and 500 meter minimum distance from the Canister Transfer Building to the OCA fence. The maximum dose rate of 2.10 mrem/yr (assuming a hypothetical individual conservatively spends 2,000 hours a year at the OCA fence) is below the 25 mrem annual dose limit of 10 CFR 72.104.

The nearest residence is located approximately 2 miles east-southeast of the PFSF. As discussed in Section 7.3.3.5, a total dose rate of 3.56 E-2 mrem/yr (HI-STORM casks containing relatively hot fuel represented by PWR fuel having 40 GWd/MTU burnup and 10-year cooling time) is estimated at about 2 miles from the fully loaded ISFSI array, taking no credit for intervening shielding from berms, natural terrain, or buildings at the PFSF. This annual dose of 3.56 E-2 mrem assumes full-time occupancy (8,760 hrs/yr), and is far less than the 25 mrem to any real individual outside the controlled area criteria of 10 CFR 72.104.

7.6.1 Effluent and Environmental Monitoring Program

10 CFR 72.126(c) requires the means to measure effluents. Since there are no radioactive liquid or gaseous waste effluents released from the PFSF during transfer and storage operations, this criterion is not applicable to the PFSF.

The storage system is a passive design with the spent fuel stored dry within welded canisters. No handling of individual fuel assemblies is planned at the PFSF. Therefore, a radioactive effluent monitoring system is not needed and routine monitoring for effluents is not performed.

Solid low level radioactive wastes will be temporarily stored in the LLW holding cell while awaiting shipment to a LLW disposal facility, as discussed in Section 6.4. The LLW holding cell will be regularly surveyed and inventoried, including inspection of the materials stored to evaluate the status of materials and controls (e.g. physical condition of containers, access control, posting). Radiation protection procedures govern the packaging, storage, surveying, inventorying, and monitoring of solid LLW.

The PFSF spent fuel storage operations will emit radiation that will be monitored in the environment with TLDs that will be located along the perimeter of the RA and along the OCA boundary fence.

7.6.2 Analysis of Multiple Contributions

Evaluation of incremental collective doses resulting from other nearby nuclear facilities in addition to the ISFSI is required per 10 CFR 72.122(e). This is not applicable to the PFSF since there are no other nuclear facilities located within a 5-mile radius of the PFSF. The closest nuclear facility is the Envirocare low-level radioactive and mixed waste disposal facility, which is about 25 miles northwest of the PFSF.

7.7 REFERENCES

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2. 10 CFR 20, Standards for Protection Against Radiation.

3. 10 CFR 19, Notices, Instructions and Reports to Workers: Inspection and Investigations.

4. Regulatory Guide 8.8, Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable, U.S. NRC, Revision 3, June 1978.

5. Regulatory Guide 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable, U.S. NRC, Revision 1-R, May 1977.

6. Final Safety Analysis Report for the Holtec International Storage and Transfer Operation Reinforced Module Cask System (HI-STORM 100 Cask System), Holtec Report HI-2002444, NRC Docket No. 72-1014, Revision 0, July 2000.

7. (deleted)

8. DOE/RW-0184-R1, Characteristics of Potential Repository Wastes, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, July 1992.

9. PNL-6906, Spent Fuel Assembly Hardware: Characterization and 10 CFR 61 Classification for Waste Disposal, Pacific Northwest Laboratory, June 1989.

10. ORNL/TM-9591/V1&R1, Physical and Decay Characteristics of Commercial LWR Spent Fuel, Oak Ridge National Laboratory, January 1996.

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13. Holtec Report HI-971645, Revision 2, Radiation Shielding Analysis for the Private Fuel Storage Facility, Holtec International, March 2001.

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20. PFSF Calculation No. 05996.02-UR-6, Calculational Basis for PFSF SAR Tables 7.4-1 and 7.4-2, Estimated Personnel Exposures for Canister Transfer Operations, Revision 2, Stone & Webster.

21. PFSF Calculation No. 05996.02-UR-5, Dose Rate Estimates from Storage Cask Inlet Duct Clearing Operations, Revision 2, Stone & Webster.

22. DOE/RW-0184, Characteristics of Spent Fuel, High Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation, U.S. Department of Energy, December 1987.

23. PFSF Calculation No. 05996.02-UR(D)-12, Dose Rates From the 4000 Storage Cask PFSF Array Representative of PFSF Typical Spent Fuel, Assumed to be PWR Fuel Having 35 GWd/MTU Burnup and 20 Year Cooling Time, Revision 1, Stone & Webster.

24. Topical Safety Analysis Report for the Holtec International Storage, Transport, and Repository Cask System (HI-STAR 100 Cask System), Holtec Report HI-951251, Docket 71-9261, Revision 9, April 2000.

25. Holtec Report HI-2002424, Revision 0, A Deterministic Evaluation of Potential for Leakage from a HI-STAR/HI-STORM Multi-Purpose Canister, May 2000.

TABLE 7.3-7

DOSE RATES AT LOCATIONS OF INTEREST FROM THE PFSF ARRAY OF 4,000 ASSUMED HI-STORM STORAGE CASKS *

Distance and Direction to Detector from Nearest Storage Pad	Dose Rate from Sides of Casks	Dose Rate from Tops of Casks	Total Dose Rate
150 ft north (security fence)** (mrem/hr)	1.65	3.58 E-2	1.69
150 ft east or west (security fence) (mrem/hr)	1.40	3.35 E-2	1.43
2,119 ft north (OCA boundary)*** (mrem/yr)	5.78	7.64 E-2	5.85
2,119 ft west (OCA boundary)*** (mrem/yr)	4.28	7.35 E-2	4.35

* Casks assumed to contain 40 GWd/MTU, 10-year cooled PWR fuel.

** The security (Restricted Area) fence is 150 ft from the nearest storage pad in the north, east, and west directions. It is further (265 ft) from storage pads in the south direction. Therefore, the dose rate at the south security fence will be less than that at the north security fence.

*** The distance from the nearest pads to the north and west Owner Controlled Area (OCA) boundary fence is 2,119 ft. Distances to the OCA boundary fence are further from the storage pads in the south (≈2,300 ft) and east (≈2,260 ft) directions, and dose rates would be lower at these sections of the OCA boundary fence.

TABLE 7.3-8

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8.1.4 Operator Error

This event consists of off-normal operator load handling errors that develop from the canister impacting against the inside of the shipping, transfer, or storage cask.

8.1.4.1 Postulated Cause of the Event

Several postulated events involving off-normal handling have been considered, all caused by personnel error. Load drops by the overhead bridge crane, the semi-gantry crane, or the canister downloader are not considered credible because of the single-failure-proof design of these lifting systems. Postulated events are: (1) while lifting the canister out of the shipping cask and into the transfer cask, personnel error could result in lifting the canister too high so it contacts the top of the transfer cask; (2) during placement of the canister into the storage cask, improper operation of the crane or canister downloader may cause a lateral impact against the inside of the storage cask (this could also occur during transfer of the storage cask to a storage pad, where an inadvertent movement could cause lateral impact of the canister against the inside of the storage cask); and (3) during canister lowering into the storage cask with the transfer cask improperly aligned with the storage cask, the canister could encounter interference, such as catching on the edge of the storage cask.

8.1.4.2 Detection of Event

The off-normal handling event would be detected by facility operators and personnel monitoring canister transfer operations or storage cask movement from the Canister Transfer Building to a storage pad. Audible noises would be heard from the canister impacting a cask, and slackening of the slings that connect the canister to the crane hook or to the canister downloader would be observed.

8.1.4.3 Analysis of Effects and Consequences

Off-normal handling events are evaluated in the HI-STORM SAR. The following is a summary of the evaluations of the different credible off-normal handling events.

Horizontal Impacts of the Canister

The horizontal impact of the canister event assumes that the canister impacts the side of the storage cask at a speed of 2 ft/sec, which is equivalent to a drop from a height of 0.75 inch. The resulting deceleration is conservatively calculated to be 17.5 g for the representative storage system (Section 11.1.5 of Reference 78). This acceleration is bounded by those determined for the canisters in drop accidents. Therefore, the associated stresses resulting from this accidental impact are bounded by those for design basis drop accidents. Canister accelerations analyzed due to postulated side drop/tipover accidents are 45 g for HI-STORM (Reference 2).

Interference During Canister Lowering Operations

The interference during canister lowering operations event postulates that the canister impacts the storage cask edge or side while the canister is lowered into the storage cask. Procedures to ensure alignment of the transfer cask with the storage cask should prevent this condition from occurring, but it is assumed that operator error results in inadequate clearance / misalignment. Since the only force acting on the canister during lowering is gravity, the worst case condition would be a load of 1 g on the canister bottom or side, if it were completely supported by the interference. The stresses applied to the canister in this scenario are again bounded by those assessed for the canister in drop accidents, analyzed in the HI-STORM SAR. The analyses determined that the canister vessel and its internals would maintain their structural integrity and continue to perform their safety functions for the drop accidents.

8.1.4.4 Corrective Actions

In the case of interference during canister lifting, the canister downloader operator lowers the canister. Workers would inspect the alignment of the transfer cask on the shipping cask, make necessary adjustments, and complete the lift. If unable to satisfactorily correct the situation, workers would lower the canister back to the bottom of the shipping cask, lift the transfer cask off the shipping cask, and determine the cause of any interference/misalignment.

In the horizontal impact scenario, the canister is designed to withstand horizontal acceleration loads that bound the canister horizontal impacts on the storage cask discussed above. No corrective actions are necessary.

To recover from interference during the canister lowering situation, the crane or canister downloader operator would immediately stop lowering the canister, inspect the area for interference, and raise the canister back into the transfer cask. The personnel involved in the transfer operation would check the alignment of the transfer cask on the storage cask. If necessary, the transfer cask will be lifted off the storage cask to permit inspection for foreign objects.

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seismic hazard at a nuclear power plant site. In response to the regulatory changes in seismic analysis methodology for siting nuclear power plants, and anticipated changes to Part 72 (SECY-98-126), a PSHA has been performed for the PFSF for vibratory ground motions and surface fault displacement. The seismic design basis for the PFSF has been revised (References 29 and 41), with the current design basis ground motions based on the PSHA, as discussed in Sections 2.6 and 3.2.10. The design basis ground motions are characterized by site specific response spectrum curves having peak ground accelerations of 0.711g horizontal (two directions) and 0.695g vertical (based on Reference 81), as identified in Sections 2.6.4.9 and 3.2.10.1.1.

The site specific cask stability analyses were initially performed based on the PFSF original site specific deterministic design earthquake, which has been superseded by the current design basis ground motion established by the PSHA. These analyses determined that while the casks do rock slightly, they do not tip over, nor does rocking result in collision of storage casks with adjacent casks. In addition, the analyses determined that while the casks could slide, they could not slide off the storage pad, nor would sliding result in collision of storage casks with adjacent casks. Since the initial cask stability analyses were performed, Holtec (the HI-STORM storage cask vendor) has performed a cask stability analysis for the HI-STORM storage cask, based on the PSHA design basis ground motion (0.711g horizontal and 0.695g vertical). The results of this analysis are included in the following section (Section 8.2.1.2).

The storage system structural design bases, which identifies earthquake loads and the structural design of the storage system, are contained in Section 4.2.1.5.1 (H).

8.2.1.2 Accident Analysis

The HI-STORM storage casks are analyzed for a generic design earthquake as selected by Holtec and as described in its SAR (Reference 2). The HI-STORM storage casks were also analyzed for the previously determined PFSF site specific deterministic design earthquake, represented by response spectrum curves with a zero period acceleration of 0.67g horizontal (two directions) and 0.69g vertical. More recently, the HI-STORM storage casks were analyzed for the PFSF site specific PSHA design basis ground motion (0.711g horizontal and 0.695g vertical, based on Reference 81), as discussed below.

In addition to Holtec's PFSF site specific cask stability analyses, a separate and independent site specific cask stability analysis was performed by a structural-mechanical engineering consultant specializing in seismic dynamic analysis of equipment and structures. The analysis was performed by J. D. Stevenson, Consulting Engineer, for the purpose of independently confirming the cask stability conclusions of the vendor's analyses. This bounding case analysis considered the HI-STORM storage casks, and was based on the original PFSF deterministic design earthquake. The analysis demonstrates the storage casks will not tip over or slide excessively in an earthquake and confirms the conclusions of Holtec's analysis of the capability of its storage casks to withstand the PFSF deterministic design earthquake.

A summary of Holtec's cask stability analysis and the independent cask stability analysis performed by J. D. Stevenson, Consulting Engineer, follows. Holtec has completed the analyses of the HI-STORM storage casks for the PSHA design basis ground motion (0.711g horizontal and 0.695g vertical). The results of this more recent analysis, which supercede the analysis for the PFSF deterministic design earthquake, are presented below.

HI-STORM Cask Stability Analysis

The HI-STORM generic seismic cask stability analysis is described in Section 3.4.7.1 of the HI-STORM SAR. The analysis basis is a conservative two-dimensional quasi-static evaluation of incipient tipping or sliding. The seismic input is: (1) a horizontal force, applied at the cask centroid, equal to the loaded cask weight multiplied by the Zero Period Acceleration (ZPA) associated with the resultant of two horizontal seismic events; and (2), a vertical force, applied at the cask centroid, equal to the loaded cask weight multiplied with a ZPA for the vertical earthquake.

The generic analysis determined that inertia loads produced by the seismic event are less than the 45 g loads for which the storage system is designed. Stresses in the canister due to the seismic event are bounded by stresses resulting from the hypothetical end drop and side drop events described in Section 3.4.10 and Appendix 3A of the HI-STORM SAR. Further, as discussed in Appendix 3.B of the HI-STORM SAR, ready retrievability of the MPC is assured under the most severe postulated accident event, hypothetical cask tipover.

The generic cask stability analysis in the HI-STORM SAR for incipient tipping or sliding does not bound the PFSF design basis ground motion. In order to demonstrate the cask stability under site specific conditions, site specific cask stability analyses have been performed by the cask vendor. Results of the initial HI-STORM cask stability analysis for the PFSF deterministic design earthquake are documented in Reference 8. Holtec has also performed a cask stability analysis for the PSHA design basis ground motion (Reference 82), described below.

The HI-STORM storage cask was analyzed using proprietary qualified software for the PFSF design basis ground motion characterized by response curves with a zero period acceleration of 0.711g in both horizontal directions and 0.695g in the vertical direction. The analysis considered soil-structure interaction, actual storage pad size, and a variety of cask placements on the pad.

The site specific cask stability analysis was performed by developing three statistically independent acceleration time histories from the site specific response spectra, generated from the PSHA. This seismic input was applied three-dimensionally to the structural system model, which included the storage pad, soil springs, and various cask placements to determine the worst case response. The site specific seismic analysis employs a mass-spring representation of the cask behavior and boundary conditions, and a numerical integration of the dynamic equations.

Each cask is modeled as a two body system with each overpack described by six degrees of freedom to capture the inertial rigid body motion of the overpack. Within each overpack the internal MPC is modeled by an additional five degrees of freedom which are sufficient to define all but the rotational motion of the MPC about its own longitudinal axis, a motion which is of no significance in this analysis. Compression-only spring constants are developed to simulate the contact stiffness between the MPC concrete pad linear compression only contact springs and for the associated friction springs at each of the 36 contact locations for each overpack on the pad.

Soil-structure interaction is incorporated into the model by the development of soil springs to reflect the characteristics of the underlying soil mass beneath the pad. Horizontal, vertical, rocking and torsional spring rates were calculated along with appropriate soil mass and damping values and applied at the pad-soil interface. The sensitivity of the cask response to upper and lower bounds of soil-spring interaction was studied and determined not to have a significant effect on cask displacements.

The Reference 82 cask stability analysis was performed by computer methods using a cask-to-pad coefficient of friction equal to 0.8 (which emphasizes tipping potential) to bound the maximum displacement of the cask. Previous cask stability analyses (e.g., Reference 42) determined that the tipping potential exceeds the sliding potential. The results of the site-specific analysis show that the storage casks will not tip over or slide to the extent of impacting adjacent casks during the PFSF design basis ground motion.

For the limiting case with a 0.8 coefficient of friction (maximum tip), there is minimal rotation of the cask vertical centerline. The maximum excursion of the top of the cask during rocking, identified as the lateral motion of the cask top center point from its initial position, is less than 4 inches for any of the configurations. The cask stability analyses (Reference 82) evaluated a case with a coefficient of friction of 0.2 to maximize sliding, and a maximum sliding displacement of 1.96 inches was computed, which is less than the maximum tipping displacement as anticipated. For both coefficients of friction considered, cask motions are generally in-phase with each other. The casks are spaced on the storage pad at 15 ft center-to-center along the short dimension of the pad, and 16 ft center-to-center along the pad's long dimension, which provides at least 47.5 inches clear between casks (cask diameter is 132.5 inches) and provides a considerable margin of safety against impacts between casks during a seismic event.

The site specific cask stability analysis performed by the cask vendor demonstrates that the HI-STORM storage cask will not tip over in a seismic event. The calculated cask movements are much less than the cask spacing on the storage pad and as such, the storage casks are shown not to impact one another or move off of the storage pad in a seismic event. Therefore, no radioactive material would be released from the storage system when subjected to the DE. The HI-STORM storage system thus meets the general design criteria of 10CFR 72.122(b), as it relates to earthquakes.

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8.2.6 Hypothetical Storage Cask Drop / TipOver

The hypothetical drop / tipover of a storage cask is classified as Design Event IV as defined by ANSI/ANS-57.9. As discussed below, storage cask tipover events, and vertical end drop events from heights greater than 9 inches, are not credible.

8.2.6.1 Cause of Accident

The stability of the loaded storage casks in the upright position on the PFSF concrete storage pad is demonstrated in Chapter 4 of this SAR. The effects of earthquakes, tornado wind, and missiles are described in the HI-STORM SAR, where it is shown that the loaded storage cask will not tip over under the severe design basis natural phenomena specified in Chapter 3 of this SAR. Seismic analyses by Holtec confirm the cask will not tip over in the event of the site-specific DE (Section 8.2.1).

The storage casks are moved from the Canister Transfer Building to the storage pad using the cask transporter. The bottom of a storage cask is only raised approximately 4 inches above the ground during movement of a loaded storage cask. The cask transporter is designed to mechanically prevent a storage cask lift of more than 9 inches above the ground. As discussed in the following paragraphs, storage cask end drops of up to 9 inches would not result in canister breach, and the storage cask would retain its structural integrity and continue to provide shielding and natural convection cooling for the canister.

Storage cask tipover accidents, and storage cask vertical end drop accidents from heights greater than 9 inches, are hypothetical events, since there are no credible causes. A storage cask tipover, and a storage cask vertical end drop from 9 inches, are analyzed in order to assess potential consequences of such accidents.

8.2.6.2 Accident Analysis

Analyses of the hypothetical storage cask drop and/or tipover are documented in the HI-STORM SAR. Holtec analyzes tipover and vertical end drop accidents separately in HI-STORM SAR Chapter 3, and Appendices 3A and 3B. The finite element model and code algorithm were reviewed by the NRC staff during the review of the SAR.

Holtec established design basis vertical and horizontal acceleration values for the HI-STORM storage cask system of 45 g for the stored fuel. It is demonstrated in the HI-STORM SAR that deceleration levels at the top of the stored fuel from hypothetical cask tipover and 11 inch vertical end drop accidents are within the design basis, based on impact with a reference ISFSI pad 36 inches thick, constructed of 4200 psi concrete with reinforcing steel having a 60 ksi yield strength and grounded on a soil foundation with an effective Young's Modulus not exceeding 28,000 psi. The pad thickness at PFSF is 36 inches, which meets the reference pad thickness criteria. The PFSF pad concrete compressive strength shall not exceed 4,200 psi, and the pad reinforcing bar is 60 ksi yield strength ASTM material. The soil foundation beginning 2 foot below the ISFSI pad concrete has an effective soil Young's Modulus not exceeding 28,000 psi. However, the first 2 feet of foundation directly below the ISFSI pad concrete is a soil-cement mixture with an effective Young's Modulus of 75,000 psi. To ensure that the 45 g limit at the top of the fuel is met, PFSF site-specific tipover and vertical drop events have been analyzed by Holtec (Reference 83) using the same methodology and computer codes used in the analyses discussed in the HI-STORM SAR.

Based on the site-specific properties of the PFSF pad and underlying foundation, Holtec calculated that the maximum cask deceleration level, in the event of a vertical drop from 10 inches, is 45.15 g. Reducing the drop height to 6.5 inches, Holtec calculated a maximum deceleration of 36.15 g's. Interpolating between the decelerations associated with these drop heights, it is determined that the deceleration resulting from a 9 inch drop would be less than 45 g's. Since the design of the transporter limits the maximum height of the load to 9 inches, credible drops at the PFSF ISFSI pad will not result in deceleration levels that exceed the HI-STORM design basis.

Holtec also performed a PFSF site-specific tipover analysis using the analysis model from the HI-STORM SAR with appropriate modifications to reflect the actual stiffness of the soil-cement and the underlying native soils existing at the PFSF (Reference 83). The analysis of the overpack steel structure incorporated elastic-plastic material behavior to permit energy absorption at the impact interface locations where local large deformations occur. The concrete for both the ISFSI pad and in the HI-STORM overpack was modeled using the same formulation used in the HI-STORM SAR tipover analysis, and the MPC model was identical to that used in the HI-STORM SAR analysis. The results from the site-specific non-mechanistic tipover analysis demonstrated that the maximum deceleration at the top of the active fuel region is 43.82 g's, which is below the HI-STORM design basis value of 45 g's. Therefore, the HI-STORM 100 system deployed at PFSF meets the design basis requirements in the HI-STORM SAR for vertical end drop and non-mechanistic tipover.

For the canister, the design basis maximum acceleration of 45 g established for the side and end drops is less than the 60 g acceleration analyzed and determined to be acceptable in the HI-STAR Transport SAR (Reference 20). Since the accelerations are bounding, the stresses (produced by 60 g vertical and horizontal accelerations) analyzed in the HI-STAR stress analyses and determined to be acceptable also bound stresses that would result from the HI-STORM tipover and end drop accidents. The canister would retain its integrity and the canister and canister internals would continue to perform their safety functions (i.e. confinement; $k_{eff} < 0.95$; transfer of decay heat from the spent fuel assemblies to the canister shell; and shielding, especially in the top axial direction).

For the storage cask, the HI-STORM SAR evaluates the buckling capacity of the cask based on a 45 g acceleration. No credit was taken for the structural stiffness of the radial concrete shielding. The minimum factor of safety for material allowable stresses for all portions of the cask structure is 1.10. The tip over event evaluated in the HI-STORM SAR specifies that the cask lid must remain in-place after a hypothetical tipover event. Chapter 3 of the HI-STORM SAR demonstrates that the minimum factor of safety for the cask lid and lid bolts is 1.29. It is considered that the tipover accident could cause some localized damage to the radial concrete shield and outer steel shell where the storage cask impacts the surface.

Studies of the capability of spent fuel rods to resist impact loads indicate that the most vulnerable fuel can withstand 63g's in the side impact orientation (Reference 21). Therefore, limiting the maximum lateral deceleration of the HI-STORM system to 45g's ensures that the fuel rod cladding integrity is maintained for side impacts such as would occur during a hypothetical storage cask tipover event.

Reference 21 also indicates that fuel rods can withstand 82g's axial loading without buckling; however, the analysis neglected the weight of fuel pellets (which could possibly be fused or locked to the cladding) and only the weight of the cladding was considered. In Interim Staff Guidance-12 (ISG-12, Reference 43), the NRC staff indicated that fuel rod buckling analyses should include the weight of the fuel pellets and consider material properties of irradiated cladding. Holtec performed such an analysis consistent with the staff recommendations, which is documented in Section 3.5 of the HI-STORM SAR. This analysis identified the most limiting fuel assembly with respect to buckling (Westinghouse 14X14 Vantage), and determined the minimum deceleration loading at which buckling of this limiting assembly could occur, using material properties of irradiated Zircalloy. Holtec's analysis takes credit for confinement of fuel assemblies by the HI-STORM canister basket assembly, which provides continuous support to limit lateral movement of fuel rods along their entire length.

Lateral movement of fuel rods in a fuel assembly is limited to: 1) the clearance gap between the grid straps and the fuel basket cell wall, at the grid strap locations; and 2) in the region between grid straps, the maximum available gap between the fuel basket cell wall and the fuel rod. For the most restrictive case analyzed, Holtec determined the limiting axial deceleration to be 64.8g. At this limiting deceleration loading, fuel rod cladding of fuel assemblies in the HI-STORM basket will not exceed yield stresses. Since the limiting axial deceleration for the fuel rods is greater than the design axial deceleration of the HI-STORM system, the fuel rod cladding will retain its integrity for the 9 inch vertical end drop. Designing the HI-STORM system, and limiting the maximum credible vertical end drop height such that the maximum deceleration experienced by the system is 45g's or less, ensures that fuel rod cladding integrity is maintained during all normal, off-normal, and accident conditions.

Cask Transporter Carrying a Storage Cask Loaded with Spent Fuel

In addition to the cask analyses, the following evaluation is provided to quantify the effects of natural forces on the transporter loaded with a cask full of spent fuel assemblies to show that a loaded transporter will not tip or overturn.

Information was reviewed from two track type cask transporters that have recently been supplied for similar casks to establish a basis for the cask transporter stability analysis, since the actual transporter to be used at the PFSF has not been determined. The transporters are manufactured by J&R Engineering and Lift Systems (References 72 and 73). The following information was collected:

Attribute	J&R Engineering 160 ton unit	Lift Systems 180 ton unit
Width of transporter	228 in.	228 in.
Length of transporter	336 in.	297 in.
Height of transporter (w/ cask)	264 in.	271 in.
Center of Gravity Height	55 in.	66 in.
Weight of transporter (w/o cask)	185,000 lbs.	160,000 lbs.

The transporter by Lift Systems will be used to evaluate the transporter stability since it has the same width, highest center of gravity, highest height, and lowest weight.

The following information regarding the storage casks was obtained from the HI-STORM SAR (Reference 2) and References 79 and 80 for the representative storage cask:

Attribute	HI-STORM	Representative Storage Cask
Height of storage cask	231 in.	223 in.
Diameter of storage cask	133 in.	136 in.
Center of Gravity Height	123 in.	114 in.
Weight of loaded storage cask	355,575 lbs.	307,600 lbs.

The representative storage cask will be used in the transporter stability analysis since it has considerable less weight to resist overturning and approximately the same height and diameter.

a. Stability of a Loaded Cask Transporter with Tornado Missile Impact

The tornado-generated missile loading specified in Table 3.6-1 used for this analysis is a 3990 lb. automobile traveling at a horizontal velocity of 134 ft/sec. This missile will produce the highest momentum for tipping the loaded cask transporter. The tornado missile is assumed to strike the transporter in the worse case direction, which is against the side where the transporter has the least width i.e., resistance to tipover. In addition, the automobile is placed at the top of the transporter for maximum tipping potential and it is assumed the transporter will not slide. The transporter loading conditions are shown on Figure 8.2-1.

It is also assumed that the transporter components will retain structural integrity during missile impact. In the event a component, such as the lift beam, fails, the cask will simply drop approximately 4" to the ground. The HI-STORM storage cask is determined to be structurally sound for drops up to 9 inches, as shown in Section 8.2.6.

The event can be thought of as two separate events. The first event is the collision, during which some of the kinetic energy of the missile is transferred to the cask/transporter system (target). How much of the energy is imparted to the target depends upon the nature of the collision. Not all of the missile energy can be transferred to the target, since this would violate the law of conservation of momentum. The energy not transferred to the target remains as kinetic energy of the rebounding missile.

The most conservative collision would be a perfectly elastic collision, where no energy is lost and both momentum and kinetic energy are conserved during impact. The angular momentum and kinetic energy of the missile before and after the impact is:

Before impact: Angular momentum of the missile = $m_m V_o H$
Kinetic energy of the missile = $0.5\ m_m V_o^2$

After impact: Angular momentum of the missile = $m_m V_f H$
Kinetic energy of the missile = $0.5\ m_m V_f^2$

where:

m_m = mass of missile = 3990 lbs / 386 in/sec^2 = 10.34 lb-sec^2 / in.
V_o = initial velocity of missile = 134 fps = 1608 in./sec
H = height of transporter = 271 inches
V_f = velocity of missile after impact

After impact the angular momentum of the transporter = $I_p \omega_p$

where:

I_p = mass moment of inertia of loaded transporter about pivot point P
ω_p = angular velocity of the transporter after impact

The mass moment of inertia of the cask about pivot point P is:

$$I_{p\,cask} = m_{cask}/12(3r_{cask}^2 + h_{cask}^2) + m_{cask}\,d_{cg\,cask}^2$$

where:

m_{cask} = mass of cask = 307,600 lbs / 386 in/sec^2 = 797 lb-sec^2 / in.
r_{cask} = radius of cask = 136 in./2 = 68 in.
h_{cask} = height of cask = 223 in.
$d_{cg\,cask}$ = distance from cask center of gravity to pivot point P calculated from the cask center of gravity height raised 4" (118") and the horizontal distance from the center of gravity to pivot point P (taken as half the transporter width, 228 in. /2 = 114) or $d_{cg\,cask} = [(118)^2 + (114)^2]^{1/2} = 164$ in.

Therefore, the cask mass moment of inertia about pivot point P is:

$$I_{p\,cask} = 797/12\,[3(68)^2 + (223)^2] + (797)(164)^2 = 25.66 \times 10^6 \text{ in}\cdot\text{lb}\cdot\text{sec}^2$$

The mass moment of inertia of the transporter about pivot point P is (assume the transporter is a rectangular parallelepiped that represents the lower "track" portion of the transporter where most of the weight is located):

$$I_{p\,xptr} = m_{xptr}/12\,(h_{xptr}^2 + w_{xptr}^2) + m_{xptr}\,d_{cg\,xptr}^2$$

where:

m_{xptr} = mass of transporter = 160,000 lbs / 386 in/sec^2 = 415 lb-sec^2/in.
h_{xptr} = height of transporter for calculating center of gravity (assume twice the height of the center of gravity) = 66 in. x 2 = 132 in.
w_{xptr} = overall width of transporter = 228 in.
$d_{cg\,xptr}$ = distance from transporter center of gravity to pivot point P calculated from the transporter center of gravity height (66") and the horizontal distance from the center of gravity to pivot point P (taken as half the transporter width, 228 in./2 = 114") or $d_{cg\,xptr} = [(66)^2 + (114)^2]^{1/2} = 132$ in.

returns the target to its original position. The distance the center of gravity moves upward before stopping can be calculated by equating the rotational kinetic energy of the target to the work required to raise the center of gravity.

The rotational kinetic energy of the target after impact can be determined and as the loaded transporter tips about point P, the kinetic energy is transferred to potential energy as the center of gravity rises a distance y:

$$E_{tipping} = \text{Kinetic Energy} = \text{Increase in Potential Energy}$$
$$= 0.5\, I_p\, \omega_p^2 = W_t\, y$$
$$= 0.5(35.29\text{x}10^6)(0.250)^2 = 467{,}600\ y$$
$$y = \underline{2.36\ \text{in.}}$$

In conclusion, 1) The loaded transporter will not tip over because the center of gravity only lifts 2.36", which is considerably less than 51.6", the distance required for the center of gravity to pass over the pivot point P and 2) The Technical Specification lift height won't be exceeded since raising the cask an additional 2.36" above the carrying height of 4" = 6.36", which is less than the 9" allowable lift height.

b. Stability of a Loaded Cask Transporter Under Seismic Conditions

The transporter is not designated an important to safety component and therefore is not subject to specific seismic design requirements. The loaded transporter is generally a flexible system with low frequencies, which would probably not be excited due to the short duration of a seismic event. In the event a seismic load could cause a failure of the transporter structure, the cask would drop or lower to the ground as vehicle members fail or yield. In the event that the cask were to drop, the HI-STORM storage cask is determined to be structurally sound for drops up to 9 inches, as shown in Section 8.2.6.2.

The cask transporter shall be designed to ensure that its dimensions, center of gravity, and weight when carrying a loaded storage cask are such that the loaded transporter will not tip over, nor will the storage cask temporarily rise above its analyzed drop height of 9 inches in the event of: 1) the PFSF design basis ground motions, and 2) a design basis tornado-driven missile postulated to strike the cask transporter or storage cask being carried by the cask transporter.

8.2.6.3 Accident Dose Calculations

Based on the results of the analyses described above, the cask/canister storage systems would retain their confinement integrity and there would be no release of radioactivity and no resultant doses in the event of hypothetical drop/tipover of a fully loaded storage cask. For tipover of a HI-STORM storage cask, it is considered that localized damage to the radial concrete shield and outer steel shell where the cask impacts the pad could result in an increased surface dose rate due to the damage. However, this would not produce a noticeable increase in the dose rates at the RA fence or OCA boundary because the affected area would likely be small (HI-STORM SAR, Section 11.2.3).

In the hypothetical event of a storage cask tipover / drop accident that is postulated to result in damage to a storage cask, the PFSF staff would evaluate the extent of damage and if needed would remove a canister from the damaged storage cask and transfer the canister to a new storage cask in the Canister Transfer Building utilizing a transfer cask to provide canister shielding and a single-failure-proof crane.

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8.2.7 Canister Leakage Under Hypothetical Accident Conditions

The leakage of a canister under hypothetical accident conditions wherein cladding of 100% of the fuel rods is postulated to have ruptured is classified as Design Event IV as defined by ANSI/ANS-57.9. This is not a credible accident at the PFSF.

8.2.7.1 Cause of Accident

The HI-STORM and representative storage system canisters are totally sealed, integrally welded pressure vessels, designed to Section III of the ASME BPVC. There are no gaskets, mechanical seals, or packing that could provide a potential leakage path for the radioactive fission products contained within the fuel cladding. The canisters are provided with multiple closures to confine the radioactive fuel. Following welding of the closures, the canisters are tested to verify their leaktight integrity. No components are required to penetrate the sealed canisters after helium backfilling is completed and the outer closure is welded in place. The postulated failure of the cladding of all fuel rods in a canister and release of gases normally contained in the fuel rod cladding under pressure would not challenge the integrity of the canisters (Section 8.2.10). Maximum canister leakage under conditions wherein cladding of 100% of the fuel rods is postulated to have ruptured is considered to be a non-credible event, which will not occur over the life of the PFSF. Nevertheless, this accident is hypothesized and analyzed below. Doses resulting from the canister leakage under hypothetical accident conditions were calculated in accordance with Interim Staff Guidance-5 (ISG-5, Reference 31).

8.2.7.2 Accident Analysis

In this accident analysis, it is postulated that a canister leaks at the maximum rate permitted by the closure helium leakage test acceptance criteria. Such a leak would require a significant defect in each of two redundant closure welds. In this hypothetical

33. Topical Safety Analysis Report for the Holtec International Storage, Transport, and Repository Cask System, (HI-STAR 100 Cask System), Holtec Report HI-941184, Docket 72-1008, Revision 8, August 1998.

34. NUREG/CR-6487, Containment Analysis for Type B Packages Used to Transport Various Contents, prepared for the U.S. NRC by Lawrence Livermore National Laboratory, November 1996.

35. NUREG-1617, Standard Review Plan for Transportation Packages for Spent Nuclear Fuel, Draft Report for Comment, March 1998.

36. RESRAD Computer Code, Version 5.82 for Windows.

37. Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Revision 1, July 1977.

38. Interim Staff Guidance-3, Post Accident Recovery and Compliance with 10 CFR 72.122(l), U.S. NRC Spent Fuel Project Office, October 6, 1998.

39. Fire Protection Handbook, Sixteenth Edition, National Fire Protection Association, 1986.

40. Report by Carlton M. Britton, dated February 8, 1999; This report is Attached to the Response to PFSF Safety RAI No. 2, SAR 8-3, submitted to the NRC by PFS letter J. Parkyn to Director, Office of Nuclear Material Safety and Safeguards, dated February 10, 1999.

41. PFS Letter, Parkyn to U.S. NRC Document Control Desk, Request for Exemption to 10 CFR 72.102(f)(1), dated August 24, 1999.

42. Holtec Report No. HI-992277, Multi-Cask Response at the PFS ISFSI, From 2000 Year Seismic Event, Revision 0, dated August 20, 1999.

43. Interim Staff Guidance-12, Buckling of Irradiated Fuel Under Drop Conditions, U.S. NRC Spent Fuel Project Office, May 21, 1999

44. PFSF Calculation No. 05996.02-UR-5, Dose Rate Estimates from Storage Cask Inlet Duct Clearing Operations, Revision 2, Stone & Webster.

45. PFSF Calculation No. 05996.01-UR-3, Postulated Release of Removable Contamination from Canister Outer Surfaces - Dose Consequences, Revision 2, Stone & Webster.

46. PFSF Calculation No. 05996.02-UR-009, Accident Dose Calculations at 500m and 3219m Downwind for Canister Leakage Under Hypothetical Accident Conditions for the Holtec MPC-68 and SNC TranStor Canisters, Revision 1, Dade Moeller & Associates.

47. PFSF Calculation No. 05996.02-UR-010, RESRAD Pathway Analysis Following Deposition of Radioactive Material From the Accident Plumes, Revision 1, Dade Moeller & Associates.

48. American Society for Testing and Materials (ASTM) Standard D975-1997, Standard Specification for Diesel Fuel Oils.

67. NISTIR 5486-1, FPEtool, Version 3.2, U.S. Department of Commerce Technology Administration, National Institute of Standards, April 1995.

68. ASTM E-119, Standard Test Methods for Fire Tests of Building Construction and Materials, 1998.

69. Reinforced Concrete Fire Resistance, Concrete Reinforcing Steel Institute, 1980.

70. PFSF Calculation No. 05996.02-P-007, Radiant Heat Flux Calculations for Canister Transfer Building Heavy Haul Vehicle Tire Fire, Revision 0, Risk Technologies.

71. Society of Fire Protection Engineers (SFPE) Handbook, Second Edition, published by the National Fire Protection Association, Boston MA, 1995.

72. J&R Engineering Company, Inc. fax from R. Johnston to DW Lewis of Stone & Webster, J&R Engineering Drawing No. 1481L001, Rev. B, "Preliminary Layout TL250-40 Commonwealth Edison," with revisions to suit PFSF, dated June 15, 2000.

73. Lift Systems electronic letter from J. Pelkey to DW Lewis of Stone & Webster, Lift Systems Drawing No. MS204, Rev. 6-3-2000, "Nuclear Fuel Crawler Cask Transporter for the NAC Storage Cask at Palo Verde Nuclear Generating Station," dated June 14, 2000.

74. PFSF Calculation No. 05996.02-UR(D)-13, Dose Calculation at 500 Meters for the HI-STORM BWR Canister for Postulated Accident Conditions, Revision 0, Stone & Webster.

75. PFSF Calculation No. 05996.01-UR-1, Accident χ/Qs for the Private Fuel Storage Facility (PFSF), Revision 2, Stone & Webster.

76. PFSF Calculation No. 05996.02-P-008, Propane Release Analysis With Dispersion and Delayed Ignition, Revision 1, Risk Technologies.

77. Material Safety Data Sheet for Commercial Propane, Air Products Corporation, Allentown, Pennsylvania.

78. Safety Analysis Report for the Ventilated Storage Cask System, Pacific Sierra Nuclear Associates Report PSN-91-001, Revision 0A, December 1993

79. TranStor Storage System Weight and C.G. Calculation, Sierra Nuclear Corporation Calculation No. TSL-1.10.06.01, Revision 2, November 23, 1998.

80. TranStor Storage Cask Assembly, Sierra Nuclear Corporation Drawing No. TCC-001, Revision 1, November 20, 1998.

81. Geomatrix Consultants, Inc., "Development of Design Ground Motions for the Private Fuel Storage Facility, Revision 1, March 2001.

82. Holtec Report No. HI-2012640, Multi-Cask Response at the PFS ISFSI, From 2000 Year Seismic Event, Revision 2, March 2001.

83. Holtec Report No. 2012653, PFSF Site-Specific HI-STORM Drop/Tipover Analyses, March 2001.

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1.2 NEED FOR THE FACILITY

As a result of the status of DOE's program and DOE's interpretation of its authority, utilities have had to plan on continuing to provide interim storage for their spent fuel beyond 1998. Even those utilities who would have been entitled to make spent fuel deliveries to DOE in the first years following the 1998 deadline now have to assume that it will be a decade or more before any deliveries will occur.

In the past, utilities have generally been able to provide adequate at-reactor storage for their spent fuel. Some reactors, particularly those that were constructed after reprocessing of spent fuel was no longer an option, may have significantly greater spent fuel pool storage capacity than reactors that were built prior to the mid-1970's. Most reactors have been able to add additional capacity to their spent fuel pools by reracking. Other utilities have constructed dry spent fuel storage capacity at their reactor sites. But some utilities are running out of options or are running the risk that those options will not be available to them. Some reactors have reached their maximum spent fuel pool capacity because of structural or other physical limitations. Some utilities are subject to state or local restrictions or regulatory processes that could restrict or prohibit storage expansions. In some cases, state legislation or state regulatory decisions have imposed very costly and burdensome restrictions or limitations on storage expansions, raising the risk that future expansions may be restricted, delayed, limited, or prohibited. The unavailability of added storage has become a significant risk that utilities must consider. Inability of an operating reactor to provide sufficient spent fuel storage capacity will cause the shutdown of that reactor.

In addition to the need for spent fuel storage capacity for operating reactors, reactors that have reached the end of their operating life must also provide spent fuel storage until the spent fuel can be shipped off-site. Until such off-site shipment takes place, the reactor site cannot be completely decommissioned. Particularly in those situations where all reactors at a site have been permanently shut down, the absence of an off-site option for spent fuel storage will result in significant added costs of maintaining a licensed site. It will also result in increased decommissioning costs. Delayed decommissioning would leave the utility with a large ongoing operations and maintenance cost at a non-revenue producing facility. Uncertainties in the cost and availability of low-level radioactive waste disposal facilities caused by delayed decommissioning will also cause greater decommissioning costs.

PFS members have and are pursuing at-reactor spent fuel storage technologies to provide spent fuel storage capacity until the PFS ISFSI is available, as described in the letter from J. Parkyn, PFS to Director, Office of Nuclear Material Safety and Safeguards, NRC, dated May 18, 1998.

PFS members have reracked spent fuel storage pools and some have implemented dry storage or have plans to implement dry storage at reactor sites if needed, as discussed in the above letter. However, at least three of the PFS member reactors have limited spent fuel storage capacity that cannot be expanded due to state political constraints (Prairie Island 1 and 2) or may not be able to be expanded using existing dry storage technologies due to site constraints (Indian Point 2). Other facilities that have not added dry storage and have exhausted in-pool storage expansion alternatives may experience either political or site constraints that could prohibit dry storage and thus require shutdown of the nuclear power plants prior to the end of their useful lives.In addition, PFS members own three shutdown nuclear power plants (Indian Point 1, LaCrosse, and San Onofre 1) which will have to store spent fuel at the reactor sites for an estimated 30 to 40 years if spent fuel cannot be shipped off-site until 2015 or later.

Following is information on the remaining fuel storage capacity available in fuel pools of PFS member utilities, and projected dates when full-core offload capability will be lost, (information current as of November 2000):

Utility	Reactor	Remaining storage capacity (no. spaces)	Projected date of loss of full-core offload capability
Consolidated Edison Company of New York	Indian Point Unit 1	Shutdown; fuel onsite	N/A (shutdown)
	Indian Point Unit 2	385	2004
Southern California Edison Co.	San Onofre Unit 1	Shutdown; fuel onsite [a]	N/A (shutdown)
	San Onofre Unit 2	480	2006
	San Onofre Unit 3	524	2006
Genoa FuelTech Inc.	La Crosse Boiling Water Reactor	Shutdown; fuel onsite	N/A (shutdown)
Indiana-Michigan Company (American Electric Power)	D. C. Cook Units 1 and 2	1553 (shared)	2010 (both units)
Florida Power and Light Company	St. Lucie Unit 1	483	2005
	St. Lucie Unit 2	528	2007
	Turkey Point Unit 3	520	2010
	Turkey Point Unit 4	501	2011
GPU Nuclear Corporation	No Reactors	N/A	N/A
Northern States Power Company	Monticello	971	2006
	Prairie Island Units 1 and 2	140 (shared)	2007 (both units)
Southern Nuclear Operating Co.	Farley Unit 1	376	2006
	Farley Unit 2	560	2008
	Hatch Units 1 and 2	859 (shared)	[b]
	Vogtle Units 1 and 2	2,066 (shared)	2014 (both units)

a Pool is full; additional Unit 1 assemblies are being stored on an interim basis in Units 2 and 3 pools and in space leased at the General Electric Morris Facility through 2002.

b Southern Nuclear Operating Co. has obtained a license for an ISFSI to store spent fuel from Hatch Units 1 and 2, and has transferred some spent fuel from the Hatch reactors' fuel pool out to the dry storage facility where the fuel is stored in storage casks. As a result of this on-site dry storage capability, full-core offload capability is planned to be maintained at all times for Hatch Units 1 and 2, so there is no projected date for loss of full-core offload capability.

The need for the PFSF facility can be summarized under the four headings of economics, decommissioning capability, assurance of continued operations, and state restrictions. Following is a summary of how these needs relate to the PFSLLC member utilities.

Economics - Each of the PFSLLC member utilities made a conscientious decision to proceed with PFS based on the economics issue since it provides a lower cost alternative than the other options that are available. Most of the utilities have no capability remaining to re-rack within their existing pools. On-site dry storage is the only other option readily available. Due to economies of scale, spent fuel storage at a centralized storage facility is projected to be more cost effective than long-term storage of spent fuel at nuclear power plant sites until a DOE repository is available

Decommissioning Capability - Each of the PFS members that have fuel on-site (21 units) will reach the end of their operating license prior to the capability of the DOE's facility to remove all accumulated fuel from the individual sites. The time required for the DOE removal causes an impediment to decommissioning in each of these cases. The existing three reactors that are shutdown need to remove fuel from site to complete decommissioning. As closure at the end of an operating period through decommissioning is an established principle of the NRC license, the clear existence of this need is a strong motivator to construct and operate a single site that would be dedicated solely to spent fuel oversight.

Assurance of Continued Operations - Several utilities expressed a need for the PFSF to continue to operate for the time specified in their operating license. Consolidated Edison at Indian Point #2 pointed out the potential of being unable to make appropriate arrangements for on-site storage of its' spent nuclear fuel, which would curtail the operation of Indian Point #2. California Edison indicated a need at San Onofre Units #2 and #3 to have the PFSF available to ensure full-core reserve and continued operation throughout its' license. Indiana-Michigan Company (American Electric Power) indicated a need for its Cook Nuclear Plants (Units #1 and #2) to use the PFSF to ensure full-core off-load and operation capability until the end of its license. Northern States Power indicated a need to have the PFSF available to be capable of operating Prairie Island Units #1 and #2 beyond a date in which fuel storage is lost. Due to current state law, Northern States Power is limited to the use of a set number of casks or other equivalent for on-site storage. Southern Nuclear, which operates six reactors, indicated a need to have the PFSF to operate some of its units to the end of their license. Failing to provide the PFSF would require multiple expansions of on-site capability.

State or Local Restrictions - Minnesota has already imposed restrictions on further expansion of expended fuel storage capability at Northern States Power's Prairie Island facility.

With all of these considerations in mind, several utilities have formed the Private Fuel Storage L.L.C. (PFSLLC) to construct a privately-owned independent spent fuel storage installation (ISFSI) that will store spent fuel from several nuclear plants at a central site. This ISFSI, called the Private Fuel Storage Facility (PFSF), will be located on the Skull Valley Indian Reservation in northwestern Utah. The PFSLLC has entered into a lease agreement with the Skull Valley Band of Goshute Indians for the site.

The PFSF would allow reactors that are permanently shutdown to remove all the spent fuel from the site, thus permitting the complete decommissioning of the site. The availability of the PFSF would provide assurance of continued operation for those reactors which may be unable to increase at-reactor spent fuel storage due to physical or other limitations or restrictions. It would also provide insurance for situations where increased on-site storage might be physically possible but economically disadvantageous. In these latter situations, the availability of the PFSF may be the only alternative to the premature shutdown of a nuclear power reactor with its attendant costs, loss of generating capacity, and negative environmental impact.

The construction and operation of the PFSF is therefore the substitute for building dozens of individual on-site ISFSIs throughout the country. The canister-based transportable storage cask system to be used at the PFSF also will make subsequent transportation to a permanent repository or other location more efficient by use of a consistent packaging design and the use of the PFSF as a staging facility allowing for more efficient transportation campaigns.

The PFSF would utilize the dry cask storage technology which is currently in use at several operating nuclear power plants in the United States and abroad. Dry cask storage safely stores spent nuclear fuel inside of sealed canisters rather than in a spent fuel pool. The canister-based system confines the radioactive waste and therefore minimizes the potential for contamination of the environment. The casks are licensed by the Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 72, which establishes requirements for the independent storage of spent nuclear fuel. The storage system technology is compatible with the long-term plans of the DOE interim storage facility and permanent repository (DOE/RW 1994). The PFSF is designed to store spent fuel for up to 40 years, by which time it is anticipated that all of the spent fuel will be transferred offsite and the facility ready for decommissioning. The initial request for a license is for a term of 20 years. Prior to the end of the initial license term an application for license renewal will be submitted.

The PFSF is designed to store up to 40,000 Metric Tons of Uranium [1](MTU) of spent fuel from U.S. commercial power reactors in sealed metal canisters (approximately 4,000 storage casks). The canister-based spent fuel storage system selected for use at the PFSF utilizes sealed metal canisters to store multiple spent fuel assemblies. Each canister is placed inside a storage cask. The storage system is passive and relies on natural convection for cooling. The system is an integral part of the facility "Start Clean/ Stay Clean" philosophy which precludes handling individual fuel assemblies at the site. The system assures there is negligible contamination or radioactive waste generated at the site and facilitates the ease of decommissioning at the end of the life of the facility.

[1] Metric Tons of Uranium (initial uranium). This includes the small amount of mixed oxide fuels that are anticipated to require storage.

It is planned that four mixed-oxide fuel assemblies will be stored at the PFS facility. These assemblies are owned by the Southern California Edison and the San Diego Gas & Electric companies. The four assemblies were loaded into San Onofre Nuclear Generating Station Unit 1 for cycles 2 and 3 (operation 1970-1973) as part of the Edison Electric Institute's plutonium recycle demonstration program. They have been stored in the SONGS Unit 1 spent fuel pool since they were removed from the reactor.

The total spent nuclear fuel estimated to be generated by PFS member nuclear power plants that may be shipped to the PFS Independent Spent Fuel Storage Installation (ISFSI) is approximately 14,000 MTU of spent nuclear fuel. While all of the remaining capacity may not be used, a 40,000 MTU facility would make additional spent fuel storage capacity available for other nuclear power plants that are projected to require additional storage capacity while operating and for acceptance of spent fuel from shutdown nuclear power plants. While additional nuclear power plants have not joined PFS to date, the larger facility capacity could accommodate utilization of PFS's cost effective storage by additional nuclear power plants instead of building additional at-reactor storage capacity or continuing to store spent fuel at shutdown nuclear power plant sites.

A total of 86,000 MTU of spent fuel is projected to be discharged from U.S. nuclear power plants through the end of their 40-year operating licenses. PFS assumes that a DOE repository would be available by 2015 to begin spent fuel acceptance from commercial nuclear power plants. If DOE does not begin spent fuel acceptance until 2015, it is projected that approximately 20,000 MTU of additional storage capacity in excess of current pool capacity would be required at operating nuclear power plants nationwide. In addition, by 2015 there would be an estimated 27,000 MTU of spent fuel in storage at shutdown nuclear power plants nationwide. In a scenario in which DOE does not begin spent fuel acceptance until 2015, nuclear power plants would have to store spent fuel at nuclear power plant sites for an average of 23 years after shutdown for decommissioning. For older shutdown nuclear power plants this number would be as high as 41 years of at-reactor spent fuel storage unless there is an interim storage facility to which spent fuel can be shipped.

Although PFS assumes that a DOE repository would be available by 2015 to begin spent fuel acceptance from commercial nuclear power plants, PFS also assessed additional storage requirements assuming that DOE begins SNF acceptance in 2010. If DOE begins spent fuel acceptance in 2010, it is projected that approximately 14,300 MTU of additional storage capacity in excess of current pool capacity would be required at operating nuclear power plants nationwide. In addition, by 2010 there would be an estimated 6,800 MTU of spent fuel in storage at shutdown nuclear power plants nationwide. In a scenario in which DOE does not begin spent fuel acceptance until 2010, nuclear power plants would have to store spent fuel at nuclear power plant sites for an average of 18 years after shutdown for decommissioning. For older shutdown nuclear power plants this number would be as high as 36 years of at-reactor spent fuel storage unless there is an interim storage facility to which spent fuel can be shipped.

Due to economies of scale, spent fuel storage at a centralized storage facility is projected to be more cost effective than long-term storage of spent fuel at nuclear power plant sites until a DOE repository is available.

Assuming a 40,000 MTU storage facility begins operation in 2003 and is utilized by all commercial nuclear power plants prior to spent fuel being accepted by DOE in 2015, approximately 4,100 MTU of additional storage capacity would be required at operating nuclear power plants nationwide. Under a 2003 PFS ISFSI scenario, spent fuel would be stored at nuclear power plants nationwide for an average of 12 years following plant shutdown for decommissioning.

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1.3 PROPOSED PROJECT SCHEDULE

It is anticipated that the PFSF will be issued a specific license to receive, transfer and possess spent fuel in accordance with the requirements of 10 CFR 72 in the spring of 2002. Construction would begin thereafter with construction and preoperational testing completed in time to support operation of the facility in the latter part of 2003.

Chapter 3 provides a more detailed description of the facility construction. The areas of construction consist of the following components:

AREA OF CONSTRUCTION

Access Road

Storage Facility
- Canister Transfer Building
- Security and Health Physics Building
- Storage Pads
- Site infrastructure

Installation of pads in the southwest quadrant and the northern half of the site is expected to continue beyond the initial commercial operation date while pads in the southeast quadrant are being loaded. Chapter 3 provides a detailed discussion on the installation sequence of the pads.

Balance of Facility

Operations and Maintenance Building

Administration Building

Intermodal Transfer Point (if required)

Railroad siding

Gantry Crane

Crane enclosure

Low Corridor Rail Line (preferred alternative)

Testing and startup would overlap the latter stages of construction so as to allow commencement of commercial operation in the latter part of 2003.

2.6 GEOLOGY AND SEISMOLOGY

2.6.1 Geologic and Physiographic Setting

The PFSF is situated in western Utah near the eastern boundary of the Basin and Range Physiographic Province with the Middle Rocky Mountain Province (Figure 2.6-1). This area is characterized by a series of roughly north-south trending, tilted fault-block ranges separated by down-faulted linear basins. The PFSF is located near the middle of the Skull Valley basin, at approximate elevation 4,460 to 4,470 ft, between the Stansbury Mountain range on the east and the Cedar Mountains on the west. Surficial soils at the PFSF are mainly lacustrine marly silts and clays deposited by Lake Bonneville during the Late Pleistocene. As shown on the boring logs, below about 25 to 35 ft is a very dense fine sand with minor gravel and silt layers to at least the 100 foot depth (see PFSF SAR, Appendix 2A). The base of the Bonneville deposits is believed to be at a depth of 45 to 50 ft. in the site area where the Promontory Soil was identified (Geomatrix Consultants, Inc., 2001a) and the soil blow-counts increase dramatically (Appendix 2A). The base of the Quaternary section is not well-constrained but the Tertiary "Walcott ash" is known in several borings at a depth of about 85 ft. Bedrock was not encountered in the borings but is believed to occur at a depth of between 520 and 820 ft, based on seismic survey results (see PFSF SAR, Appendix 2B). Bedrock outcroppings, about 1.25 miles south of the PFSF at Hickman Knolls, have been mapped as the Fish Haven Dolomite of Late Ordovician age (Moore and Sorensen, 1979; Geomatrix Consultants, Inc., 2001a). Based on seismic refraction surveys and onsite monitoring well data, the groundwater table is believed to occur beneath the PFSF at a depth of about 125 ft.

The Stansbury fault, exposed along the base of the western escarpment of the Stansbury Mountains about 6 miles east of the PFSF, is considered to be "capable" as defined in 10 CFR 100, Appendix A. The fault dips to the west and is projected beneath the PFSF at a depth of 4.4 miles (55° dip assumed). Arabasz et al. (1987) consider the Stansbury fault capable of generating an earthquake with a maximum magnitude 7.3. Wells and Coppersmith (1994) using surface rupture length criteria suggest the maximum earthquake magnitude on the Stansbury fault is 7.0 ± 0.28 (moment mag.). Helm (1995) has calculated that the next seismic event on the fault should be a 6.8-6.9 ± 0.04 M_S, based on strain accumulation rates of previous events. Geomatrix Consultants, Inc. (2001a) calculate an expected value (mean) of **M** 7.0 for the maximum magnitude on the Stansbury Fault.

Two unnamed faults were identified in the PFSF area, and are informally named the East and West faults (Geomatrix Consultants Inc., 2001a). Late Pleistocene activity is indicated for both of these faults, based on geophysical and geomorphological studies. The East fault lies 0.9 km east of the site and the West is 2 km to the west. Mean maximum magnitudes for the East and West faults were calculated to be **M** 6.5 and **M** 6.4, respectively. The Stansbury, East, and West faults are the most important structures with respect to the assessment of seismic hazard in the PFSF vicinity. A transition zone or zone of distributive fault offset between the East and West faults was identified and evaluated as a surface displacement hazard beneath the PFSF. Results are discussed in Geomatrix Consultants Inc., (2001a). The maximum "random" earthquake for this region has been defined by Pechmann and Arabasz (1995) as $M_L = 6.5$.

Geomatrix Consultants, Inc. (2001a and 2001b) performed a probabilistic seismic hazard analysis to assess vibratory ground motion and fault displacement hazards at the PFSF site. Peak accelerations for design bases were calculated to be 0.711g horizontal and 0.695g vertical for a return period of 2,000 years. Ground surface displacements associated with faults believed to exist beneath the site were determined to be less than 0.1 cm for the same return period.

2.6.2 Site Geomorphology

Figure 2.6-2 shows PFSF topography, and Figures 2.1-1 and 2.6-4 show topography in the PFSF vicinity. The PFSF lies near the center of Skull Valley about mid-way between the Stansbury Mountains and the Cedar Mountains. Skull Valley is in a part of the Great Basin that was once occupied by Lake Bonneville, a large lake that developed in the Late Pleistocene (30,000 to 25,000 years before present (B.P.)). As the climate became warmer in the latest Pleistocene, the lake shrank in size and outlets for the lake were abandoned; the water gradually became saline. The gently north-sloping floor of Skull Valley is the former bottom of the lake and the unconsolidated deposits at the PFSF are sediments laid down in and by Lake Bonneville. About 2 miles east of the PFSF, the valley bottom meets the toe of an alluvial apron built up from a series of coalescing alluvial fans along the base of the Stansbury Mountains. The apron slopes at about 200 ft/mile in the vicinity of the Skull Valley Indian Reservation village. A wave-cut bench or terrace can be seen near the head of the apron representing the maximum level of Lake Bonneville about 15,300 years B.P. at elevation 5,240 ft. A scarp and small graben in Quaternary deposits reflecting Quaternary movement on the Stansbury fault (Barnhard and Dodge, 1988; Geomatrix Consultants, Inc., 2001a) are also present.

The apron is only slightly dissected by streams originating in the steep bedrock terrain of the Stansbury Mountains. Stream and spring flow are rapidly absorbed into the coarse granular fan deposits resulting in very little water reaching the valley bottom as surface runoff in this area.

The valley floor is relatively smooth, being interrupted in only a few locations by bedrock outcrops, such as Hickman Knolls rising about 400 ft above the valley bottom near the PFSF. Relief on the valley bottom is slight consisting of a few shallow (1 to 3 ft) north-trending dry washes and low (1 to 3 ft) linear soil ridges. The washes are marked by more dense desert shrub vegetation, whereas the ridges tend to be grass covered. The washes carry water for very short periods during spring snowmelt and infrequent, local thunderstorms. A few shallow depressions appear to pond water at times until they evaporate. This network of shallow washes eventually leads offsite to the north where it joins the central valley drainage system leading to the Great Salt Lake. Perennial surface water is found about 10 miles north of the PFSF in a large mudflat fed mainly by springs along the base of the Stansbury Mountains.

Other features recognized on the valley bottom near the PFSF include beach ridges and shoreline deposits associated with Lake Bonneville and eolian dune deposits in various forms, mainly parabolic or shrub-coppice dunes (Sack, 1993).

There is no evidence of flash flooding near the PFSF site area nor any deposits indicative of mudflows or recent landslides. The great depth to bedrock and the very dense condition of most subsurface soils preclude the development of collapse or uplift features associated with karst terrains or tectonic depressions. There is no history of mineral extraction or injection in the area and little likelihood of future development. Withdrawal of water in the area is widely scattered and consists of a few domestic supply wells, irrigation wells, and stock watering wells. There is no potential for subsidence from water withdrawal because of the distance from these sources and the present depth to water at the PFSF (125 ft).

In summary, the geomorphology of the PFSF is typical of a semi-arid to arid desert setting. The adjacent ranges are affected by mass-wasting processes and stream erosion that deliver their load of sediments to a complex of alluvial fans at the edge of the ranges. Most of the sediment load is dropped here as the water infiltrates or evaporates. The central part of the valley is relatively unaffected by fluvial processes. Mechanical and chemical weathering of rock and soil proceeds very slowly in this flat dry environment.

Essentially, the only geomorphic processes to affect the PFSF are microprocesses wherein soil moisture from occasional precipitation is drawn upward by capillary action and evaporates near the ground surface. This results in a gradual buildup of calcium carbonate, alkali, and sulfate in the near-surface soils. Soils at the PFSF are described in the County soil report (USDA, undated) as being calcareous and saline.

2.6.3 Site Area Structure and Geologic History

2.6.3.1 Bedrock

The PFSF lies above a sediment-filled, structural basin that is bounded on the east and west by uplifted range blocks, the Stansbury-Onaqui Mountains and the Cedar Mountains, respectively. This pattern is repeated throughout western Utah and Nevada and elsewhere and is so characteristic that the name Basin and Range is applied to the physiographic area containing this structural arrangement (Figure 2.6-1). The eastern border of this province is generally drawn along the north-south trending Wasatch Front about 55 miles east of the PFSF. The western boundary of the Front is known to be a major, active normal fault, the Wasatch fault, along which the Front has been uplifted and the Salt Lake basin is down-dropped. This major structural element is believed to have persisted since at least Late Precambrian time. The Uinta arch, which includes the present Uinta Mountains east of the Wasatch Front, is an east-west trending, anticlinal structure with a similarly long history of uplift. It intersects the Wasatch line at right angles and is believed to have influenced sedimentation patterns, as well as provided a stable buttress during tectonic episodes. Evidence of the Uinta arch has been traced as far west as central Nevada (Roberts et al., 1965) and is postulated to have affected sedimentation patterns in the rocks of the Stansbury Mountains and patterns of faulting and mineralization (Zoback, 1983; Helm, 1995; Stokes, 1986). The regional bedrock geology is depicted on Figure 2.6-3.

The Stansbury Mountains are but one of numerous mountain ranges in the Great Basin with similar origins and characteristics. The ranges are oriented roughly north-south, are commonly 9 to 12 miles wide, and are separated by valleys or basins filled with alluvium and colluvium derived from the ranges. The thickness of sediment in the valleys ranges from 1,000 ft to as much as 12,000 ft. Elevation of the ranges (and subsidence of adjacent basins) occurs by movement along major faults on one or both sides of the uplifted range blocks. It is generally believed that the faulting is distributed along several range-front faults, many of which are buried beneath the valley-fill deposits. Many of the mountain blocks show significant tilt; in the eastern Great Basin, most blocks are tilted to the east (Stewart, 1978).

Latest movement is known to be Quaternary or younger on many of the range front faults. Offset of Quaternary sediments or Holocene alluvial fans is well documented in numerous studies, particularly along the Wasatch fault. The Stansbury fault has been considered to be active at least since the work of Rigby (1958). More recent analyses suggest the fault may be segmented with movement on the southern segment occurring less than 18,000 years B.P. (latest Pleistocene) (Helm, 1995; Geomatrix Consultants, Inc., 2001a). The most recent events on the Stansbury fault displace late Pleistocene shorelines that are estimated to be about 18,000 years old. Detailed discussion of the Stansbury fault and the seismic implications are found in the PFSF SAR, Section 2.6.2.3, and Sections 5 and 6 of Geomatrix Consultants, Inc. (2001a).

Other Tertiary normal faults in Skull Valley have been proposed by various authors (Cook et al., 1989; Helm, 1995; Zoback, 1983). Recent work for the PFSF has identified two additional west-dipping normal faults and one east-dipping normal fault in the vicinity of the PFSF, based mainly on geophysical data and subtle geomorphic expression (Bay Geophysical Associates, 1999; Geomatrix Consultants, Inc., 2001a). These faults are informally named the “East”, “West” and “F” faults and are discussed in detail in

Geomatrix Consultants, Inc. (2001a), Sections 2, 5, and 6. As shown on the cross sections, Figures 2-1 and 2-2 in Geomatrix Consultants, Inc. (2001a), the East fault is interpreted to form the east margin of the Tertiary basin that underlies Skull Valley whereas the West fault lies within the basin, west of the PFSF location. The East and West faults are interpreted to merge together about 9 miles southeast of the site. The PFSF appears to be located in the stepover zone between the East and West faults where the slip is transferred from the East to the West fault. The west boundary of the Tertiary Skull Valley basin is believed to be the East Cedar Mountains fault.

Interpretation of the high resolution seismic reflection survey (Bay Geophysical Associates, 1999) performed across the PFSF site indicates the East fault displaces a subsurface reflector believed to be the unconformity at the base of the Bonneville alloformation on the Promontory soil. The Bonneville sediments are 30,000 years old or younger. Therefore, the East fault is considered to be capable as defined in 10 CFR 100 Appendix A. The West fault is also considered to be capable based on apparent changes in elevation along a geomorphic feature, the late Pleistocene Stansbury gravel bar, southwest of the PFSF. The evidence for the fault and an analysis of its slip rate are discussed in Section 2 and 5 of Geomatrix Consultants, Inc. (2001a). The zone of distributed faulting, where slip is transferred from the East fault to the West fault, was also interpreted from the high resolution reflection survey. Small normal faults, both east-and west-dipping, were imaged; some were interpreted to offset the base of the Bonneville alloformation whereas others clearly do not (Bay Geophysical Associates, 1999). Displacement on individual faults within the zone of distributed faulting is small (Geomatrix Consultants, Inc., 2001a, Table 5-1). A drilling program conducted across this zone confirmed the presence and nature of this zone of faulting, as shown on Figure 5-4 in Geomatrix Consultants, Inc. (2001a).

2.6.3.2 Surficial (Basin-fill deposits)

The surficial geology of Skull Valley is predominantly unconsolidated material of Quaternary age deposited by Lake Bonneville (~ 30,000 to 12,000 years B.P.). Pre-Lake Bonneville lacustrine deposits have been found in other valleys in the region indicating numerous lakes occupied the Salt Lake basin prior to Lake Bonneville. These deposits date from at least 600,000 B.P. to 30,000 B.P. (Lund et al., 1990). Pre-Lake Bonneville sediments were encountered in borings, test pits, and trenches in the site vicinity, as discussed by Geomatrix Consultants, Inc. (2001a).

Gilbert (cited in Sack, 1993) believed that the extensive pre-Bonneville alluvial fans were an indication of a long period of hot, dry climate prior to the transgression of Lake Bonneville. Most investigators believe that the Bonneville lake cycle began between 30,000 and 25,000 years B.P., coinciding with the final glacial maximum in the Rocky Mountains (Scott, 1988). Lake levels continued to rise until about 21,000 to 20,000 years B.P. when the level remained somewhat stable for an extended period of time. The Stansbury shoreline developed at this time and has been identified throughout the Bonneville Basin (Oviatt et al., 1990), near elevation 4,468 ft. Sack (1993) and Geomatrix Consultants, Inc. (2001a) have also mapped this shoreline through the southern part of Section 6, T5S, R8W near the PFSF, based on aerial photographs (Figure 2.6-4). Geomatrix Consultants, Inc. (2001a) mapped numerous additional shoreline features in the area shown on their Figure 1-3.

Continued filling of the basin after 20,000 years B.P. caused the lake to rise to its maximum elevation of about 5,240 ft approximately 15,300 years B.P. At that time, an outlet for the lake into the Snake River drainage was reached. The Bonneville shoreline was created at this time and can be seen as a bench on the alluvial fan east of the PFSF. At about 14,500 years B.P., unconsolidated deposits in the lake outlet channel were rapidly eroded. The lake dropped more than 300 ft in a matter of a few weeks, and resulted in the Bonneville flood. The outlet stabilized at about elevation 4,740 ft, and the Provo level developed (Malde, 1968). Sack (1993) has also mapped this shoreline east of the PFSF on the alluvial fan (Figure 2.6-4).

Climatic change beginning about 14,000 years B.P. caused the gradual shrinkage of Lake Bonneville to at least the lowest level of the present Great Salt Lake by about 12,000 years B.P. (Currey, 1990). A brief transgression of the lake occurred between about 10,900 and 10,300 years B.P. to about elevation 4,250 ft (Currey, 1990). This level is known as the Gilbert level of the Great Salt Lake and has been mapped about 11 miles north of the PFSF (Sack, 1993). Since that time the lake has receded and fluctuates within about 20 ft elevation of its historic average (Lund et al., 1990). Only once in the past 10,000 years has the level of the lake been as high as 4,220 ft (Atwood and Mabey, 1995). The PFSF is at approximate elevation of 4,465 ft, well above any recorded maximum level of the Great Salt Lake.

2.6.4 Site Stratigraphy

The PFSF site geology was investigated in 1996 by a subsurface drilling program totaling 24 borings to a maximum depth of 100 ft, and a seismic refraction and reflection program. Logs of borings are included in the PFSF SAR, Appendix 2A, and the results of the seismic surveys are found in the PFSF SAR, Appendix 2B. Section 2.6.5 includes a description of the generalized subsurface profile and engineering characteristics of the subsurface materials.

Additional investigations were conducted in 1998 and included surficial and bedrock mapping, excavation and mapping of numerous test pits and trenches, drilling of more than 40 additional boreholes to a maximum depth of 225 ft, and completion of 6 kilometers of high-resolution seismic shear-wave reflection lines. A summary of these efforts is included below. Additional detail and discussion are found in the original reports of this work (Geomatrix Consultants, Inc., 2001a; Bay Geophysical Associates, 1999).

The PFSF site is situated near the center of Skull Valley where Quaternary lacustrine and geomorphic features dominate the topography. The stratigraphy beneath the site consists of approximately 500 to 800 ft of Quaternary and Tertiary basin fill overlying Paleozoic bedrock. The nature of the deepest Tertiary deposits is unknown at this time but is believed to include sediments of the Salt Lake Formation, mainly sand, silt, marl and tuff in varying states of consolidation. The Salt Lake Formation extends up to a depth of about 85 ft in the central part of the PFSF. A volcanic ash at that level has been correlated with the Walcott tuff, known to be late Miocene in age (approximately 6 m.y.; SAR Appendix 2E). This boundary was also identified as a prominent reflector the high-resolution shear wave profiles (Bay Geophysical Associates, 1999; Geomatrix Consultants, Inc., 2001a, Plate 4).

There is evidence for four major lake cycles in the Bonneville basin during the past 700,000 years (Machette and Scott, 1988; Oviatt et al., 1997). Evidence for the three oldest is not well preserved regionally and was found only sporadically in the PFSF vicinity. The most recent cycle, the Lake Bonneville cycle, occurred between about 30,000 and 12,000 years ago and is well documented in Skull Valley. Several transgressions and recessions of the lake occurred during this time, each leaving an identifiable characteristic in the geomorphology of the valley or in the stratigraphic record. This evidence is presented in detail in Geomatrix Consultants, Inc. (2001a, Section 3.2). Near-surface Pleistocene deposits at the PFSF consist mainly of fine sand, silt, clay and marl. In general, the finer grained materials, such as silt, clay and marl were deposited during the deeper water portions of the lake cycle and the sand represents shallower, near-shore beach or deltaic fan environments. The engineering properties of those materials are discussed in Section 2.6.1.6. Locally, Holocene eolian and fluvial activities have reworked the surface soils to some extent (Sack, 1993). Eastward from the PFSF, along the proposed access road to Skull Valley Road, the influence of the proximity to the range-front alluvial fans is apparent as an increase in gravel content at shallow depths (SAR Appendix 2A).

Bedrock is not exposed at the PFSF but is found about 1.5 miles to the south at Hickman Knolls, and about 1.5 miles northeast in a series of unnamed low hills. Hickman Knolls has been mapped as Fish Haven Dolomite of Ordovician age (Moore and Sorensen, 1979; Geomatrix Consultants, Inc., 2001a). At this location the formation is a medium to dark gray dolomite and limestone breccia. Bedding is massive to indistinct, and breccia pebbles are angular to sub-round and appear to be the same composition as the enclosing matrix. Bedding strikes northerly to northeasterly and dips to the east at moderate to steep angles. Bedrock fracturing consists mainly of two sets of high angle fractures, one trends east-west and the other north-south. These fractures tend to coincide with more silicified zones that form prominent scarps on the Knolls that are strongly expressed in the morphology and are associated with many of the aerial-photo lineaments (See Plate 1, Geomatrix Consultants, Inc., 2001a).

Several faults and ductile shear zones were identified at Hickman Knolls during the recent investigations. Geomatrix Consultants, Inc. (2001a) presents evidence that indicates the faults developed prior to the dolomitization process and the shear zones are likely penecontemporaneous with the process of brecciation. No large, through-going faults are believed to exist on Hickman Knolls.

There has been some enlargement of a few joints from dissolution, and a few small caves or openings (1 to 4 ft deep) can be seen on some of the steeper rock faces. Karst conditions do not exist at Hickman Knolls nor are they likely to develop because of the near-desert environment and the depth to ground water (~125 ft). The outcrop mapped northeast of the PFSF has been identified as Deseret Limestone of Mississippian age (Moore and Sorensen, 1979).

Areas of bedrock outcrop are indicated on Figure 2.6-4, in addition to the surficial deposits. Scarps in soil near the PFSF identified on the map have been investigated by Dr. Donald Currey for this project (see PFSF SAR, Appendix 2C). Currey concluded the features were related to lacustrine processes of Lake Bonneville and are not of tectonic origin.

2.6.5 Engineering Characteristics of Site Materials

Figure 2.6-2 is a plot plan showing the locations of the major structures of the PFSF, the locations of the 1996 geotechnical borings and geophysical survey lines, and the location of Foundation Profile A-A'. Plate 1 of Geomatrix Consultants, Inc. (2001a), indicates the locations of both the 1996 and 1998 investigations, exclusive of the geotechnical borings for the Canister Transfer Building.

Geotechnical boring programs were conducted in 1996 and 1998. The borings drilled in October 1996 were located in the pad emplacement area and along the access road corridor. The borings drilled in October and December of 1998 were located in the Canister Transfer Building area, as shown in Figure 2.6-11. The soil samples obtained from these borings were sent to the Stone & Webster Geotechnical Laboratory in Boston, MA for testing. The results of the boring programs and laboratory testing are found in Appendix 2A of the SAR.

In April 1999, ConeTec, Inc performed cone penetration tests (CPT) and dilatometer tests (DMT) in the pad emplacement area and the Canister Transfer Building area. The uppermost layer described above; i.e., silt, silty clay, and clayey silt, although the layer is somewhat thinner. Sands were encountered at depths of 5 and 10 ft in Boring AR-1 and from a depth of 5 ft to 20 ft in Boring AR-2. Silty or sandy gravels were encountered at depths of 30 ft in Boring AR-3, 20 ft in Boring AR-4, and 6 ft in Boring AR-5.

None of these borings encountered bedrock. Interpretation of the seismic reflection survey data indicates that the depth to bedrock is between 520 ft and 820 ft below the surface in the vicinity of the PFSF and that it drops off towards the east, dipping from an estimated depth of 740 ft at Station 700 on Seismic Line 3 to approximately 1,020 ft at the eastern end of this seismic line.

Geotechnical laboratory tests were performed on samples obtained from the boring programs. The results of these tests, which are included in PFSF SAR, Appendix 2A, are summarized below.

The results of the tests of the silty clay/clayey silts obtained from the upper 25 to 30 ft layer in the pad emplacement area, as shown in Figure 2.6-5, are as follows:

Index Property:	**Minimum**	**Maximum**	**Average**
Water Content, %	8	58	32
Liquid Limit	25	77	44
Plastic Limit	20	46	30
Plasticity Index	0.5	38	14
Moist Unit Weight, pcf	64	91	78
Dry Unit Weight, pcf	40	71	56
Void Ratio	1.4	3.2	2.1
Saturation, %	28	64	53
Specific Gravity =2.72			

Consolidation parameters:	Low	High	Average
Maximum past pressure, ksf:	5.6	7.2	6.2
Virgin compression ratio, CR:	0.25	0.34	0.29
Recompression ratio, RR:	0.008	0.017	0.012

Rate of secondary compression, as shown by the dashed curve in Figure 2.6-6.

Table 6 of Calculation 05996.02-G(B)-05 (SWEC, 2001) summarizes the results of the triaxial tests that were performed within depths of ~10 ft at the site. These test results are included in Appendix 2A of the SAR. 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, 2001) 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. Refer to SAR Section 2.6.1.11 for additional details about the strengths of these soils.

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:

were derived from the results of one-dimensional site response analyses. These analyses were performed using the three different velocity profiles presented in Table 2.6-1A, to determine the response based on the best-estimate velocities and the high and low velocities. Figures 2.6-7 and 2.6-8 present the strain-compatible shear-wave velocity and damping ratio profiles for these three cases. Based on the strain-compatible profiles obtained from the one-dimensional site response analyses, idealized horizontally layered soil profiles were developed for use in the SSI analyses based on the SASSI continuum model. The dynamic properties for these idealized layers are presented in Table 2.6-1B, and the details of this idealization are presented in Geomatrix Consultants, Inc (2001c).

The equivalent, single-layer shear modulus, Young's modulus, damping ratio, and unit weight of the soil were computed as a weighted average of the values within 30 ft below the surface (the minimum width of the cask storage pads). The weighting factors were assumed to decrease linearly with increasing depth. These equivalent dynamic soil parameters were computed for a rectangular foundation of 30 ft by 67 ft in accordance with Table 3.1 of Newmark and Rosenblueth (1971) for vertical, horizontal, and rocking modes. The resulting parameters are presented in Table 2.6-1C.

2.6.6 Earthquake History

The historic record of earthquakes in Utah began in 1850 with the publication of the region's first newspapers in Salt Lake City. Prior to mid-1962 when a scattered, state-wide network of seismographic stations became operational, most records were based upon felt reports. A few larger events were recorded instrumentally at regional stations beginning in the 1950's, including seismograph stations at Salt Lake City and Logan since 1955. Since 1974, a network of modern stations (presently > 85 stations) has provided data to the University of Utah's Seismograph Station (Arabasz et al., 1980). Coverage in the PFSF site area has been provided since 1968 by a station at Dugway, about 14 miles to the south; at Fish Springs, about 50 miles southwest; and on Stansbury Island, about 30 miles north-northeast. Arabasz et al. (1980) estimated the historical catalog for the Wasatch Front region to be complete for Modified Mercalli (MM) intensity greater than VIII since 1850; greater than VII since 1880; greater than VI since 1940; and greater than V since 1950. They judged that instrumental monitoring has provided a complete record down to magnitude (M_L) 2.3 since mid-1962. (For explanation of various magnitude designations, see Stover and Coffman, 1993, p. 2-3.)

Figure 2.6-9 is a map of all earthquakes within 160 km (100 miles) of the PFSF of magnitude 3.0 or greater from the University of Utah Seismograph Station catalog. Table 2.6-2 is a chronological listing and description of those events. Only one earthquake greater than magnitude 3.0 has been reported within 50 km of the PFSF. This event occurred on August 11, 1915 at an assumed location north of Deseret Peak in the Stansbury Mountains. It was reported at Iosepa, a settlement on the western foothill of the Stansbury Mountains. The University of Utah catalog indicates a magnitude 4.3, based on conversion of MM intensity V from the felt report (Arabasz et al., 1987). Stover et al. (1986) list an intensity VI for this event. However, Stover and Coffman (1993) do not list this event in their catalog which has a threshold magnitude of 4.5. The earthquake was not reported in Tooele, less than 20 miles from Iosepa (Everitt and Kaliser, 1980), nor in Salt Lake City, about 43 miles away to the east (Arabasz et al., 1987).

The largest historic earthquakes to occur within 160 km (100 mi) of the PFSF occurred in the Hansel Valley at the northern end of the Great Salt Lake. A magnitude 6.6 earthquake occurred on March 12, 1934 and produced the only surface offset associated with an historic earthquake in Utah. The event occurred beneath an alluvium-filled valley and resulted in 50 cm of vertical ground surface displacement in a zone 12 km long.

be part of a larger zone that extends in a curvilinear pattern from northern Arizona and southern Nevada to northwestern Montana (Figure 2.6-10). This zone was first recognized in 1970 and is known as the Intermountain Seismic Belt (ISB) (Smith and Sbar, 1970; Sbar and Barazangi, 1970). Since that time, numerous investigators have discussed the origin and history of the ISB and have attempted to define the seismicity in a plate tectonic setting. Notable among these are the following: Smith and Sbar (1974), Anderson (1989), Stickney and Bartholomew (1987), Smith (1978), Smith et al. (1989), and Smith and Arabasz (1991).

The PFSF is interpreted to lie within the ISB near its western boundary (Arabasz et al., 1987) although it should be noted the boundary is somewhat arbitrary because of the diffuse, low level of seismic activity in this area. At least 16 earthquakes of magnitude 6.0 or greater have occurred in the ISB since settlement of the area began in the late 1840's (Figure 2.6-10). Ground surface faulting has been documented for three of these events: 1959 Hebgen Lake, MT (M_s 7.5); 1983 Borah Peak, ID (M_s 7.3); and 1934 Hansel Valley, UT (M_s 6.6). Surface faulting has also occurred elsewhere in the Basin and Range, in central and western Nevada and eastern California (Slemmons, 1980). The largest of these were the 1915 Pleasant Valley, NV (7.75 magnitude) and the 1872 Owens Valley, CA (8.0 magnitude) events. Arabasz et al. (1987) discuss these events in relation to determining a maximum size for Wasatch Front earthquakes. They concur with studies by Youngs et al. (1987) that the maximum probable event is M_s 7.5 and could have up to 6 meters of vertical displacement.

Other studies, summarized by Arabasz et al. (1987), indicate there is a threshold magnitude value below which surface faulting is not likely in the Basin and Range. This value is approximately magnitude 6.0 to 6.5. More recent studies also suggest an estimated maximum magnitude of $M_L \sim 6.5$ (Arabasz et al., 1992; dePolo, 1994). This value represents the hypothetical maximum "background" or "random" earthquake for this area, one of several seismic sources evaluated to determine peak ground accelerations at the PFSF. Geomatrix Consultants, Inc. (2001a) considers the maximum magnitude for the "random" event to be between M 5.5 and 6.5, with a mean value of 6.0.

Probabilistic analysis of capable faults and seismic zones in the region is summarized in Section 2.6.8 and detailed in Geomatrix Consultants, Inc. (2001a). Geomatrix Consultants, Inc. calculated peak ground acceleration levels of 0.711g for horizontal ground motion (both directions) and 0.695g for the vertical ground motion as the design bases of the PFSF, based on a 2,000-yr return period (Geomatrix Consultants, Inc., 2001b).

2.6.8 Design Basis Ground Motions

Federal regulations governing the requirements for siting an ISFSI are contained in 10 CFR 72. These regulations require that seismicity at an ISFSI located west of the Rocky Mountain Front, such as the PFSF, be evaluated using the criteria for determining the safe shutdown earthquake at a nuclear power plant (10 CFR 100 Appendix A) in the same area. Vibratory ground motion design bases were determined by using a "deterministic" approach based upon a single set of earthquake sources. The regulations for siting nuclear power plants (10 CFR 100.23) were amended in 1997 in order to recognize the many uncertainties in geologic and seismologic parameters that must be addressed in determining the seismic hazard at a nuclear power plant site. One of the ways to address these uncertainties is through a probabilistic seismic hazard analysis (PSHA). In response to the Part 100 changes and anticipated changes to Part 72 (SECY-98-126), a probabilistic seismic hazard assessment has been performed for the PFSF for vibratory ground motions and surface fault displacement. Methodologies used and the results thereof are detailed in Sections 6 and 7 and Appendix F of Geomatrix Consultants, Inc. (2001a). The hazards results are presented as mean hazard curves that incorporate the uncertainty in input data and interpretations. The seismic source model used 16 capable fault sources and 4 seismic source zones within 100 km.

The NRC staff has recommended a risk-informed, graded approach in their proposed changes to 10 CFR 72 when determining the appropriate hazard frequency or return period. It was determined that an appropriate design probability level for the PFSF is 5×10^{-4} per year, or a 2,000-yr return period (PFS letters of April and August 1999).

Seismic sources include all structures that have some potential for causing strong ground motion at the PFSF (≥ magnitude 5). Seismic sources modeled in the probabilistic seismic hazard analysis (PSHA) are of two types: fault-specific sources and seismic source zones. Fault-specific sources include mapped late Quaternary faults. Seismic source zones are areas that have similar geological or seismologic characteristics that are assumed to have uniform earthquake potential. Seismic source zones are used to model the occurrence of seismicity that cannot be attributed to any mapped late Quaternary faults.

A total of sixteen fault-specific sources were analyzed and included in the PSHA as well as four separate seismic source zones. Fault sources are listed in Table 6-1, Geomatrix Consultants, Inc. (2001a). The key parameters used to characterize these sources are as follows:

- Total fault length and plan-view geometry
- Probability of activity
- Maximum earthquake magnitude
- Slip rate
- Recurrence

The values for these key parameters and the weighting factors assigned to each parameter for all seismic sources used in the PSHA are given in Table 6-2, Geomatrix Consultants, Inc. (2001a).

Figure 6-12 in Geomatrix Consultants, Inc. (2001a) shows the contributions of the various fault sources to the total hazard for horizontal motion at the Canister Transfer Building location. The largest contributors to the hazard are the Stansbury and East-Springline faults. For long period ground motions the contribution due to the Stansbury fault increases due to the potential for larger earthquakes on the Stansbury than on the mid-Valley faults. The contribution of various earthquake magnitude intervals to the mean hazard for horizontal motion at the CTB location is shown on Figure 6-13 (Geomatrix Consultants, Inc., 2001a). It is evident the hazard is dominated by ground motions from nearby **M** 6 to 7 events, consistent with the proximity of the Stansbury and East-Springline faults to the CTB. Figure 6-22 (Geomatrix Consultants, Inc., 2001a) shows the contributions of the various seismic sources to the total hazard for vertical motions. Again, the Stansbury and East-Springline faults are the dominant sources. The effects of using various models of attenuation, fault segmentation, and fault independence are documented in the report.

Geomatrix Consultants, Inc. (2001a) divided the Stansbury fault into four segments and analyzed five rupture combination scenarios. Based on empirical relationships between magnitude and rupture length, magnitude and rupture area, magnitude and single event displacement, and a relationship between magnitude, rupture length, and slip rate, Geomatrix Consultants, Inc. determined the maximum magnitude distribution for the Stansbury fault is M 6.5 to 7.5 with a mean of 7.0.

Similarly, they also determined mean maximum magnitudes for the recently identified East fault (**M** 6.5) and the West fault (**M** 6.4). These values for the individual faults were utilized in the probabilistic seismic hazard assessment of the PFSF site.

The site investigations document the presence of capable faults in the immediate PFSF vicinity. In order to determine the potential hazard of coseismic displacement on these faults, a probabilistic fault displacement hazard analysis was also performed and is described in Geomatrix Consultants, Inc., 2001a, Section 7. Fault displacement hazard analysis is based on methodology developed for the Yucca Mountain repository. Three separate categories of faults that appear to underlie the site were evaluated for displacement hazard: faults that appear to displace the Promontory/Bonneville unconformity (Faults D and F), faults that appear to displace the Tertiary/Quaternary unconformity but not the Promontory/Bonneville (Fault C), and, the zone of distributive faulting between the East and West faults.

Two separate approaches were utilized, an "earthquake approach" and a "displacement approach". Figure 7-8 in Geomatrix Consultants, Inc. (2001a) shows the contribution of the various seismic sources to the displacement hazard using the earthquake approach. The East fault dominates the hazard due to the potential for distributive faulting from a large event near the site. Figure 7-9 compares the mean hazard results for both approaches at the three fault locations beneath the site. The earthquake approach produces similar hazard as the displacement approach at Fault C and lower hazards at the other two locations.

As the consequences of failure of the cask storage system due to fault displacement are comparable to those due to ground motions, the probability level of interest for displacement is also judged to be 5×10^{-4} per year, or a 2,000-yr return period. At these probability levels, the displacements associated with faulting on Faults C, D, and F were determined to be less than 0.1cm (Geomatrix Consultants, Inc. 2001a, Figure 7-7).

Design basis ground motions were determined by this probabilistic seismic hazard analysis for a 2,000-yr return period and are defined as having a peak horizontal ground acceleration of 0.711g and a peak vertical ground acceleration of 0.695g.

2.6.9 Stability of Subsurface Materials

Dolomite or limestone bedrock is believed to underlie the PFSF at depths between 520 to 820 ft. Examination of outcrops in the area indicates no evidence of cavernous or karst conditions in these rocks, and there is no history of karst development in the region. The near-desert conditions make the development of karst very unlikely, and the great depth to bedrock precludes effects at the ground surface. There is no evidence of any significant soluble mineral deposits in the unconsolidated materials beneath the PFSF to at least a depth of 225 ft, and water well records in the valley do not indicate the presence of similar material at greater depths. Evaporites associated with the waning stages of Lake Bonneville and the Great Salt Lake were not deposited here, as the area remained above the extent of saline stages of these lakes.

There is no history of oil or gas development or subsurface mining in the Skull Valley and little potential for development in the future. There are no injection wells in the area and no evidence of past activities affecting the ground surface. Groundwater is withdrawn at a few scattered locations in the valley bottom for irrigation and stock watering, but not to such an extent to cause surface subsidence or ground cracking. The nearest wells of this type are located 2.5 miles northeast and 3 miles southeast of the PFSF.

Bedrock is not exposed at the PFSF and will not be encountered by excavations for foundations. As a result, problems associated with alteration, deformation, or weathering of bedrock or anomalous in situ stresses are not a consideration for the PFSF foundations.

2.6.9.1 Use of Soil Cement to Stabilize Eolian Silt in Pad Emplacement Area

The surficial layer of eolian silt, existing across the entire site as shown in the pad emplacement area foundation profiles (SAR Figure 2.6-5, Sheets 1 through 14), is a major factor in the earthwork required for construction of the facility. Discussions presented in SAR Section 2.6.1.12 indicate that the soils underlying the eolian silt layer at the surface of the PFSF site are suitable for support of the proposed structures; therefore, no special construction techniques are required for improving the subsurface conditions below the eolian silt.

The eolian silt, in its in situ loose state, is not suitable for founding the structures at the site. This layer consists of a nonplastic to slightly plastic silt, and it has an average thickness of approximately 1 to 2 feet across the pad emplacement area. This layer was expected to be removed prior to construction of the storage pads. However, based on evaluation of the earthwork associated with site grading requirements for flood protection and the environmental impacts of truck trips required to import fill to replace this material, PFS will stabilize this soil with cement. The eolian silt will be mixed with sufficient portland cement and water and compacted to form a strong soil-cement subgrade to support the cask storage pads. Refer to SAR Section 2.6.4.11, Techniques to Improve Subsurface Conditions, for additional details.

An additional benefit of incorporating the soil cement into the design is that it will minimize the environmental impacts of constructing the facility. Using on-site materials to construct the soil cement, rather than excavating and spoiling those materials, will reduce environmental impacts of the project. In addition, replacement of some of the structural fill layer between the rows of pads with soil cement, as shown in SAR Figure 4.2-7, will result in reduced trucking requirements associated with transporting those materials to the site, as well as reduced trucking requirements associated with excavating and spoiling the eolian silt.

2.6.9.2 Collapse Potential of High Void Ratio Soils

Due to the high void ratios of some of the in situ soils and their weakly cemented nature, there is the potential that these soils may be collapsible soils, which could settle dramatically due to wetting caused by the PMF flood or due to vibrations from the design earthquake. SAR Section 2.6.1.11.4 demonstrates that these soils are not "collapsible soils". It also demonstrates that these soils will not be subject to wetting due to floodwaters associated with the Probable Maximum Flood (PMF), because, as indicated in SAR Section 2.4.2.2, the tops of the cask storage pads are at least 4 ft above the nearest approach of the PMF to the PFSF pad emplacement area. The collapse potential due to vibrations from the design earthquake is demonstrated to be nonexistent, as described in SAR Section 2.6.4.7, based on the results of cyclic triaxial tests, which are discussed below.

2.6.9.3 Dynamic Settlements

Dynamic settlements due to Design Basis Ground Motions are not expected to occur at the PFSF because of the nature of the subsurface materials. Dynamic settlements, as reported in the geotechnical literature, are based on two different mechanisms, depending on whether the soils are above or below the groundwater table. Silver and Seed (1971) developed a technique for estimating dynamic settlements of dry

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TABLE 2.6-1A
LOW-STRAIN DYNAMIC SOIL PROPERTIES INPUT TO SHAKE

Best Estimate Velocity Profile

Constant Tertiary Velocity

Layer Base (ft)	H (ft)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Computed Poisson's Ratio	Density (pcf)
5	5	1500	2390	0.175	100
10	5	528	1131	0.361	80
12	2	727	1260	0.250	80
18	6	854	1472	0.246	100
26	8	872	1440	0.210	94
35	9	1021	1667	0.200	115
50	15	1190	2085	0.258	115
90	40	1800	3400	0.305	120
125	35	2900	5023	0.250	135
300	175	2900	5023	0.250	145
500	200	2900	5023	0.250	145
700	200	2900	5023	0.250	145
Halfspace		6398	11155	0.255	170

Increasing Tertiary Velocity

Layer Base (ft)	H (ft)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Computed Poisson's Ratio	Density (pcf)
5	5	1500	2390	0.175	100
10	5	528	1131	0.361	80
12	2	727	1260	0.250	80
18	6	854	1472	0.246	100
26	8	872	1440	0.210	94
35	9	1021	1667	0.200	115
50	15	1190	2085	0.258	115
90	40	1800	3400	0.305	120
125	35	2900	5023	0.250	135
300	175	2900	5023	0.250	145
500	200	4000	6928	0.250	145
700	200	5000	8660	0.250	145
Halfspace		6398	11155	0.255	170

High and Low Velocity Profiles

Layer Base (ft)	H (ft)	High Range Vs (fps)	High Range Vp (fps)	Low Range Vs (fps)	Low Range Vp (fps)
5	5	2121	3380	1061	1690
10	5	647	1385	431	923
12	2	890	1543	594	1029
18	6	1046	1803	697	1202
26	8	1068	1764	712	1176
35	9	1250	2042	834	1361
50	15	1683	2949	841	1474
90	40	2546	4808	1273	2404
125	35	4101	7104	2051	3552
300	175	4101	7104	2051	3552
500	200	5657	9798	2051	3552
700	200	6398	11155	2051	3552
Halfspace		6398	11155	6398	11155

Source: Geomatrix Consultants, Inc, 2001c

TABLE 2.6-1B
DYNAMIC SOIL PARAMETERS FOR SASSI MODEL

High Range Properties

Depth of Top (ft)	Depth of Bottom (ft)	Density (pcf)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Damping Ratio Shear (%)	Damping Ratio Compression (%)	Poisson's Ratio
0	5	100	2120	3380	0.91	0.91	0.176
5	10	80	557	1385	3.48	3.48	0.403
10	12	80	807	1543	2.69	2.69	0.312
12	18	100	983	1803	1.82	1.82	0.289
18	26	94	973	1764	2.31	2.31	0.281
26	35	115	1053	2042	5.07	5.07	0.319
35	50	115	1488	2949	4.04	4.04	0.329
50	90	120	2481	4808	1.21	1.21	0.318
90	125	135	4101	7104	4.28	4.28	0.250
125	300	145	4101	7104	4.28	4.28	0.250
300	500	145	5657	9798	3.10	3.10	0.250
500	700	145	6398	11155	2.53	2.53	0.255
700		170	6398	11155	2.16	2.16	0.255

Best Estimate Properties

Depth of Top (ft)	Depth of Bottom (ft)	Density (pcf)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Damping Ratio Shear (%)	Damping Ratio Compression (%)	Poisson's Ratio
0	5	100	1497	2390	0.94	0.94	0.177
5	10	80	415	1131	4.78	4.78	0.422
10	12	80	622	1260	3.60	3.60	0.339
12	18	100	779	1472	2.29	2.29	0.306
18	26	94	760	1440	3.01	3.01	0.307
26	35	115	818	1667	6.21	6.21	0.341
35	50	115	956	2085	6.13	6.13	0.367
50	90	120	1716	3400	1.74	1.74	0.329
90	125	135	2900	5023	4.32	4.32	0.250
125	300	145	2900	5023	4.32	4.32	0.250
300	500	145	3450	5976	3.67	3.67	0.250
500	700	145	3950	6842	3.33	3.33	0.250
700		170	6398	11155	1.76	1.76	0.255

Low Range Properties

Depth of Top (ft)	Depth of Bottom (ft)	Density (pcf)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Damping Ratio Shear (%)	Damping Ratio Compression (%)	Poisson's Ratio
0	5	100	1053	1690	1.08	1.08	0.183
5	10	80	298	923	6.57	6.57	0.442
10	12	80	622	1260	3.60	3.60	0.339
12	18	100	610	1202	2.97	2.97	0.327
18	26	94	593	1176	3.73	3.73	0.330
26	35	115	614	1361	8.09	8.09	0.372
35	50	115	565	1474	9.82	9.82	0.414
50	90	120	1191	2404	2.18	2.18	0.337
90	125	135	2051	3552	3.97	3.97	0.250
125	300	145	2051	3552	3.97	3.97	0.250
300	500	145	2051	3552	3.97	3.97	0.250
500	700	145	2051	3552	3.97	3.97	0.250
700		170	6398	11155	2.16	2.16	0.255

Source: Geomatrix Consultants, Inc, 2001c

TABLE 2.6-1C
DYNAMIC SOIL PARAMETERS FOR SPRING, DASHPOT, AND MASS MODEL

	Upper Range	Best Estimate	Lower Range	
Vp	2205	1527	1157	
Vs	1322	842	579	
G (ksf)	5015	2027	955	
beta S (%)	2.3	3.3	4.6	
E (ksf)	12234	5194	2546	
beta P (%)	2.3	3.3	4.6	
Poisson's Ratio	0.220	0.281	0.333	
Unit Wt. (pcf)	92.4	92.0	91.8	
A (30x67) sqft	2010	2010	2010	
Aspect Ratio	2.233	2.233	2.233	
Vertical Mode				
h	12.10	12.10	12.10	
m (pcf-sec^2)	**34.75**	**34.58**	**34.52**	mass/area (pcf-sec^2)
kv (kcf)	**315.20**	**138.29**	**70.23**	spring constant/area (kcf)
c (kcf-sec)	**4.84**	**3.20**	**2.28**	dashpot constant/area (kcf-sec)
Horizontal Mode				
h	2.24	2.24	2.24	
Kappa T	0.937	0.892	0.760	
m (pcf-sec^2)	**6.43**	**6.40**	**6.39**	mass/area (pcf-sec^2)
kh (kcf)	**268.79**	**112.24**	**48.52**	spring constant/area (kcf)
c (kcf-sec)	**2.70**	**1.74**	**1.14**	dashpot constant/area (kcf-sec)
Rocking Mode				
h	15.69	15.69	15.69	
Kr	112978035.57	49565892.37	25172167.30	
C	538785.878	356027.756	253487.104	
m (pcf-sec^2)	**45.04**	**44.83**	**44.75**	mass/area (pcf-sec^2)
kr (kcf)	**736.87**	**323.28**	**164.18**	spring constant/area (kcf)
c (kcf-sec)	**3.57**	**2.36**	**1.68**	dashpot constant/area (kcf-sec)

Source: Geomatrix Consultants, Inc, 2001c

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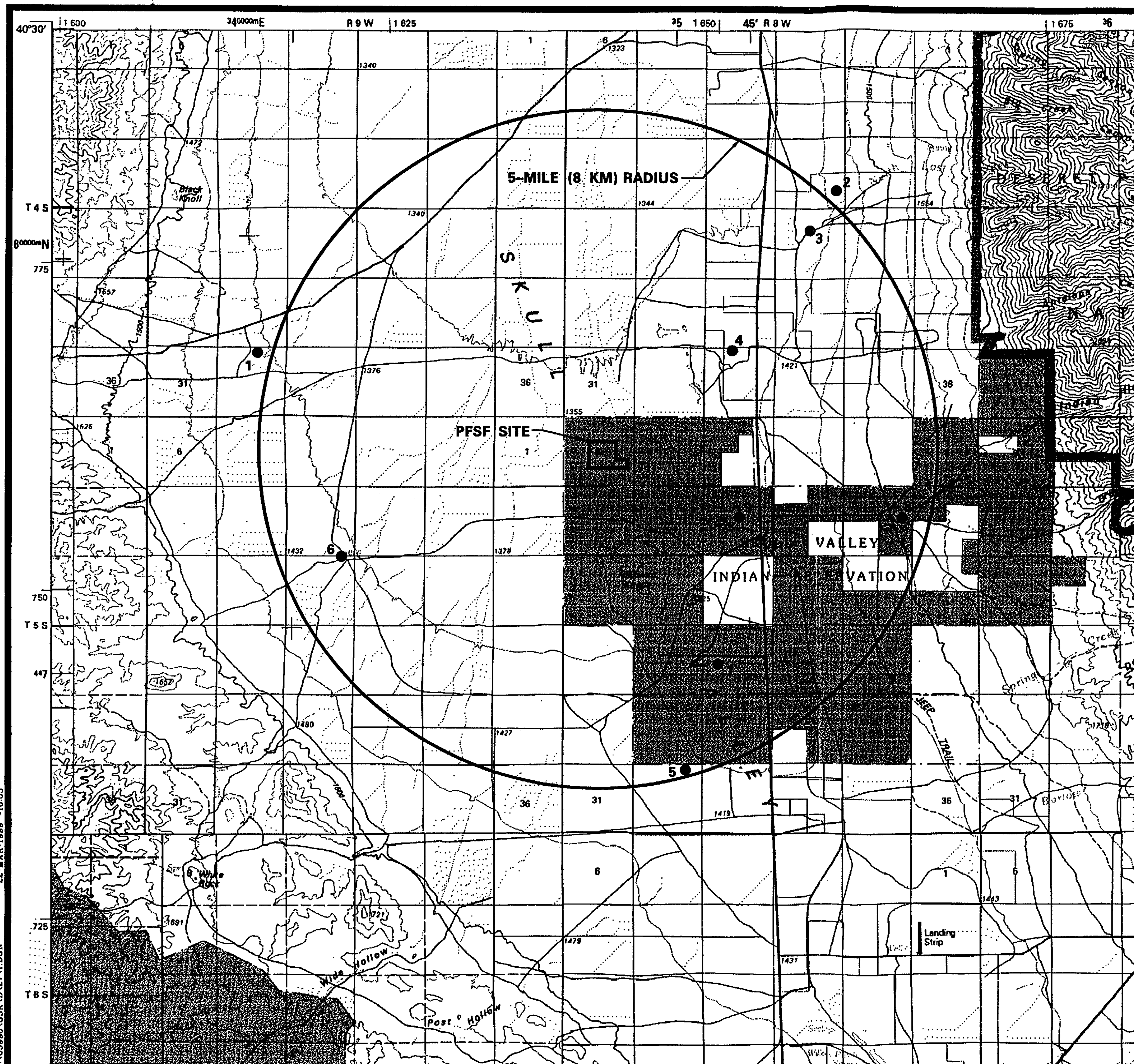
FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION



Well Map No.	Owner	Total Depth	Date Drilled	Use	Depth to Water Before Pumping	Yield When Well Drilling Was Completed	Priority/ Allowed Diversion
1	Skull Valley Co., Ltd.	340'	1967	Stock watering	297'	No Data	0.015 cfs 1955
2	Island Ranching Co., Inc.	325'	1959	Irrigation, Stock watering	No Data	765 gpm	2.18 cfs 1959
3	Island Ranching Co., Inc.	347'	1954	Irrigation, Stock watering	168'	No Data	1.226 cfs 1954
4	Anschutz Land Company	408'	No Data	Irrigation, Stock watering	No Data	No Data	0.7487 cfs 1960
5	Anschutz Land Company	209	1948	Stock watering	150	20 gpm	0.015 cfs 1948
6	Anschutz Land Company	292'	1940	Stock watering	280'	12 gpm	0.015 cfs 1940
7	Skull Valley Indian Reservation	401'	1975	Domestic Industrial	77.5'	15 gpm	Not Required
8	Skull Valley Indian Reservation	651'	1976	Domestic	519.5'	60 gpm	Not Required
9	Skull Valley Indian Reservation	No Data	No Data	Domestic	No Data	No Data	Not Required

SOURCES: BASE MAP IS RUSH VALLEY, UT, BUREAU OF LAND MANAGEMENT SPECIAL EDITION, SURFACE MANAGEMENT STATUS, 1:100,000 SCALE METRIC, 1981. WELL DATA ARE FROM STATE OF UTAH, DIVISION OF WATER RIGHTS AND HOOD AND WADDELL (1968).

LEGEND:

● WATER WELL LOCATION

SCALE 1 : 100,000

CONTOUR INTERVAL IS 50 METERS

KILOMETERS 0 1 2 3 4 5 6

MILES 0 1 2 3 4

Figure 2.5-2

WATER WELLS WITHIN 5 MILES (8 KM) OF PFSF SITE

PRIVATE FUEL STORAGE FACILITY ENVIRONMENTAL REPORT

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FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

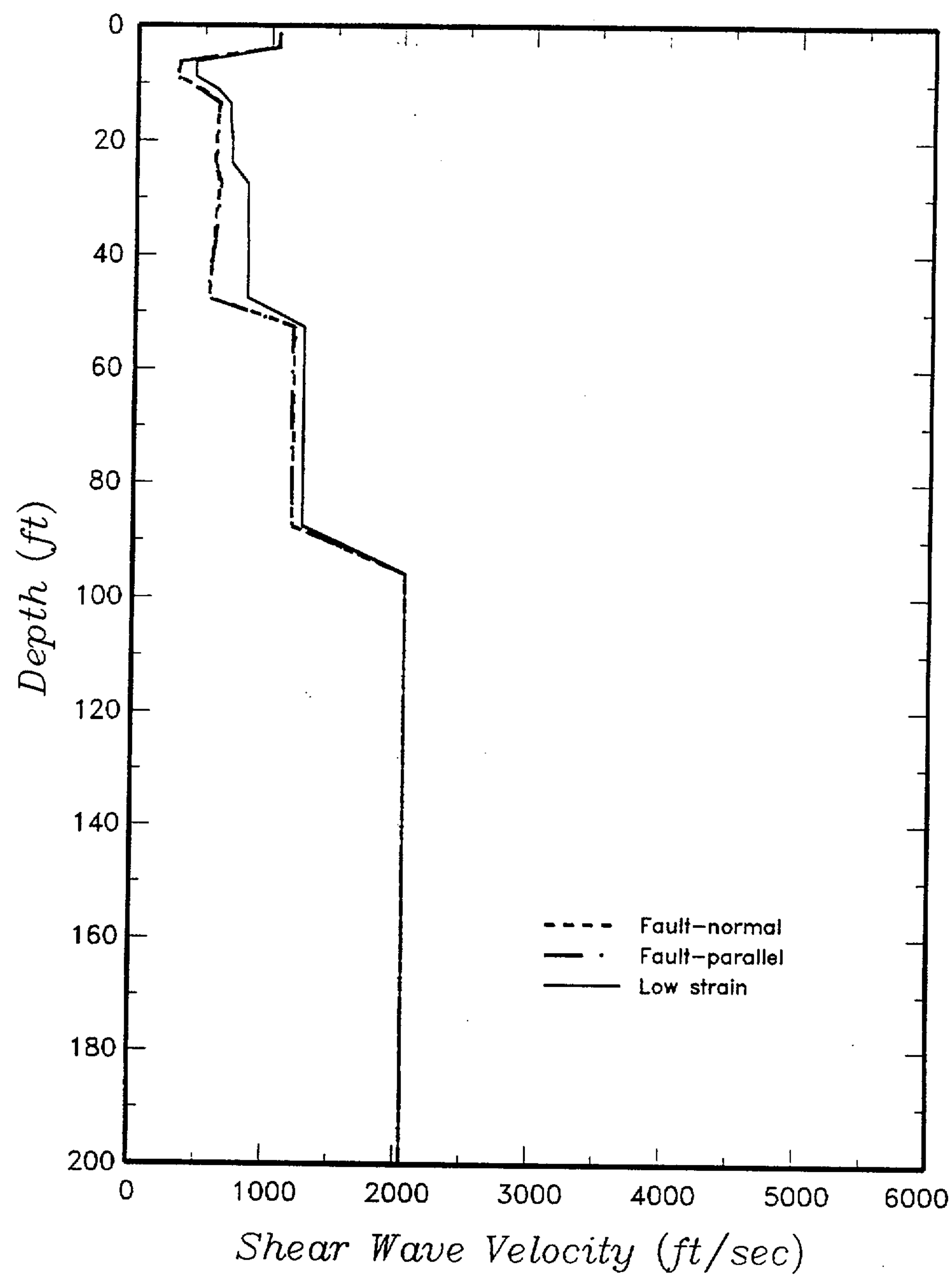
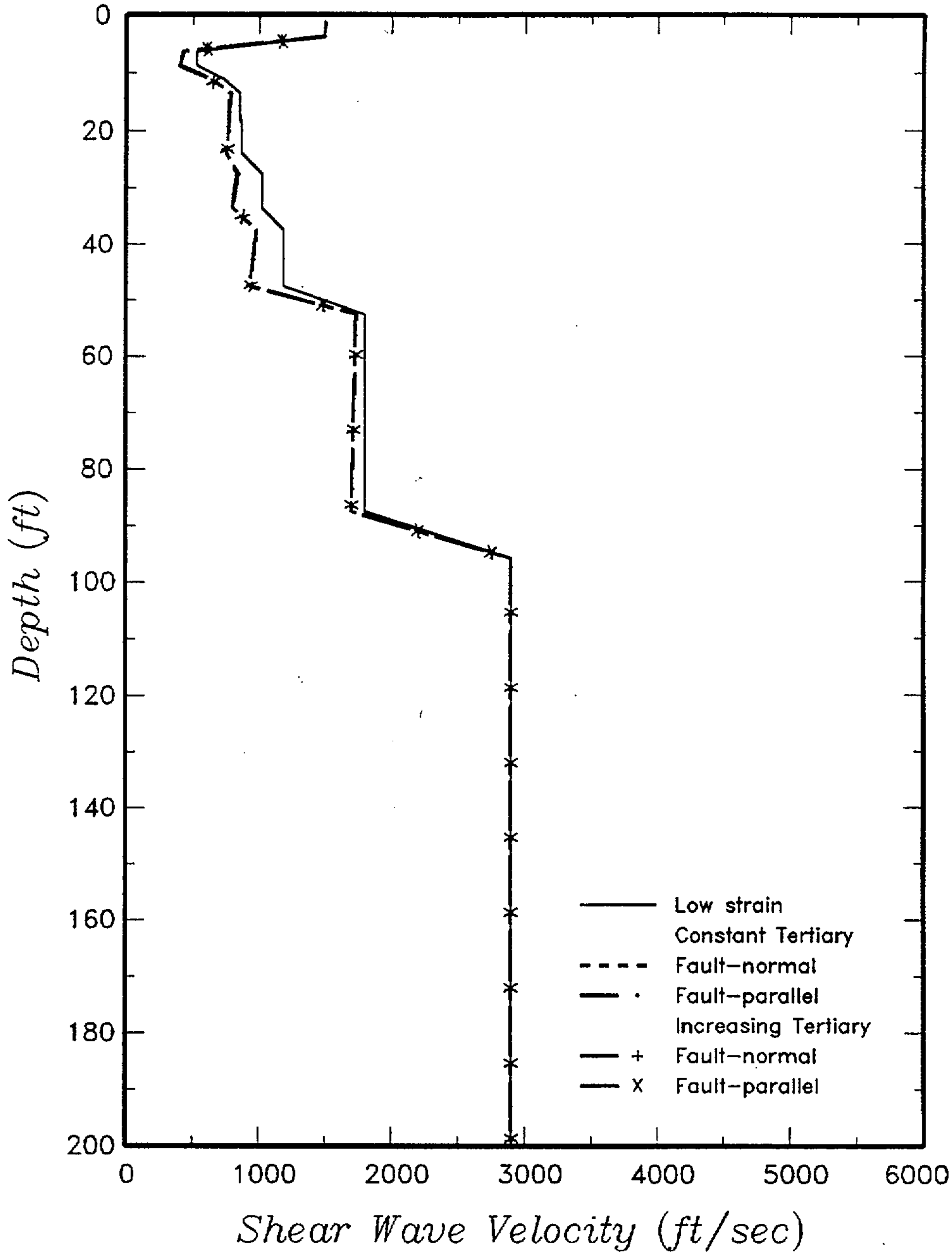


Figure 2.6-7A

STRAIN-COMPATIBLE SHEAR-WAVE VELOCITY PROFILE LOW RANGE PROPERTIES

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)



SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)

Figure 2.6-7B
STRAIN-COMPATIBLE SHEAR-WAVE VELOCITY PROFILE BEST-ESTIMATE PROPERTIES

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

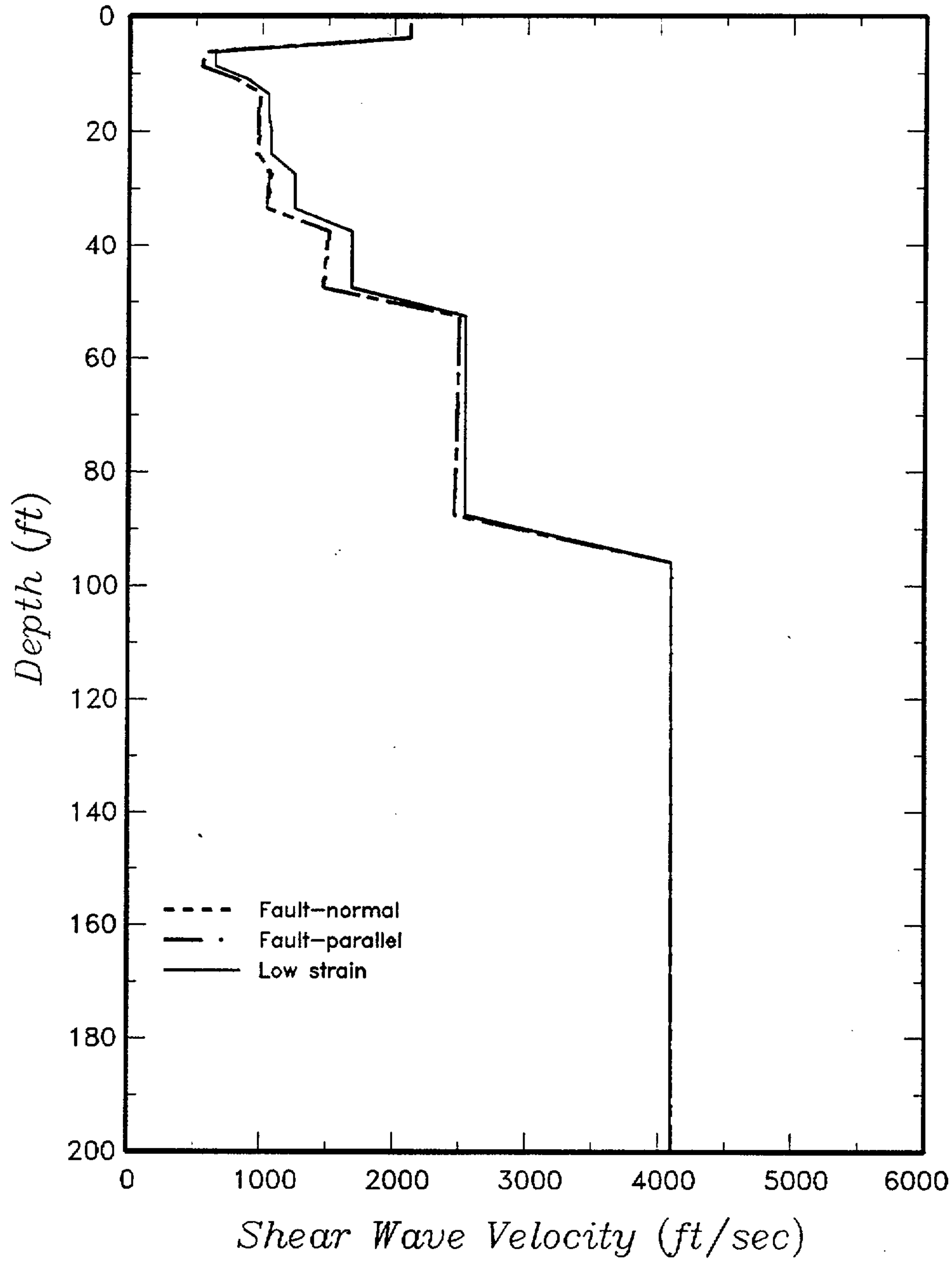
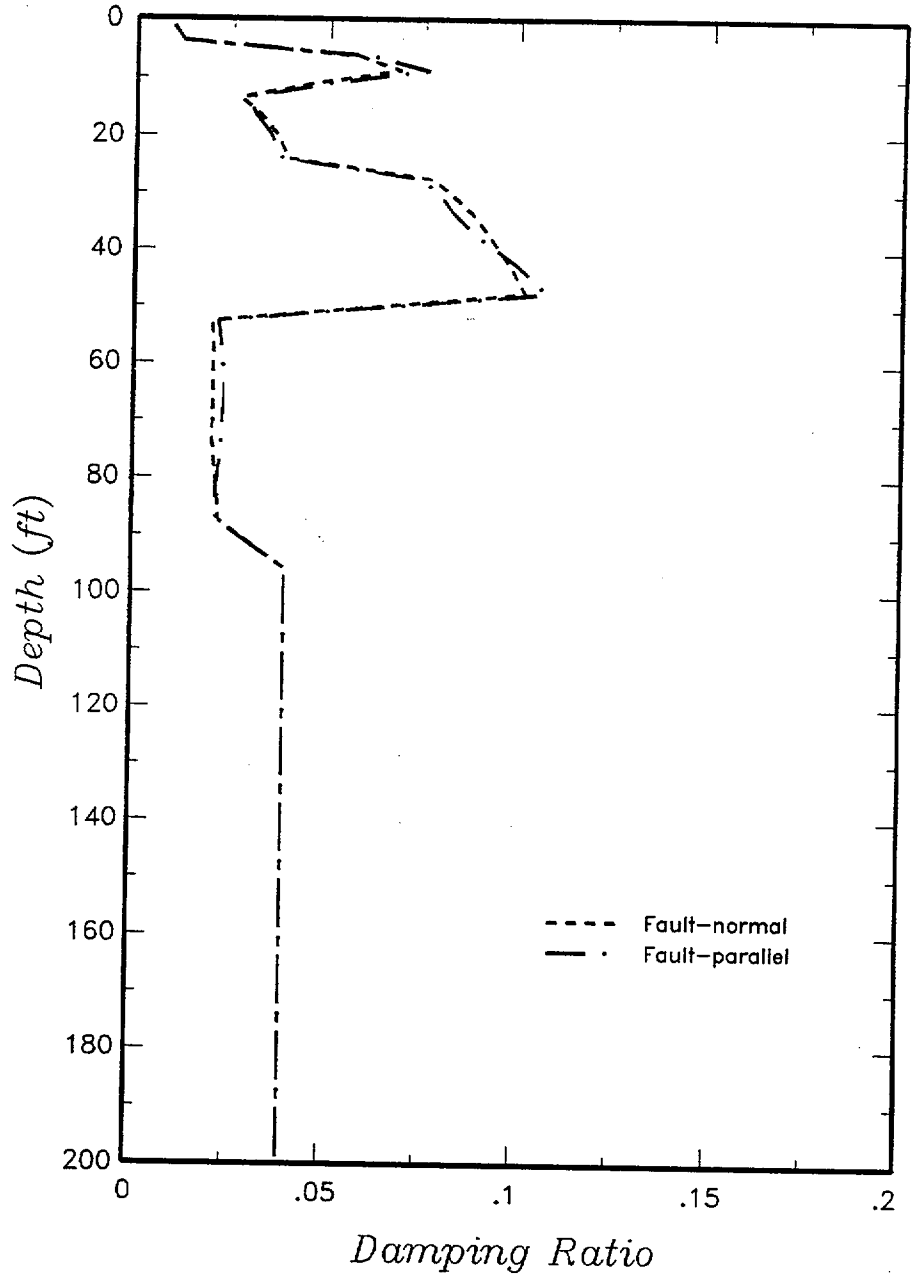


Figure 2.6-7C

STRAIN-COMPATIBLE SHEAR-WAVE VELOCITY PROFILE HIGH RANGE PROPERTIES

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)

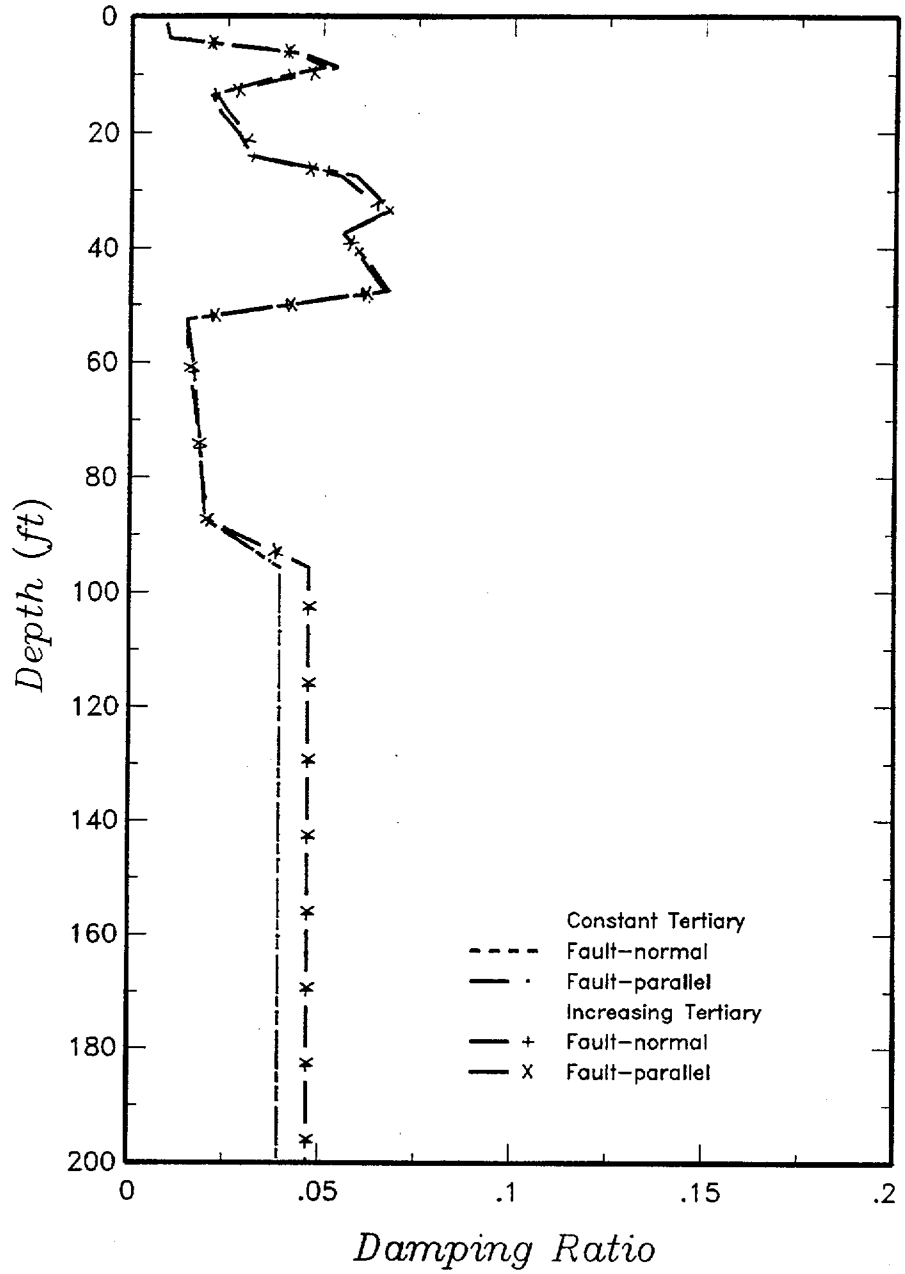


SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)

Figure 2.6-8A

STRAIN-COMPATIBLE DAMPING RATIO PROFILE LOW RANGE PROPERTIES

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT



SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)

Figure 2.6-8B

STRAIN-COMPATIBLE DAMPING RATIO PROFILE BEST-ESTIMATE PROPERTIES

PRIVATE FUEL STORAGE FACILITY ENVIRONMENTAL REPORT

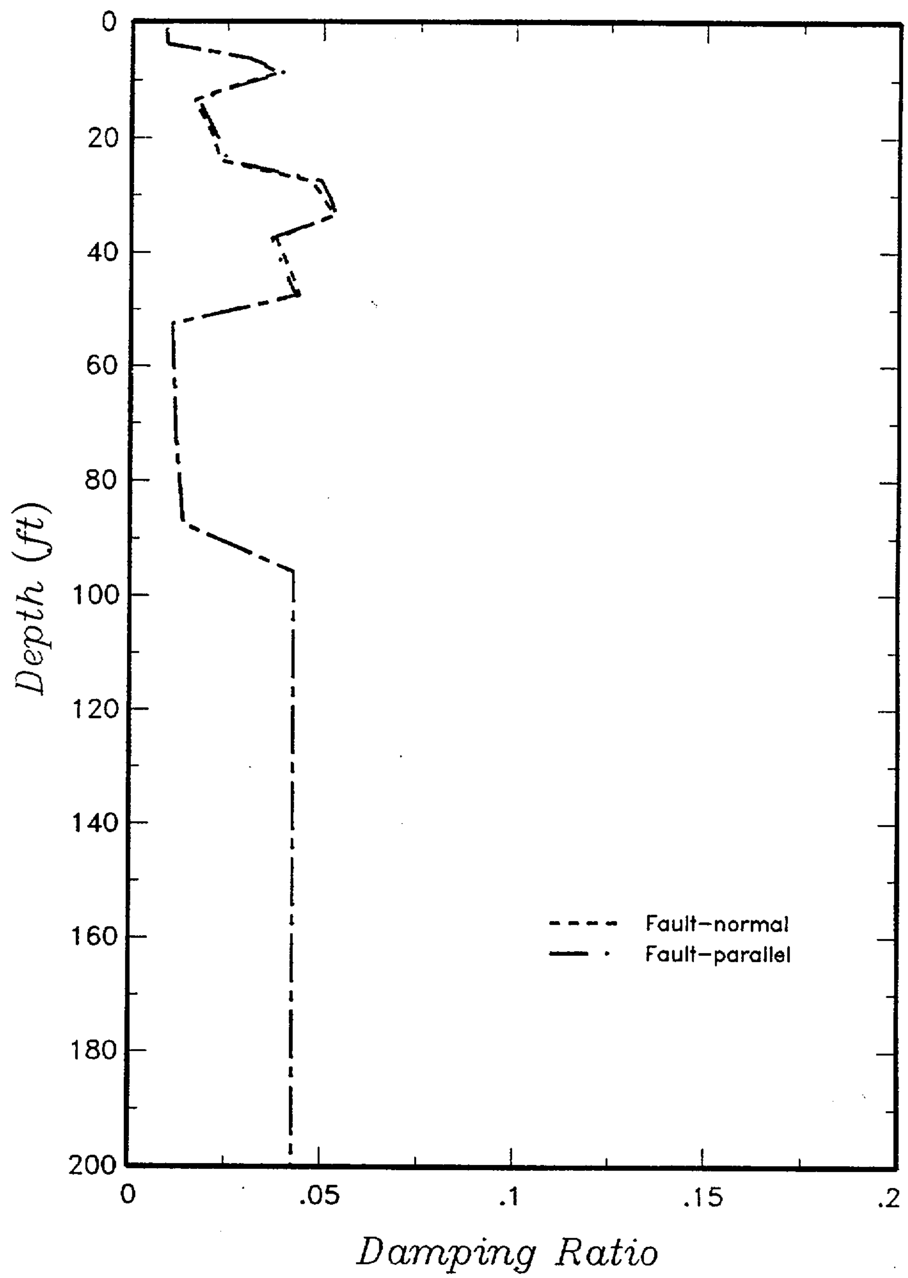
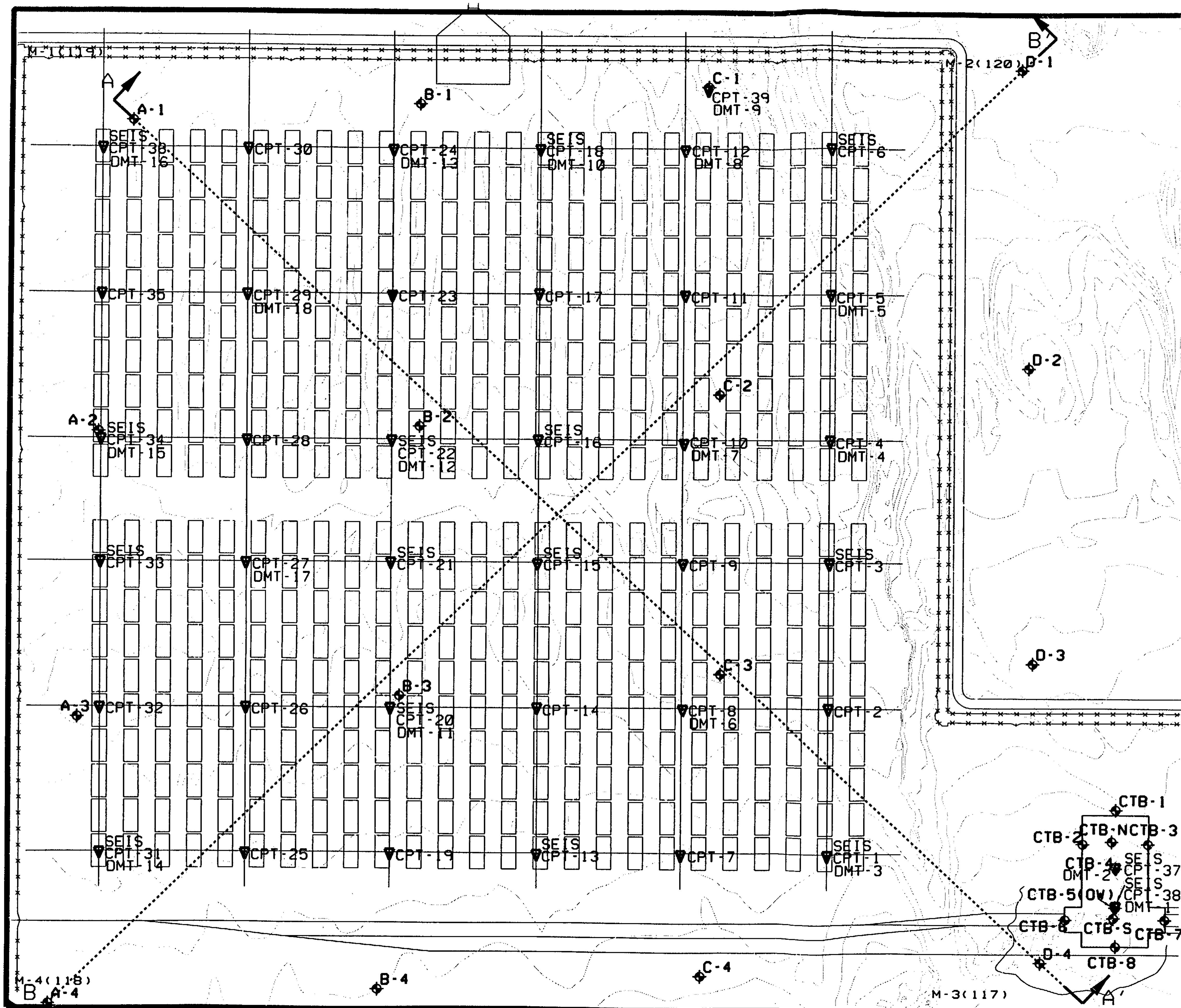


Figure 2.6-8C

STRAIN-COMPATIBLE DAMPING RATIO PROFILE HIGH RANGE PROPERTIES

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

SOURCE: GEOMATRIX CONSULTANTS, INC (2001c)



LEGEND:

CPT-1 / DMT-3 ▼ CONE PENETRATION TESTS AND DILATOMETER TESTS

C-3 ⌖ STONE & WEBSTER BORINGS

M-4(118) ▲ SURVEY CONTROL POINT

0 200 400 FEET

1" = 200'-0"

FIGURE 2.6-12

LOCATIONS OF CONE PENETRATION AND DILATOMETER TESTS

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

REVISION 13

CHAPTER 3

THE FACILITY

3.1 EXTERNAL APPEARANCE

The dominant external features of the Private Fuel Storage Facility (PFSF) are the access road and the storage facility itself. The noticeable features of the storage facility include the storage casks and pads, the Canister Transfer Building, the Administration Building, the Operations and Maintenance Building, the Security and Health Physics Building, light poles, security and access road fences, a storm water detention basin, and earthen berms for flood and storm water diversion. The overall site or owner controlled area (OCA) is approximately 820 acres with the actual storage area or Restricted Area (RA) occupying approximately 99 acres. Figure 2.1-2 shows the overall layout of the PFSF. The general arrangement of the proposed facility is shown in Figure 3.1-1.

The spent nuclear fuel will be stored in cylindrical shaped storage casks which are approximately 11 ft in diameter and 19 ft tall. The casks will be stored on concrete storage pads which are arranged in a rectilinear grid pattern within the facility. Each storage pad is 30 feet wide and 67 feet long and can accommodate up to eight casks. At full capacity the facility will store 4000 casks. The area around the storage pads is surfaced with compacted crushed rock with a gentle slope toward the north to facilitate drainage.

The Administration Building, located at the entrance to the OCA, is a single story steel frame building and is approximately 80 feet wide, 150 feet long, and 17 feet tall. The Operations and Maintenance Building located between the Administration Building and the storage area is a single story steel frame building and is approximately 80 feet wide, 200 feet long and 26 feet tall. The Security and Health Physics Building located at the entrance to the RA, is a single story concrete masonry building and is approximately 76 feet wide, 120 feet long, and 18 feet tall. The Canister Transfer Building is located within the RA and is a reinforced concrete high bay structure and is approximately 200 feet wide, 260 feet long, and 92 feet tall. A general arrangement of the buildings is shown in Figures 3.1-2 through 3.1-5.

The RA is surrounded by an eight foot chain link security fence (w/ barbed wire), a 20 foot isolation zone and an eight foot chain link nuisance fence. A 20 foot wide compacted gravel perimeter road surrounds the RA. The boundary of the OCA is surrounded by a typical 4-strand wire range fence, which will serve to identify the limit of PFSF activities and to keep out any stray livestock. Specifications for the fence, such as wire type and spacing, and pole type and spacing will meet the requirements of the BLM Manual Handbook H-1741-1 for Fencing and/or other applicable requirements identified by the BLM and BIA. PFS will consult with the BLM and BIA prior to construction of the fence to make sure the fence meets the latest BLM/BIA requirements.

The site access road is approximately 2.5 miles long and connects the PFSF with the Skull Valley Road located 1.5 miles from the OCA boundary. The access road is provided with multiple culverts beneath the road to accommodate storm runoff under the road. The access road will be designed with two 15 foot paved lanes to facilitate the potential use of heavy haul tractor/trailer for shipment by highway of spent fuel from the intermodal transfer point to the PFSF. The preferred shipping method is by means of a new rail line. The new rail line will be constructed to connect the PFSF directly to the Union Pacific mainline to facilitate shipment by rail from the mainline railroad to the PFSF. These shipment routes are discussed in more detail in section 3.2.

3.2 FACILITY CONSTRUCTION

The facility will require the removal of vegetation and soil excavation and backfill for construction of the site and access road. Approximately 140 acres of desert shrub/saltbush vegetation will be cleared. This includes the site, which is made up of the cask storage area and buildings within the RA, the storm water detention basin located north of the RA, and the earthen berm located on the west and south sides of the RA. The area for the access road that must be cleared of vegetation is 2.5 miles long and 80 feet wide (approximately 22 acres).

An additional 24 acres (approximately) will be temporarily disturbed during construction, which includes 5 acres for a construction laydown area located south of the site, 2 acres for the installation of the facility septic system, and 17 acres for construction of the access road.

3.2.1 Construction Plan

It is anticipated that the PFSF will be issued a specific license to receive, transfer and possess spent fuel in accordance with the requirements of 10 CFR 72 in spring of 2002. Construction would begin thereafter with construction and preoperational testing completed in time to support operation of the facility in the latter part of 2003.

The following describes the conceptual plan for construction of the PFSF and includes the following components:

- Access Road
- Restricted Area (Storage Area)

- Balance of Facility
- Rail Line or Intermodal Transfer Point

The project will be constructed in three phases. This approach will optimize the resources and schedule required to expedite facility operation and will provide continuous local employment for construction of concrete pads and casks. Phase 1 construction will include all the buildings (Administration Building, Operations and Maintenance (O&M) Building, Security and Health Physics Building, and Canister Transfer Building), the access road, the intermodal transfer point or the new rail line, and the complete southeast quadrant of the Restricted Area. Testing and startup would overlap the latter stages of Phase 1 construction so as to allow commencement of commercial operation in the latter part of 2003.

The remainder of the Restricted Area will be constructed in Phases 2 and 3. Phase 2 will include construction of the pads in the SW quadrant, and Phase 3 will include construction of the pads in the northern half of the Restricted Area. Completion of Phase 2 and 3 will be scheduled to meet the spent fuel storage needs of the nuclear power plants.

A portable, concrete batch plant will be located at the PFSF through the completion of Phase 3 to provide concrete for construction of the storage pads and casks.

3.2.1.1 Access Road

The access road is approximately 2.5 miles long and connects the PFSF with the existing Skull Valley Road located 1.5 miles from the OCA boundary. The access road will be constructed early in the first year of construction to facilitate access to the site for construction equipment, materials, and personnel. Road grading will be performed, large concrete box culverts will be installed, and the PMF diversion berm will be constructed. To minimize damage from the heavy construction equipment required to perform the major site excavation and grading, the roadway will initially be constructed with a gravel surface. After completion of the major site earthwork, the access road will be paved with asphalt.

3.2.1.2 Restricted Area

The RA includes the Canister Transfer Building, the Security and Health Physics Building, and the cask storage pads. The Canister Transfer Building is a large, concrete structure and the Security and Health Physics Building is a one-story, concrete-block building. The RA occupies approximately 99 acres and provides for a total of 500 concrete cask storage pads which are capable of supporting a total of 4000 storage casks.

As described previously, construction of the RA will be performed in 3 phases. The phases are further described below:

Phase 1 is divided up into 3 periods: Period 1 is to last 2 months, Period 2 is to last 7 months, and Period 3 is to last 9 months. The objective of Phase 1 is to provide an operational facility with a portion (25%) of the storage pads completed. Phase 1 construction will include completion of the Canister Transfer Building (Period 2), the Security and Health Physics Building (Period 2), and one quarter of the storage pads

(130 total) located in the southeast quadrant of the RA (Periods 2 & 3). Phase 1 construction also includes the Administration Building (Period 3) and the Operations and Maintenance (O&M) Building (Period 3). The southwest quadrant will be rough graded (Period 2). The storm water detention basin and PMF diversion berm on the south and west sides of the RA will also be constructed (Period 2). The site drainage from the southeast and southwest quadrants will be channeled to the detention basin by means of a rockfill ditch. Yard lighting, duct banks, grounding, security fences, perimeter intrusion detection system and perimeter road will be completed for the southeast quadrant. The duration of Phase 1 construction is approximately 18 months.

The objective of Phase 2 is to provide additional storage capacity to the operating facility by adding the second 25 percent of the storage pads. Construction in the southwest quadrant (Phase 2) will be performed while the storage pads in the southeast quadrant are being loaded with casks, and will be completed before all of the Phase 1 casks are in-place. When all of the pads are constructed in the southwest quadrant, the Phase 1 security fence, perimeter road, and perimeter intrusion detection systems will be extended to include the Phase 2 area. Planned to commence with the start of operations, the duration of Phase 2 construction is approximately 5 years.

The objective of Phase 3 is to provide additional storage capacity to the operating facility by completing the remaining 50 percent of the storage pads. Construction of the northern half of the RA (Phase 3) will be performed while the Phase 2 (southwest quadrant) pads are being loaded with casks, and will be completed before all of the Phase 2 casks are in-place. When all of the pads are constructed in the northern half of the RA, the security fence, perimeter road, and perimeter intrusion detection systems will be extended to include this area. Planned to commence with the completion of Phase 2, the duration of Phase 3 construction is approximately 5 years.

3.2.1.3 Balance of Facility

The Balance of Facility is made up of the O&M Building and the Administration Building, both of which are single story steel frame buildings with pre-fabricated (insulated) metal siding and roofing panels. Construction of these two buildings will take place during Phase 1, Period 3. Parking areas around the O&M Building and the Administration Building are surfaced with asphalt or concrete pavement.

3.2.1.4 Intermodal Transfer Point/Skull Valley Road

The intermodal transfer point (if required) will be located 1.8 miles west of the intersection of Interstate highway 80 and Skull Valley Road at the mainline Union Pacific Railroad approximately 24 miles north of the PFSF (Figure 3.2-1). At the intermodal transfer point there will be a short rail siding and a pre-engineered metal building, which will house a gantry crane for cask transfer. An access road will be provided to connect the intermodal transfer point to the frontage road which runs along the north side of Interstate highway 80.

Although the site is nearly level, rough grading will be required to level the site. Excavation will be required for installation of the mat foundation for the gantry crane and enclosure. The enclosure will be a pre-engineered metal building approximately 80-ft. wide by 100-ft. long and 54-ft. high. The access road will be an asphalt-paved private road approximately 30-ft wide and 400-ft. long.

The equipment at the intermodal transfer point (if required) will be constructed during Phase 1 to support testing and startup of the PFSF.

3.2.1.5 Low Corridor Rail Line

A new rail line, the preferred transportation method, will be constructed by the PFSLLC to connect the PFSF directly to the Union Pacific mainline railroad at Low. The rail line will be approximately 32 miles long and will originate from the mainline on the south side of Interstate highway 80 at Low (Figure 3.2-2). From the mainline at Low, the rail line will proceed southeast parallel to Interstate highway 80 for approximately 3 miles, then turn south along the western side of Skull Valley for approximately 26 miles, and then turn east for approximately 3 miles to the PFSF. The rail line will consist of a single track installed on undeveloped public rangeland administered by the BLM.

Construction activities will begin at Low Junction where excavation will be required to connect the new line to the existing mainline railroad and to provide the required sidings. The existing grades are elevated where the railroad and interstate highway cross the north end of the Cedar Mountains. The mainline is depressed beneath the two Interstate highway 80 overpasses at Low Junction. The excavated soils will be stockpiled for use as fill for rail line construction in Skull Valley.

Construction of the rail line beyond the Low Junction will be on the relatively flat terrain of Skull Valley. Approximately 65 dry arroyos cross the transportation corridor. Sufficient culverts will be provided in the design to facilitate drainage from these arroyos and to allow passage of the 100-year flood. Construction will begin with clearing and grubbing activities as necessary to accommodate a 40 ft wide rail bed. The upper 6-in. of soil (topsoil) will then be excavated for a width of approximately 10-ft. (5-ft. on both sides of rail line centerline) and stockpiled for later use. The roadbed will be proof-rolled and backfilled with 1-ft. of compacted fill material (excavated or imported). A minimum of eight inches of sub-ballast will be placed on the prepared surface. The ties and rail will be laid on top of the sub-ballast and a rail construction machine will travel along the previously laid track and install the remaining crushed gravel or rock ballast (approximately 8 inches) beneath and around the wooden ties. The construction machine will also attach the rails to the ties using spikes and tie plates. The rail will be spliced with bolts for ease of assembly.

Construction of the new rail line will take place during Phase 1 to support testing and startup of the PFSF.

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FIGURE WITHHELD AS SENSITIVE
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Figure 3.1-5

CANISTER TRANSFER BUILDING

PRIVATE FUEL STORAGE FACILITY
ENVIRONMENTAL REPORT

other nearby suitable habitats. Prior to construction, a comprehensive wildlife survey should be conducted to assure that no sensitive or endangered species are nesting (or denning) within 0.5 mile of the PFSF site. If any animals are located, mitigation plans such as construction timing restrictions should be implemented and alternative nest (or den) site locations should be established in consultation with the BLM, UDWR, and FWS to offset the loss of these sites due to construction.

The proposed construction activities that will be likely to cause the most disturbance to wildlife (due to noise, land disturbance, and general human activity) will occur mostly in the first construction phase. These activities include grading the first portion of the RA, installing yard lighting, duct banks and grounding, and constructing all buildings, the access road, PMF berms, detention basin, perimeter road, security fence, all of the southeast quadrant storage pads, and clearing vegetation to a distance of 300 ft out from the perimeter road and planting crested wheat grass for the fire barrier. As a result, most of the construction impacts on wildlife discussed above will occur in the first construction phase. Subsequent construction activities in the second and third construction phases will consist of grading and constructing the remaining storage pads, along with the operation of the portable concrete batch plant. Construction lighting is also likely to contribute to wildlife disturbance. The impacts on wildlife will lessen as the level of construction related activities is reduced and wildlife should repopulate the area shortly thereafter.

Increased traffic on Skull Valley Road during construction and project operations could result in temporary minor impacts on wildlife that frequent the road area by altering individual behavioral patterns for some species (including mule deer, black-tailed jack rabbits, and pronghorn antelope) and increasing rates of carrion. Section 4.1.7 discusses the anticipated increases in traffic volumes. Increased traffic will be greatest during the first construction season (as shown in table 4.1-3) with an increase in the Average Daily Traffic (ADT) on Skull Valley Road south of Iosepa from 325 to 735 vehicles per day for Phase 1, Period 1 (2 months); an increase from 325 to 647 vehicles per day for Phase1, Period 2 (7 months); and an increase from 325 to 615 vehicles per day for Phase 1, Period 3 (9 months).

Traffic during the latter two construction phases (Phase 2 (5 years) and Phase 3 (5 years), excluding December, January, and February of each year), will decrease from peak construction levels to an ADT of 545 vehicles for both phases. These numbers include traffic from facility construction and operational staff as well as ongoing construction activities. Individual resident wildlife are likely to adjust to these changes and will resume more preconstruction activities and behaviors as construction traffic decreases. Although local population levels could potentially be reduced for some species in the first few years of construction, no long-term impacts on fecundity or population levels are expected. Some wildlife species may experience a temporary increase in population levels in the first few years of construction. Species such as coyotes or carrion-feeding raptors may be attracted to the Skull Valley Road due to the increased likelihood of carrion.

Consultation with the Utah Division of Wildlife Resources (UDWR) and the U.S. Fish and Wildlife Service (USFWS) indicates that, except for transient, infrequent occurrences, there are no state or federally-listed threatened or endangered wildlife species known to occur within the proposed site boundary or access road (letters from, USFWS, Utah Field Office, dated February 10, 1997, February 27, 1997, July 31, 1998 and UDWR, 1997). Threatened or endangered species that may occasionally occur in the area, including bald eagle or peregrine falcon, will not be affected by vegetation removal since only a small portion of available prey habitat is affected and these species do not perch or roost in the vicinity of the project facilities.

The U.S. Forest Service (USFS) stated that increased traffic along Skull Valley Road from construction and operation of the facility could have an effect on bald eagles feeding on carrion along the road (letter from K. Clapier, Kamas Field Office, USFS to S. Davis, SWEC, January 27, 1997). According to the Stansbury Mountains Habitat Management Plan (BLM, 1990), traditional bald eagle hunting and roosting areas occur in southern

Skull Valley. However, the nearest roost is approximately 10 miles south of the site, and the nearest high-use foraging area is almost 20 miles to the south. Construction of the project facility is, therefore, not likely to have an adverse impact on bald eagles during construction or operation. In fact, increased traffic could result in additional carrion on Skull Valley Road, thereby providing an additional source of food for eagles.

Peregrine falcons may travel more than 18 miles from the nest site to hunt for food, however, a 10-mile radius around the nest is an average hunting area, with 80 percent of foraging occurring within a mile of the nest (letter from K. Clapier, Kamas Field Office, USFS to S. Davis, SWEC, January 27, 1997). Since the only known peregrine falcon nest site is located in the Timpie Springs Waterfowl Management Area approximately 24 miles north of the site, any peregrine falcon occurrence around the site will, therefore, be unusual and infrequent. The 10-mile radius frequented by the peregrine falcons will include, however, the northern-most part of Skull Valley Road. There will be increased traffic on this road during construction and operation. The construction traffic will not travel near the nest location and the increased construction traffic will be temporary. Migratory peregrines are also not likely to be affected by increased construction traffic. Overall, the construction of the site is unlikely to have any impact on peregrine falcons.

The Skull Valley pocket gopher is not protected as a state or federally listed threatened or endangered species. However, this endemic gopher is a “high interest” species in the state and is a BLM sensitive species. It has been documented south of the project and could be found on the project area. UDWR (1997) requests that a survey of gopher mounds be conducted and surface disturbance within 100 feet of any burrow be avoided to protect this species. To accommodate the UDWR request, surveys will be conducted shortly before construction in consultation with UDWR. All appropriate protection and mitigation measures will be taken to mitigate construction effects on the pocket gopher.

The UDWR has requested (1997) that if project construction inadvertently unearths a snake den, a critical valued use area, UDWR's Central Region Habitat Manager should be contacted so that the animals can be relocated to an appropriate alternate habitat in the region. Additionally, to avoid impacts on protected raptor nests, UDWR requests that a survey be conducted shortly prior to construction to identify any nesting locations. Surveys will be conducted in consultation with UDWR, and appropriate protection and mitigation measures will be developed to mitigate construction effects on raptor nests near the project facilities.

Erosion control methods during construction will consist of silt fencing and hay bales on the downstream side of drainage's. Construction dust will be controlled using methods that are in accordance with state, local, and federal laws.

4.1.3 Effects on Air Quality

Air quality related impacts associated with the construction of the PFSF will be comprised mainly of gaseous pollutant emissions from diesel-powered construction equipment and fugitive dust emissions from excavation activities and construction equipment travelling on paved and un-paved roads (dump trucks, cement trucks, watering trucks, bulldozers, graders, scrapers, front end loaders, and back hoes). A concrete batch plant will also be a source of fugitive dust emissions. There will also be pollutant emissions from private vehicles driven by the construction labor force estimated to be no more than 130 workers at any given time. These types of emissions will have only very localized impacts. Construction air quality impacts are usually mitigated to the extent that potential offsite nuisance conditions (or a condition of air pollution) are prevented.

Although not applicable to construction of the PFSF (see Chapter 9), the Utah Department of Environmental Quality (DEQ) regulations for fugitive dust generated by construction activities (R307-12.3) requires any person engaged in clearing or leveling land over 1/4 acre, earthmoving, excavation, or movement of trucks over cleared land greater than 1/4 acre in size or access haul roads to take steps to minimize dust emissions. The DEQ regulations have no specific provisions for quantifying construction impacts. Dust control techniques may include watering and/or chemical stabilization of potential dust sources. Other techniques that will be used to control fugitive dust emissions include covering materials being hauled from the site by truck and by employing routine washing of trucks. Dust emissions from anticipated concrete batch plant operations will also be mitigated through the use of enclosures, hoods, shrouds, and water sprays. Gaseous emissions from construction equipment are mitigated typically by requiring regular maintenance of equipment.

Communications with local a supplier indicates that the estimated quantity of asphalt paving to be placed at the facility does not justify locating a batch plant onsite.

Annual estimates of air pollutant emissions due to construction activities are provided in Table 4.1-4 on the basis of estimates of material usage (e.g., cubic yards of concrete) during Phase 1 construction, and reasonable assumptions regarding construction vehicle mileage and hours of operation during this construction phase. Annual air pollutant emissions associated with Phase 1 are bounding, and annual emissions during construction Phases 2 and 3 would be less. Emissions estimates are provided for fugitive dust emissions (PM10) from clearing and excavation activities as well as from the concrete batch plant. Gaseous criteria pollutant emissions (SO_2, NO_x, CO, VOC) from vehicular traffic (NO_x, CO, and VOC) are also provided. All of the construction activities are conservatively assumed to be occurring simultaneously during any given construction month for purposes of these emissions estimates. The emission factors used in the estimates for construction activities are taken from the 5th edition of EPA's AP-42 document (EPA 1995a) assuming reasonable levels of emissions control as needed to satisfy DEQ requirements. Vehicle emissions are derived from the latest version of EPA's MOBILE5b emissions estimating model (EPA 1996).

The plant wide controlled PM-10 emission factor (E) for concrete batching is taken from Section 11.12, Table 11.12-3 of AP-42 and is expressed as 0.12 pound per cubic yard of concrete produced. It is conservatively assumed that all of the concrete required to be produced for Phase 1 facility construction (having a scheduled duration of 18 months), estimated at 54,068 cubic yards of concrete, is produced in one year yielding 3.2 tons of PM-10 emissions per year or 0.27 ton per month.

The potential impact of these construction related pollutant emissions on ambient concentrations in public areas has also been assessed using the EPA

SCREEN3 screening level dispersion model (EPA 1995b). This model calculates ground level concentrations of pollutants emitted from both point and area sources as a function of downwind distance utilizing either a standard matrix of meteorological conditions designed to produce worst case impacts or user input meteorological conditions. For fugitive dust impact estimates, the neutral atmospheric stability class (D stability) and a wind speed of 5 meters per second is assumed to be a representative combination of conditions causing dusting. General construction activities such as excavation and other fugitive dust sources are represented as area sources while emissions from the concrete batch plant are treated as a point source. Ambient pollutant concentrations are calculated at two locations where the general public could be impacted: the closest point from the facility to Skull Valley Road; and at the Goshute Village, located approximately 3.5 miles from the site.

Based on estimated quantities of required concrete and information from local concrete suppliers, the concrete batch plant would be sized for a maximum capacity of 75 yd^3 per hour. The batch plant and material storage for this capacity would require a footprint area of approximately 300-ft. x 300-ft., or approximately 2 acres. The specific location for the batch plant on the PFSF site would be determined during the construction planning phase of the project, but it will likely be sited North of the Canister Transfer Building on the Eastern side of the storage area. The batch plant location would be provided with controls, e.g., perimeter berm and drainage retention, to mitigate any environmental effects on the immediate area.

Emissions from the concrete batch plant are treated as point sources. One-hour concentrations calculated by SCREEN3 are adjusted to 3-, 8-, and 24-hour average concentrations using the factors 0.9, 0.7, and 0.4, respectively. The annual average adjustment factor used is 0.05.

The concrete batch plant PM-10 emissions are assumed to be released from a height of 20 feet above ground level. Annual pollutant emissions are based on an assumed 2,200 hours per year of operation of the concrete batch plant.

4.1.5.2 Excess Materials Resulting from Construction Activities

The construction of the PFSF site only generates material during stripping operations. The 121,000 cubic yards of material produced will be used to construct the PMF berm and used as slope dressing on the access roads and perimeter roads. Again, this will help stabilize the slopes by promoting the growth of vegetation and increase the stability of the slopes by flattening them. No material will be disposed of off site.

Construction of the PMF berms (with elevation and side slopes as shown on PFSF drawings) will require approximately 55,000 cubic yards of material. The excess 66,000 cubic yards of material (121,000 CY – 55,000 CY) from the stripping operations will be used to increase the width of the PMF berms and to flatten the slopes of the PMF berms, access roads and perimeter roads, and to fill the area between the PMF berm and the storage facility. The type and quantity of required imported materials necessary for construction of the rail line, ITP, and the PFSF site are provided in Table 4.1-6.

The soil cement will be constructed and placed in the cask storage area by quadrants. The SE quadrant will be placed during Phase 1, along with soil cement around the foundation mat of the Canister Transfer Building. The SW quadrant during Phase 2, and the northern half of the cask storage area during Phase 3. The soil cement will be produced and placed in each quadrant of the cask storage area as follows:

> Excavate all the eolian silt in the quadrant and stockpile locally. Grade the area to an elevation approximately 2 ft beneath the elevations of the bottoms of the concrete storage pads. Mix the eolian silt with cement and water and place over the cask storage pad area in approximate 6-inch lifts until the entire area is covered to the level determined for the bottoms of the storage pads, with the depth of soil cement not to exceed 2 ft. Construct the cask storage pads on top of the soil cement. Mix and place soil cement in approximate 6-

inch lifts around and between the cask storage pads, up to a level 28 inches above the bottom of the storage pads. The remaining 8 inches up to grade, even with the tops of the pads, is filled with compacted coarse aggregate. This method avoids excavation of the soil cement to place the concrete for the cask storage pads and may result in excess eolian silt.

Soil cement will surround the foundation mat of the Canister Transfer Building. The lower elevation of the soil cement will be at the same elevation as the bottom of the foundation mat, a depth of approximately 5 ft below grade. The soil cement will extend out from the building to a distance equal to the associated foundation mat dimension, i.e. approximately 240 ft out from the mat in the east and west directions, and approximately 280 ft out in the north and south directions. The soil cement will be produced and placed in the area bordering the Canister Transfer Building basemat as follows:

Excavate the eolian silt and other soil to a depth of approximately 5 ft around the foundation mat of the Canister Transfer Building (which is 5 ft thick). Mix the eolian silt and other soil with cement and water and place it over the designated area in approximately 6 inch lifts until the entire area is covered with soil cement to a depth of 4 ft, 4 inches. The remaining 8 inches up to grade is filled with compacted coarse aggregate.

Excess material (such as eolian silt) will be used on site. No material will be disposed of off site.

4.1.6 Effects on Socioeconomics

Local employment will increase during the extended construction phase of the proposed project. During the initial construction phase, an estimated 130 workers will be required for various tasks related to project development. Table 4.1-1 shows the anticipated breakdown by labor categories and the projected level of effort for each trade required for this project. During subsequent construction phases 2 and 3 an estimated work force of 43 persons will be required to continue activities associated with site earthwork and concrete finishing as the remaining portions of the facility are developed (Table 4.1-2).

As of 1991, there were 10,219 jobs in Tooele County (Tooele, 1995). The area supported some 780 construction jobs and another 2,804 manufacturing positions (Census 1993). Because of this abundant local labor force, the construction work force is expected to be drawn from Tooele County and the Salt Lake City metropolitan area. It is anticipated that these workers will be current residents of these communities who will commute daily to the project site. Consequently, project construction will not induce the in-migration of families with school-age children, and there will be no impact on housing availability, schools, or levels of other government services.

The Salt Lake City region of Utah in which the PFSF site is located has had more than an adequate supply of skilled construction personnel to meet the area's needs in recent years and there is no indication that critical skill shortages will appear in the near future. Commercial construction has flourished recently which has, in turn, increased the number of construction workers in the area. According to the Utah Building and Construction Trades Council, the major venues for the 2002 Winter Olympics, hosted in Salt Lake City, have already been built with only the construction of private facilities to be completed before 2002. A continuation of this construction boom is anticipated for the next two years until the onset of the 2002 Winter Olympics. The construction trades work force has been rapidly growing to meet the upswing in demand, and the PFSF project will be positively impacted by this job market expansion.

In addition to construction activities for the Olympics, over $1 billion in highway construction projects are currently underway in the state. These projects are expected to peak in the year 2000. As the need for labor on the highway projects declines, there will be a surplus of construction workers skilled in the civil trades.

The earnings of local construction personnel and the spending of construction-related salaries at local retail and service establishments in the Tooele County area will benefit the local economy. In addition, it is expected that the project will purchase some equipment and much of the construction materials required for structural fill and concrete aggregate from local suppliers, thereby providing additional economic benefits during the extended 21-year construction period (11-12 years for phases 1, 2, and 3 facility construction, with storage cask construction continuing out to about 21 years).

The determination of daily quantities of material traveling to or from the site was based on the estimated quantity for given tasks in the project schedule, divided by the number of work days included in the task, and the anticipated size of the trucks to be used (20 CY), to arrive at the average daily traffic volume. The material quantities were increased by a factor of 10 percent to reflect the fact that granular materials will expand in volume and a truck full of rock will have voids. It should be recognized that the numbers shown are averages, and that some days will have higher traffic volumes while others will have less depending on the actual timing of specific activities.

A concrete batch plant will be located onsite to provide concrete to the project and allow for a reduction in the number of concrete trucks that will have to use public roads. However, because the onsite materials are not suitable for concrete aggregate, these materials will be brought to the site from a quarrying operation located in Tooele County. The material volumes estimated below for traffic level purposes include both structural fill and concrete aggregate for a total constructed material volume.

4.1.7.1 Construction Phase 1

The initial construction period of this phase will include construction of the site access road, soil stabilization of the southeast quadrant of the cask storage pad area by mixing cement with the upper layer of soil, the access road flood diversion berm, and initial grading and excavation for the Administration Building and the Operation and Maintenance Building. These activities will take approximately 2 months (52 working days) to complete. These construction activities will require the transport of approximately 53,599 CY of solid material over the 52 day period per Stone & Webster Calculation No. 05996.01-SY-7, Rev. 5. In addition, it is estimated that there would be 36 water truck trips per day (supply and return, assuming 7,500 gallon water truck capacity) for the first six weeks, and 10 water truck trips per day over the remainder of the period. Including a 10 percent expansion factor for the solid material to accommodate void space and assuming a 20 CY truck capacity, these activities will require an estimated average of 150 truck trips per day or 15 vehicles per hour to transport the required volumes for construction of these project elements over the first six weeks, and 124 truck trips per day or 12 truck trips per hour for the remainder of the period.[1]

During the second period of this phase (7 months), the storage facility will be leveled to final grade. Additional construction activities will include construction of the first half of the concrete storage pads in the south-east quadrant, the site flood diversion berm and storm detention basin, the Canister Transfer Building, and the Security and Health Physics Building. These activities will require the transport of approximately 77,869 CY of solid material over the 7 month period per Stone & Webster Calculation No. 05996.01-SY-7, Rev. 5. In addition, it is estimated that there would be 14 water truck trips per day (supply and return) for the first five months, and 6 water truck trips per day over the remainder of the period. Including the solid material expansion factor, these activities will require an estimated average of 62 truck trips per day or 6 vehicles per hour over the first five months, and 54 truck trips per day or 5 truck trips per hour for the remainder of the 7 month period.

During the third period of this first construction phase (9 months), the Administration Building and the Operation and Maintenance Building will be completed as well as the remaining concrete storage pads in the south-east quadrant. These activities will require the transport of approximately 40,014 CY of solid material over the 9 month period per Stone & Webster Calculation No. 05996.01-SY-7, Rev. 5. In addition, it is estimated that there would be 10 water truck trips per day (supply and return) for the first two months, and 6 water truck trips per day over the remainder of the period. Including the solid material expansion factor, these activities will require an estimated average of 30 truck trips per day or 3 vehicles per hour over the first two months, and 26 truck trips per day or 3 truck trips per hour for the remainder of the 9 month period.

[1] A truck trip, or vehicle trip, is defined as a single or one direction vehicle movement. Therefore, a vehicle arriving and departing the site constitutes 2 vehicle trips.

Site preparation and facility construction will affect traffic and noise levels along Skull Valley Road. In addition to material and equipment deliveries, a peak construction labor force of 130 workers is projected. It is anticipated that workers will commute to and from the construction site on a daily basis utilizing individual passenger vehicles and light trucks. These workers will increase the ADT on Skull Valley Road south of the settlement of Iosepa from 325 to 585 trips. Trucks carrying fill material and water will add another 150 trips during the first period of Phase 1, increasing the ADT to 735 trips (Table 4.1-3). This anticipated additional traffic volume will lower the level of service (LOS) on Skull Valley Road from A to B.[2] This reduction in LOS results from delivery trucks moving at a slower rate of speed (estimated at 40 mph) than the posted limit of 55 miles per hour, requiring other traffic to reduce travel speed or make additional passing maneuvers. The LOS change is not significant and will not affect emergency response time for public safety vehicles. The second and third periods of the first construction phase will have less impact. The ADT resulting from construction activities during the second period of the first construction phase is estimated to be 647 for the first five months, and 639 for the remaining two months. The ADT resulting from construction activities during the third period of the first construction phase is estimated to be 615 for the first two months, and 611 for the remaining seven months (see Table 4.1-3).

Additional traffic volumes will also affect traffic generated noise levels. Noise levels are reported in units of Leq, which is the energy average sound level. During the first construction period of Phase 1 the average peak-hour traffic volume will increase to 134 trips and the traffic generated sound level (between Iosepa and Route 199) will increase by 5 dBA over the pre-construction levels to approximately 72 dBA at a distance of 50

[2] Level of service (LOS) is defined as a qualitative measure that represents the collective factors of speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating costs provided by a highway facility under a particular volume condition. There are six levels of services, A through F. Level A is the highest quality of service. There is little or no restriction on maneuverability or speed caused by other traffic. Level F is the lowest. Level B is a zone of stable flow where operating speed is beginning to be affected by other traffic.

feet. During the latter two periods of this construction phase the average peak-hour volume will increase to 125 vehicle trips and 122 vehicle trips, respectively, and traffic-generated sound levels will increase during both periods from the existing sound level of 67 dBA to approximately 71 dBA at a 50 ft distance.

In general, the land along the Skull Valley Road corridor is undeveloped and is therefore included within activity Category D under the Federal Highway Administration (FHWA) Design Noise Level guidelines. FHWA prescribes no upper level design noise limits for activities within Category D areas. There are, however, at least two residences along Skull Valley Road within 50 feet of the road. These two homes will experience a sound level of 72 dBA during the daytime working shifts. This level is 5 dBA higher than FHWA guidelines for category B (67 dBA exterior noise level for residences), but, because of the undeveloped nature of Skull Valley, only minor noise impacts are anticipated.[3]

4.1.7.2 <u>Construction Phase 2</u>

During this phase, the southwest quadrant of the storage facility will be constructed. These activities take approximately 5 years to complete. Construction activities (casks excluded) will require approximately 57,826 CY of solid material to be transported to the site over the 45 month construction period (no construction is assumed during the three winter months of Dec – Feb) per Stone & Webster Calculation No. 05996.01-SY-7, Rev. 5. In addition, it is estimated that there would be 36 water truck trips per day (supply and return) for the first six weeks of phase 2 construction, and 2 water truck trips over the remainder of the period. During

[3] The FHWA has established four activity categories, A through D for recommended exterior, upper limits for acceptable highway traffic noise levels. The upper level for Category A, for lands on which serenity and quiet are of extraordinary significance and are to be preserved, is 57 dBA. The upper level for Category B, for lands including residences, picnic and recreation areas, schools, churches, hotels, libraries, and hospitals, is 67 dBA. The upper level for Category C, for developed lands and properties not covered by A and B, is 72 dBA. There is no upper level for Category D, undeveloped land.

phase 2 construction of the storage pads in the southwest quadrant, storage casks will be constructed for storage of fuel in the southeast (phase 1) storage area. Each cask requires approximately 47 CY of material to be supplied to the PFSF, by truck or rail. Assuming construction of 200 casks per year and truck delivery of cask materials, approximately 9,400 CY of material would be required annually, supplied by 517 trucks. Based on construction taking place 9 months per year, with 22 work days per month, about 6 truck trips per day would be required for storage cask construction.

Including the solid material expansion factor and accounting for materials for construction of storage casks, these activities will require an estimated average of 50 truck trips per day or about 5 vehicles per hour over the first six weeks, and 16 truck trips per day or about 2 truck trips per hour for the remainder of the 5 year construction period.

A construction labor force of 43 workers is estimated for this phase. An additional 84 vehicle trips will be generated by the operational labor force. The ADT resulting from construction activities during the second phase of construction is estimated to be 545 for the first six weeks, and 511 for the remainder of the 5 year construction phase (Table 4.1-3). The additional traffic will not affect the LOS on Skull Valley Road. The average peak-hour volume will increase to 102 vehicle trips for the first 6 weeks of phase 2 construction and result in an increased traffic generated equivalent sound level between Iosepa and Route 199 of 2 dBA to 69 dBA at 50 ft. This level is 2 dBA higher than FHWA guidelines for category B (67 dBA exterior noise level for residences), but, because of the undeveloped nature of Skull Valley (only 2 residences within 50 ft of the roadway) no significant noise impacts are anticipated from this minor increase in sound levels.

4.1.7.3 Construction Phase 3

During this phase, the remainder of the storage facility will be constructed, consisting of the two northern quadrants. These activities will take approximately 5 years to complete. Construction activities (casks excluded) will require approximately 110,807 CY of solid material to be transported to the site over the 45 month construction period (no construction is assumed during the three winter months of Dec – Feb) per Stone & Webster Calculation No. 05996.01-SY-7, Rev. 5. In addition, it is estimated that there would be 30 water truck trips per day (supply and return) for the first twelve weeks of phase 3 construction, and 2 water truck trips per day over the remainder of the period. During phase 3 construction of the storage pads in the two northern quadrants, storage casks will be constructed for storage of fuel in the southwest (phase 2) storage area. As discussed for phase 2, about 6 truck trips per day would be required to supply materials for storage cask construction. Including the solid material expansion factor and accounting for materials for construction of storage casks, these activities will require an estimated average of 50 truck trips per day or about 5 vehicles per hour over the first twelve weeks, and 22 truck trips per day or about 2 truck trips per hour for the remainder of the 5 year construction period.

A construction labor force of 43 workers is estimated for this phase. An additional 84 vehicle trips will be generated by the operational labor force. The ADT resulting from construction activities during the third phase of construction is estimated to be 545 for the first twelve weeks, and 517 for the remainder of the 5 year construction phase (Table 4.1-3). The additional traffic will not affect the LOS on Skull Valley Road. The average peak-hour traffic volume will increase to 102 vehicle trips for the first 12 weeks of phase 3 construction and result in an increased traffic generated equivalent sound level between Iosepa and Route 199 of 2 dBA to 69 dBA at 50 ft. This level is 2 dBA higher than FHWA guidelines for category B (67 dBA exterior noise level for residences), but, because of the undeveloped nature of Skull Valley (only 2 residences within 50 ft of the roadway) no significant noise impacts are anticipated from this minor increase in sound levels.

Construction equipment used during the three construction phases will generate site construction noise. Equipment will consist of scrapers, bulldozers, dump trucks, compactors, graders, front-end loaders, cement trucks, water trucks, asphalt trucks, loaded on the SE quadrant of storage pads beginning on the eastern side and advancing toward the west. This sequence maximizes the distance between the personnel constructing the Phase 2 pads and the casks being placed in the SE quadrant (from east to west) to minimize potential radiation exposure to workers. Stone & Webster Calculation No. 05996.02-UR(D)-11 Revision 1 estimates an annual dose of 23 mrem/yr for Phase 2 pad construction activities to an individual construction worker, assuming all storage casks are HI-STORM casks.

Phase 3 pad construction (northern half of the Storage Facility) will be performed while the Phase 2 (SW quadrant) pads are being loaded with casks, and will be completed before all of the Phase 2 casks are in place. Phase 3 pad construction will utilize a different sequence than that used for Phases 1 and 2 in order to assure dose rates to storage pad construction workers are as low as is reasonably achievable (ALARA). Phase 3 storage pad construction will begin in the NW quadrant, with pad construction beginning at the south end and moving north. During Phase 3 construction, storage casks will be loaded on the SW quadrant of storage pads (which were constructed during Phase 2) beginning on the south side and advancing toward the north, maximizing the distance of pad construction workers in the NW quadrant from loaded storage casks in the SW quadrant. Following completion of the storage pad construction in the NW quadrant, workers will construct storage pads in the NE quadrant, again starting at the south end and moving north.

Phase 3 pad construction is scheduled for 5 years. It is assumed that construction of the NW quadrant pads will take place during the first 2.5 years, and construction of the NE quadrant pads during the next 2.5 years. Stone & Webster Calculation No. 05996.02-UR(D)-11 Revision 1 estimates an annual dose of 189 mrem/yr for Phase 3 NW quadrant pad construction activities to an individual construction worker, assuming all storage casks are HI-STORM casks. As for the NE quadrant pad construction, the referenced calculation estimates worker doses of 345 mrem/yr, assuming all storage casks are HI-STORM casks. This dose is higher than those associated with pad construction in the previous quadrants since the SE quadrant would be fully loaded with casks throughout the period of pad construction in the NE quadrant, and construction of pads at the south end of this quadrant places construction workers relatively close to casks in the SE quadrant. ALARA measures will be taken to reduce this dose, such as placement of cooler storage casks along the north side of the SE quadrant array of storage casks.

During the early stages of the project, construction activities would be likely to keep many species, especially raptors, away from the area. However, as casks are installed and activity moves to a different area, wildlife could move into the established areas.

Nevertheless, if left undeterred wildlife may exist inside the fenced areas of the PFSF and around the casks. Therefore to restrict habitation, PFS will monitor any wildlife activity onsite and will take measures to prevent habitation. Animal deterrent devices will be employed to keep all wildlife from being within the area for any length of time. A chain link fence, 8 ft high and embedded 1 ft into the ground, will be installed around the perimeter of the storage pads to prevent large wildlife such as deer antelope, coyotes, fox, rabbits, etc. from entering the area. If birds are found to be perching and/or nesting around or on the casks, and the potential exists for the birds to accrue doses in excess of PFSF's 100 rem/yr criteria for wildlife (Section 4.2.9.2.2), deterrent devices such as cones or spikes will be installed to prevent this from happening. Small mammals and reptiles will also be kept from remaining in the cask area, using traps if necessary. Furthermore, the entire area will be surveyed frequently by facility workers. If any permanent signs of wildlife are found, actions will be taken immediately to remove the animals.

Operational noise resulting from the human activity/traffic and operation of the concrete batch plant and other equipment could also have a limited effect on wildlife. Some individuals that are particularly intolerant of human presence are likely to avoid the immediate area. Operational noise is likely to be minimal (see Section 4.2.7) with most of the additional noise occurring during the day when wildlife is more accustomed to human activity.

Increased traffic along Skull Valley Road and the access road from the daily workforce is not likely to have an impact on wildlife since the percent increase in traffic is small. Table 4.2-1 identifies the number of personnel required to operate the PFSF (not including security personnel). At night and on weekends the workforce will be reduced to security personnel only. Travel to and from the PFSF site by personnel involved in PFSF operations is estimated to result in a maximum increase of 84 operational vehicle trips on Skull Valley Road, increasing the current ADT of 325 vehicle trips to 409 vehicle trips.

4.2.3 Effects on Air Quality

The operation of the PFSF is not expected to have any measurable impact on the local meteorology or air quality. The heat given off from the surface of the casks will only have a trivial effect on the temperature of the air in the immediate vicinity of the casks and should have no discernable off-site impact on the atmosphere.

Precipitation events could result in some very localized fogging as water is evaporated from the surface of the casks but will only occur under high ambient humidity conditions during which time natural fogging events will be likely. The downwind extent of any such fogging will be very limited and the frequency of occurrence will be very small as the site area receives very little rainfall throughout the year (approximately 8 inches per year).

There are no significant air pollution sources associated with the operation of the PFSF. The only fuel burning equipment to be operated on-site will be small space heating furnaces, the infrequent use of a small emergency generator for testing purposes, and the storage cask transporter. Although not applicable to the PFSF, small space heating sources of air pollutants (less than one million Btu per hour heat input) would be exempt from the Utah air quality regulations. The storage cask transporter is powered by a 220 horsepower diesel engine and is considered to be a mobile source which would not be regulated by the DEQ. While it is considered that operation of the emergency diesel generator will be so infrequent as to have trivial emissions, the following quantifies emissions from the emergency diesel generator on a very conservative basis, assuming that it operates 500 hours per year.

The PFSF will utilize a 250 horsepower diesel generator during operation to supply back-up electrical power when normal service is interrupted. Criteria pollutant emissions estimates for this engine are provided using uncontrolled emission factors from the latest version of AP-42 Chapter 3.3, "Gasoline and Diesel Industrial Engines" (Supplement B, October, 1996) for diesel fueled engines. AP-42 assumes that all particulate matter is less than or equal to 1 micrometer. Also, the emission factor shown for VOC is actually based on total organic compounds (TOC) which is conservative for VOC. The annual emissions below assume a maximum of 500 operating hours per year.

The emission factors used and estimates of criteria pollutant emissions are summarized as follows:

Pollutant	Emission Factor (lb/hp-hr)	Hourly Emissions (lb/hr)	Annual Emissions (tons/yr)
NO_x	0.031	7.75	1.94
SO_2	0.00205	0.51	0.13
PM-10/PM-2.5	0.0022	0.55	0.14
CO	0.00668	1.67	0.42
VOC	0.00247	0.62	0.16
Pb	N/A	N/A	N/A

The air pollutant emissions from the private vehicles driven by the operational labor force (Table 4.2-1) are not regulated under EPA or state regulations as they are mobile sources which are regulated at the manufacturer level.

The emissions estimates for the line-haul locomotives used for cask transport to the PFSF facility are provided in Section 4.4.3 which considers the number of locomotives used over the course of a year along with the total mileage covered, locomotive speed and appropriate air pollutant emission factors.

The annual air pollutant emissions from the small switchyard locomotive that will operate on the PFSF site are estimated in the same manner as those from the line-haul locomotives but using emission factors for switch locomotives. These emission factors are also based on current estimates (1997) provided by the Internet Web site DieselNet (http://www.dieselnet.com). EPA standards for locomotives with remanufactured engines were not applied since these engines are not likely to be used in the Low Corridor rail system.

The air pollutants for which emissions estimates are provided include hyrdocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM). The emission factors used in this estimate are expressed as grams per break horsepower per hour (g/bhp-hr) and are summarized below:

HC	CO	NO_x	PM
1.1	2.4	19.8	0.41

Annual switch locomotive operation is estimated to be 520 hours corresponding to 2 hours per day, 5 days per week, and 52 weeks per year. Therefore, assuming a 1,500 bhp locomotive engine, the annual air pollutant emissions in tons per year resulting from switch locomotive operation are as follows:

HC	CO	NO_x	PM
1.0	2.1	17.0	0.4

4.2.4 Effects on Hydrological Resources

Potable water needs during operation of the PFSF are minimal (approximately 1800 gallons per day), similar to a light industrial facility with a 24-hour-a-day contingent of security personnel. Highest water demand is associated with a larger daytime work-force as well as operation of the concrete batching plant. It is anticipated that surface storage tanks will be erected for potable water, emergency fire water, and for the batching plant, as it is unlikely that water wells drilled into the main valley aquifer will yield adequate quantities of water for these purposes on demand. Several wells on the site may be required to meet demand. In the event that onsite water quality or quantity are inadequate for drinking water, an additional well or wells may be drilled in a different geographical location of the Goshute Reservation, or potable water will be obtained directly from the Reservation's existing supply, or drinking water will be purchased from an offsite source.

Localized drawdown of the valley aquifer will occur in the vicinity of the wells, the extent of which cannot be estimated until the wells are drilled, developed, and pump-tested. Future site water wells will be located and developed such that its drawdown influence will have no impact on any public, domestic, or irrigation water supply wells in Skull Valley. A few isolated stock watering wells may exist several miles downgradient of the site, but are not likely to be affected due to distances involved and large size of the aquifer (Section 4.5.7).

The RA will be constructed to collect and drain storm-water to a detention basin adjacent to the north edge of the RA, as shown in Figure 2.1-2. The 800 ft by 200 ft basin is free-draining and sized to accommodate a 100-year storm event. The basin is designed with a concrete inlet from the storage site that precludes erosion from site drainage. The basin is constructed of compacted soil with 10 to 1 side slopes. Side slopes this gradual will reduce the velocity of rainwater flowing into the basin and minimize wind pressure thereby reducing the potential for wind or water erosion. In addition, the basin is located within the crested wheat wildfire barrier that will be planted out to a distance of 300 ft from the RA. The presence of the crested wheat grass on the side slopes and bottom of the basin will stabilize the soil and help prevent erosion due to wind or water.

The detention basin is not expected to have standing water except possibly following a severe rainstorm. Water drainage from the storage site from a typical rainstorm may soak into the ground before it reaches the detention basin. The detention basin was sized for a 100-year flood event in which the depth of water in the basin was calculated to be 4.77 ft. (S&W Calculation No. 05996.01-SY-2). Water that may collect here will dissipate by evaporation and percolation into the subsoils. In the unlikely event of a 100-year flood, the time for the water that has collected in the basin to be removed via evaporation and ground percolation is approximately 140 days assuming an evaporation rate of 0.32 in/day (Houghton, Handbook of Applied Meteorology, 1985) and percolation rate of 0.09 in/day (Lambe & Whitman, Soil Mechanics, 1969). If this unlikely event occurred, temporary pumps would be used to drain the detention basin and eliminate long term standing water. Operation of the detention basin will have a very local, sporadic effect on the subsurface hydrology. This water will slowly migrate northward and will most likely be transpired by vegetation at the ground surface or will be brought to the surface by capillary action and evaporated.

Storm-water that drains into the detention basin is not expected to be radiologically contaminated for the following reasons:

- the canisters are sealed by welding that precludes leakage of the canisters,

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- measures are applied at the originating nuclear power plants when fuel is loaded into the canisters to prevent contamination of the canister outer surfaces,
- the canisters are not permitted to be transported to the PFSF unless surveys determine that they are free of surface contamination,
- a contamination survey of the canister is again performed after the canister is received at the PFSF to ensure that the canister is not contaminated,
- following loading of canisters into storage casks at the PFSF, contamination surveys are performed on the surfaces of the storage casks to verify they are free of contamination.

Also, monitoring of contaminants in the detention pond is not required under current National Pollutant Discharge Elimination System (NPDES) storm water regulations since the storm-water flows into an onsite detention pond with no possibility of discharge to the waters of the United States. A NPDES storm water permit, with its associated monitoring and reporting requirements, is not applicable to PFSF operations and it is not planned to sample for non-radiological contaminants.

Nevertheless, PFS considers it prudent to obtain samples of water from the detention pond to verify that storm-water runoff is contamination free. Precipitation in Skull Valley ranges from 7 to 12 inches per year. Most of the relatively small volume of water in the cask storage area produced by a typical rainstorm will probably settle into the 8 inch thick compacted gravel surface surrounding the storage pads and not drain to the detention pond. Only during a substantial rain event would water be expected to drain from the cask storage area to the detention pond. In addition, it is considered likely that the only time sufficient freestanding water would be available in the detention pond for sampling purposes would be after a substantial rain event. PFS will obtain a sample of water from the detention pond following a rain that is sufficient to collect freestanding water and analyze the sample.

Mountains area range from 300 to 2,400 feet above the facility grade. While some occasional overnight camping in the Cedar Mountains does occur, there are no established camping areas in the region within view of the facility. Due to the infrequent use of the area after dark as well as the distance and elevations involved, the nighttime views of the facility are not expected to be obtrusive.

Direct views of the facility from Interstate-80 at the north end of Skull Valley are generally shielded by topographical features and the low elevation of the freeway as compared to the site. Some skyglow may be faintly visible in the distance on extremely clear nights, but nearby lighted structures (such as Akzo Salt and facilities at Delle) and homesteads will dominate the landscape. Given the great distances involved and the lighting features employed at the facility, nighttime views of the facility are not expected to be obtrusive.

These features will not present a significant impact on the area's scenic resources nor will the facility be inconsistent with the visual resource management (VRM) objectives that the BLM has established for its abutting property. Public land administered by the BLM within the 5-mile study radius has a VRM classification of Class IV. VRM Class IV lands allow activities that may result in major modifications to the existing character of the landscape and that may dominate the view and be a major focal point for the viewer. A Class IV designation anticipates high levels of change in the visual character of the landscape, yet attempts should be made to control the impact of activities through repetition of visual elements, sensitive siting, and minimization of disturbances (BLM, 1988).

Appendix 4A presents artist's concepts of the PFSF viewed from locations that the public would reasonably find accessible, including the highest accessible point (private road) of Deseret Peak, the Skull Valley Band of Goshute tribal village, the Pony Express Store on the reservation, and from the Skull Valley Road on the reservation.

4.2.9 Radiological Effects

The storage system is a passive design with the spent fuel stored dry within sealed canisters. Under normal conditions, there will be no handling of individual fuel assemblies at the PFSF. There are no liquid or gaseous radioactive effluents released from the PFSF to the surrounding environment under normal conditions of operation. Potential effects of radioactive material releases from the PFSF during postulated off-normal and accident conditions are assessed in Chapter 5, including impacts of accidents on the surrounding population.

4.2.9.1 Radiation to the Nearby Population and Onsite Personnel

4.2.9.1.1 Nearby Population

During normal conditions, the PFSF operations will emit radiation that will be monitored with thermoluminescent dosimeters (TLDs) posted along the perimeter of the RA and along the OCA boundary fence. Effects of radiation emitted from the storage casks to the environment are assessed in Sections 7.3 and 7.6 of the PFSF SAR, where doses are estimated to offsite individuals.

The site is located a substantial distance from population centers, and there are no towns within 10 miles of the PFSF. There are about 36 residents within the 5-mile study radius of the PFSF, with the nearest residence located approximately 2 miles east-southeast of the PFSF. The nearest town, Dugway, is a military town on the Dugway Proving Grounds with a population of approximately 1,700, located about 12 miles south of the PFSF. Terra, a small residential community of about 120 people, is located 10 miles east-southeast of the PFSF.

Figure 3.1-1 shows the PFSF OCA boundary fence, which serves as the site boundary. Areas at and beyond the OCA fence are considered to be offsite. As described in Section 7.6 of the PFSF SAR, a maximum dose rate of 2.10 mrem/yr (assuming a 2,000 hour annual occupancy) was calculated at the OCA boundary fence 600 meters from the RA fence at its closest points of approach. This dose rate is comprised of direct and scattered gamma and neutron radiation assumed to emanate from 4,000 HI-STORM storage casks and is based on the assumption that all 4,000 casks contain typical fuel expected to be received at the PFSF with 35-GWd/MTU burnup and 20-year cooling time. The maximum dose rate of 2.10 mrem/yr is below the 25 mrem annual dose limit to any real individual located beyond the controlled area boundary of 10 CFR 72.104.

The nearest residence is located approximately 2 miles east-southeast of the PFSF. As discussed in Section 7.3.3.5 of the PFSF SAR, a total dose rate of 8.12 E-3 mrem/yr (2,000 hour annual occupancy) is estimated at about 2 miles from the fully loaded PFSF, assuming all storage casks are HI-STORM casks containing relatively hot fuel (PWR fuel: 40 GWd/MTU burnup and 10-years cooling time), taking no credit for intervening shielding from berms, natural terrain, or buildings at the PFSF. Assuming full-time occupancy (8,760 hrs/yr), this equates to an annual dose of about 3.56 E-2 mrem, which is well within the 25 mrem annual dose limit of 10 CFR 72.104. Doses to other members of the surrounding population from the PFSF will be less. This represents a negligible impact to the surrounding population from normal operations at the PFSF.

4.2.9.1.2 Onsite Personnel

The PFSF operational organization is shown in SAR Figure 9.1-3. A list of personnel identified in Figure 9.1-3 that are expected to receive occupational radiation exposure is provided below, identified by the following four categories: (1) personnel receiving, transferring, and moving spent nuclear fuel to storage; (2) personnel involved with security, inspection, and maintenance; (3) personnel at the facility not routinely associated with Items 1 or 2, but who are expected to be exposed to radiation in the course of their duties; and (4) personnel involved at the proposed Intermodal Transfer Point. Following each organizational breakout there is an indication of which of the above categories these personnel are involved with and the number of personnel involved. For instance, the instrument/electrical and mechanical maintenance personnel are involved in receipt, transfer, and moving SNF to storage (Category 1), performing maintenance operations (Category 2), and they are also involved in intermodal transfer operations (Category 4). The radiation protection personnel and Emergency Preparedness/Training Coordinator (who provides health physics backup) are involved in receipt, transfer, and moving SNF to storage (Category 1), performing radiological inspections/surveillances at the PFSF (Category 2), and could provide any necessary health physics coverage of intermodal transfer operations (Category 4).

General Manager/Chief Operating Officer (Cat. 3)	(1)
Instrument/Electrical Maintenance personnel (Cats. 1, 2, and 4)	(4)
Mechanical Maintenance/Operations personnel (Cats. 1, 2, and 4)	(4)
Quality Assurance personnel (Cats. 2 and 4)	(3)
Emergency Preparedness/Training Coordinator, health physics backup (Cats. 1, 2, and 4)	(1)
Radiation Protection personnel (Cats. 1, 2, and 4)	(3)
Security personnel (Cats. 2 and 4)	(*)
Nuclear Engineering (Cat. 3)	(1)
Transportation Specialist (Cat. 3)	(1)
Total number expected to receive occupational exposure	(18*)

* This does not include the number of security personnel

As seen from the above, most of the personnel in the PFSF operational organization are expected to receive occupational exposure. A list of personnel identified in SAR Figure 9.1-3, Operational Organization, that are not expected to receive occupational exposure under any of the above listed Categories 1 – 4 is provided below.

Nuclear Engineering Secretary	(1)
Administrative Assistant	(1)
Administrative Secretary	(1)
Public Relations Coordinator	(1)
Financial/Purchasing Specialist	(1)
Total number of personnel not receiving occupational exposure	(5)

or life spans between irradiated and control iguanid lizards, but after one or two years females of two other lizard species occupying the same enclosure became sterile. IAEA 1992 includes discussion of possible reasons for the differences, but does not provide a minimum chronic exposure level for adverse effects of ionizing radiation to lizard populations.

Based on the above information, PFS uses the 1 Gray/year value from National Biological Service, 1994, (which is a more recent publication than IAEA 1992), the "lowest dose rate at which harmful effects of chronic irradiation have been reliably observed in sensitive species" as the criteria for acceptability at the PFSF. As stated above, this equates to an annual dose of 100 Rad.

4.2.9.2.1 Potential for Wildlife in the Vicinity of Storage Casks

As discussed in Section 4.2.2, avian species are likely to be attracted to the casks, buildings, and light posts for perching and potential nesting because of the limited perching/nesting sites available in the valley. In addition, the exterior surfaces of the casks are at above-ambient temperatures, which will be attractive to birds, small mammals, and reptiles, during the winter. Section 4.2.2 also discusses measures that will be implemented to keep wildlife away from the storage casks.

4.2.9.2.2 Calculated Doses to Wildlife in the Vicinity of Storage Casks

The following discussion evaluates external radiation dose from the storage casks to animals in the vicinity of the PFSF. Doses to animals from radioactivity released to the environment are not evaluated since (unlike nuclear power plants) there are no radioactive liquid or gaseous effluents released from the PFSF. The HI-STORM canisters are high integrity vessels sealed by welding and a through-wall leak of a canister is not a credible event, as stated in SAR Section 7.6.3. Since the canisters will not leak under normal conditions of storage, there will be no liquid or gaseous effluents released from the PFSF, and there will be no doses attributable to effluents in the areas surrounding the PFSF.

Animals could find reasonably good habitat beyond the perimeter road that runs along the outside of the nuisance fence and surrounds the PFSF. Dose rates at the security fence produced by the PFSF cask array assumed to contain 4,000 casks have been calculated and are discussed in PFSF SAR Section 7.3.3.5. The analysis of 4,000 HI-STORM casks estimated dose rates at the north security fence (maximum dose rates) of 0.60 mrem/hr. This dose rate was calculated for fuel representative of typical fuel expected to be received at the PFSF (35 GWd/MTU burnup and 20-year cooling time). As shown in PFSF SAR Figure 1.2-1, the nuisance fence is 20 ft from the security fence; there is a 10 ft wide strip of land between the nuisance fence and the perimeter road; and the perimeter road is 20 ft wide (also surfaced with compacted crushed rock). Therefore, the distance from the security fence to the outside of the perimeter road is 50 ft. It is conservative to consider doses to animals at the security fence.

Assuming an animal is continuously present at the security fence, and assuming the maximum dose rate at this fence, the annual dose would be:

Dose (HI-STORM) = (0.60 mrem/hr)(8,760 hrs/yr)(1 rem/1000 mrem) = 5.3 rem

The annual dose of 5.3 rem is below the 100 rad/year PFSF criteria, and harmful effects would not be expected even in sensitive species. The equivalent dose in units of rads is lower than the rem dose (if some of the dose is from neutrons), since quality factors having values greater than or equal to unity are used to multiply the rad dose (energy deposited) to arrive at the rem dose (damage effects on soft body tissue). While the quality factor for gamma radiation is 1 (Table 1004(b).1 of 10 CFR 20), quality factors for neutron radiation vary from 2 for low energy neutrons up to 11 for higher

4.5 RESOURCES COMMITTED

Several resources will be permanently committed as a result of construction and operation of the PFSF. Development of the PFSF and access road will require the permanent commitment of raw materials used in the building structures, concrete storage casks, storage pads, and road building materials. These include cement, sand, aggregate, steel, asphalt, and other building materials. Construction of the Low Corridor rail line (preferred transport mode) will require the permanent commitment of ballast and subballast material, and construction of the ITP (alternate transport mode, if required) will require commitment of the same types of construction materials used at the PFSF, along with ballast and subballast. Table 4.1-6 identifies quantities of imported materials estimated for construction of the Low Corridor rail line, the Intermodal Transfer Point, and the PFSF and access road, and Table 4.1-7 identifies sources of aggregate in the Skull Valley area. Sufficient quantities of the needed materials are available in the region to meet construction needs.

Development of this facility will also require the commitment of approximately 22 acres of land for the access road corridor. The new rail line will require an additional 155 acres of land. It is planned at this time to return the PFSF land area to its original habitat following decommissioning. Some additional acreage will be lost if the facility buildings are retained. These modifications will permanently alter the vegetation and wildlife habitat within the affected area.

Following is an assessment of water needs for construction and operation of the Low Corridor rail line, the Intermodal Transfer Point, and the PFSF.

4.5.1 Water Needs for the Low Corridor Rail Line Construction and Operation

The majority of water required during construction of the rail line will primarily be for wetting haul roads to minimize fugitive dust emissions and for providing water for soil compaction. The required quantity of water from SWEC Calculation 05996.01-P-002, Rev 5, is approximately 165,000 gal/day.

This quantity of water, suitable for construction, is available from private water sources located within 15 miles of Timpie and Low, Utah. Alternate or additional water sources that may become available during the course of the project will be considered by PFS.

Additional water will be required for making concrete for the culverts on the rail line. The quantity of water required for making this concrete is minimal in terms of the project requirements. Drinking water for construction personnel will be supplied in bottles/containers purchased from local commercial suppliers.

Water required during operation of the rail line will be exclusively to provide drinking water for personnel, and it will be supplied in drinking water bottles/containers from the PFSF.

4.5.2 Water Needs for the Intermodal Transfer Point (ITP) Construction and Operation

Water for construction of the ITP will be required for controlling dust and for making compacted fill (soil compaction). Concrete for the ITP would be obtained from commercial sources and no extra water for concrete production would need to be provided for by PFS. The required quantity of water from SWEC Calculation 05996.01-P-002, Rev 5, is approximately 18,800 gal/day for soil compaction and dust control.

The quantity of water required for soil compaction and dust control is available from private water sources located within 15 miles of Timpie and Low, Utah. Alternate or additional sources that may become available during the course of the project will be considered by PFS. Drinking water for construction personnel will be supplied in bottles/containers purchased from local commercial suppliers.

Water requirements at the ITP during operation will be to provide drinking water and water for the restroom. These requirements will be minimal since the ITP is staffed only intermittently. Water will be supplied from an onsite storage tank and distribution system. The tank will be refilled periodically by a local commercial drinking water supplier.

4.5.3 Water Needs for the Skull Valley Road

There are no improvements planned for Skull Valley Road and, therefore, no requirements for water.

4.5.4 Water Needs for the PFSF Construction and Operation

Water for construction of the PFSF will be required for compacting soils, making soil cement and concrete, controlling dust, and worker use. The required quantity of water from SWEC Calculation 05996.01-P-002, Rev 5, is as follows:

Soil Compaction

- The volume of water required for soil compaction, which is assumed to be required during earthwork activities for all of Phase 1 Period 1, 5 months of Phase 1 Period 2, and 2 months of Phase 1 Period 3 = 17,300 gal/day.

Soil Cement

- The volume of water required for soil cement, which is assumed to be placed during Phase 1 construction (under and around SE quadrant pads, around the Canister Transfer Building), Phase 2 construction (under and around SW quadrant pads) and Phase 3 (under and around northern half of the pad emplacement area) is:

  Phase 1, Period 1 = 102,600 gal/day
  Phase 1, Period 2 = 23,100 gal/day
  Phase 1, Period 3 = 6,500 gal/day

  Phase 2 (first 6 weeks) = 99,100 gal/day
  Remainder of Phase 2 = 2,700 gal/day

  Phase 3 (first 12 weeks) = 74,100 gal/day
  Remainder of Phase 3 = 3,500 gal/day

Concrete

- Volume of water required during Phase 1, Period 2 for making concrete to construct the Canister Transfer Building, the Security & Health Physics Building foundation, and half of the storage pads in the SE quadrant = 6,700 gal/day
- Volume of water required during Phase 1, Period 3 for making concrete to construct the foundations for the Administration Building and Operations & Maintenance Building and half of the storage pads in the SE quadrant = 2,300 gal/day.
- Volume of water required during Phase 2 for making concrete to construct the storage pads in the SW quadrant and 200 storage casks per year = 2,600 gal/day.
- Volume of water required during Phase 3 for making concrete to construct the storage pads in the northern half of the site and 200 storage casks per year = 3,600 gal/day.
- Volume of water required during the next 10 years to make concrete to construct 200 storage casks per year = 1,700 gal/day.

Dust Control

- Dust control is required during earthwork activities, which occurs over the entire 18 months of Phase 1, the first 6 weeks of Phase 2 (SW quadrant earthwork), and the first 12 weeks of Phase 3 (Northern half pad earthwork) = 15,100 gal/day

Worker Use

- Volume of water required for worker use during Phase 1 facility construction = 3,300 gal/day.
- Volume of water required for worker use during Phase 2 and 3 construction and following 10 years storage cask construction = 1,800 gal/day.
- Volume of water required for worker use during operation = 1,800 gal/day.

4.5.5 Summary of PFSF Water Requirements

Phase 1, Period 1 (2 months)

- First 6 weeks = 138,300 gal/day (3,300 from wells + 135,000 trucked in)
- Remaining weeks = 35,700 gal/day (3,300 from wells + 32,400 trucked in)

Phase 1, Period 2 (7 months)

- First 5 months = 58,900 gal/day (10,000 from wells + 48,900 trucked in)
- Remaining 2 months = 31,700 gal/day (10,000 from wells + 21,700 trucked in)

Phase 1, Period 3 (9 months)

- First 2 months = 39,500 gal/day (5,600 from wells + 33,900 trucked in)
- Remaining 7 months = 25,800 gal/day (5,600 from wells + 20,200 trucked in)

Phase 2 + operations (5 years)

- First 6 weeks = 135,100 gal/day (3,600 from wells + 131,500 trucked in)
- Remainder of 5 yr. period = 8,900 gal/day (6,200 from wells + 2,700 trucked in)

Phase 3 + operations (5 years)

- First 12 weeks = 110,100 gal/day (3,600 from wells + 106,500 trucked in)
- Remainder of 5 yr. period = 10,700 gal/day (7,200 from wells + 3,500 trucked in)

Operations w/ cask construction (10 years)

- 5,300 gal/day (all from onsite wells)

Operations only (20 years)

- 1800 gal/day (all from onsite wells)

Water for worker use and for making concrete will be obtained from onsite wells. As stated in Section 4.2.4, it is anticipated that surface storage tanks will be erected for potable water, emergency fire water, and for supplying water to the concrete batch plant, as it is unlikely that water wells drilled into the aquifer beneath the site will yield adequate quantities of water on demand for these purposes. Several wells on the site may be required to meet the daily demand. In the event that onsite water quality or quantity are inadequate, potable water will be obtained directly from the Reservation's existing supply, or an additional well or wells will be drilled east of the site, where the quantity and quality of ground water are likely to be more satisfactory. These wells would be outside of the OCA , but they would still be on the Reservation.

The remaining quantity of water, suitable for construction, is available from private water sources located within 15 miles of Timpie and Low, Utah. Alternate or additional water sources that may become available during the course of the project will be considered by PFS. PFS provided one reputable Tooele County contractor pertinent information on water needs for construction of the PFSF, the ITP, and the Low Corridor, and asked if existing water sources in northern Skull Valley could supply these needs. This contractor has an extensive work history on large construction projects, similar to the PFS project, in the Utah West Desert. The contractor indicated that, based on historical experience, sufficient quantity and quality of water is available in the northern end of the Stansbury Mountain range to supply the needs for construction of the PFSF and the Low Corridor rail line or the Intermodal Transfer Point (ITP) in the time period identified.

It is anticipated that wells drilled into the aquifer beneath the site will yield more water than required for making concrete and worker use during site construction and operation. Localized drawdown of the aquifer caused by the site water wells is not expected to have any effects on adjacent water well users.

As indicated in SWEC Calculation 05996.01-P-002, Rev 5, the maximum anticipated withdrawal rate for the proposed PFSF water well will be approximately 10,000 gal/day (6.9 gpm or 11.2 ac-ft/yr) during the first nine months of construction, and it will decrease thereafter. Over a 42-year period (Years 2000 through 2042), the average withdrawal rate from the well will be approximately 2,040 gal/day (1.4 gpm or 2.3 ac-ft/yr). It should be noted that six existing wells within five miles of the site have water rights ranging from approximately 11 to 1,600 ac-ft/yr.

4.6 DECONTAMINATION AND DECOMMISSIONING

4.6.1 Decommissioning Plan

Prior to the end of the PFSF life, canisters loaded with spent fuel will be transferred from storage casks into shipping casks and transported off site. Since the canisters are designed to meet DOE guidance applicable to multi-purpose canisters for storage, transport and disposal of spent fuel, the fuel assemblies will remain sealed in the canisters such that decontamination of the canisters is not required. Following shipment of the canisters off site, the PFSF will be decommissioned by identification and removal of any residual radioactive material, and performance of a final radiological survey. Additional details on decommissioning are found in License Application Appendix B, "Preliminary Decommissioning Plan."

4.6.2 Decommissioning Facilitation

The design features of the dry cask storage concept, to be utilized at the PFSF, provide for the inherent ease and simplicity of decommissioning the facility in conformance with 10 CFR 72.130. Details of these design features and measures that will be taken to both minimize the potential for contamination and facilitate any decontamination efforts which may be required are found in License Application Appendix B, "Preliminary Decommissioning Plan."

4.6.3 Cost of Decommissioning and Funding Method

The cost of decommissioning the PFSF, excluding the storage casks, is estimated to be $1,631,000. The cost of decommissioning the storage casks is estimated to be $17,000 each. Decommissioning the PFSF will be funded by a letter of credit coupled with an external sinking fund. Decommissioning the storage casks will be funded by prepayment of $17,000 to an externalized escrow account for each cask to be utilized.

4.6.4 Long Term Land Use and Irreversible Commitment of Resources

Following removal of all the storage casks from the PFSF and decontamination of the storage pads and Canister Transfer Building, as necessary, disposition of the storage pads and PFSF buildings (Canister Transfer Building, Security and Health Physics Building, Operations and Maintenance Building and Administration Building) will be decided in conjunction with the Skull Valley Band of Goshute Indians. The Band will retain ownership of the property on which the PFSF is located throughout the construction, operation, and decommissioning phases of the PFSF, with the land leased from the Band by the PFSLLC. The Band will be consulted prior to dismantlement of the PFSF buildings, and their preferences accommodated as to the future of the buildings, which could function in some other usage that will benefit the Band. PFS is obligated (and is collecting sufficient advanced funding) to remove these buildings if the tribe does not foresee uses for them.

The cask storage area consists of up to 500 reinforced concrete storage pads; each pad 67 ft. long, by 30 ft. wide, and 3 ft. thick. The areas between and around the storage pads are surfaced with compacted gravel. Following characterization of the storage pads, any necessary decontamination, and release of the storage pads for unrestricted use, storage pads can be excavated, cut into smaller sections, and trucked off-site for disposal at a local landfill. The storage pads could be sectioned using a method such as diamond wire cutting, or alternatively could be left in place. The preferred alternative for decommissioning of the concrete storage pads is to leave them in place and cover the cask storage area with soil and replant with native vegetation to minimize soil erosion. In either case, the former cask storage area will be covered with topsoil and replanted with native vegetation. Soil from the flood diversion berms south of the storage area and east of the storage area could be used to cover the former cask storage area, or, alternatively, soil could be trucked in from outside the PFSF.

In the event the entire removal of the pads is performed, this would involve removal of 111,667 CY of material [(67-ft X 30-ft X 3-ft) / (27 CY/ft^3) X 500 pads = 111,667 CY]. Using a 20 CY truck and a factor of 0.9 to allow for void spaces, yields approximately 6,204 truckloads [111,667/(20 X 0.9) = 6,204]. Since decommissioning will occur many years into the future, location of a suitable landfill cannot be determined at this time.

After the PFSF cask storage area is resurfaced with topsoil suitable for supporting native vegetation, the land is essentially returned to its original condition. There is no irreversible commitment of natural resources associated with the long term plans for the PFSF land, unless the Band chooses to keep some of the buildings or other structures intact for their own use.

At the intermodal transfer point (if required) the rail siding, pre-engineered metal building and foundation, and access road will be dismantled and removed. The area will be covered with topsoil and replanted with native vegetation. There is no irreversible commitment of natural resources associated with the intermodal transfer point.

It is anticipated that the low corridor rail line will be utilized by others in the Skull Valley and will not be dismantled and removed. This would result in a permanent commitment of about 155 acres of public land administered by the BLM associated with the rail line.

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TABLE 4.1-3 (Sheet 1 of 2)

SKULL VALLEY ROAD TRAFFIC/NOISE SOUTH OF IOSEPA

	Average Daily Traffic (ADT)	Morning 2-hour commute (vehicles/hr)	Non-peak traffic (vehicles/hr)	Evening 2-hour commute (vehicles/hr)	Sound Level During Peak Traffic Volume (dBA @50')
Existing Traffic	325	54	9	54	67
Construction Phase 1-Period I (2 months)					
First 6 weeks	735	134	24	134	72
Remainder of period	709	131	21	131	72
Construction Phase 1-Period II (7 months)					
First 5 months	647	125	15	125	71
Last 2 months	639	124	14	124	71
Construction Phase 1-Period III (9 months)					
First 2 months	615	122	12	122	71
Last 7 months	611	122	12	122	71

Note:
"Sound Level During Peak Traffic Volume" values are taken from Stone & Webster Calculation No. 05996.01-E(B)-03, Revision 3.

TABLE 4.1-3 (Sheet 2 of 2)
SKULL VALLEY ROAD TRAFFIC/NOISE SOUTH OF IOSEPA

	Average Daily Traffic (ADT)	Morning 2-hour commute (vehicles/hr)	Non-peak traffic (vehicles/hr)	Evening 2-hour commute (vehicles/hr)	Sound Level During Peak Traffic Volume (dBA @50')
Construction Phase 2 (approximately 5 years)					
First 6 weeks	545[4]	102	14	102	69
Remainder of 5-yr period	511	99	11	99	69
Construction Phase 3 (approximately 5 years)					
First 12 weeks	545	102	14	102	69
Remainder of 5-yr period	517	99	11	99	69
Operation					
(following 10 years)	501	104	10	104	69
(10 years +)	409	81	0	81	68

Note:
"Sound Level During Peak Traffic Volume" values are taken from Stone & Webster Calculation No. 05996.01-E(B)-03, Revision 3.

[4] ADTs and peak volume figures include traffic generated by Facility operation which begins at the start of Phase 2 PFSF construction.

Table 4.1-4

ESTIMATED CONSTRUCTION RELATED POLLUTANT EMISSIONS FOR THE PFSF

Activity	Pollutant	Emission Rate (tons/month)	Basis
Clearing/Excavation • vehicular traffic on unpaved and paved roads • wind erosion • material handling • bulldozing • scraping • grading • watering	PM10	20.2	Assumes 470,360 total construction vehicle miles traveled in one year
Concrete Batch Plant	PM10	0.27	Assumes 54,068 cubic yards of concrete used in one year
Vehicle Operation	NO_x CO VOC	0.56 0.65 0.12	Assumes 470,360 total vehicle miles traveled in one year

Table 4.1-5

ESTIMATED CONSTRUCTION AIR QUALITY IMPACTS FOR THE PFSF

Source	Pollutant	Estimated Impact (μg/m³) Skull Valley Rd	Estimated Impact (μg/m³) Residences	Standard (μg/m³)
Fugitive Dust Sources	PM10			
	24-hour	35.5	21.5	150
	Annual Avg	4.4	2.7	50
Concrete Batch Plant	PM10			
	24-hour	15.9	8.6	150
	Annual Avg	2.0	1.1	50

Table 4.1-6
(Sheet 1 of 2)
IMPORTED CONSTRUCTION MATERIAL QUANTITIES

Item	Quantity (CY)
PFSF Construction Phase I	**18 Months**
Concrete Materials	
Cement	28800
Small Aggregate (Sand)	21000
Large Aggregate (Crushed rock)	16300
Crushed Rock Grading	
Access Road Base	32500
Storage & Building Areas	42000
Rip-rap	11100
Asphalt Paving	9600
PFSF Construction Phase II	**5 Years**
Concrete Materials	
Cement	18900
Small Aggregate (Sand)	10200
Large Aggregate (Crushed rock)	8100
Crushed Rock Grading	
Storage Area	15500
PFSF Construction Phase III	**5 Years**
Concrete Materials	
Cement	28400
Small Aggregate (Sand)	21200
Large Aggregate (Crushed rock)	16800
Crushed Rock Grading	
Storage Area	33500

Note:
The quantities of solid imported materials identified in this table are slightly less than those identified in Sections 4.1.7.1 through 4.1.7.3, due to the assumptions that were made in these sections to conservatively estimate the number of truck trips during construction of the PFSF facility. For instance, in estimating the number of truck trips, one cubic yard of concrete was conservatively assumed to consist of one cubic yard of solid material. The quantities of solid material identified above are based on realistic material fractions (e.g., the volume of solid materials – cement, sand, and crushed rock – used to produce concrete is actually less than 90% of the finished volume).

Table 4.1-6
(Sheet 2 of 2)
IMPORTED CONSTRUCTION MATERIAL QUANTITIES

Item	Quantity (CY)
Direct Rail Alternative	
Subballast	225,000
Ballast	95,732
Intermodal Transfer Point	
Concrete Aggregate	
Small (Sand)	1150
Large (Crushed rock)	1600
Crushed Rock Grading	
Access Road Base	650
Oval Track Base	3000
Subballast	5450
Ballast	4300
Structural Fill	2700
Asphalt Paving	2800 (Tons)

Notes:
All quantities are in-place cubic yards unless otherwise noted

7.2 BENEFITS

The categories of direct and indirect benefits of the Private Fuel Storage Facility are based on those set forth in Table 1 of Regulatory Guide 4.2.

7.2.1 Direct Benefits

Chapter 1 demonstrates that there is a need to provide centralized, interim storage of spent fuel for some nuclear generating plants; to allow for the complete dismantlement and decommissioning of other nuclear plants; and to allow for the standardized packaging and staging of spent fuel in a uniform manner prior to its shipment to a federal spent fuel storage facility and/or repository. The availability of the PFSF would provide insurance for those reactors which may be unable to increase at-reactor spent fuel storage or where increased on-site storage would not be economically advantageous. Therefore, the direct benefits of the storage facility are reducing the risk of interruptions in the operation of existing nuclear power plants, as well as the unfettered decommissioning of permanently shut down commercial reactors.

Several U.S. reactors have already used all available space in their spent fuel pools and have built onsite ISFSIs for continued storage of spent fuel generated through operation of the plants. Some of these utilities have received limited, conditional approval from their states for additional onsite storage for their reactors for a period of time which would not allow operation through the end of licensed life, potentially resulting in premature shutdown. Some of the conditions attached to additional storage approval are very costly and burdensome. Other reactors are approaching the time when their spent fuel pool capacity will be exhausted and will be required to build additional onsite storage capacity or shut down. As of January 2001, 28 reactors have run out of storage pool space and have implemented at-reactor dry storage. Recent studies indicate that 46 reactors will run out by

2002. By 2015, 93 of the nation's reactors will have exhausted their spent fuel pool capacity (Radwaste, 1997). If no other alternative storage capacity is provided, many of these reactors will be forced to shut down before the end of their licensed lifetime.

The potential effects of premature nuclear plant shutdowns due to insufficient on-site spent fuel storage capacity include:

- Utilities would need to provide electrical power that was being produced by the nuclear plant by some other means to meet demands.
  a. Build replacement generation
  b. Purchase power

Both the above options would likely result in increased air emissions as fossil fuel use in the State increases.

- Following permanent shutdown, complete decommissioning of the fuel pool could not be undertaken until all the spent fuel has been removed. Since insufficient spent fuel storage capacity forced the nuclear plant to shutdown, it may not be possible to remove spent fuel from the fuel pool and transfer the fuel to an on-site dry storage facility, with the following resulting impacts:
  a. The utility would incur significant maintenance and administrative costs of keeping its fuel pool and associated systems operational, such as maintenance, surveillance, and inspections.
  b. Since decommissioning would be delayed until spent fuel could be removed from the nuclear power plant, including the fuel pool, the utility may be unable to terminate its 10 CFR 50 license, and may be required to continue to implement relatively expensive programs required by this license, such as the Physical Protection Plan.
  c. The cost of Low Level Waste (LLW) disposal has increased dramatically in recent years as disposal sites are closed and regional compact efforts to

evaluate, select and license disposal sites are being delayed. Over the last 10 years, costs have increased over 960%, a rate much faster than the rate of inflation (see Figure 7.2-1). Because of the rapid escalation of LLW burial charges and the continuing uncertainty of burial site availability, decommissioning delays incurred by inability to remove spent fuel from fuel pools would likely result in higher costs of LLW disposal when the spent fuel is transferred and decommissioning of the fuel pool is eventually undertaken. In some cases, LLW disposal may become unavailable to the utility at the time when the fuel is eventually removed and decommissioning is scheduled to begin.

d. Delays in decommissioning will result in delays in restoring the site, or reusing the site for other potential economic development, at a cost to the utility and it's ratepayers.

- In order to enable decommissioning and termination of the 10 CFR 50 license, the utilities would need to construct an on-site dry storage facility so that the spent fuel could be transferred out of the fuel pool (assuming a centralized spent fuel storage facility, such as the PFSF, is not in existence).

  The construction of additional onsite ISFSIs at plant sites will result in more sites disturbed and greater environmental impact than constructing one site in a remote, desert environment, such as the PFSF. In addition, lack of standardization will increase the complexity and cost of eventually preparing and shipping spent fuel to a federal facility, and increase the decommissioning burden for utilities with onsite ISFSIs.

- The availability of the PFSF may enable utilities that have limited spent fuel storage space to consider life extension of their operating units and possibly operate beyond their license term. Life extension may be the least-cost alternative for additional capacity, and may result in lower emissions of greenhouse gases.

Development of the PFSF will result in new industry standards for the storage and transportation of large amounts of spent fuel.

Other direct benefits include reduced costs for centralized storage in comparison to continued onsite spent fuel storage at some reactors, allowing for early dismantlement and disposal of wastes, and reduced handling of spent fuel by packaging in a transportable, canister-based, storage cask system. Recent estimates place the savings to utilities and their customers of a centralized interim storage facility over construction of additional on-site storage facilities for spent fuel at $897.2 million (PFSLLC, November 22, 2000), assuming an interim storage facility opens in 2003 and a 40 year operating period.

Packaging spent fuel in multi-purpose storage and transportation canisters will eliminate the need to directly handle the spent fuel at the PFSF. Reduced handling will result in lower operational costs for utilities.

The direct benefits for the Skull Valley Band of Goshute Indians (Band) are shown to be a steady revenue stream for the Tribal Government and Band members, a diverse set of meaningful jobs for tribal members and training/development opportunities for other Band members.

Currently Skull Valley Band of Goshute Indians have an enrollment of 119 members, with about 30 members of the Band living on the reservation. Six of these members are over the age of eighteen. The balance of the enrollment reside in the outlying cities or out-of-state. Two adult Band members from the reservation are students; one Band

Low Corridor rail line, but does not include the cost of constructing the Intermodal Transfer Point.

Other indirect benefits include local procurement of materials and supplies for the construction and operation of the facility from the surrounding region. Procurement of casks and other goods, as well as possible local fabrication of canisters will have a large impact on the local area. Each dollar earned which is spent in the local economy has a multiplier effect, further increasing the positive spending impact on the local area.

It is estimated that U.S. operating nuclear plants reduce the emission of 168 million metric tons of carbon into the air each year (NEI, 2000). Likewise, a significant amount of nitrogen oxide and sulfur dioxide emissions are also prevented. Plants which are shut down or not relicensed due to lack of spent fuel storage availability will likely be replaced with fossil generation. In the U.S. Clean Air Act and the Global Climate Action Plan, aggressive goals for reduced emissions have been established. Compliance and attainment of these goals would be jeopardized by plants idled due to lack of spent fuel storage capability.

The indirect benefits for the Band include increased traffic and business at their convenience store during construction and operation, and an increased profile for the Band in the Utah business economy, potentially bringing new economic development initiatives to the Band. Other indirect benefits will include construction of a rail line to the site which will provide opportunities for further Band economic development projects. In addition, the project will provide improved access to the western portion of the reservation and improved electric and phone services through upgraded distribution and communications lines to the reservation area.

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7.3 COSTS

The categories of direct and indirect costs of the PFSF are based on those recommended from Table 2 of Regulatory Guide 4.2.

The direct costs of the PFSF include initial costs to site the facility, the costs to engineer and construct the facility and annual costs associated with the Tribal lease, maintenance, operation, transportation, at reactor loading costs, security, license fees, and taxes. The estimated capital cost for the PFSF is $100 million, including engineering and licensing, construction, not including the storage canisters and casks. Fuel shipment schedules from utilities to PFS were optimized based on limiting the amount of dry storage utilities would need to add on-site, and reducing the amount of time spent fuel would remain on-site following reactor shutdown for decommissioning (PFSLLC, November 22, 2000). The total life cycle cost for the facility and its operation over its projected 40 year operating life, using a 3.8% real interest rate, is $1.1503 billion, including all the above categories and a 2010 repository opening (PFSLLC, November 22, 2000). For a 2015 repository opening year, the life cycle cost is $1.1489 billion. Appendix 7A provides a basis for using a 3.8% real interest rate for discounted cash flow calculations. Appendix 7B provides a summary of at-reactor spent fuel storage costs. Appendix 7C summarizes the net benefits (avoided costs) of building the PFS facility. Appendix 7D provides the basis for using pool storage costs versus dry storage for post shutdown costs at reactors.

The indirect costs, which are derived from socioeconomic and environmental impacts of the facility, are minimal due to the remote location and small size of the actual storage area.

These total project costs are less than the total project benefits gained by reduced fuel storage costs, continued plant operation and early decommissioning as described in Section 7.2.

7.5 REFERENCES

PFSLLC, Response to Third Round EIS Request for Additional Information, Docket 72-22/TAC No. L22462, Private Fuel Storage Facility, PFSLLC, November 22, 2000

Nuclear Energy Institute, Fact Sheet, Nuclear Energy and the Environment, July 2000

PFSLLC, Private Fuel Storage L.L.C. Business Plan, June 1998

Radwaste Magazine, "The Cost of Prolonging the Status Quo", Energy Resource International, May 1997

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TABLE 7.3-1

PRIVATE FUEL STORAGE FACILITY

LIFE CYCLE AVOIDED COSTS (NET BENEFITS)

EXPECTED CASE

($ in thousands)

Repository Opening Date	2010	2015
Repository Size	17,000 MTU	20,000 MTU
Operating Expenses	$1,150,300	$1,148,900
Environmental Costs	negligible	negligible
TOTAL	$1,150,300	$1,148,900
Project Benefits to Utilities	$1,532,400	$2,046,100
Net Project Benefit	$382,100	$897,200

Notes: 1. Benefits and Costs discounted using a 3.8% Real Interest Rate.
2. Operating expenses include decommissioning costs, interest and depreciation, as well as loading costs for shipment.

APPENDIX 7B

At-Reactor Spent Fuel Storage Cost Summaries

Parameters for Spent Fuel Acceptance Scenarios

Assumptions	Case 1	Case 3	Case 5	Case 6	Case 7	Case 8
PFSF Operation Date	2003 PFSF	No PFSF	2003 PFSF	No PFSF	2003 PFSF	No PFSF
Repository Operation Date	2015	2015	2015	2015	2015	2015
Peak PFSF Capacity (MTU)	20,000	0	8, 800	0	38,000	0
Reactors in Comparison	51	51	21	21	all	all
License Duration (Years)	40		40		40	

Assumptions	Case 9	Case 10	Case 11	Case 12	Case 13	Case 14
PFSF Operation Date	2003 PFSF	No PFSF	2003 PFSF	No PFSF	2003 PFSF	No PFSF
Repository Operation Date	2010	2010	2010	2010	2010	2010
Peak PFSF Capacity (MTU)	17,000	0	7,400	0	38,000	0
Reactors in Comparison	51	51	21	21	all	all
License Duration (Years)	40		40		40	

At-Reactor Spent Fuel Storage Cost Summary (Millions Constant 1999$)

Cost Category	Comparisons of Costs for PFSF versus 2015 Repository Only Systems					
	Case 1 versus Case 3		Case 5 versus Case 6		Case 7 versus Case 8	
PFSF Operation Date	Case 1 2003 PFSF 20,000 MTU	Case 3 No PFSF	Case 5 2003 PFSF 8,800 MTU	Case 6 No PFSF	Case 7 2003 PFSF 38,000 MTU	Case 8 No PFSF
Operating Reactor Storage	$ 269.5	$ 950.3	$ 78.2	$ 449.4	$ 791.6	$ 3,060.2
Shutdown Reactor Storage	$ 3,066.0	$ 7,419.8	$ 952.0	$ 2,108.44	$ 7,552.2	$ 13,563.8
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 393.3	$ 307.9	$ 148.5	$ 107.9	$ 699.1	$ 547.3
Total Utility At-Reactor Storage	$ 3,728.8	$ 8,678.0	$ 1178.7	$ 2,665.7	$ 9,042.9	$ 17,171.3
PFSF At-Reactor Storage Benefit	$ 4,949.2		$ 1,487.0		$ 8,128.4	
PFSF Facility Cost	$ 1,862.7		$ 1,065.0		$ 2,367.0	
Net Benefit	**$ 3,086.5**		**$ 422.0**		**$ 5,761.4**	

Cost Category	Comparisons of Costs for PFSF versus 2010 Repository Only Systems					
	Case 9 versus Case 10		Case 11 versus Case 12		Case 13 versus Case 14	
PFSF Operation Date	Case 9 2003 PFSF 17,000 MTU	Case 10 No PFSF	Case 11 2003 PFSF 7,400 MTU	Case 12 No PFSF	Case 13 2003 PFSF 38,000 MTU	Case 14 No PFSF
Operating Reactor Storage	$ 269.5	$ 740.6	$ 77.6	$ 307.1	$ 849.9	$ 2,432.7
Shutdown Reactor Storage	$ 3,074.0	$ 6,010.8	$ 960.0	$ 1,662.4	$ 5,208.8	$ 10,562.8
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 393.3	$ 328.2	$ 148.5	$ 114.8	$ 697.5	$ 589.6
Total Utility At-Reactor Storage	$ 3,736.8	$ 7,079.6	$ 1,186.1	$ 2,084.3	$ 6,756.2	$ 13,585.1
PFSF At-Reactor Storage Benefit	$ 3,342.8		$ 898.2		$ 6,828.9	
PFSF Facility Cost	$ 1,862.7		$ 1,065.0		$ 2,366.0	
Net Benefit	**$ 1,480.1**		**$ (166.8)**		**$ 4,462.9**	

At-Reactor Spent Fuel Storage Cost Summary (Millions NPV 1999$ - 3.8% Real Interest Rate)

	Comparisons of Costs for PFSF versus 2015 Repository Only Systems					
Cost Category	**Case 1 versus Case 3**		**Case 5 versus Case 6**		**Case 7 versus Case 8**	
PFSF Operation Date	Case 1 2003 PFSF 20,000 MTU	Case 3 No PFSF	Case 5 2003 PFSF 8,800 MTU	Case 6 No PFSF	Case 7 2003 PFSF 38,000 MTU	Case 8 No PFSF
Operating Reactor Storage	$ 248.8	$ 710.3	$ 71.4	$ 313.2	$ 706.8	$ 2,151.9
Shutdown Reactor Storage	$ 1,932.0	$ 3,667.0	$ 490.2	$ 881.0	$ 3,364.8	$ 5,540.8
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 277.4	$ 127.0	$ 100.7	$ 40.1	$ 393.5	$ 209.5
Total Utility At-Reactor Storage	$ 2,458.2	$ 4,504.3	$ 662.3	$ 1,234.3	$ 4,465.1	$ 7,902.2
PFSF At-Reactor Storage Benefit	$ 2,046.1		$ 572.0		$ 3,437.1	
PFSF Facility Cost	$ 1,148.9		$ 636.0		$ 1,442.0	
Net Benefit	**$ 897.2**		**$ (64.0)**		**$ 1,995.1**	

	Comparisons of Costs for PFSF versus 2010 Repository Only Systems					
Cost Category	**Case 9 versus Case 10**		**Case 11 versus Case 12**		**Case 13 versus Case 14**	
PFSF Operation Date	Case 9 2003 PFSF 17,000 MTU	Case 10 No PFSF	Case 11 2003 PFSF 7,400 MTU	Case 12 No PFSF	Case 13 2003 PFSF 38,000 MTU	Case 14 No PFSF
Operating Reactor Storage	$ 248.8	$ 590.4	$ 70.8	$ 234.4	$ 758.9	$ 1,817.6
Shutdown Reactor Storage	$ 1,935.0	$ 3,241.4	$ 492.4	$ 762.5	$ 2,729.3	$ 4,763.8
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 277.6	$ 162.0	$ 100.7	$ 50.2	$ 421.8	$ 267.3
Total Utility At-Reactor Storage	$ 2,461.4	$ 3,993.8	$ 663.9	$ 1,047.1	$ 3,910.0	$ 6,848.7
PFSF At-Reactor Storage Benefit	$ 1,532.4		$ 383.2		$ 2,938.7	
PFSF Facility Cost	$ 1,150.3		$ 636.0		$ 1,442.0	
Net Benefit	**$ 382.1**		**$ (252.8)**		**$ 1,496.7**	

At-Reactor Spent Fuel Storage Cost Summary (Millions NPV 1999$ - 7.0% Real Discount Rate)

	Comparisons of Costs for PFSF versus 2015 Repository Only Systems					
Cost Category	**Case 1 versus Case 3**		**Case 5 versus Case 6**		**Case 7 versus Case 8**	
PFSF Operation Date	Case 1 2003 PFSF 20,000 MTU	Case 3 No PFSF	Case 5 2003 PFSF 8,800 MTU	Case 6 No PFSF	Case 7 2003 PFSF 38,000 MTU	Case 8 No PFSF
Operating Reactor Storage	$ 236.2	$ 579.0	$ 67.4	$ 242.3	$ 660.7	$ 1,690.7
Shutdown Reactor Storage	$ 1,465.8	$ 2,376.5	$ 324.1	$ 505.8	$ 2,064.9	$ 3,131.6
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 218.9	$ 65.4	$ 78.1	$ 19.0	$ 273.3	$ 101.8
Total Utility At-Reactor Storage	$ 1,920.9	$ 3,020.9	$ 469.6	$ 767.1	$ 2,998.9	$ 4,924.1
PFSF At-Reactor Storage Benefit	$ 1,100.0		$ 297.5		$ 1,925.2	
PFSF Facility Cost	$ 820.6		$ 452.0		$ 1,004.0	
Net Benefit	**$ 279.4**		**$ (154.5)**		**$ 921.2**	

	Comparisons of Costs for PFSF versus 2010 Repository Only Systems					
Cost Category	**Case 9 versus Case 10**		**Case 11 versus Case 12**		**Case 13 versus Case 14**	
PFSF Operation Date	Case 9 2003 PFSF 17,000 MTU	Case 10 No PFSF	Case 11 2003 PFSF 7,400 MTU	Case 12 No PFSF	Case 13 2003 PFSF 38,000 MTU	Case 14 No PFSF
Operating Reactor Storage	$ 236.2	$ 501.9	$ 66.8	$ 192.8	$ 706.2	$ 1,486.1
Shutdown Reactor Storage	$ 1,467.1	$ 2,205.2	$ 324.9	$ 462.7	$ 1,836.8	$ 2,856.8
Loading Costs for Shipment Offsite Includes DTS, as needed.	$ 219.1	$ 97.0	$ 78.1	$ 27.3	$ 298.6	$ 150.1
Total Utility At-Reactor Storage	$ 1,922.4	$ 2,804.1	$ 469.8	$ 682.8	$ 2,841.6	$ 4,493.0
PFSF At-Reactor Storage Benefit	$ 881.7		$ 213.0		$ 1,651.4	
PFSF Facility Cost	$ 821.9		$ 452.0		$ 1,004.0	
Net Benefit	**$ 59.8**		**$ (239.0)**		**$ 647.4**	

APPENDIX 7C

SUMMARY OF AVOIDED COSTS (PFS NET BENEFITS)

Repository Open Date	Size (MTU)	Avoided Costs Constant 1999$	Avoided Costs NPV 3.8%	Avoided Costs NPV 7%
2010	17,000	$1,481,100,000	$ 382,100,000	$ 59,800,000
2010	7,400	$ (166,800,000)	$(252,800,000)	$(239,000,000)
2010	38,000	$4,462,900,000	$1,496,700,000	$ 647,400,000
2015	20,000	$3,086,500,000	$ 897,200,000	$ 279,400,000
2015	8,800	$ 422,000,000	$ (64,000,000)	$ (154,500,000)
2015	38,000	$5,761,400,000	$1,995,100,000	$ 921,200,000

APPENDIX 7D

BASIS FOR USING SPENT FUEL POOL STORAGE COSTS FOLLOWING SHUTDOWN AND PRIOR TO DECOMMISSIONING

The April 2000 ERI Report assumes that spent fuel pools would remain operational until all spent fuel has been removed from individual reactor sites. This assumption was made because at the present time, no reactors have yet unloaded spent fuel from storage pools to dry storage although a number of recently shutdown reactors plan to do so. The annual operating and maintenance costs to store spent fuel at shutdown reactors have been conservatively projected to be $4 million per year per site if dry storage were utilized instead of pool storage. However, this has not yet been achieved and it would be speculative to assume these costs for a system-wide analysis at this time. It is possible that the costs for post-shutdown dry storage could be significantly higher than projected. Like the costs for pool operation which vary widely, the operating and maintenance cost for post-shutdown dry storage are also expected to vary widely depending on individual reactor situations. For example, operating and maintenance costs would be significantly higher if the shutdown reactor site had to maintain a corporate infrastructure as well as maintaining the dry storage facility.

It should also be noted that while the annual operating and maintenance costs may be lower if spent fuel were transferred to dry storage, there would be a subsequent large increase in the capital costs associated with the purchase and loading of dry storage systems to house the entire inventory of the spent fuel storage pool. Most of the reactors that are currently shutdown have done so prior to reaching the end of their 40-year operating licenses and many were small reactors; thus, spent fuel inventories are relatively small and require a smaller capital investment than a reactor that operates for its entire licensed lifetime. A typical 1,000 MW reactor is expected to produce 1,000 MTU of spent fuel over its 40 year license. This would require a significant capital expenditure to transfer all spent fuel to dry storage. As presented in Table 1 of the January 26, 2000, *EIS Commitment Resolution Letter #4,* to the NRC from PFS, the summary of Storage System and Loading costs from *Supko 1999* show capital and loading costs of $70 to $130 million for a hypothetical 1,000 MTU dry storage facility. In addition to these capital and loading costs, there would also be additional upfront costs associated with building a dry storage facility capable of storing 1,000 MTU. In addition to the capital costs, there would also be a significant carrying cost associated with the large capital investment required to offload spent fuel to dry storage.

While the minimum cooling time for transferring spent fuel to dry storage following reactor shutdown for decommissioning is approximately 5 years, this will be dependent upon the spent fuel burnup, initial enrichment, the age of the spent fuel in inventory, and the characteristics of the dry storage system. Many dry storage systems may require that spent fuel be cooled for periods longer than 5 years depending upon the spent fuel burnup. Thus, given the increased capital costs that accompany transfer of spent fuel from the pool to dry storage, it may not be possible to offload the spent fuel pool to dry storage in a timely manner that might take advantage of possible lower dry storage operating and maintenance costs.

Due to the large capital investment required to offload the spent fuel storage pools to dry storage, one of the primary considerations regarding whether this would be cost-effective would be the projected time period required for post-shutdown storage. The April 2000 ERI report, assumes a limited time period based on a projected PFSF operation date of 2002 or a DOE repository operation date of 2015. If post-shutdown spent fuel storage were required for a 50 or 100 year period, there may be a system-wide benefit to unload spent fuel pools to dry storage despite the large upfront capital costs projected.

It should also be noted that *TRW 1993* did not provide a complete analysis of the possible post-shutdown spent fuel storage costs. While TRW 1993 did provide an estimate of post-shutdown dry storage costs, ERI considers its estimate to be unrealistically low as was the *TRW 1993* estimate for pool storage operating costs.

Other analyses that show benefits for dry storage of spent fuel at currently shutdown reactors must consider the fact that those reactors that are currently shutdown did so prior to the end of their licensed lifetimes. Most of these shutdown reactors have small inventories of spent fuel requiring dry storage and spent fuel inventories with burnups that require shorter cooling prior to loading into dry storage. This will not be the case for currently operating reactors that are expected to generate spent fuel for 40 years of reactor operation with burnups in excess of 52 GWD/MTU for PWRs and 45 GWD/MTU for BWRs. Currently operating reactors will require a large capital expenditure to offload all spent fuel into dry storage and will require spent fuel to be cooled for longer than 5 years prior to dry storage.

Based on the above discussion, it would be reasonable to conclude that the combined capital and operating costs associated with removing spent fuel from pool storage to dry storage following reactor shutdown for decommissioning would be greater than or equal to the cost of continued pool storage. This is due to several factors including the large capital expenditures required to construct a dry storage facility and to purchase casks for the entire spent fuel inventory, the carrying cost associated with this capital expenditure, and the added costs associated with loading storage casks. It must also be recognized that spent fuel storage pools may have to remain operational for longer than 5 years due to the fact that spent fuel with higher burnup will require longer cooling times prior to being transferred to dry storage. Longer pool storage requirements along with the added capital costs associated with dry storage would offset possible operating and maintenance cost savings associated with dry storage. In addition, while annual operating and maintenance costs for dry storage have been estimated to be $4 million annually per site, the operating and maintenance cost for post-shutdown dry storage could be much higher depending on individual reactor situations.

A calculation is provided in the enclosed Table 2 of the February 25, 2000, *EIS Commitment Resolution Letter #7,* to the NRC from PFS to demonstrate the above conclusion that dry storage is more expensive than pool storage for post-shutdown spent fuel pool storage at a typical reactor site. For simplicity, costs are provided for a median site size. Since most reactor sites are multi-unit sites, the median reactor site would contain approximately 965 MTU of spent fuel after 40 years of reactor operation. This is consistent with the April 2000 ERI Report's estimate of amounts of spent fuel generated at reactor sites. Two additional ISFSI site sizes are provided for comparison purposes. One is a small site storing 500 MTU of spent fuel and the other is a "Break Even" site storing approximately 230 MTU of spent fuel. The amount of spent fuel at the "Break Even" site was determined by calculating the dry storage facility capacity and associated capital costs that, when combined with ISFSI fixed and Operating and Maintenance costs, would be approximately equal to the costs of post-shutdown pool storage. The average number of years of post-shutdown spent fuel storage is consistent with the No Action Alternative – 2015 Repository scenarios from the April 2000 ERI Report. Spent fuel must be stored for an average of 18 years following reactor shutdown for decommissioning until all spent fuel has been removed from the reactor site by DOE.

As presented in Table 2 , post-shutdown dry storage is more expensive than pool storage for the median reactor site – $209.9 million for dry storage compared to $144 million for pool storage. This is also true for a small site, $167.2 million for dry storage compared to $144 million for pool storage. The "Break Even" site size for which spent fuel pool storage would be approximately equal to the costs of dry storage was calculated to be approximately 230 MTU. These calculations are consistent with actions taken by recently shutdown reactors. Most currently shutdown reactors have a relatively small amount of spent fuel requiring storage and many have decided to transfer spent fuel to dry storage. In addition, because many of these sites shutdown prematurely, spent fuel will be stored at these sites for periods longer than the 18 years calculated for an average reactor operating for 40 years. Thus, while currently shutdown reactors may project that dry storage is the most cost-effective alternative for their spent fuel storage situations, this is not likely to be true for the typical reactor site that has multiple reactors, producing more than 900 MTU of spent fuel, and requiring a projected 18 years of post-shutdown spent fuel storage.

It should also be noted that the calculation does not reflect the time value of money which would result in even higher post-shutdown dry storage costs than pool storage costs since the upfront capital investment required for dry storage would not be discounted for as long a period as annual pool operating and maintenance costs.

CHAPTER 9

ENVIRONMENTAL APPROVALS AND CONSULTATION

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CHAPTER 9

ENVIRONMENTAL APPROVALS AND CONSULTATION

There are several environmental permits and plans required by federal, state and local agencies that are being developed and approved in order to construct and operate the PFSF, the Low Corridor rail line, or the intermodal transfer point. As part of this process, PFS has been meeting with applicable agencies to address environmental compliance related to the project. Further, the federal agencies including the Nuclear Regulatory Commission (NRC), U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Environmental Protection Agency (EPA), Army Corps of Engineers (COE), and certain State agencies continue to consult and be contacted for consultation in accordance with all statutory and regulatory requirements. Comments and recommendations made by these agencies are made part of the review process for NRC and other project-related approvals.

9.1 UNITED STATES GOVERNMENT

The following is a summary of federal agencies that will be involved in the environmental permit and plan approvals and the consultation process for PFSF project construction and operation activities.

9.1.1 Nuclear Regulatory Commission (NRC)

The NRC is responsible for the review and licensing of spent nuclear fuel storage facilities. The federal guidelines for an independent spent fuel storage installation (ISFSI) are identified in 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Wastes". Submittal of a comprehensive License Application (LA), which includes a Safety Analysis Report (SAR) and Environmental Report (ER) that address environmental issues, is required by 10 CFR 72. This ER is being submitted to the NRC with other LA documents for its review and approval.

The transportation of spent fuel from the originating nuclear power plants to the PFSF requires a transportation container that is approved and certified under the requirements of 10 CFR 71. The certification in part ensures that the shipping containers are designed to maintain confinement of the fuel during shipping and preclude any accident scenarios with adverse effects to the environment.

The storage/transportation system vendor, who is providing the storage and transportation systems (Holtec), is required to submit applications to the NRC for approval of a storage system under 10 CFR 72 and a transportation cask under 10 CFR 71. Upon approval of these applications, the NRC will issue Certificates of Compliance for the specific designs.

9.1.2 Department of the Interior (DOI)

9.1.2.1 U.S. Fish and Wildlife Service (USFWS)

The USFWS furnishes lists of threatened and endangered species located near or at a proposed project site. Information from the USFWS has indicated that, there are two threatened (i.e., Bald Eagle and Ute Ladies-tresses), one endangered (i.e., Peregrine Falcon), one proposed endangered (i.e., Least Chub), and two candidate (i.e., Mountain Plover and Spotted Frog) species found in Tooele County and which may occur in the project area. Baseline ecological surveys indicate that none of the listed species, except for transient, infrequent occurrences by Bald Eagles and Peregrine Falcons, are within the proposed PFSF site or transportation corridors. Therefore, there are no expected impacts to rare or endangered species resulting from construction or operation of the PFSF, Low Corridor, or the intermodal transfer point.

9.1.2.2 Bureau of Land Management (BLM)

The Low Corridor rail line and the intermodal transfer point (ITP) will both be located on public lands administered by BLM. The BLM's granting of rights of way will be necessary to utilize public lands for siting these facilities. Applications for rights of way have been submitted to the BLM for both areas. As part of the licensing and right-of-way processes, the federal cooperating agencies including BLM are complying with various federal and state laws, implementing regulations, and related procedures that require the identification, evaluation, protection, and mitigation of cultural and historic resources that could be affected by the Project.

9.1.2.3 Bureau of Indian Affairs (BIA)

Under federal laws and regulations governing business leases with Indian Tribes, the Secretary of Interior, or authorized representative acting pursuant to delegated authority ("Secretary of Interior"), must approve the lease between the PFSLLC and the Skull Valley Band of Goshute Indians (Band) (25 U.S.C. § 415 and 25 CFR 162). This is a federal approval process, which requires compliance with NEPA, and mitigation of any environmental effects identified. Since NRC approval also requires compliance with NEPA, the two agencies are working together on an EIS with the BIA and DOI, acting as cooperating agencies with the NRC. The lease with the Band has been approved subject to the successful completion of the environmental analysis, issuance of the EIS, modification of the lease to incorporate mitigation measures, if any, and the issuance of the NRC License.

9.1.3 Environmental Protection Agency (EPA)

The permitting of the PFSF, which is located on the Skull Valley Indian Reservation, is governed by federal and tribal law. The following is a summary of the status of environmental permitting activities related to PFSF activities on the Reservation; any associated federal environmental permitting activities are generally administered by EPA Region VIII in Denver, Colorado.

Surface Water Protection

In accordance with the requirements of Section 402 of the Federal Water Pollution Control Act (hereinafter referred to as the Clean Water Act (CWA)), point source discharges of pollutants to waters of the United States must typically be covered by permit. Correspondingly, EPA regulations implement the point source permitting program with respect to storm water and require permit coverage for construction projects disturbing 1 or more acres of soil with discharges to jurisdictional waters (40 CFR 122.26(b)(14) & (15)). EPA has issued an NPDES General Permit for construction projects disturbing 5 or more acres of soil. Soil disturbing activities associated with the construction of the PFSF include:

- 99 acres for the restricted area;
- 6 acres for the PMF berms that will function as diversion ditches;
- 8 acres for the stormwater detention basin located outside the RA, but within the Owner Controlled Area (OCA);
- 22 acres for the construction of the 2.5-mile site access road;
- 5 acres for a construction lay down area south of the site;
- 2 acres for the installation of a septic system and leach field systems; and,
- 17 additional acres (e.g., security) of soil associated with the proposed access road.

EPA is currently developing general permits for discharges associated with smaller construction projects.

If NPDES obligations were triggered, EPA Region VIII would have jurisdiction over storm-water related permitting activities associated with construction on the Skull Valley Indian Reservation. The region in and around the location of the PFSF site is, however, characterized as lacking jurisdictional waters of the United States (see Section 9.1.4). Accordingly, construction on the Reservation will not trigger a CWA permitting obligation. PFS will, however, prepare and implement an Erosion Control Plan that will rely on common engineering/best management practices (BMPs) to minimize any potential for precipitation-related erosion.

Within the Erosion Control Plan, there will be provisions outlining erosion and sediment controls, soil stabilization practices, structural controls, and other BMPs that will be employed during construction to effectively manage construction-related storm water runoff. The Plan will also outline maintenance, inspection, and other BMPs for the effective management of storm water runoff from the concrete batch plant. The detention basin will also be appropriately sized to effectively manage water runoff.

Some of the BMPs that PFS will implement at each construction location are shown in Table 9.1-1. As detailed design of the facility progresses, additional BMPs will be developed, if needed, and incorporated into the construction plans as appropriate.

The Erosion Control Plan will be maintained onsite throughout the construction process and will be updated as appropriate. This document will also be made available for review, upon request, to the EPA and the Band.

As with construction activities, operation of the facility will not trigger an NPDES permitting obligation for at least two reasons. First, the operations will not discharge any process wastewater. Second, as described above, there are no jurisdictional waters in or around the PFSF site.

A Spill Prevention, Control and Countermeasures (SPCC) Plan may be developed prior to facility operation since all diesel fuel storage tanks at the PFSF will be placed above the ground. This fuel tank orientation and the quantity of diesel fuel stored may exceed the threshold that would typically require the development of a SPCC Plan. However, because there are no jurisdictional waters in the vicinity of the facility, any such plan that would be developed would be in accordance with facility management practices rather than pursuant to a CWA requirement.

Drinking Water and Groundwater Protection

Drinking water requirements for the initial construction phase (Phase 1) of the PFSF will be satisfied by early development of the facility water well(s), providing bottled water, or by using an equivalent source of offsite drinking water. Drinking water needs during the later phases of construction (Phases 2 and 3) and operation are expected to be met using surface water tanks fed by one or more wells drilled on the PFSF site, provided that suitable quantity and quality is available onsite.

In the event the onsite well water quality and quantity is inadequate, or if a determination is made that this source of water is no longer viable, the following alternatives for providing potable water to the PFSF site will be explored:

- Placement/development of wells in a different geographical location of the Skull Valley Reservation that can provide the quality and quantity of potable water needed;
- Use of the Reservation's existing water supply; or,
- The purchase of drinking water from an offsite source.

Regardless of which drinking water option is ultimately used, PFS will comply with all applicable Safe Drinking Water Act (SDWA) enabling regulations associated with the delivery of safe and reliable drinking water for the PFS employees.

Sanitary wastewater from PFSF construction and operation activities will be disposed of using two (2) septic tank/leach field systems, each with a design capacity to serve 20 or more people. All PFSF floor drains will be designed to ensure that inadvertent spills of oil, antifreeze, and other chemicals, will not enter the sanitary waste leach field system. The size of these septic tank/leach field systems will require an Underground Injection Control (UIC) registration with EPA Region VIII since septic tank/leach fields with a design capacity to serve 20 or more people are classified as Class V injection wells per 40 CFR 144.81(9). The UIC regulations specify the basic inventory information that must be submitted to EPA before injection of fluids is authorized. That information includes specifics on the nature and type of injection wells. This information must be filed with EPA shortly before placing the sanitary systems into service.

Preservation of Air Quality

Construction and operation activities at the PFSF are not expected to have any measurable impact on the local air quality since no significant criteria or hazardous air pollution emissions will occur. Gaseous criteria pollutant emissions at the PFSF are limited to small propane space heating furnaces, a standby emergency diesel generator, a fire pump diesel, heavy haul trucks, cask transporters, and workers' private vehicles.

The emergency and fire pump diesels, which are non-construction stationary sources of air pollutants smaller than 150kW, and not operating more than 250 hours per year, will not trigger any 40 CFR 60 New Source Performance Standards (NSPS) nor 40 CFR 52 Prevention of Significant Deterioration (PSD) levels. Moreover, the heavy haul trucks, transporters, and private vehicles are considered mobile sources, which are not regulated as stationary sources by the EPA. Finally, the quantity of criteria and hazardous air pollutants expected to be emitted during PFSF operations are not of sufficient magnitude to trigger Clean Air Act (CAA) Title V (40 CFR 71) compliance regulations.

Any potential air quality-related impacts associated with the construction of the PFSF will result from gaseous pollutant emissions from diesel-powered construction equipment, and from fugitive dust emissions from excavation activities and construction equipment. In addition, the concrete batch plant will also be a source of fugitive dust emissions. There are no EPA regulations governing the generation of fugitive dust resulting from construction activities. However, for a project of this size, steps would need to be taken to minimize fugitive dust emissions. Accordingly, a BMP Emissions Control Plan will be developed to provide assurance that fugitive dust emissions will be effectively managed and minimized throughout all of the construction phases of the project. This Plan, which will be integrated into the Erosion Control Plan, will include dust control techniques, such as watering and/or chemical stabilization of potential dust sources.

There are no expected airborne effluents of radionuclides from normal PFSF operation. Accordingly, the 40 CFR 191.03(a) offsite dose limit of 25 mrem is not exceeded and airborne effluent monitoring will not be required.

The diesel tanks for the standby emergency diesel generator and the diesel fire pump will be located above ground. The small levels of Volatile Organic Compound (VOC) emissions from these tanks will be well within 40 CFR 52 and 40 CFR 60 compliance levels.

Refrigerants used for air conditioning at the PFSF will consist of Class II refrigerants (i.e., non-ozone depleting substances). Therefore, provisions of Clean Air Act Title VI, Stratospheric Ozone Protection, relative to the usage and storage of refrigerants will not be applicable.

Because propane stored on site will be used as a fuel, and because no other regulated substances will be present above threshold quantities, the Clean Air Act Risk Management Program regulations, 40 CFR 68, will not apply to the PFSF. PFS will comply with the "general duty" provisions of Section 112(r)(1) of the Clean Air Act.

Pollution Prevention and Waste Management

The PFSF project is committed to pollution prevention and waste minimization practices and will incorporate all Resource Conservation and Recovery Act (RCRA) pollution prevention goals, as identified in 40 CFR 261. Non-hazardous RCRA wastes from construction activities will be appropriately disposed offsite. Throughout operations, the small quantities of waste generated in the health physics lab (40 CFR 262), and the potential 40 CFR 261 RCRA materials, such as lead, dye-penetrant materials (i.e., phosphorescent materials), hydraulic fluids, and miscellaneous lubricants used at the PFSF, will be appropriately handled and disposed. The small quantities of hazardous wastes that would be generated is expected to be much less than 100 kg/month. Thus, PFSF will qualify as a Conditionally Exempt Small Quantity hazardous waste Generator (CESQG). All hazardous wastes that are generated will then be identified, stored, and disposed of in accordance with RCRA requirements applicable to CESQG's.

Since the PFSF design does not include Underground Storage Tanks (UST's), no UST registration with EPA Region VIII will be required.

9.1.4 Army Corps of Engineers (COE)

PFS conducted an extensive wetland and stream survey to determine if any jurisdictional waters of the United States, particularly wetlands or perennial, intermittent, or ephemeral streams, are present along the proposed railroad alignment. This assessment was made to determine PFS permitting obligations under CWA Section 404 (the dredge and fill permit program). The survey, which reflects the characteristics of the entire region, concluded that there are no jurisdictional wetlands or other kinds of waters along the proposed alignment. The ephemeral drainages in the region possess no characteristic ecosystems and end without reaching any jurisdictional water of the United States. The U.S. Army Corps of Engineers has concurred with the survey's findings in a February 1, 2001 letter from the Chief, Utah Regulatory Office, U.S. Army Corps of Engineers.

9.1.5 Department of Transportation (DOT)

Transportation of spent fuel is regulated under 49 CFR 173, "Shippers - General Requirements for Shipments and Packagings", specifically Subpart I addressing radioactive materials. Other regulations pertaining to the transportation of material to the PFSF are:

- 49 CFR 171, "General Information, Regulations and Definitions";
- 49 CFR 172, "Hazardous Materials Tables, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements";
- 49 CFR 174, "Carriage by Rail";
- 49 CFR 177, "Carriage by Public Highway"; and,
- 49 CFR 107 Subpart G (registration/fee to DOT as a person who offers or transports hazardous materials).

9.1.6 The Surface Transportation Board (STB)

In order for PFS to implement either of the two alternative means proposed for cask transport from the railroad mainline at Low, Utah to the PFSF – construction and operation of a new rail line to the PFS (the preferred alternative) or use of heavy haul tractor/trailer via Skull Valley Road – regulatory authority must first be obtained from the United States Surface Transportation Board (STB). As to the first alternative, the STB would have to approve construction and operation of a new rail line and associated sidings between Low, Utah and a point in the south-central portion of the Skull Valley, Utah, where PFS would construct the PFSF. As to the second alternative, the STB would have to approve the construction of a run-around track and sidings at a point approximately 1.8 miles west of Timpie, Utah, where PFS would construct an Intermodal Transfer Point that would be employed to transfer spent nuclear fuel casks transported on existing rail lines to truck for movement to the PFSF. A Notice of Intent to construct rail lines was filed with the STB on August 6, 1999. PFS filed an application for STB approval of the foregoing actions on January 5, 2000. On December 13, 2000, the STB issued a decision approving the two alternatives, subject to further consideration of the environmental impacts upon completion of the environmental review process.

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9.2 STATE OF UTAH

The Low Corridor rail line or intermodal transfer point (ITP) are on land administered by the BLM; the implementation of certain federal and state environmental regulatory programs on those lands is administered by Utah State agencies. The following is a summary of environmental permitting issues insofar as they relate to State agencies.

9.2.1 Utah Department of Environmental Quality (UDEQ)

Surface Water Protection

The Utah Department of Environmental Quality (UDEQ) regulates the discharge of storm water to jurisdictional waters through a Utah Pollutant Discharge Elimination System (UPDES) General Permit (i.e., UAC R317-8-3.9). The UPDES General Permit closely tracks the scope of and conditions in the USEPA Region VIII NPDES General Permit available for construction activity on Indian lands in Utah.

Construction of the Low Corridor rail line will disturb approximately 200 acres of soil; the ITP construction will disturb approximately 11 acres of soil. However, as described above (Sections 9.1.3 and 9.1.4), there is no potential for construction-related storm water discharges to jurisdictional waters. Accordingly, no UPDES permit is required. An Erosion Control Plan will be implemented using common engineering practices to contain soils in and around the construction area. Also, because there are no jurisdictional waters present, a Joint Application for a Stream Alteration Permit from the Utah State Engineer, to satisfy 401 water quality certification, and the COE, to satisfy Clean Water Act Section 404 permitting statutes, is not required.

Once construction is complete, a UPDES Permit will not be required for operational activities at the Low Corridor and ITP since there will be no process wastewater generated or potential for discharge to jurisdictional waters of the United States. An SPCC Plan is also not required at the Low Corridor and ITP locations due to the absence of any above ground or underground diesel fuels or gasoline storage tanks.

Drinking Water and Groundwater Protection

Drinking water needs for the ITP and Low Corridor construction activities will be satisfied by providing bottled water or by using an equivalent offsite source of drinking water. No permanent onsite source of drinking water will be provided for the Low Corridor. Drinking water needs for the ITP will be supplied via a nearby municipal connection.

Sanitary wastewater generated during the construction of the ITP and Low Corridor will be collected in portable toilets and properly disposed of at an offsite location. Sanitary wastes generated at the ITP will be either collected in portable toilets and properly disposed of offsite, or will be routed to a small septic tank/leach field that may have to be installed.

Preservation of Air Quality

Similar to the PFSF, construction and operation activities at Low Corridor rail line or ITP are not expected to have any measurable impact on the local air quality.

Since air pollution emissions generated from the operation and construction of the Low Corridor rail line and the ITP will be either mobile sources, or below regulated levels for stationary sources, no approvals pursuant to Utah's minor new source review program, R307-401, should be required. Similarly, potential emissions will be below the applicability thresholds of the state administered Clean Air Act Title V requirements, R307-415.

Any potential air quality-related impacts associated with the construction of the Low Corridor rail line and ITP will result from pollutant emissions from diesel-powered construction equipment, and from fugitive dust emissions from excavation activities and construction equipment. Concrete for the ITP would be obtained from commercial sources and there would be no related fugitive dust emissions from a concrete batch plant. Fugitive dust generated by construction activities of the rail line and ITP will be minimized as prescribed by Utah Regulation R307-205. A Construction Emissions Control Plan (CECP), will be developed and submitted to UDEQ to provide assurance that fugitive dust emissions will be effectively managed and minimized throughout all of the construction phases of the project.

Pollution Prevention and Waste Management

No RCRA wastes will be generated during operations at the ITP. However, should operational activities result in the generation of minor quantities of hazardous wastes, they will be identified, stored, and disposed of in accordance with CESQG requirements.

9.2.2 Utah State Historic Preservation Office (USHPO)

As part of the licensing and right-of-way processes, the federal cooperating agencies are consulting with Utah's State Historic Preservation Officer (USHPO) and a number of other parties; the consultation is consistent with the NRC NEPA review process and comply with various federal and state laws, implementing regulations, and related procedures that require the identification, evaluation, protection, and mitigation of cultural and historic resources that could be affected by the Project.

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9.3 SKULL VALLEY BAND OF GOSHUTE INDIANS

The PFSF is located on tribal trust lands within the Skull Valley Indian Reservation. The lands are leased to the PFSLLC by the Band, and approved by the Secretary of Interior (See Section 9.1.2.3). The Band is in the process of developing a Tribal Environmental Code and implementing rules. The Band may also be seeking EPA authorization to be the permitting agency for the environmental protection of the Reservation. Until the EPA grants the Band primacy for the implementation and enforcement of federal environmental regulations, the Band has the right to comment on any of the environmental documentation as an independent review agency. Any comments and recommendations will become part of the NRC's NEPA review and approval.

The Band intends to assume the functions of the USHPO for cultural resources issues with respect to Skull Valley Indian Reservation lands, and has indicated that no cultural, sacred or religious sites are present that could be affected by the project. Further, a Class 3 evaluation of historical preservation impacts at the PFSF site has been completed which has identified no cultural or historical impacts on Reservation lands.

The Band could provide drinking water from the existing tribal supply on its Reservation for the construction and operation activities of PFSF. The water may also be used for drinking during the construction of the Low Corridor rail line, and the ITP.

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9.4 TOOELE COUNTY

Tooele County may review the Erosion Control Plan for the portions of the project that are not on the Reservation to ensure that applicable soil erosion and sediment control ordinances are being met. In addition, there is also a County Zoning Ordinance and General Development Plan. However, the Tooele County Zoning Ordinance does not apply to federal lands, such as the land administered by the BLM, and therefore does not apply to development of the Low Corridor rail line, the ITP, or the PFSF.

If a septic tank is installed at the ITP, a construction permit for a septic system with a design capacity of less than 5,000 gallons per day may need to be obtained from Tooele County.

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9.5 PERMIT AND APPROVAL STATUS AND CONSULTATIONS

9.5.1 Permit and Approval Status

An Environmental Permitting matrix was developed to determine Federal, State, Tribe, and local requirements for obtaining various permits and approvals, and towards the development of various environmental plans. This includes obtaining pertinent data including developing a meteorological monitoring plan for the facility and obtaining engineering data on material and waste stream flows.

Several permits and plans associated with construction activities are in various stages of preparation and will be formally filed with the appropriate agency prior to the commencement of construction. Operational permits and plans will be prepared and filed prior to facility operation.

9.5.2 Agency and Public Consultations

Multiple consultations have been initiated and are occurring by and between PFS, federal and state agencies. For example, PFS representatives met with EPA Region VIII on February 9, 1999 and March 23, 2000. Other resource agencies, interested parties and the Band have been contacted to address environmental compliance related to the project.

Additional discussions will be held with review agencies and local citizens groups as the project progresses.

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9.6 REFERENCES

Federal Laws

25 U.S.C. § 415, Leases of Restricted Lands.

33 U.S.C. § 1342, Clean Water Act, Section 402, National Pollutant Discharge Elimination System (NPDES), 1972 with Amendments of 1987.

33 U.S.C. § 1344, Clean Water Act, Section 404, Permits for Dredged or Fill Material, 1972 with Amendments of 1987.

42 U.S.C. § 4321 et seq., National Environmental Policy Act, 1970 with Amendments.

42 U.S.C. § 300f et seq., Safe Drinking Water Act, 1974 with Amendments.

42 U.S.C. § 6901 et seq., Resource Conservation and Recovery Act (RCRA), 1976 with Amendments.

42 U.S.C. § 7661, Clean Air Act, Section 501, Title V - Permits, Amendment of 1990.

Code of Federal Regulations

10 CFR 51.45, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Environmental Reports, NRC.

10 CFR 71, Packaging and Transportation of Radioactive Material, NRC.

10 CFR 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, NRC.

25 CFR 162, Leasing and Permitting, BIA.

40 CFR 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans, EPA.

40 CFR 52, Approval and Promulgation of Implementation Plans, EPA.

40 CFR 60, Standards of Performance for New Stationary Sources, EPA.

40 CFR 68, Chemical Accident Prevention Provisions, EPA.

40 CFR 71, Title V Operating Permits, EPA.

40 CFR 112, Oil Pollution Prevention, EPA.

40 CFR 122, EPA Administered Permit Programs: The National Pollution Discharge Elimination System, EPA.

40 CFR 141, National Primary Drinking Water Regulations, EPA.

40 CFR 144, Underground Injection Control Program, EPA.

40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, EPA.

40 CFR 261, Hazardous Waste Management System; Identification and Listing of Hazardous Waste, EPA.

40 CFR 280, Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks, EPA.

40 CFR 1500 - 1508, Council on Environmental Quality (CEQ) Regulations, EPA.

49 CFR 107, Hazardous Materials Program Procedures

49 CFR 171, General Information, Regulations, and Definitions for Hazardous Materials Regulations, DOT.

49 CFR 172, Hazardous Materials Tables and Communications Regulations, DOT.

49 CFR 173, Shippers - General Requirements for Shipments and Packages, DOT.

49 CFR 174, Carriage by Rail, DOT.

49 CFR 177, Carriage by Public Highway, DOT.

Utah State Regulations

Utah Environmental Rules, Section 307-205, Fugitive Emissions and Fugitive Dust, UDEQ.

Utah Environmental Rules, Section 307-401, Notice of Intent and Approval Order, UDEQ.

Utah Environmental Rules, Section 307-415, Operating Permit Requirements, UDEQ.

Utah Environmental Rules, Section 317-8, Utah Pollutant Discharge Elimination System (UPDES), UDEQ.

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TABLE 9.1-1 (Sheet 1 of 4)

Description of Best Management Practices that Will be Employed During the Construction of the Private Fuel Storage Facility

Construction Location	Site Construction Activity	Minimum Controls/BMPs to be Employed *
PFS Site	Construction of the Probable Maximum Flood (100-year storm) diversion channels	Drainage ditches will be stabilized and lined with rock aggregate/rip rap to reduce flow velocity and prohibit scouring.
	Containment of sediment laden storm water runoff during the grading and construction work associated with storage pad construction	Detention basin - A large storm water infiltration basin will be constructed at the PFS site during the initial phase of construction. This basin will collect the vast majority of wet weather runoff from the construction site. The basin will be designed to capture the 100-year storm event and will be equipped with a stilling basin and an emergency overflow constructed of stabilized non-erodible material. Any solids collected within the runoff entering the basin will settle out and the water will either be evaporated off or will percolate into the subsoils.
	Dissipation of storm water runoff routed around the facility boundary	Flow dissipaters will be installed at each diversion channel to further reduce the velocity of the storm water sheet flow. At a minimum, these devises will be constructed of riprap.
	Stabilization of disturbed soils around the concrete fuel storage pads	Disturbed soils around the 30' x 67' concrete storage pads will be permanently stabilized with a layer of limestone aggregate.

TABLE 9.1-1 (Sheet 2 of 4)

Construction Location	Site Construction Activity	Minimum Controls/BMPs to be Employed *
PFS Site (continued)	Stabilization of disturbed soils around the Canister Transfer Building, Security & Health Physics Building, Operations and Maintenance Building and Administration Building.	Silt fencing and sediment traps will be installed where appropriate. The construction roads will be periodically watered down to control fugitive dust emissions.
PFSF Access Road Construction	Construction of the Probable Maximum Food (100-year storm) diversion channels	As with the drainage ditches around the fuel storage facility, the probable maximum flood drainage ditch constructed perpendicular to the access road entering the site will be stabilized and lined with rock aggregate/rip rap to reduce flow velocity and prohibit scouring. If necessary, a storm water flow dissipation devise will also be placed where the diversion berm redistributes meteoric flow.
	Grading and construction of the access road	Silt fencing and sediment traps will be installed where appropriate. The construction road will be periodically watered down to control fugitive dust emissions. Stone construction pads will be placed at the entrance/exit point of access roads to avoid excessive tracking of dirt and sediment onto county or state highways. Where appropriate, external vehicle washing (without the use of detergents) will be performed on-site if it becomes necessary.

TABLE 9.1-1 (Sheet 3 of 4)

Construction Location	Site Construction Activity	Minimum Controls/BMPs to be Employed *
PFSF Access Road Construction (continued)	Fugitive dust controls from the access road construction	Fugitive dust emissions will be controlled through the implementation of a variety of BMPs. Construction road watering trucks will be used to periodically wet active construction road surface, stone construction entrance pads will be placed at constriction road egress points to avoid excessive sediment tracking onto roadways.
	Construction of drainage ways under the road	Box culverts will be placed at select locations under the access road entering the PFS site. Riprap or other flow dissipation devices will be placed at the culvert where water is dissipated and silt fencing and/or sediment traps will be employed were appropriate.
Low Corridor	Grading and construction of the low corridor rail spur	Silt fencing and sediment traps will be installed where appropriate. Disturbed soils will be limited to the extent practicable to place the rail line. Soils immediately around the rail line will be stabilized with crushed aggregate.
	Stabilization of soil stockpiles associated with cut and fill activities.	Soil stockpiles generated during the construction of the Low Corridor will be placed in a manner to reduce erosion and down gradient areas will be protected by silt fencing. Temporary seeding or additional temporary soil stabilization measures will be applied if necessary.

TABLE 9.1-1 (Sheet 4 of 4)

Construction Location	Site Construction Activity	Minimum Controls/BMPs to be Employed *
	Arroyo crossings	Culverts will be placed in drainage ways along the low corridor and they will be specified to convey runoff from a 100-year storm. In addition, the stone aggregate or other flow dissipation devices will be placed to reduce storm water velocity and minimize erosion. Sideslope soil stabilization devices, including silt fencing and aggregate, will be used where appropriate.
Intermodal Transfer Point	Grading and construction of the ITP and access road	Silt fencing and sediment traps will be installed where appropriate. The construction road will be periodically watered down to control fugitive dust emissions.
Universal Housekeeping BMPs (applicable for all sites)		Construction equipment maintenance and repair will be designated and controlled to prevent the discharge of oils, grease, hydraulic fluids, etc.
		Waste receptacles and/or trash dumpsters will be placed at convenient locations for the regular collection of wastes. Where practicable, materials suitable for recycling will be collected.
		If external washing of construction vehicles is necessary, no detergents will be used and the runoff will be captured in a sediment trap.
		Adequately maintained sanitary facilities will be provided for all construction crews.

* The BMPs identified herein are only a subset of the BMPs that will likely be employed during construction. As detailed design work progresses, additional appropriate BMPs may be identified for specific construction activities and the list correspondingly expanded. Where this occurs they will be added to this list.

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County Comments Tab

Tooele County letter dated June 3, 1997 (2 pages)

SWEC letter dated June 19, 1997 (2 pages) condition. The requirements of EPCRA have therefore been met with respect to hazardous materials at the PFSF. The Emergency Plan implementing procedures will contain a list of all hazardous materials used at the PFSF, including quantities, locations, use and storage requirements.

2.3 CLASSIFICATION SYSTEM

There is a single emergency classification level for events at the PFSF, the Alert classification. This is based on worst-case consequences of potential accidents at the PFSF, the requirements of 10 CFR 72.32(a)(3), and the guidance of NUREG-1567 (Reference 9), which states at page C-6, "Regulations for ISFSI installations located away from a reactor site require only one level of emergency classification; an Alert." This guidance is consistent with NUREG-1140 (Reference 10), which concluded that the worst-case accident involving an ISFSI has insignificant consequences to the public health and safety.

Evaluation of the consequences of credible accidents along with non-credible accidents hypothesized to occur at the PFSF determined that radioactive releases would not require a response by an offsite response organization to protect persons offsite. Therefore, accidents that could occur at the PFSF would be limited to the Alert classification.

2.4 ACCIDENT CLASSIFICATION

Accidents and off-normal events that are possible at the PFSF, including some considered to be non-credible, have been reviewed and assigned a classification of either Non-Emergency or Alert. Table 2-1 summarizes events classified as Alert. The following is a listing and brief description of events considered that fall into each category and rationale for the assigned classification. Emergency action levels at which an Alert is declared are included in Table 2-2.

2.4.1 Representative Off-Normal Events Which Would Not Constitute an Emergency Condition

1. Vertical drop of a storage cask while it is in the process of being transferred from the Canister Transfer Building to its storage location on the pad is not considered to constitute an emergency. The storage casks can withstand a vertical drop of 9 inches without significant damage. The storage casks are lifted less than 9 inches off the ground during movement from the Canister Transfer Building to the concrete pad, and a dropped storage cask would therefore not cause a breach of the canister. The storage cask would continue to perform its safety functions of providing protection from environmental events, shielding, and transferring heat from the canister.

2. Off-normal load handling events occurring during canister transfer operations that result in bumping or dropping a canister are not considered to be emergency events, provided there is no radiological indication of a breached canister. Contamination on the external surfaces of a canister could become airborne in such an accident. This off-normal event was analyzed in the PFSF SAR (Reference 7), where it was determined that doses at the OCA boundary would not exceed 1 mrem, assuming maximum allowable contamination concentrations on the outer surfaces of a canister and 100 percent contamination release. As long as there is no indication of a release of fission products from within the

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

Figure 1.3

PFSF SITE PLAN

PRIVATE FUEL STORAGE FACILITY
EMERGENCY PLAN

FIGURE WITHHELD AS SENSITIVE UNCLASSIFIED INFORMATION

Figure 1.4

PFSF

GENERAL ARRANGEMENT

PRIVATE FUEL STORAGE FACILITY
EMERGENCY PLAN