UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	Docket No. 72-22-ISFSI
PRIVATE FUEL STORAGE, LLC (Independent Spent Fuel Storage Installation)	ASLBP No. 97-732-02-ISFSI November 23, 1997

STATE OF UTAH'S CONTENTIONS ON THE CONSTRUCTION AND OPERATING LICENCE APPLICATION BY PRIVATE FUEL STORAGE, LLC FOR AN INDEPENDENT SPENT FUEL STORAGE FACILITY

Pursuant to 10 CFR § 2.714(b), the State of Utah hereby submits its contentions regarding the construction and operating license application by Private Fuel Storage, LLC's for an Independent Spent Fuel Storage Installation on the Skull Valley Band of Goshutes reservation, Utah. Contentions regarding general NEPA issues, the intermodal transfer site, quality assurance, financial assurance, emergency planning, geotechnical and seismic issues are supported by the Declaration of Lawrence White, PE, Executive Vice President and Senior Program Manager of Versar, Inc., attached hereto as Exhibit 1. Contentions regarding NRC dose limits, facilitation of

decommissioning, thermal design, inspection and maintenance of safety components, quality assurance, helium in canisters, technical qualifications, impacts of onsite storage and transportation of spent nuclear fuel, are supported by the Declaration of Dr. Marvin Resnikoff, Senior Associate of Radioactive Waste Management Associates, attached hereto as Exhibit 2. Other contentions are supported by Affidavits as specified in the particular contention. As documented below, the Applicant, Private Fuel Storage, LLC, does not comply with 10 CFR Part 72 and regulatory guidance. In fact, the license application is substantially incomplete. The State of Utah therefore respectfully submits that this license should be denied.

A. Statutory Authority

CONTENTION: Congress has not authorized NRC to issue a license to a private entity for a 4,000 cask, away-from reactor, centralized, spent nuclear fuel storage facility.

BASIS: The NRC may only license the storage of spent fuel at facilities which are authorized by statute. Bowen v. Georgetown Univ. Hosp., 488 U.S. 204, 208 (1988) ("It is axiomatic that an administrative agency's power to promulgate legislative regulations is limited to the authority delegated by Congress."). The Nuclear Waste Policy Act (NWPA), Part B, Interim Storage Program, 42 USC §§ 10151 - 10157, defines the scope of facilities authorized for interim storage of spent nuclear fuel. In light of the NWPA, NRC cannot rely on its general statutory authority or authority to license spent nuclear fuel as the source of its authority to license a centralized 4,000 cask away-from-reactor facility operated by a limited liability corporation. American Petroleum Institute v. EPA, 52 F.3d 1113, 1119 (D.C. Cir. 1995) ("EPA cannot rely on its general authority to make rules necessary to carry out its functions when a specific statutory directive defines the relevant functions of EPA in a particular area."); Sierra Club v. EPA, 719 F.2d 436, 455 (D.C. Cir 1983), *cert. denied*, 468 U.S. 1204 (1984). NRC's general licensing authority does not give NRC carte blanche authority to make any rules it wishes regarding away-from-reactor storage of spent nuclear fuel.

Initially, NRC licensed ISFSIs under its general regulation for the Domestic Licensing of Special Nuclear Material, 10 CFR Part 70. *See* 45 Fed. Reg. 74,693 (Nov. 12, 1980). Chapter 6 of the Atomic Energy Act deals specifically with special nuclear material in terms of the acquisition and domestic and foreign distribution of special nuclear material. 42 USC §§ 2071, 2073 to 2077. Under the Atomic Energy Act congressional authorization extended to NRC's authority to license civilian ownership and possession of special nuclear material. 42 USC § 2073. However, it was not until the NWPA that Congress specifically addressed storage of spent nuclear fuel.

In the NWPA of 1982 Congress specifically authorized <u>private</u> storage of spent nuclear fuel <u>at reactor sites</u>. Congress authorized storage of spent nuclear fuel <u>away from reactors</u> only at <u>federally owned</u> facilities. 42 USC § 10,155(h). Neither the NWPA, nor the statutory basis in 1980 for NRC to promulgate Part 72, can be construed as authorizing NRC to issue a license for a 4,000 cask, centralized, privately owned, away-from-reactor, nuclear waste storage facility that is being sought by this Applicant.

The NWPA expresses Congress's purpose and intent in dealing with spent nuclear fuel storage.[1] 42 USC § 10,151. Congress directed the NRC and other

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[1] As stated in the legislative history of the Nuclear Waste Policy Act of 1982, PL 97-425, House Report No. 97-491, Pt. 1, p.26 "Background," U.S. Code Cong. & Admin. News 1982, at 3,792: "The need for legislation to address problems besetting nuclear waste management, and **Congressional efforts to address these problems**, has increased and become urgent since the early 1970's. Prior to this time, the inventory of wastes from nuclear activities grew with little public notice and **minor**

authorized federal officials to encourage and expedite the storage of spent nuclear fuel at the site of each civilian nuclear power reactor. 42 USC §§10,151 and 10152. Congress granted the NRC rulemaking authority for licensing technologies for the storage of civilian spent nuclear fuel at the site of any civilian nuclear power reactor. Id. § 10,153. Finally, the NWPA authorized the "establishment of a federally owned and operated system for the interim storage of spent nuclear fuel at one or more facilities owned by the Federal Government with not more than 1,900 metric tons of capacity...." Id. § 10,151(b)(2).

Congress imposed limits on centralized storage of spent nuclear fuel. First, the facility is to be federally owned and operated. 42 USC § 10,155(a). Second, maximum storage capacity is no more than 1,900 metric tons. Id. Third, when providing storage capacity, Congress directed the Department of Energy (DOE) to seek to minimize the transportation of spent nuclear fuel. Id. at § 10155(a)(3). Fourth, storage of spent fuel must be removed from the site not later than 3 years following the date on which a repository or monitored retrievable storage (MRS) facility is available. Id. § 10,155(e). Finally, Congress imposed annual reporting requirements on DOE. Id. § 10155(f).

The stark contrast between what the Applicant is requesting NRC to authorize under Part 72 and the directives Congress imposed on the federal ownership and operation of centralized interim away-from-reactor storage under the NWPA bespeaks

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Congressional concern. (*emphasis added*).

the lack of statutory authority for NRC to license the proposed PFS facility. First, the Applicant's facility would not have the backing of the federal government but would be owned and operated by a limited liability company with no independent assets. Second, instead of a maximum limit of 1,900 metric tons the Applicant requests a maximum limit of 40,000 metric tons. Third, spent nuclear fuel would be transported from all over the United States, primarily from the eastern states, thousands of miles to the Utah facility. Fourth, the Applicant's facility is de-linked from completion of Yucca Mountain or an MRS. There is no assurance that the stored fuel in Utah will ever be moved. Finally, as the licensing of an off-site ISFSI is totally an NRC regulatory creation, there are no Congressional reporting requirements.

Another glaring aberration between this Applicant's proposal under Part 72 and the centralized away-from-reactor storage under NWPA is to contrast the involvement of States. *See* 42 USC § 10,155(d). First, under NWPA, the Secretary of Energy must appraise the State Governor and its legislature of potentially acceptable interim storage sites and the Secretary's intention to investigate those sites.. 42 USC § 10,155(d)(1). Second, the Secretary is required to give timely updates and results of investigations to the Governor and State legislator and enter into negotiations to establish a cooperative agreement between the Secretary and the State. Under such an agreement the State "shall have the right to participate in a process of consultation and cooperation ... in all stages of the planning, development, modification, expansion,

operation and closures of storage capacity at a site or facility within such State for the interim storage of spent fuel from civilian nuclear power reactors." Id. § 10,155(d)(2). Third, the cooperative agreement must include sharing of all technical and licensing information; use of available expertise; joint project review, surveillance and monitoring arrangements; and schedule of milestones and decisions points and opportunities for State review and objection. Id. § 10,155(d)(3). Fourth, the Secretary must periodically report to Congress. Id. § 10,155(f). Finally, a State may voice its disapproval to Congress of a proposal to construct storage capacity of 300 metric ton or larger at any one site. Id. § 10,155(d)(6).

In contrast to a cooperative agreement and meaningful role ascribed to the State under the NWPA, Part 72 requires no cooperation or involvement with the State. What has occurred to date is indicative of the pitiful role assigned to the State under Part 72. First, the Applicant made no effort to apprize the State of its proposed facility. The State first learned about the facility through press releases and by sending State officials to Washington, D.C. to attend meetings between the Applicant and the NRC that were open to the public. Second, there has been no cooperation or consultation between the Applicant and the State. Failure to even allow the State to review and comment on the Emergency Plan, as required by 10 CFR § 72.32(a)(14), is just one conspicuous example of the Applicant's refusal to deal up-front with the State. Finally, there is no opportunity for State review or oversight of the project, except

through litigation. The State endeavored to place some its concerns before the NRC, prior to NRC's acceptance of the application, through 2.206 petitions but the NRC ignored those efforts. Instead, the State has to expend thousands of dollars to participate through intervention in the NRC formal license adjudication if it wants to have any voice in the siting and licensing of this facility. This is a far cry from the role Congress assigned to the State under § 10,155(d).

Another salient factor in the analysis of whether NRC has statutory authority to license the PFS facility is the way in which the Applicant will use public services without any compensation to government coffers. Congress recognized that there would be social and economic impacts associated with a large centralized storage facility. 42 USC § 10,156(e). Accordingly, Congress authorized payment of up to $15 per kilogram of spent fuel or ten percent of costs associated with planning, public services and other social and economic impact costs. Part 72 imposes no requirements on the Applicant to give financial assistance to governmental entities. For example, if NRC licenses the PFS facility, annual shipments of up to 200 casks of nuclear waste may travel through the rail congested and populated Wasatch front area, including downtown Salt Lake City. The State at least receives training and financial assistance from the federal government for the military nuclear waste shipments (such as WIPP wastes) passing through the State as it would if this facility were authorized by the NWPA. But no such assistance will be forthcoming from this Applicant. In fact, the

State is unaware of what arrangements the Applicant intends to use to safeguard shipments and respond to emergencies en route, at Rowley Junction, or along Skull Valley Road. Rather than receiving financial assistance, the State of Utah will be forced to expend funds to ensure that its citizens will not be harmed.

After comparing what this Applicant is requesting and what Congress requires under the NWPA, it should be obvious that NRC by regulation is thwarting the national policy and directives Congress set in the NWPA. NRC is without statutory authority to license the proposed PFS facility.

B. License Needed for Intermodal Transfer Facility

CONTENTION: PFS's application should be rejected because it does not seek approval for receipt, transfer, and possession of spent nuclear fuel at the Rowley Junction Intermodal Transfer Point ("ITP"), in violation of 10 CFR § 72.6(c)(1).

BASIS: PFS has applied to NRC for a materials license to possess spent nuclear[2] fuel rods for storage at the proposed ISFSI site on the Skull Valley Indian Reservation. *See* Notice of Hearing, 62 Fed Reg. 41,099 (July 31, 1997). PFS in its license application states: "Transportation of spent fuel shipping casks from the originating reactor to the [Private Fuel Storage Facility] will occur in accordance with 10 CFR 71 and the originating reactor's license, and is not a part of this License Application." LA at 1-3. PFS identifies two alternatives of shipping spent fuel to the ISFSI. The first alternative is to ship spent fuel by rail to an "Intermodal Transfer Point" at Timpie, also known as Rowley Junction, which lies about 24 miles north of the proposed ISFSI. SAR, Section 4.5.4. The ITS consists of a "rail siding off the Union Pacific Railroad mainline, a 150 ton gantry crane, and a tractor/trailer yard area." Id. The crane is single-failure proof, and housed in a weather enclosure. Id. At the ITS spent fuel casks will be transferred from railroad cars to heavy-haul tractor/trailer trucks for transport to the ISFSI. Id.

The other alternative identified PFS is to build a railroad spur from Rowley

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[2] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

Junction directly to the ISFSI. SAR, Section 4.5.5.1. However, PFS has not shown that it will be feasible to construct a rail spur from the Union Pacific mainline to the proposed ISFSI. *See* Contention T (Inadequate Assessment of Required Permits and Other Entitlements), whose basis 1(c) is incorporated herewith. Until such time as PFS can prove by documentary evidence that it will have the technical, legal and financial capability to construct a rail spur, the assumption should be made that shipments will be offloaded at Rowley Junction and transferred from rail to truck by PFS at the ITP at an intermodal building constructed at Rowley Junction. *See* SAR Fig. 4.5-1.

Contrary to PFS's assertions, the Rowley Junction operation is not merely a part of the transportation operation. Rather, PFS will be receiving and handling thousands of tons of spent nuclear fuel at a fixed location, using fixed equipment that is owned and operated by PFS for the purpose of facilitating the onsite storage of the spent fuel at the ISFSI. Moreover, given the enormous volume of spent fuel that must pass through the ITS, the laborious operation that is required to transfer the extremely heavy casks from railroad cars to heavy haul trucks, it is more than likely that casks shipped to the ITS will become bottlenecked there.[3]

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[3] Even in the unlikely event that PFS finds a way to build a rail spur from the Union Pacific mainline located to the north of Interstate 80 at Rowley Junction, by bringing the rail spur over or under Interstate 80, and acquiring the appropriate rights-of-way and other necessary approvals for a 24 mile long rail track to the Skull Valley reservation, the volume of rail traffic will likely result in some storage at Rowley Junction.

The sheer volume of rail traffic carrying spent fuel casks coming into Rowley Junction will be substantial. The Applicant expects to receive shipments of up to 200 casks per year, all of which will come through Rowley Junction. SARat 1.4-2. Each cask will contain approximately 10 MTU (metric tons of uranium) of spent fuel.[4] Contrasting the anticipated volume and quantity of fuel shipments that will pass through Rowley Junction with similar shipments that occurred during 1979 to 1996, illustrates the magnitude of the shipping regime required under this license application. NRC's complication of total spent nuclear fuel shipments from nuclear utilities and research facilities during the period 1979 to 1996 shows there were 1,319 total shipments or 77 shipments per year. The total amount of fuel shipped was 1,413 MTU or 83 MTU per year, of which 75% was shipped by rail. U.S. NRC, Public Information Circular for Shipments of Irradiated Reactor Fuel, NUREG-0725, Rev. 12, Washington, DC: October 1997,at 4. The foregoing also illustrates that the volume of fuel to be handled at the Applicant's intermodal transfer facility will be unlike the intermodal transfer operations that have actually occurred at commercial nuclear power plant sites, such as heavy haul truck to onsite rail, when the power plant's on-site fuel handling building did not have a rail spur.

The volume of fuel shipments will not be capable of passing directly through

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[4] The Applicant is requesting a license for 40,000 MTU of spent fuel which will require approximately 4,000 casks. LA at 3-1.

Rowley Junction, especially given the recent and ongoing operational and safety concerns Union Pacific is experiencing with its railroad system, without undergoing storage. *See* State of Utah's Request for Hearing and Petition for Leave to Intervene, Docket No. 72-22, Exh. 3. (filed Sept. 11, 1997). It is reasonable to assume that a number of casks will arrive via rail contemporaneously, necessitating some type of temporary storage at the site of the ITP. The operational constraints on the ITP associated with the anticipated slow speeds and long travel distances (24 miles one-way) required for heavy haul transport from the transfer point to the proposed ISFSI, the anticipated volume of shipments (100 to 200 casks annually, requiring 200 to 400 one-way heavy haul trips), and the anticipated use of a public highway (with no available heavy haul routing alternatives), a queuing of casks at the intermodal transfer point awaiting heavy haul transport is apparent. During the projected lifetime of the facility a large number of casks will be transported though the Rowley Junction, and at least part of the time, a cask or casks will be present at Rowley Junction, thus, making Rowley Junction a storage facility for nuclear materials.

The application fails to discuss the number of heavy haul trucks (referred to in the SAR as "heavy haul transport tractor/trailers") that will be available to transport the casks, the mechanical reliability of these units, and their performance under all weather conditions. Such a explanation is necessary to analyze the amount of queuing and storage that will occur at Rowley Junction. SAR 4.45.4.2 states that the maximum

weight of the loaded shipping cask will be 142 tons and require the use of overweight trailers. The tractor/trailer are 12 feet wide and travels at "low speeds." Given the special design features, size and probably costs of these units (*see* Fig. 4.5-4), it is important to ascertain whether the Applicant anticipates acquiring more than only a few of these units.

Another factor that may significantly contribute to the queuing of casks at Rowley Junction is the fact that PFS intends to return defective or contaminated casks to the originating utility. Thus, there are likely to be heavy haul trucks and railroad shipments going in both directions, necessitating greater use of cranes and more coordination of transfer operations.

As a result, the ITP will constitute a de facto interim spent fuel storage facility, as defined in 10 CFR § 72.3, at which PFS will receive, handle, and possess spent nuclear fuel for extended periods of time. Accordingly, PFS should not be granted a license unless it includes possession of spent nuclear fuel at the ITP.

Moreover, Part 72 licensing is necessary in order to protect the public health and safety. The ITP is stationary in nature, including the construction and installation of a facility and heavy equipment, the continuous presence of spent fuel arriving at or departing from the ITP, and the potential long-term storage of some of the fuel. Because of the stationary nature of the ITP, it is important to provide the public with the regulatory protections that are afforded by compliance with 10 CFR Part 72. For

instance, PFS should have a security plan that protects the site from intruders according to NRC standards. There should also be an emergency plan to protect workers and the public in the event of an accident at the ITP. In addition, the boundaries of the ITP site should be identified, and dose analyses performed to ensure that nearby members of the public are not exposed to unacceptable doses from spent fuel that is sitting on the site. PFS should also provide assurance that the ITP is designed in a way that protects public health and safety, using appropriate structures, equipment, and protective measures. None of this information is currently provided in the SAR. In the absence of such measures, the ITP poses an unacceptable safety and health risk to workers and the public.

C. Failure to Demonstrate Compliance With NRC Dose Limits.

CONTENTION: The Applicant has failed to demonstrate a reasonable assurance that the dose limits specified in 10 CFR § 72.106(b) can and will be complied with.[5]

BASIS: Pursuant to 10 CFR § 72.106, any individual located on or beyond the nearest boundary of the controlled area of an ISFSI may not receive a dose greater than 5 rem to the whole body or any organ from any design basis accident. NRC regulations at 10 CFR § 72.126(d) require the submission of analyses that demonstrate compliance with this requirement. In addition, 10 CFR § 72.24(m) requires that an application for an ISFSI or MRS license must contain an "analysis of the potential dose equivalent or committed dose equivalent to an individual outside the controlled area from accidents or natural phenomena events that result in the release of radioactive material to the environment or direct radiation from the ISFSI or MRS." The dose calculations "must be performed for direct exposure, inhalation, and ingestion occurring as a result of the postulated design basis event." *See also* NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage (Draft) at 12-3 (October 1996), which defines a design-basis accident as "the subset of all credible accidents that bound the entire spectrum of accidents that could occur in terms of the nature and consequences of accidents."

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[5] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

The Applicant does not meet the requirements of 10 CFR §§ 72.106(b), 71.126(d), or 72.24(m) in two respects. First, the Applicant makes assumptions about the HI-STORM and TranStor casks that have not been reviewed or approved in a proceeding for approval of those casks. Second, the Applicant fails to provide an adequate evaluation of the dose consequences of a design basis accident involving loss of containment barrier. The analysis performed by the Applicant is internally inconsistent, and fails to take into account significant factors affecting the dose consequences of a design basis accident involving loss of confinement barrier.

The Applicant's failure to demonstrate that offsite doses can be contained within acceptable limits not only violates 10 CFR §§ 72. 106(b), 71.126(d), and 72.24(m), but undermines the Applicant's basis for failing to require offsite emergency planning measures in the event of an accident. As discussed in the preamble to the Commission's 1986 proposed amendments to the Part 72 standards, the determination that "special offsite emergency preparedness" is not necessary for spent fuel storage is based on the assumption that doses calculated to result from potential accidents are "far below" EPA protective action guides. 51 Fed. Reg. 19,106, 19,109 (May 27, 1986). Because this assumption appears to be valid in the case of the proposed ISFSI, the need for offsite emergency planning must be considered.

1. Use of unreviewed data about HI-STORM and TranStor casks.

According to the Applicant, the design basis accident is based in part on the design of

the Holtec-HI-STORM and SNC TranStor casks. *See, e.g.*, SAR at 8.2-2 - 8.2-10, 8.2-16 - 8.2-17, 8.2-22, 8.2-25 - 8.2-26, 8.2-31 - 8.2-34, 8.2-38. The design for these casks has yet to be fully reviewed or approved by the NRC; thus, they provide an inadequate basis for the SAR.

2. **Selective and inappropriate use of data sources, failure to consider significant dose contributors, and use of outdated model.** In Section 8.2.7, the Applicant evaluates a hypothetical loss of confinement barrier, which is defined in the applicable industry guidance (ANSI/ANS 57.9) as a Design Event IV. Although the Applicant does not deem this accident to be credible, it nevertheless proceeds to evaluate the dose consequences of the accident, and concludes that they are below the dose limits specified in 10 CFR § 72.106(b). The Applicant's assertion that a loss of confinement accident is not credible is contradicted by studies showing the credibility of sabotage-induced accidents which lead to loss of confinement barrier. *See, e.g.*, Halstead and Ballard, Nuclear Waste Transportation Security and Safety Issues: The Risk of Terrorism and Sabotage Against Repository Shipments, for the Nevada Agency for Nuclear Projects at 25 (October 1997), Exhibit 3. Moreover, the Applicant's analysis of the dose consequences of loss of containment barriers is inadequate, because it makes selective and inappropriate use of data sources regarding doses, and fails to take important dose contributors into account.

a. **Selective and inappropriate use of data sources.** First, the

Applicant's accident analysis, presented in Section 8.2.7.2 of the SAR, makes inconsistent use of regulatory guidance and studies to support its conclusion that doses from the postulated accident scenario will be below regulatory limits. As presented in the table on page 8.2-37, the Applicant assumes that the fraction of Cs-134, Cs-137, and Sr-90 that will be released into the canister is 2.3 E-5 for each constituent. This fraction comes from NUREG-1536, Standard Review Plan for Dry Cask Storage Systems. Then, PFS uses figures from a report by Sandia National Laboratories on impacts of transportation accidents, to argue that of the fraction released from the spent fuel to the canister, 90% of the volatiles (Co-60, Sr-90, I-129, Ru-106, Cs-134 and Cs-137) will not escape the canister. SAR at 8.2-38, *citing* Table XIX of SAND80-2124, Transportation Accident Scenarios for Commercial Spent Fuel, Sandia National Laboratories (1981) (hereinafter "Sandia report"). The use of the 90% figure is suspect in two respects. First, PFS's use of the Sandia Report is selective. The Sandia Report also provides an estimate of the initial release fraction into the canister, of 4E-3. Id. at 8.2-39. This is almost 200 times greater than the initial release fraction estimated in NUREG-1536, and used by PFS. PFS appears to have selectively chosen data that would support a lower dose calculation. As a result, PFS estimates a release from the canister of 1.15 E-7, which is a factor of almost 3,000 smaller than the release of 3 E-4 estimated by Sandia. SAND-2124 at 42, Scenario 4. Moreover, the assumption that 90% of the inventory will not be released is based on a transportation accident

scenario, in which the cask is breached through a high-velocity impact. *See* SAND-2124 at 25-30, Accident Scenarios. In contrast, the scenario evaluated in the SAR involves an accident during onsite storage. PFS does not appear to have evaluated the differences in the characteristics of high-velocity transportation accidents and accidents involving static storage of dry casks, and thus does not provide a basis for the use of the Sandia figure.

The Applicant also relies on the Sandia report for its assumption that only 5% of the release fraction of Co-60 and Sr-90 will be respirable.[6] SAR at 8.2-39. Based on this assumption, the Applicant calculates a committed effective dose equivalent (CEDE) to an adult at 500 meters from the HI-STORM cask to be 547 mrem, that is, less than the regulatory limit of 5 rems. Again, PFS does not explain why it was appropriate to use this particular assumption from the Sandia Report, but not the assumption regarding the initial release to the plenum, which would have yielded a higher dose than calculated by PFS. Moreover, Sandia's assumption of a 5% respirable release fraction is based on a transportation accident involving impact and fire, in which some irradiated fuel will flake off in large pieces and not be respirable. SAND-2124 at 38. While this may be an appropriate assumption for a transportation accident, PFS provides no evidence that it is an appropriate assumption for the fuel failure accident evaluated in the SAR. In fact, it is reasonable to anticipate that in an onsite

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[6] Respirable particles have a diameter of less than 10 μm.

1. Presiding – lose independence –

2. Staff – bias –

3. Delay – re prehearing order – ?

4. ADR –

5. Voluntary disclosure –

6. Bifurcated Comm –

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accident not involving a high-velocity impact that breaks fuel into large chunks, particulates in the gap between the canister and the cask will be of a smaller size. Therefore a greater percentage will be respirable.

b. Failure to take dose contributors and relevant guidance into account. PFS calculates the dose to an adult 500 m from the accident, due solely to inhalation of the passing cloud. SAR at 8.2-39. Other relevant pathways, such as direct radiation from cesium deposited on the ground, and ingestion of food and water or incidental soil ingestion, are not considered, in violation of 10 CFR § 72.24(m). PFS also appears to assume that local residents will be evacuated until contamination is removed, although this is not expressly discussed. This is an unreasonable assumption because PFS's emergency plan does not assume residents are evacuated. In addition, PFS fails to calculate doses to children, which are higher because a child's ratio of surface area to volume of organs is higher. Finally, PFS uses the ICRP-30 dose model, which is an outdated dose model that is inadequate to calculate radiation doses to humans, especially inhalation doses. PFS should be required to use the ICRP-60 dose model which is more accurate for human radiation doses, and also correctly calculates the dose to children.

D. Facilitation of Decommissioning

CONTENTION: The proposed ISFSI is not adequately designed to facilitate decommissioning, because PFS has not provided sufficient information about the design of its storage casks to assure compatibility with DOE repository specifications. Moreover, in the reasonably likely event that PFS's casks do not conform to DOE specification, PFS fails to provide any measures for the repackaging of spent fuel for ultimate disposal in a high level radioactive waste repository. Moreover, PFS provides no measures for verification of whether the condition of spent fuel meets disposal criteria that DOE may impose.[7]

BASIS: Pursuant to 10 CFR § 72.130, an ISFSI or MRS:

> must be designed for decommissioning. Provisions must be made to facilitate decontamination of structures and equipment, minimize the quantity of radioactive wastes and contamination of structures and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated materials at the time the ISFSI or MRS is permanently decommissioned.

Reg. Guide 3.48 also states that "the applicant should discuss the considerations given in the design of the facility and its auxiliary systems, including the storage structures, to facilitate eventual decommissioning." Id. at 3-8.

Proposed measures to facilitate the decommissioning of the proposed PFS facility are discussed in Appendix B of the License Application, and in Section 3.5 of

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[7] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

the SAR. Neither of these discussions proposes any measures for addressing the significant impediment to safe, timely, and efficient decommissioning of the proposed ISFSI, posed by the potential incompatibility between the design of PFS storage canisters and the DOE's acceptance criteria for the packaging of spent fuel in a high level nuclear waste repository. These criteria are currently under development.

The SAR states that, "When the storage period for any particular canister of spent fuel is completed, the canister shall be transferred into a shipping cask and shipped offsite." Id. at 3.5-2. No further details are provided, except a reference to Section 2.4 of the HI-STORM and TranStor applications, and Appendix B of the License Application mentioned above. Section 2.4 of the TranStor application does not address the issue of compatibility with DOE requirements at all. Section 2.4 of the HI-STORM application states that the HI-STORM canister is "[d]esigned to be completely congruent with the MPC concept, as articulated by the U.S. Department of Energy." However, the HI-STORM application provides no information regarding the nature of the "MPC concept", how it relates to DOE waste acceptance criteria, or how exactly the HI-STORM system is "congruent" with the concept. In the absence of any such information, there is no basis for concluding that PFS has taken any measures to facilitate the decommissioning of the ISFSI by ensuring compatibility of its storage casks with DOE acceptance criteria.

Moreover, although DOE has not yet issued its design criteria, currently available information shows a significant potential for disparities between the waste acceptance criteria and the specifications for PFS's storage canisters. For instance, DOE will have requirements on thermal limits per unit area. DOE will have limits on the size and weight of shipping containers. Sierra Nuclear and Holtec storage casks may be incompatible with these acceptance criteria. DOE's MPC cask is designed to hold 21 PWR fuel assemblies, i.e., less fuel assemblies than the Holtec (24 or 32 PWR assemblies) and the Sierra Nuclear canister. DOE, Office of Civilian Radioactive Waste Management, Multi-Purpose Canister (MPC) Implementation Program, Conceptual Design Phase Report, Volume I – MPC Conceptual Design Summary Report (Final Draft: September 30, 1993) attached as Exhibit 4. DOE may also require that irradiated fuel be transferred to the proposed Yucca Mountain repository in DOE casks, which may not be compatible with the Holtec or TranStor canister.

DOE may also place limits on the acceptable physical state of irradiated fuel, *i.e*, by requiring a demonstration that there are no gross cladding defects. It is reasonable to anticipate that in connection with such a requirement, DOE will require that a representative canister of irradiated fuel be opened to demonstrate that irradiated fuel is acceptable. Although 10 CFR § 72.122(h) requires PFS to confine spent fuel in a way that degradation of fuel during storage will not pose operational safety problems with respect to its removal from storage, PFS has no means of inspecting the interior

of spent fuel canisters in order to determine the condition of the fuel for purposes of complying with this requirement.

In order for PFS to transfer fuel to casks that are compatible with DOE requirements, or to inspect the fuel for degradation of cladding, a hot cell is needed. In the hot cell, fuel cylinders with degraded cladding would be removed from the canister, repackaged, and replaced in the canister. However, PFS's design makes no provision for a hot cell. Instead, PFS apparently expects that these operations will take place at the originating reactor or at the Yucca Mountain repository.

Neither of these expectations is realistic. Few, if any of the originating reactors will be available to handle irradiated fuel by the time Yucca Mountain is ready to receive spent fuel, which may be as late as 2063, or even later. The proposed repository is not expected to operate until the year 2015, according to the NRC, or as late as the year 2023, according to the GAO. GAO/T-RCED-93-58, Yucca Mountain Project Management and Funding Issues, statement of Jim Wells (1993). A queue has been established for the first ten years of repository operation. DOE/RW-0457, Department of Energy Annual Capacity Report (OCRWM: March 1995), attached hereto as Exhibit 5. On average, power plants will be able to unload approximately ¼ of their irradiated fuel inventory the first ten years. It may require an additional 30 years to dispose of the remainder. That is, it is entirely possible that all irradiated fuel may not leave the PFS site until the year 2063, if the Yucca Mountain repository is

indeed licensed in the year 2023. At such a late date, it is unlikely that irradiated fuel pools will be available to transfer fuel from one canister to another.

It is also unreasonable to rely on a facility to transfer individual fuel assemblies at Yucca Mountain. First, if fuel is degraded, it should not be shipped from the ISFSI. Degradation of cladding increases the risk of accidents during transportation, because it diminishes or removes one of the key barriers to environmental release of radiation. Instead, the problem should be addressed at the ISFSI. Moreover, there is no reason to believe that the Yucca Mountain facility will be equipped with the necessary equipment to handle inspections and inter-cask transfers for the many cask designs that are now and will be in use when it is opened. It is far more reasonable for the DOE to require all potential users of the repository to properly package their waste before shipping it to the facility.

Thus, contrary to the requirements of 10 CFR § 72.130 and Reg. Guide 3.48, the PFS facility is not designed to facilitate decommissioning, because the facility does not have the capability to repackage canisters by transferring individual fuel assemblies.

E. **Financial Assurance.**

CONTENTION: Contrary to the requirements of 10 CFR §§ 72.22(e) and 72.40(a)(6), the Applicant has failed to demonstrate that it is financially qualified to engage in the Part 72 activities for which it seeks a license.[8]

BASIS: A Part 72 application must state "information sufficient to demonstrate to the Commission the financial qualifications of the Applicant to carry out, in accordance with the regulations in this chapter, the activities for which the license is sought." 10 CFR §72.22(e).

The Commission will issue a license upon a finding that "the applicant for an ISFSI or MRS is financially qualified to engage in the proposed activities in accordance with the regulations of this part." 10 CFR § 72.40(a)(6).

The Part 72 standard, which is very general, may be interpreted by reference to the standards for financial qualifications set forth in 10 CFR Part 50 and Appendix C. A recent decision by the Licensing Board, interpreting the financial requirements in 10 CFR Part 70, illustrates the reasons why it is appropriate to apply the Part 50 standards to PFS. *See* Louisiana Energy Services, L.P. (Claiborne Enrichment Center), 44 NRC 333 (1996) (appeal pending) (hereafter "Claiborne"). In that case, the Licensing Board relied on the Part 50 regulations to review the financial qualifications of a newly formed special purpose entity without an operating record in a Part 70 licensing action.

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[8] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

Under Part 70, the Commission will approve a license if it determines that "the Applicant appears to be financially qualified to engage in the proposed activities in accordance with the regulations of this part." 10 CFR §72.23(a)(5). The Part 50 standard contains very similar language, requiring the Commission to consider whether "[t]he applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in the chapter." 10 CFR § 50.40(b). In Claiborne, the Board turned to the rule of statutory construction that provisions that relate to the same subject matter should be construed *in pari materia*. Id. at 384, *citing* 2B Sutherland Stat. Const. §§ 51.05, 51.05 (5th ed. 1992). Moreover, the Board found the Part 50 and Part 70 regulations "essentially began as twins." Id. At 391. As the Board observed:

> Although the paths of the regulations have diverged somewhat since 1967, the essence of the Part 70 and Part 50 regulations with respect to construction financing and the standard the Commission must apply in granting a license under these Parts has not significantly changed since the initial issuance of the regulations. At that time, because the critical language of the provisions was nearly identical, the provisions had the same basic meaning. Indeed, as the Director of Regulation's response to a congressional inquiry indicated, the Commission's financial qualifications reviews of Part 70 and Part 50 license applicants applied the same principles under both regulations at that time.

44 NRC at 391. Thus, the Board concluded that the regulations began with "the same basic meaning" that "has not significantly changed since the issuance of the regulations." Id. Finally, the Board found that Part 50 was applicable because the "fundamental purpose" of the Appendix C requirements, to protect public health and

safety is "equally involved" in the licensing of a nuclear plant and "the first privately owned enrichment facility in the United States." Id. at 392.

The same analysis is applicable under Part 72. First, the language of the Part 50 and Part 72 standards is identical, requiring the license applicant to demonstrate that it "is financially qualified." Moreover, the congruent history of the Part 50 and 70 standards, which the Board describes in detail at 42 NRC 384-391, is equally applicable to the development of the Part 72 standard. Until 1980, ISFSIs were regulated under Part 70. The "Information Handbook on Independent Spent Fuel Storage Installations," NUREG 1571 at 1-1, 2, gives a brief history of the development of Part 72 regulations:

> ISFSI regulation was originally governed by 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." In 1974, the Atomic Energy Commission (predecessor of the NRC) issued a regulatory guide on storage of spent fuel in ISFSIs, Regulatory Guide 3.24, "Guidance on the License Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation," which then supported 10 CFR Part 70.... In November 1980, the staff issued 10 CFR 72, "Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation," superseding 10 CFR Part 70 and Regulatory Guide 3.24 with respect to the regulation of spent fuel storage in ISFSIs.

Moreover, the "fundamental purpose" of the Part 50 standard is "equally involved" in this case, where a newly formed entity seeks permission to construct and operate a first-of-its kind, major nuclear facility for the long-term storage of thousands of tons of spent nuclear reactor fuel. Thus, Part 50 provides relevant guidance to

review whether this Applicant has demonstrated adequate financial assurance under Part 72.

The Applicant, Private Fuel Storage, LLC (PFS), is a Delaware limited liability company. LA at 1-4. The company was formed to construct and operate a privately owned ISFSI for the purpose of providing private centralized spent nuclear fuel storage to the nuclear utility industry. ER at 1.2-2. The Applicant is a newly formed special purpose entity without an operating record. Thus, the regulatory standards in Part 50 for financial qualifications of newly formed entities must be applied to PFS's license application.

Under Part 50.33(f) "[e]ach application for a construction permit or an operating license submitted by a newly-formed entity organized for the primary purpose of construction or operating a facility must also include information showing:

> (i) The legal and financial relationships it has or proposes to have with its stockholders or owners;
> (ii) Its financial ability to meet any contractual obligation to the entity which they (sic) have incurred or proposed to incur; and
> (iii) Any other information considered necessary by the Commission to enable it to determine the applicant's financial qualifications.

Additional guidance, provided in Part 50, Appendix C, describes the general kinds of financial data and other related information that will demonstrate the applicant's financial qualifications. In Appendix C, the Commission distinguishes between two classes of applicants: those which are established organizations (App C.I) and those that are newly formed entities (App C.II). PFS is a newly formed entity

without an established operating record and thus its financial qualifications should be reviewed under the criteria established in Appendix C.II.

> As to the source of construction funds, Appendix C.II requires the applicant to specifically identify the source or sources upon which the applicant relies for the funds necessary to pay the cost of constructing the facility, and the amount to be obtained from each. With respect to each source, the applicant should describe in detail the applicant's legal and financial relationships with its stockholders, corporate affiliates, or other (such as financial institutions) upon which the applicant is relying for financial assistance.

When the Applicant relies on parent companies or corporate affiliates as a source of funding, it must also demonstrate "the financial capability of each such company or affiliate to meet its commitments to the applicant" and "[o]rdinarily, it will be necessary that copies of agreements or contracts among the companies be submitted." Id. Finally, the Applicant should "include in its application a statement of its assets, liabilities, and capital structure as of the date of the application." 10 CFR Part 50, App C.II. While Appendix C recognizes that construction costs will vary by the type of facility, it requires construction costs "be itemized by categories of cost in sufficient detail to permit an evaluation of its reasonableness." Id. App. C.I.[9]

The Applicant's financial qualifications to carry out the activities it seeks under this license application and the information the Applicant submitted to demonstrate its financial qualifications are deficient in the following respects:

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[9] Appendix C generally treats estimates of construction costs the same for established organizations and newly formed entities. 10 CFR § 50, App. C.II.A.1.

1. Information in the application about the legal and financial relationship among the owners of the limited liability company (*i.e.* the license Applicant) is appallingly deficient. The Applicant merely states it is "a limited liability company owned by eight U.S. utilities which serve more than 17 million customers in 21 states." LA at 1-3. These owners are not explicitly identified, nor are their relationships discussed, as required by 10 CFR §§ 50.33(c)(2) and 50.33(f) and Appendix C, § II. Instead, the only information provided by the Applicant which might conceivably be relevant to this requirement is a list seven nuclear utility officials who serve as Directors of PFS as of June 1997. LA at 1-10. It is not clear whether these individuals represent the owners of the business, or if so, what happened to the eighth owner. This extremely limited information does not even begin to satisfy the NRC's financial qualifications to engage in the Part 72 activities it seeks under this license application.

2. The Applicant is a limited liability company organized under the laws of Delaware. LA at 1-4. There is no evidence that the Applicant is anything more than a shell company devoid of any assets or capital. As part of the Applicant's demonstration of financial qualifications, the Applicant must be required to submit a current statement of its assets, liabilities, and capital structure. *See* 10 CFR Part. 50, App. C.II.

3. The Applicant has not taken into account the difficulty of allocating financial responsibility when casks are centrally stored and owned by different entities.

Further, the Applicant also does not address its financial responsibility as the "possessor" of spent fuel casks. The Applicant assumes that the "owner" of the spent fuel will retain responsibility for the fuel. However, the proposition that the originating reactor licensee retains assumption of responsibility for the fuel even when it is in the Applicant's possession create numerous problems. The Applicant intends that its facility will provide storage of spent fuel from commercial nuclear power reactors that are located throughout the United States. LA at3-1. A complex and unworkable liability scheme arises from the storage of fuel casks owned by a myriad of licensees. For example, how will liability, response and cleanup be allocated should there be an accident involving nuclear materials or a spill or release of nuclear materials. The potential for accidents given the surrounding hazardous military activities is not inconsequential. *See* State of Utah's Petition to Intervene, pp. 4, 13. Furthermore, the casks will be located less then four feet apart and will be "owned" by different licensees. This will make it exceedingly difficult to allocate liability and responsibility. The Applicant must address these issues as part of its financial qualification to undertake the licensed activities. 10 CFR § 72.22(e)

4. As the Licensing Board has observed, reasonably accurate cost estimates are important safety requirements under the financial qualifications regulations, because " a licensee in financially straitened circumstances would be under more pressure to commit safety violations or take safety 'shortcuts' than one in good

financial shape." Gulf States Utilities Co. (River Ben Station, Unit 1), LBP-95-10, 41 NRC 460, 473 (1995), *quoting* Gulf States Utilities Co. (River Ben Station, Unit 1), CLI-94-10, 40 NRC 43, 48 (1994). However, the Applicant has failed to show that it has the necessary funds to cover the "[e]stimated operating costs over the planned life of the ISFSI" as required by 10 CFR § 72.22(e)(2) because the application is devoid of specifics about financial information, including cost estimates.

For example, the License Application estimates total construction costs at $100 million, "including site preparation; construction of the access road, administration building, visitors center, security and health physics building, operations and maintenance building, canister transfer building and storage pads; procurement of canister transfer and transport equipment; and transportation corridor construction." LA at 1-5. Similarly, in the ER, the Applicant aggregates all direct costs into one lump sum of $100 million for "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, security, license fees, and taxes." ER at 7.3-1, ER Table 7.3-1. The Applicant lists total life cycle cost for the facility and its operation at $1.526 billion (40 year life) or $1.125 billion (20 year life). Id.

Such vague and generalized cost estimates are insufficient to satisfy 10 CFR Part 50, App.C. § II, which requires that construction costs must be itemized by categories of cost in sufficient detail to permit an evaluation of its reasonableness. Indeed, the

Applicant's representations are meaningless, because they cannot be evaluated unless each portion of the construction costs is specified and the basis for each cost estimate is provided.

Moreover, PFS appears to have significantly underestimated construction costs. In 1993, the Department of Energy (DOE) considered locating a monitored retrievable storage installation (MRS) at the same Skull Valley Reservation. DOE proposed a dry cask storage MRS with a capacity of 15,000 MTU (42 USC § 10168(d)(4)), half the quantity of spent fuel proposed by the Applicant. DOE estimated the construction cost, in 1992-93 dollars, of a dry cask storage facility at $530 million. Skull Valley Band of Goshutes MRS brochure, attached hereto as Exhibit 6. The Applicant's 1997 construction cost estimates are less than one fifth of DOE's 1993 estimates although the Applicant proposes to store twice as much spent fuel as the DOE MRS proposal. Itemization of costs and justification for the cost estimates are essential to estimate cost estimates.

5. Part of the Applicant's plan to obtain funding for its operations includes "equity contributions from PFSLLC members pursuant to Subscription Agreements." LA at 1-4. The Applicant indicates that each of the eight consortium members will contribute equity contributions of an additional $6 million each for a total of $48 million. LA at 1-5. However, the application does not include pertinent portions of subscription agreements or other legally binding commitments to give any assurance

that the Applicant will obtain the necessary funds or even the initial $48 million. When the Applicant relies on its owner members (or its parent companies or corporate affiliates) to provide a source of funding, the Applicant must submit a copy of each Subscription Agreement between PFS and its member companies. *See* Part 50, Appendix C.II.

Moreover, the amount of equity contributions is dependent upon the number of members in the limited liability company; thus the amount of available funds is affected by any withdrawing utility member. In fact, the number of member utilities has already decreased since the formation of the consortium. PFS was initially organized with eleven utility members. The application itself mentions eight members but only identifies seven board members; apparently each board member represents a consortium member. The Applicant must demonstrate financial qualification prior to licensing the facility–not at some future date. *See* Claiborne, 44 NRC at 403. The Applicant's failure to document its funding source is one reason why this Applicant has not shown it either possesses the necessary funds or has reasonable assurance of obtaining or even retaining necessary funds for the activities sought under its license application. *See* 10 CFR § 72.22(e)

6. The Applicant also plans to raise additional capital through "Service Agreements" with customers. LA at 1-5. Based on the Applicant's own estimates, at a minimum it must raise an additional $52 million just to complete construction. The

Applicant must demonstrate "reasonable assurance of obtaining the necessary funds" not simply identify a mechanism for obtaining funds. Furthermore, the terms of the service agreements are not even provided, including items such as costs, periodic terms, liability, performance, and breach clauses.

To show it has reasonable assurances of obtaining funds, the Applicant should document an existing market and the commitment of a sufficient number of service agreements to fully fund construction of the facility. The Applicant implies that 15,000 MTU of storage commitments would be adequate to fund construction. LA at 1-5. The Applicant has not substantiated how storage commitments for 15,000 MTUs would be adequate. In addition, there must be sufficient funds committed for operation, decommissioning, and contingencies for the number of casks contracted to fund construction.

7. The Applicant also mentions an option to finance construction costs through debt financing secured by service agreements. LA at 1-6. Similarly, debt financing will not be viable until a minimum value of service agreements is committed. Moreover, the Applicant will not be capable of securing debt financing without providing supporting documentation, including the service agreements. Thus, the Applicant failed to show that it has reasonable assurance of obtaining necessary funds through debt financing.

8. The License Application states that "on-going operations and maintenance costs . . . will be paid by the customer on an annual basis." LA at 1-6. Although the Applicant states that it will require financial information from its "customers," Id., it has not addressed funding contingencies in the event a customer breaches the service agreement or becomes insolvent while the customer's spent fuel is stored at the ISFSI. The Applicant does not provide reasonable assurance that adequate funds are available to ensure the safe operation and maintenance of spent fuel storage in the event of insolvencies or even while disputes are being resolved.

F. **Inadequate Training and Certification of Personnel.**

CONTENTION: Training and certification of PFS personnel fails to satisfy Subpart I of 10 CFR Part 72 and will not assure that the facility is operated in a safe manner.[10]

BASIS: "Under Subpart I, operation of equipment and controls that have been identified as important to safety in the SAR and in the license must be limited to trained and certified personnel or be under the direct visual supervision of an individual with training and certification in the operation." Further, under 10 CFR § 72.192, the applicant for a license shall establish a program for training, proficiency testing and certification of ISFSI or MRS personnel. This program must be submitted to the Commission for approval with the license application." Finally, under 10 CFR § 72.194, the physical conditions of operators must ensure that operational errors are not caused. Conditions that might cause impaired judgment must be considered in the selection of personnel.

PFS organizational structure, including responsibilities and qualifications is laid out in Section 9.1 of the SAR. The pre-operational testing program is discussed in section 9.2; the testing program in section 9.3. These sections do not satisfy the minimal NRC requirements and do not provide assurance the facility will be operated in a safe manner.

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[10] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

1. **Training and certification program.** Contrary to these regulations, the Applicant has not explicitly defined a training and certification program. A training, certification and testing program has not been submitted with the license, and a listing of physical conditions that would bar a person from employment in specific positions has not been defined.[11]

2. **Physical condition of operators.** The SAR has no discussion regarding the physical condition of operators, as required by 10 CFR § 72.194. A potential operator should be required to pass a medical examination that certifies the operator has the physical ability to carry on duties of his/her specific job and has no physical impairments or mental conditions that would adversely affect his/her performance or cause operational errors that would endanger public health and safety.

3. **Trained and certified personnel.** The minimum qualification of personnel are detailed in SAR § 9.1.3 For example, the general manager must have ten years of experience within the nuclear power industry (though up to four years could be academic training) and must have a BA. The Lead Mechanic/Operator must have a high school diploma and a minimum of six years experience in mechanical maintenance. The Lead Mechanic/Operator will become, according to the SAR, a certified storage facility operator prior to facility operation. The Lead Nuclear Engineer shall have a minimum of a BS in nuclear engineering and four years

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[11] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

experience in the nuclear power industry. Id.

The Applicant has not shown that these qualifications are sufficient to guarantee that the facility will be operated safely. For example, neither the General Manager nor Operators are required to have any experience in dry storage operations. The details of instruction courses, training programs or work on simulation facilities is not laid out in detail. No tests are specified for certification, that is, evidence the trainee has successfully manipulated real or simulated equipment. The Applicant has not specified any written examinations and operating tests, including the items that would be on such a test. The Applicant has not specified the terms of qualification and revocation of operators license, provisions for requalification, and enforcement. The Applicant merely states that "each member of the site staff involved with important safety activities will be required to meet the minimum qualifications of the License," without stating these minimum qualifications and how they will assure the public health and safety. SAR at 9.1-27. The Applicant promises "Programs for additional site familiarization training and ongoing training and retraining" without stating the specific details of the training program and the minimum passing grade for certification. Id. Specific operational tests are stated on SAR 9.2-5 without indicating the minimum terms for passing the course. A training program is mentioned in Section 9.3 of the SAR, but it constitutes nothing more than a promise without specific details. Thus, it is inadequate to satisfy the regulations.

G. Quality Assurance.

CONTENTION: The Applicant's Quality Assurance ("QA") program is utterly inadequate to satisfy the requirements of 10 CFR Part 72, Subpart G.[12]

Basis: NRC regulations at 10 CFR § 72.24(n) require each applicant for an ISFSI license to submit "a description of the quality assurance program that satisfies the requirements of subpart G to be applied to the design, fabrication, construction, testing, operation, modification, and decommissioning of the structures, systems, and components important to safety." Subpart G sets forth numerous quality assurance requirements, including the requirement that the description of the QA program must discuss which requirements of Subpart G are applicable, and explain how they will be implemented. 10 CFR § 72.140(c).

The description of the QA program submitted by PFS in support of its license application falls woefully short of this standard. Private Fuel Storage L.L.C., Quality Assurance Program Description (August 1996) (hereinafter "QAPD"). The QAPD constitutes nothing more than a general summary of PFS's intentions to implement a QA program. Moreover, contrary to the requirement of 10 CFR § 72.24(140)(c) that the applicant must describe "how" the program is to be implemented, the QAPD contains not a shred of information about how PFS intends to implement the general goals set forth in the QAPD. Nor does it address the unique QA problems raised by

[12] This contention is supported by the Declarations of Lawrence A. White, attached hereto as Exhibit 1 and Marvin Resnikoff, attached hereto as Exhibit 2..

this license application, relating to the Applicant's lack of control over procurement of materials and packaging of spent fuel by nuclear power plant licensees, and the ISFSI's lack of design features for inspection of canisters and fuel cladding.

1. **Lack of detail.** The proposed ISFSI is a huge and complicated operation that will accept thousands of casks, from all over the country, and store them for at least 20 years. A QA program description for such a facility should contain enough detail to demonstrate how the Applicant can and will conduct a QA program that complies with the numerous quality assurance standards set forth in Subpart G. The QAPD submitted by the Applicant, however, contains only the sketchiest information regarding the Applicant's intentions. In effect, it constitutes a list of broad goals for quality assurance corresponding to the regulatory requirements, rather than a description of the means by which quality assurance will be achieved. Virtually no information is provided about the nature of the ISFSI or its unique operations. Instead, the QAPD is a "one size fits all" document, apparently intended to be vague enough to cover any licensee or operation related to spent fuel handling. Indeed, the QAPD originally was submitted in 1995 under the NRC's Part 71 transportation regulations, by the Mescalero Apache tribe. The fact that PFS merely changed the name of the Applicant and made virtually no changes to the QAPD for an entirely new organization and operation, vividly illustrates the non-specific and non-informative nature of the QAPD. As such, it is completely inadequate to "provide

sufficient detail. . . to enable staff to determine its adequacy." NUREG-1567, Draft Standard Review Plan for Spent Fuel Dry Storage Facilities, USNRC at 15-1 (1996).

For instance, 10 CFR § 71.146 establishes requirements for design control. Subsection (a) requires the applicant to:

> establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license application for those structure, systems, and components to which this section applies, are correctly translated into specifications, drawings, procedures, and instructions. These measures must include provisions to ensure that appropriate quality standards are specified and included in design documents and that deviations from standards are controlled. Measures must be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the functions of the structures, systems, and components which are important to safety.

The Applicant provides virtually no information about how this requirement will be met, other than to state that "design control procedures" will be prepared. Id. QAPD at 5. The QAPD says nothing about how design reviews will be conducted under these procedures, or by whom, other than "by qualified personnel other than those performing the design." Id. There is no description, for instance, of the structure or content of the QA organization, or who in the QA organization will fulfill this function. Thus, the description is utterly inadequate to satisfy the regulations. For instance, while the QAPD briefly refers to training of QA program employees, it does not specify the type of training and the level of training required for

specific Quality Assurance functions. Id. at 4. Moreover, it fails to identify what training will be provided for all types of personnel as a QA measure. Thus, it lacks sufficient detail to comply with 10 CFR § 72.144(d).

Similarly, while the QAPD program states that the QA program will be reviewed at established intervals, it does not specify the minimum review intervals nor does it define what will trigger an earlier review (*e.g.*, implementing corrective action on the same activity, etc.). Id. at 4.

The rest of the QAPD is written in the same way, substituting a statement of the QAPD's goals for a description of the actual program.

2. **Lack of quality control.** The QAPD is completely inadequate to satisfy the requirements of 10 CFR §§ 72.154 (control of purchased material, equipment and services), 72.156 (identification and control of materials, parts and components) and 72.166 (handling, storage, and shipping control). PFS's cursory discussion of these requirements, in Sections 7, 8, and 9 of the QAPD, completely fails to address the specific quality control issues raised by the proposed ISFSI.

The nature of the proposed ISFSI and its operation, as proposed by PFS, poses unique QA problems. Ordinarily, for an ISFSI operated by a single reactor licensee, all of the operations affecting storage of spent fuel are controlled by the licensee. The licensee also procures and owns all of the materials involved. In the case of the proposed ISFSI, although the SAR is not clear, it is Petitioner's understanding that PFS

will own the shipping casks, canisters, and associated materials. Nevertheless, PFS will not control the packaging of spent fuel inside the casks and canisters. Instead, numerous utilities with their individual team of welders and other staff will load the canisters for transport to the proposed ISFSI. Here, PFS will be accepting spent fuel packaged at 19 different nuclear plants, by up to 19 different sets of employees, under up to 19 different sets of procedures.

While quality in the operations and the materials used in the packaging of the canisters is extremely important to the safe handling and storage of spent fuel, the license application gives the Applicant no control over these operations. No attention is given in the QAPD or Chapter 11 of the SAR to the procurement of materials or the training and quality control of so many technicians beyond the control of the storage facility operators. Instead, this responsibility seems to rest with the cask manufacturer and the nuclear power plant licensee.

For instance, 10 CFR § 72.154(a) requires that:

> The licensee shall establish measures to ensure that purchased material, equipment and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures must include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery.

PFS's extremely brief discussion in Section 7 of the QAPD gives no indication whatsoever of how PFS's QA program will deal with the significant problem that,

while PFS has responsibility for maintaining the integrity of the casks during transfer and 20-plus year storage, it has no apparent control over their purchase or manufacture. This appears to be left to the nuclear power plant licensees.

The QAPD also fails to address PFS's measures for satisfying the requirements of 10 CFR § 72.156. Among other things, this regulation requires that "identification and control measures must be designed to prevent the use of incorrect or defective materials, parts, and component." Id. Section 8 of the QAPD vaguely calls for paper documentation that identifies materials, parts and components, and a "means of identification." But it says nothing about the means PFS intends to "control" its operation to prevent the use of degraded or substandard parts, as also required by the regulation. This is an extremely grave omission, in light of the recent Demand for Information issued by the NRC to Sierra Nuclear Corporation, manufacturer of the TranStor casks for defective cask construction, EA 97-411 (October 6, 1997) ACN # 9710100120. *See also* description of defective or degraded cask contents in Contention J (Inspection and Maintenance of Safety Components) whose Basis 1 (Regulatory Violation) is herewith incorporated by reference. The QAPD also fails to address the important question of how welds on shipping casks and canisters will be inspected. These welds should be inspected using ultrasound, to ensure that the welds are secure. This is a standard technique recommended by the NRC. There is no indication as to whether this inspection will be performed by the licensee, the cask manufacturer, PFS,

or anyone else. As a result, this important QA operation may fall through the cracks, in violation of 10 CFR § 72.158.

The QAPD completely fails to address PFS's measures for controlling the quality of handling, storage, and shipping of spent fuel casks to prevent damage or deterioration, as required by 10 CFR § 72.166. For instance, improper handling of fuel during packaging at the originating nuclear power plant could lead to fuel degradation and reduction in the safety margin during storage. PFS proposes no specific QA measures for verifying the adequacy of these handling measures. The QAPD is completely vague as to whether and how it will conduct inspections on receipt of the casks. The QAPD mysteriously states that receipt inspection will be performed "consistent with importance and complexity," but fails to define those terms or state which components satisfy them. QAPD at 12. From the SAR, it appears that PFS intends to accept the casks as-is, with only the most cursory physical inspection to the outside of the casks. Id. § 5.1.4.2. Moreover, as discussed in Contention J (Inadequate Inspection and Maintenance of Safety Components), PFS has no means of verifying the adequacy of handling at the originating nuclear power plant by opening the canisters or of verifying that the casks have been properly packaged. Thus, PFS's QAPD is completely inadequate to describe how the Applicant will fulfill its responsibility under 10 CFR § 72.154 for control of purchased material, and equipment and services.

3. **Inconsistency with SAR.** The QA program description in the SAR is

inconsistent with the description in Docket 71-0829. For example, QA Docket 71-0829 describes a different organization for PFS than that described in the SAR. *Compare* QA Docket 71-0829 at 3 with SAR Figures 9.1-1, 9.1-2, and 9.1-3. For example, the QA Docket 71-0829 identifies a Business Services Unit, NRC Liaison, and a Human Resources Development Group not identified in the SAR. Id. Similarly, the SAR shows a number of positions and company units, such as a transportation specialist and a safety review committee, not described in the QA Docket 71-0829. Id. There is no attempt to show how or whether the positions and company units described in these two documents correspond to each other, or why the organization of the same company is described so differently in these two documents.

Similarly, the QA Docket 71-0829 indicates that for organizational independence the QA organization shall have direct access to the Board of Directors. QA Docket 71-0829 at 3. However, the SAR makes no reference to a Board of Directors but refers to a Board of Managers. SAR at 11.1-1, -3. QA Docket 71-0829 Figure 1 depicts the QA organization as reporting to the Board of Managers and indicates that the Board of Managers is responsible for budget approval, financial oversight, step IV planning, liaison to utilities, and business development. If the Board of Managers responsible for cost and schedule referred to in the SAR is the group to which the QA organization will report, organizational independence may be jeopardized. As stated in 10 CFR § 71.103(d), "[t]he persons and organizations

performing quality assurance functions shall report to a management level that assures that the required authority and organizational freedom, including sufficient independence from cost and schedule, when opposed to safety considerations, are provided."

4. Failure to Demonstrate Independence of QA Organization

The SAR describes the Applicant's personnel organization in three stages: (1) pre-licensing, (2) licensing and construction, and (3) operational. SAR figures 9.1-1, 9.1-2, and 9.1-2. The QA responsibilities of the Board of Managers, the Architect/Engineer, and the QA Committee during the pre-licensing stage. SAR at 11.1-1 to -3, SAR figure 9.1-1. Although the SAR indicates that the "QA Committee is an independent organization reporting to the Board of Managers" and it "has the organizational freedom and authority to identify quality problems; to stop unsatisfactory work," the SAR fails to describe the interrelationships between the Architect/Engineer group and the QA Committee and how the relationship enhances QA. *See e.g.*, SAR at 11.1-2. In addition, the SAR fails to identify who is responsible for pre-licensing "day to day activities, costs, or schedules" and how the organizational structure ensures QA in quality- and safety-related activities.

In addition, although the SAR briefly describes broad QA responsibilities for the Board of Managers and Lead QA Technician, it fails to provide any meaningful description of the licensing and construction, and operational functional

responsibilities, interrelationships, and various authority for performing quality and safety related activities. *See e.g.,* SAR at 11.1-3. Pre-licensing and pre-construction planning is vital to the success of an operation. However, construction, operation, and decommissioning QA are also critical to ensuring quality and safe activities when spent fuel is onsite. Moreover, it is impossible to evaluate the QA program without an understanding of the construction, operation, and decommissioning duties for each position or group and their interrelationships with other personnel.

Further, the QA Docket 71-0829 states that "[m]anagement of other organizations participating in the Quality Assurance program shall regularly review the status and adequacy of that part of the program which they are executing." Id. Allowing responsible individual organization management to determine the adequacy of the QA over their own programs does not allow independent oversight nor objectivity in establishing QA procedures. QA Docket 71-0829 at 4. Thus, contrary to the requirements of 10 CFR § 72.142, the QAPD fails to demonstrate the independence of the QA organization.

H. Inadequate Thermal Design.

CONTENTION: The design of the proposed ISFSI is inadequate to protect against overheating of storage casks and of the concrete cylinders in which they are to be stored.[13]

BASIS: Pursuant to 10 CFR 72.122(b), structures, systems and components of an ISFSI must be designed to accommodate the effects of, and be compatible with, site characteristics and environmental conditions associated with normal operation. Section 72.128(a) also requires that spent fuel storage systems such as the proposed ISFSI must be designed to "ensure adequate safety under normal and accident conditions." Among other things, these systems must be designed to include "[s]uitable shielding for radioactive protection under normal and accident conditions," and "[a] heat-removal capability having testability and reliability consistent with its importance to safety." 10 §§ CFR 72.128(a)(2) and (4).

PFS has failed to demonstrate that the design of the proposed ISFSI is adequate to accommodate the high temperatures that may be expected at the site. In particular, PFS has failed to demonstrate adequate design temperatures for storage casks and for the concrete cylinders in which the casks are to be stored. Nor does PFS propose design features to assure that the casks and concrete will not be overheated. Both the cladding in the storage casks and the concrete cylinders constitute shielding for

[13] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

radioactive protection which could be degraded under high temperatures, thus posing an undue safety risk. Therefore, PFS does not meet the requirements of 10 CFR §§ 72.122(b) or 71.128(a).

1. Temperature specifications for storage casks

According to the SAR, the record high temperatures in Skull Valley range from 105 °F to 109 °F. SAR at 2.3-5. PFS has established a site design ambient temperature of 110 °F. SAR at 4.2-15. However, PFS is planning to use HI-STORM and TranStor storage casks, which are designed for lower ambient temperatures. The TranStor cask is designed for ambient temperatures of 75°F, and off-normal temperatures of negative 40°F and 100 °F. TranStor SAR, Rev. B at 4-4. The Holtec cask is designed for a daily average ambient air temperature of 80°F, and off-normal conditions of negative 40°F and 100°F. HI-STORM TSAR Rev 2 at 2.2-17.

PFS recognizes that the off-normal design temperature of 100°F is below PFS's design ambient temperature of 110°F. SAR at 4.2-15. However, PFS argues that the 100° F condition "represents a maximum daily average temperature over a period of several days and nights required for the system to reach thermal equilibrium." SAR at 4.2-15. PFS contends that, while daily ambient temperatures could exceed 100°F, the average daily temperature would not exceed 100°F, averaging day and night temperatures. SAR at 4.2-15. In support of this assertion, PFS cites the maximum

average daily ambient temperature of 93.2°F for cities in Utah nearest the site. SAR at 4.2-15.

PFS's analysis is faulty, for several reasons. First, temperatures in unnamed cities somewhere in Utah do not necessarily correspond to the conditions in Skull Valley. PFS should provide information on actual temperatures at the Skull Valley site, using measurements taken at the distance from the ground that is comparable to the location of intake vents on the storage casks, where air will be drawn into the casks.

Second, PFS's projection that average daily temperatures will not exceed 100°F fails to take into account the heat stored and radiated by the concrete pad and by the concrete cylinders in which each cask will be stored. These massive concrete structures will serve as reservoirs that trap and radiate heat throughout the day and night, thus having a potentially significant effect on average ambient temperatures.

Third, in projecting ambient temperatures, PFS fails to take into consideration the heat generated by the casks themselves. The TranStor casks are placed at a center-to-center distance of 15 feet. Since the diameter of each TranStor cask is 11.3 feet, the spacing between casks on the pad is only 3.7 feet. TranStor SAR, Rev. B at 1-17. The Holtec cask is 11 feet in diameter and the spacing between Holtec casks is therefore 4 feet. Holtec HI-STORM 100 TSAR Rev. 2 at 1.2-1. Given the close proximity of the casks, it is likely that additional heat from an adjacent cask would increase the external

and internal temperatures of the concrete storage cylinders, and therefore the maximum cladding temperature.

Finally, PFS has not taken into account the thermal impact of the temperature differential between the level of the concrete pad and the level of the tops of the storage casks, 15 feet above. Because of the heat-retaining nature of the concrete pad, the air temperature near the ground will be higher than the temperature 15 feet above. This will have an impact on the ventilation system for the casks, which relies on convection, in which cool air is drawn into the cask inlets and is heated by the inner canister, causing the air to rise. This "chimney effect" depends on a difference in temperature between the incoming and outgoing air. If the temperature of air going into the vents is higher than the temperature of the air 15 feet off the pad, the buoyancy and velocity of air through the ducts is reduced. Air moving more slowly through the ducts, and at a higher temperature, will cool the canisters more slowly than cooler air. Thus, the design temperature for the casks (and the cladding inside them) may be exceeded due to the reduced effectiveness of convection cooling.

PFS's design of the ISFSI is inadequate because it fails to take into account these factors in establishing the temperature-related design limits for storage casks, or to establish measures to ensure that the manufacturer's design limits will not be exceeded during storage. PFS should be required to perform the requisite calculations and re-evaluate the temperature-related design limits of the facility.

2. Temperature limits for concrete storage cylinders

In a "Request for Additional Information" from Lawrence E. Kokajko, NRC, to William J. McConaghy, Sierra Nuclear Corporation, December 17, 1996, (hereafter called RAI), the NRC states its policy on temperature limits for the concrete structures in which storage casks are housed. The Staff recommends a maximum allowable temperature of 150°F for normal operation for bulk concrete (assumed here to be inner concrete), 200°F for local areas, 350°F and for accident or other short-term periods. The purpose of these limits is to assure that the concrete structures housing the casks, which serve as radiation shields, do not degrade and crack due to unacceptably high heat levels. RAI at 9, 10.

Information submitted by Sierra Nuclear Corporation (SNC) and Holtec in support of their applications for Certificates of Compliance shows that projected temperatures for concrete either exceed or are very close to the NRC's recommended limits, thus compromising the integrity of the concrete. In fact, these calculations probably underestimate the concrete temperatures, because they do not appear to take into account the heat generated by the casks themselves and the storage pads.

TranStor. For example, at page 4-1 of the TranStor SAR, SNC presents concrete temperature calculations, based on a worst-case temperature of 125° with

maximum solar load, lasting for 12 hours. The resultant temperatures in degrees Fahrenheit are shown in the Table below:

TranStor Cask (°F)

Case	Ambient Conditions	Solar Load	Outer Concrete	Inner Concrete	Max Cladding
Base	75	No	85	188	664
Off-Normal	100	Yes	141	222	688
12 Hour Max Thermal Load	125	Yes	190	257	712

The Table shows that under off-normal conditions, the inner concrete temperature of 222°F exceeds the 200°F limit recommended by the NRC. Moreover, the off-normal temperature of 141°F for outer concrete is close to the NRC's recommended limit of 150°F. The NRC staff expressed concern about these temperatures in the RAI. It is stated that the staff would allow use of TranStor provided PFS uses a different concrete mix, as specified in an American Concrete Institute publication, ACI-349, Appendix A. RAI at 10. However, to Petitioner's knowledge, this issue remains unresolved.

Moreover, SNC's calculations only take into account the contribution of solar heat, and do not appear to take into account the heat contributed by the casks themselves. As discussed above, the heat input of the casks themselves is likely to be significant. It may raise the heat level of the concrete above acceptable levels, even using the concrete mix specified by the staff. Finally, SNC does not discuss the

problem of heat build-up in the concrete structures, a likely result of the reduced effectiveness of convection cooling.

HI-STORM. Holtec presents the following results at pages 4.4-32, 11.1-8, and 11.1-9 of the TSAR for the HI-STORM 100 cask:

Hi-Storm Cask (°F)

Case	Ambient Conditions	Solar Load	Outer Concrete	Inner Concrete	Max Cladding
Base	80	Yes	146	264	632
Off-Normal	100	Yes	166	287	652
12 Hour Max Thermal Load	80	Yes	150	288	656

These temperatures are clearly above the NRC recommended values. At the very least, they would require a different concrete formulation, as discussed in the NRC Staff's December 17, 1996 letter to SNC. Moreover, like SNC's calculations, Holtec's calculations are nonconservative, thus suggesting that even a different concrete formulation may be an insufficient design measure. Although Holtec does consider an array of casks in evaluating concrete temperatures, its equations only account for reduced air flow in the array, and do not consider the heat generated by the casks themselves. Nor does Holtec discuss the reduced effectiveness of convection cooling caused by relatively high air temperatures near the concrete pad.

Accordingly, PFS has not demonstrated that concrete structures for storage of spent fuel are design to withstand the temperatures that can be expected at the

proposed ISFSI, or that it has taken measures to ensure protection of the concrete from excessive temperatures.

I. Lack of a Procedure for Verifying the Presence of Helium in Canisters.

CONTENTION: The design of the proposed ISFSI fails to satisfy 10 CFR §§ 72.122(f) and 10 CFR § 72.128(a), and poses undue risk to the public health and safety, because it lacks a procedure, or any evidence of a procedure, for verifying the presence of helium inside spent fuel canisters.[14]

BASIS: The general design criteria for ISFSIs require that "[s]ystems and components important to safety must be designed to permit inspection, maintenance, and testing." 10 CFR § 72.122(f). NRC regulations at 10 CFR § 72.128(a)(1) also require that spent fuel storage systems must be designed with a capability to test and monitor components important to safety. *See also,* Reg. Guide 3.48, § 4.7, which states that:

Spent fuel or high-level radioactive waste handling facilities will be needed at the facility site for some of all of the following functions: receiving and inspection of loaded shipping casks, cask unloading, spent fuel or high-level radioactive water transfer and examination, fuel assembly-disassembly, placement of spent fuel in a container, container sealing and testing, spent fuel or high-level radioactive waste container short-term storage, shipping cask decontamination, SSSC and drywell loading and preparation for storage, SSSC transfer to storage, fuel or high-level

[14] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

radioactive waste container removal from storage site to shipping cask, and damaged fuel element containerization.

In dry cask transportation and storage, helium is injected into the canister and the cask as a coolant. The presence of helium is important to protect the contents of the canister from overheating, corrosion, and oxidation of uranium.

PFS's SAR indicates that during cask transfers, PFS intends to sample the inside of the casks for "gas," presumably including helium. SAR Table 5.1-1, item 6 (HI-STORM), Table 5.1-2, item 6 (TranStor). However, PFS appears to have no measures for testing the helium content inside the canisters. Because the helium will be expected to play a critical role in protecting the fuel from degradation over a 20-plus year storage period and during transportation to a final repository, it is important that PFS have and implement some means for verifying the presence of helium in the canister.

Moreover, the nature of the materials and operations involved in packaging fuel for shipment to the ISFSI create significant opportunities for human error in filling the casks with helium, thus making such a procedure all the more important. Under the "Operating Procedures" for the TranStor cask, (*see* TranStor SAR at 7-11), the canister is first evacuated and then backfilled with "99.9%" pure helium. Since this filling is being done while the canister is exposed to our normal atmosphere, it is possible that some air (containing oxygen) could leak in with the helium, perhaps due to carelessness or a slightly leaky helium hose connection. In this connection, it is important to recall

that there is a vacuum in the canister that may have the effect of sucking gases other than helium into the canister. Because of the potential for error in the filling operation, and because PFS lacks control over the filling operation, it is all the more important that PFS have the capability to open the cask and check for the presence of helium.

Another reason to require inspection of canisters for helium arises from the fact that the spent fuel will be shipped, perhaps thousands of miles, from reactors to the ISFSI. This stands in contrast to ISFSIs located on or near the sites of the reactors. During transportation, the welding on canister lids may loosen, thus allowing helium to escape.

J. **Inspection and Maintenance of Safety Components, Including Canisters and Cladding.**

CONTENTION: The design of the proposed ISFSI fails to satisfy 10 CFR §§ 72.122(f) and 72.128(a), and poses undue risk to the public health and safety, because it lacks a hot cell or other facility for opening casks and inspecting the condition of spent fuel.[15]

BASIS: Most dry cask storage facilities are located on the sites of nuclear reactors, where there is a spent fuel pool that can be used for inspection and repairs to the contents of dry storage casks. In the case of the proposed ISFSI, which would constitute a brand new facility, there is no existing spent fuel pool or hot cell that can be relied upon. Moreover, PFS has no plan to include one in the design. The SAR simply states that all casks are expected to be properly packed, and that any defective or contaminated casks will be returned to the originating shipper. Technical Specifications at TS-9. PFS's failure to provide a spent fuel pool where canisters and fuel cladding can be inspected and repaired violates NRC regulations. Moreover, a hot cell is needed to protect workers and the public against the undue risks caused by the handling and storage of spent fuel.

1. **Regulatory violation.** The general design criteria for ISFSI's require that "[s]ystems and components important to safety must be designed to permit inspection,

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[15] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

maintenance, and testing." 10 CFR § 72.122(f). NRC regulations at 10 CFR § 72.128(a)(1) also require that spent fuel storage systems must be designed with a capability to test and monitor components important to safety. *See also* Reg. Guide 3.48, § 4.7, which states that:

> Spent fuel or high-level radioactive waste handling facilities will be needed at the facility site for some of all of the following functions: receiving and inspection of loaded shipping casks, cask unloading, spent fuel or high-level radioactive water transfer and examination, fuel assembly-disassembly, placement of spent fuel in a container, container sealing and testing, spent fuel or high-level radioactive waste container short-term storage, shipping cask decontamination, SSSC and drywell loading and reparation for storage, SSSC transfer to storage, fuel or high-level radioactive waste container removal from storage site to shipping cask, and damaged fuel element containerization.

The Commission emphasized the importance of providing measures for inspection and maintenance of critical safety components in the course of proposing them in 1978:

> The large inventory of radionuclides in an ISFSI represents a potential hazard to public health and safety. Storage conditions must provide an environment which will insure the long-term integrity on [sic] the fuel cladding as the primary containment for the radioactive materials contained in spent fuel. . . . .
>
> To assure the long-term integrity of the stored spent fuel, the storage racks and other important components of an ISFSI, <u>there must be provisions for periodic inspection and surveillance of critical components.</u>

Proposed Rule, Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI), 43 Fed. Reg. 46,309, 46,310 (October 6, 1978) (emphasis added). Clearly, the

canister and cladding which hold the spent fuel, and protect against the release of radiation, constitute such critical safety components.

Moreover, the NRC's conclusion regarding the safety of dry cask storage for extended periods of time is based on the presumed ability to inspect the condition of spent fuel during storage. In 1988, in amending Part 72 to add standards for the design of Monitored Retrievable Storage ("MRS") facilities, the Commission prepared an Environmental Assessment which concluded that dry cask storage is safe for extended periods of time. NUREG-1092, Environmental Assessment for 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Fuel and High-Level Radioactive Waste at II-7 (1984). In discussing the impacts of monitored retrievable storage, the Commission found that:

> The principle [sic] operations to take place in the MRS are to provide spent nuclear fuel and HLW handling, transfer, and storage. Installations would have to be designed to ensure confinement of radioactive materials as well as provide for monitoring HLW and spent fuel storage containers. An MRS will have to be designed to permit spent nuclear fuel and high-level wastes to be retrieved and shipped to reprocessing facilities or geologic repositories. Verification of material integrity during the design lifetime of the MRS is necessary to ensure structural integrity of HLW and spent fuel storage containers for the protection of the public from releases of radioactive material into the environment.

Id. at II-3 (*emphasis added).*

The EA's Finding of No Significant Impact was based in part on "[k]nowledge of material degradation mechanisms under dry storage conditions and the ability to institute repairs in a reasonable manner without endangering the health of the public."

Id. At III-2. *See also* Final Rule, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, 53 Fed. Reg. 31,651, 31,658 (August 19, 1988).

The DOE concurred, in DOE/RW-0402, Monitored Retrievable Storage System Requirements Document, Revision 1 (1994). DOE states that:

> The MRS facility should have the capability to provide for inspection and verification of the description and characteristics of the SNF or the content of the loaded MPCs received. If the SNF or loaded MPC is improperly described, Waste Acceptance will be notified for resolution of the waste description.

Id. at 56. DOE also requires that: "[t]he MRS facility shall have the capability to open, remove SNF, load SNF, and seal the MPC, without damaging the SNF." Id. at 61.

PFS's failure to provide a hot cell or other facility for the inspection and repair of the contents of spent fuel canisters and the spent fuel canisters themselves violates the NRC's regulatory requirement that safety components must be capable of inspection, testing and maintenance. As one of the key barriers to the escape of radioactivity from the casks, the cladding inside the cask, and the canister which holds it, constitute vital safety components which must be subject to inspection and maintenance.

2. Hot cell needed to protect against undue risk. By failing to include a hot cell in the design for the proposed ISFSI, PFS poses undue risk to public health and safety. PFS's failure to include a design for a hot cell appears to be based on three assumptions, none of which is valid.

a. Verification of fuel condition. First, PFS assumes that the fuel shipped to it will be in good condition. This assumption is unreasonable, on several grounds. First, as discussed in Contention G regarding Quality Assurance, the Applicant will have no control over the packing of canisters and transportation casks at nuclear power plants. This operation will be performed by employees of the nuclear power plant licensees. Important safety operations such as the welding of cask and canister covers will not be under the control of PFS, and may be carried out without proper controls or inspections.

Moreover, the potential for errors in packing methods is multiplied by the fact that the fuel will be shipped by eight or more separate nuclear power plant licensees around the country, comprising at least 19 power reactors. This is compounded by the fact that SNC, the manufacturer of the TranStor cask, has had serious problems with the quality of its materials. *See* NRC Demand for Information, EA No. 97-441 (October 6, 1997), ACN # 9710100120.

Second, the process of preparing casks at a nuclear plant for shipment to an ISFSI involves numerous complex steps that present the potential for error. The lid

must be seal welded, the canister evacuated and filled with helium and the vent and drain ports welded shut. Leak testing must also be performed. Accidents or near-accidents in the recent past demonstrate that the packing of transportation and/or storage casks is subject to human error, and that it is essential to provide some means for inspecting and repairing the damaged fuel and canister. For instance, in 1994, NRC inspectors discovered that irradiated fuel had been loaded into a defective cask at the Palisades nuclear plant. NRC Inspection Report No. 71-1007/92-01 (May 6, 1992). The defect in the cask was not noticed by the licensee when the fuel was packed into the cask. The faulty welds were only discovered when NRC inspectors reviewed operations at the cask manufacturers after the time the cask had been loaded. That cask has still not been unloaded despite the fact that unloading procedures were to have been in place and are part of the Certificate of Compliance.

Another example of cask loading problems occurred at Duke Power in 1981. An NLI-1/2 cask, holding one PWR fuel assembly, was to have been shipped dry, but a worker incorrectly filled the cask with water. Letter from William Parker, Duke Power, to John Davis, NRC (December 1, 1981), ACN # 8112140019. The technician mixed up drain and vent ports while attempting to fill the cask with helium. Id. Fortunately no highway accident involving a fire occurred in the shipment. This error is also possible with the TranStor cask, because the drain and vent ports look alike.

Another example of defective fuel loading occurred in 1980, when the fuel inside an NLI-1/2 truck shipping cask self-heated, causing the uranium fuel pellets to oxidize into a fine powder.[16] The fuel was too hot to be transported within the shipping cask. The error occurred due to the use of an outdated heat generation formula. Even under routine conditions, the spent fuel temperature is quite high in the canister/basket. As past experience has shown, if helium is not present in the cask, any air near the fuel could oxidize the fuel pellets in leaking rods.

Finally, accidents may occur at the PFS facility. The transfer cask can be dropped, or the canister can be too rapidly pulled into the transfer cask. No stresses are likely to open the welds, as the TSAR's show. *See, e.g.*, TranStor TSAR at 8.1-13. But it is quite possible to warp the canister with a drop, or otherwise damage the canister so that it no longer fits within a storage or transport cask. In this case, PFS has no means for inspecting or repairing a damaged canister, or of transferring its contents to another canister. The only effective means of performing these operations is to use a spent fuel pool or hot cell.

The only feasible way to verify the condition of the contents of the casks, including cladding degradation, is through the use of a spent fuel pool or hot cell.

b. Detection and control of contamination. PFS's second invalid assumption is that it is capable of detecting unacceptable levels of contamination.

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[16] "Airborne contamination Released During Unloading of a Failed PWR Spent Fuel Assembly," PATRAM 80, p. 646.

According to PFS, "[i]n the event contamination above acceptance levels is discovered, the canister will be shipped back to the originating nuclear power plant for canister decontamination and/or spent fuel repackaging." SAR at 10.2-14. PFS states that it will take smear samples in accessible regions of the casks (although there is nothing in the Tech Specs which commits PFS to do this). Id. The accessible regions consist of the canister cover, which is shielded. However, without a hot cell, it is impossible to take smear samples of the other parts of the canister which may be contaminated, because they are too radioactive for workers to approach. These other parts of the canisters may be contaminated in the spent fuel pool at the reactor, during the initial packaging of spent fuel. Moreover, even assuming the canister is "clean," it is likely vibrations on the rail or highway will shake loose radioactive contamination from metal pores, That is, even if the canister is clean when leaving the reactor, the levels of smearable contamination could rise after transit. This has happened often and is called, "weeping."

If the contamination is allowed to remain on the canisters, it may be shaken loose during transportation and transfer, and contaminate workers and the site of the ISFSI. However, PFS has no effective means of determining whether the canisters are contaminated, or removing the contamination.

The principle, "Start clean. Stay clean," should really be "Start clean. Get Dirty." PFS argues (SAR at 7.2-11) that if smearable contamination exceeds regulatory

limits, the cask will be returned to the utility. It would be highly improper to send a cask with smearable contamination above regulatory limits back on the rails and highway. Rather, a hot cell is needed to decontaminate the canister.

c. **Returning defective casks is unsafe.** PFS's third invalid assumption is that if casks are found to be degraded or contaminated, they can be safely shipped back to the originating licensee. SAR at 7.2-11. Putting degraded or contaminated spent fuel containers back on the road should be the **last** option considered, not the licensee's official protocol. The risk of accidents during return transportation and handling may be significantly increased if the condition of fuel is degraded or the casks contaminated. Moreover, even if transportation and handling are incident-free, vibrations during transportation may shake loose any contamination on the canisters, thus posing a risk to workers handling the returned casks.

Accordingly, the license application fails to comply with NRC regulations or provide adequate to public health and safety because it does not provide for a hot cell for inspection and handling of spent fuel canisters.

K. **Inadequate consideration of credible accidents.**

CONTENTION: The Applicant has inadequately considered credible accidents caused by external events and facilities affecting the ISFSI, intermodal transfer site, and transportation corridor along Skull Valley Road, including the cumulative effects of the nearby hazardous waste and military testing facilities in the vicinity.[17]

BASIS: The Applicant is required to identify, examine, and evaluate the frequency and severity of external natural and man-induced events that could affect the safe operation of the proposed facility design, as well as the past and present man-made facilities and activities that may endanger the proposed facility, as required by 10 CFR §§ 72.90 and 72.94; *see also*, §§ 72.98, 72.100, 72.108, and 72.122. While the Applicant mentioned land uses within a five mile radius of the proposed ISFSI (ER § 2.2.2, and SAR §§ 2.1.4 and 2.2), it failed to adequately address the provisions of NUREG-1567, which states:

> The locations of nearby nuclear, industrial, transportation, and military installations should be indicated on a map which clearly shows their distance and relationship to the ISFSI. All facilities within an 8-km (5-mi) radius should be included, <u>as well as facilities at greater distances, as appropriate to their significance</u>. For each facility, a description of the products or materials produced, <u>stored or transported</u> should be provided, along with a discussion of potential hazards to the ISFSI from activities or materials at the facilities.

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[17] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage Facilities (Draft), § 2.4.2, U.S. NRC, October 1996 (*emphasis added*).

Skull Valley is surrounded by industrial and military facilities incompatible with the proposed ISFSI and potentially a source of incidents, including a catastrophic accident, threatening the facility, the Applicant's intermodal transfer facility, and the transportation corridor along Skull Valley Road. The application's land use discussion generally refers to these nearby facilities but the Applicant has failed to adequately analyze the potential risks posed by these activities. SAR § 2.2. The Applicant examined several of the nearby facilities in a cursory manner, and concluded that an accidental explosion of conventional Army weapons being transported along Skull Valley Road en route to or from Dugway Proving Ground was the only credible explosion event that could potentially occur. SAR at 2.2-1 to -2, and 8.2-21 to -22.

The Applicant dismissed any threat of a credible accident from the Tekoi Rocket Engine Test facility (Tekoi) just 2.5 miles from the proposed ISFSI facility. (SAR at 8.2-21). The Tekoi facility is used to static fire rocket motors, conduct hazard testing of explosives, and to store rocket motors for aging tests. Alliant Techsystems Bacchus Works, Baseline Risk Assessment for Tekoi High Hazard Test Area at 2, Global Environmental Solutions (March 1996), excerpts attached hereto as Exhibit 7. The Tekoi facility static fires Titan rocket motors with approximately 210,000 pounds of propellant and has the ability to test rocket motors up to the size used for the Space

Shuttle. In addition, hazard explosive testing typically requires between 10 and 100 pounds of explosives per test. Id. The Tekoi facility also has a number of test bays to concurrently store and test a number of rocket motors and has a number of activities with varying hazard ranges that may impact the proposed ISFSI. For example, the Applicant has failed to consider possibilities, such as the potential for a static fired rocket motor to escape from the test harness, or the impact of an explosion to reach the ISFSI facility or to impact casks or cask-hauling trucks (or railcars) traveling along the access road, including the type of damage that could result from such rocket motors.

Dugway Proving Ground (Dugway), the 806,139.61 acre U.S. military reservation located approximately eight miles southwest of the proposed ISFSI, is used for combat training using live munitions and testing of conventional weapons. Dugway also tests chemical agents, chemical agent decontaminants, personal protective equipment, smokes, illuminates, and chemical and biological defense monitoring equipment. Additionally, the National Guard and Air Force use Dugway to train with live munitions, and Air Force bombers must occasionally land at Dugway with "hanging bombs," i.e., live ordnance that fails to drop from the plane and is stuck in the bombing bay during air-to-ground combat training. *See* Affidavit of David C. Larsen, attached hereto as Exhibit 8, ¶ 8. While the Applicant calculates the probability of an aircraft impacting the proposed facility (*see* SAR at 2.2-3), there is no

indication that it included data involving such emergency incidents as hanging bombs, nor is there any mention that it considered the potential for sabotage relating to air flights, although the Applicant admits the possibility of sabotage against the ISFSI itself (EP at 2-16, ¶ 8).

The Applicant does not specify the in-flight crash rate per mile used in the air crash probability calculation. The Applicant indicates it utilized methods obtained from the U.S. Nuclear Commission's Standard Review Plan, NUREG-0800. SAR at 2.2-3. NUREG-0800 incorporates data from the Department of Energy Air Crash Risk Analysis Methodology (ACRAM). *See*, Vol. 1 Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment at 5-97, U.S. Army (December 1996) (hereinafter TOCDF Risk Assessment),[18] excerpts attached hereto as Exhibit 9. ACRAM calculates the in-flight crash rate per mile for commercial and military aircraft based on actual crash data for each aircraft type. TOCDF Risk Assessment at 5-97. In addition, for general aviation and helicopters, the ACRAM study generated a computer program that accepts a site latitude and longitude as input and provides the frequency per unit per year. Id. at 5-97, -98. The ACRAM computer program represents a fit to actual crash locations for the continental United States. Id. Thus, the source and accuracy of the in-flight crash rate used is critical in determining the

[18] This portion of the TOCDF risk assessment discusses the site-specific aircraft crash frequency estimates based on ACRAM for TODCF, a facility located approximately 20 nautical miles from the proposed ISFSI site.

probability of an aircraft crash into the ISFSI site. Moreover, if the in-flight crash rate is not a worse case rate for all types of aircraft, then the Applicant should calculate the aircraft frequency per aircraft type.

The Applicant must collectively consider the probability of commercial and military aircraft crashing into the ISFSI site. The Salt Lake City International Airport may direct approximately 15% of its commercial aircraft through Rush Valley, flight pattern V257. Id. at 5-100, 102. Flight pattern V257 runs north and south on the east side of the Onaqui and Stansbury Mountains. Id. at 5-100. Because of the close proximity of flight pattern V257 to the ISFSI site, the Applicant should evaluate the probability of a commercial aircraft crash into the site.

The mid to southern portion of Skull Valley is located within restricted military air space under the Sevier B & D Memorandum of Agreement. Id. at 5-101. The Applicant has failed to take into account in its accident analysis that military aircraft from Dugway Proving Grounds or from Hill Air Force Base may occupy the restricted military air space over the proposed ISFSI site during training or security missions. Moreover, the Applicant has failed to analyze potential risks from the North or South Utah Test and Training Range (UTTR). UTTR is used by the U. S. Air Force as a training range for air-to-air and air-to-ground live munitions training, propagation testing of military ordnance, and is located just 18.3 miles from the proposed ISFSI. *See*, Exhibit 8, Larsen affidavit at ¶ 12. The Applicant has also failed

to take into account that Dugway is the proposed landing site of the X-33 hydrogen-powered space plane. *See*, Vol. 1, Final Environmental Impact Statement, X-33 Advanced Technology Demonstrator Vehicle Program at 2-25, National Aeronautics and Space Administration (September 1997), excerpts attached hereto as Exhibit 10. In addition, the Applicant should consider whether military training missions have a higher in-flight crash rate per mile than a military aircraft flying a routine mission, e.g., transferring from one air base to another.

Further, the Applicant has completely failed to apply any aircraft accident scenarios to the intermodal transfer point or to the proposed cask transportation route, including along Skull Valley Road as required by 10 CFR §§ 72.90, 72.94, and 72.108, nor has the Applicant made any mention of what airways, military or commercial, pass over these areas. For example, flight pattern J154 flies directly over the intermodal transfer facility. *See*, TOCDF Risk Assessment, Exh. 7 at 5-100. PFS provides no basis for its assertion that the casks and the facility need not be "designed to withstand the direct impact of an aircraft crash" because such an accident is not a "credible event." *See*, SAR at 2.2-3, and EP at 2-15. Given the high level of military aircraft activity in the area, and the fact that this activity includes transport of live munitions, PFS should not be granted a license unless it evaluates the risks posed by aircraft accident scenarios to the intermodal transfer facility and the casks themselves as they travel on trucks or railcars to the ISFSI.

Additionally, the Applicant has failed to identify, examine, and evaluate the potential cumulative effects of the many land uses presently existing in the proposed ISFSI region. In addition to Dugway transporting conventional munitions along Skull Valley Road, as the Applicant discusses (SAR at 2.2-2), Dugway also transports various chemical agents used for testing. *See* Exhibit 8, Larsen affidavit at ¶ 4. The Applicant should evaluate the potential impacts of an accident involving chemical agent, including an accident caused by increased heavy haul truck traffic on Skull Valley Road.

Additionally, the Applicant fails to identify, examine or evaluate the potential cumulative effects of the concurrent transport of spent fuel and other hazardous materials in the region. Hazardous munitions and other materials are routinely shipped in and out of the surrounding military facilities. In addition, the commercial facilities - the Laidlaw APTUS hazardous waste incinerator, the Envirocare low level radioactive and mixed waste landfill, the Laidlaw Clive Hazardous Waste Facility, and Laidlaw's Grassy Mountain hazardous waste landfill - located 25-35 miles northwest of the proposed ISFSI receive thousands of tons of waste yearly. Most of these shipments pass through Rowley Junction. *See*, Exhibit 8, Larsen affidavit at ¶ 12. The Applicant's proposed activities involving movement of high level nuclear waste increase the potential for accidents associated with the transportation and handling of these other types of waste.

The Applicant has made no attempt to identify, examine and evaluate the "occurrence and severity" of "important potential man-induced events" that may affect the ISFSI design, as required by 10 CFR § 72.94, from activities involving other industrial and military facilities. The Applicant must address the impacts from accidental releases from a facility that may cause the evacuation of the ISFSI or intermodal transfer station and abandonment of spent fuel casks. In addition, the Applicant should address the impact of hazardous chemical products, hazardous waste, low level radiological waste, and industrial waste being shipped along the same rail or highway routes as spent nuclear fuel casks. The Applicant should also address the potential safety and security impacts from spent fuel or other hazardous materials remaining in rail yards while awaiting shipment to a final destination, as well as the impact of such an occurrence.

L. Geotechnical

CONTENTION: The Applicant has not demonstrated the suitability of the proposed ISFSI site because the License Application and SAR do not adequately address site and subsurface investigations necessary to determine geologic conditions, potential seismicity, ground motion, soil stability and foundation loading.[19]

BASIS:

1. **Surface faulting.** NRC regulations recognize that areas west of the Rocky Mountains may potentially be seismically active. 10 CFR § 72.102(b). These areas, including the proposed ISFSI site, must be evaluated by the techniques of 10 CFR Part 100, Appendix A. Specifically, Appendix A, IV(b)(2) requires the "[e]valuation of tectonic structures underlying the site, whether buried or expressed at the surface, with regard to their potential for causing surface displacement at or near the site." The purpose of the evaluation is to define capable faults which exhibit "[m]ovement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years." 10 CFR Part 100, Appendix A, III(g)(1).

Although the Applicant concludes that there is "[n]o evidence of fault offset of the surficial soils" (SAR at 2.6-35), the SAR does not provide sufficient supporting evidence of the presence or absence of buried capable faults that have moved at least

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[19] This contention is supported by the Affidavit of Barry J. Solomon and the Declaration of Lawrence A. White, attached hereto as Exhibits 11, and 1, respectively.

once within the past 35,000 years or repeatedly within the past 500,000 years. Surficial material at the site was deposited by Lake Bonneville sometime between 10,000 and 25,000 years ago; however, additional material beneath the lake deposits may range in age from 500,000 to 25,000 years old. Dorothy Sack, Quaternary Geologic Map of Skull Valley, Tooele County, Utah, Utah Geological Survey Map 150 (1993).

The Applicant conducted seismic-reflection surveys to detect subsurface geologic structure in deeper bedrock and unconsolidated material directly overlying the bedrock, and seismic-refraction surveys to detect subsurface geologic structure in shallower unconsolidated material. The Applicant detected buried faults in Paleozoic bedrock beneath the site in a seismic reflection survey (SAR Appendix 2B), but concluded that the faults "do not appear to extend into the overlying unconsolidated sediments." SAR at 2.6-36. However, based on a review of the reflector profiles, several of these faults apparently displace a significant reflector above what the Applicant interpreted as the top of the bedrock, and extend upwards into the overlying unconsolidated sediments. Irregular surfaces in layers in seismic-refraction profiles of overlying shallow sediments may support an interpretation of displacement in younger material during more recent times than the Applicant determined.

Of particular concern are faults in the western half of seismic line 2 (SAR Appendix 2B, figure 4.6) which directly underlie the proposed ISFSI area; other faults which may offset unconsolidated sediments are found in seismic line 3 crossing the

proposed easement area. The faults in both areas, if capable, may produce greater vibratory ground motion than that for which the facility is designed. Moreover, the faults beneath the storage area may also pose a threat of surface fault rupture which must be accommodated in facility siting and design.

Regardless of the evidence showing displacement within the last 35,000 years, the Nevada Bureau of Mines recently determined that 64 percent of the surface-rupturing historical earthquakes in the Basin and Range physiographic province, which includes Skull Valley, occurred on faults with no prior evidence of Holocene (within the last 10,000 years) movement. DePolo, C.M., and Slemmons, D.B., 130,000 Year vs. 10,000 Year (Holocene) Classification of "Active" Faults in the Basin and Range Province (abstract), *in* Basin and Range Province Seismic Hazards Summit Program and Abstracts: Reno, Nevada, Western States Seismic Policy Council, 1997, at 28. Many of the earthquakes were on faults that had not experienced prior large earthquakes for up to 130,000 years. The Hickman Knolls Horst block, where the Skull Valley Reservation is located, may include similar faults which may be buried. Thus, the Applicant should extend its evaluation to determine the potential for seismic activity from earthquakes on faults in the site vicinity.

2. **Ground motion.** The site may also be subject to ground motions greater than those anticipated by the Applicant due to spatial variations in ground motion amplitude and duration because of near surface traces of potentially capable faults (the

Stansbury and Cedar Mountain faults). Sommerville, P.G., Smith, N.F., Graves, R.W., and Abrahamson, N.A., Modification of empirical strong ground motion attenuation relations to include the amplitude and duration effects of rupture directivity, *in* 68 Seismological Research Letters (No. 1) 199 (1997). Failure to adequately assess ground motion places undue risk on the public and the environment and fails to comply with 10 CFR § 72.102(c).

3. Characterization of subsurface soils. Perhaps the most significant shortcoming in the license application and SAR is the lack of any rigorous and detailed investigation of subsurface conditions that would be appropriate for any nuclear facility. The level of investigations presented is more typical of very preliminary studies for site screening efforts and not a detailed determination of site suitability for establishing design parameters.

a. Subsurface investigations. The location plans for completed subsurface investigations, cross-sections, and profiles showing subsurface soil and rock layering at the site contained in the license application is deficient in that these data could not be compared with the Applicant's boring logs. Structure specific cross sections and profiles were not prepared utilizing the boring log records. Only a generalization of the boring logs were used to establish the site geologic characterization. It is not possible to ascertain whether or not all the data collected, particularly data on zones of soft/loose conditions encountered in the explorations,

have been used to characterize subsurface conditions and to establish design values and that the uncertainties normally associated with the estimation of the thickness and extent of various materials occurring at the site have been conservatively considered in developing the soil and rock layering.

Additionally, SAR section 2.6 defining geologic features is not acceptable because the discussions, geologic maps, profiles of the site stratigraphy, structural geology, geologic history, and engineering geology are not complete and are not supported by investigations sufficiently detailed to obtain an unambiguous representation of the site geology. The maps do not provide the requisite detail to evaluate the assumed geologic conditions stated in the text. For example, only 25 borings were taken across the site, and from this a single generalized geologic profile in an obtuse angle across the canister fuel storage facility is presented. SAR figure 2.6-5. The geologic profile cannot be correlated with surface topography, geologic deposition soil characteristics, or seismic profiling completed for the site. Details missing include the interrelationship of the subsurface conditions with geologic history of the site.

Further, the application does not discuss the geochemical effects of the environment (weather and rain water) on the physical and strength characteristics of the soil and rock at the ISFSI site, particularly if there is potential for geochemical weathering and leaching of soils and rocks at the storage site. Correlations should be

made with previous groundwater conditions which led to the calcareous deposition and probable cementation of the subsoils.

b. Sampling and analysis. Site specific investigations and laboratory analyses must show that soil conditions are adequate for the proposed foundation loading. 10 CFR 72.102(d). However, PFS's sampling program is not adequate in quantity (number of samples) and quality (suitable recovery of disturbed and undisturbed samples)[20] to ensure that all materials that are critical for geotechnical evaluation of the site have been adequately sampled. For example, only five undisturbed samples were collected, and only five consolidation tests with accompanying physical properties analyses, and two unconsolidated undrained strength tests were made. Unless subsurface conditions are predictably uniform across the site, the number of tests and analyses are inadequate to accurately model the expected behavior of the soil foundation under static and dynamic loading. The prediction of soil foundation performance cannot be predicted adequately with limited data.

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[20] Soil samples from each predominant soil type within the site stratigraphy should comply with the following criteria: they should contain no visible distortion of strata, or opening or softening of materials; specific recovery ratio (length of sample recovered divided by length of sampler extension) should exceed 95 percent; and they should be taken with a sampler with an area ratio (annular cross-sectional area of sampling tube divided by full area of the outside diameter of samples) less than 15 percent. Naval Facilities Engineering Command Soil Mechanics Volume Design Manual 7.1 at 7.1-73, Dept. of the Navy (May 1982).

The investigations (sampling and analysis) to determine the properties of various materials underlying the site are not sufficient. The scope of investigations should match the design requirements of the facility and complexities of the site. For example, the analysis of soil is not based on the results of dynamic testing of insitu samples either in a stress or strain controlled manner. These data are essential in order to correlate with the field seismic profiling (shear wave determination) for use in the analysis of the seismic response of the buildings and their contents, and to determine the potential for soil collapse.

There are insufficient soil test data presented in the application to determine that strength tests have been performed on undisturbed samples and that there are sufficient relevant test data to support the selection of design parameters. *See e.g.*, SAR App. 2A, Attach. 2, at 2 and tables immediately following. For example, the soil test data did not include samples taken from each of the soil strata, did not include each foundation of buildings or structures, did not include the PMF diversion dike foundation, and did not evaluate compacted soils. There is also insufficient data to conclude whether or not soil and rock characteristics derived from the investigations have been completely and conservatively interpreted to develop design parameters. If site building foundations and soil structures have not been investigated and laboratory tests to measure and quantify the soil performance not documented, a decision regarding suitability or applicability cannot be made.

The collected field data must be compared with the soil information found in the literature, and correlated with other data for similar soils when comparing the shear modulus values. The Applicant must obtain representative undisturbed samples of each of the site soils and determine their dynamic properties. The apparent differences in Poisson's ratio as cited in SWECO calculations should be evaluated, not assumed to be an appropriate value, and then used for safety related calculations. *See e.g.*, PFS calculation package, Vol. I, Subdivision 7 at 17A and B (calculation number 01-1).

The license application does not provide a detailed and quantitative discussion of the criteria used to determine if samples were taken in accordance with acceptable test methods and tested in sufficient number to define all the soil and rock parameters needed for characterizing the site and borrow areas in accordance with the general guidance of ASTM Standards. The basis for the selection of samples and the type of test to be made is a function of the structure, anticipated loading, duration of loading (seismic) and the need to modify the soil's physical characteristics. The boring location plan appears to be merely a grid across the site and not structure specific. *See*, SAR, figure 2.6-2.

The descriptions of the test results for field and laboratory tests are generally insufficient to allow detailed analysis. While the conditions of the testing were explained to be in accordance with accepted testing procedure, any deviations from the

normal procedure recommended in the standard test should be documented. For example, throughout calculation number 04-3, the criteria for the assignment of unit weight of soil, typically used in most all soil analysis (strength, consolidation, and dynamic response) are assumed values without justification of the effects of percent clay or calcareous materials. *See* PFS calculation package Vol. II, Subdivision 10 (calculation number 04-3). The justification of the values should be provided before their use is permitted in static and dynamic analysis, particularly when determining the dynamic strain response of soils under triaxial testing. Calculation number 04-3 involving bearing capacity reports the foundation soil to consist of compacted structural fill with a unit weight of 125 pounds per cubic foot, while laboratory data calculation 05996.01-G(B)-01 in the Geomatrix (1997B) For Bases For Dynamic Soil Properties (*referred to in* PFS calculation package Vol.II Subdivision 11 at 4 (calculation number 05)), reports a value almost 50% lower (unit weight of 80 pounds per cubic foot).

A major failing in the application is the lack of a detailed discussion of field and laboratory sample preparation for testing, the omission of which prevents independent review and assessment of the quality of data collected. How samples are prepared and tests performed can significantly impact test results and their interpretation, potentially making the test results and interpretations meaningless. Additionally, the tests results may not reflect those conditions to be modeled in the field and therefore either

underestimate or overestimate the response of the foundation system to actual field loading conditions. For strength tests conducted in the laboratory, full details must be given; for example, how saturation of the sample was determined and maintained during testing and how the pore pressures changed. For sites that are underlaid by cohesionless soils and sensitive clays that are or may become saturated, particularly at depths greater than 30 feet, the Applicant should show that all zones that could become unstable because of liquefaction or strain-softening phenomena have been sampled and tested to evaluate their ground-failure potential. The Applicant must also show that the static and dynamic engineering properties of the soils, such as unconfined compressive strength, shear strength parameters for strength parameters from cyclic triaxial tests, were properly determined and that reasonable and conservative values were used in the design. This demonstration should explain how the developed data were used in design analyses, how the test data were enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameter used in design should be provided and should be supported by field and laboratory test records.

c. **Physical property testing for engineering analysis.** The static and dynamic properties of materials needed for geotechnical analyses and design should be determined by performing appropriate laboratory and field tests which are conservative and accepted in practice by the geotechnical engineering profession. This

is especially a complex site from the standpoint of assessing potential earthquakes and resulting ground motion that may affect plant operation. However, it is not possible to ascertain if the Applicant's field and laboratory test data have been conservatively interpreted to determine the design parameters recommended for the various materials at the site. The SAR relies heavily on the published values for static and dynamic strength and the performance of compacted materials, not the physical characteristics of specific site soils. PFS calculation package, Vol. I, Subdivision 7 at 35 (calculation number 01-1). Because of the limited number of tests and generalizations made with respect to the soil profile and use of general uncorroborated published soil data, a reasonable judgment cannot be made regarding the applicability of the averaging conditions as assumptions used in the design calculations. There is too much uncertainty regarding the applicability of published data to the site. For example, The dynamic analyses presented instead use published information from 1970[21] which is extrapolated to the site without any basis for such extrapolation. The variation of shear modulus determined from testing cited in this reference is based upon a very small strain derived for laboratory compacted loose to medium dense sand materials. This data is not applicable for characterizing dynamic properties of slightly cemented

[21] Seed and Idress (1970) is referred to in the PFS Calculation Package, Vol. 1, Subdivision 1 at 41 (calculation 05996.01-G(P05)-1 entitled "Development of soil and foundation parameters in support of dynamic soil structure interaction analysis" (Rev O, 3/13/97)).

silts found at the site based on SW-AJA (1972) at 39 of SWECO calculation. Please note the variation in shear modulus is reported on the graph "Range for Sands" while the recommended range of values defined by the curve for use for layer 1 curve is for silts, clays, and clayey silt. The Applicant should explain why the data extrapolated from this curve is appropriate considering the various shear strain levels. In addition, strain controlled dynamic triaxial tests should be conducted to reference one or more strain intervals to support the basis of the curves. *See e.g.*, PFS calculation package, Vol. II Subdivision 9 at 33 (calculation number 03-1).

Also some of the data do not fit together, and it appears data presented from different sources have been combined without assessing their applicability to the site. For example, the void ratio for soils indicate very loose soil conditions yet blow counts from standard penetration test are indicative of dense soils. The void ratio equation which represents the volume of soil voids divided by the volume of solids in the soil is in excess of two. *See* laboratory data results, PFS calculation package, Vol. II Subdivision 11 at 4 (calculation number 05). This soil structure may be typical of cemented sands, but no data are available to confirm that this is the case. Consolidation tests indicate the value e_0 varies between 1.615 and 2.285. Id.

$$\text{The equation } e_0 = \frac{\text{Volume Voids}}{\text{Volume Solids}} = 2 +$$

based on these consolidation test values indicates that the volume of voids in the soil is more than twice the volume of the solid materials in the soil. The Applicant should verify if this abnormally high void ratio is typical of cemented soils.

Further, the Applicant performed only limited soil engineering tests (*see*, SAR App. 2A, Attachment 2), omitting a number of additional widely accepted index and engineering properties tests, such as unit weights, porosity, compaction, etc., which should be performed for layer 1 and 2 soils. *See*, 4 Annual Book of ASTM Standards § 04.08 (Soil and Rock Dimension Stone), American Society for Testing and Materials Annual Publication (1997). Such additional tests will allow a reviewer to make a reasonable judgment about how the soil will perform under the anticipated static and dynamic loading of the short and long term conditions.

4. **Soil stability and foundation loading.** Based on its investigations, the SAR apparently did not consider the potential for the presence of collapsible soils beneath the site to be significant. Although collapsible soils have considerable strength when dry, they are subject to hydro-compaction and settle dramatically when wetted. Thus, settlement associated with wetting may result in significant foundation damage.

Collapsible soils typically exhibit a loose, honeycomb structure associated with a low unit weight. Rollins, K.M., and Williams, Tonya, Collapsible Soil Hazard Mapping for Cedar City, Utah, *in* Proceedings of the 1991 Annual Symposium on Engineering Geology & Geotechnical Engineering, No. 27: Pocatello, Idaho State

University 31-1 (1991). These characteristics are exhibited by three of the five soil samples subjected to consolidation tests by the Applicant; samples C-1/U-3C, C-1/U-3D, and C-2/U-2E. The three samples have void ratios ranging from 1.952 to 2.285, compared to void ratios of 1.615 and 1.625 in the other two samples, and unit weights ranging from 51.7 to 57.5 pounds/cubic foot (pcf), compared to unit weights of 64.7 and 64.9 pcf in the other two samples. SAR Appendix 2A.

Collapsible soils also have intergranular bonds composed of silt, clay, evaporites, or other cementing agents that separate larger grains, forming the loose structure and imparting a high dry strength. The tested samples were alkaline, suggesting a possible evaporitic cement component, and reacted immediately with a dilute solution of hydrochloric acid, probably indicating carbonate cement. SAR Appendix 2A, attachment 2 at 2.

When saturated, the cement in collapsible soils weakens or dissolves and the larger grains collapse into a denser, grain-to-grain soil structure. Therefore, test samples must be saturated during consolidation testing to determine their collapse potential, but only two of the three samples, C-1/U-3D and C-2/U2E, were saturated. The Applicant states that after inundation with distilled water and the application of incremental loads over time, the test data for these two samples "appeared to indicate primary consolidation was not complete" after a considerable test interval. SAR Appendix 2A, attachment 2 at 2.

The low unit weight, high void ratios, alkalinity, reactivity with hydrochloric acid, and incomplete consolidation after a substantial test interval indicate a significant potential for the presence of collapsible soils beneath the site. The Applicant's data do not support its conclusion that "there is no potential for . . . collapse . . . or excessive settlement" of foundation soils. SAR at 2.7-2.

The SAR also concludes "there is no evidence of soluble mineral deposits in unconsolidated materials beneath the site to at least a depth of 100 feet." SAR at 2.6-37; ER at 2.6-19. However, the Applicant presents data that show evidence of alkaline shallow soil samples that reacted immediately with a dilute solution of hydrochloric acid. SAR Appendix 2A, attachment 2 at 2. These data argue for the presence of soluble minerals (evaporites and carbonates) in shallow unconsolidated materials.

Outcrops of white marl, a calcareous, laminated, open-water deposit of Lake Bonneville, were mapped throughout Skull Valley. Dorothy Sack, Quaternary Geologic Map of Skull Valley, Tooele County, Utah, Utah Geological Survey Map 150 (1993). The white marl is typically exposed in ephemeral stream cuts, underlying lake deposits similar to those at the surface of the site. Surficial samples of the marl analyzed by Sack have calcium-carbonate contents ranging from 23.2 to 52.5 percent and are texturally similar (silt) to unconsolidated materials encountered in boreholes drilled by the Applicant. Id. Thus, the Applicant did not consider the presence of

such soluble minerals during the evaluation of adequate soil conditions for the proposed foundation loading as required under 10 CFR § 72.102(d).

M. **Probable Maximum Flood**

CONTENTION: The application fails to accurately estimate the Probable Maximum Flood (PMF) as required by 10 CFR § 72.98, and subsequently, design structures important to safety are inadequate to address the PMF; thus, the application fails to satisfy 10 CFR § 72.24(d)(2).

BASIS: The Applicant inaccurately determined a drainage area of 26 square miles in its estimate of PMF. ER at 2.5.1, and SAR at 2.4.1.2. The facility is proposed to be located in Section 6, Township 5 South, Range 8 West. The topography of Section 6 is fairly flat from east to west with a large drainage area of over 240 square miles, producing runoff that will cross the depression in the northeast part of the section. The Applicant's 26 square mile estimate is inaccurate because the Applicant failed to account for all the drainage sources that will impact the ISFSI site during extraordinary storm events. 10 CFR § 72.98(a)-(c). *See* Affidavit of David B. Cole, attached herein as Exhibit 12. For example, the Applicant's drainage area does not take into account high canyons south of and including Deadman Canyon on the western slope of the Stansbury Mountains that produce significant runoff in wet years. Id. at ¶ 6. Consequently, the Applicant's figures for the 100-year flood and the PMF are undervalued by at least half.

Failure to adequately estimate the PMF results in the diversion berm being under-designed and does not comply with 10 CFR § 72.24(d)(2). Due to this inaccurate

assessment, the need to implement emergency plans may be underestimated. The Applicant's assertion that the facility area is "flood dry" (*see* ER at 2.5-6) may not hold true when calculations are recomputed to include the larger, more realistic drainage area. Moreover, a facility not accurately protected from flooding will impact the operation, maintenance and ultimate safety of the ISFSI. Furthermore, there is no justification to show that flood water will not curl around the berm, which will only be placed at the south end and portions of the southwest end of the ISFSI.

A number of consequences important to safety may occur because of flooding or an inadequate berm construction and location. The access road may be flooded or washed out, preventing necessary operations personnel or emergency service providers access to the site. Hence the Applicant would not be able to cope with emergencies as required by 10 CFR § 72.24(k). If the flooding is not prevented, translation motion of the storage pad and building foundations could occur, resulting in structural damage or failure. Therefore, the Applicant would not meet the requirement of 10 CFR § 72.24(d)(2) that structures, systems and components provide for the prevention and mitigation of accidents caused by natural phenomena. Flooding of the ISFSI would also transport onsite chemical and radiological contaminants to offsite soils and ground and surface waters, thus violating 10 CFR § 72.24(l).

N. Flooding

CONTENTION: Contrary to the requirements of 10 CFR § 72.92, the Applicant has completely failed to collect and evaluate records relating to flooding in the area of the intermodal transfer site, which is located less than three miles from the Great Salt Lake shoreline.

BASIS: Most spent fuel will be shipped to Rowley Junction on rail lines paralleling the Great Salt Lake. This is an area that has been impacted by extensive flooding events in the recent past due to the rise in elevation of the lake. The elevation of rail tracks in the Rowley Junction area is just three to eight feet higher than the Great Salt Lake's historic high, 4211.85 feet, which occurred in 1986 following several wetter than average years. During this extensive flooding, rail tracks located on a causeway in the lake were lost, and on several occasions, the tracks along the southern shore of the lake were threatened with inundation. Further, the elevation at the intermodal transfer site is only seven feet higher than the lake's historic high. In very wet years, these critical areas may be vulnerable to the potential of flooding, or swamping by water waves generated by wind. *See* Exhibit 12, Cole affidavit at ¶¶ 8 and 9.

By failing to identify, document, and evaluate the significance of potential flooding events to the design of the intermodal transfer site and rail route paralleling the Great Salt Lake, PFS does not satisfy the requirements of 10 CFR § 72.92.

Further, the Applicant has failed to investigate information regarding floods and water waves along the lake shore that may have been generated by earthquake or landslide events, as required by 10 CFR Part 100, Appendix A, IV(c)(2), and 10 CFR § 72.92 and § 72.102(b).

O. Hydrology

CONTENTION: The Applicant has failed to adequately assess the health safety and environmental effects from the construction, operation, and decommissioning of the ISFSI and the potential impacts of transportation of spent fuel on groundwater, as required by 10 CFR §§ 72,24(d), 72.100(b) and 72.108.

BASIS: The Applicant must evaluate its proposed site for regional environmental effects resulting from the construction, operation and decommissioning of the ISFSI and also with respect to the potential impact on the environment form the transportation of spent fuel. 10 CFR §§ 72.100(b) and 72.108. The Applicant must also assess the impact on public health and safety resulting from the operation of the ISFSI. Id. § 72.24(d).

1. **Pathways and Contaminants**

The facility as designed, the intermodal transfer point, and transportation of spent fuel present the potential for a number of contaminant sources. Thus, in order to satisfy § 72.100(b), the Applicant must identify the actual contaminant sources, the potential for surface and groundwater contamination, and the impact of any contamination on downgradient resources.

The SAR is required to describe "the ability of the surface and ground water environment to disperse dilute or concentrate normal and inadvertent releases of radioactive effluents for the full range of anticipated operating conditions" and to

identify contaminant pathways. NUREG 1567, Standard Review Plan for Spent Fuel Dry Storage Facilities (hereafter "NUREG 1567"), p.2-10 Furthermore, the Applicant is required to review "the transport characteristic of aquifers which are subject to radionuclide contamination, and an adequate description of the contaminant pathways" and ensure that "potential future groundwater uses are conservatively estimated." Id. p. 2-19.

The Applicant has failed to identify all effluent sources and potential contaminants and contaminant pathways that may have subsequent impacts to surface water and groundwater in the following respects:

a. Sewer/Wastewater

The Applicant expects to meet sanitation needs for the facility with an underground sewage (septic) system with leach field. ER at 3.3-4, 5 and SAR 4.3-3. However, the Applicant does not describe the facility wastewater system. In addition to the sanitation system providing a direct pathway to groundwater for chemical, heavy metal, and radiological contaminants that are collected or accidentally drained into the sewage system, it will also be a pathway for contaminants from employee hand washing, laundry, restrooms, showers, cafeteria, and laboratory waste streams. Furthermore, drain sumps used to catch and collect water which drips from shipping casks in the canister transfer building will be discharged into the sanitary system. SAR at 7.5-4.

b. Retention Pond

The Applicant proposes to collect and drain storm-water to a retention pond at the north edge of the restricted area. ER at 4.2-4. The retention pond is "free-draining" and water collected in the pond will dissipate by evaporation and percolation into the subsoil. Id. Judging from this description, the pond will be unlined. Under routine operations and from effluent run-off, including rain water and snow melt, the storage pads will likely transport various radiological, heavy metal, and chemical contaminants to the unlined retention pond which will act as a direct pathway to groundwater. Furthermore, during heavy rains or flood events the retention pond may overflow and contaminate perennial and intermittent surface streams.

c. Operations

The Applicant's proposed operations will generate a number of radiological, chemical, or heavy metal contaminate sources that may be transferred to the groundwater. Routine maintenance of diesel generators, facility vehicles, and equipment, such as the tractor, overhead cranes, will generate various solvents and other organic contaminants. Washing or rinsing heavy haul trucks and other vehicles will generate an effluent that may be contaminated with radioactive, heavy metal, or organic contaminants both on site and at Rowley Junction. Precipitation may wash off contaminants from vehicles or cask surfaces. Laboratory operations may generate a variety of radiological, heavy metal, or chemical contaminants.

d. Construction

Construction of the ISFSI, and the access road, and widening Skull Valley Road or building a rail spur will generate a number of radiological, chemical, or heavy metal contaminate sources from the heavy machinery, vehicles, construction materials and chemicals, including fuel, solvents, asphalt, etc. that will be used during construction. These activities presents the potential for these contaminants to be released to groundwater and surface water via drainage ditches, culverts and through seepage. For example, culverts will be located through the access road embankment "to carry the occasional runoff" and the Applicant's access road off Skull Valley Road. ER at 4.1-10.

2. **Groundwater and Surface Water**

The Applicant maintains that "[d]iscussion of potential contamination of groundwater is not applicable since the depth to groundwater at the site is substantially removed from any activity at the site finished grade." SAR at 2.5-5. To support its statement, the Applicant generically describes the strata at the site, the depth to groundwater at approximately 100 to 127 feet, and the low general permeability and groundwater velocity. However, the Applicant does not support its statements with any calculations based on specific factors, or the identification of the potential contaminants or direct pathways to groundwater. Moreover the Applicant has not assessed the potential for groundwater contamination at the intermodal transfer point at Rowley Junction or along the transportation route.

The Applicant estimates the groundwater depth at the ISFSI site at about 120 to 127 feet. ER 2.5-11. The Applicant then assumes groundwater along the proposed rail spur is also at a depth of over 100 feet and that "it is unlikely that the railroad spur will have any impact on hydrological resources." ER at 4.4-4. However, groundwater depths range from less than 10 feet to over 30 feet at various points along Skull Valley Road, the proposed location for the rail spur or expansion of Skull Valley Road. *See* Exhibit 13, Map: Shallow Groundwater and Related Hazards. In addition, the intermodal transfer point (Rowley Junction) is adjacent to a protected wetland area where groundwater is encountered at less than 10 feet. Id. Furthermore, while the Applicant describes the subterranean strata, the low permeability, and the low groundwater velocity at the site, ER § 2.5.5, the Applicant does not discuss these factors along the transportation route or the at intermodal transfer point.

The Applicant has failed to adequately identify surface waters that may be effected if NRC issues a Part 72 license. The Applicant generically states that there are "few perennial streams in Skull Valley and none in the vicinity of the [ISFSI;]" some dry washes that drain northward or northwestward in the vicinity of the ISFSI; and that no springs occur within 5 miles of the ISFSI but some spring channels are located near Timpie and Delle. ER at 2.5-2, 4.1-10. In addition, the Applicant mentions that "[s]prings also occur at several locations along Skull Valley Road, surfacing at various distances from the highway ... [and] no perennial lakes or ponds are within 5 miles of

the [ISFSI] other than a few stock ponds or small reservoirs built for irrigation purposes." ER at 4.3-6. This discussion is inadequate to permit an assessment of surface waters that may be affected by construction, operation, and decommissioning of the site and transportation of spent fuel. For example, there are at least fifty springs located within 15 miles of the proposed ISFSI. Exhibit 14, Springs Within the Skull Valley Watershed. Furthermore, there are perennial waters protected for agricultural uses located within 10 miles of the site. Id.

The Applicant states that earthen berms which serve to divert flooding will "have little effect on the natural surface hydrology." ER at 4.2-5. However, the Applicant fails to justify its conclusion that a concentration of flood water around the facility will not impact surface water or groundwater. *See* Contention M (Probable Maximum Flood) whose basis is adopted herein by reference.

3. **Water Usage**

The Applicant has failed to adequately discuss or evaluate the effect of its water usage on other well users and on the aquifer.

The Applicant estimates its water needs at 1,500 gallons per day. ER 4.2-4. However, the Applicant does not specify if the estimate is a daily average or a peak usage estimate. The Applicant also does not indicate if the 1,500 gallons per day is the estimate during construction, construction/operation, or decommissioning. Furthermore, the Applicant implies that it plans to draw water from onsite wells. Id.

In addition to the requirements of 10 CFR §§ 72.24(d), 72.011(b) and 72.108, for a site located over an aquifer which is a source of well water, NUREG 1567, p. 2-10, requires the Applicant to survey groundwater users and well locations, static water levels, well pumping rates and aquifer drawdown. Also required in the SAR is a discussion of the future projected amount of water withdrawals. Id. p. 2-13.

Well water is used as a source of potable water by users near the vicinity of the proposed ISFSI site. For example, the Petitioners, Castle Rock, et al, in their petition to intervene, p. 4, state that they owns nine separate homes located in Skull Valley north of the ISFSI along Skull Valley Road and each home is provided with culinary water through wells located adjacent to the homes. Also the affidavits attached to Ohngo Gaudadeh Deva (OGD) Petition to Intervene state that the affiants rely on well water for their culinary needs. *See* Affidavits of Lester Wash ¶ 7, Garth Bear ¶ 5, Abby Bullcreek ¶ 8; Margene Bullcreek ¶ 8 attached to OGD's Petition to Intervene. The Applicant states that "[l]ocalized 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." SAR at2.5-5. This statement is inadequate to comply with the regulations as implemented by NUREG 1567. The Applicant should provide an estimate based on an estimated pump rated and local hydrological data. Furthermore, the Applicant has failed to discuss water needs, the impact of water usage, and water rights at the intermodal transfer site.

4. **Downgradient Impacts**

The Applicant has failed to discuss the impact of groundwater contamination on downgradient hydrological resources. As the Applicant generally indicates (ER 2.5-8 to 10), recharge to the groundwater in Skull Valley watershed is from precipitation mainly collected from the Stansbury, Onaqui, and Cedar Mountains. Hood, J.W. and Waddell, K.M., Hydrologic Reconnaissance of Skull Valley Tooele County, Utah: Utah Department of Natural Resources Technical Publication No. 18, 1968. Groundwater generally flows from the recharge areas along both sides of the valley (base of the mountains) toward the middle axis of Skull Valley. Id.

The proposed ISFSI site and Skull Valley Road are located within the Skull Valley watershed. Groundwater at the site moves northwest, toward the axis of Skull Valley. North of the reservation, the groundwater then flows north, then northeast where it discharges through evapotranspiration or surface flow and under flow to the Great Salt Lake. Id. at 57.

In generically discussing groundwater characteristics, the Applicant has failed to discuss the environmental effects and impact from groundwater contamination on more than thirty wells used for irrigation and stock watering located down gradient of the ISFSI. In addition, the Applicant has failed to discuss the impact on approximately fifty springs that located within 15 miles of the ISFSI. Exh. 14 Also, the Applicant has failed to discuss the impact of groundwater contamination on the downgradient

Timpie Springs Waterfowl Management Area (Timpie Springs) and the Great Salt Lake. These areas provide wetlands and habitat for aquatic wildlife and shorebirds. In fact the Great Salt Lake is a western hemisphere shorebird reserve and the world's largest staging area for Wilson's Phalaropes and has seventy-five percent of the western population of Tundra swans; it also provides habitat for bald eagles (threatened species) and peregrine falcons (endangered species). *See e.g.,* ER Table 2.3.2 Timpie Springs and the Great Salt Lake, like all ground and surface water resources in the area, are critical to Utah's ecosystem. Potential accidents involving casks being transported along the rail route which parallels the Great Salt Lake and Timpie Springs into Rowley Junction would have serious effects on these areas as would contamination of ground of ground and water along the corridor route and from the ISFSI site.

P. **Inadequate Control of Occupational and Public Exposure to Radiation**

CONTENTION: The Applicant has not provided enough information to meet NRC requirements of controlling and limiting the occupational radiation exposures to as low as is reasonably achievable and analyzing the potential dose equivalent to an individual outside of the controlled area from accidents or natural phenomena events. **BASIS**: The Applicant has not complied with the Commission's radiation protection and monitoring regulations pursuant to 10 CFR § 72.24(e) and (m); NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities (Draft)*, U.S. NRC (October 1996) Section 9 (Radiation Protection Evaluation) (hereinafter NUREG-1567); NRC Reg. Guide 3.62, *Standard Format and Content for the Safety Analysis Report for Onsite Storage of Spent Fuel Storage Casks,* Section 9, (Radiation Protection); NRC Reg. Guide 8.8, *Information Relevant to Ensuring the Occupational Radiation Exposures at Nuclear Power Stations will be As Low As Reasonably Achievable,* U.S. NRC, Revision 3 (June 1978); and NRC Reg. Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low as is Reasonably Achievable*, U.S. NRC, Revision 1-R (May 1977), in the following respects:

1 The Applicant has not provided detailed technical information to show that the policy of minimizing exposure to workers as a result of handling the casks is adequate. Reg. Guide-3.62 § 7.1.1. If the design of the ISFSI has incorporated ALARA concepts then the casks chosen from vendors should have the lowest dose rates but PFS

has failed to provide the technical information describing why the two cask vendors were chosen and a description and comparison of the dose rates with other comparable casks for the OCA boundary array. PFS has not described the design features that provide ALARA conditions during transportation, storage and transfer of the waste. 10 CFR § 72.24(e).

2. The Applicant has failed to provide an analysis of alternative procedures to indicate whether the proposed procedures for workers handling the casks will result in the lowest individual radiation and collective doses. NUREG-1567, § 9 and Reg. Guide-3.62 § 7.1.2.

3. The Applicant has not adequately described why the OCA boundary was chosen and whether boundary dose rates will be the ultimate minimum values compared to other potential boundaries. Reg. Guide-3.62 § 7.1.2, Design Considerations.

4. The Applicant has failed to indicate whether rain water or melted snow from the ISFSI storage pads will be collected and analyzed prior to disposal and whether it will be handled as radioactive contaminated waste. Reg. Guide-3.62 § 7.1.3, Operational Considerations.

5. The Applicant does not provide design information for the ventilation systems in the unloading facility to show that contamination will be controlled and workers protected during unloading of the shipping casks, loading of the storage casks

and preparation of leaking canisters for offsite shipment to be compatible with the ALARA principle. Procedures to service, test, inspect, decontaminate, measuring filter efficiency and replace components of the ventilation system are not provided. Reg. Guide-3.62, § 7.3.1. Without an adequate ventilation system airborne contamination will spread within the facility and to the outside.

6. Reg. Guide 3.62 states that the Applicant should provide "information on methods for radiation protection and on estimated radiation exposures to operating personnel during normal operation and anticipated operational occurrences (including radioactive material handling, packaging, transfer, processing, storage and disposal; maintenance, routine operational surveillance and calibration."PFS has failed to provide adequate or complete methods for radiation protection. Information on how estimated radiation exposure values to operating personnel were derived is not provided to determine whether the dose rates are adequate.

7. The Application is deficient in many other respects related to ensuring that occupational exposures to radiation are ALARA including: (1) adequately describing the management policy and organizational structure related to ensuring ALARA exposures reflected in administrative procedures for personnel (Reg. Guide 3.62 § 7.1.1); (2) adequately describing a training program that insures all personnel working with radioactive materials, entering radiation areas or directing the activities of others who work with radioactive materials or enter radiation areas understand and

can evaluate the significance of radiation doses in terms of the potential risk, including outlines of the training classes (Reg. Guide 8.8 § 1.c); (3) providing specifics on personnel and area, portable and stationary radiation monitoring instruments and personnel protective equipment including specifications that include reliability, serviceability and limitations of internal accumulations of radioactive material, and a description of the program for routine calibration and checks for equipment operation and accuracy that reflect the ALARA program (Reg. Guide 8.8 § 1.d); (4) description of a program to effectively control access to radiation areas and control over the movement of sources of radiation within the facility (Reg. Guide 8.10 § 1.b); (5) adequately describing a program to maintain ALARA exposures of personnel servicing leaking casks for offsite shipment or onsite storage; (6) an adequate description of a program for monitoring clean areas to assure that they remain clean and monitoring dose rates in radiation zones to ensure they are kept ALARA; and (7) specific information on formal audits and reviews of the radiation protection program, including reviews of operating procedures and past exposure records. Reg. Guide 8.8 § 4. The Applicant does not describe a fully developed radiation protection program and thus the safety of workers due to potential radiation exposure cannot be assured.

8. 10 CFR § 72.126(d) requires that "[a]nalyses must be made to show that releases to the general environment during normal operations and anticipated occurrences will be within the exposure limit given in § 72.104. Analyses of design

basis accidents must be made to show that releases to the general environment will be within the exposure limits given in § 72.106." The Applicant has completely failed to include an analysis of accident conditions including accidents due to natural phenomena.

9. Applicant's failure to adequately control airborne effluent, *see* Contention T, whose Basis 3(a) (Air Quality) is adopted and incorporated by reference herein, may cause unacceptable exposures to workers and the public.

Q. **Adequacy of ISFSI Design to Prevent Accidents**

CONTENTION: The Applicant has failed to adequately identify and assess potential accidents, and, therefore, the Applicant is unable to determine the adequacy the ISFSI design to prevent accidents and mitigate the consequences of accidents as required by 10 CFR 72.24(d)(2).

BASIS:

1. The Applicant states that"the most vulnerable fuel" can withstand 63g in the most adverse orientation. SAR at 8.2-32. However, the Applicant does not provide the basis for its statement. The Applicant does not specify whether this includes fuel with leaks and cladding failures which has been stored underwater for many years and dry for many more years. Furthermore the Applicant has not provided the g loading that would cause such fuel to fail.

2. The Applicant has failed to discuss canister end accidents involving improperly constructed casks. It is unclear whether the TranStor cask is subject to the same quality of fabrication as the VSC-24. SAR at 8.2-34. The NRC issued a Demand for Information to SNC on October 7, [illegible] as a result of numerous NRC inspection findings indicating that, since 1992, Sierra Nuclear's quality assurance and corrective action programs have failed to identify and correct design control and fabrication deficiencies. A canister with fabrication deficiencies could fail, and if it contained failed fuel, fission products could be released.

3. The cask maximum lift heights of 10 and 18 inches imply that vertical drops greater than these amounts would result in damage to the canister or interior contents. SAR at 10.2-9. The Applicant must not only address lifting accidents while onsite at the ISFSI, but at the intermodal transfer site or during transport on either rail or highway, where significant damage could occur during an accident with potential resulting release of nuclear material. Cladding of spent fuel elements is likely to be very brittle through extensive radiation embrittlement, so cladding failure is likely during such accidents.

R. Emergency Plan

CONTENTION: The Applicant has not provided reasonable assurance that the public health and safety will be adequately protected in the event of an emergency at the storage site, at the transfer facility, or offsite during transportation.[22]

BASIS: The Applicant has not complied with the Commission's emergency planning regulations in 10 CFR § 70.22, nor has it followed Regulatory Guide 3.67, Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities, U.S. Nuclear Regulatory Commission (September 1990) (hereinafter Reg. Guide 3.67); or NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage Facilities *(Draft)*, U.S. Nuclear Regulatory Commission (October 1966) Appendix C (Emergency Planning) (hereinafter NUREG-1567), in the following respects:

1. The Applicant has not adequately described the facility, the activities to be conducted at the facility, and the area near the facility in sufficient detail to evaluate the adequacy and appropriateness of the Emergency Plan. Reg. Guide 3.67 § C.1 provides applicable guidance to the Applicant for incorporating in the [illegible] of "the type, form and quantities of radioactive and other hazardous materials," including a "list of all hazardous chemicals used at the site, typical quantities possessed,

[22] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

locations of use and storage, and the hazardous characteristics;" an adequate description of the "primary routes for access of emergency equipment" which should include a description of an alternate route for use in adverse weather conditions; a "description of potential impediments to traffic flow;" a description of "the types of terrain and the land use patterns around the site;" and an adequate description of the intermodal transfer station and the liquid retention pond, including the "hazardous characteristics" of the storage pad runoff pond. The Applicant has merely touched on some of these requirements without adequately addressing any of them, and in fact, regularly refers to its "Emergency Plan implementing procedures" which will be developed sometime in the future to take care of numerous details which should have been described in its Emergency Plan. *See e.g.*, EP at 2-7 and 5.1.

PFS has failed to describe and consider area specific impediments to emergency response such as flooding, high winds, range fires, ice and snow, and the presence of grazing domestic and wild animals on access roads which will impede the response of off-site emergency assistance and the transporting of on-site victims to off-site medical facilities.

2. The Applicant has not identified "adequate emergency and medical facilities and equipment to respond to an onsite emergency" as provided by Reg. Guide 3.67 § 4.3. The Emergency Plan (EP at 1-4) identifies Tooele County/City as the primary off-site support for major emergency support, but has not provided a

description of Tooele County's capabilities and training in handling wounds and emergency conditions involving radioactive materials. The Applicant merely states that the "Tooele Valley Medical Center ....is equipped to provide decontamination and ambulance services..." but does not supply any details about Tooele Valley Medical Center's capabilities. EP at 1-4. Notably, in commenting on PFS's Emergency Plan, Kari Sagers, Tooele County's Emergency Management Director, pointed out: "Some of the items I find conspicuously absent include ... [o]n-site and off-site training, monitoring, and protective equipment requirements." *See* Sagers' June 3, 1997 letter at 2, included as an attachment to the EP. The Applicant should address whether the Tooele Valley Medical Center actually has the expertise to handle radiological medical emergencies. At the very least the Applicant should "[d]escribe the measures that will be taken to ensure that offsite agencies ... have the necessary periodic training, equipment, and supplies to carry out their emergency response functions," as provided by Reg. Guide 3.67 § 4.3.[23]

Furthermore, support from Tooele Valley Medical Center and Tooele City is at least two hours away from providing any real response. *See e.g.*, Affidavit of Garth Bear ¶ 7 attached to Ohngo Gaudadeh Devia's Petition to Intervene and Request for Hearing dated September 12, 1997. The Applicant has not identified what extra

[23] The expertise in the State for providing radiation training would come from Utah Division of Radiation Control. However, the State has no records showing it provided training in responding to radiologic incidents to the Tooele Valley Medical Center personnel.

preparedness the site has or will implement as a result of off-site support being so far away, especially in adverse weather conditions.

3. The Applicant has not adequately identified, notified nor coordinated with "the principal State agency and other government (local, county, State, and Federal) agencies or organizations having responsibility for radiological or other hazardous material emergencies at the facility." Reg. Guide 3.67 § 4.4. The Applicant has not included "the local emergency planning committee established under the Emergency Planning and Community Right-to-Know Act of 1986; State departments of health, environmental protection, and emergency and disaster control" as provided by Reg. Guide 3.67 § 4.4. The plan assumes that no assistance will be required from resources external to Tooele County/City because "[t]he PFSF will not have extremely hazardous substances present in an amount equal or greater than the threshold planning quantities of 10 CFR 355." EP at 2-6 But the plan does not provide a list of hazardous materials used at the PFSF, including quantities, locations, use and storage requirements as provided by Reg. Guide 3.67 § 1.2.

The application states that "the worst case accident involving an ISFSI has insignificant consequences to the public health and safety." EP at 2-7. But the application has completely failed to address response to transportation accidents and accidents at the Applicant's transfer station at Rowley Junction. From 100 to 200 shipments of loaded spent fuel canisters will be transported through the State annually.

SAR at 1.4-2. The most likely mode of transportation to the site from Rowley Junction is by heavy haul truck. The management and handling of such a large volume of material will create a high potential for accidents having significant consequences to public health and safety. The application does not address response action for accidents and fatalities occurring either in the Applicant's intermodal transfer area or in the Applicant's transportation route along Skull Valley Road, a description of how emergency information will be disseminated to these areas, nor a description of the training program to respond to these emergencies as provided by Reg. Guide 3.67 §§ 4 and 5. For example, the Applicant merely repeats the provisions of Reg. Guide 3.67 § 7.2 regarding orientation tours for off-site emergency response personnel. EP at 6-2 to 6-3. Without identification of these fundamental components of an emergency plan, there is no assurance that PFS can or will take adequate protective actions in the event of an emergency.

4. The Applicant has not provided details to "describe the means and equipment provided for mitigating the consequences of each type of accident" as provided by Reg. Guide 3.67 § 5.3 and 10 CFR § 72.32(a)(5). For example, the means and equipment for restoring safe conditions to the site after a cask tip-over accident are not described. The Plan states that after a tip-over accident, the cask must be returned to its natural upright position within 48 hours and that PFS will procure a capable crane within the necessary timeframe. EP at 3-4. As the proposed ISFSI site is located

in a rural area, the Applicant must identify with specificity the location from which a capable crane can be procured and the time in which it will take to acquire such a crane. Furthermore, the Applicant must also address its ability to locate a crane on-site within the 48 hour critical time limit during adverse weather conditions, taking into account the secondary and mountain roads that provide access to the site.

The SAR at 2.3-2 describes the climate of Skull Valley as "semi-arid continental," with precipitation ranging from 7 to 12 inches/year (SAR 2.3-12). Thus, fire is a serious risk which must be taken into account. However, the Plan states that fire fighting capability is available on-site which includes a fire truck and fire fighting equipment but does not state whether sufficient water is available to fight a fire of any consequence and does not describe the program for maintaining any equipment. EP at 3-5. The Applicant expects to obtain water for fire fighting, as well as for potable water and for the concrete batching plant, from surface storage tanks since "it is unlikely that water wells drilled into the main valley aquifer would yield adequate quantities of water for these purposes on demand." SAR at 2.5-5. However, whether the storage tanks could hold sufficient water for a serious fire must be further examined, especially since the Applicant has identified the use of a fire truck at the site, another fire truck available from the reservation, as well as trucks supplied by Tooele County Fire Department, all of which may need access to the water tanks in a widespread difficult fire situation. *See e.g.*, Affidavit of Garth Bear ¶ 5.

5. The Emergency Plan does not contain sufficient detail to meet the provisions of Reg. Guide 3.67 § 5.4.1, because the Applicant has failed to provide adequate information on specific protective, communication, medical, contamination control, decontamination, fire fighting, radiation detection and hazardous material detection equipment with inventory lists and specific locations of the equipment. *See* EP at 5-8 to 5-9. Without specific adequate information, emergency preparedness personnel may not be capable of providing a timely response to an emergency. For example, the Plan provides no description of the locations of emergency equipment and supplies, a means for distributing these items, nor even criteria for issuance of emergency equipment, pursuant to Reg. Guide 3.67 § 5.4.1.2.

S. Decommissioning.

CONTENTION: The decommissioning plan does not contain sufficient information to provide reasonable assurance that the decontamination or decommissioning of the ISFSI at the end of its useful life will provide adequate protection to the health and safety of the public as required by 10 CFR § 72.30(a), nor does the decommissioning funding plan contain sufficient information to provide reasonable assurance that the necessary funds will be available to decommission the facility, as required by 10 CFR § 70.3(b).

BASIS: The Applicant's decommission plan and funding of the plan are deficient in the following respects:

1. The Applicant has failed to provide reasonable assurance, as required by 10 CFR § 72.30(b), that funds will be available to decommission the ISFSI. The Applicant intends to obtain a letter of credit "in amount of $1,631,000 to cover the estimated facility and site decommissioning costs, exclusive of the storage casks." LA at [illegible]-2. As a newly formed entity and without any documentation included in the application as to [illegible] capital structure or assets, the Applicant offers no reasonable assurance that it will be qualified to obtain such a letter of credit. Contention E (Financial Qualifications), which more fully discusses the financial assurance for newly formed entities, and whose basis is incorporated by reference into this contention.

2. The financial assurance regulations for decommissioning allow for use of an external sinking fund coupled with a surety method or insurance. 10 CFR § 72.30(c). The application specifies a surety will be in the form of a letter of credit, but does not provide the wording for the letter of credit or state that the letter of credit is irrevocable. LA at 10-2, LA App B, at 5-2, SAR at 9-6. This is contrary to Regulatory Guide 3.66, <u>Standard Format and Content of Financial Assurance Mechanisms required for decommissioning under 10 CFR Parts 30, 40, 70 and 72</u> (hereafter "Reg. Guide 3.66"), p. 1-4, which states that the Decommissioning Funding Plan "should include the text of the financial assurance instrument(s) that a licensee has chosen to comply with the financial assurance requirements."

3. The application states that decommissioning will be preceded by off site shipment of the canisters containing the spent fuel. LA App. B, at. 1-1, 2-3; SAR at 9.6-1. However, the Applicant's own words belie this possibility. In its discussion of "Need for the Facility" (ER 1.2), the Applicant portrays existing reactor sites as running out of spent fuel storage options. The Applicant also states that its facility "would allow reactors that are permanently shutdown to remove all the spent fuel from the site, thus permitting the complete decommissioning of the site." ER at 1.2-2. Therefore, the shipment of the spent fuel back to the originating nuclear power plants will not be viable at the time of decommissioning of the ISFSI.

It is not unrealistic to expect that once the spent fuel casks are stored at the PFS ISFSI, they will remain there beyond the expected license term because there are no off site shipment options. Fuel shipments to Morris, Illinois and West Valley, New York, offer two excellent examples of the plausibility of a this occurrence.

The facility at Morris, Illinois, built by General Electric for reprocessing of spent fuel but never operated as such, included a wet storage pool in which spent fuel was staged for reprocessing. Although no spent fuel was reprocessed in that facility, the spent fuel has remained in storage for decades in the absence of disposal or alternative storage. Similar circumstances developed at the West Valley facility, which was originally built and operated by Nuclear Fuel Services. At that location, spent fuel was reprocessed and high-level waste was generated, and in the absence of disposal or alternative storage capacity, the high-level waste has also remained at that site for decades.

Furthermore, the federal government has not provided a disposal facility to which the spent fuel could be sent. Therefore, the major prerequisite for decommissioning (*i.e.*, a facility to which the spent fuel could be shipped so that decommissioning could begin) is simply assumed to be available. This points out another defect in the application. The Applicant has failed to identify contingent costs in the realistic event that the ISFSI cannot be decommissioned at the end of the license term.

4. The Applicant has failed to justify the basis for all decommissioning cost estimates. The application estimates the cost to decommission a storage cask is $17,000 and estimates the decommissioning cost for the remainder of the ISFSI at $1,631,000. LA pp. 1.7, 3.2. There can be no meaningful review of these amount unless they are broken down with some specificity. Furthermore, the decommissioning cost estimates do not state the year's dollars used (*e.g.*, 1997 dollars) as provided in NUREG-1567, <u>Draft Standard Review Plan for Spent Fuel Dry Storage Facilities</u>. LA Appendix B, Chapter 4.

In addition, some of the estimates provided do not appear consistent. For example, the Applicant specifies that $5 per square foot is adequate to decontaminate the Canister Transfer Building, whereas the Applicant estimated cost to decontaminate the cask surface is $1 per square foot. LA, App B, pp. 4-2 & 3. The reader is unable to determine whether the Applicant erred in estimating the decommissioning costs or whether there is a reason for the discrepancy in costs.[24]

The application lacks the detailed and justified cost estimates are necessary to evaluate the adequacy of the Applicant's decommissioning costs. The Applicant tries to excuse this omission by stating that decontamination efforts are not currently capable of being quantified, LA, App B, at 2-[illegible]. This excuse is invalid. An applicant

[24] Adding the disposal costs of $550 per cask, which is not included in the $1 per square foot cask decontamination costs, only adds an additional $1.50 per square foot to that cost per cask. LA App. B, at 4-2. The cost per square foot to decontaminate the Transfer Building is double this cost.

for a part 72 ISISI license must submit a Decommissioning Funding Plan "at the time of the license application." Regulatory Guide 3.66, Standard Format and Content of Financial Assurance Mechanisms required for decommissioning under 10 CFR Parts 30, 40, 70 and 72 (hereafter "Reg. Guide 3.66"), at.1-3, 1-6. Moreover, the Decommissioning Plan must include "comprehensive consideration of both direct and all indirect decommissioning costs. The plan must compare the cost estimate with present funds, and if there is a deficit in present funding the plan must indicate the means for providing sufficient funds for completion of decommissioning." NUREG 1567, at 16-4. This information is missing from the application.

Furthermore, to ensure that sufficient decommissioning funds are available, the Applicant should take a conservative approach in estimating the following: maximum quantities of spent fuel, other radioactive waste, and solid and hazardous waste generated during the license term; size of decontamination surface areas; disposal needs for spent fuel, low level radioactive waste, solid waste, hazardous waste and other regulated materials; and demolition and removal of the structures and restoration of the site to its original state.

5. The decommissioning cost estimate totally ignores the potential for large accidents and associated release or contamination at the ISFSI. LA Appendix [illegible], Chapter 4. The very large number of casks that are to be handled at the ISFSI and the large number of operations and movements that will be required argue strongly for

anticipating this potential and making arrangements for a multimillion dollar increase in decommissioning to "provide reasonable assurance that the planned decommissioning of the ISFSI will be carried out" as required by 10 CFR § 72.30.

6. The Applicant has failed to reasonably anticipate the extent of severity of contamination by optimistically presuming there will be no residual contamination on the casks or pads. For example, the Applicant indicates that the storage pads will not be contaminated and only includes funding to decontaminate 10% of the total surface area. LA, Appendix B. The basis for funding cleanup of only 10% of the storage pads is not justified. *See also* Contention J (Inspection and Monitoring of Safety components), Basis 2(b) (Detection and control of contamination). Therefore, the Preliminary Decommissioning Plan should provide procedures and cost estimates that reflect realistic consideration of the potential need for decommissioning of a facility that has experienced contamination from canister releases. LA App. B, at 2-1, 6-1.

7. The Applicant has failed to identify the types of waste it anticipated will be generated at the facility. Moreover, the Applicant has failed to propose decontamination and disposal practices except to state that "to the extent practicable ... conventional methods [will be used]." LA App. B, at 2-3. For instance, the Applicant assumes that the welded closure of canisters of spent fuel makes impossible or precludes leakage of canisters. As recently evidenced by the Sierra Nuclear VSC-24

cask design deficiencies, welding does not always result in a leak tight closure and demonstrated leak tight welded closures can subsequently fail. *See e.g.*, NRC Demand for Information, EA 97-441 (October 6, 1997) ACN # 9710100120.

8. The application inadequately addresses decontamination of storage casks. The Applicant makes the following statement: "Storage casks with contamination or activation levels above the applicable NRC limits for unrestricted release will be dismantled, with the activated or contaminated portions segregated and disposed of as low level waste" (*emphasis added*). LA, App. B, at 2-3. Nowhere does the Applicant discuss the process by which dismantling will occur, where dismantling will occur, and whether the Applicant will have trained personnel, suitable equipment and appropriate safety procedures to undertake this operation. This information is necessary to provide effective detail on decommissioning plans and costs.

9. The Applicant has failed to adequately estimate the cost of decontaminating each storage cask liner. The estimated cost of decontamination of a typical storage cask liner is dependent upon the percentage of the liner assumed to exhibit contamination or activation. The analysis presented includes an unsupported assumption that only 20% of the typical liner will be contaminated. A larger percentage would increase the estimated decontamination cost beyond that provided for in cask decontamination prepayments to the decommissioning funding plan. Adequate funding for storage cask decommissioning cannot be assured because it

would then depend on successful assessment of participating customers to pay for the additional costs. LA App. B, at 4-2. This cost may also be increased as a result of Applicant's failure to provide a means for decontaminating all parts of the canisters. *See* Contention J, Inspection and Maintenance of Safety Components, Basis 2 (Hot cell needed to protect against undue risk).

10. The Applicant specifies that decommissioning costs include $250,000 for a survey of the ISFSI site. LA, App B, pp. 4-2, 3. However, the Applicant does not describe the type of survey or the sampling protocol. Without such information, it is impossible to determine the adequacy of the plan or the decommissioning cost estimates. The Applicant's generic description of an intent to meet NRC limits for unrestricted release fails to meet the "sufficient information on proposed practices and procedures for the decommissioning of the site and facility" required by 10 CFR § 72.30(a). Id. at 2.3.

11. The Applicant has failed to provide decommissioning procedures and costs at an intermodal transfer facility (Rowley Junction). In fact the application has failed to provide any significant details concerning the planned structures and operations at the transfer facility.

T. **Inadequate Assessment of Required Permits and Other Entitlements**

CONTENTION: In derogation of 10 CFR § 51.45(d), the Environmental Report does not list all Federal permits, licenses, approvals and other entitlements which must be obtained in connection with the PFS ISFSI License Application, nor does the Environmental Report describe the status of compliance with these requirements.

BASIS: NEPA requires the NRC to fully assess any other permit, license, approval or other entitlement the Applicant is required to obtain in connection with this license application and also to address applicable environmental quality standards and requirements. Because the Applicant has not addressed all of these requirements, the NRC cannot timely and adequately assess these requirements nor can the petitioners or the general public assess the scope and effect of granting the license sought by this Applicant.

1. **Property Rights and Entitlements**

a. **Entitlement to use and control the proposed site**

The Applicant has failed to show that it is entitled to use the land for the ISFSI site and if it does have such a right whether there are any legal constraints imposed on the use and control of the land.

The Applicant and the Executive Committee of the Skull Valley Band of Goshute Indians have entered into a lease for the facility site. The lease between the

tribe and the Applicant must be approved by the Bureau of Indian Affairs (BIA). 25 USC § 415, 25 CFR Part 162. The BIA has waived certain regulatory requirements and has granted "conditional" approval of the lease, subject to completion of the NRC's Environmental Impact Statement. After several Freedom of Information Act requests, the BIA eventually sent the State a copy of the lease between the tribe and the Applicant. However, the BIA redacted significant portions of the lease, including lease termination provisions, frustration of purpose provisions, surety bonding arrangements, lease rent, and taxes and regulations. Amended and Restated Business Lease between Skull Valley Band of Goshute Indians and Private Fuel Storage, L.L.C., May 20, 1997 is attached hereto as Exhibit 15.

The State is concerned that it will be left in legal limbo because BIA is deferring to the NRC process for an evaluation of the environmental effects caused by the tribe entering into the lease and NRC may defer to the BIA the evaluation of the lease provisions. However, it is incumbent on NRC to require the Applicant to fully disclose all provisions of the lease in order that the NRC and petitioners may evaluate under what conditions the Applicant is entitled to use and control the site, the financial costs associated with the lease, the termination and frustration of purpose provisions, and tribe's regulatory requirements.

b. Intermodal transfer point

Rail shipments of up to 200 casks of nuclear waste will be arriving at Rowley Junction annually. The Applicant completely ignores any discussion or proof of its legal entitlement to build a transfer facility at Rowley Junction.[25] In addition, the Applicant has not identified the number of casks expected on each shipment or explained the effects of rail congestion at Rowley Junction. Furthermore, the Applicant has not shown that Union Pacific Railroad is capable or willing to handle the shipments coming into Rowley Junction. Finally, the Applicant has not demonstrated that it has the right to use a terminal at Rowley Junction to handle each shipment or that Rowley Junction has the capacity of handling the expected number of casks. These entitlements must be addressed as part of this licensing action.

c. Right to construct a rail spur

The Applicant has shown absolutely no ability or authority to build a rail spur from the rail head at Rowley Junction to the proposed ISFSI site. The main rail line is on the north side of interstate 80. A narrow freeway underpass allows access to Skull Valley Road on the south side of interstate 80 and from there it is 25 miles along the two-way 22 foot wide Skull Valley Road to the proposed ISFSI site. *See* copy of photographs and construction drawing of the underpass at Exh. 2 to the State's July 21, 1997 2.206 petition. PFS has the audacity to claim that it may build a rail spur in the

[25] All land, except for a 100 ft. right-of-way from the middle of the main line is privately owned. *See* plat map attached as Exh. 1 to the State's July 21, 1997 2.206 petition.

public right-of-way parallel to Skull Valley Road. ER at 3.2-5. If PFS cannot use the public right-of-way, it must acquire the right to use land from property owners along Skull Valley Road, namely the U.S. Bureau of Land Management and Intervenors, Castle Rock, et. al. It is highly unlikely that these landowners will grant a right-of-way to PFS that will permit rail transportation of high level nuclear waste across their land. Thus, it should be presumed that PFS will have to build an intermodal transfer facility at Rowley Junction and transport the nuclear waste to the proposed ISFSI by road.

d. Widening Skull Valley Road

If a rail spur from Rowley Junction to the facility is not feasible, the Applicant must use heavy haul trucks to move the casks from Rowley Junction to the facility. The trucks are anticipated to be twelve feet wide and weigh 142 tons when loaded, SAR at 4.5-4, while the existing Skull Valley Road is 22-24 feet wide with 0-3 feet aggregate shoulders. ER at 3.2-5. Apparently the Applicant intends to add a three feet paved surface to each side of Skull Valley Road to take the road 15 foot wide in each direction. The Applicant <u>assumes</u> that all road work (road widening, shoulder work, relocation of drainage culverts, etc.,) would take place within the existing road right-of-way. ER at 3.2-5. The Applicant also assumes that road improvements will be performed in cooperation with Tooele County.

The assumptions made by the Applicant are just that: assumptions. Under Utah Code Ann. § 27-12-133 a person is guilty of a misdemeanor if a right-of-way of

any state highway or county road is "dug up or excavated .. or structures or objects of any kind or character [are] placed constructed or maintained within any such right-of-way" unless permitted by the appropriate authority. There is absolutely no indication that the Applicant may undertake widening a public road, moving drainage culverts, etc. solely with the cooperation of Tooele County. Also there is no indication that Tooele County is in any way in accord with the Applicant's scheme. Furthermore, the Applicant has not even provided plat maps of the area to show the existing rights-of-way and whether such road widening is feasible. Finally, there is no justification that a 15 foot road is sufficient to accommodate the size and quantity of heavy haul trucks that will use Skull Valley Road over the life of the ISFSI.

Before the petitioners and NRC expend enormous amounts of time and resources on this license application, it is incumbent on the Applicant to show that it is entitled to widen the road, that the proposed road work is within the scope of existing public rights-of-way, that the casks containing spent nuclear fuel can be safely moved from the railhead 24 miles along on a 15-foot wide roadway to the facility in all weather and traffic conditions. To date, the application contains little more than the Applicant's hope to widened the road without any right to do so and without any discussion of why a 15-foot roadway would satisfy health, safety and environment concerns.

2. NRC Requirements

a. Part 75 Facility

The proposed PFS ISFSI is an installation subject to Part 75 and is eligible for IAEA safeguards under the US/IAEA Safeguards Agreement. 10 CFR §§ 75.2, 75.4.[26] The Commission must designate the PFS installation as subject to IAEA safeguards and require the Applicant to establish, maintain and follow written material accounting and control procedures. 10 CFR §§ 75.21, 75.41. The Applicant must comply with Part 75 requirements as part the Part 72 licensing proceeding, and provide information such as: identification of IAEA material balance areas and key measurement points; organizational responsibility for material accounting and control, including information with regard to separation of functions to provide internal checks and balances; devices designed to limit the mobility of nuclear material, the access of personnel, or the unauthorized operation of equipment and structural elements (including the design of building and the layout of equipment) which minimize and control access to nuclear materials. 10 CFR §§ 75.14, 75.4(e).

The requirements of Part 75 may implicate NRC's Part 72 review of the Applicant's management structure, access provisions and the certain safety and design features of the facility. Thus Part 75 must be addressed as part of the Part 72 license

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[26] The definition of "installation" includes an ISFSI as defined in § 72.3. *See* 10 CFR § 75.4(k)(4).

application and the Applicant must supplement its submittal with relevant Part 75 information.

3. Environmental Quality Standards and Requirements

a. Air Quality

The Applicant's air quality analysis does not satisfy the requirements of 10 CFR § 52.45. The Applicant has failed to adequately analyze whether it will be in compliance with the health-based National Air Quality Standards (NAAQS), whether it is subject to regulation under Section 111 of the Clean Air Act, and whether it is a major stationary source of air pollution requiring a Prevention of Significant Deterioration (PSD) permit. The Applicant's statement '[t]here are no air emission sources, including the emergency diesel generator, large enough to require a Clean Air Act, Title V permit, " falls far short of an adequate air quality analysis to satisfy the Clear Air or NEPA. *See* ER at 9.1-4

The Applicant's analysis of air quality impacts, ER 4.3.3, is totally inadequate. Although the Applicant fails to discuss modeling techniques, the Applicant references EPA "SCREEN3" at ER 4.8-2 so it is assumed that this is what the Applicant used to perform its air quality dispersion modeling analysis. The SCREEN3 model is inappropriate because it dilutes the impact of the project by spreading the emission releases over areas where the releases will not occur and during hours of the day when

construction operations will not take place.[27] Also, the effects of terrain limit the directional flow of air. Thus, the persistency factor used in converting one-hour SCREEN3 modeled concentrations into 24-hour concentrations results in an under-prediction of the source's impact. The Applicant must complete a more refined dispersion analysis and describe the source of input information and assumptions–such as monitored hourly meteorological data sets (wind speed, direction, stability class, temperature, and mixing height), source data, background concentrations, and other contributing industrial sources–to show that there will be no potential violation of NAAQS or significant air quality impacts off the Reservation.

The PFS facility is subject to regulation under § 111 of the Clean Air Act and may require a PSD permit. Construction will entail an onsite asphalt batch plant used for the construction of storage pads, cask shielding and concrete building(s). ER p, 3.2-2. The concrete batch plant is subject to § 111 of the Clean Air Act, and to 40 CFR Subpart I, New Source Performance Standards for Hot Mix Asphalt Facilities. As such, the PFS facility could be considered to be a major stationary source of air pollution required to obtain a PSD permit. See 40 CFR 52.21(b)(1)(i)(*b*), 52.21(c)(iii)(*aa*), and 60.90. If the PFS facility is required to obtain a PSD permit it will also be required to obtain a Title V permit. The Applicant must be required to

[27] While construction activities will be continuous throughout the initial license term and beyond, those activities will not occur 24 hours a day. Also, construction activities will not occur during the winter months. *See* ER at 3.2-2.

complete a more rigorous analysis of the air quality impacts associated with its proposed facility. The Applicant must be required to complete a more rigorous analysis of the air quality impacts associated with its proposed facility.

Additionally, even if a PSD permit is not required, a state air quality approval order issued under Utah Code Ann. § 19-2-108 will most likely be required. The concrete batch plant, asphalt batch plant, and other air emission sources, even if located on the Skull Valley reservation, because of the limited size of the reservation, will have a significant impact on state air resources. Therefore a state approval order will be required.

b. Groundwater discharge permit

The Applicant has not addressed the requirement to obtain a Utah Groundwater Discharge Permit. The State of Utah, as trustee and in its capacity of *parens patriae*, has jurisdiction over all groundwater within the State. Utah Code Ann. § 73-1-1. An Indian tribe may have an implied reservation of water under the Winters doctrine,[28] however, an implied right to the use of water under certain conditions does not restrict State jurisdiction over groundwater quality. Nor does NRC's authority under the Atomic Energy Act preempt State regulation of groundwater. *See* 42 U.S.C. § 2021(k); Pacific Gas & Electric v. Energy Resources Commission, 461 U.S. 190 (1983); Kerr-McGee v. City of West Chicago, 914 F.2d 820 (7th Cir. 1990).

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[28] *See* Winters v. United States 207 U.S. 564 (1908).

Furthermore, off-reservation effects caused by the Applicant–a non-tribal member–lends added support to the State's jurisdiction and control of groundwater quality. The Applicant has not addressed the requirement to obtain a Groundwater Discharge Permit in accordance with Utah Code Ann. § 19-5-107 and Utah Admin. Code R317-6.

c. **Other Water Permits**

The Applicant's analysis of other required water permits lack specificity and does not satisfy the requirements of 10 CFR § 52.45. In sections 9.1.3. and 9.2 of the ER, the Applicant merely states that it "might" need a Clear Water Act Section 404 dredge and fill permit for wetlands along the Skull Valley transportation corridor, that it will be required to consult with the State on the effects of the intermodal transfer site on the neighboring Timpie Springs Wildlife Management Area. The fact that an Indian tribe may be treated as a state under the Clear Water Act is irrelevant to the discussion of permits because the Skull Valley Band of Goshutes has not applied for delegation of any Clear Water Act programs. ER at 9.1-4. The Applicant must describe with specificity the wetlands affected by its operations, the point discharge sources and the activities that may require control under a storm water permit.

The Applicant merely assumes that it will be able to drill wells for its water needs, which are estimated at 1,500 gallons per day. ER at 4.2-4. The Applicant must show that its has the legal authority to drill such wells and that its water appropriations do not interfere with or impair prior existing water rights.

Furthermore, the Applicant does not specify whether the 1,500 gallons per day is a daily average or a peak usage estimate or whether that quantity of water will be required throughout the life of the facility.

U. Impacts of Onsite Storage not Considered

CONTENTION: Contrary to the requirements of NEPA and 10 CFR 51.45(c), the Applicant fails to give adequate consideration to reasonably foreseeable potential adverse environmental impacts during storage of spent fuel on the ISFSI site.[29]

BASIS: In a number of respects, PFS's application gives inadequate consideration to the potential adverse impacts of onsite spent fuel storage.

1. The ER fails to consider the impacts of overheating of casks due to the facility's inadequate thermal design. *See* Contention H (Inadequate Thermal Design), whose basis is adopted and incorporated herein by reference.

2. The ER fails to consider the safety risks and costs raised by PFS's failure to provide adequate means for inspecting and repairing the contents of spent fuel canisters, or for detecting and removing contamination on the canisters. These include risks to workers posed by handling or inspecting casks with contaminated or defective contents, during receipt of casks, storage of casks, or in preparing them for shipment to a repository. They also include health risks and increased costs during the decommissioning process. *See* Contention J (Inadequate Inspection and Maintenance of Safety Components, Including Canisters and Cladding), whose basis is adopted and incorporated herein by reference.

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[29] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

3. The ER fails to consider the risks posed by a blockage of the cooling vents on the storage casks. The concrete storage casks utilize passive, natural convective air movement for cooling. SAR at 5.1-10, 5.4-1. Although the Applicant maintains that the ducts will be cleaned, this relies on human intervention, which is subject to error. It is reasonable to anticipate that the cleaning of ducts will be delayed or overlooked, or that an evacuation or fire will make it impossible to perform this function. Therefore, the Applicant must assess the consequences of an inadvertent blockage of the cooling ducts by animal or plant infestation, or by snow and ice during the winter.

4. The ER fails to consider the risks of a sabotage event in which one or more storage casks is or are breached. As discussed in Contention V (Inadequate Consideration of Transportation-Related Environmental Impacts), whose basis 3(b) (sabotage), is adopted and incorporated herein by reference, sabotage is a credible cause of a serious accident, and therefore should be considered in the Environmental Report and Environmental Impact Statement. This is true whether the spent fuel is onsite or in transit.

V. Inadequate Consideration of Transportation-Related Radiological Environmental Impacts.

CONTENTION: The Environmental Report ("ER") fails to give adequate consideration to the transportation-related environmental impacts of the proposed ISFSI.[30]

BASIS: NRC regulations at 10 CFR § 51.45(b)(1) require the Applicant's ER to address the impacts of the proposed action on the environment. Pursuant to 10 CFR § 72.108, the Applicant must also evaluate the impacts of spent fuel transportation within the "region" of the ISFSI. Petitioner submits that in order to comply with NEPA, PFS and the NRC Staff must evaluate all of the environmental impacts associated with transportation of spent fuel to and from the proposed ISFSI, including preparation of spent fuel for transportation to the ISFSI, transportation of spent fuel to the ISFSI, spent fuel transfers during transportation to the ISFSI, transferring and returning defective casks to the originating nuclear power plant, and transfers and transportation required for the ultimate disposal of the spent fuel.

The ER addresses the transportation-related impacts of the ISFSI in Sections 4.7 (radioactive material movement) and 5.2 (transportation accidents). According to PFS, the environmental impacts of spent fuel transportation are addressed in 10 CFR § 51.52 and the accompanying Summary Table S-4. ER at 4.7-1, 5.2-1. The ER uses the

[30] This contention is supported by the Declaration of Marvin Resnikoff, attached hereto as Exhibit 2.

numerical values in Table S-4 for its evaluation of the transportation-related environmental impacts of the proposed ISFSI, claiming that these values are conservative with respect to the scope of activities of the PFSF. Id. PFS also calculates the radiation doses caused by intercask transfer at Rowley Junction, and concludes that they are insignificant. ER at 4.7.1 and 4.7.2.

PFS's reliance on Table S-4 is inappropriate and inadequate in several respects. First, it is not supported by the regulations. Second, it is not conservative. Third, PFS ignores or minimizes significant impacts related to the transportation of spent nuclear fuel to and from the ISFSI. In addition, PFS's additional calculation of the impacts of inter-cask transfer at Rowley Junction is inadequate.

1. PFS's reliance on Table S-4 is inappropriate and inadequate.

a. Section § 51.52 applies only to construction permit applicants.

PFS invokes 10 CFR § 51.52 as a regulatory basis for applying Table S-4 to its ISFSI application. By its own terms, however, 10 CFR § 51.52 applies only to nuclear power plant construction permit applicants. Nothing in Section 51.52 permits an applicant for an ISFSI to invoke the numerical values in Table S-4. Moreover, while 10 CFR § 51.53(d) permits licensees to incorporate environmental data submitted at the construction permit stage into post-operating-license applications for onsite spent fuel storage, the regulation makes no such provision for the use of the data in applications for offsite ISFSI applications

b. Even if 10 CFR § 51.52 applied, PFS does not satisfy the conditions for using Table S-4.

Moreover, even if 10 CFR § 51.52 were applicable, PFS has failed to show that the threshold conditions specified in 10 CFR § 51.52(a)(1)-(6) are met. PFS fails entirely to identify the specific plants whose fuel will be stored at the ISFSI or to provide any evidence that they satisfy the conditions of 10 CFR § 51.52(a)(1)-(6). For instance, § 51.52(a)(2) requires that the reactor fuel must be in the form of sintered uranium dioxide pellets having a uranium-235 enrichment not exceeding 4% by weight, and the pellets must be encapsulated by zircaloy rods. Section 51.52(a)(3) requires, *inter alia*, that the average level of irradiation of the irradiated fuel from the reactor must not exceed 33,000 megawatt-days per metric ton. PFS does not specifically state whether these requirements are met by the reactors whose fuel will be stored at the ISFSI. Instead, PFS cites a finding in the EIS for license renewal of nuclear power plants, that a burn up level of up to 60,000 MWd/MTU will not result in environmental impacts that are greater than the values currently in Table S-4, and that experience in handling fuel with burn ups over 55,000 MWd/MTU and up to 5.5% U-235 enrichment "has not revealed any unresolved safety concerns." ER at 4.7-2, *quoting* NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (May 1996). The statements in NUREG-1437 relied on by PFS were not incorporated into 10 CFR § 51.52(a), and thus they cannot be relied on absent an application for an exception to § 51.52(a). In any event, the conclusion in

NUREG-1437 is incorrect. Higher burn ups have the result that a longer cooling time, up to 18 years, is necessary before fuel can be transported in the TranStor or Holtec casks. The need to calculate an appropriate period of delay for shipment of spent fuel increases the chance for human error, by shipping fuel that is too thermally hot.

Section 51.52(a)(6) also incorporates the threshold conditions in Table S-4, including the condition that the weight of each shipping cask may not exceed 100 tons per cask per rail car, or 73,000 pounds per truck. As PFS acknowledges, the maximum weight of a loaded shipping cask is 142 tons, thus putting it outside the threshold limit for reliance on Table S-4. ER at 4.7-3. PFS's argument that the additional weight is insignificant must be rejected as an impermissible attack on the regulations. Moreover, the various arguments made by PFS as to why the additional weight is negligible are unsupported and unreasonable. For instance, PFS argues that an increase of 42 tons, or 42% per cask, is a negligible percentage of the overall weight of a typical train. This argument is not supported by any calculations or documentation. Moreover, it ignores the fact that heavier trains are more likely to lose braking on downgrades. Moreover, transportation casks, taken together with rail carriages, will weigh over 200 tons. Such heavy weights are not easily mixed with light loads in a mixed-use train. Conversation between Marvin Resnikoff, RWMA, and Robert Fronczak, American Association of Railroads (November 20, 1997).

PFS also appears to argue that the additional risk posed by a heavier cask is off-set by the reduction in the number of shipments resulting from the use of larger casks. Again, this argument is not supported by any calculation or documentation. Moreover, although the argument may have some merit with respect to incident-free transportation, it is unreasonable with respect to transportation-related accidents. The heavier a cask is, the more difficult it will be to retrieve if it falls from a train, thus raising the risk of accidents. Moreover, once an accident occurs, the higher inventory of spent fuel inside the larger cask raises the consequences of a radiological release.

Additionally, the assumptions concerning traffic density in Table S-4 do not apply to the ISFSI. Table S-4 assumes no more than one truck shipment per day and no more than three rail shipments per month. In contrast, PFS projects 100-200 rail shipments per year. SAR at 1.4-2. This amounts to approximately 8-17 rail shipments per month, far in excess of the number of rail shipments assumed in Table S-4. The higher frequency of rail shipments significantly increases the potential for backup of trains and casks at Rowley Junction. If casks have to be stored at Rowley Junction awaiting transfer to trucks, both the radiation doses to workers and the public and the risk of accidents will increase. These impacts are not anticipated in Table S-4.

Thus, because it has not satisfied the conditions specified in 10 CFR § 51.52(a)(1)-(6), PFS must provide "a full description and detailed analysis of the

environmental effects of transportation of fuel and wastes to and from the reactor." 10 CFR § 51.52(b).

2. The SAR is inadequate to supplement Table S-4.

WASH-1238 includes the dose to the truck crew, garagemen and freight handlers for a standard spent fuel shipment. But PFS's proposal involves additional handling of the fuel canisters and casks. At the originating reactors, the fuel canister must be placed in a transfer cask for placement in a transportation overpack, transported to intermodal transfer point at Rowley Junction, Utah; then the transportation cask must be lifted onto a heavy haul truck, carted to the Canister Transfer Facility at the ISFSI in Skull Valley, and the fuel canister must then be transferred to a storage overpack.

In an apparent effort to supplement Table S-4, the SAR contains an analysis of the impacts of fuel transfer at Rowley Junction. Assuming that Table S-4 even applies, this analysis is inadequate in several respects. First, PFS assumes that there will be one cask on the Rowley Junction site every day. ER at 4.7-5. This assumption is unreasonable. As discussed in Contention B, given the high volume of rail shipments involved, it is likely that bottlenecks will form at Rowley Junction, and therefore it is likely that more than one cask will be stored onsite at any given time. PFS has failed to evaluate the potential for bottlenecks and their impacts with respect to incident-free

handling and accidents. PFS has also failed to take into account the additional doses that will be incurred by State and Federal radiation inspectors.

Second, PFS fails to make any calculation for the impacts caused by the return of substandard or degraded casks to the originating nuclear power plant licensees. As discussed in Contention J, the design for the ISFSI contains no provision for a hot cell. Instead, PFS plans to return any substandard or degraded casks to the originating licensee. This will entail additional radiation doses to workers and the public, which are not considered in Table S-4 or the SAR. In addition, the shipment of fuel with degraded cladding increases the risk of accidents, since cladding is one of the barriers relied on to contain the radioactivity in spent fuel. Finally, PFS does not consider the foreseeable risk posed by a cask drop accident in which a canister is dented or warped, and cannot be returned to its shipping cask. If this occurs, PFS has no provision for repacking the spent fuel.

Finally, PFS does not evaluate the environmental impacts of shipping spent fuel to the proposed ISFSI from nuclear power plants not serviced by any rail lines. Although PFS states that all fuel will be shipped to the ISFSI by rail, some of the plants it serves have no rail access. Those with sufficient crane capability may transfer the casks to heavy haul trucks, and from thence to rail cars. The impacts of these transfers are not assessed in the SAR. Moreover, there are some plants, such as Indian Point, which do not have sufficient crane capability to handle heavy shipping casks. The

SAR does not state how these casks will be shipped to the ISFSI, or describe the impacts.

3. New information shows that Table S-4 grossly underestimates transportation impacts.

Table S-4 is based on WASH-1238, a 1972 report by the Atomic Energy Commission. The WASH-1238 study is poorly documented and outdated. Its conclusions regarding the probability and consequences of transportation accidents must be re-examined in light of the significant new information that is available.

Moreover, NRC regulations at 10 CFR § 51.45(c) require that, to the extent practicable, the costs and benefits of a proposal should be quantified. WASH-1238 makes no attempt to quantify the risks of spent fuel transportation, but merely asserts that they are low. Now that additional data have been collected on accident risks and transportation conditions, this rationale is no longer acceptable. The NRC must prepare a new EIS that takes into account current information, and quantifies the risks posed by spent fuel transportation.

a. Poor and outdated data. The data on which the WASH-1238 risk estimate is based are slim to none. For accident speeds, WASH-1238 refers to an unpublished DOT study, for which the data are unavailable. For major fires, no reports are cited. *See* WASH-1238 at 67. Clearly, highway and rail conditions have changed since 1972. There are more interstate highways, and cars use higher speeds. Freight traffic on the rails has also increased in recent years. However, WASH-1238

contains no data that can be compared with data for current conditions. Thus, it does not provide a reasonable basis for conclusions about highway or rail conditions.

b. New information and changed circumstances. WASH-1238's conclusion that the probability of a severe accident is very small is based on an overly narrow range of accidents. For instance, it does not include accidents caused by human error or sabotage. While there was very little information on these subjects in 1972, significant experience and technical studies have been collected since then.

Sabotage. Since the time when WASH-1238 was prepared, the threat of sabotage has become more real and the technology more sophisticated. The bombings at the World Trade Center and the Federal Courthouse in Oklahoma City have vividly demonstrated the credibility of sabotage as a very real threat. Moreover, expert studies have demonstrated the credibility of this threat with respect to nuclear waste transportation. *See, e.g.*, Halstead and Ballard, Nuclear Waste Transportation Security and Safety Issues: The Risk of Terrorism and Sabotage Against Repository Shipments, for the Nevada Agency for Nuclear Projects (October 1997), Exhibit 3; Tuler, Kasperson and Ratick, The Effects of Human Reliability in the Transportation of Spent Nuclear Fuel (Clark University: June 1988), attached hereto as Exhibit 16. Irradiated fuel storage casks, while extremely sturdy, can be compromised by anti-tank weapons or commonly available explosive devices. For example, as discussed in Richard Barbour, Pyrotechnics in Industry at 47-48 (McGraw-Hill, New York: 1981),

attached hereto as Exhibit 17, a simple conical charge weighing 743 grams, 15 cm in length, can penetrate 356 mm of mild steel (lead would be simpler) with a hole diameter 45 mm. These devices should be readily available since they are used by the oceanographic industry for cable cutters, construction contractors for drilling aids and the steel industry for tapping open-hearth furnaces. To create greater mischief, the conical shaped charge can be combined with an incendiary pellet. After the explosive punches a hole through metal, the incendiary pellet is pulled through the blast hole and burns at 1649 °C. Id. at 53. This would serve to fragment fuel rods and pellets, vaporize semi-volatile radionuclides such as cesium, and release radioactivity from the cask due to overpressure. A modern shoulder-fired anti-tank weapon can penetrate over 16 inches of armor plate. The most common shoulder-held anti-tank weapons have effective ranges over 500 meters, with sights for night use. The VSC-24 is constructed of only 2 1/2 inches of steel plate (1 inch in the MSB and 1 1/2 inches forming the inside of the concrete silo) and could be easily punctured. The TranStor and Holtec casks are similar to the VSC-24. The TOW 2 anti-tank missile can penetrate greater than 27 inches of armor and has an effective range of 3.75 kilometers; the Milan anti-tank missile can penetrate more than 39 inches of armor and has an effective range up to 2 kilometers. Exhibit 3, Halstead and Ballard, Nuclear Waste Transportation Security and Safety Issues at 59 - 61. The threat of sabotage is a real

and foreseeable risk that should be evaluated in assessing the impacts of transportation of spent nuclear fuel.

Human error. WASH-1238 assumes a perfect container and perfect operation in an imperfect world. Casks are not necessarily built according to design. On October 6, 1997, for example, the NRC Staff issued a Demand for Information to Sierra Nuclear Corporation, manufacturer of the TranStor cask, citing numerous deficiencies in the construction of SNC's VSC-24 cask. Demand for Information, EA No. 97-441, PDR Document, ACN # 9710100120. These deficiencies are so severe that NRC has demanded that SNC demonstrate why it should not be forbidden from constructing the casks. Id. The following are additional examples:

In 1979, the NRC discovered NAC-1 shipping casks had not been constructed to design specifications. They were bowed out of shape, and additional copper plates had been welded on to increase radiation shielding, without permission by the NRC. *See* Resnikoff, M. and Audin, L., The Next Nuclear Gamble at 206-210 (Council on Economic Priorities: 1983), attached hereto as Exhibit 18.

An NLI-1/2 cask, holding one PWR fuel assembly, was to have been shipped dry, but a worker incorrectly filled the cask with water. Letter from William Parker, Duke Power, to John Davis, NRC (December 1, 1981), PDR Document, ACN # 8112140019.

In May of 1980, a fuel assembly exceeding heat output conditions in the Certificate of Compliance was shipped from Haddam Neck to Battelle Columbus, and contaminated the spent fuel pool. The UO_2 had oxidized into U_3O_8. Memorandum to John Davis, NRC, from Robert Minogue, NRC (March 5, 1984), attached hereto as Exhibit 19. Yet human error is not factored into accident probabilities in WASH-1238.

Maximum credible accidents. WASH-1238 also does not include up-to-date analyses of maximum credible accidents. *See* Wilmot, Transportation Accident Scenarios for Commercial Spent Fuel, SAND80-2124 (1981), attached hereto as Exhibit 20. WASH-1238 does not consider the dynamics of a transportation accident, as done by Wilmot and later authors. In an impact followed by a fire, the fuel cladding may burst on heating, or shatter upon impact. The fuel may oxidize under heat and an air environment. Wilmot at 32 - 38. WASH-1238 also does not take into account more recent information regarding the risks of rail transportation. For instance a 1985 analysis by Rogers & Associates projected a maximum clean-up cost of $620 million and a cleanup time of 460 days for a rail accident (14 PWR fuel assemblies/cask) in a rural area.[31] The population exposures ranged up to 63,000 person-rems in the most severe rural accident. PFS does not mention a study by Sandia National Laboratory of

[31] Sandquist, GM et al, Exposures and Health Effects from Spent Fuel Transportation, prepared by Rogers & Associates for the DOE (November 1985), attached hereto as Exhibit 21.

irradiated fuel shipping accidents in urban areas, in which costs over a $1 billion are calculated.[32] Other studies show that falls from high bridges are a significant contributor to the risk of severe rail accidents. The fall of a spent fuel cask from a railroad bridge into a muddy river bottom could pose a very severe risk to the public if the cask was buried by the mud and overheated. As shown in calculations for the TN-40 shipping cask, if a cask is buried in sediment, it can rapidly overheat. The cask, which has a maximum heat load of 27 kW, is predicted to double its temperature in just 120 hours.[33] Thus, a successful salvage operation must be rapid, which is not simple for a 142-ton object. This is a foreseeable and significant risk which should be, but has not been, taken into account in WASH-1238 and Table S-4. Another potentially catastrophic accident involves a severe impact or fall from a bridge into a rocky river bottom, in which water enters the cask and the nuclear fuel goes critical. Casks which hold 24 PWR fuel assemblies hold more than a critical mass of fissionable material. WASH-1238 argues that, "Although the consequences of a release could be very serious, the probability of occurrence is small, and therefore the risk or impact on the environment is very small." Id. at 74. As discussed above, the probability of a release is reasonably foreseeable, and therefore should be considered. In any event, it is

[32] Finley, NC et al, "Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment," prepared by Sandia National Laboratories for the NRC, NUREG/CR-0743 (July 1980), attached hereto as Exhibit 22.

[33] Northern States Power Company, "TN-40 Safety Analysis Report," Docket 50-282, September 1991, fig. 3.3-15.

important to note that risk is a product of probability and consequences, and that a low probability of occurrence does not in any way mitigate the impact if such an accident were to occur.

Degradation of fuel cladding. WASH-1238 assumed that irradiated fuel would be stored under water in pools for a short period, and then, individual fuel assemblies would be shipped by truck (1 PWR or 2 BWR fuel assemblies) or by train (7 PWR fuel assemblies) to a reprocessing plant. In contrast, PFS asserts that all spent fuel will be stored onsite for at least five years. ER at 4.7-2. Some of this fuel is likely to have been stored in dry casks prior to shipment. Additionally, 6,000 fuel assemblies are projected to be in dry storage by 1999,[34] out of over 100,000 discharged assemblies to date.[35] Long-term dry storage before fuel is shipped to Utah may degrade fuel cladding. Based on Pescatore, "Zircaloy Cladding Performance Under Spent Fuel Disposal Conditions," BNL-52235, April 1990, the maximum cladding temperature for dry storage within a VSC or NUHOMS concrete storage cask can reach the same temperature as while a power reactor is operating, about 360°C. But in dry storage these high temperatures can cause cladding degradation, because unlike an operating power reactor, the pressure from within the fuel rod is not balanced by pressure from

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[34] Energy Information Administration, "Spent Nuclear Fuel Discharges from U.S. Reactors 1994," SR/CNEAF/96-01, US DOE, at 46 (February 1996), attached hereto as Exhibit 23.

[35] Id., at xiii.

outside the cladding. This net outward pressure is responsible for creep corrosion cracking of fuel cladding. During transportation, weakened cladding increases the likelihood of impact rupture and burst rupture of fuel cladding in a severe accident. Irradiated fuel that remains in a fuel pool until shipment to a reprocessing plant does not experience the potentially damaging environment of dry storage. Therefore WASH-1238 may not apply to fuel that is to be shipped to the PFS.

Accident consequences. Recent analyses suggest that during a severe accident, a greater fraction of cesium-137 may be released than estimated in WASH-1238. WASH-1238 assumes 650 Ci of fission products are released; for cesium-137, the estimated WASH-1238 release is approximately a fraction 5 x 10^{-5} of the cesium-137 cask inventory. More recent analyses assume a cesium-137 fraction of 10^{-3} could be released, that is a fractional release 20 times greater.[36] Since the cesium-137 inventory of the TransStor is a factor of 3.4 greater than assumed in WASH-1238, the amount of cesium-137 that can be expected to be released from a TranStor in a severe accident is approximately 68 times the WASH-1238 results.

Regional Characteristics. WASH-1238 does not separately estimate the consequences of an accident in a specific location, or even limit the analysis to an urban or rural area. It is a generic calculation. (p.3) Thus, it is inadequate to satisfy the requirement of 10 CFR § 72.108, that the EIS must take regional characteristics into

[36] Wilmot, EL, at 35, Exhibit 20.

account. For example, it fails to estimate the consequences of a severe rail accident in Salt Lake City, a high population area.

Criticality. The TranStor and HI-STAR 100 casks which PFS proposes to use hold more than a critical mass of fuel (17 PWR assemblies). This stands in contrast to the assumption underlying WASH-1238 and Table S-4, which is 7 PWR assemblies for a train cask, an amount less than a critical mass. To insure that a cask cannot go critical under any circumstances, cask manufacturers would need to include neutron absorbing material between fuel assemblies or demonstrate that a cask could not go critical. The nuclear industry has been attempting to convince the NRC Staff to give "burn up credit" arguing that used fuel assemblies would have less fissionable material and therefore there is less need for neutron absorbing material. If the nuclear industry is successful in lobbying for burn up credit, then the decision as to when fuel is sufficiently used up to justify shipment becomes essentially a management decision. This is an additional source of human error, in which mistakes could lead to criticality accidents. A criticality event, in which fuel is re-arranged and water enters the cask, would be far outside the envelope of consequences assumed in Table S-4 and NUREG-170.

RADTRAN. WASH-1238 predates the RADTRAN computer code, which is significantly more accurate and generally shows much higher radiological doses to the general public. WASH-1238 assumes a member of the general public

would spend three minutes at an average distance of three feet from the truck or railcar and that ten persons would be so exposed during shipments. But railcars go through the center of cities and trucks would gather great attention at truck stops. RADTRAN allows the user to enter parameters for the number of persons at a rest stop, the stop time, the distance of onlookers from the cask, and the number of stops per mile. The standard default assumption by RADTRAN is 50 persons at a rest stop. In addition, the user can input the velocity in each population zone, the number of persons per vehicle, the fraction of urban travel during rush hour, the traffic density. Using RADTRAN default assumptions, the incident-free exposures under RADTRAN lead to much higher exposures than estimated under Table S-4. In light of the availability of the much more accurate dose modeling RADTRAN program, and the likelihood that it will show significantly higher dose than WASH-1238, the Applicant's reliance on WASH-1238 and Table S-4 is inadequate to demonstrate compliance with NEPA.

Transportation Distance. WASH-1238 is based on a transportation distance of approximately 1,000 miles. Id. at 38. But as PFS acknowledges, the distance may be more than twice that amount. ER at 4.7-3. Most spent fuel is located at reactors in the Eastern United States, which implies transportation distances much greater than 1000 miles.[37] For example the one way mileage from Boston

[37] Spent Nuclear Fuel Discharges from U.S. Reactors 1994, U.S. Department of Energy, Energy Information Administration, SR/CNEAF/96-01 at xiv (February 1996), Exhibit 23.

Massachusetts to Salt Lake City is 2388 miles.[38] PFS cites NUREG-1437 for the proposition that this increase is inconsequential. However, in light of all the deficiencies in WASH-1238, this is not a valid assertion. Doses must be recalculated for the entire shipping distance from plants to the ISFSI, and from the ISFSI to the repository, for all 19 plants served by the proposed ISFSI.

[38] Gousha New Deluxe Road Atlas, HM Gousha, New York, 1995.

W. Other Impacts not Considered.

CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 CFR § 51.45(b).

BASIS: The Environment Report must contain a description of the "impact of the proposed action on the environment." 10 CFR § 51.45. The Applicant has failed to consider impacts with respect to the following:

1. **Cumulative Impacts.** The Applicant does not discuss the cumulative from hazardous and industrial activities located in the region of the ISFSI site and the Intermodal Transfer site. *See* Contention K (Inadequate consideration of credible accidents) whose basis is incorporated by reference herein.

An accident involving spent fuel casks may cause facilities such as the Army's chemical weapons incinerator (TOCDF) to be evacuated. Conversely, an accident at TOCDF may cause evacuation of the ISFSI or the intermodal transfer site. In any event, the cumulative impacts of this facility in relationship to other facilities has not been considered.

2. **Risk of Accidents along the Transportation Corridor.** Heavy haul trucks could make up to 400 trips per year along Skull Valley Road, a secondary two-way paved road. The potential for accidents from these vehicles has not been evaluated.

3. **Flooding.** The Applicant has not considered the impact of flooding on its facility or the Intermodal Transfer Point. See Contention N (Flooding), whose basis is incorporated herein by reference.

4. **Pollution.** Construction, operation and maintenance of the ISFSI will cause degradation of air quality and water resources. See Contention T (Inadequacy of Required Permits and other Entitlements) Basis 3 (Environmental Quality Standards and Requirements) which is incorporated by reference into this contention. Such impacts are inadequately discussed.

5. **Seismic.** The site chosen by the Applicant is one with complex seismicity, capable faults and potentially unstable soils. *See* Contention L (Geotechnical) whose basis is incorporated herein by reference. The impact of placing 4,000 casks over such a site is not fully assessed.

6. **Visual.** The Applicant has not adequately considered the cost of the visual impact the proposed ISFSI and the continual (up 200 shipments per year) transportation of spent fuel by heavy haul truck along Skull Valley Road and transportation of spent fuel will have on the public's use and enjoyment of the area. The Applicant states that the ISFSI "will not significantly interrupt views across the Skull Valley floor." ER at 4.1-19. The Applicant goes on to state that the "presence of the construction equipment in an otherwise barren landscape will naturally draw the viewer's attention as a temporary focal point." Id.

While the Applicant may considers the area a "barren landscape," the esthetic use and enjoyment of the area by the public, should nonetheless be analyzed. The application does not take into account how the visual impact of its facility and the transportation of casks along Skull Valley Road will have in detracting from visitors' enjoyment of Deseret Peak, the Deseret Wilderness Area and the Wasatch National Forest in the Stansbury Mountains. Furthermore, the Applicant has not addressed how its activities will impact the public's esthetic enjoyment of public lands and Horseshoe Springs, located directly off Skull Valley Road and 15 miles north of the ISFSI. Public access is allowed on the public lands located adjacent to the site and managed by the Bureau of Land Management. ER at 2.2-3. Typical activities enjoyed by the public include "off-highway vehicle use," camping, and hunting. Id. Horseshoe Springs is a protected recreational area with ponds and hiking trails where typical activities include fishing, hunting, and bird watching. ER at 2.2-3. Id. The Applicant must objectively consider and impact that its facility and transportation of casks will have on these activities.

X. Need for the Facility

CONTENTION: The Applicant fails to demonstrate there is a need for the facility as is required under NEPA.[39]

BASIS: As support for its need for the facility, the Applicant merely recites that reactor sites are physically or economically unable to meet their anticipated spent fuel storage requirements. ER 1.2. There is no substantiation of these statements. To the contrary, one of the PFS consortium members, Northern States Power, says that it has enough room at its existing on-site storage facility for all the storage containers the plant will need.[40] Even the Applicant acknowledges that most reactors have been able to add additional storage capacity by reracking and by constructing on site dry spent fuel storage. ER at 1.2-1.

The Applicant's underlying premise is that the owners of nuclear reactors will be in a substantially superior economic position if they can ship their spent nuclear fuel half way across the country to a centralized storage facility in Utah. The Applicant's own words in the Environmental Report, "Need for the Facility" (ER pp. 1.2-1,2), illustrate that economic advantage to a select group is the driving need for this facility:

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[39] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

[40] *See* Northern States Power home page "Prairie Island Spent Fuel Storage FAQ" at *http://www.nspco.com/nsp/spntful.htm#q13.*

> [R]eactors 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 the added costs of maintaining a licensed site.... [The PFS facility] would also provide insurance for situations where increased on-site storage might by physically possible but economically disadvantageous.[41]

This limited benefit is insufficient to justify the need for the facility.

The application is for storage of spent nuclear fuel rods from domestic power reactors located throughout the United States. The application must, therefore, discuss the national need for storage at its proposed facility. Rather than unsupported and generalized statements about on-site storage capacity and storage costs, the Applicant should at least detail and substantiate for each reactor site, the present and projected quantity of spent nuclear fuel, the projected storage capacity, the cost of on-site storage, the specifics of state-imposed restrictions and whether those restrictions are preempted by federal law.

Furthermore, the Applicant also refers to premature plant shutdown because of the fear that utilities may not be able to obtain state approval for onsite storage. ER 8.1-2,3. However, the Applicant fails to give any basis for this fear and, thus, it must be rejected as mere speculation.

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[41] Under this approach, the Applicant is running afoul of NEPA. Rather than isolate the costs or benefits to a particular group as Applicant does, NEPA requires overall benefits to be weighed against overall costs. Detroit Edison Company (Enrico Fermi Atomic Power Plant, Unit 2), LBP-78-11, 7 NRC 381, 391 (1978).

Y. Connected Actions

CONTENTION: The Applicant fails to adequately discuss the link between this proposal and the national high level waste program, a connected action, as is required under NEPA.[42]

BASIS: Given that this proposal is for storage of spent nuclear fuel rods located throughout the United States, it is tightly linked to the previous and pending decisions of DOE's high level waste program. As connected actions, this proposal and other high level waste decisions need to be considered together to ensure that the cumulative effects of these actions are properly evaluated. 40 CFR § 1502.4.

The Applicant links the need for the facility to DOE's inability to accept spent fuel by January 1998, by stating that it will be at least a decade before utilities can make spent fuel deliveries to DOE. ER at 1.2-1. While the 1987 amendments to the Nuclear Waste Policy Act of 1982 authorize DOE to construct a monitored retrievable storage (MRS) facility, the siting and construction of the MRS was linked to the schedule for developing a high level waste repository. There are currently both House (HB 1270) and Senate versions of congressional bills to authorize construction of an MRS in Nevada near the Yucca Mountain repository site.

Implementation of the proposed action will commit the government to one of many alternative courses of action for dealing with high level waste disposal in general,

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[42] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

thus eliminating or discouraging other alternatives that may result in fewer or lower adverse environmental impacts. For instance, the proposed ISFSI project does nothing to advance the ultimate objective of safely disposing of radioactive waste. Instead, it adds significant cumulative impacts caused by transporting spent fuel across the country to Utah and then moving the fuel to wherever a final repository will be located. These impacts could be avoided by leaving the fuel onsite until a repository is ready. As another connected action, the Applicant needs to consider the implication that the Skull Valley site will become a de facto permanent repository for spent fuel casks. NRC will not fulfil its NEPA responsibilities if it does not address these issues.

Z. No Action Alternative

CONTENTION: The Environmental Report does not comply with NEPA because it does not adequately discuss the "no action" alternative.[43]

BASIS: NEPA requires a discussion of the no action alternative, 40 CFR § 1502.14(2). To satisfy NEPA, the NRC must consider the environmental consequences of not undertaking the action at all or of continuing with the current plans and management regime. The Applicant's Environmental Report can not be used to meaningfully discuss the no build alternative, because the Applicant focuses <u>solely</u> on the perceived <u>disadvantages</u> of the no build alternative. *See* footnote 41 NEPA requires that the no action alternative be included in the analysis to serve as a baseline and basis of comparison with the proposed action and other alternatives. By not properly considering the no build alternative, the Applicant fails to provide the balanced comparison of environmental consequences among alternatives. For example, the application does not consider the advantages of not transporting 4,000 casks of spent fuel rods thousands of miles across the country, not enhancing the potential for sabotage at a centralized storage facility, not increasing the risk of accidents from additional cask handling, etc. An example of the Applicant's tunnel vision is the following statement: "The construction of additional onsite ISFSIs at plant sites will result in more sites disturbed and greater environmental impact than

[43] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

constructing one site in a remote, desert environment." ER at 8.1-3. The "remote desert environment" referred to be the Applicant is thousands of miles from ANY domestic nuclear power reactor and twenty four miles from the nearest railhead. The Applicant fails to discuss the considerable safety advantages of storing spent fuel near the reactors, whose spent fuel pools will be available for transfers or inspections of degraded fuel. *See* Contention J (Inspection and Maintenance of Safety Components). In contrast to expansion of onsite storage capacity within the reactor basin and any environmental disturbance that may entail, the "remote desert site" chosen by the Applicant is an undisturbed site used primarily for grazing and an area of cultural and historical significance to a number of groups, including Native Americans.

NRC cannot rely on the Applicant's inadequate and one-sided discussion of the no build alternative. Thus, NRC will not satisfy NEPA if it does not adequately address all sides of the no action alternative. City of Tenakee Springs v. Clough, 915 F.2d 1308, 1312 (9th Cir. 1990)(agency's failure to consider alternatives is contrary to law); Bob Marshall Alliance v. Hodel, 852 F.2d 1223, 1228 (9th Cir. 1988)(failure to discuss no-action alternative improper), *cert. denied*, 489 U.S. 1066 (1989); Van Abbema v. Fornell, 807 F.2d 633, 640-43 (7th Cir. 1986)(court remanded because agency did not discuss no-build alternative); Getty Oil Co. v. Clark, 614 F.Supp 904, 920 (D. Wyo. 1985) (upholding remand by appeals board because agency failed to discuss no-action alternative).

AA. Range of Alternatives

CONTENTION: The Environmental Report fails to comply with the National Environmental Policy Act because it does not adequately evaluate the range of reasonable alternatives to the proposed action.[44]

BASIS: NEPA requires consideration of all reasonable alternatives, 40 CFR § 1502.14, and it is well established that alternatives are at the heart of an EIS. Calvert Cliffs' Coordinating Committee, Inc. v. Atomic Energy Commission, 449 F.2d 1109 (DC Cir. 1971).

The discussion of siting alternatives in Chapter 8 of the Environmental Report is woefully inadequate. The Applicant first developed a list of sites based on whether the site was included on the original list of applicants to the Nuclear Waste Negotiator's office or whether the entity directly expressed an interest to PFS. ER at 8.1-2. Out of this came a list of 38 separate sites. Table 8.1-1. At least 20 of these sites appear to be located on an Indian reservation. The Applicant's basis for coarse screening seems to be the following:

> The key requirements of a candidate site in this phase included: a willing jurisdiction public acceptability reasonable distance to know capable seismic faults and reasonable known ground accelerations, reasonable site flooding conditions, and favorable proximity to transportation access. Any jurisdictional restriction that would prohibit the facility was used as an exclusion factor.

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[44] This contention is supported by the Declaration of Lawrence A. White, attached hereto as Exhibit 1.

ER at 8.1-4.

The second screening phase apparently involved regulatory criteria, however, there is no discussion or tabulation of the results from phase two screening. The most confusing part of the Applicant's site section is the third phase.[45] Apparently, the Applicant used a questionnaire to determine site suitability. *See* Table 8.1-2. There is no mention of whether the Applicant sent the questionnaire to all 38 site owners or just to the Skull Valley Band of Goshutes. There is absolutely no discussion or tabulation of the responses to the questionnaire, if in fact the Applicant received any responses. The Applicant discusses "the remaining (3) candidate sites" (*see* n.* 2) but the reader is absolutely baffled to understand what "three" sites the Applicant refers to because the only sites mentioned by name are the 38 initial sites and the two sites located on the Skull Valley reservation. The final screening final phase was to choice

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[45] The full text of Applicant's third phase, ER at 8.1-5, is as follows:

> The third phase, Candidate Area Selection, was used to identify at least two candidate siting areas that would likely meet NRC licensing regulations, and would not be unreasonably expensive to develop. At least two sites were desired in order to have an alternate choice should problems with the primary site develop further into the process. The evaluation process used in this phase utilized two primary methods. First, a list of detailed questions (Table 8.1-2) intended to determine site suitability was sent to the owners/promoters of the remaining (3) [sic] candidate sites. Second, a major engineering firm familiar with nuclear construction issues was to be engaged to conduct a field evaluation visit to each of the remaining (3) [sic] candidate sites. A set of requirements, exclusion factors, avoidance factors and preference factors was developed for the phase three evaluation.

between two sites on the Skull Valley reservation that were almost contiguous to each other. *See* Fig. 8.1-2.

The Applicant's overarching criterion seems to be a willing jurisdiction. The Applicant's "screening" process jumped from 38 sites to two sites located almost next to each other on the Skull Valley reservation. How the Applicant arrived at the two sites is a mystery. The application of 10 CFR Subpart E, §§ 72.90-108, Site Evaluation Factors, to the candidate sites are not discusses at all in the Environmental Report. Major omissions include failure to consider the adequacy of transportation corridors as well as accident and risk analyses.

The NRC cannot rely on the Applicant's site selection criteria because it has not been applied at all levels of screening. Furthermore, information used in the screening process has not been described and tabulated. Thus, the siting criteria in the Environmental Report is fatally flawed, and fails to demonstrate that the Applicant fully and objectively considered the range of alternative sites available to it.

BB. Site Selection and Discriminatory Effects

CONTENTION: The Applicant's site selection process does not satisfy the demands of the President's Executive Order No. 12,898 or NEPA and the NRC staff must be directed to conduct and thorough and in-depth investigation of the Applicant's site selection process.

BASIS: The Agency's Responsibility under the President's Executive Order No. 12,898, is to make achieving environmental justice part of its mission.[46] The Presidential Order further directs agencies to conduct their activities without

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[46] In Executive Order 12898, Subsection 1-101, "Agency Responsibilities," the President directs that

> [t]o the greatest extent practicable and permitted by law . . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States.

3 CFR at 859.

discriminating against low income and minority populations.[47] The Commission has voluntarily agreed to implement the President's directive on environmental justice.

In addition, NEPA mandates that the NRC must evaluate the Applicant's siting process to ensure the site selection is free from discrimination. NEPA guarantees procedural protections to "all" persons and does not brook subjecting some people to environmental impacts not suffered by others. *See* 42 USC § 4221(c) ("each person should enjoy a healthful environment."). *See also* §§ 4331(b)(2), 4332. Furthermore, courts have made it clear that biased decisionmaking will not be tolerated. Clavery Cliffs Coordinating Comm. v. AEA, 449 F.2d 1109, 1115 (D.C. Cir. 1971). Thus, any discriminatory effects in the site selection process must be evaluated under both NEPA and the President's Executive Order.

The Atomic Safety and Licensing Board left no doubt in Louisiana Energy Services, L.P. (Claiborne Enrichment Center), LBP-97-9, 45 NRC 367 (1997) (hereafter "Claiborne") that the NRC is obligated to carry out, in good faith, the President's

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[47] In section 2.2 of the Executive Order, the President orders that

> [e]ach Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin.

Id. at 861.

Executive Order on Environmental Justice in its activities that substantially affect human health and the environment. The Board found the President's Executive Order applicable to NRC licensing actions because those actions substantially affect human health and the environment.

As in the Claiborne case, where progression of the site selection process and narrowing of the search raised, dramatically, the level of minority representation in the population, the Applicant's search had been focused disproportionately on areas of high minority populations. As discussed above, the Applicant started its site selection with 38 sites, over 20 of which were located on Indian reservations and ended up with two closely located sites on the Skull Valley reservation. This raises an inference of discrimination in the site selection process. The NRC may not approve the selection of the Skull Valley site without conducting a thorough and in-depth investigation of the Applicant's siting process to ensure the site selection was not discriminatory. Claiborne, 45 NRC at 391.

CC. **One-Sided Costs-Benefit Analysis**

CONTENTION: Contrary to the requirements of 10 CFR. § 51.45(c), the Applicant fails to provide an adequate balancing of the costs and benefits of the proposed project, or to quantify factors that are amenable to quantification..

BASIS: The Applicant's Environmental Report makes no attempt to objectively discuss the costs of the project. Other than the financial costs incurred by the Applicant in constructing and operating the facility, the sum and substance of the Applicant's discussion of costs are as follows:

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

ER at 7.3-1. This brief discussion is completely inadequate to satisfy the requirements of 10 CFR. 51.45(c). The Applicant fails to weigh the numerous adverse environmental impacts discussed, for example, in Contentions H through P above, against the alleged benefits of the facility.

Moreover, the Applicant fails to compare the environmental costs of the proposal with the significantly lower environmental costs of the no-action alternative. In addition, the Applicant fails to weigh the benefits to be achieved by alternatives that could reduce or mitigate accidents, environmental contamination, and decommissioning costs, such as inclusion of a hot cell in the facility design (Contention J).

Finally, the Applicant makes no attempt to quantify the costs associated with the impacts of the facility. Many such costs are amenable to quantification: for instance, costs related to accidents and contamination may be quantified in terms of health effects and dollar costs; decommissioning impacts can be quantified; visual impacts can be quantified in terms of lost tourist dollars; and emergency response costs can be quantified based on the cost of those services.

Given the lack of an adequate cost-benefit analysis, the Applicant provides no meaningful basis for a comparison of alternatives. Therefore, the application must be rejected as insufficient to satisfy NEPA.

DD. Ecology and Species

CONTENTION:

The Applicant has failed to adequately assess the potential impacts and effects from the construction, operation and decommissioning of the ISFSI and the transportation of spent fuel on the ecology and species in the region as required by 10 CFR §§ 72.100(b) and 72.108 and NEPA.

BASIS: The Applicant has failed to adequately assess ecological impacts from proposed activities, impacts on species, and impacts on specific habitats. The underlying deficiency is the failure to perform surveys and studies to acquire the necessary information to make an adequate assessment.

1. Impacts from Proposed Activities:

a. Construction Activities. The Applicant indicates that construction activities will "temporarily disturb resident wildlife species." ER at 4.1-4. The Applicant does not discuss the long term impacts to the overall ecological system in Skull Valley. The impact from construction will not be temporary because the Applicant plans to have ongoing construction for over twenty years. ER at 4.1-4 to 5.

b. Retention pond and water management. The Applicant has failed to address the adverse impacts as a potential result of contaminated ground or surface waters, including contaminated puddles and ponds, on various species. *See,* Contention O, Hydrology. The Applicant has not indicated an intent to sample the

retention pond or prevent the retention pond from draining in the event contaminates are present. Thus, the Applicant cannot support the argument that "[s]urface runoff is uncontaminated and will not adversely affect vegetation or wildlife." ER at 4.2-2. Moreover, the Applicant does not address any water born radioactive, chemical, or heavy metal contaminants that may be absorbed by wildlife, aquatic organisms, or vegetation.

c. **Prevention or Mitigation Measures.** The Applicant has failed to propose and develop various protective or mitigation plans in conjunction with the appropriate authorities. The Applicant's plans include a mitigation plan for Horseshoe Springs and protective plan for Salt Mountain Springs developed with the U.S. Bureau of Land Management, mitigation plans for Timpie Springs Waterfowl Management Area and protection of raptor nests developed with the Utah Division of Wildlife Resources. ER at 4.3-3 to 4. The protective or mitigative measures must be identified now so they can be evaluated and the feasibility of the proposed ISFSI site determined.

2. Impacts on Species

The Applicant has not estimated potential impacts to ecosystems and "important species." A species is "important":

> if a specific causal link can be identified between the nuclear power station [or in this case an ISFSI] and species and if one or more of the following criteria applies: (a) the species is commercially or recreationally valuable, (b) the species is threatened or endangered, (c) the species affects the well-being of some important species within criteria (a) or (b), or (d) the species is critical to the structure and

function of the ecological system or is a biological indicator of radionuclides in the environment.

NRC Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations, Revision 2, July 1976, p. 2-4 (hereafter "Reg. Guide 4.2").

a. Ecological System. In the Environmental Report, the Applicant discusses, to a limited extent, the anticipated short term impacts on mammals, raptors, snakes, fish, and a few plant species that may be found within the vicinity of the proposed ISFSI site, Skull Valley Road, or the intermodal transfer station. The Applicant does not discuss and acknowledge the importance of the variety of species found in the Skull Valley ecological system, including aquatic organisms. The Applicant does not discuss the interdependence of various species on one another. The Applicant does not discuss the collective impact of the proposed action on the ecological system as a whole.

The Applicant does not discuss the impact of additional traffic, fugitive dust, radiation, and other pollutants on various species. Impact on wetland species, aquatic organisms, plants, fish, and birds are vastly different. The Applicant has failed to assess the individual and collective impacts on each species.

b. Endangered, Threatened Species, and other high interest species. The Applicant indicates that "except for transient, infrequent occurrences, there are no state or federally-listed threatened or endangered wildlife species known to occur within the site boundary. ER at 4.1-6, *emphasis added.* However, the Applicant

identifies a federally endangered, peregrine falcon nest in the Timpie Springs Waterfowl Management Area. ER at 4.1-6, 7. The Applicant argues that the proposed action is unlikely to have any impact on peregrine falcons. Id. The Applicant ignores that the peregrine falcon nest on the Timpie Springs Waterfowl Management Area is adjacent to the proposed intermodal transfer station at Rowley Junction. The Applicant must address all possible impacts on federally endangered or threatened species, including all potential behavior. Reg. Guide 4.2, at 2-4, n. 2.

The Applicant indicates that the Skull Valley pocket gopher is identified as a "high interest" species in the State of Utah. ER at 4.1-7. The Applicant indicates it will conduct a survey of gopher mounds prior to construction to avoid surface disturbance within 100 feet of any burrow. The Applicant must conduct the survey now to determine the presence of Skull Valley pocket gophers and the overall impact.

c. Culturally or Medicinal Species. The Applicant has not identified any plant species that may be culturally or medicinally (scientific) significant to various individuals. For example, the Confederated Tribes of Goshute Reservation gather plants in the vicinity of the Skull Valley Reservation. See, Request for Hearing and Petition to Intervene of the Confederated Tribes of the Goshute Reservation and David Pete, Docket No. 72-22, p.2, 3, filed August 28, 1997. The Applicant must determine whether significant plant species may be impacted by the proposed action.

d. Related Ecosystem Species. The Applicant has not identified aquatic plants which may be adversely impacted by the proposed action and upset the fragile ecological system of wetlands. Also, the Applicant indicates that "[n]o federal or state-listed threatened or endangered plant species are known to occur within the site or access road." ER at 4.1-3, *emphasis added.* However, the Applicant acknowledges two high interest" plants, Pohl's milkvetch and small spring parsley, may occur in the area. ER at 4.1-4. The Applicant has not adequately assessed plant species and impact on those identified.

e. Domestic Species. The Applicant broadly describes and estimates the number of domestic livestock grazing on U.S. Bureau of Land Management property in the area. ER 2.2-2. However, the Applicant acknowledges, but does not identify the private domestic animal (livestock) or the domestic plant (farm produce) species in the area. Private property adjacent to the proposed site and Skull Valley Road is currently used for ranching and farming. *See*, Castle Rock Land and Livestock, L.C., Skull Valley Company, Ltd., and Ensign Ranches of Utah, L.C., Request for Hearing and Petition to Intervene, Docket No. 72-22, p. 2, filed March 11, 1997. Approximately 4,000 mother cows and calves winter on the private property north of the proposed facility and U.S. Bureau of Land Management Land. Id at 2 to 4. In addition, the private property produces a variety of crops, including alfalfa, oats, barley, and wheat. Id at 3. Adverse impacts may include impacts on livestock and

plants from the radiological, chemical, heavy metal, noise, or visual pollution due to the proposed action.

3. **Specific Habitats**

a. Horseshoe Springs Wildlife Management Area. ("Horseshoe Springs") is located approximately 9.5 miles south of Timpie Junction (Rowley Junction) and approximately 1100 feet west of Skull Valley Road. ER 4.3-3. The U.S. Bureau of Land Management has designated Horseshoe Springs a wetland/riparian area and restricts disturbing activities, including new road construction or new right-of-ways, within 1,200 feet. Id. The Applicant must identify the potential impacts to Horseshoe Springs and it species.

b. Timpie Springs Waterfowl Management Area. The proposed intermodal transfer station is located within the Timpie Springs Waterfowl Management Area. ER at 4.3-4. The Applicant must assess the potential impacts to Timpie Springs Waterfowl Management Area.

c. Great Salt Lake. The Applicant failed to assess the impact on the Great Salt Lake and its dependent species. The Great Salt Lake is just north of Timpie Springs Waterfowl Management Area, near the proposed intermodal transfer station. In addition, the Great Salt Lake is only 21.7 miles northeast of the proposed ISFSI site and the likely eastern transportation routes will closely follow the southern and eastern shorelines of the Great Salt Lake. The Great Salt Lake is a unique body of

water that has no outlet and is, therefore, a sensitive ecosystem. Utah Administrative Code R317-2-6.6. Seventy-five percent of Utah's vital wetlands are supported by the greater Great Salt Lake Wetland Ecosystem. In addition, the Great Salt Lake is a western hemisphere shorebird reserve.

d. Salt Mountain Springs is approximately 300 feet west of Skull Valley Road. ER at 4.3-4. The Applicant indicates that the speckled dace, a state protected indigenous fish is known to inhabit one of the springs in the area. Id. The Applicant plans to implement sediment and erosion control measures to prevent any impacts, but the Applicant does not discuss impacts from other sources, *e.g.*, radiation or other pollution. The Applicant does not discuss the various species that depend on the fragile wetland.

4. Failure to Conduct Adequate Surveys

The Environmental Report addresses ecological impacts to the environment by generically describing the "known" species within the vicinity of the proposed ISFSI site. ER at 2.3-1 to 21. Additionally, to a very limited extent, the Applicant identifies some of the species near Skull Valley Road and the intermodal transfer station at Rowley Junction. However, the Applicant does acknowledge that various species either exist within a potential impact area or that some additional data must be gathered. Rather than conduct a detailed analysis now, the Applicant has proposed to conduct some species surveys or to develop mitigation plans or prevention plans prior

to initiating an action in that area. Unless the surveys are conducted and plans are prepared now, it is impossible to determine 1) if the ecological system is adversely effected by the proposed action as required by 10 CFR §§ 72.100(b) and 72.108, 2) if prevention or mitigation plans may be effectively implemented, or 3) whether the proposed transportation routes and ISFSI location are even feasible given various ecological impacts.

Dated this 23rd day of November, 1997

Respectfully submitted,

Denise Chancellor
Fred G Nelson
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 72-22-ISFSI
PRIVATE FUEL STORAGE, LLC)		
	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel Storage	)	
Installation)	)	November 23, 1997

CERTIFICATE OF SERVICE

I hereby certify that copies of STATE OF UTAH'S CONTENTIONS ON THE APPLICATION SUBMITTED BY PRIVATE FUEL STORAGE L.L.C. FOR 10 CFR PART 72 LICENSE TO CONSTRUCT AND OPERATE A SPENT FUEL STORAGE INSTALLATION, were served on the persons listed below by overnight hand delivery (unless otherwise noted) with conforming copies by United States First Class mail to those indicated, this 23rd day of November, 1997:

Attn: Docketing & Services Branch
Secretary of the Commission
U. S. Nuclear Regulatory Commission
Mail Stop: O16G15
11555 Rockville Pike, One White Flint North
Rockville, MD 20852-2738
(*Electronic mail; original and two conforming copies*)

G. Paul Bollwerk, III, Chairman
Administrative Judge
Atomic Safety and Licensing Board
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Office of the Commission Appellate Adjudication
Mail Stop: 16-G-15 OWFN
U. S. Nuclear Regulatory Commission
Washington, DC 20555
(*United States First Class Mail*)

Dated this 23rd day of November, 1997.

Denise Chancellor
Assistant Attorney General
State of Utah

EXHIBIT 1

UNITED STATES OF AMERICA

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE, L.L.C.	)	
	)	Docket No. 72-22-ISFSI
(Independent Spent Fuel	)	
Storage Installation)	)	November ___, 1997
	)	

DECLARATION OF LAWRENCE A. WHITE, PE

I, Lawrence A. White, PE declare under penalty of perjury that:

1. I am an Executive Vice President of Versar, Inc., an engineering and consulting firm headquartered in Springfield, Virginia. I have extensive experience in the areas of nuclear licensing, radioactive waste management, including the siting, design construction, operation, and decommissioning of nuclear facilities, the National Environmental Policy Act (NEPA), NRC regulations and licensing procedures, and the Nuclear Waste Policy Act of 1982. Copies of my resume and a description of Versar, Inc. are attached to this Declaration.

2. I am familiar with Private Fuel Storage's ("PFS's") License Application, Safety Analysis Report and Environmental Report in this proceeding, as well as the storage and transportation casks PFS plans to use. I am also familiar with NRC regulations, NRC guidance documents, and with NEPA documentation requirements and environmental, scientific, and engineering studies relating to the transportation, storage and disposal of spent nuclear fuel.

3. I assisted in the preparation of, and have reviewed, the State of Utah's Contentions dealing with general NEPA issues, the intermodal transfer site, geotechnical, quality assurance, financial assurance, and emergency planning requirements as well as seismic analyses and radiation shielding. The technical facts presented in those contentions are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

____

Lawrence A. White, PE

LAWRENCE A. WHITE, PE

Education/Professional Registrations:

M.E.A., Engineering Administration, George Washington University, 1980
M.S.E., Geotechnical Engineering, The Catholic University of America, 1972
B.S.C.E., Civil Engineering, University of Maryland, 1968

Registered Professional Engineer
American Society of Civil Engineers
American Management Association

Experience:

Mr. White is a senior program manager and Executive Vice President of Versar, Inc., a nationally recognized environmental engineering and professional services firm. He has over 29 years of experience, including experience as Project Director responsible for all technical support to the Pennsylvania Department of Environmental Resources for the siting and development of the Appalachian Compact Facility for the disposal of low level radioactive waste. Mr. White's accomplishments included the development of the state's regulatory framework for the selection of an operator - Licensee, technical assistance in the review of alternative proposals and technologies for the development of a disposal facility, and all preparatory work for the site selection effort including the implementation of a Geographic Information Management System to aide the State's Licensee in the site selection process. Mr. White consulted to the state on complex issues of mixed waste and greater than Class C waste and their impact on the Compact's facilities. In addition, Mr. White managed a contractor support team to the DOE Office of Civilian Radioactive Waste Management. His team was responsible for all siting and licensing support to DOE for the development of the first-of-a-kind geologic repository for the disposal of high-level radioactive waste. Support included assisting DOE in the identification of resolution of policy issues includes assisting them in negotiation with EPA on their risk based standard 40 CFR 191. Other accomplishments included supporting the development of siting guidelines and the preparation of nine environmental assessments, which supported DOE decision on the selection of three sites for characterization. Mr. White also led negotiations with the EPA on behalf of the NRC to establish their operations and long-term performance standards. As a Federal employee, Mr. White worked on the development of health, safety, and environmental regulations, standards, and guidance for the nuclear power industry and on the application of those regulations in the field. Mr. White was NRC's Project Manager and spokesman for the Licensing and Environmental Impact Assessment of the Byron and Braidwood Nuclear Power Plants. . As Chief, NRC Regulatory and Siting Section, Division of Waste Management, Mr. White, managed the development of NRC's regulations and technical support program which now defines the DOE program for licensing the handling and disposal of high-level radioactive wastes and spent fuel under 10 CFR Part 60. Mr. White managed a $9M/year R&D budget in support of the high-level waste rule. This R&D program was aimed at the evaluation of alternative waste forms, their leach resistance and performance of engineered barriers including canisters for spent fuel disposal and engineered backfill materials response to heat generation in the repository. Studies also focused on DOE Defense HLW, including vitrification technology, and waste form and packaging criteria required to ensure waste compatibility in the commercial repository facility. Mr. White performed licensing reviews of all geotechnical aspects of over 20 nuclear power plant projects throughout the U.S., including the Clinch River Breeder Reactor and Barnwell fuel cycle facilities

EXHIBIT 2

UNITED STATES OF AMERICA

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE, L.L.C.	)	
	)	Docket No. 72-22-ISFSI
(Independent Spent Fuel	)	
Storage Installation)	)	November 20, 1997
	)	

DECLARATION OF DR. MARVIN RESNIKOFF

I, Dr. Marvin Resnikoff, declare under penalty of perjury that:

1. I am the Senior Associate at Radioactive Waste Management Associates, a private consulting firm based in New York City. I have extensive experience in the areas of nuclear waste transportation, storage, and disposal, and decommissioning of nuclear facilities. A copy of my resume is attached to this Declaration.

2. I am familiar with Private Fuel Storage's ("PFS's") license application and Safety Analysis Report in this proceeding, as well as the nonproprietary versions of applications for the storage and transportation casks PFS plans to use. I am also familiar with NRC regulations, guidance documents, and environmental studies relating to the transportation, storage and disposal of spent nuclear power plant fuel, and with NRC decommissioning requirements.

3. I assisted in the preparation of, and have reviewed, the State of Utah's Contentions regarding failure to comply with NRC dose limits; inadequate facilitation of decommissioning; inadequate thermal design; inadequate inspection and maintenance of safety components, such as canisters and cladding; inadequate quality assurance program; lack of a procedure for verifying presence of helium in canisters; inadequate technical qualifications; inadequate monitoring and control of effluents; failure to consider impacts of onsite storage and transportation of spent nuclear fuel; and the no-action alternative. The technical facts presented in those contentions are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

Dr. Marvin Resnikoff

Exhibit MR-2. Resume of Marvin Resnikoff, Ph.D.

Dr. Marvin Resnikoff is Senior Associate at Radioactive Waste Management Associates and is an international consultant on radioactive waste management issues. He is Principal Manager at Associates and is Project Director for risk assessment studies on radioactive waste facilities and transportation of radioactive materials. Dr. Resnikoff has concentrated exclusively on radioactive waste issues since 1974. He has conducted studies on the remediation and closure of the leaking Maxey Flats, Kentucky radioactive landfill for Maxey Flats Concerned Citizens, Inc. under a grant from the Environmental Protection Agency, the Wayne and Maywood, New Jersey thorium Superfund sites and on proposed low-level radioactive waste facilities at Martinsville (Illinois), Boyd County (Nebraska), Wake County (North Carolina), Ward Valley (California) and Hudspeth County (Texas). He has conducted studies on transportation accident risks and probabilities for the State of Nevada and dose reconstruction studies of oil pipe cleaners in Mississippi and Louisiana, residents of Canon City, Colorado near a former uranium mill, residents of West Chicago, Illinois near a former thorium processing plant, and former workers at a thorium processing facility in Maywood, New Jersey. In West Chicago he calculated exposures and risks due to thorium contamination and served as an expert witness for plaintiffs A Muzzey, S Bryan, D Schroeder and assisted counsel for plaintiffs KL West and KA West. He also evaluated radiation exposures and risks in worker compensation cases involving G Boeni and M Talitsch, former workers at Maywood Chemical Works thorium processing plant.

In Canada, he has conducted studies on behalf of the Coalition of Environmental Groups and Northwatch for hearings before the Ontario Environmental Assessment Board on issues involving radioactive waste in the nuclear fuel cycle and Elliot Lake tailings and the Interchurch Uranium Coalition in Environmental Impact Statement hearings before a Federal panel regarding the environmental impact of uranium mining in Northern Saskatchewan. He has also worked on behalf of the Morningside Heights Consortium regarding radium-contaminated soil in Malvern and on behalf of Northwatch regarding decommissioning the Elliot Lake tailings area before a FEARO panel. More recently he completed a study for Concerned Citizens of Manitoba regarding transportation of irradiated fuel to a Canadian high-level waste repository.

He was formerly Research Director of the Radioactive Waste Campaign, a public interest organization conducting research and public education on the radioactive waste issue. His duties with the Campaign included directing the research program on low-level commercial and military waste and irradiated nuclear fuel transportation, writing articles, fact sheets and reports, formulating policy and networking with numerous environmental and public interest organizations and the media. He is author of the Campaign's book on "low-level" waste, *Living Without Landfills*, and co-author of the Campaign's book, *Deadly Defense, A Citizen Guide to Military Landfills*.

Between 1981 and 1983, Dr. Resnikoff was a Project Director at the Council on Economic Priorities, a New York-based non-profit research organization, where he authored the 390-page study, *The Next Nuclear Gamble, Transportation and Storage of Nuclear Waste*. The CEP study details the hazard of transporting irradiated nuclear fuel and outlines safer options.

In February 1976, assisted by four engineering students at State University of New York at Buffalo, Dr. Resnikoff authored a paper which changed the direction of power reactor decommissioning in the United States. His paper showed that power reactors could not be entombed for long enough periods to allow the radioactivity to decay to safe enough levels for unrestricted release. The presence of long-lived radionuclides meant that large volumes of dismantled reactors would still have to go to low-level waste disposal facility. He has more recently served as a technical consultant on irradiated fuel storage facilities for the Palisades, Prairie Island and Point Beach nuclear reactors, testifying at hearings before Public Service Commissions and the courts.

Dr. Resnikoff is an international expert in nuclear waste management, and has testified often

before State Legislatures and the U.S. Congress. He has extensively investigated the safety of the West Valley, New York and Barnwell, South Carolina nuclear fuel reprocessing facilities. His paper on reprocessing economics (Environment, July/August, 1975) was the first to show the marginal economics of recycling plutonium. He completed a more detailed study on the same subject for the Environmental Protection Agency, "Cost/Benefits of U/Pu Recycle," in 1983. His paper on decommissioning nuclear reactors (Environment, December, 1976) was the first to show that reactors would remain radioactive for hundreds of thousands of years.

Dr. Resnikoff has prepared reports on incineration of radioactive materials, transportation of irradiated fuel and plutonium, reprocessing, and management of low-level radioactive waste. He has served as an expert witness in state and federal court cases and agency proceedings. He has served as a consultant to the State of Kansas on low-level waste management, to the Town of Wayne, New Jersey, in reviewing the cleanup of a local thorium waste dump, to WARD on disposal of radium wastes in Vernon, New Jersey, to the Southwest Research and Information Center and New Mexico Attorney General on shipments of plutonium-contaminated waste to the WIPP facility in New Mexico and the State of Utah on nuclear fuel transport. He has served as a consultant to the New York Attorney General on air shipments of plutonium through New York's Kennedy Airport, and transport of irradiated fuel through New York City, and to the Illinois Attorney General on the expansion of the spent fuel pools at the Morris Operation and the Zion reactor, to the Idaho Attorney General on the transportation of irradiated submarine fuel to the INEL facility in Idaho and to the Alaska Attorney General on shipments of plutonium through Alaska. He was an invited speaker at the 1976 Canadian meeting of the American Nuclear Society to discuss the risk of transporting plutonium by air. As part of an international team of experts for the State of Lower Saxony, the Gorleben International Review, he reviewed the plans of the nuclear industry to locate a reprocessing and waste disposal operation at Gorleben, West Germany. He presented evidence at the Sizewell B Inquiry on behalf of the Town and Country Planning Association (England) on transporting nuclear fuel through London. In July and August 1989, he was an invited guest of Japanese public interest groups, Fishermen's Cooperatives and the Japanese Congress Against A- and H- Bombs (Gensuikin).

Between 1974 and 1981, he was a lecturer at Rachel Carson College, an undergraduate environmental studies division of the State University of New York at Buffalo, where he taught energy and environmental courses. The years 1975-1977 he also worked for the New York Public Interest Group (NYPIRG).

In 1973, Dr. Resnikoff was a Fulbright lecturer in particle physics at the Universidad de Chile in Santiago, Chile. From 1967 to 1973, he was an Assistant Professor of Physics at the State University of New York at Buffalo. He has written numerous papers in particle physics, under grants from the National Science Foundation. He is a 1965 graduate of the University of Michigan with a Doctor of Philosophy in Theoretical Physics, specializing in group theory and particle physics.

Dr. Marvin Resnikoff

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526 West 26th Street, Room 517
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(212)620-0526 FAX (212)620-0518

241 W. 109th St, Apt. 2A
New York, NY 10025
(212) 663-7117

EXPERIENCE:

April 1989 - present **Senior Associate**, Radioactive Waste Management Associates, management of consulting firm focused on radioactive waste issues, evaluation of nuclear transportation and military and commercial radioactive waste disposal facilities.

1978 - 1981; 1983 - April 1989 **Research Director**, Radioactive Waste Campaign, directed research program for Campaign, including research for all fact sheets and the two books, *Living Without Landfills*, and *Deadly Defense*. The fact sheets dealt with low-level radioactive waste landfills, incineration of radioactive waste, transportation of high-level waste and decommissioning of nuclear reactors. Responsible for fund-raising, budget preparation and project management.

1981 - 1983 **Project Director**, Council on Economic Priorities, directed project which produced the report *The Next Nuclear Gamble*, on transportation and storage of high-level waste.

1974 - 1981 **Instructor**, Rachel Carson College, State University of New York at Buffalo, taught classes on energy and the environment, and conducted research into the economics of recycling of plutonium from irradiated fuel under a grant from the Environmental Protection Agency.

1975 - 1976 **Project Coordinator**, SUNY at Buffalo, New York Public Interest Research Group, assisted students on research projects, including project on waste from decommissioning nuclear reactor.

1973 **Fulbright Fellowship** at the Universidad de Chile, conducting research in elementary particle physics.

1967 - 1972 **Assistant Professor of Physics**, SUNY at Buffalo, conducted research in elementary particle physics and taught range of graduate and undergraduate physics courses.

1965 - 1967 **Research Associate**, Department of Physics, University of Maryland, conducted research into elementary particle physics.

EDUCATION

University of Michigan	PhD in Physics, June 1965
Ann Arbor, Michigan	M.S. in Physics, Jan 1962
	B.A. in Physics/Math, June 1959

EXHIBIT 3

NUCLEAR WASTE TRANSPORTATION SECURITY AND SAFETY ISSUES

The Risk of Terrorism and Sabotage Against Repository Shipments

by

Robert J. Halstead
Transportation Consultant
Portage, Wisconsin

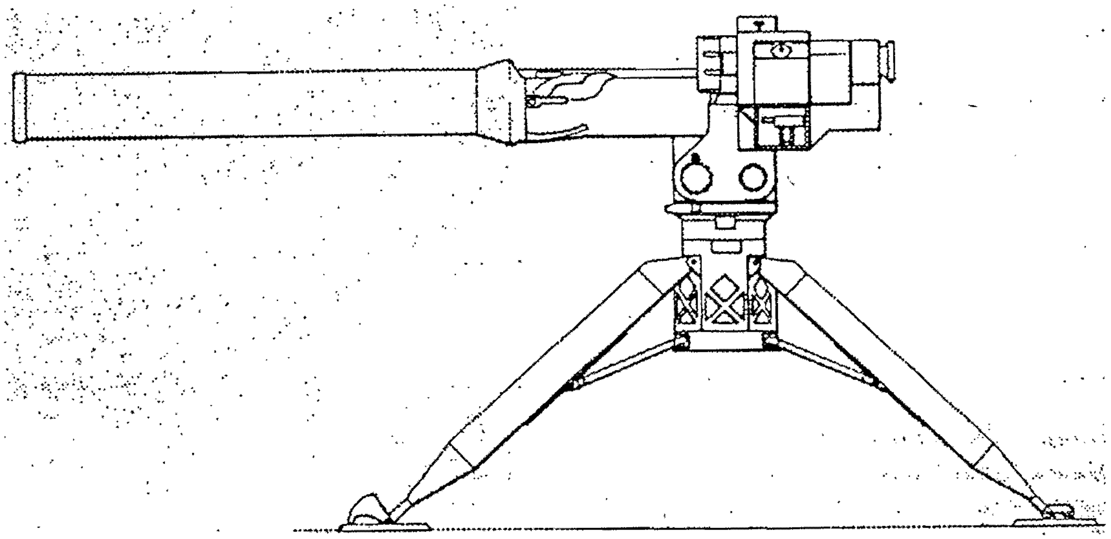
and

James David Ballard
School of Criminal Justice
Grand Valley State University
Grand Rapids, Michigan

October, 1997

This Report is an Expanded Version of a Presentation at the 1996 Southwest Counter-Terrorism Training Symposium, Las Vegas, Nevada, September 24, 1996.

The U.S. TOW anti-tank missile of Iran-Contra fame was introduced for service in the U.S. Army in 1970. Current versions are capable of penetrating more than 30 inches of armor, or "any 1990s tank," at a maximum range of more than 3,000 meters. It can be fired by infantrymen using a tripod, as well from vehicles and helicopters, and can launch 3 missiles in 90 seconds. Manufactured by Hughes Aircraft Company, the TOW is "the most widely distributed anti-tank guided missile in the world," with over 500,000 built and in service in the U.S. and 36 other countries. The TOW has extensive combat experience in Vietnam and the Middle East. Iran may have obtained 1,750 or more TOWs and used TOWs against Iraqi tanks in the 1980s. [Ref. 66]



Specifications:

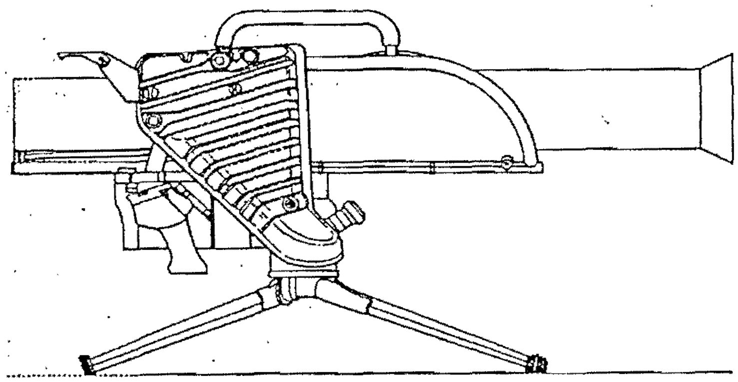
Guidance: Semi-automatic, wire	Max. effective range: 3750 m
Warhead Diameter: 127 mm	Max. velocity: 200 m/sec
Launch unit weight: 87.5 kg	Penetration of armor: >700 mm
Missile weight: 28 kg	Manufacturer: Hughes Missile Systems, USA
Missile length: 1174 mm	

Figure 19a: Schematic and Specifications of the TOW 2 Anti-tank Missile

Figures 19a and 19b reproduced by permission of the Publisher from Ian V. Hogg, Infantry Support Weapons: Mortars, Missiles, and Machine Guns, Greenhill Military Manual, No. 5, (1995) Greenhill Books, Lionel Leventhal Limited, London.

Figure 19b. Photo of the TOW Anti-Tank Missile

The Milan anti-tank missile, developed by a French-led consortium, is considered "one of the most successful" man-portable guided missiles. The current version, the Milan 3, is capable of penetrating over 40 inches of armor at a maximum range of 2,000 meters. Manufactured by Aerospatiale-Missiles in France and under license in Britain, Germany, and India, "several tens of thousands have been produced, it is used by most NATO and several other armies, and the basic principle has been widely copied." [Ref. 62] The Milan is noted for its sight-on-target guidance system, its night vision sight, and its ability to defeat reactive armor with an extended explosive probe. In addition to the NATO forces, Milan is used by Iran, Iraq, Pakistan, and India. The Milan has extensive combat experience in Chad, the Iran-Iraq Gulf War, and the Falklands/Malvinas War between Great Britain and Argentina. [Ref. 55, 62]



Specifications:

- Guidance: Semi-automatic, wire
- Warhead diameter: 133 mm
- Warhead weight: 3.12 kg
- Launch unit weight: 16.9 kg
- Missile weight: 11.91 kg
- Missile length: 1200 mm
- Max. effective range: 2000 m
- Max. velocity: 210 m/sec
- Penetration of armor: >1000 mm
- Manufacturer: Aerospatiale-Missiles, France

Figure 20a: Schematic and Specifications of the MILAN Anti-tank Missile

EXHIBIT 4

DOC ID: A20000000-00811-5705-00001
WBS: 3.1.7
QA: N/A

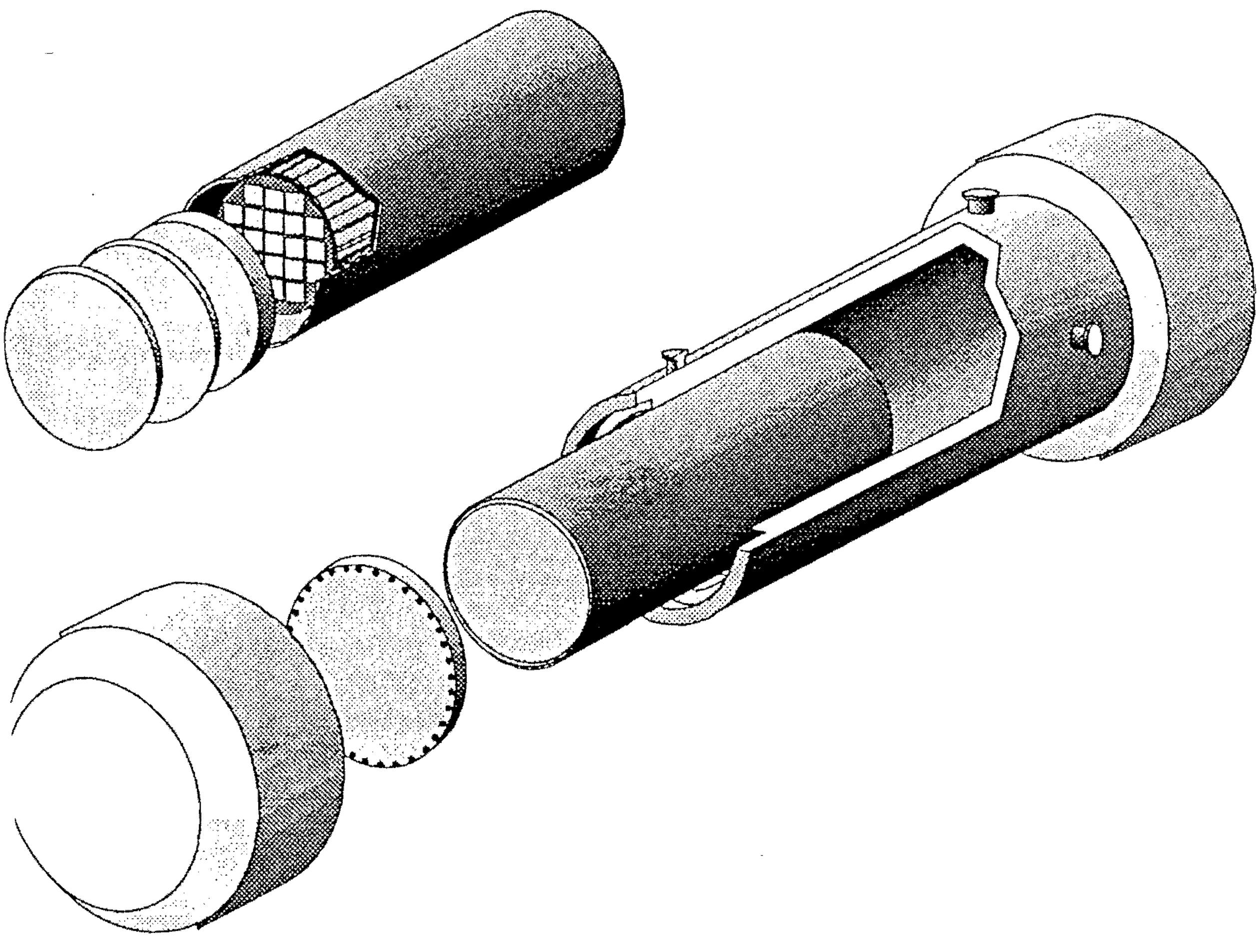
Multi-Purpose Canister (MPC) Implementation Program Conceptual Design Phase Report

Volume I - MPC Conceptual Design Summary Report

DECOM 2

Final Draft

September 30, 1993



U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C.
Under Contract Number DE-AC01-91RW00134

4. MPC SYSTEM DESIGN CONCEPTS

This chapter summarizes the results of the conceptual designs for the MPC, the transportation casks, the MRS, and the utility transfer system. The conceptual design report describes the approach taken to address the various structural, thermal, criticality safety and radiological protection considerations important to MPC system design, and addresses issues that affect MPC capacity.

4.1 MPC DESIGN

The MPC is a triple purpose sealed container for SNF which provides dry storage, transportation, and disposal capabilities. MPCs are provided with two lids which are welded to provide a dry inert environment for SNF and are overpacked separately and uniquely for the various system elements of storage, transportation, and geologic disposal. The MPC is based on existing technology adapted to the specific requirements of the multi-purpose environment, and is intended to be licensed under 10 CFR 72 for storage, 10 CFR 71 for transportation, and be compatible with 10 CFR 60 for disposal. The requirements of 10 CFR 72 and 10 CFR 71 are well-known, and the task of simultaneously satisfying the storage and transportation regulations has been explored for several commercial cask products, although no dual-purpose cask products have been licensed to date. Existing cask designs for storage and transportation do not incorporate repository disposal requirements, which have not been defined at the present time.

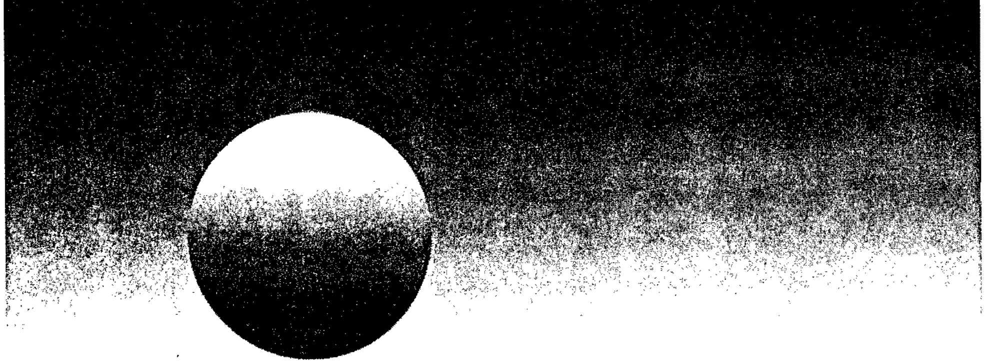
The major design considerations for the MPC are to provide reasonable cost for storage, high strength and criticality control for transportation, and low fuel cladding temperatures for disposal. The conceptual MPC designs provide these features, and meet all other requirements for dry storage and transportation. It is expected that a license for storage and a license for transportation may be obtained that would not require opening the MPC after storage and prior to transportation to an MRS or the repository. With the exception of the burnup credit issue, no new regulations or regulatory interpretations are needed for on-site storage or for transportation.

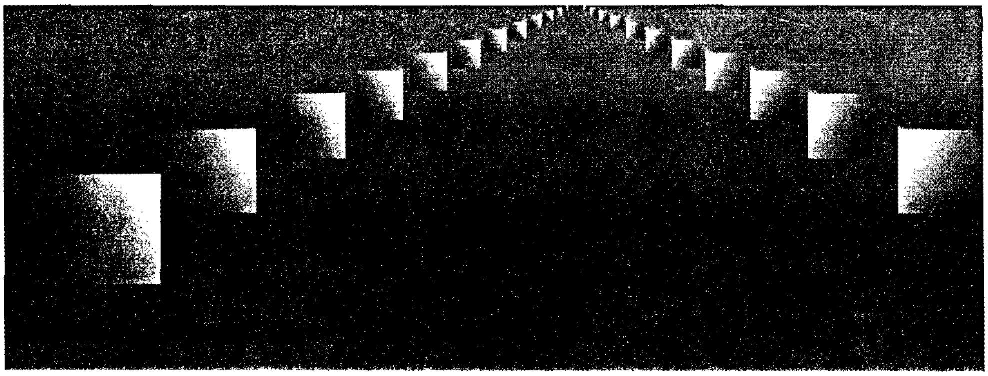
The MPC is designed in two versions: a large MPC which satisfies a 125-ton crane hook weight limit, and a medium MPC which meets a 75-ton crane hook weight limit. These weight limits were selected based on individual Purchaser handling capabilities. The MPC capacity, crane hook weight estimates, and the total package weight on rail are provided in Table 4-1. All MPC versions are designed for transportation in a Type B, Fissile Class I transportation package. The presently projected maximum capacity of the large MPC is 21 PWR assemblies with the use of burnup credit. A 40 BWR assembly version of the large MPC was also designed. The medium MPC has a capacity of 12 PWR assemblies or 24 BWR assemblies. The medium PWR and both BWR MPC basket designs do not rely upon the use of burnup credit.

EXHIBIT 5

DOE/RW-0457

ACCEPTANCE PRIORITY RANKING
&
ANNUAL CAPACITY REPORT





U.S. DEPARTMENT OF ENERGY

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

WASHINGTON, DC 20585

MARCH 1995

DECOM 2

1.0 INTRODUCTION

The Nuclear Waste Policy Act of 1982, as amended (the Act)[1], assigns the Federal Government the responsibility for the disposal of spent nuclear fuel and high-level waste. The Director of the Department of Energy's Office of Civilian Radioactive Waste Management (the Department) is responsible for carrying out the functions assigned to the Secretary of Energy by the Act. Section 302(a) of the Act authorizes the Secretary to enter into contracts* with the owners and generators** of commercial spent nuclear fuel and/or high-level waste. The Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste[2] (Standard Contract) established the contractual mechanism for the Department's acceptance and disposal of spent nuclear fuel and high-level waste. It includes the requirements and operational responsibilities of the parties to the Standard Contract in the areas of administrative matters, fees, terms of payment, waste acceptance criteria, and waste acceptance procedures. The Standard Contract provides for the acquisition of title to the spent nuclear fuel and/or high-level waste by the Department, its transportation to Federal facilities, and its subsequent disposal.

The Standard Contract requires the Department to issue an annual Acceptance Priority Ranking (APR) report and an Annual Capacity Report (ACR). The APR establishes the order in which the Department allocates the projected acceptance capacity for commercial spent nuclear fuel. The ACR applies projected nominal acceptance rates for the system to the priority ranking in the APR, resulting in individual allocations for the owners and generators expressed in metric tons of uranium (MTU). These capacity allocations, as listed in the ACR, form the basis for the Purchasers' submittal of Delivery Commitment Schedules (DCS). As specified in the Standard Contract, the ACR is for planning purposes only and, thus, is not contractually binding on either DOE or the Purchasers.

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*Individual contracts are based upon the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961).

**Owners and generators of spent nuclear fuel and high-level waste who have entered into agreements with the Department and/or have paid fees for purchase of disposal services are referred to as "Purchasers."

In reviewing the data provided by Purchasers for preparation of the 1993 APR, the Department determined that discrepancies in the weights of the discharged fuel assemblies existed. These discrepancies were between the information provided by Purchasers on Annex B to Appendix G of the Standard Contract and information being provided by Purchasers on the Nuclear Fuel Data Form, RW-859. The Department initiated a review to determine the cause of these discrepancies in order to ensure consistency and accuracy of the detailed information used in the APR. This review, which was limited to fuel that was permanently discharged, incore, or temporarily discharged as of April 7, 1983, resulted in numerous minor adjustments to previously reported APR values. Previous editions of the APR, which reported discharges to a 0.01 MTU level of precision, required numerous adjustments as Purchasers implemented various fuel management activities. The Department has determined that this level of precision is not necessary for allocating nominal waste acceptance capacity. Therefore, beginning with this publication, all discharges in the APR will be listed to the 0.1 MTU level of precision. Consequently, the ACR and subsequent DCS reviews will also be to the 0.1 MTU level of precision. Since this change in precision was applied uniformly to the entire APR, changes from the 1992 report caused by the change in precision are not individually explained, however all other changes reported by the Purchasers are listed and explained in Appendix C. In all cases, adjustments to previously reported values have been made by rounding up to the next highest 0.1 MTU. An annual nominal waste acceptance capacity was used to assure that no Purchaser had been impacted adversely with respect to a waste acceptance allocation as compared to an allocation reported in previous editions of the ACR.

The length and thoroughness of this review delayed the issuance of the 1993 ACR and APR. The information from the 1993 APR and ACR is combined with this report. In an effort to reduce the administrative burden associated with the publication of separate ACR and APR reports, the Department has decided to issue a consolidated APR/ACR Report for 1994 and subsequent years. The 1994 APR/ACR Report has been printed in a loose-leaf binder format, to allow for the updating of selected pages rather than revision of the entire report.

1.1 BASIS FOR THE ACCEPTANCE PRIORITY RANKING

As required by the Standard Contract, the APR is based on the date the spent nuclear fuel was permanently discharged, with the oldest spent nuclear fuel, on an industry-wide basis, given the highest priority. The phrase "date the spent nuclear fuel was permanently discharged" means the date the reactor went subcritical for the purpose of permanently discharging the spent nuclear fuel, as reported to the Department by the Purchasers on the Nuclear Fuel Data Form, RW-859. The APR is the basis for allocating projected spent nuclear fuel (SNF) acceptance capacity in the ACR. The 1994 APR listing is based on SNF discharges through December 31, 1993. The APR listing has been included as Appendix A.

Revisions to the information base of this APR were, and in the future will be, addressed consistent with the Department's May 15, 1991, communication on the opportunity to verify the accuracy of the information contained in the draft version of the 1991 APR. Discharges that were not identified during the comment period on the draft 1991 APR were assigned a Ranking Date (i.e. the end of the priority ranking of the report year). Future discharges will be added to the priority ranking based on their date of permanent discharge. If SNF currently designated as temporarily discharged is redesignated as permanently discharged (without subsequent irradiation), the date of redesignation will become the Ranking Date, instead of the date of actual discharge. Reinserted assemblies, previously designated as permanently discharged, will be removed from the priority ranking. Appendix C itemizes all of the differences between the 1992 APR and the 1994 APR which have resulted in changes to the overall ranking.

1.2 BASIS FOR THE ANNUAL CAPACITY REPORT

The ACR (see Appendix B) applies a 10-year projected nominal waste acceptance rate to the APR, resulting in individual capacity allocations. In the previous ACR, the projected nominal acceptance rate was based on the assumption of SNF acceptance beginning in 1998 at a Monitored Retrievable Storage facility prior to repository operations. Due to the uncertainty associated with the date of commencement of operation of the waste management system, the annual nominal waste acceptance rates are presented by year(s) of operation of the system rather

than by specific calendar year(s). The projected nominal acceptance rates also reflect the capacity limit imposed by the Act on such a storage facility prior to repository operations. These projected nominal waste acceptance rates are presented in Table 1. The Department will continue to process DCS submittals on an annual basis.

Table 1. Projected Nominal Waste Acceptance Rates for Spent Nuclear Fuel

Year	SNF (MTU)
Year 1	400
Year 2	600
Year 3	900
Year 4	900
Year 5	900
Year 6	900
Year 7	900
Year 8	900
Year 9	900
Year 10	900
TOTAL	8,200

Operation of the system with the nominal waste acceptance rates presented in Table 1 will result in the acceptance of 8,200 MTU of SNF for the first 10 years. This table provides only an approximation of the system throughput rates and is subject to change depending on Congressional action regarding the conditions for the siting, construction, and operation of an interim storage facility, if any, the repository, and the system design and configuration. The Department will further define and specify the system operating and waste acceptance parameters as the Program progresses, and inform the Purchasers accordingly. Until the SNF is accepted by the Department, Section 111(a)(5) of the Act assigns the waste owners and generators the primary responsibility to provide for, and pay the costs of, interim storage.

The Tables in Appendix B list the Purchasers' annual allocations for each of the first 10 years*** of projected CRWMS operation. Table 2 presents a summary of all Purchasers' annual allocations based on the nominal waste acceptance rates for the 10-year period covered by this report. Fuel assembly reinsertions identified during the reporting period ending December 31, 1993, have resulted in changes to the APR. Additionally, modifications have been made to reflect changes in weight of certain fuel assemblies as determined from the review of the Annex B information. The allocations in years 1 to 10 have been adjusted to reflect; 1) reinsertions of SNF previously identified as being permanently discharged; 2) cycle discharge date correction; and 3) updated weights from Annex B information. However, the projected nominal waste acceptance rates were adjusted for each of the allocation years so that the acceptance queue would not be impacted. The notes to Appendix B, Tables B.1 through B.10, identify and document the reasons for the changes affecting the first 10 years of projected CRWMS operation.

*** The term "year," when used in reference to capacity allocation in this report, means the calendar year, beginning January 1 and ending December 31.

TABLE 2. SUMMARY OF PURCHASERS' ANNUAL ALLOCATIONS (MTU)[a]

PURCHASER	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	TOTAL
ALABAMA POWER COMPANY	--	--	--	--	--	21.2	--	--	24.4	12.9	58.5
ARIZONA PUBLIC SERVICE	--	--	--	--	--	--	--	--	--	--	--
ARK POWER & LIGHT COMP	--	--	--	23.3	28.2	--	30.2	--	46.4	--	128.1
BABCOCK AND WILCOX COM	--	--	0.1	0.1	--	--	--	--	--	--	0.1[b]
BALTIMORE GAS & ELEC C	--	--	--	12.6	41.5	28.5	52.2	--	55.3	29.6	219.7
BOSTON EDISON COMPANY	--	3.9	25.5	82.6	--	--	11.5	5.6	--	42.7	171.8
CAROLINA POWER & LIGHT	--	70.1	24.3	23.7	50.5	32.1	20.6	93.1	--	49.6	364.0
CLEVELAND ELEC ILLUM C	--	--	--	--	--	--	--	--	--	--	--
COMMONWEALTH EDISON CO	21.1	60.5	154.5	121.9	164.2	175.3	66.9	107.8	98.2	98.3	1068.7
CONNECTICUT YANKEE ATO	65.5	22.5	19.8	21.8	21.9	20.2	--	21.9	--	21.9	215.5
CONSOLIDATED EDISON CO	3.0	27.7	32.8	--	27.1	--	28.3	2.3	22.2	--	143.4
CONSUMERS POWER COMPAN	--	2.5	87.4	2.7	27.4	3.5	26.5	--	2.9	30.8	183.7
DAIRYLAND POWER COOP	0.8	6.0	3.0	3.9	--	3.4	--	--	1.5	3.3	21.9
DETROIT EDISON COMPANY	--	--	--	--	--	--	--	--	--	--	--
U.S. DOE	22.8	6.4	3.3	4.5	7.3	72.9	16.4	--	3.3	20.0	156.9
DUKE POWER COMPANY	--	24.9	47.7	62.5	58.4	56.2	61.2	31.6	63.5	66.4	472.4
DUQUESNE LIGHT COMPANY	--	--	--	--	--	--	16.2	--	--	24.4	40.6
FLORIDA POWER & LIGHT	--	20.9	37.0	40.5	32.9	40.9	71.4	33.1	52.2	37.7	366.6
FLORIDA POWER CORP	--	--	--	--	1.4	--	26.1	20.5	--	30.2	78.2
G. E. URANIUM MGT.	145.2	--	--	--	--	--	--	--	--	--	145.2
GENERAL ATOMICS	0.1	0.1	--	--	0.1	--	--	0.1	0.1	0.1	0.1[b]
GEORGIA POWER COMPANY	--	--	--	0.8	4.5	--	35.3	--	56.4	15.2	112.2
GPU NUCLEAR	31.1	43.0	46.8	49.5	33.9	55.3	--	27.6	--	--	287.2
GULF STATES UTILITIES	--	--	--	--	--	--	--	--	--	--	--
HOUSTON LIGHTING & POW	--	--	--	--	--	--	--	--	--	--	--
IES UTILITIES, INC.	--	--	15.4	13.9	21.8	0.8	--	16.6	15.5	--	84.0
ILLINOIS POWER COMPANY	--	--	--	--	--	--	--	--	--	--	--
INDIANA & MICH ELEC CO	--	--	--	28.6	29.2	--	62.5	27.9	69.8	--	218.0
KANSAS GAS AND ELECTRI	--	--	--	--	--	--	--	--	--	--	--
LONG ISLAND POWER AUTH	--	--	--	--	--	--	--	--	--	--	--
LOUISIANA POWER AND LI	--	--	--	--	--	--	--	--	--	--	--
MAINE YANKEE ATOMIC	--	26.4	57.9	27.3	--	50.7	--	26.3	28.2	--	216.8
MISSISSIPPI POWER & LI	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA PUB POWER DIS	--	--	--	23.6	13.8	--	31.2	28.7	21.0	--	118.3
NEW YORK POWER AUTH	--	--	--	25.9	3.7	51.1	34.7	30.0	--	69.8	215.2
NORTH ATLANTIC ENERGY	--	--	--	--	--	--	--	--	--	--	--
NIAGARA MOHAWK POWER C	9.4	49.0	38.9	30.8	--	31.2	--	--	36.9	--	196.2
NORTHEAST UTIL SVC COM	5.5	40.7	28.2	24.3	41.9	26.6	28.1	59.1	--	28.4	282.8
NORTHERN STATES POWER	--	26.2	83.6	29.9	33.9	17.6	32.6	43.3	35.7	16.1	318.9
OMAHA PUB POWER DIST	--	--	9.4	12.9	19.0	16.4	--	14.8	--	14.6	87.1
PACIFIC GAS AND ELECT	7.3	6.0	2.6	13.3	--	--	--	--	--	--	29.2
PENNSYLVANIA POWER & L	--	--	--	--	--	--	--	--	--	--	--
PHILADELPHIA ELEC COMP	--	--	36.3	68.1	47.7	48.8	51.7	51.3	40.6	50.8	395.3
PORTLAND GENERAL ELEC	--	--	--	--	0.5	--	--	24.4	16.1	17.0	58.0
PUB SVC COMPANY OF COL	--	--	--	--	--	--	--	--	--	--	--
PUB SVC ELEC & GAS COM	--	--	--	--	--	--	17.5	29.5	--	25.8	72.8
ROCHESTER GAS & ELEC	32.0	4.6	24.4	16.1	16.2	15.7	--	14.2	5.9	6.8	135.9
SACRAMENTO MUNICIP UTI	--	--	--	9.3	--	26.0	--	30.2	19.0	--	84.5
SOUTH CAROLINA ELEC &	--	--	--	--	--	--	--	--	--	--	--
SOUTHERN CALIF EDISON	35.6	20.5	19.3	19.3	--	19.2	--	19.3	--	--	133.2
TENNESSEE VALLEY AUTHO	--	--	--	--	58.7	5.5	115.6	66.0	116.2	52.4	414.4
TEXAS UTILITIES GENERA	--	--	--	--	--	--	--	--	--	--	--
TOLEDO EDISON COMPANY	--	--	--	--	--	--	--	--	--	25.1	25.1
UNION ELEC COMPANY	--	--	--	--	--	--	--	--	--	--	--
VERMONT YANKEE NUCLEAR	--	72.9	--	12.0	8.7	27.5	25.7	17.0	--	22.2	186.0
VIRGINIA POWER	--	8.2	69.4	43.9	54.7	20.2	23.4	32.9	29.0	52.8	334.5
WASH PUB POWER SUPPLY	--	--	--	--	--	--	--	--	--	--	--
WISCONSIN ELEC POWER C	16.3	43.1	19.8	27.1	36.8	24.9	9.7	12.9	16.1	21.8	228.5
WISCONSIN PUB SVC CORP	--	--	4.4	17.7	16.1	--	5.3	13.3	16.5	14.5	87.8
YANKEE ATOMIC ELEC COM	9.9	10.1	9.7	8.7	--	9.4	--	--	8.5	--	56.3
NOMINAL TOTAL	400.0	600.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	8200.0

a All allocations have been adjusted from the 1992 ACR to reflect the change in the degree of precision.
b These totals are not the sum of the annual allocations because the actual annual values are much less than .1 MTU.

EXHIBIT 6

Dear Interested Community Member:

I am writing to give you information on the Tribe's consideration of the Monitored Retrievable Storage facility project. I hope that if you need further information you will contact me.

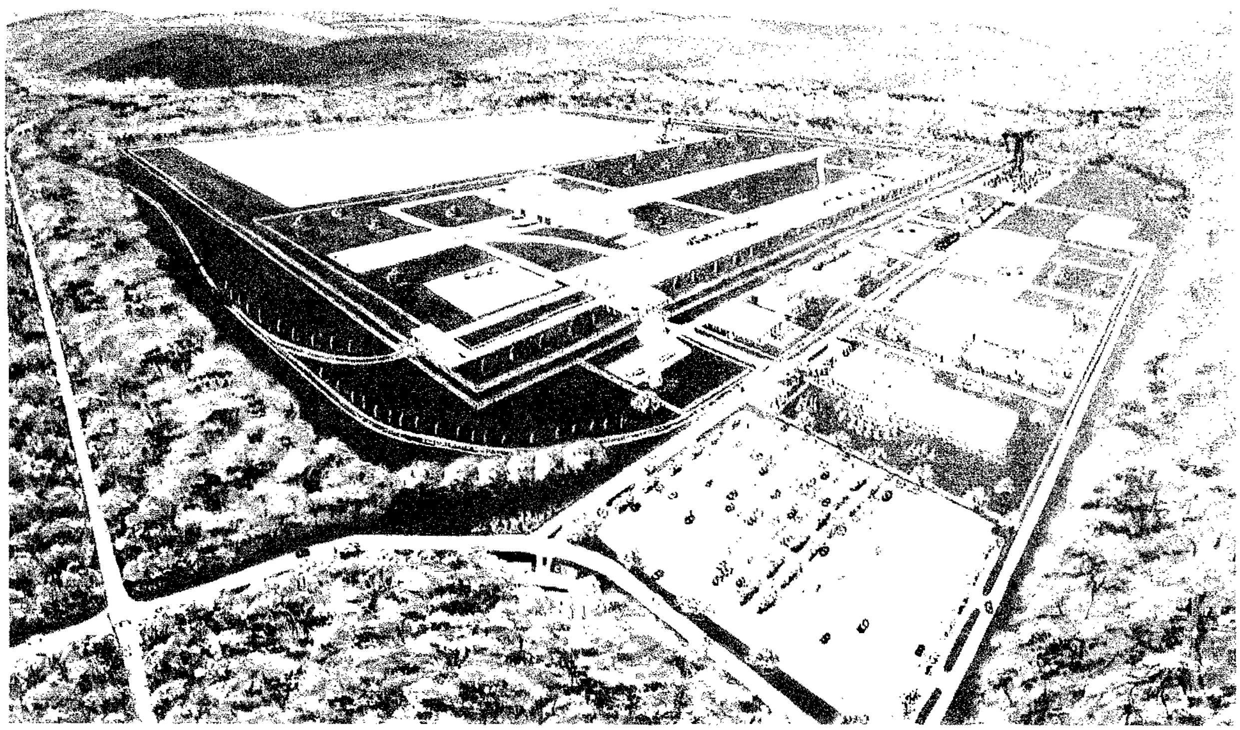
The Executive Committee has been studying this business opportunity pursuant to a General Council Resolution. We have found the project to be worth pursuing. This opportunity could give the Tribe a financial security that many generations will enjoy.

You may hear from those who don't want the Tribe to even consider hosting this project. Mostly they will tell you it is not safe. Do not be misled. The Executive Committee has been looking into this project for more than two years. We have talked at length with experts about this issue. We have concluded it will be safe.

We will sign a siting agreement with the federal government only after a General Council resolution is approved by the Tribe. That issue will come before the General Council in 1995. I hope you find this information useful and I will keep you informed as we move forward.

Sincerely,

Lawrence Bear
Chairman, Skull Valley Goshute Tribe



Artist's drawing of monitored retrievable storage facility

EXHIBIT 1

UNITED STATES OF AMERICA

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE, L.L.C.	)	
	)	Docket No. 72-22-ISFSI
(Independent Spent Fuel	)	
Storage Installation)	)	November ___, 1997
	)	

DECLARATION OF LAWRENCE A. WHITE, PE

I, Lawrence A. White, PE declare under penalty of perjury that:

1. I am an Executive Vice President of Versar, Inc., an engineering and consulting firm headquartered in Springfield, Virginia. I have extensive experience in the areas of nuclear licensing, radioactive waste management, including the siting, design construction, operation, and decommissioning of nuclear facilities, the National Environmental Policy Act (NEPA), NRC regulations and licensing procedures, and the Nuclear Waste Policy Act of 1982. Copies of my resume and a description of Versar, Inc. are attached to this Declaration.

2. I am familiar with Private Fuel Storage's ("PFS's") License Application, Safety Analysis Report and Environmental Report in this proceeding, as well as the storage and transportation casks PFS plans to use. I am also familiar with NRC regulations, NRC guidance documents, and with NEPA documentation requirements and environmental, scientific, and engineering studies relating to the transportation, storage and disposal of spent nuclear fuel.

3. I assisted in the preparation of, and have reviewed, the State of Utah's Contentions dealing with general NEPA issues, the intermodal transfer site, geotechnical, quality assurance, financial assurance, and emergency planning requirements as well as seismic analyses and radiation shielding. The technical facts presented in those contentions are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

____

Lawrence A. White, PE

LAWRENCE A. WHITE, PE

Education/Professional Registrations:

M.E.A., Engineering Administration, George Washington University, 1980
M.S.E., Geotechnical Engineering, The Catholic University of America, 1972
B.S.C.E., Civil Engineering, University of Maryland, 1968

Registered Professional Engineer
American Society of Civil Engineers
American Management Association

Experience:

Mr. White is a senior program manager and Executive Vice President of Versar, Inc., a nationally recognized environmental engineering and professional services firm. He has over 29 years of experience, including experience as Project Director responsible for all technical support to the Pennsylvania Department of Environmental Resources for the siting and development of the Appalachian Compact Facility for the disposal of low level radioactive waste. Mr. White's accomplishments included the development of the state's regulatory framework for the selection of an operator - Licensee, technical assistance in the review of alternative proposals and technologies for the development of a disposal facility, and all preparatory work for the site selection effort including the implementation of a Geographic Information Management System to aide the State's Licensee in the site selection process. Mr. White consulted to the state on complex issues of mixed waste and greater than Class C waste and their impact on the Compact's facilities. In addition, Mr. White managed a contractor support team to the DOE Office of Civilian Radioactive Waste Management. His team was responsible for all siting and licensing support to DOE for the development of the first-of-a-kind geologic repository for the disposal of high-level radioactive waste. Support included assisting DOE in the identification of resolution of policy issues includes assisting them in negotiation with EPA on their risk based standard 40 CFR 191. Other accomplishments included supporting the development of siting guidelines and the preparation of nine environmental assessments, which supported DOE decision on the selection of three sites for characterization. Mr. White also led negotiations with the EPA on behalf of the NRC to establish their operations and long-term performance standards. As a Federal employee, Mr. White worked on the development of health, safety, and environmental regulations, standards, and guidance for the nuclear power industry and on the application of those regulations in the field. Mr. White was NRC's Project Manager and spokesman for the Licensing and Environmental Impact Assessment of the Byron and Braidwood Nuclear Power Plants. . As Chief, NRC Regulatory and Siting Section, Division of Waste Management, Mr. White, managed the development of NRC's regulations and technical support program which now defines the DOE program for licensing the handling and disposal of high-level radioactive wastes and spent fuel under 10 CFR Part 60. Mr. White managed a $9M/year R&D budget in support of the high-level waste rule. This R&D program was aimed at the evaluation of alternative waste forms, their leach resistance and performance of engineered barriers including canisters for spent fuel disposal and engineered backfill materials response to heat generation in the repository. Studies also focused on DOE Defense HLW, including vitrification technology, and waste form and packaging criteria required to ensure waste compatibility in the commercial repository facility. Mr. White performed licensing reviews of all geotechnical aspects of over 20 nuclear power plant projects throughout the U.S., including the Clinch River Breeder Reactor and Barnwell fuel cycle facilities

EXHIBIT 2

UNITED STATES OF AMERICA

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE, L.L.C.	)	
	)	Docket No. 72-22-ISFSI
(Independent Spent Fuel	)	
Storage Installation)	)	November 20, 1997
	)	

DECLARATION OF DR. MARVIN RESNIKOFF

I, Dr. Marvin Resnikoff, declare under penalty of perjury that:

1. I am the Senior Associate at Radioactive Waste Management Associates, a private consulting firm based in New York City. I have extensive experience in the areas of nuclear waste transportation, storage, and disposal, and decommissioning of nuclear facilities. A copy of my resume is attached to this Declaration.

2. I am familiar with Private Fuel Storage's ("PFS's") license application and Safety Analysis Report in this proceeding, as well as the nonproprietary versions of applications for the storage and transportation casks PFS plans to use. I am also familiar with NRC regulations, guidance documents, and environmental studies relating to the transportation, storage and disposal of spent nuclear power plant fuel, and with NRC decommissioning requirements.

3. I assisted in the preparation of, and have reviewed, the State of Utah's Contentions regarding failure to comply with NRC dose limits; inadequate facilitation of decommissioning; inadequate thermal design; inadequate inspection and maintenance of safety components, such as canisters and cladding; inadequate quality assurance program; lack of a procedure for verifying presence of helium in canisters; inadequate technical qualifications; inadequate monitoring and control of effluents; failure to consider impacts of onsite storage and transportation of spent nuclear fuel; and the no-action alternative. The technical facts presented in those contentions are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

Dr. Marvin Resnikoff

Exhibit MR-2. Resume of Marvin Resnikoff, Ph.D.

Dr. Marvin Resnikoff is Senior Associate at Radioactive Waste Management Associates and is an international consultant on radioactive waste management issues. He is Principal Manager at Associates and is Project Director for risk assessment studies on radioactive waste facilities and transportation of radioactive materials. Dr. Resnikoff has concentrated exclusively on radioactive waste issues since 1974. He has conducted studies on the remediation and closure of the leaking Maxey Flats, Kentucky radioactive landfill for Maxey Flats Concerned Citizens, Inc. under a grant from the Environmental Protection Agency, the Wayne and Maywood, New Jersey thorium Superfund sites and on proposed low-level radioactive waste facilities at Martinsville (Illinois), Boyd County (Nebraska), Wake County (North Carolina), Ward Valley (California) and Hudspeth County (Texas). He has conducted studies on transportation accident risks and probabilities for the State of Nevada and dose reconstruction studies of oil pipe cleaners in Mississippi and Louisiana, residents of Canon City, Colorado near a former uranium mill, residents of West Chicago, Illinois near a former thorium processing plant, and former workers at a thorium processing facility in Maywood, New Jersey. In West Chicago he calculated exposures and risks due to thorium contamination and served as an expert witness for plaintiffs A Muzzey, S Bryan, D Schroeder and assisted counsel for plaintiffs KL West and KA West. He also evaluated radiation exposures and risks in worker compensation cases involving G Boeni and M Talitsch, former workers at Maywood Chemical Works thorium processing plant.

In Canada, he has conducted studies on behalf of the Coalition of Environmental Groups and Northwatch for hearings before the Ontario Environmental Assessment Board on issues involving radioactive waste in the nuclear fuel cycle and Elliot Lake tailings and the Interchurch Uranium Coalition in Environmental Impact Statement hearings before a Federal panel regarding the environmental impact of uranium mining in Northern Saskatchewan. He has also worked on behalf of the Morningside Heights Consortium regarding radium-contaminated soil in Malvern and on behalf of Northwatch regarding decommissioning the Elliot Lake tailings area before a FEARO panel. More recently he completed a study for Concerned Citizens of Manitoba regarding transportation of irradiated fuel to a Canadian high-level waste repository.

He was formerly Research Director of the Radioactive Waste Campaign, a public interest organization conducting research and public education on the radioactive waste issue. His duties with the Campaign included directing the research program on low-level commercial and military waste and irradiated nuclear fuel transportation, writing articles, fact sheets and reports, formulating policy and networking with numerous environmental and public interest organizations and the media. He is author of the Campaign's book on "low-level" waste, *Living Without Landfills*, and co-author of the Campaign's book, *Deadly Defense, A Citizen Guide to Military Landfills*.

Between 1981 and 1983, Dr. Resnikoff was a Project Director at the Council on Economic Priorities, a New York-based non-profit research organization, where he authored the 390-page study, *The Next Nuclear Gamble, Transportation and Storage of Nuclear Waste*. The CEP study details the hazard of transporting irradiated nuclear fuel and outlines safer options.

In February 1976, assisted by four engineering students at State University of New York at Buffalo, Dr. Resnikoff authored a paper which changed the direction of power reactor decommissioning in the United States. His paper showed that power reactors could not be entombed for long enough periods to allow the radioactivity to decay to safe enough levels for unrestricted release. The presence of long-lived radionuclides meant that large volumes of dismantled reactors would still have to go to low-level waste disposal facility. He has more recently served as a technical consultant on irradiated fuel storage facilities for the Palisades, Prairie Island and Point Beach nuclear reactors, testifying at hearings before Public Service Commissions and the courts.

Dr. Resnikoff is an international expert in nuclear waste management, and has testified often

before State Legislatures and the U.S. Congress. He has extensively investigated the safety of the West Valley, New York and Barnwell, South Carolina nuclear fuel reprocessing facilities. His paper on reprocessing economics (Environment, July/August, 1975) was the first to show the marginal economics of recycling plutonium. He completed a more detailed study on the same subject for the Environmental Protection Agency, "Cost/Benefits of U/Pu Recycle," in 1983. His paper on decommissioning nuclear reactors (Environment, December, 1976) was the first to show that reactors would remain radioactive for hundreds of thousands of years.

Dr. Resnikoff has prepared reports on incineration of radioactive materials, transportation of irradiated fuel and plutonium, reprocessing, and management of low-level radioactive waste. He has served as an expert witness in state and federal court cases and agency proceedings. He has served as a consultant to the State of Kansas on low-level waste management, to the Town of Wayne, New Jersey, in reviewing the cleanup of a local thorium waste dump, to WARD on disposal of radium wastes in Vernon, New Jersey, to the Southwest Research and Information Center and New Mexico Attorney General on shipments of plutonium-contaminated waste to the WIPP facility in New Mexico and the State of Utah on nuclear fuel transport. He has served as a consultant to the New York Attorney General on air shipments of plutonium through New York's Kennedy Airport, and transport of irradiated fuel through New York City, and to the Illinois Attorney General on the expansion of the spent fuel pools at the Morris Operation and the Zion reactor, to the Idaho Attorney General on the transportation of irradiated submarine fuel to the INEL facility in Idaho and to the Alaska Attorney General on shipments of plutonium through Alaska. He was an invited speaker at the 1976 Canadian meeting of the American Nuclear Society to discuss the risk of transporting plutonium by air. As part of an international team of experts for the State of Lower Saxony, the Gorleben International Review, he reviewed the plans of the nuclear industry to locate a reprocessing and waste disposal operation at Gorleben, West Germany. He presented evidence at the Sizewell B Inquiry on behalf of the Town and Country Planning Association (England) on transporting nuclear fuel through London. In July and August 1989, he was an invited guest of Japanese public interest groups, Fishermen's Cooperatives and the Japanese Congress Against A- and H- Bombs (Gensuikin).

Between 1974 and 1981, he was a lecturer at Rachel Carson College, an undergraduate environmental studies division of the State University of New York at Buffalo, where he taught energy and environmental courses. The years 1975-1977 he also worked for the New York Public Interest Group (NYPIRG).

In 1973, Dr. Resnikoff was a Fulbright lecturer in particle physics at the Universidad de Chile in Santiago, Chile. From 1967 to 1973, he was an Assistant Professor of Physics at the State University of New York at Buffalo. He has written numerous papers in particle physics, under grants from the National Science Foundation. He is a 1965 graduate of the University of Michigan with a Doctor of Philosophy in Theoretical Physics, specializing in group theory and particle physics.

Dr. Marvin Resnikoff

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526 West 26th Street, Room 517
New York, NY 10001
(212)620-0526 FAX (212)620-0518

241 W. 109th St, Apt. 2A
New York, NY 10025
(212) 663-7117

EXPERIENCE:

April 1989 - present **Senior Associate**, Radioactive Waste Management Associates, management of consulting firm focused on radioactive waste issues, evaluation of nuclear transportation and military and commercial radioactive waste disposal facilities.

1978 - 1981; 1983 - April 1989 **Research Director**, Radioactive Waste Campaign, directed research program for Campaign, including research for all fact sheets and the two books, *Living Without Landfills*, and *Deadly Defense*. The fact sheets dealt with low-level radioactive waste landfills, incineration of radioactive waste, transportation of high-level waste and decommissioning of nuclear reactors. Responsible for fund-raising, budget preparation and project management.

1981 - 1983 **Project Director**, Council on Economic Priorities, directed project which produced the report *The Next Nuclear Gamble*, on transportation and storage of high-level waste.

1974 - 1981 **Instructor**, Rachel Carson College, State University of New York at Buffalo, taught classes on energy and the environment, and conducted research into the economics of recycling of plutonium from irradiated fuel under a grant from the Environmental Protection Agency.

1975 - 1976 **Project Coordinator**, SUNY at Buffalo, New York Public Interest Research Group, assisted students on research projects, including project on waste from decommissioning nuclear reactor.

1973 **Fulbright Fellowship** at the Universidad de Chile, conducting research in elementary particle physics.

1967 - 1972 **Assistant Professor of Physics**, SUNY at Buffalo, conducted research in elementary particle physics and taught range of graduate and undergraduate physics courses.

1965 - 1967 **Research Associate**, Department of Physics, University of Maryland, conducted research into elementary particle physics.

EDUCATION

University of Michigan	PhD in Physics, June 1965
Ann Arbor, Michigan	M.S. in Physics, Jan 1962
	B.A. in Physics/Math, June 1959

EXHIBIT 3

NUCLEAR WASTE TRANSPORTATION

SECURITY AND SAFETY ISSUES

The Risk of Terrorism and Sabotage Against Repository Shipments

by

Robert J. Halstead
Transportation Consultant
Portage, Wisconsin

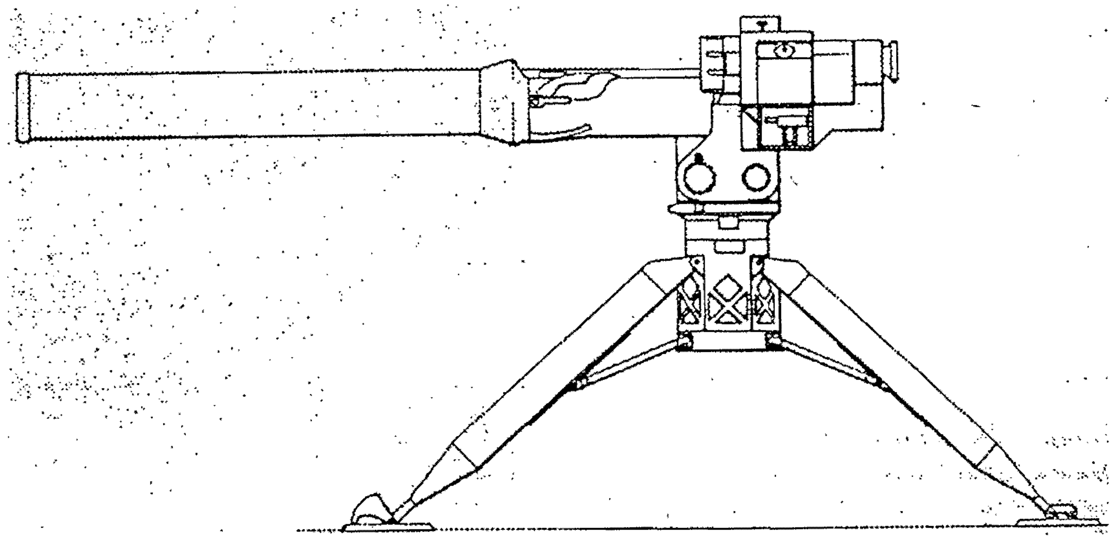
and

James David Ballard
School of Criminal Justice
Grand Valley State University
Grand Rapids, Michigan

October, 1997

This Report is an Expanded Version of a Presentation at the 1996 Southwest Counter-Terrorism Training Symposium, Las Vegas, Nevada, September 24, 1996.

The U.S. TOW anti-tank missile of Iran-Contra fame was introduced for service in the U.S. Army in 1970. Current versions are capable of penetrating more than 30 inches of armor, or "any 1990s tank," at a maximum range of more than 3,000 meters. It can be fired by infantrymen using a tripod, as well from vehicles and helicopters, and can launch 3 missiles in 90 seconds. Manufactured by Hughes Aircraft Company, the TOW is "the most widely distributed anti-tank guided missile in the world," with over 500,000 built and in service in the U.S. and 36 other countries. The TOW has extensive combat experience in Vietnam and the Middle East. Iran may have obtained 1,750 or more TOWs and used TOWs against Iraqi tanks in the 1980s. [Ref. 66]



Specifications:

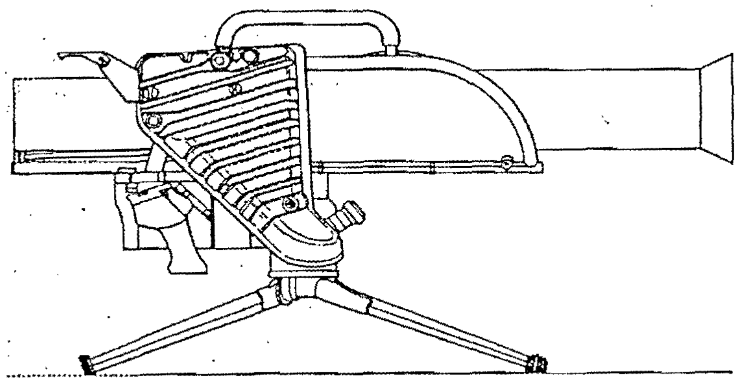
Guidance: Semi-automatic, wire	Max. effective range: 3750 m
Warhead Diameter: 127 mm	Max. velocity: 200 m/sec
Launch unit weight: 87.5 kg	Penetration of armor: >700 mm
Missile weight: 28 kg	Manufacturer: Hughes Missile Systems, USA
Missile length: 1174 mm	

Figure 19a: Schematic and Specifications of the TOW 2 Anti-tank Missile

Figures 19a and 19b reproduced by permission of the Publisher from Ian V. Hogg, Infantry Support Weapons: Mortars, Missiles, and Machine Guns, Greenhill Military Manual, No. 5, (1995) Greenhill Books, Lionel Leventhal Limited, London.

Figure 19b. Photo of the TOW Anti-Tank Missile

The Milan anti-tank missile, developed by a French-led consortium, is considered "one of the most successful" man-portable guided missiles. The current version, the Milan 3, is capable of penetrating over 40 inches of armor at a maximum range of 2,000 meters. Manufactured by Aerospatiale-Missiles in France and under license in Britain, Germany, and India, "several tens of thousands have been produced, it is used by most NATO and several other armies, and the basic principle has been widely copied." [Ref. 62] The Milan is noted for its sight-on-target guidance system, its night vision sight, and its ability to defeat reactive armor with an extended explosive probe. In addition to the NATO forces, Milan is used by Iran, Iraq, Pakistan, and India. The Milan has extensive combat experience in Chad, the Iran-Iraq Gulf War, and the Falklands/Malvinas War between Great Britain and Argentina. [Ref. 55, 62]



Specifications:

- Guidance: Semi-automatic, wire
- Warhead diameter: 133 mm
- Warhead weight: 3.12 kg
- Launch unit weight: 16.9 kg
- Missile weight: 11.91 kg
- Missile length: 1200 mm
- Max. effective range: 2000 m
- Max. velocity: 210 m/sec
- Penetration of armor: >1000 mm
- Manufacturer: Aerospatiale-Missiles, France

Figure 20a: Schematic and Specifications of the MILAN Anti-tank Missile

EXHIBIT 4

DOC ID: A20000000-00811-5705-00001
WBS: 3.1.7
QA: N/A

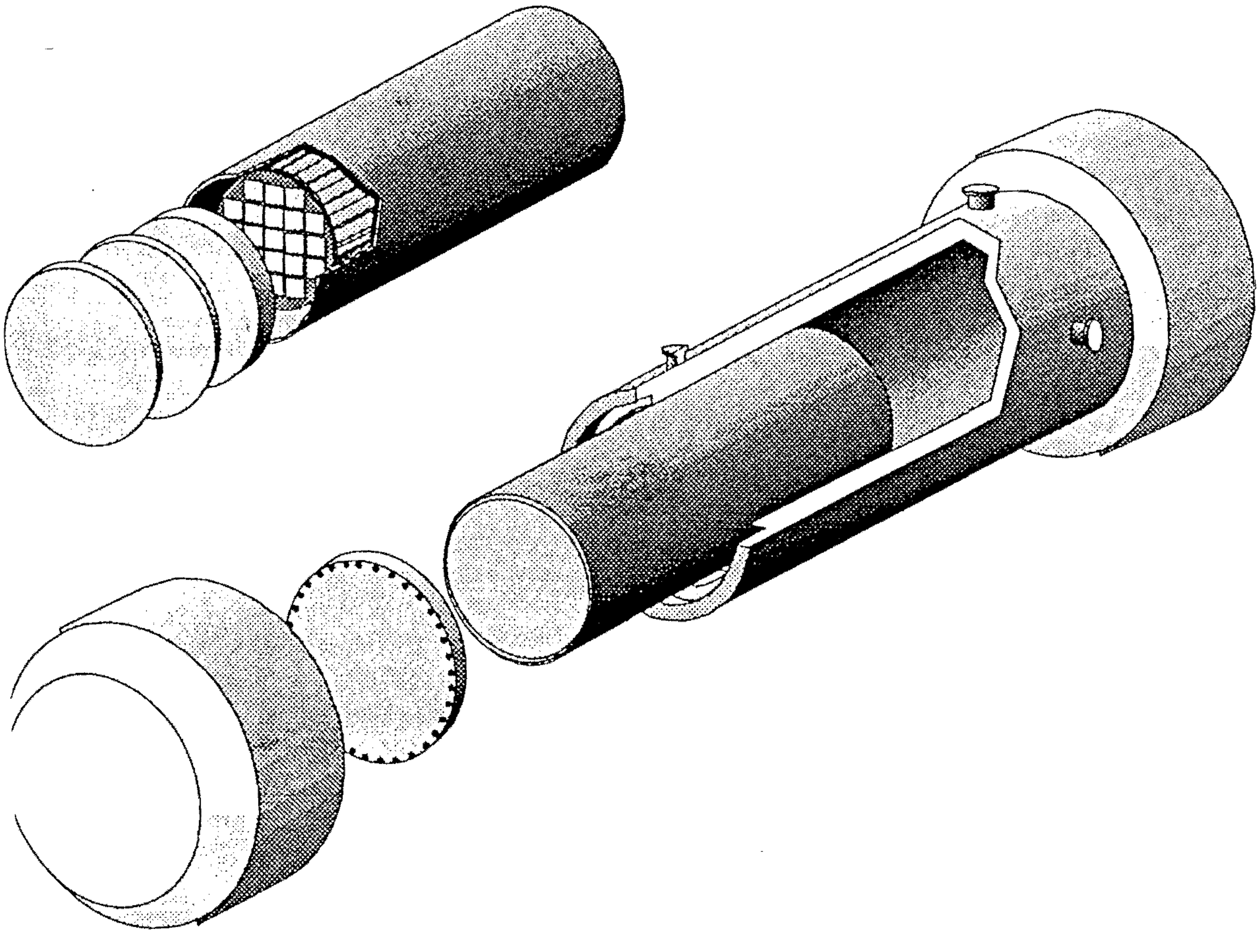
Multi-Purpose Canister (MPC) Implementation Program Conceptual Design Phase Report

Volume I - MPC Conceptual Design Summary Report

DECOM2

Final Draft

September 30, 1993



U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C.
Under Contract Number DE-AC01-91RW00134

4. MPC SYSTEM DESIGN CONCEPTS

This chapter summarizes the results of the conceptual designs for the MPC, the transportation casks, the MRS, and the utility transfer system. The conceptual design report describes the approach taken to address the various structural, thermal, criticality safety and radiological protection considerations important to MPC system design, and addresses issues that affect MPC capacity.

4.1 MPC DESIGN

The MPC is a triple purpose sealed container for SNF which provides dry storage, transportation, and disposal capabilities. MPCs are provided with two lids which are welded to provide a dry inert environment for SNF and are overpacked separately and uniquely for the various system elements of storage, transportation, and geologic disposal. The MPC is based on existing technology adapted to the specific requirements of the multi-purpose environment, and is intended to be licensed under 10 CFR 72 for storage, 10 CFR 71 for transportation, and be compatible with 10 CFR 60 for disposal. The requirements of 10 CFR 72 and 10 CFR 71 are well-known, and the task of simultaneously satisfying the storage and transportation regulations has been explored for several commercial cask products, although no dual-purpose cask products have been licensed to date. Existing cask designs for storage and transportation do not incorporate repository disposal requirements, which have not been defined at the present time.

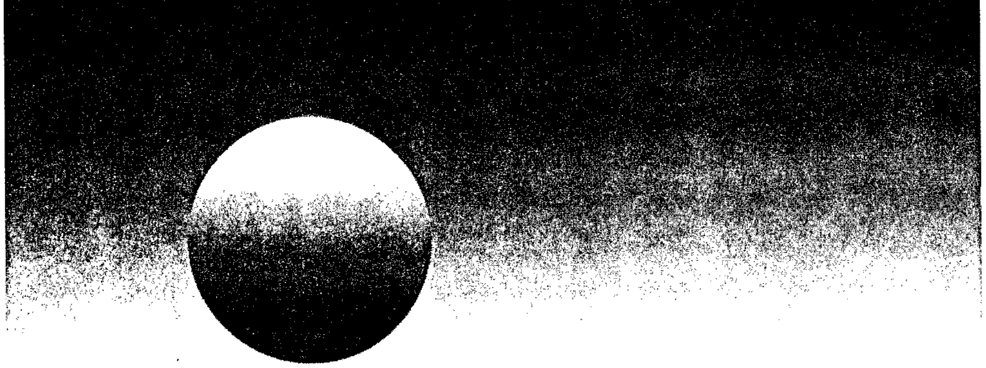
The major design considerations for the MPC are to provide reasonable cost for storage, high strength and criticality control for transportation, and low fuel cladding temperatures for disposal. The conceptual MPC designs provide these features, and meet all other requirements for dry storage and transportation. It is expected that a license for storage and a license for transportation may be obtained that would not require opening the MPC after storage and prior to transportation to an MRS or the repository. With the exception of the burnup credit issue, no new regulations or regulatory interpretations are needed for on-site storage or for transportation.

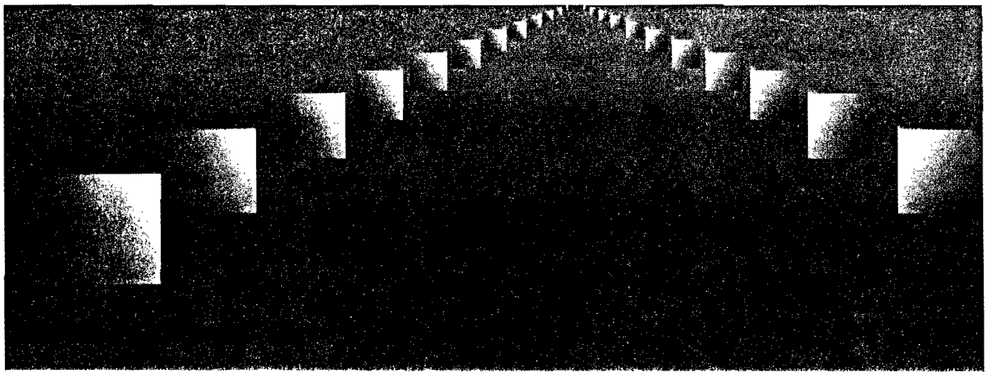
The MPC is designed in two versions: a large MPC which satisfies a 125-ton crane hook weight limit, and a medium MPC which meets a 75-ton crane hook weight limit. These weight limits were selected based on individual Purchaser handling capabilities. The MPC capacity, crane hook weight estimates, and the total package weight on rail are provided in Table 4-1. All MPC versions are designed for transportation in a Type B, Fissile Class I transportation package. The presently projected maximum capacity of the large MPC is 21 PWR assemblies with the use of burnup credit. A 40 BWR assembly version of the large MPC was also designed. The medium MPC has a capacity of 12 PWR assemblies or 24 BWR assemblies. The medium PWR and both BWR MPC basket designs do not rely upon the use of burnup credit.

EXHIBIT 5

DOE/RW-0457

ACCEPTANCE PRIORITY RANKING
&
ANNUAL CAPACITY REPORT





U.S. DEPARTMENT OF ENERGY

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

WASHINGTON, DC 20585

MARCH 1995

DECOM 2

1.0 INTRODUCTION

The Nuclear Waste Policy Act of 1982, as amended (the Act)[1], assigns the Federal Government the responsibility for the disposal of spent nuclear fuel and high-level waste. The Director of the Department of Energy's Office of Civilian Radioactive Waste Management (the Department) is responsible for carrying out the functions assigned to the Secretary of Energy by the Act. Section 302(a) of the Act authorizes the Secretary to enter into contracts* with the owners and generators** of commercial spent nuclear fuel and/or high-level waste. The Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste[2] (Standard Contract) established the contractual mechanism for the Department's acceptance and disposal of spent nuclear fuel and high-level waste. It includes the requirements and operational responsibilities of the parties to the Standard Contract in the areas of administrative matters, fees, terms of payment, waste acceptance criteria, and waste acceptance procedures. The Standard Contract provides for the acquisition of title to the spent nuclear fuel and/or high-level waste by the Department, its transportation to Federal facilities, and its subsequent disposal.

The Standard Contract requires the Department to issue an annual Acceptance Priority Ranking (APR) report and an Annual Capacity Report (ACR). The APR establishes the order in which the Department allocates the projected acceptance capacity for commercial spent nuclear fuel. The ACR applies projected nominal acceptance rates for the system to the priority ranking in the APR, resulting in individual allocations for the owners and generators expressed in metric tons of uranium (MTU). These capacity allocations, as listed in the ACR, form the basis for the Purchasers' submittal of Delivery Commitment Schedules (DCS). As specified in the Standard Contract, the ACR is for planning purposes only and, thus, is not contractually binding on either DOE or the Purchasers.

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*Individual contracts are based upon the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961).

**Owners and generators of spent nuclear fuel and high-level waste who have entered into agreements with the Department and/or have paid fees for purchase of disposal services are referred to as "Purchasers."

In reviewing the data provided by Purchasers for preparation of the 1993 APR, the Department determined that discrepancies in the weights of the discharged fuel assemblies existed. These discrepancies were between the information provided by Purchasers on Annex B to Appendix G of the Standard Contract and information being provided by Purchasers on the Nuclear Fuel Data Form, RW-859. The Department initiated a review to determine the cause of these discrepancies in order to ensure consistency and accuracy of the detailed information used in the APR. This review, which was limited to fuel that was permanently discharged, incore, or temporarily discharged as of April 7, 1983, resulted in numerous minor adjustments to previously reported APR values. Previous editions of the APR, which reported discharges to a 0.01 MTU level of precision, required numerous adjustments as Purchasers implemented various fuel management activities. The Department has determined that this level of precision is not necessary for allocating nominal waste acceptance capacity. Therefore, beginning with this publication, all discharges in the APR will be listed to the 0.1 MTU level of precision. Consequently, the ACR and subsequent DCS reviews will also be to the 0.1 MTU level of precision. Since this change in precision was applied uniformly to the entire APR, changes from the 1992 report caused by the change in precision are not individually explained, however all other changes reported by the Purchasers are listed and explained in Appendix C. In all cases, adjustments to previously reported values have been made by rounding up to the next highest 0.1 MTU. An annual nominal waste acceptance capacity was used to assure that no Purchaser had been impacted adversely with respect to a waste acceptance allocation as compared to an allocation reported in previous editions of the ACR.

The length and thoroughness of this review delayed the issuance of the 1993 ACR and APR. The information from the 1993 APR and ACR is combined with this report. In an effort to reduce the administrative burden associated with the publication of separate ACR and APR reports, the Department has decided to issue a consolidated APR/ACR Report for 1994 and subsequent years. The 1994 APR/ACR Report has been printed in a loose-leaf binder format, to allow for the updating of selected pages rather than revision of the entire report.

1.1 BASIS FOR THE ACCEPTANCE PRIORITY RANKING

As required by the Standard Contract, the APR is based on the date the spent nuclear fuel was permanently discharged, with the oldest spent nuclear fuel, on an industry-wide basis, given the highest priority. The phrase "date the spent nuclear fuel was permanently discharged" means the date the reactor went subcritical for the purpose of permanently discharging the spent nuclear fuel, as reported to the Department by the Purchasers on the Nuclear Fuel Data Form, RW-859. The APR is the basis for allocating projected spent nuclear fuel (SNF) acceptance capacity in the ACR. The 1994 APR listing is based on SNF discharges through December 31, 1993. The APR listing has been included as Appendix A.

Revisions to the information base of this APR were, and in the future will be, addressed consistent with the Department's May 15, 1991, communication on the opportunity to verify the accuracy of the information contained in the draft version of the 1991 APR. Discharges that were not identified during the comment period on the draft 1991 APR were assigned a Ranking Date (i.e. the end of the priority ranking of the report year). Future discharges will be added to the priority ranking based on their date of permanent discharge. If SNF currently designated as temporarily discharged is redesignated as permanently discharged (without subsequent irradiation), the date of redesignation will become the Ranking Date, instead of the date of actual discharge. Reinserted assemblies, previously designated as permanently discharged, will be removed from the priority ranking. Appendix C itemizes all of the differences between the 1992 APR and the 1994 APR which have resulted in changes to the overall ranking.

1.2 BASIS FOR THE ANNUAL CAPACITY REPORT

The ACR (see Appendix B) applies a 10-year projected nominal waste acceptance rate to the APR, resulting in individual capacity allocations. In the previous ACR, the projected nominal acceptance rate was based on the assumption of SNF acceptance beginning in 1998 at a Monitored Retrievable Storage facility prior to repository operations. Due to the uncertainty associated with the date of commencement of operation of the waste management system, the annual nominal waste acceptance rates are presented by year(s) of operation of the system rather

than by specific calendar year(s). The projected nominal acceptance rates also reflect the capacity limit imposed by the Act on such a storage facility prior to repository operations. These projected nominal waste acceptance rates are presented in Table 1. The Department will continue to process DCS submittals on an annual basis.

Table 1. Projected Nominal Waste Acceptance Rates for Spent Nuclear Fuel

Year	SNF (MTU)
Year 1	400
Year 2	600
Year 3	900
Year 4	900
Year 5	900
Year 6	900
Year 7	900
Year 8	900
Year 9	900
Year 10	900
TOTAL	8,200

Operation of the system with the nominal waste acceptance rates presented in Table 1 will result in the acceptance of 8,200 MTU of SNF for the first 10 years. This table provides only an approximation of the system throughput rates and is subject to change depending on Congressional action regarding the conditions for the siting, construction, and operation of an interim storage facility, if any, the repository, and the system design and configuration. The Department will further define and specify the system operating and waste acceptance parameters as the Program progresses, and inform the Purchasers accordingly. Until the SNF is accepted by the Department, Section 111(a)(5) of the Act assigns the waste owners and generators the primary responsibility to provide for, and pay the costs of, interim storage.

The Tables in Appendix B list the Purchasers' annual allocations for each of the first 10 years*** of projected CRWMS operation. Table 2 presents a summary of all Purchasers' annual allocations based on the nominal waste acceptance rates for the 10-year period covered by this report. Fuel assembly reinsertions identified during the reporting period ending December 31, 1993, have resulted in changes to the APR. Additionally, modifications have been made to reflect changes in weight of certain fuel assemblies as determined from the review of the Annex B information. The allocations in years 1 to 10 have been adjusted to reflect; 1) reinsertions of SNF previously identified as being permanently discharged; 2) cycle discharge date correction; and 3) updated weights from Annex B information. However, the projected nominal waste acceptance rates were adjusted for each of the allocation years so that the acceptance queue would not be impacted. The notes to Appendix B, Tables B.1 through B.10, identify and document the reasons for the changes affecting the first 10 years of projected CRWMS operation.

*** The term "year," when used in reference to capacity allocation in this report, means the calendar year, beginning January 1 and ending December 31.

TABLE 2. SUMMARY OF PURCHASERS' ANNUAL ALLOCATIONS (MTU)[a]

PURCHASER	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	TOTAL
ALABAMA POWER COMPANY	--	--	--	--	--	21.2	--	--	24.4	12.9	58.5
ARIZONA PUBLIC SERVICE	--	--	--	--	--	--	--	--	--	--	--
ARK POWER & LIGHT COMP	--	--	--	23.3	28.2	--	30.2	--	46.4	--	128.1
BABCOCK AND WILCOX COM	--	--	0.1	0.1	--	--	--	--	--	--	0.1[b]
BALTIMORE GAS & ELEC C	--	--	--	12.6	41.5	28.5	52.2	--	55.3	29.6	219.7
BOSTON EDISON COMPANY	--	3.9	25.5	82.6	--	--	11.5	5.6	--	42.7	171.8
CAROLINA POWER & LIGHT	--	70.1	24.3	23.7	50.5	32.1	20.6	93.1	--	49.6	364.0
CLEVELAND ELEC ILLUM C	--	--	--	--	--	--	--	--	--	--	--
COMMONWEALTH EDISON CO	21.1	60.5	154.5	121.9	164.2	175.3	66.9	107.8	98.2	98.3	1068.7
CONNECTICUT YANKEE ATO	65.5	22.5	19.8	21.8	21.9	20.2	--	21.9	--	21.9	215.5
CONSOLIDATED EDISON CO	3.0	27.7	32.8	--	27.1	--	28.3	2.3	22.2	--	143.4
CONSUMERS POWER COMPAN	--	2.5	87.4	2.7	27.4	3.5	26.5	--	2.9	30.8	183.7
DAIRYLAND POWER COOP	0.8	6.0	3.0	3.9	--	3.4	--	--	1.5	3.3	21.9
DETROIT EDISON COMPANY	--	--	--	--	--	--	--	--	--	--	--
U.S. DOE	22.8	6.4	3.3	4.5	7.3	72.9	16.4	--	3.3	20.0	156.9
DUKE POWER COMPANY	--	24.9	47.7	62.5	58.4	56.2	61.2	31.6	63.5	66.4	472.4
DUQUESNE LIGHT COMPANY	--	--	--	--	--	--	16.2	--	--	24.4	40.6
FLORIDA POWER & LIGHT	--	20.9	37.0	40.5	32.9	40.9	71.4	33.1	52.2	37.7	366.6
FLORIDA POWER CORP	--	--	--	--	1.4	--	26.1	20.5	--	30.2	78.2
G. E. URANIUM MGT.	145.2	--	--	--	--	--	--	--	--	--	145.2
GENERAL ATOMICS	0.1	0.1	--	--	0.1	--	--	0.1	0.1	0.1	0.1[b]
GEORGIA POWER COMPANY	--	--	--	0.8	4.5	--	35.3	--	56.4	15.2	112.2
GPU NUCLEAR	31.1	43.0	46.8	49.5	33.9	55.3	--	27.6	--	--	287.2
GULF STATES UTILITIES	--	--	--	--	--	--	--	--	--	--	--
HOUSTON LIGHTING & POW	--	--	--	--	--	--	--	--	--	--	--
IES UTILITIES, INC.	--	--	15.4	13.9	21.8	0.8	--	16.6	15.5	--	84.0
ILLINOIS POWER COMPANY	--	--	--	--	--	--	--	--	--	--	--
INDIANA & MICH ELEC CO	--	--	--	28.6	29.2	--	62.5	27.9	69.8	--	218.0
KANSAS GAS AND ELECTRI	--	--	--	--	--	--	--	--	--	--	--
LONG ISLAND POWER AUTH	--	--	--	--	--	--	--	--	--	--	--
LOUISIANA POWER AND LI	--	--	--	--	--	--	--	--	--	--	--
MAINE YANKEE ATOMIC	--	26.4	57.9	27.3	--	50.7	--	26.3	28.2	--	216.8
MISSISSIPPI POWER & LI	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA PUB POWER DIS	--	--	--	23.6	13.8	--	31.2	28.7	21.0	--	118.3
NEW YORK POWER AUTH	--	--	--	25.9	3.7	51.1	34.7	30.0	--	69.8	215.2
NORTH ATLANTIC ENERGY	--	--	--	--	--	--	--	--	--	--	--
NIAGARA MOHAWK POWER C	9.4	49.0	38.9	30.8	--	31.2	--	--	36.9	--	196.2
NORTHEAST UTIL SVC COM	5.5	40.7	28.2	24.3	41.9	26.6	28.1	59.1	--	28.4	282.8
NORTHERN STATES POWER	--	26.2	83.6	29.9	33.9	17.6	32.6	43.3	35.7	16.1	318.9
OMAHA PUB POWER DIST	--	--	9.4	12.9	19.0	16.4	--	14.8	--	14.6	87.1
PACIFIC GAS AND ELECT	7.3	6.0	2.6	13.3	--	--	--	--	--	--	29.2
PENNSYLVANIA POWER & L	--	--	--	--	--	--	--	--	--	--	--
PHILADELPHIA ELEC COMP	--	--	36.3	68.1	47.7	48.8	51.7	51.3	40.6	50.8	395.3
PORTLAND GENERAL ELEC	--	--	--	--	0.5	--	--	24.4	16.1	17.0	58.0
PUB SVC COMPANY OF COL	--	--	--	--	--	--	--	--	--	--	--
PUB SVC ELEC & GAS COM	--	--	--	--	--	--	17.5	29.5	--	25.8	72.8
ROCHESTER GAS & ELEC	32.0	4.6	24.4	16.1	16.2	15.7	--	14.2	5.9	6.8	135.9
SACRAMENTO MUNICIP UTI	--	--	--	9.3	--	26.0	--	30.2	19.0	--	84.5
SOUTH CAROLINA ELEC &	--	--	--	--	--	--	--	--	--	--	--
SOUTHERN CALIF EDISON	35.6	20.5	19.3	19.3	--	19.2	--	19.3	--	--	133.2
TENNESSEE VALLEY AUTHO	--	--	--	--	58.7	5.5	115.6	66.0	116.2	52.4	414.4
TEXAS UTILITIES GENERA	--	--	--	--	--	--	--	--	--	--	--
TOLEDO EDISON COMPANY	--	--	--	--	--	--	--	--	--	25.1	25.1
UNION ELEC COMPANY	--	--	--	--	--	--	--	--	--	--	--
VERMONT YANKEE NUCLEAR	--	72.9	--	12.0	8.7	27.5	25.7	17.0	--	22.2	186.0
VIRGINIA POWER	--	8.2	69.4	43.9	54.7	20.2	23.4	32.9	29.0	52.8	334.5
WASH PUB POWER SUPPLY	--	--	--	--	--	--	--	--	--	--	--
WISCONSIN ELEC POWER C	16.3	43.1	19.8	27.1	36.8	24.9	9.7	12.9	16.1	21.8	228.5
WISCONSIN PUB SVC CORP	--	--	4.4	17.7	16.1	--	5.3	13.3	16.5	14.5	87.8
YANKEE ATOMIC ELEC COM	9.9	10.1	9.7	8.7	--	9.4	--	--	8.5	--	56.3
NOMINAL TOTAL	400.0	600.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	8200.0

a All allocations have been adjusted from the 1992 ACR to reflect the change in the degree of precision.
b These totals are not the sum of the annual allocations because the actual annual values are much less than .1 MTU.

EXHIBIT 6

Dear Interested Community Member:

I am writing to give you information on the Tribe's consideration of the Monitored Retrievable Storage facility project. I hope that if you need further information you will contact me.

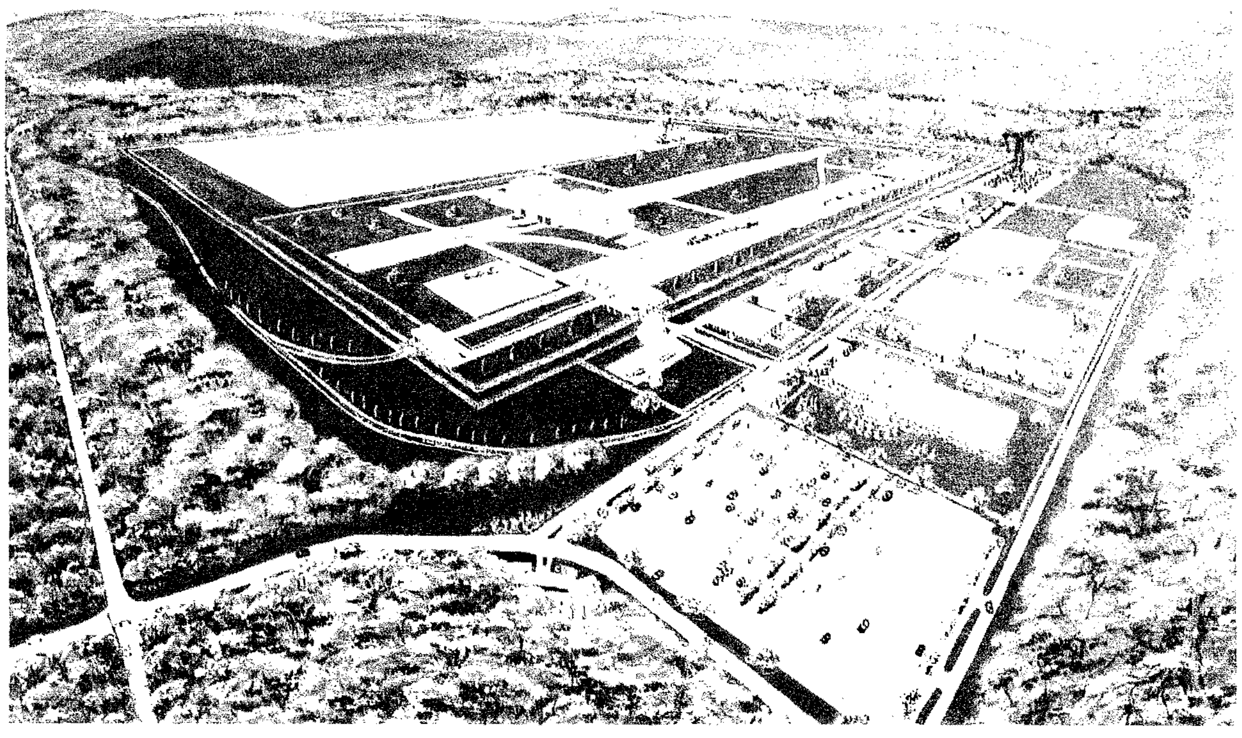
The Executive Committee has been studying this business opportunity pursuant to a General Council Resolution. We have found the project to be worth pursuing. This opportunity could give the Tribe a financial security that many generations will enjoy.

You may hear from those who don't want the Tribe to even consider hosting this project. Mostly they will tell you it is not safe. Do not be misled. The Executive Committee has been looking into this project for more than two years. We have talked at length with experts about this issue. We have concluded it will be safe.

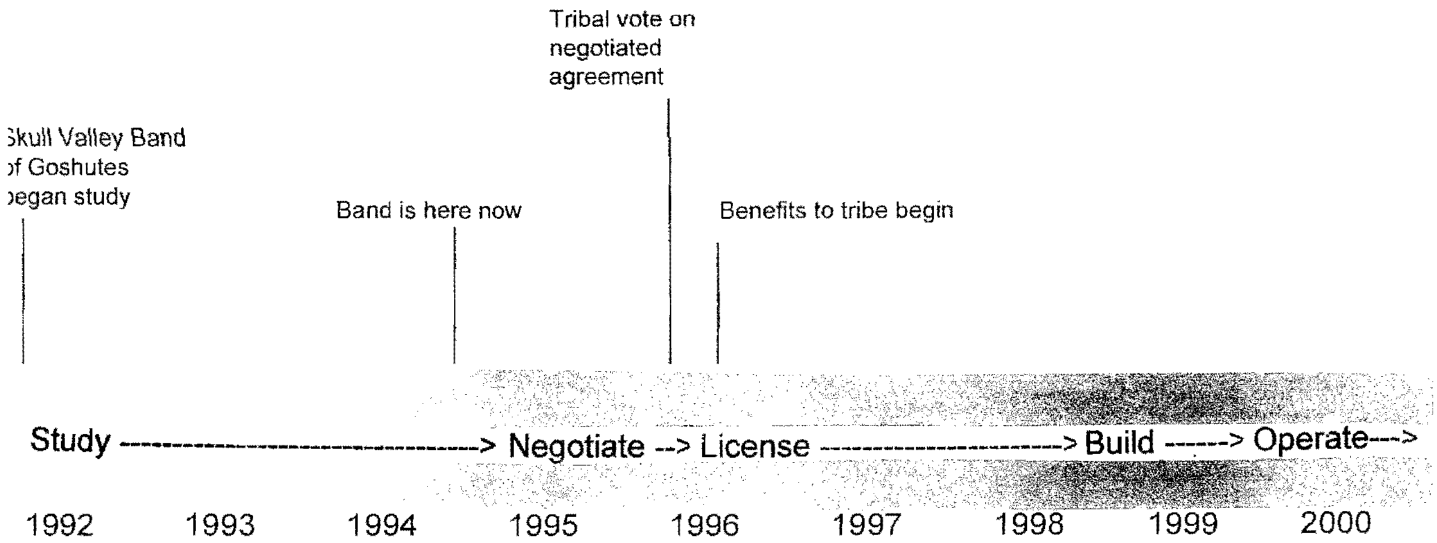
We will sign a siting agreement with the federal government only after a General Council resolution is approved by the Tribe. That issue will come before the General Council in 1995. I hope you find this information useful and I will keep you informed as we move forward.

Sincerely,

Lawrence Bear
Chairman, Skull Valley Goshute Tribe



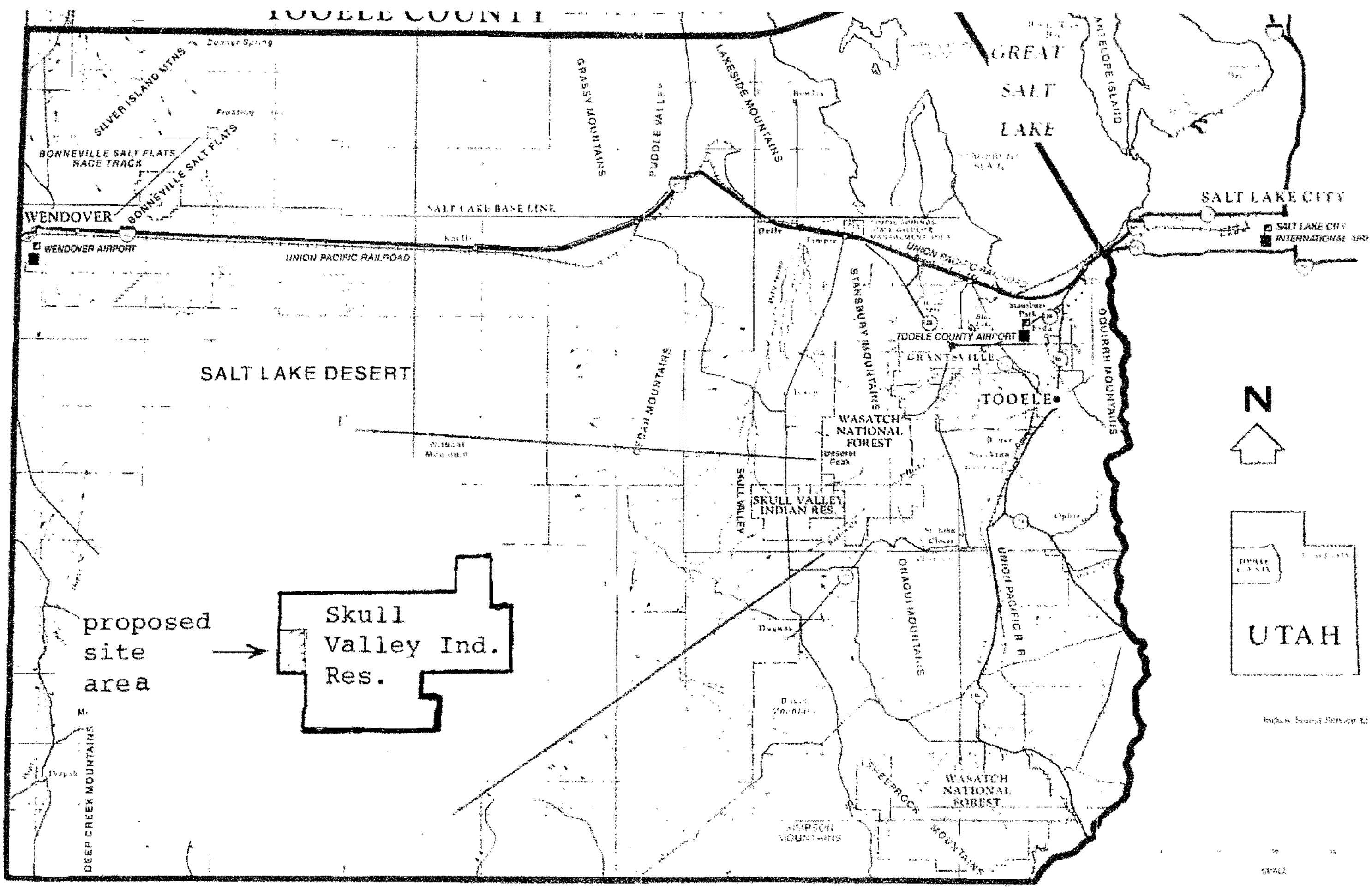
Artist's drawing of monitored retrievable storage facility



Project Process

The Tribe has the right to negotiate the terms for siting the Monitored Retrievable Storage facility.
These terms would include annual payments for the use of the land,
and whatever participation the Tribe considers necessary.
If at any time the Tribe is not satisfied with the progress toward an agreement, it has the right to stop the process.

These rights are in the federal law.



FACT SHEET

Employees Managers-10; Engineers & Professionals-50; Technicians-240; Security-70; Clerical-59	**429**
Local hiring (training provided)	**80%**
Salaries	**$15,000 - $60,000+**
Construction workers	**1,000**
Construction Costs	**$530 million**
Construction Time	**16 months**
Minimum Land Required	**621 acres**
Period of Operation	**40 years**

Constructed and operated by U.S. Department of Energy

Standards established by U.S. Environmental Protection Agency

Facility regulated by U.S. Nuclear Regulatory Commission

Transportation regulated by U.S. Department of Transportation

EXHIBIT 7

Alliant Techsystems
Bacchus Works

Baseline Risk Assessment for the Tekoi High Hazard Test Area

March 1996

Prepared by

Global Environmental Solutions
4100 South 8400 West, Annex 16
Magna, UT 84044

ALLIANT TECHSYSTEMS

2.0 Site Background

The High Hazard Test Area of the Tekoi Firing Range facility is operated by Alliant Techsystems (formerly Hercules Aerospace) and is located on the Skull Valley Indian Reservation in Tooele County, Utah. Alliant leases 87 acres of land from the Skull Valley Band of Goshute Indians for the purpose of testing rocket motors and conducting high hazard explosive tests. This risk assessment pertains only to the section of Tekoi involved with the high hazard explosive testing.

The Tekoi facility has been in use since 1976. For safety reasons, this facility is sited in a remote, sparsely populated location, approximately 25 miles south of the Rowley Junction exit of Interstate 80 on the Skull Valley road.

Figure 1 shows the overall location of Tekoi with respect to the Skull Valley road. The Tekoi area is separated into three separate parcels. Two of these parcels, designated "A" and "C", are used for firing of large rocket motors. Parcel "B", about 9 acres in size, is dedicated to high hazard testing. All closure activities are associated with Parcel "B", known as the High Hazard Test Area.

High hazard testing involves testing energetic materials (explosives), usually in quantities between 10 and 100 pounds, to determine the reaction of the material to stimulus such as heat or shock. Most of the time the explosive material is completely consumed in the resulting explosion. Occasionally small pieces or fragments of explosive material remain after the test. These fragments are gathered together and burned in place.

Possible contaminants at the site include explosives, metals, and certain volatile organic solvents. The explosives include nitroglycerine (NG), nitrocellulose (NC), ammonium perchlorate (AP), and cyclotetramethylene tetranitramine (HMX).

Because of infrequent activity at the site, native soils are expected to be clean or very lightly contaminated with explosives, metals, or solvents; therefore, a health risk-based closure criteria has been accepted by the USEPA, and will be used. State of Utah methodology for risk-based closure standards is included as Appendix A.

Figure 2 identifies the two waste management units at the High Hazard Test Area as the test pit and the unconfined burn area. Each of these units is described below.

Many of the tests conducted in the High Hazard Test Area resulted in detonations that could possibly have thrown shrapnel. The area known as the test pit is designed to capture flying debris by surrounding the test area with a 25-foot-tall earthen barricade. This barricade was constructed by digging a hole approximately 12-feet deep and then piling the dirt around the hole to form a 25-foot wall. The earthen walls have been reinforced to prevent slumping; however, a major slump has occurred recently, as

EXHIBIT 8

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of: PRIVATE FUEL STORAGE, LLC (Independent Spent Fuel Storage Installation)	Docket No. 72-22-ISFSI ASLBP No. 97-732-02-ISFSI

STATE OF UTAH)
) ss.
COUNTY OF SALT LAKE)

AFFIDAVIT OF DAVID C. LARSEN

I, DAVID C. LARSEN, being first duly sworn upon oath, depose and state as follows:

1. I am employed as Environmental Scientist III at the Division of Solid and Hazardous Waste (Division), Utah Department of Environmental Quality, and have worked at this Division since August 29, 1988.

2. I earned a Masters of Science degree in Geology in 1987, from Brigham Young University.

3. The State has been delegated the Resource Conservation and Recovery Act (RCRA) program by the U.S. Environmental Protection Agency and issues hazardous waste managment permits to Dugway Proving Ground (Dugway), a U.S. military reservation located in Tooele County approximately eight miles southwest of the Skull Valley Band of Goshutes Indian Reservation. I act as lead for all RCRA compliance and permitting issues for Dugway.

4. Dugway's mission includes testing chemical and biological defense systems for the Department of Defense . For example, Dugway tests chemical agents, chemical agent decontaminants, personal protective equipment, smokes and illuminants and chemical and biological defense monitoring equipment, and on occasion also receives chemical agent from Deseret Chemical Depot. The National Guard and Air Force also use Dugway to train with live munitions. Dugway is the proposed landing site of the X-33 hydrogen-powered space plane. Dugway also stores hazardous waste and open burns and open detonates waste explosives and propellants.

5. I also assist as needed on other projects, including the Tooele Chemical Agent Disposal Facility (TOCDF) and the Chemical Agent Munitions Disposal System (CAMDS), both of which also are located in Tooele County and are part of the federal Deseret Chemical Depot facility.

6. My current duties include performing frequent inspections of activities related to waste management and overseeing clean up of contaminated sites at Dugway as described above. I have been lead on Dugway permitting issues since about 1990, and lead on all permitting and compliance issues since about 1994. I review technical and scientific documents, such as permit applications and permit modification requests, clean up plans and reports, closure plans and other documents related to waste management at Dugway. I write inspection reports based on my observations and investigations, permits, and modify other documents to meet regulatory requirements. As part of my job duties, I evaluate the site hydrology, contaminant migration, compliance

with applicable rules, and the impacts of various current and past practices on the environment.

7. I have nine years of on the job training and I have attended several RCRA specific training courses. On the job training includes participation in compliance inspections at a variety of facilities throughout Utah, participation in penalty settlement negotiations, writing inspection reports, sampling for contamination, writing and performing assessments of potential environmental contamination, and writing various permits. I have attended many different types of environmental courses including 40-hour OSHA safety training, annual 8-hour OSHA refreshers, inspector training, waste identification and sampling, quality assurance and quality control, groundwater and soil sampling, and site cleanup and risk assessment.

8. The State occasionally issues emergency hazardous waste permits for the detonation of "hanging" bombs which occasionally occur during Hill Air Force Base's (HAFB) munition detonation tests in which F-16 bombers are loaded and drop live bombs for practice north and northwest of Dugway (directly west and northwest of the proposed ISFSI). Approximately five times per year a munition becomes stuck and does not drop from the bomber. It is too dangerous for the bomber to return to HAFB in that condition, and must land at Dugway to have the "hung" ordnance removed.

9. Dugway does tests with smoke, obscurant and illuminating agents. For example, white phosphorus burns on the ground and is used to mark a location and burning of fog oil creates a smoke cloud designed to obscure vision. Other agents are

used as illuminants and generally burn-up before contacting the earth. I have observed these agents burning in the air and on the ground.

10. Dugway occasionally recovers munitions from the ranges and has requested emergency permits from the State to open detonate unexploded projectiles, mortars and other munitions filled with high explosive, white phosphorus, FS smoke, nerve and blister agent and other compounds. Thousands of unexploded chemical filled munitions are present on the ranges and buried in landfills at Dugway.

11. The National Guard fires projectiles and other munitions down range at Dugway as part of its training exercises. The National Guard generates waste propellant as part of the down range firing of munitions. The propellant is burned on the ground at various locations on Dugway. I have observed propellant burning activities on a range.

12. I am aware of other facilities in Skull Valley in the vicinity of the proposed ISFSI. The Utah Test and Training Range (UTTR), 18.3 miles from the proposed ISFSI, is used by the U. S. Air Force as a training range for air-to-air and air-to-ground live munitions training, propagation testing of military ordnance. Commercial facilities, the Laidlaw APTUS hazardous waste incinerator, the Envirocare low level radioactive and mixed waste landfill, the Laidlaw Clive Hazardous Waste Facility, and Laidlaw's Grassy Mountain hazardous waste landfill, are located northwest of the proposed ISFSI and receive thousands of tons of waste annually, most of which is shipped by way of Rowley Junction.

13. I have observed that during the summers of 1995 and 1996 large tracts of land near the Goshute Indian reservation and at Dugway burned during range fires. Nearly every year there seems to be a range fire in Skull Valley.

14. During 1996, a range fire occurred at Deseret Chemical Depot. The fire resulted because abandoned white phosphorus grenades decayed and ignited.

15. To fulfill my inspection duties at Dugway, I travel west on I-80 from Salt Lake City, take the Rowley Junction exit, then travel south on Skull Valley Road which runs within two miles of the site of the proposed independent spent fuel storage installation (ISFSI) on the Skull Valley Indian Reservation, and then pass the Tekoi rocket testing facility en route to Dugway. During these trips on Skull Valley Road I have observed that most vehicles travel at 70-80 mph rather than the legal speed limit of 55 mph. The road is narrow, approximately 22 feet wide, receives minimal maintenance during the summer and has developed bumps due to frost heaves that cause drivers to reduce speed in at least two locations. During the winter, the road is usually not plowed and becomes very icy and dangerous to negotiate, causing vehicles to easily slide off the road. Most times I have driven along Skull Valley Road there have been stray cattle on the road from the large cattle ranches which exist in Skull Valley, and many times there are cattle drives along the road. I have observed many trucks and military vehicles, some oversized, use the road for transporting munitions, explosives, tanks, military personnel, etc. to Dugway, and have frequently seen that campers and mineral collectors use the road as access to the Pony Express Trail. Along Skull Valley Road, I typically see eagles,

many hawks, and a few deer or antelope. Based on my observations, I would estimate that thousands of vehicles travel the Skull Valley Road each year.

FURTHER AFFIANT SAYETH NOT.

DATED this November ___, 1997.

DAVID C. LARSEN

Voluntarily signed and sworn to before me this 21st day of November, 1997, by the signer, whose identity is personally known to me or was proven to me on satisfactory evidence.

NOTARY PUBLIC

Residing at: SLC Utah

My Commission expires: 5-15-2001

EXHIBIT 9

Report No. SAIC-96/2600

An Employee-Owned Company

Tooele Chemical Agent Disposal Facility
Quantitative Risk Assessment

Prepared by:

Science Applications International Corporation
Abingdon, MD 21009
Under Contract DAAA15-91-D-0005

Prepared for:

U.S. Army Program Manager
for Chemical Demilitarization
Aberdeen Proving Ground, MD 21010

December 1996

Volume I
Main Report, Appendices A & B
References and Acronyms

modeling. Table 5-8 shows these combinations. The complete APET logic for seismic events is included in appendix L.

5.2 Site-Specific Aircraft Crash Frequency Estimate

Aircraft crashes at TOCDF or its chemical agent storage area could result in the release of large quantities of agent. These releases could pose significant hazards to the health of onsite (TOCDF) workers, depot workers, or the surrounding public population. To address the potential for agent release from an aircraft crash, accident sequences were defined and their initiating frequencies estimated.

5.2.1 Aircraft Hazards. Aircraft crashes into agent-containing structures pose a hazard due to the potential for agent release and dispersion that could result in health consequences for the public or site workers. Damage to agent-containing structures

Table 5-8. Seismic Structure Failure Combinations Modeled in the QRA

	Median Capacity Values (PGA)			
Failure Combination	CHB/UPA	CHB	MPF	LPG
CHB/UPA fails alone	0.26	—	—	—
CHB fails alone	—	0.49	—	—
MPF fails alone	—	—	0.40	
LPG tank fails alone	—	—	—	0.70
CHB/UPA and CHB both fail	0.26	0.49	—	—
CHB/UPA and MPF both fail	0.26	—	0.40	—
CHB/UPA and LPG both fail	0.26	—	—	0.70
CHB and MPF both fail	—	0.49	0.40	—
CHB and LPG both fail	—	0.49	—	0.70
CHB/UPA and CHB and MPF all fail	0.26	0.49	0.40	—
CHB/UPA and MPF and LPG all fail	0.26	—	0.40	0.70
CHB/UPA and CHB and LPG all fail	0.26	0.49	—	0.70

could result from the direct impact of the aircraft on the structure or from impacts of high speed missiles such as aircraft engines. Furthermore, fires could result from the large quantity of fuel potentially carried by the aircraft.

The analysis of aircraft risk at the TOCDF and its storage area was based on the U.S. Nuclear Regulatory Commission's *Standard Review Plan*, NUREG-0800 (USNRC, 1981) updated for the results of the draft DOE Aircraft Crash Risk Analysis Methodology (ACRAM) (DOE, 1996). Because greater potential for structural damage exists when larger aircraft are involved, aircraft statistics were gathered based on size. This allowed separate frequencies to be calculated for large (i.e., commercial air carriers and military bombers), medium (i.e., commercial air taxis, military attack planes, and general aviation jets), and small (i.e., other general aviation planes and helicopters) aircraft. Assignment of consequences appropriate to each aircraft size was then possible.

For commercial and military aviation, the in-flight portion of the crash frequency is calculated for each aircraft type using the following formula:

$$\frac{F_j}{A_j} = \frac{C_j\, N_j}{w} \quad \text{for } j = 1, \ldots, M \qquad (5\text{-}3)$$

where F_j/A_j = frequency per unit area for the j-th aircraft type, occurrences per year per square mile (yr^{-1}-mi^{-2})

- M = number of types of aircraft
- C_j = in-flight crash rate for aircraft type j, occurrences per mile
- w = width of the airway in miles (twice the distance from the edge of the airway to the site is added when the site is located outside the airway)
- N_j = number of flights of aircraft type j along the airway.

The value for C, the in-flight crash rate per mile, has been calculated for commercial and military aircraft based on actual crash data as part of the DOE ACRAM study (DOE, 1996). The values are presented in table 5-9. As discussed in the following paragraphs, the values for N and w were obtained from aviation maps and interviews with regional representatives from the Federal Aviation Administration (FAA). Values of A were based on physical sizes of the facility and storage area.

Table 5-9. In-Flight Crash Rates for Commercial and Military Aviation

Aviation Type	In-Flight Crash Rate, per mile (C_j)
Commercial Aviation	
Air Carriers	2.2×10^{-10}
Air Taxis	2.7×10^{-8}
Military Aviation	
Cargos, Bombers, etc.	1.9×10^{-9}
Attack Planes, Trainers, etc.	1.7×10^{-8}

For general aviation and helicopters, the DOE ACRAM study generated a computer program that accepts as input the latitude and longitude of the site and returns the frequency per unit area per year. The computer program represents a fit to actual crash locations for the continental United States.

Data for aircraft traffic near TOCDF was obtained from interviews with personnel at the Salt Lake City Air Traffic Control Tower (ATCT) (Hess, 1994; Bayley 1995) and from a survey of high- and low-altitude aeronautical charts (USGFIP, 1994a; NOAA, 1994a) (see figures 5-30 to 5-32).

Initial screening against the flight density criteria discussed in appendix I showed that aviation usage in the vicinity of TOCDF failed to satisfy one of the three screening

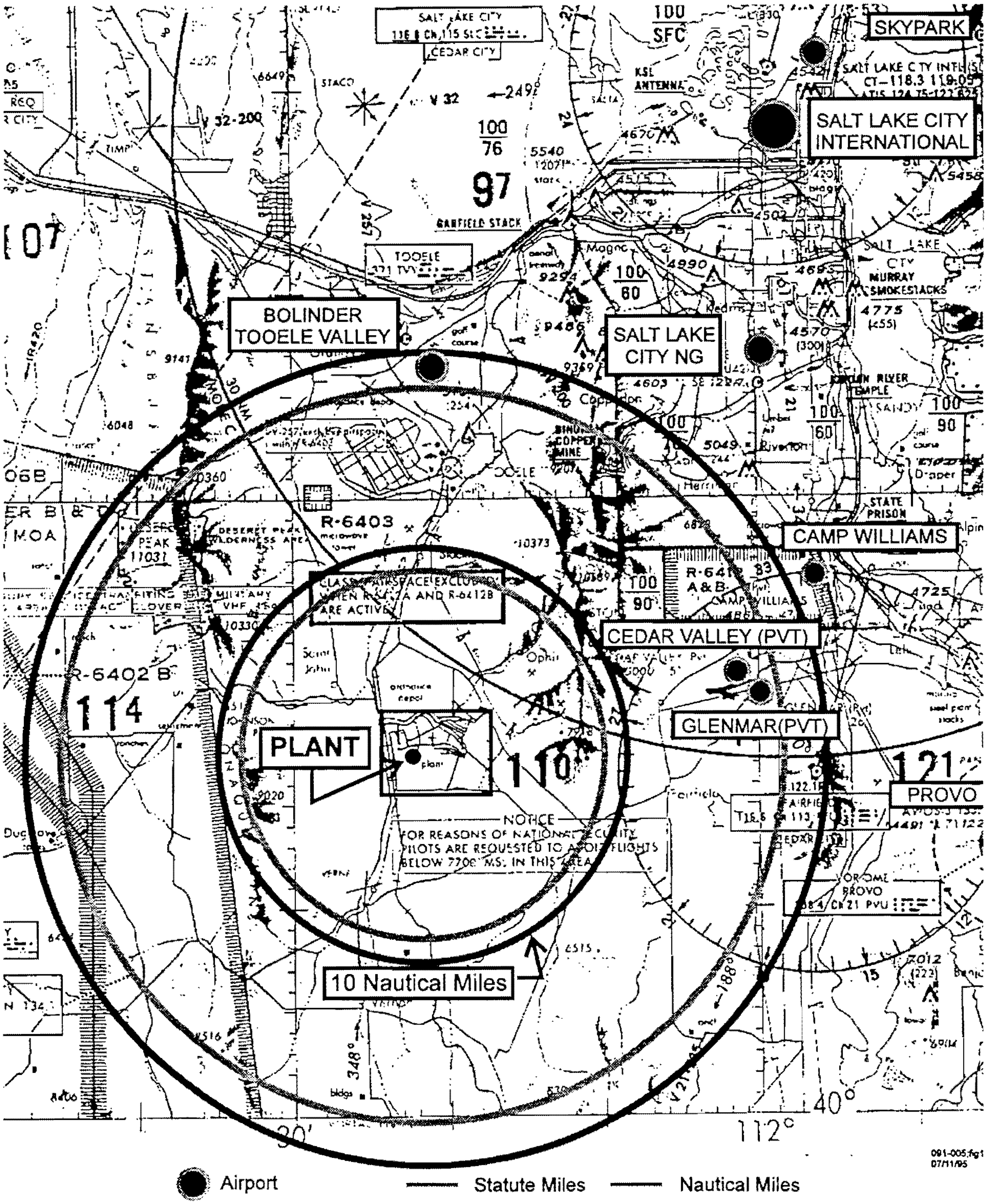


Figure 5-30. Survey of Aviation Activities in the Vicinity of TOCDF

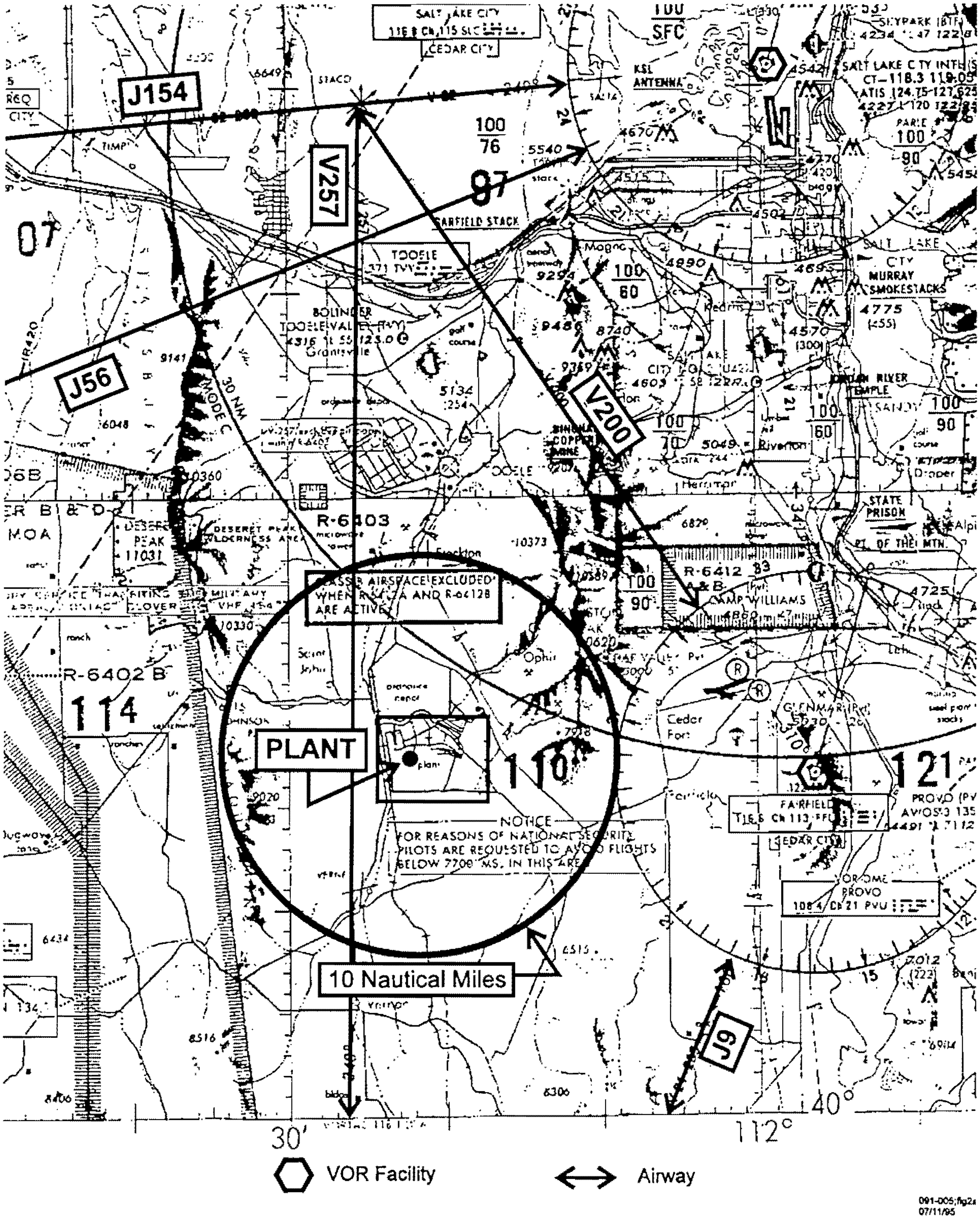


Figure 5-31. Survey of Airways in the Vicinity of TOCDF

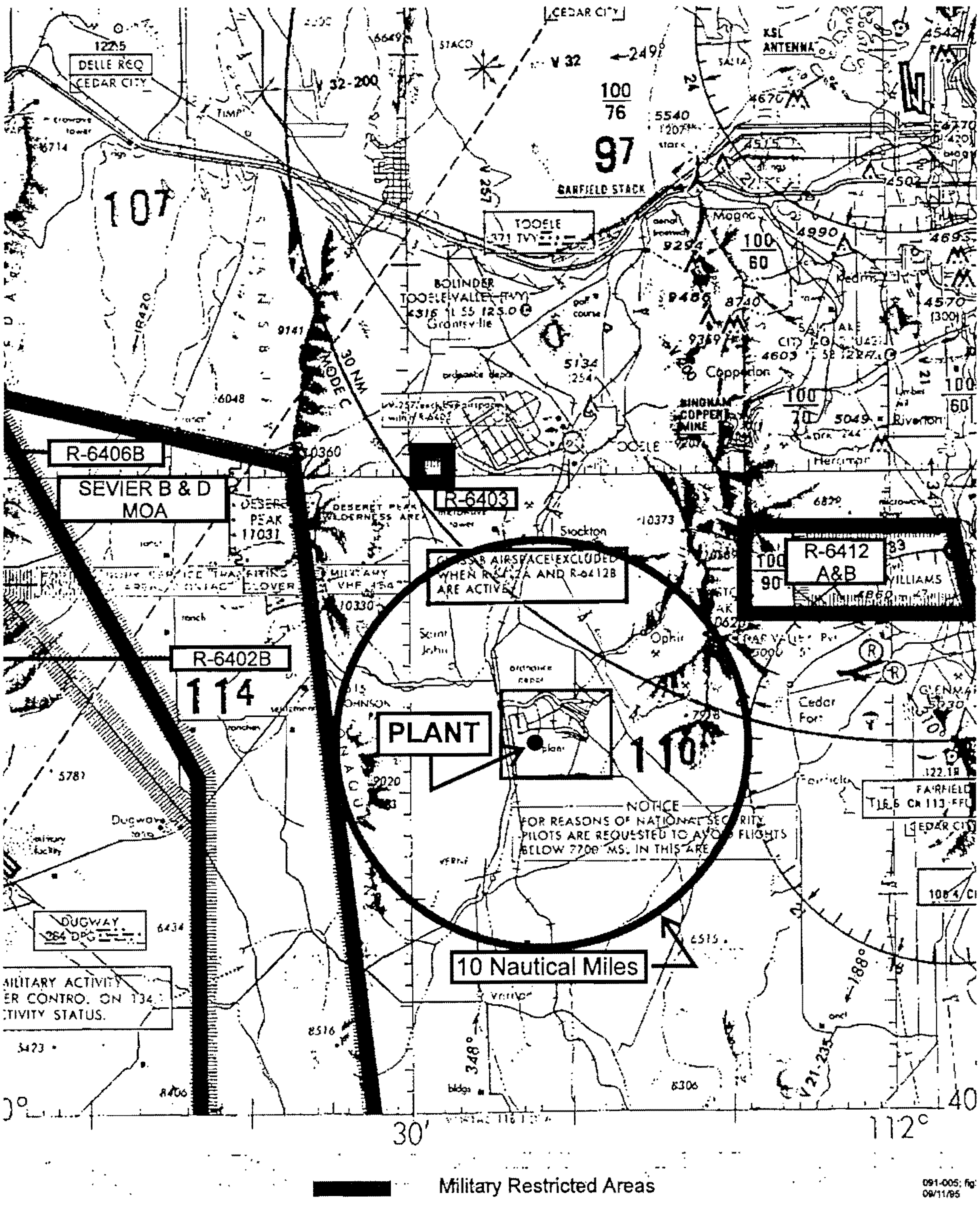


Figure 5-32. Survey of Military Restricted Areas in the Vicinity of TOCDF

criteria. The in-flight proximity criterion is failed in two ways: 1) a low-altitude federal airway, V257, has its nearest edge within 2 miles of the site, and 2) Salt Lake City International Airport standard instrument departure (SID) and standard arrival routes (STAR) direct aircraft near TOCDF (see figure 5-30). These activities required that a more detailed analysis be performed.

5.2.1.1 Calculation of Aircraft Crash Frequency per Unit Area. This section discusses the use of site-specific data for in-flight operations, takeoffs and landings, and special use airspaces to evaluate aircraft crash frequencies per unit area.

5.2.1.1.1 In-Flight Operations. Survey of a 10-nautical-mile radius around TOCDF identified one route: V257. V257 is a low-altitude instrument flight rule (IFR) route with a width of 12 nautical miles (13.8 miles). Its nearest edge passes 2 miles west of TOCDF (see figure 5-31).

Although holding patterns do not bring aircraft close to the facility, Salt Lake City International Airport SIDs and STARs direct aircraft through Rush Valley and, therefore, over the TOCDF site. Due to these flight patterns, the FAA representative from the Salt Lake City control tower estimated that 15 percent of the total instrument operations at Salt Lake City International Airport pass over the site.

Visual flight rule (VFR) traffic near TOCDF is limited by a notice to pilots appearing on the VFR sectional map indicating the aircraft should stay clear of DCD. Rather than assume that all VFR traffic maintains an adequate distance from the site, an estimate for VFR traffic is made based on the computer program developed as part of the DOE ACRAM study. The program was run with the latitude and longitude coordinates of the TOCDF to obtain the crash frequency per unit area per year for general aviation aircraft and helicopters. The split between medium (i.e., jets) and small (i.e., all others) general aviation aircraft was assumed to be 20 percent medium to 80 percent small.

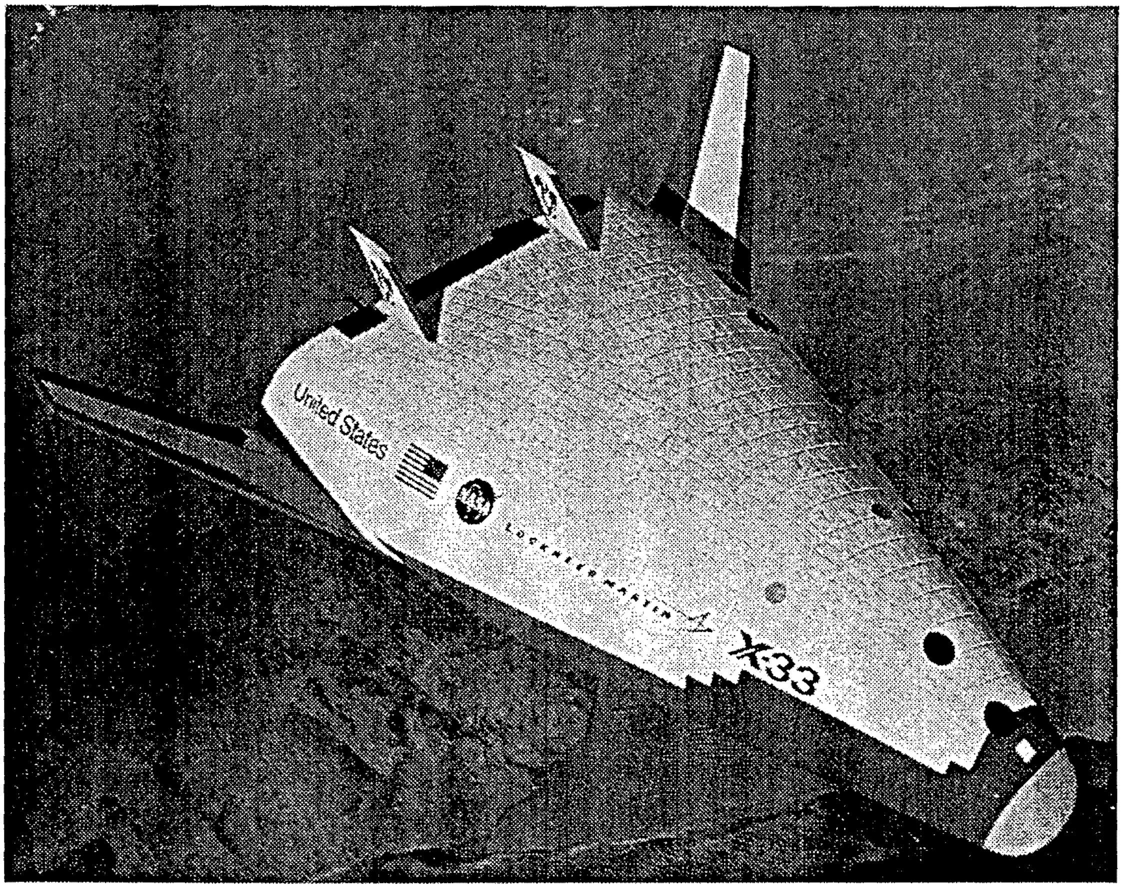
Aviation activity in the vicinity of the depot does not occur on well-defined airways. As a result, an equivalent airway width was defined. Aircraft flying under IFR on SIDs or

EXHIBIT 10

National Aeronautics and
Space Administration

X-33 Advanced Technology Demonstrator Vehicle Program

FINAL ENVIRONMENTAL IMPACT STATEMENT
Volume I



Prepared by:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

George C. Marshall Space Flight Center
Environmental Engineering and Management Office
Marshall Space Flight Center, AL 35812

and

John F. Kennedy Space Center
Environmental Program Office
Kennedy Space Center, FL 32899

September 1997

NP-1997-09-02-MSFC

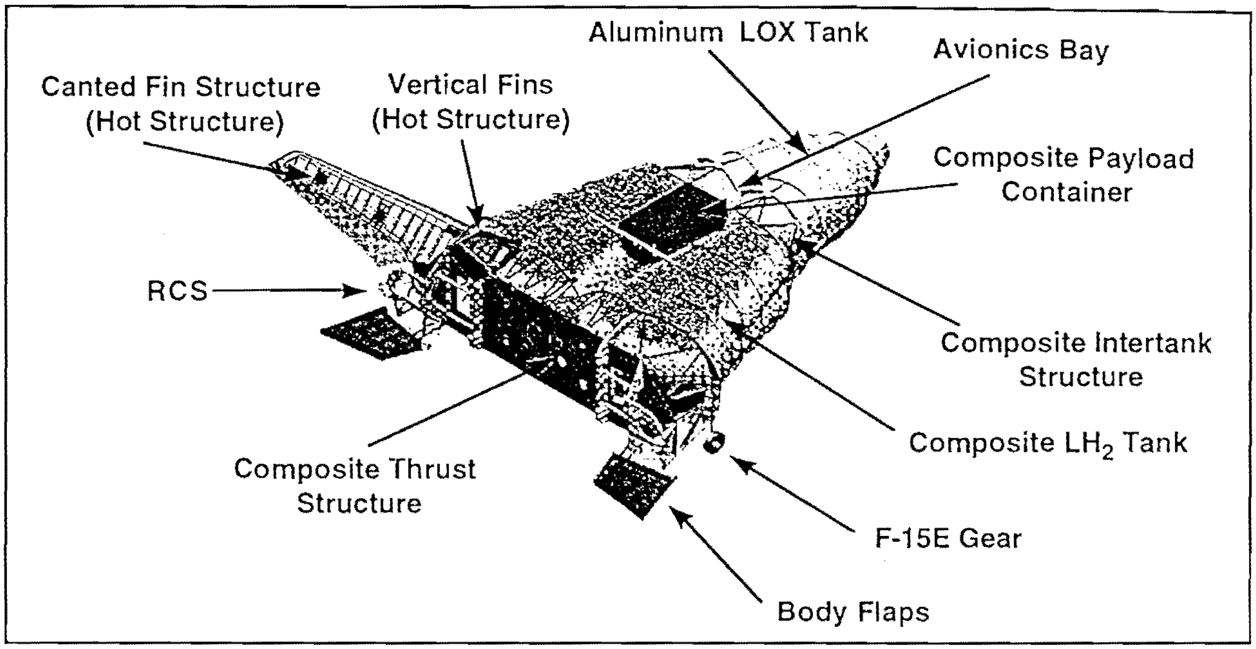


Figure 2-4. Internal Configuration of the X-33.

The spaceplane would use two linear J-2S aerospike engines made by Boeing North American Division and Rocketdyne, shown in Figure 2-5. Linear aerospike engines were developed in the 1970's and have been previously tested on the ground by firing them on engine test stands while secured to the stand and equipped with sensors to record performance and other vital data for the short- and mid-range flights. The main propulsion system (full system of engines and propellant tanks) consists of two J-2S aerospike engines, one aluminum LOX tank in the front, and two LH_2 tanks in the rear for short- and mid-range flights. The vehicle could sustain one engine out at liftoff and still have sufficient power from the remaining engine to continue acceleration and make a safe landing at the intended runway or an abort landing area depending on where the engine out occurred during flight. For the long- range flights an engine out situation could be tolerated approximately 30 seconds after liftoff.

The engine burns liquid hydrogen (LH_2) and liquid oxygen (LOX), releasing only water vapor into the atmosphere. All other fuel sources required to provide energy for onboard computers, the reaction control system, etc., depend on LH_2 and LOX, thereby greatly reducing the toxicity of fuel gases to those of normal, nontoxic constituents of the atmosphere. The engine does not require a "bell nozzle" to channel the hot gases of combustion for directional control of the vehicle. The hot gases expelled by the J-2S engine from the thrust cells would be directed in such a way that the atmosphere provides a natural channeling effect. Elimination of the bell nozzle provides significant weight and size reductions of the overall engine.

2.2.2.2 Alternative Mid-Range Landing Sites

Dugway Proving Ground, Utah

Dugway Proving Ground is located approximately 130 km (80 mi) southwest of Salt Lake City, Utah, near the town of Tooele. Dugway encompasses approximately 324,000 ha (800,000 ac) of the Great Salt Lake Desert. Dugway is part of the U.S. Army Test and Evaluation Command, headquartered at Aberdeen Proving Ground, Maryland.

The airfield within Dugway Proving Ground proposed for landing of the X-33 is called Michael Army Airfield. This airfield as shown in Figure 2-13 is situated on the eastern portion of Dugway. The airfield has a 3,960 m (13,000 ft) long by 61 m (200 ft) wide hard surfaced runway. Immediate surrounding terrain is relatively flat. It is a secure facility with a long history of flight operations. The airspace above Dugway is controlled by Hill Air Force Base which manages and approves use of the Utah Test and Training Range.

If use of Dugway is determined to not meet environmental and/or Program needs or suitability, test objectives for flying the X-33 to the long-range landing site will be modified, and all test flights except those to Silurian Lake or China Lake Naval Air Weapons Station will be conducted to the selected long-range landing site.

EXHIBIT 11

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of: PRIVATE FUEL STORAGE, LLC (Independent Spent Fuel Storage Installation)	Docket No. 72-22-ISFSI ASLBP No. 97-732-02-ISFSI

STATE OF UTAH)
) ss.
COUNTY OF SALT LAKE)

AFFIDAVIT OF BARRY J. SOLOMON

I, BARRY J. SOLOMON, being first duly sworn upon oath, depose and state as follows:

1. I am a Senior Geologist at the Utah Geological Survey (Division), Applied Geology Program, Utah Department of Natural Resources, and have worked at this Division since September, 1988. I earned a Bachelor of Arts degree in Geology in 1972, from University of California, Santa Barbara, and a Master of Science degree in Geology in 1979, from San Jose State University.

2. My duties at work have included the study of geologic hazards throughout Utah. I have studied the surficial geology and geologic hazards of Tooele Valley, with basin-and-range characteristics similar to those of Skull Valley and within 12 miles of the proposed independent spent fuel storage installation (ISFSI) site, and have

reviewed the geologic portions of a license application for a proposed site for the disposal of low-level radioactive waste near the Great Salt Lake Desert, also with basin-and-range characteristics similar to those of Skull Valley and within 15 miles of the proposed ISFSI site. My experience prior to employment with the Utah Geological Survey includes geologic characterization of two proposed nuclear power plant sites and a proposed site for the disposal of high-level radioactive waste. A copy of my resume is attached to this Affidavit.

3. I have evaluated the geologic and seismologic characteristics in the area of the proposed ISFSI site. I am familiar with Private Fuel Storage L.L.C.'s Safety Analysis Report (SAR) and Environmental Report (ER) in this proceeding. Specifically, I have reviewed ER Ch. 2 § 2.6 (Geology and Seismology), SAR Ch. 2 § 2.6 (Geology and Seismology), and related appendices of the SAR concerned with Geotechnical Data (Appendix 2A), Seismic Survey (Appendix 2B), Geomorphological Survey (Appendix 2C), Earthquake Ground Motions Analysis (Appendix 2D), and Analysis of Volcanic Ash (Appendix 2E). I am also familiar with NRC regulations and guidance documents related to geological and seismological characterization of nuclear-related facilities, including 10 CFR § 72.102 (characterization of geology and seismology as a licensing requirement for the independent storage of spent nuclear fuel and high-level radioactive waste); 10 CFR § 100, Appendix A (seismic and geologic siting criteria for nuclear power plants); NUREG-0800, parts 2.5.1, 2.5.2, and 2.5.3 (standard review plans for basic geologic and

seismic information, vibratory ground motion, and surface faulting); NUREG-1199, part 2.3 (standard format and content of the geology and seismology portions of a license application for a low-level radioactive waste disposal facility); and NUREG 1200, part 2.3 (standard review plan of the geology and seismology portions of a license application for a low-level radioactive waste disposal facility). I am also familiar with many scientific studies related to geological site characterization and geological hazard analysis applicable to the siting of nuclear-related facilities.

4. I assisted in the preparation of, and have reviewed, the State of Utah's Contention dealing with geotechnical issues. The technical facts presented in that contention are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

FURTHER AFFIANT SAYETH NOT.

DATED this November 21, 1997.

BARRY J. SOLOMON

Voluntarily signed and sworn to before me this 21st day of November, 1997, by the signer, whose identity is personally known to me or was proven to me on satisfactory evidence.

NOTARY PUBLIC

Residing at: SLC Utah
My Commission expires: 5-15-2001

BARRY J. SOLOMON
3435 Enchanted Hills Drive
Salt Lake City Utah 84121
Res: (801) 944-9545
Bus: (801) 537-3388
e-mail: nrugs.bsolomon@state.ut.us

BACKGROUND SUMMARY: Twenty-three years of successful development, implementation, and management of geologic studies for evaluation of geologic hazards and for site screening, selection, and characterization of hazardous and nuclear waste, construction, and mining projects to comply with governmental regulations.

EDUCATION: M.S., Geology, San Jose State University, 1979
B.A., Geology, University of California at Santa Barbara, 1972

ADDITIONAL COURSES, SEMINARS, AND TRAINING:
Geological Engineering
Geostatistics and Multivariate Analysis
Construction Management
Well Logging
Remote Sensing Techniques
Soils and Applied Geology
Quaternary Dating Methods
Reducing Radon in Structures

PUBLICATIONS: Forty-eight publications on geologic studies. Co-author of regulatory documents related to nuclear waste and site characterization, selection, and screening.

PROFESSIONAL ASSOCIATIONS:
Association of Engineering Geologists
(former Chairman, Utah Section)
Utah Geological Association (former Treasurer)
Geological Society of America
American Association of Petroleum Geologists
Northern California Geological Association (former Vice-President)

Registered Professional Geologist, State of Florida, No. PG0000318

EMPLOYMENT HISTORY:

UTAH GEOLOGICAL SURVEY, Salt Lake City, Utah (1988 to Present)

SENIOR GEOLOGIST. Responsible for assessment of geologic hazards within Utah. Directed program, under grant from EPA, to determine geologic causes of indoor-radon hazard. Devised system for regional screening of solid-waste landfill sites. Reviewed geotechnical data in license application for low-level radioactive waste site near Great Salt Lake Desert to ensure compliance with state and federal regulations. Managed team of geologists conducting detailed Quaternary stratigraphic, geomorphic, and geochronologic studies related to paleoseismicity, hazard evaluation, and facility siting; areas of study included Tooele Valley, Cache Valley, West Desert Hazardous Industry Area, and Springdale, Utah.

BATTELLE PROJECT MANAGEMENT DIVISION, Columbus, Ohio, and Hereford, Texas (1985 to 1988)

GEOTECHNICAL ADVISOR. Responsible for planning and direction of geotechnical surface-based site activities of the salt characterization program for siting of a high-level nuclear waste repository. Monitored the cost and technical status of geotechnical elements by preparing planning documents and work scopes.

BRECKINRIDGE MINERALS, INC., Salt Lake City, Utah (Southern Pacific Petroleum, Brisbane, Australia) (1980 to 1985)

SENIOR GEOLOGIST/PROJECT MANAGER. Directed all phases of exploration for oil-shale and tar-sand deposits in the United States and Canada; participated in oil-shale exploration program in Australia. Managed program of lease acquisition, and established field office. Comprehensive studies used mapping, core logging, geochemical analyses, and geophysical data to characterize potential mine sites.

U.S. GEOLOGICAL SURVEY, Menlo Park, California (1976 to 1980)

GEOLOGIST. Conducted resource evaluations and stratigraphic studies of minerals considered leasable by the U.S. Government. Provided recommendations to federal agencies regarding proper use of mineral resources on federal land.

FUGRO, INC., (now The Earth Technology Corporation), Long Beach, California (1973-1975)

ENGINEERING GEOLOGIST. Conducted engineering-geologic investigations of nuclear power plant sites in Arizona and Puerto Rico. Responsible for site mapping, logging of core and soil samples, and trenching to evaluate structure.

EXHIBIT 12

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of: PRIVATE FUEL STORAGE, LLC (Independent Spent Fuel Storage Installation)	Docket No. 72-22-ISFSI ASLBP No. 97-732-02-ISFSI

STATE OF UTAH)
) ss.
COUNTY OF SALT LAKE)

AFFIDAVIT OF DAVID B. COLE

I, DAVID B. COLE, being first duly sworn upon oath, depose and state as follows:

1. I am employed as Engineer Specialist IV at the Division of Water Resources (Division), Hydrology Section, Utah Department of Natural Resources, and have worked at this Division since November, 1971.

2. I earned a Bachelors of Science degree in Civil Engineering in 1976, from University of Utah and have been a licensed professional engineer since 1981.

3. I assisted in the preparation of, and have reviewed, the State of Utah's Contentions on flooding. The technical facts presented in those contentions are true and correct to the best of my knowledge, and the conclusions drawn from those facts are based on my best professional judgment.

4. My duties at work have included the calculation of probable maximum floods for the design of spillways. I have also written software to perform these calculations that is used by engineers in our Division and in the Division of Water Rights. Additionally, I have worked on flood studies for the Grantsville Reservoir, located in Tooele Valley with basin and range characteristics similar to those of Skull Valley and within 12 miles of the proposed ISFSI site, as well as other water supply studies.

5. I evaluated the surface runoff potential for probable maximum flood (PMF) in the area of the proposed independent spent fuel storage installation (ISFSI) site located in the center of Section 6, Township 5 South, Range 8 West, SLB&M, Tooele County, Utah. I also reviewed the Hydrology section (Chapter 2 at 2.5) of the Private Fuel Storage Facility Environmental Report (ER), the Surface Hydrology section (Chapter 2 at 2.4) of the Safety Analysis Report, and the applicant's calculation package relating to 100-year flood and probable maximum flood information.

6. The 26 square mile drainage area the applicant used to compute the PMF for what the ER calls Basin 1, which cuts across the access road east of the storage

facility (*see* SAR, figure 2.4-1), is far too small. Based on my experience and training and evaluation of United States Geological Survey 7.5 minute quadrangle sheets and other technical tools and reports, I have concluded a large drainage with an area of over 240 square miles will produce runoff that will cross the depression in the northeast part of Section 6, which otherwise is fairly flat east to west. Included in this large drainage are high canyons such as Indian Hickman and Deadman Canyon that drain the western slope of the Stansbury Mountains, canyons along the western slope of the Onaqui Mountains, the northern slope of the Sheeprock Mountains, the northeastern slope of the Davis Mountain, and much of the lower semi-arid land in the valley. *See* drainage map attached hereto as Attachment A. During wet years this drainage produces significant runoff which moves north toward the middle of the valley where it mixes with the discharge of numerous springs. Based on a 240 square mile drainage area, the 100- year flood has a peak more than twice the 2,065 cfs figure calculated by the applicant (*see* SAR at 2.4-11), and the probable maximum flood has a peak close to twice the 31,934 cfs figure calculated by the applicant (*see* SAR at 2.4-11). The access road and other structures designed for only half the expected flow of a 100-year flood would likely wash out as floodwaters impact the roadway culverts. Moreover, the retaining berms expected to protect the road and facility during the probable maximum flood may fail if they are under-designed.

7. I am aware of the conditions which have occurred in Skull Valley in much wetter than average years, such as the winter and spring of 1983-84, when the large depressions south of the access road filled with runoff, the ground became saturated, and most of Skull Valley produced runoff. The much wetter than normal conditions which would occur during a probable maximum flood event are expected to result in the depressions filling with runoff. The water produced from the southern end of Skull Valley could only drain through the depression near the northeast part of Section 6, the site of the proposed ISFSI.

8. In 1983 the Great Salt Lake started to rise sharply and peaked June 1, 1986, at an elevation of 4211.85 feet, which is the lake's historical high. This caused major flooding in some areas near the lake, including the loss of the Southern Pacific tracks which had been located on a causeway in the lake. The rail tracks on the southern shore of the lake were threatened with flooding on several occasions between 1983 and 1986 as the lake continued to rise.

9. The United States Geological Survey Timpie 7.5 minute quadrangle sheet shows the elevation of the underpass on Interstate 80 at Rowley Junction to be seven feet higher than the Great Salt Lake's historic high, and the elevations of the railroad north of Interstate 80 in the same vicinity to be between three and eight feet higher than the lake's historic high. Wind action on occasion has created

waves swamping areas near the shoreline, particularly in wetter than average years.

FURTHER AFFIANT SAYETH NOT.

DATED this November 21, 1997.

DAVID B. COLE

Voluntarily signed and sworn to before me this 21st day of November, 1997, by the signer, whose identity is personally known to me or was proven to me on satisfactory evidence.

NOTARY PUBLIC

Residing at: ____________

My Commission expires: ____________

EXHIBIT A

To Affidavit of David B. Cole

Drainage Area

Skull Valley Nuclear Waste Site

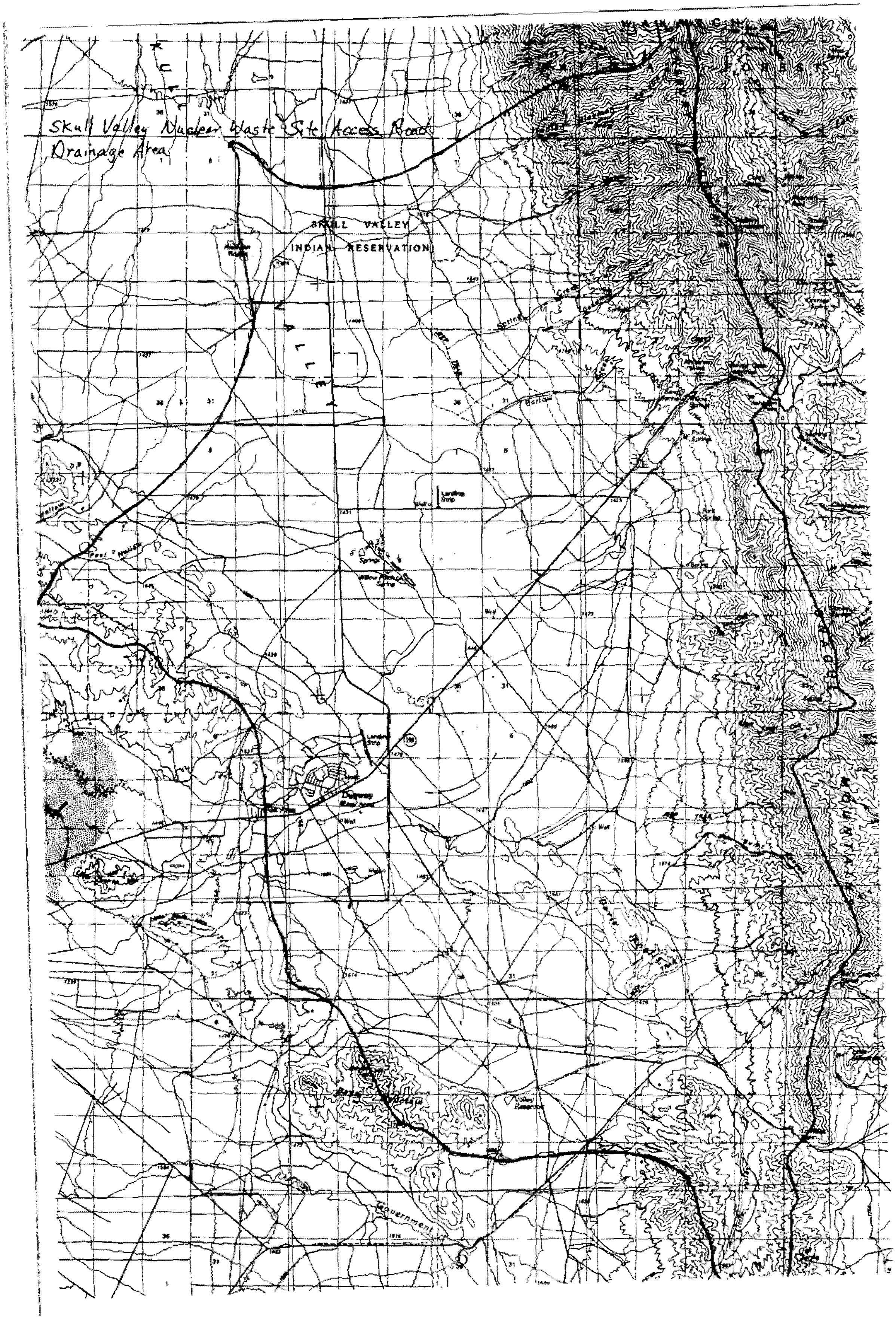
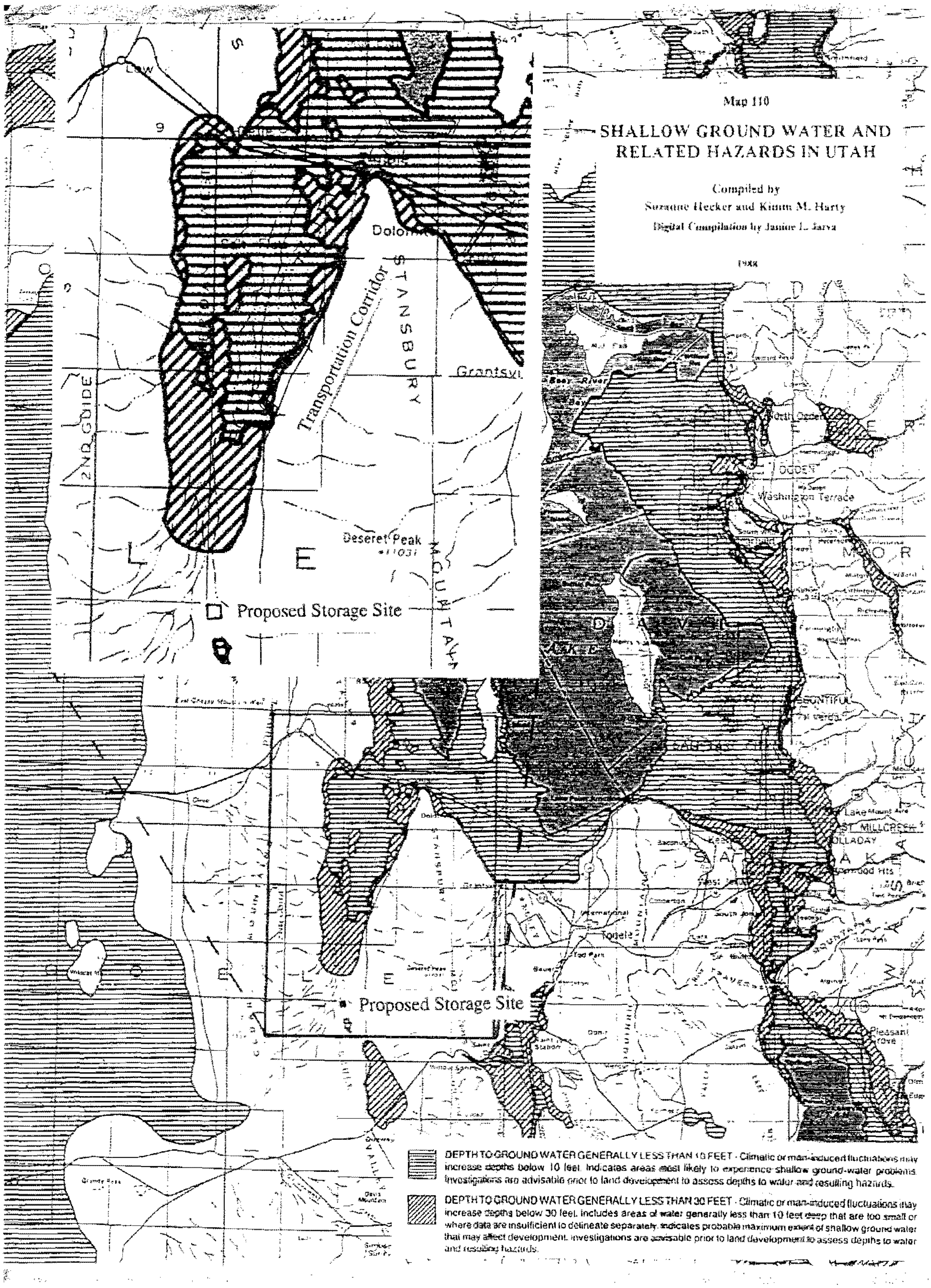

Skull Valley Nuclear Waste Site Access Road
Drainage Area
SKULL VALLEY
INDIAN RESERVATION
Government

EXHIBIT 13



Map 110
SHALLOW GROUND WATER AND RELATED HAZARDS IN UTAH
Compiled by
Suzanne Hecker and Kimm M. Harty
Digital Compilation by Janine L. Jarva
1998
Transportation Corridor
STANSBURY
Grantsville
Dolomite
2ND GUIDE
Deseret Peak
11031
Proposed Storage Site
MOUNTAINS
Proposed Storage Site
OGDEN
Washington Terrace
North Ogden
BOUNTIFUL
Tooele
Pleasant Grove
DEPTH TO GROUND WATER GENERALLY LESS THAN 10 FEET - Climatic or man-induced fluctuations may increase depths below 10 feet. Indicates areas most likely to experience shallow ground-water problems. Investigations are advisable prior to land development to assess depths to water and resulting hazards.
DEPTH TO GROUND WATER GENERALLY LESS THAN 30 FEET - Climatic or man-induced fluctuations may increase depths below 30 feet. Includes areas of water generally less than 10 feet deep that are too small or where data are insufficient to delineate separately. Indicates probable maximum extent of shallow ground water that may affect development. Investigations are advisable prior to land development to assess depths to water and resulting hazards.

EXHIBIT 14

Springs Within the Skull Valley Watershed (Hydrologic Unit Code 16020305)

Spring Name	LAT	LONG	Distance from proposed storage site (miles)	Surface Management Status
0 - 4.99 Mile Radius				
Lower S. Lost Ck. Spring	40.27.25	112.41.09	4.9	USFS
5 - 14.99 Mile Radius				
North Lost Ck. Spring	40.28.10	112.41.29	5.23	BLM
Unnamed Spring	40.28.25	112.41.28	5.32	BLM
Lower Spring Ck. Spring	40.21.47	112.40.10	5.63	BLM
Dry Canyon Spring	40.23.58	112.38.33	6.1	USFS
Upper S. Lost Ck. Spring	40.27.33	112.39.24	6.1	USFS
Lower Hickman Can. Spring	40.25.49	112.38.33	6.13	BLM
White Rock Spring	40.19.24	112.54.32	6.15	BLM
Middle Lost Ck. Spring	40.28.06	112.39.24	6.28	USFS
Upper Spring Ck. Spring	40.22.27	112.38.17	6.56	USFS
Antelope Canyon Spring	40.26.44	112.37.58	6.66	USFS
Middle Hickman Canyon Spring	40.25.45	112.37.42	6.72	USFS
Lower Spring Conyon Spring	40.29.26	112.39.51	6.78	BLM
Unnamed Spring (multiple)	40.17.43	112.43.29	6.84	BLM
Big Creek Canyon Spring	40.28.39	112.38.31	7.03	USFS
Upper Spring Canyon Spring	40.29.23	112.39.20	7.03	USFS
Middle Barlow Ck. Spring	40.21.56	112.37.50	7.09	USFS
Lower Barlow Ck. Spring	40.21.35	112.57.33	7.09	USFS
Upper Hickman Can. Spring	40.25.58	112.37.13	7.09	USFS
Upper Barlow Ck. Spring	40.22.14	112.37.34	7.18	USFS
Unnamed Spring	40.22.31	112.57.38	7.31	USFS
Lower Little Pole Can. Spring	40.31.09	112.41.31	7.31	BLM
Big Pole Canyon Spring	40.30.20	112.39.26	7.43	USFS
Willow Patch Spring	40.17.08	112.42.54	7.46	PRIVATE
Upper Spring	40.29.35	112.39.02	7.46	USFS
Middle Little Pole Can. Spring	40.31.20	112.40.45	7.53	BLM
Unamed Spring	40.21.27	112.37.10	7.71	BLM
Upper Little Pole Can. Spring	40.30.53	112.39.27	7.81	USFS
Lower Pass Canyon Spring	40.31.10	112.40.07	7.84	BLM
Chokecherry Spring	40.31.47	112.39.51	8.21	USFS
Multiple Springs	40.33.33	112.44.12	8.34	PRIVATE
Sand Spring	40.20.33	112.36.27	8.4	USFS
Upper Pass Canyon Spring	40.31.27	112.38.47	8.43	USFS
Willow Springs	40.20.23	112.38.20	8.58	USFS
Pack Springs	40.19.45	112.38.20	8.77	STATE
Eightmaile Spring	40.33.55	112.53.28	9.21	PRIVATE
Lower LIttle Granite Can. Spring	40.34.16	112.40.50	9.64	BLM
Park Springs	40.18.18	112.36.11	9.7	PRIVATE
Unnamed Spring	40.17.23	112.33.14	10.08	BLM
Upper LIttle Granite Can. Spring	40.33.43	112.37.42	10.45	USFS
Box Canyon Spring	40.34.19	112.38.38	10.51	USFS
Unnamed Spring	40.22.20	112.34.28	11.19	BLM
Horseshoe Springs	40.36.52	112.42.35	11.41	BLM

Broons Canyon Spring	40.36.08	112.37.26	12.32	USFS
Henry Springs	40.33.56	112.53.11	12.75	BLM
Muskrat Springs	40.38.23	112.41.33	12.88	PRIVATE
Dell Springs	40.15.08	112.33.21	13.06	BLM
Faust Canyon Spring	40.14.17	112.33.40	13.37	BLM
Redlam Springs	40.39.27	112.54.19	14.06	BLM
Burnt Springs	40.40.10	112.40.48	14.68	PRIVATE
15 - 30 Mile Radius				
Valley Reservoir	40.07.43	112.40.37	20.33	BLM

Source: USGS Rush Valley and Tooele 1:100,000 Topographic Maps, 1979

EXHIBIT 15

AMENDED AND RESTATED BUSINESS LEASE

between

SKULL VALLEY BAND OF GOSHUTE INDIANS,
a federally recognized Indian Tribe

and

PRIVATE FUEL STORAGE, L.L.C.,
a Delaware limited liability company

May 20, 1997

TABLE OF CONTENTS

EXHIBITS AND ATTACHMENT TO THE BUSINESS LEASE

CONFIDENTIAL AND PRIVILEGED

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS

Lease No. ____________________

Approved: ____________________

THIS AMENDED AND RESTATED BUSINESS LEASE, (this "**Lease**"), made and ·d into this 20th day of May, 1997, but effective for all purposes as of December 27, 1996, by ·tween the Skull Valley Band of Goshute Indians, a federally recognized Indian Tribe, as lessor B--d"); and the Private Fuel Storage, L.L.C., a Delaware limited liability company, as lessee, ts ..ccessors and assigns (the "**L.L.C.**"), in accordance with the provisions of the Act of st 9, 1955 (69 Stat. 539; 25 U.S.C. § 415), as amended, and as supplemented by the regulations .F.R. Part 162), which by reference are made a part hereof unless superseded by the terms and tions of this Lease. The Band and the L.L.C. may individually be referred to as a "**Party**" or :tively be referred to as "**Parties**" herein.

RECITALS

WHEREAS, the Band is a federally recognized Indian tribe possessed of all sovereign rs and rights pertaining thereto;

WHEREAS, the Band conducts its tribal business through a General Council comprised of :gible membership of the Band and an Executive Committee, a three-member governing body :d ' the General Council;

WHEREAS, the General Council authorized the Executive Committee to enter into iations for the building of an interim storage facility for spent nuclear fuel on the Skull Valley n Reservation in Tooele County in the State of Utah (the "**Reservation**") through General cil Resolution No. 94-02 dated February 19, 1994;

WHEREAS, the primary business purpose of the L.L.C. is to provide temporary storage of : Nuclear Fuel;

WHEREAS, to provide economic and employment benefits to the Band and to meet the for interim spent nuclear fuel storage, the Band and certain individual utility companies have zed the feasibility of the development, construction, financing, ownership and operation of a :e interim spent nuclear fuel storage facility (the "**Facility**") by the L.L.C., such Facility to be :d on a portion of the Reservation;

WHEREAS, the Band has authorized entry into this Lease through General Council Resolution No. 97-12A dated December 7, 1996 and Resolution Attachment No. 97-12A(1) dated December 12, 1996 and April 12, 1997 (collectively the "**Resolutions**");

NOW, THEREFORE, in consideration of the foregoing and the mutual promises contained herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties, intending to be legally bound, agree as follows:

SECTION 1. LEASE; LAND DESCRIPTION

A. **Facility Site**. For and in consideration of the rents, covenants and agreements hereinafter set out, the Band hereby leases and lets to the L.L.C. for the L.L.C.'s exclusive use and control the lands described and identified in **Exhibit "A"** attached hereto (the **"Facility Site"**) which Exhibit "A" is made a part hereof by reference, and all of which lands are located within the Reservation, in Tooele County, State of Utah, containing 820 acres, more or less. The L.L.C. shall have exclusive control and use of the Facility Site. The L.L.C. shall have the right to promptly remove any persons, equipment, or vehicles from the Facility Site. During the term of this Lease, no activities of any type may be undertaken on the Facility Site without the prior written consent of the L.L.C. The Parties agree that the L.L.C. will provide physical security for the Facility Site as necessary to comply with NRC regulations and the License or as the L.L.C. may otherwise deem necessary. This may include, without limitation, appropriate fencing.

B. **Easements and Rights-of-Way**. For and in consideration of the rents, covenants and agreements hereinafter set out, the Band hereby grants an exclusive easement and right-of-way to the L.L.C. to use the lands described and identified in **Exhibit "B"** attached hereto (the "**ROW's**"), which Exhibit "B" is made a part hereof by reference, and all of which lands are located within the Reservation, containing 202 acres, more or less, which lands shall be used for purposes of ingress and egress, highway, rail and other means of transportation, utility lines and facilities, water rights and similar purposes. The L.L.C. will appropriately fence routes of ingress and egress, including roadways and/or rail lines.

During the term of this Lease, the L.L.C. shall have the irrevocable option at a compensation amount to be agreed upon by the parties in good faith to lease or obtain a grant of additional easements and rights-of-way within the Reservation west of the Skull Valley Road which the L.L.C. shall deem necessary or appropriate for the development, construction, operation and decommissioning of the Facility, including, but not limited to, easements and rights-of-way for ingress and egress, roads and railroad spurs, other means of transportation, utility lines and facilities, water rights and similar purposes. The Band and the Secretary shall grant or consent to such easements or rights-of-way pursuant to applicable federal laws and regulations, including 25 U.S.C. § 415 and 25 C.F.R. Part 162 or 25 U.S.C. §§ 323 et seq. and 25 C.F.R. Part 169.

C. **Buffer Zone**. For and in consideration of the rents, covenants and agreements hereinafter set out, the Band hereby leases and lets unto the L.L.C. certain lands to constitute a buffer zone around the Facility Site, which shall include those lands described and identified on **Exhibit "C"** attached hereto, (the "**Buffer Zone**") and on the map attached hereto as **Exhibit "D"**, which exhibits are made a part hereof by reference, and all of which lands are located within the Reservation, in Tooele County, State of Utah, containing 3,020 acres, more or less, subject to any prior valid existing leases, easements, rights-of-way and other encumbrances and/or restrictions. All such valid existing leases, easements, rights-of-way and other encumbrances and/or restrictions are set forth on **Attachment I**. The Band and the L.L.C. hereby covenant and agree that only the land uses currently existing on the Buffer Zone will be permitted to continue during the term of this Lease unless another use is permitted by the prior written consent of both parties; **provided that**, the L.L.C. shall be allowed (i) to conduct, or have conducted, environmental, radiological, meteorological or other monitoring or sampling if required for the Project and (ii) to undertake all activities that may be required by the License, the NRC, or other applicable laws or governmental regulations and requirements. The Band hereby stipulates that the sole existing land use for the Buffer Zone is limited to livestock grazing, with the exception of that portion of "Parcel C" (as defined in the "Alliant Lease" as set forth on Attachment I) lying within Section 17, T5S, R8W; **provided, however,** that the uses of such Parcel "C" lands shall be limited solely to those uses and those parties set forth in the Alliant Lease and that such uses shall expire upon the termination of the Alliant Lease. The Band shall not conduct, or allow others to conduct, any activity within the Buffer Zone that may be considered by the L.L.C. to be incompatible with the L.L.C.'s use of the Facility. The Band and the L.L.C. shall ensure that no activity of any type is undertaken in the Buffer Zone without the express prior written consent of both Parties.

D. **Access Outside the Leased Premises**. The L.L.C., and its employees and agents, shall have the same rights of access as other members of the general public to areas of the Reservation not included within the Leased Premises. To the extent that permission for such access is required by the Band, the L.L.C., and its employees and agents, shall request the prior written approval of the Executive Committee, which approval shall not be unreasonably withheld; **provided, however**, that upon notice to the Band, the L.L.C. shall be allowed to conduct, or have conducted environmental, radiological, meteorological or other monitoring or sampling if required for the Project.

E. **Water Usage**. For and in consideration of the rents, covenants and agreements hereinafter set forth, the L.L.C. shall have the right to drill water wells on the Leased Premises to provide sufficient water capacity and quality necessary for the day-to-day operations of the Facility. Title to the water will remain in the Band. Water Usage will be limited to employee consumption and light industrial use; no water will be used for the storage process. Water developed and used will be subject to the Band's environmental regulations that govern the quality of the Reservation's existing water supply, including reservoir water and water from wells drilled by the Band or third parties on the Reservation. If sufficient capacity and quality of water cannot be recovered from the wells, the L.L.C. may, at its own expense, connect to the existing water supply on the Reservation.

If the L.L.C. connects to the Reservation water system, the L.L.C. shall supply an additional 20,000 gallon water tank, if needed and requested by the Band, and shall make such other improvements to the existing water system that would be necessary as agreed by the Band and the L.L.C. to provide the Band and the L.L.C. with the benefits of the 20,000 gallon water tank.

SECTION 2. DEFINITIONS

"Band" means the Skull Valley Band of the Goshute Indians, a federally recognized Indian Tribe as listed on 61 Fed. Reg. 58211 (Nov. 13, 1996).

"BIA" means the Bureau of Indian Affairs of the United States Department of Interior, or any other agency or instrumentality of the United States government which at any time in the future carries out the current functions of the Bureau of Indian Affairs, or any successor thereto.

"Commercial Operations Date" means the date on which Spent Nuclear Fuel is first physically accepted by the Facility for storage.

"Decommissioning Plan" means a plan developed by the L.L.C. and approved by the NRC for the safe removal of the Facility from service and the reduction of residual radioactivity to levels required by NRC for termination of the Facility's License.

"Department of Interior" means the United States Department of Interior, an agency of the government of the United States, or any other agency or instrumentality of the United States government which at any time in the future carries out the current functions of the United States Department of Interior, or any successor thereto.

"DOE" means the United States Department of Energy, an agency of the government of the United States, or any other agency or instrumentality of the United States government which at any time in the future carries out the current functions of the United States Department of Energy, or any successor thereto.

"DOE Facility" means a permanent repository or interim storage facility, owned by, under the control of, or with capacity contracted to the DOE or other government agency that can accommodate some or all of the Spent Nuclear Fuel which is owned by or otherwise under the control of the members of the L.L.C.

"Executive Committee" means the three member governing body elected by the General Council to conduct the day-to-day business of the Band, consisting of a Chairman, Vice-Chairman and Secretary.

"Facility" means the private, interim, Spent Nuclear Fuel storage facility which will be developed, constructed, owned and operated by the L.L.C. on the Leased Premises.

"Facility Site" means the 820 acres, more or less, described on Exhibit "A" upon which the Facility, supporting structures, and any improvements will be constructed and operated.

"General Council" means the entire adult membership of the Band.

"Goshute Tribal Courts" means all of the courts of the Band, whether traditional or otherwise, currently validly existing or validly established hereafter.

"Governmental Authority" means any national, state, local or tribal governmental authority or any subdivision thereof.

"Lease Payments" means all of the payments payable to the Band by the L.L.C. as further set forth in Section 5.

"Leased Premises" shall include all lands leased hereunder, including without limitation the Facility Site, the ROW's and the Buffer Zone.

"License" means a license from the NRC permitting the Facility to be constructed, owned and operated for the purpose of storing Spent Nuclear Fuel, including any technical specifications and amendment thereto.

"L.L.C." means the Private Fuel Storage, L.L.C., a limited liability company, organized and existing under the laws of the State of Delaware, and its successors and assigns.

"NEPA" means the National Environmental Policy Act of 1969.

"NRC" means the United States Nuclear Regulatory Commission, an instrumentality of the United States, or any successor thereto.

"Operating Expenses" has the meaning set forth in subparagraph G. of Section 5.

"Pre-Operational Exclusivity Fee" has the meaning set forth in Section 5.

"Profit" has the meaning as set forth in subparagraph G. of Section 5.

"Project" means the development, financing, construction, ownership, operation, and decommissioning of the Facility and its supporting structures.

"Reservation" means the Skull Valley Indian Reservation in Tooele County, in the State of Utah.

"Secretary" shall mean the Secretary of the Interior, or his authorized representative acting pursuant to delegated authority, or successor.

"Secretary Approval" means the written approval and consent of this Lease by the Secretary, including without limitation the conditional approval of the Secretary pursuant to Section 4.

"Spent Nuclear Fuel" means fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing, the non-fuel components directly associated with such fuel which can be stored with the fuel assemblies, and any other components which the DOE Facility will accept.

SECTION 3. PURPOSE OF THIS LEASE

The L.L.C. shall develop, construct, own and operate the Facility and supporting structures to service the Facility, all of which shall be located on the Leased Premises. The Parties agree that the Facility shall be designed for a capacity of 40,000 metric tons, provided that a greater capacity shall be permitted if licensed by the NRC and approved by the Band. The L.L.C. shall not be required to commence any construction of the Facility or supporting structures prior to the issuance of the License.

SECTION 4. TERM

A. Initial Term; Irrevocable Option Renewal Term. Unless terminated earlier in accordance with Section 4.C. below, the initial term of this Lease shall be for a period of twenty-five (25) years (the "**Initial Term**"); **provided, however**, that the L.L.C. shall have and the Band hereby grants to the L.L.C. an irrevocable option to extend the term of this Lease for a separate, additional period of twenty-five (25) years (the "**Renewal Term**") with no further consent or approval required from the Band, the General Council, the Executive Committee, any other Tribal agency or entity or the Secretary. The Renewal Term shall be irrevocably exercisable by the L.L.C. giving written notice to the Band and the Secretary of its exercise of the same not less than one (1) year prior to the expiration of the Initial Term. The Renewal Term shall begin immediately upon the expiration of the Initial Term and shall be upon the terms and conditions, including compensation, set forth herein. The term of this Lease shall commence, and this Lease shall be effective for all purposes, upon the date this Lease is approved by the Secretary, including, without limitation, the conditional approval of the Secretary as set forth below.

In the event that the terms and conditions of this Lease have been agreed upon by the Band and the L.L.C. (as evidenced by their execution of this Lease) and the Secretary is prepared to approve this Lease but for the completion of the environmental analysis under the National Environmental Policy Act ("**NEPA**"), then the Secretary will conditionally approve this Lease subject only to the following conditions, and the L.L.C. may not commence construction of the Facility under this Lease unless and until such conditions are met:

(i) The NRC and BIA complete the environmental analysis required under NEPA;

(ii) This Lease is modified to incorporate mitigation measures identified in the record of decision, if any;

(iii) The Environmental Impact Statement is issued; and

(iv) The License is issued.

Upon the satisfaction of these conditions, the Secretary shall certify within 30 days that the conditions set forth in (i) through (iv) above are satisfied and shall authorize the L.L.C. to take possession and commence operations.

B. **<u>Cooperation</u>**. The Band shall cooperate with the L.L.C. in obtaining any additional approvals or consents as may be required in connection with the Project, including, without limitation, any of which may be required to be obtained from the General Council, the Executive Committee, the NRC, the Department of Interior or the DOE.

C. **<u>Termination of Lease</u>**. Unless otherwise earlier terminated in accordance with the provisions set forth in Section 4.C.(1) and (2) below, this Lease shall terminate on the date of the NRC's termination of the License following completion of the final decommissioning of the Facility in accordance with the Decommissioning Plan, or the expiration of the Renewal Term; whichever is the earlier (the "**Termination Date**").

(3) **Effectiveness of Termination**. If a termination notice is given by a Party in accordance with the provisions of Section 4.C.(1), such termination shall become effective upon the effective date of termination stated in such notice, which date shall be no earlier than 45 days and no later than 360 days after the event giving rise to such termination notice. If this Lease is terminated pursuant to Section 4.C.(2), it will terminate upon the final termination of the License. If this Lease is so terminated, it will become null and void, and there will be no liability or obligation on the part of any Party (or any of its officers, directors, employees, agents or other representatives or affiliates) to the other Parties from and after the effective date of termination, including without limitation any obligation to make the payments specified in Section 5 which accrue after such termination date, except that the provisions of Sections 8, 14, 27, 32, 35 and 36 C, F, and H will survive and continue to apply following any such termination.

SECTION 5. LEASE PAYMENTS

Payments set forth in Section 5.B through 5.E shall increase by an amount negotiated in good faith by the Band and the L.L.C.

I. **Payments**. All payments will be considered to be made when the check is placed in the United States Mail, postage prepaid, or the funds have been wire-transferred.

SECTION 6. PAYMENT OF RENTS/INTEREST

The pre-operational payments set forth in Section 5.A.(1) and 5.A.(2) shall be paid to the Band without prior notice or demand. All other payments hereunder shall be paid to the Band through the Secretary unless direct payments are authorized by the Secretary. Past due rental payments received more than thirty (30) days after the due date shall bear interest at the rate of [redacted] (whichever is the greater) per annum from the due date until paid. This provision shall not be construed to relieve the L.L.C. from its obligation to make timely rental payments or to deny the Band any rights or remedies for a material breach.

SECTION 7. L.L.C. RESPONSIBLE FOR DEVELOPMENT AND DECOMMISSIONING

A. **Development and Improvement**. The L.L.C. agrees that construction of all Facility buildings, supporting structures and improvements will be completed at the sole cost and expense of the L.L.C. or its designees or licensees and that neither the Band, the Secretary nor the Band's interest in the Leased Premises shall be responsible for or subject to acts or expenses of the L.L.C. relating to the construction of buildings and improvements on the Leased Premises. Unless otherwise provided herein, upon the termination or expiration of this Lease in accordance with the provisions herein, it is understood and agreed that any buildings or other improvements shall become the property of the Band or, at the option of the Band, will be removed by the L.L.C. at its expense.

B. **Radiological Decommissioning**. On termination of operations, the L.L.C. shall radiologically decommission the Facility and supporting structures in accordance with the Decommissioning Plan as approved by the NRC and take steps to secure the termination of the License.

C. **Non-Radiological Decommissioning**. At the option of the Band, non-radiological decommissioning and restoration of the Facility are expected to include the removal of structures and reasonably returning the land to its original condition.

D. **Decommissioning Plan**. The Decommissioning Plan shall contain the funding plan to provide financial assurance for decommissioning under 10 C.F.R. § 72.30, shall comply with the requirements of 10 C.F.R. § 72.22 and § 72.54, and shall further meet all other requirements under applicable federal regulations.

SECTION 8. REMOVAL OF IMPROVEMENTS

Subject to the provisions of Section 7 hereof, removable personal property and trade fixtures of the L.L.C. on the Leased Premises may be removed. The term "removable personal property and trade fixtures" as used in this Section shall not include property which normally would be attached or affixed to the buildings, improvements, or land in such a way that it would become a part of the realty, regardless of whether such property is in fact so placed in, or on, or affixed to the buildings, improvements, or land in such a way as to legally retain the characteristics of personal property. Removable personal property and trade fixtures may be removed by the L.L.C. at any time during the term of this Lease or within ninety (90) days after termination or expiration of this Lease or within such other reasonable time after the termination of this Lease as may be agreed upon between the Band and the L.L.C. If the L.L.C. fails to remove the same within ninety (90) days after termination or expiration of this Lease, or such other reasonable time as agreed upon, said fixtures and property shall be deemed abandoned and shall become the property of the Band.

SECTION 9. INSURANCE

A. Nuclear Liability Insurance. Prior to the Commercial Operations Date, the L.L.C. shall obtain a commercially reasonable amount of nuclear liability insurance. The L.L.C. shall provide copies of all such coverage to the Band and the Secretary.

B. Workers' Compensation. The L.L.C. shall comply with all applicable State of Utah workers' compensation laws and shall maintain workers' compensation insurance in the same manner and to the same extent as any enterprise or business authorized to do business on the Reservation or in the State of Utah; **provided, however**, that if workers' compensation covers any claim, the L.L.C. shall have no further liability with respect to the same claim. The L.L.C. shall ensure that all contractors for the Facility maintain workers' compensation insurance in the same manner and to the same extent as any enterprise or business authorized to do business on the Reservation or in the State of Utah. The L.L.C. shall provide copies of all such workers' compensation coverage to the Band.

C. Other Insurance. The L.L.C. shall maintain all other insurance required by any applicable federal or state law or regulation, including without limitation any NRC regulation, and shall maintain other insurance which the L.L.C. deems necessary or appropriate, including, but not limited to, fire and damage insurance, primary comprehensive general and automobile liability, contractual liability insurance, general errors and omissions insurance, directors and officers insurance and business interruption insurance.

D. Contractor's Insurance. The L.L.C. shall require all contractors and subcontractors to maintain all insurance coverages required by law or regulation and to maintain any other insurance of the types and in the amounts normally maintained by similar businesses in such contractor's field.

E. Co-Insureds. To the extent possible and commercially practicable, the L.L.C. shall cause each insurance policy maintained pursuant to this Section 9, other than subsection 9.B, to list the Band, the United States, and each of the members of the L.L.C. as additional insureds.

SECTION 10. SURETY BOND

The Band and the Secretary waive any obligation of the L.L.C. to post a surety bond; provided that at any time during the term of this Lease, the Secretary may, only upon the L.L.C.'s failure to pay the Lease Payments in accordance with the provisions of Section 5 hereof, require the L.L.C. to post a bond satisfactory to the Secretary in a penal sum of not less than the preceding quarter's prorated share of the Annual Rental, which bond shall be deposited with the Secretary. Any other type of security which may be offered by the L.L.C. to satisfy the requirement of this Section will be given reasonable consideration by the Secretary, but it is agreed that acceptance of other security shall be at the sole reasonable discretion of the Band and the Secretary. It is agreed that the bond required by this Section will guarantee payment of the Lease Payments only, and then for only such portion of the Lease Payments which are expressly covered by the bond.

SECTION 11. SUBLEASE, ASSIGNMENT, TRANSFER

Except as otherwise provided in this Section 11, the L.L.C. shall not assign or transfer any right to or interest in this Lease without the written consent of the Band and the Secretary, with the exception of encumbrances as provided in Section 15 hereof. No such assignment or transfer shall be valid or binding without said consent and approval and then only upon the condition that the assignee has agreed in writing that in the event of conflict between the provisions of this Lease and of said assignment, the provisions of this Lease shall prevail. Notwithstanding the foregoing provisions, upon notice to the Band and the Secretary, and proof that all insurance policies are continuing, the L.L.C. shall have the right to assign this Lease to any entity wholly owned by the L.L.C., with no further approval required from the Secretary or the Band; **provided, however,** that the assignee shall agree in writing to be bound by all the terms and conditions of this Lease. The term of any assignment shall not exceed the term of this Lease and any extensions hereof. Any assignment made, except as provided in this Section, shall be deemed a breach of this Lease, and shall be null and void and of no force and effect.

SECTION 12. UTILITY FACILITIES

The L.L.C. shall have the right to enter into agreements with public and private utility companies, the Band, the State of Utah or any of the state's political subdivisions to provide utility services necessary for the full development and enjoyment of the Leased Premises in accordance with this Lease. Upon entering into any such agreement, the L.L.C. shall furnish the Band and the Secretary with executed copies thereof together with a plat or diagram showing the true location of

the utility lines and facilities to be constructed. The L.L.C. shall be responsible for contracting for solid waste removal from the Facility Site.

SECTION 13. QUIET ENJOYMENT

The Parties and the Secretary acknowledge that it is their intent that the L.L.C. shall have quiet enjoyment of the Leased Premises and the Facility throughout the term of this Lease, and that the L.L.C. and its employees, contractors, vendors, agents, designees, assigns and representatives, and all persons who need access to the Leased Premises to provide emergency and security services, shall have uninterrupted access to the Leased Premises and the Facility at all times.

SECTION 14. ACCESS BY NRC

The Band and the L.L.C. hereby covenant and agree that they will in no way restrict the access by the NRC or its contractors to the Leased Premises or Facility at any time.

SECTION 15. ENCUMBRANCE

This Lease, or any right to or interest in this Lease, or any of the improvements on the Leased Premises, may be encumbered by the L.L.C. with no further approvals required from the Band or the Secretary; **provided, however, that** an encumbrance shall be permitted only in connection with obtaining financing for the development or construction of the Facility or structures on the Facility Site and/or improvement of the Leased Premises and shall be confined to the leasehold interest of the L.L.C. and improvements thereon; **provided, further**, that any such encumbrance shall terminate upon full repayment of such financing, which is expected to occur prior to the termination of this Lease.

The L.L.C. agrees to furnish the Band and the Secretary, upon written request, any specific information regarding the status of the encumbrance at any time during the term of this Lease. The Band and the Secretary hereby consent to such encumbrances subject to the terms and conditions of this Section. Neither the Band nor the Secretary shall have the right to encumber the Leased Premises or the Facility.

SECTION 16. DEFAULT

A. Breach by the L.L.C.

(1) **Prior to the Commercial Operations Date.** In the event of a material default or breach by the L.L.C. of any of the material terms and provisions

of this Lease prior to the Commercial Operations Date, the Band and the Secretary shall give notice to the L.L.C. citing such default and allow the L.L.C. ninety (90) days from receipt of said notice to correct the alleged default: **provided, however**, that in the event of a default or breach by the L.L.C. of any term or provision of this Lease requiring the payment of money by the L.L.C. to the Band, the period of time to correct the alleged default shall be thirty (30) days. In the event that said alleged default is not corrected within said ninety (90) days (or said thirty (30) days for payments by the L.L.C. to the Band), the Band and the Secretary shall give notice to the L.L.C. of the failure of the L.L.C. to correct the alleged default and shall specify that the L.L.C. has ten (10) days from receipt of said notice to correct the alleged default or to show cause why this Lease should not be canceled. The Band and the Secretary may grant a reasonable extension of time if the L.L.C. so requests.

If the default has not been corrected and the L.L.C. fails to show cause to the satisfaction of the Band and the Secretary why this Lease should not be canceled, the Secretary may terminate this Lease by written notice of cancellation, and the L.L.C. shall quit and surrender the Leased Premises to the Band. The Band and the Secretary may proceed by suit or otherwise to enforce collection of any funds then owed by the L.L.C. which were incurred and payable prior to such cancellation notice. The L.L.C. shall have the right of appeal pursuant to 25 C.F.R. Part 2.

(2) **Subsequent to the Commercial Operations Date.** In the event of a material default or breach by the L.L.C. of any of the material terms and provisions of this Lease subsequent to the Commercial Operations Date, this Lease shall not be subject to immediate termination, but the Band and the Secretary shall instead be limited to (i) an action for monetary damages or (ii) petitioning the NRC for relief, including without limitation, the decommissioning of the Facility, or (iii) otherwise to enforce all of its rights pursuant to this Lease by any and all actions at law and/or in equity, excluding termination.

In the event of a material default by the L.L.C. of any of the material terms and provisions of this Lease subsequent to the Commercial Operations Date, the Band or Secretary shall give notice to the L.L.C., citing such default and allow the L.L.C. ninety (90) days from receipt of said notice to correct the alleged default; **provided, however**, that in the event of a default or breach by the L.L.C. of any term or provision of this Lease requiring the payment of money by the L.L.C. to the Band, the period of time to correct the alleged default shall be thirty (30) days. In the event that said alleged default is not corrected within said ninety (90) days (or said thirty (30) days for payments by the L.L.C. to the Band), the Band or Secretary shall give notice to the L.L.C. of the failure of the L.L.C. to correct the alleged default and shall specify that the L.L.C. has ten (10) days from receipt of said notice

to correct the alleged default or to show cause why the Secretary should not bring an action for damages against the L.L.C. or to petition the NRC for relief. The Band or the Secretary may grant a reasonable extension of time if the L.L.C. so requests. The L.L.C. shall have the right of appeal pursuant to 25 C.F.R. Part 2.

B. Breach by the Band.

(1) Prior to the Commercial Operations Date. In the event of a material default or breach by the Band of any of the terms and provisions of this Lease prior to the Commercial Operations Date, the L.L.C. shall give notice to the Band and the Secretary citing such default and allow the Band ninety (90) days from receipt of said notice to correct the alleged default. In the event that said alleged default is not corrected within said ninety (90) days, the L.L.C. shall give notice to the Band and the Secretary of the failure of the Band to correct the alleged default and shall specify that the Band has ten (10) days from receipt of said notice to correct the alleged default or to show cause why this Lease should not be canceled. The L.L.C. may grant a reasonable extension of time if the Band so requests.

If the default has not been corrected and the Band fails to show cause to the satisfaction of the L.L.C. why this Lease should not be canceled, the L.L.C. may terminate this Lease by written notice of cancellation, and may quit and release the Leased Premises to the Band, with no further obligations, payment or otherwise, under this Lease, from the date of default or breach.

(2) Subsequent to the Commercial Operations Date. In the event of any material breach by the Band of any of the terms and provisions of this Lease subsequent to the Commercial Operations Date, the L.L.C. shall also have the right to declare the Band in default of any of the terms and provisions of this Lease pursuant to the provisions of this Section and to enforce all of its rights pursuant to this Lease by any and all actions at law and/or in equity.

SECTION 17. OBLIGATIONS OF THE L.L.C. AND THE BAND

A. Change of Name or Structure. The L.L.C. shall furnish the Band and the Secretary documentary evidence of any change in name or structure of its organization within thirty (30) days after such change. The L.L.C. shall also keep the Band and the Secretary informed of any change of person and/or persons authorized to represent the L.L.C. and execute documents on behalf of the L.L.C. and shall furnish the Band and the Secretary documentary evidence of such change in authority within thirty (30) days after any such change.

B. Taxes and Regulations. [redacted]

C. **Further Covenants**. The Band hereby covenants and agrees that it shall use its sovereign nation status to support and promote this Lease and the Project, including but not limited to the passage of applicable land use, zoning, environmental and other laws, as necessary, to support and implement this Lease and the Project. The Band shall assist the L.L.C. in obtaining all required permits, licenses and approvals necessary for this Lease and the Project. The Band shall not, at any time, pass any law, rule or regulation which could adversely affect or burden this Lease or the Project, directly or indirectly, including any activity or action directly or indirectly related to this Lease or the Project, or any law, rule or regulation establishing land use, zoning, environmental regulation or other prohibition or land status which adversely affects or burdens the Project, unless and to the extent required by federal law.

The L.L.C. and the Band further covenant and agree that each will cooperate in emergency planning, environmental mitigation and public disclosure. All notices to third parties and other publicity concerning the transactions contemplated by this Lease shall be jointly planned and coordinated by and between the L.L.C. and the Band; **provided, however**, that this restriction shall not extend (i) to the Band as it may be necessary to respond to the BIA or (ii) to the L.L.C. in its discussions or negotiations with prospective members, lenders, customers, vendors, other service providers or as may be necessary in connection with the filing of the License or to respond to any governmental agency or court or any regulator of any members of the L.L.C.

D. **Employment Preferences**. The L.L.C. shall take all reasonable steps to employ the following classes of persons in the following order of priority for all positions (including skilled,

technical and management positions) for which they are qualified based upon their training and/or experience: **First**, members of the Band; **second**, children of members of the Band; and **third**, members of other federally recognized Native American Indian Tribes; provided that the foregoing employment preferences shall be valid only to the extent that they are in compliance with federal law.

E. Fire Fighting Capability. The Parties shall cooperate to insure integration of fire fighting resources and capability in accordance with the License and to insure that grass fires originating off the Facility Site are contained. The Facility staff will not be drawn below its minimums to be specified in the License.

SECTION 18. PAYMENTS AND NOTICES

All payments, notices, demands, requests, or other communications which may be or are required to be given, served, or sent by any party to any other party pursuant to this Lease shall be in writing and shall be mailed by first-class, registered or certified mail, return receipt requested, postage prepaid, or transmitted by hand delivery (including delivery by courier), telegram, facsimile transmission, addressed as follows:

(1) If to the L.L.C.:

Private Fuel Storage, L.L.C.
c/o Genoa Fuel Tech, Inc.
3200 East Avenue
LaCrosse, Wisconsin 54602
Attention: John D. Parkyn
Telephone: (608) 787-1236
Telecopy: (608) 787-1462

with copies (which shall not constitute notice) to:

Hogan & Hartson L.L.P.
555 Thirteenth Street, N.W.
Washington, D.C. 20004-1109
Attention: Claudette M. Christian
Telephone: (202) 637-5650
Telecopy: (202) 637-5910

and

Hall, Estill, Hardwick, Gable,
Golden & Nelson, P.C.
320 South Boston Avenue, Suite 400
Tulsa, Oklahoma 74103-3708
Attention: Margaret A. Swimmer
Telephone: (918) 594-0426
Telecopy: (918) 594-0505

(2) If to the Band:

Skull Valley Band of Goshute Indians
c/o Tapai Project Office
2480 S. Main, Suite 110
Salt Lake City, Utah 84115
Attention: Beverly Slack
Telephone: (801) 474-0535
Telecopy: (801) 474-0534

with copies (which shall not constitute notice) to:

Leon D. Bear, Chairman
P. O. Box 150
Grantsville, Utah 84029
Telephone: [redacted]
Telecopy: [redacted]

(3) If to the Secretary:

Secretary of Interior,
Bureau of Indian Affairs
Uintah and Ouray Agency Superintendent
P. O. Box 130
Fort Duchesne, Utah 84026
Attention: David L. Allison, Superintendent
Telephone: (801) 722-4300
Telecopy: (801) 722-2323

Each Party may designate by notice in writing a new address to which any notice, demand, request or communication may thereafter be so given, served or sent. Each notice, demand, request, or communication which shall be mailed, delivered or transmitted in the manner described above shall be deemed sufficiently given, served, sent and received for all purposes at such time as it is delivered to the addressee (with the return receipt, the delivery receipt, or the affidavit of messenger being

deemed conclusive (but not exclusive) evidence of such delivery) or at such time as delivery is refused by the addressee upon presentation.

SECTION 19. INSPECTION

The Secretary and Band or their authorized representatives shall have the right, at any reasonable times during the term of this Lease and subject to NRC restrictions, *e.g.*, relating to physical security or radiological health and safety, to enter upon the Leased Premises to inspect the same.

SECTION 20. DELIVERY OF PREMISES

At the termination or expiration of this Lease and any extensions thereto and subsequent to decommissioning as provided in Section 7 hereof, the L.L.C., pursuant to the terms and conditions hereof, will peaceably and without legal process deliver up the possession of the Leased Premises in good condition, reasonable wear and tear excepted, subject to the rules and regulations of the NRC.

SECTION 21. LEASE BINDING

This Lease and the covenants, conditions and restrictions hereof shall extend to and be binding upon the successors and permitted assigns of the Parties. While the Leased Premises are in trust or restricted status, all of the L.L.C.'s obligations under this Lease, and the obligations of its sureties, are to the United States as well as to the Band. Nothing contained in this Lease shall operate to delay or prevent a termination of Federal trust responsibilities with respect to the land by the issuance of a fee patent or otherwise during the term of this Lease; however, such termination shall not serve to abrogate this Lease. The owners of the land and the L.L.C. and its surety or sureties shall be notified of any such change in the status of the land.

SECTION 22. INTEREST OF MEMBER OF CONGRESS

No member of, or delegate to, Congress or Resident Commissioner shall be admitted to any share or part of this Lease or to any benefit that may arise here from, but this provision shall not be construed to extend to this Lease if made with a corporation or company for its general benefit.

SECTION 23. VALIDITY

This Lease, and any modification or amendment to this Lease, shall not be valid or binding upon the Parties until approved by the Secretary, or conditionally approved pursuant to Section 4.

As promptly as possible following the execution and delivery by the Band of this Lease, the Band shall submit this Lease to the Secretary for Secretary Approval, and the Band shall take all other necessary and appropriate actions in order to obtain a Secretary Approval for this Lease. The Band covenants and agrees that it shall not pass any law, rule, referendum or regulation, nor modify the Tribal traditions or governing documents in any manner, nor cause or permit, to the extent possible, the General Council, the Executive Committee, any tribal commission or any tribal agency to pass any ordinance, resolution, law or regulation which shall rescind, abrogate, modify or amend any approval of the Band, the General Council, the Executive Committee, any tribal commission or any tribal agency of this Lease or any of the obligations or transactions described herein.

SECTION 24. APPROVAL BY THE BAND AND/OR SECRETARY

Whenever under the terms of this Lease the acceptance, consent or approval of the Band and/or the Secretary is required, said acceptance, consent or approval shall not be unreasonably withheld.

SECTION 25. FORCE MAJEURE/FRUSTRATION OF PURPOSE

A. **Force Majeure**. No Party shall be liable for any breach, delay, nonperformance or damages because of that Party's inability to perform its obligations, excluding payment obligations, under this Lease, in whole or in part, when such inability is caused, or is materially contributed to, by any of the following (each a "Force Majeure Event"):

(1) fire, earthquake, explosion, lightning, epidemic, cyclone, flood, drought, hazardous weather, landslide, collision, storm, disease, pestilence and other actions of the elements, natural calamity or Act of God;

(2) failure of machinery, casualty or accident, lack of or failure in whole or in part of transportation facilities, communication facilities, power, materials or supplies;

(3) strike, lockout, labor dispute, delay or any other difficulties with employees, agents or independent contractors, for whatever reason, by any group or individuals;

(4) civil commotion, protests, unrest, riots or disorders, acts of the public enemy, or other belligerents, terrorism, sabotage, blockade or embargo;

(5) any act of any Governmental Authority or any person purporting to act as any such Governmental Authority or any group or combination of any such Governmental Authorities, including but not limited to (i) the promulgation of any law, order, proclamation, resolution, statute, regulation, ordinance, demand or requirement of any Governmental Authority, (ii) agreements between any Government Authorities; and (iii) the total or partial expropriation, nationalization, confiscation, allocation, or requisition by a Governmental Authority;

(6) compliance (voluntary or involuntary) by any party or any third party with any law, order, proclamation, resolution, statute, regulation, ordinance, requirement, act or request of a Governmental Authority or any judgment, decree or other act of any court, tribunal or arbitral body; or

(7) any other acts whatsoever, whether similar or dissimilar to those above enumerated and whether foreseeable or unforeseeable, beyond the reasonable control of a Party.

Notwithstanding the foregoing, the Band shall not be excused or be permitted to avoid liability with respect to any Force Majeure Event which is a result of (i) any law, order, proclamation, resolution, statute, regulation, ordinance, requirement, act, or request of any Governmental Authority, (ii) agreements between any Government Authorities, or (iii) the total or partial expropriation, nationalization, confiscation, allocation, or requisition by a Governmental Authority imposed by, at the request of, or with the acquiescence of the General Council, the Executive Committee, the Band or any tribal commission or agency.

The Party claiming a Force Majeure Event shall give the other Parties oral notice of that Party's inability to perform as soon as reasonably possible after the occurrence resulting in the inability to perform and shall confirm such oral notice in writing within three (3) working days thereafter. If such Force Majeure Event renders such Party's performance hereunder impossible for a period of ninety (90) days or longer, the other Party shall have the right to extend this Lease for a comparable period of time.

B. <u>Frustration of Purpose</u>.

SECTION 26. ENVIRONMENTAL PROTECTION REQUIREMENTS

It is agreed that it shall be the responsibility of the L.L.C. to satisfy all environmental protection requirements as set forth in the National Environmental Policy Act of 1969 ("**NEPA**") and its implementing regulations. It is further agreed that the L.L.C. will furnish the Secretary a copy of all environmental assessments and/or environmental impact statements and/or will furnish such documents to other federal agencies, if required, and cooperate fully with the Secretary, the NRC or other federal agencies with regard to NEPA compliance. It is additionally agreed that the L.L.C., as directed by the Secretary and other federal agencies, will issue any notice to the public of the availability of all environmental assessments or environmental impact statements or reports and will provide the Secretary with appropriate evidence of said notice within ten (10) days of the issuance of such notice. The L.L.C. shall also satisfy the Band's environmental protection standards as adopted; **provided however,** that such tribal standards shall not exceed federal law.

SECTION 27. DISPUTE RESOLUTION; LIMITED WAIVER OF SOVEREIGN IMMUNITY

So that the Band and the L.L.C. will be sure that it and/or they may enforce the terms and conditions of this Lease or resolve any dispute arising between the Parties, each of the Parties hereby covenants and agrees that each of them may sue or be sued to enforce or interpret the terms, covenants and conditions of this Lease or to enforce the obligations or rights of the Parties in accordance with the terms and conditions set forth in this Section.

A. **Informal Resolution.** Any disagreement or dispute arising between the Parties under this Lease shall be resolved, whenever possible, by meeting and conferring. A Party may request such a meeting by giving notice to the other, and the Parties shall meet within ten (10) days of the notice. If the disagreement or dispute cannot be resolved to the mutual satisfaction of the Parties within thirty (30) days after the meeting, then each Party shall have the rights as provided below.

B. **Forum**. Any controversy, dispute or claim arising out of or relating to this Lease, any modification or extension hereof, or any breach hereof shall be brought in any United States District Court or United States Court of Federal Claims, as applicable, in which the controversy may be heard or, if required, pursuant to 25 C.F.R. Parts 162 and 2, with rights of appeal to the appropriate federal court. If for any reason such United States District Court does not have or declines jurisdiction over the subject matter of the action, such controversy, dispute or claim shall be settled by binding arbitration as provided in Section 27.C below. For such purpose, each of the Parties hereby irrevocably submits to the non-exclusive jurisdiction of such courts and/or arbitrators.

C. **Arbitration**. In the event that each Party so agrees in writing or in the event the federal courts do not have or decline jurisdiction, any controversy, dispute or claim arising out of or relating to this Lease, any modification or extension hereof, or any breach hereof (including the question whether any particular matter is arbitrable hereunder) shall be settled by binding arbitration in accordance with the Center for Public Resources Rules for Non-Administered Arbitration of Business Disputes by three arbitrators, of whom the Party initiating the arbitration shall appoint one with the defending Party appointing one (with the third arbitrator being appointed by the other two arbitrators). The arbitration shall be governed by the United States Arbitration Act, 9 U.S.C. §§ 1-16, and judgment upon the award rendered by the arbitrators may be entered by any court having jurisdiction thereof as provided herein. The place of arbitration shall be Las Vegas, Nevada or any other city agreed upon by the Parties. The Parties shall bear equally the fees of the arbitrator(s) and related expenses of arbitration. Each of the Parties consents to the jurisdiction of any United States District Court in which the controversy may be heard for all purposes in connection with the arbitration with rights of appeal to the appropriate federal courts. If for any reason such United States District Court does not have or declines jurisdiction over the subject matter of the action, the Parties consent to the jurisdiction of the state courts of the State of Utah solely for the purpose of compelling or enforcing arbitration with rights of appeal to the appropriate courts. If for any reason both the federal courts and the state courts do not have or decline jurisdiction over the subject matter of the action, the Parties consent to the jurisdiction of the Court of Indian Offenses under 25 C.F.R. Part 11 (or its successor court) solely for purposes of compelling or enforcing arbitration with rights of appeal to the appropriate courts. The Parties consent that any process or notice of motion or other application to said court, and any paper in connection with arbitration, may be served by certified mail, return receipt requested, or by personal service, or in such other manner as may be permissible under the rules of the applicable court or arbitration tribunal, provided a reasonable time for appearance is allowed.

SECTION 28. SAFETY REVIEW COMMITTEE

The L.L.C. shall establish a Safety Review Committee if required by the License. It shall include one member of the Band. The purpose of this Safety Review Committee shall include making recommendations to the L.L.C. concerning the safe operation of the Facility.

SECTION 29. UNLAWFUL USE

The L.L.C. agrees not to use or cause to be used any part of the Leased Premises for any unlawful conduct or purpose.

SECTION 30. CONSENTS

The Band and the L.L.C. shall each not unreasonably withhold its consent to any requests for approvals, consents or other matters as may be requested from time to time by the other Party hereto in connection with this Lease and the terms and conditions herein set forth, and the Band and the L.L.C. shall cooperate with each other in obtaining any consents or approvals of the Secretary as may be required in connection with this Lease.

SECTION 31. ASSENT NOT WAIVER OF FUTURE BREACH OF COVENANTS

No assent, express or implied, to any breach of any of the L.L.C.'s or the Band's covenants shall be deemed to be a waiver of any succeeding breach of any covenants of such Party.

SECTION 32. INDEMNIFICATION; LIMITATION OF LIABILITY

Neither the Band nor its members, agents, representatives, and employees nor the United States shall be liable for any loss, damage, or injury of any kind whatsoever to the person or property of the L.L.C. or sublessees or any other person whomsoever, caused by the L.L.C.'s use of the Leased Premises, or by any defect in any structure erected thereon, or arising from any accident, fire, or other casualty on said premises or from any other cause whatsoever; and the L.L.C., as a material part of the consideration for this Lease, hereby waives on the L.L.C.'s behalf all claims against the Band and agrees to hold the Band free and harmless from liability for all claims for any loss, damage, or injury arising from the use of the Leased Premises by the L.L.C. where such claim is directly attributable to the actions of the L.L.C., its employees, agents or representatives, together with all costs and expenses in connection therewith: **provided, however**, that in the event the Band or its members, employees, agents or representatives contributed to the cause of the loss, damage or injury for which the Band is seeking to be indemnified, the Band shall bear its costs and losses arising out

of such claims in proportion to the degree to which the acts or omissions of the Band or its members, employees, agents or representatives shall have contributed to such loss.

Notwithstanding any provision in this Lease to the contrary, the L.L.C. shall not be liable to the Band, or its members, employees, agents or representatives, or to the United States in any instance for damages in any amount in excess of the amount of insurance the L.L.C. would be able to recover in such instance; **provided, however**, that the foregoing limitation of liability shall not apply to the extent such damages are caused by acts or omissions of the L.L.C. which constitute gross negligence or willful misconduct.

SECTION 33. OBLIGATIONS TO THE UNITED STATES

While the Leased Premises are in trust or restricted status, all the L.L.C.'s obligations under this Lease, and the obligations of its sureties, are to the United States as well as to the Band.

SECTION 34. RELINQUISHMENT OF SUPERVISION BY THE SECRETARY

Nothing contained in this Lease shall operate to delay or prevent a termination of Federal trust responsibilities with respect to the Leased Premises by the issuance of a fee patent or otherwise during the term of this Lease; however, such termination shall not serve to abrogate this Lease. The Band and the L.L.C. and its surety or sureties shall be notified by the Secretary of any such change in the status of the Leased Premises.

SECTION 35. REPRESENTATIONS AND WARRANTIES

A. **Representations and Warranties of the Band**. The Band hereby represents and warrants as follows:

(1) **Enforceability; Binding Effect of Band's Obligations**. This Lease, after execution and delivery by the Band and Secretary Approval, will be a valid and binding obligation of the Band, enforceable against the Band in accordance with its terms. [redacted] Neither the execution and delivery of this Lease nor the compliance by the Band with any of the provisions contained herein do or will (i) violate, or conflict with, the constitution or any other organizational or governing documents

of the Band in effect on the date of this Lease or (ii) violate, or conflict with, any order, writ, injunction, tribal or judicial decree, statute, rule, regulation or resolution applicable to the Band or any of the properties or assets of the Band.

(2) __No Litigation__. There is no litigation, administrative proceeding or other action against the Band existing, pending or threatened that would affect the ability of the Band to fulfill its obligations under this Lease.

B. **__Representations and Warranties of the L.L.C.__** The L.L.C. hereby represents and warrants as follows:

(1) **__Organization and Good Standing__.** The L.L.C. is a limited liability company duly organized, validly existing, and in good standing under the laws of the State of Delaware.

(2) **__Due Authorization; No Conflicts__**. The execution, delivery and performance by the L.L.C. of this Lease has been duly and effectively authorized by all necessary limited liability company action of the L.L.C., which authorization has not been modified or rescinded and is in full force and effect. No other proceedings or actions are necessary to authorize the execution and delivery of this Lease. This Lease, after execution and delivery by the L.L.C., will be a valid and binding obligation of the L.L.C., enforceable against the L.L.C. in accordance with its terms. Neither the execution and delivery of this Lease, nor the compliance by the L.L.C. with any of the provisions contained herein or therein do or will (i) violate, or conflict with, the Certification of Formation of the L.L.C. or the Limited Liability Company Agreement of the L.L.C. in effect on the date of this Lease or (ii) violate, or conflict with, any order, writ, injunction, judicial decree, statute, rule or regulation applicable to the L.L.C. or any of its properties or assets.

(3) **__No Litigation__**. There is no litigation, investigation, administrative proceeding or other action against the L.L.C. existing, pending or threatened that would affect the ability of the L.L.C. to fulfill its obligations under this Lease.

SECTION 36. __MISCELLANEOUS__

A. **__Parties' Good Faith Obligations__.** The Parties agree that they will in good faith undertake to fulfill their obligations in a timely manner and to execute and deliver such agreements, certificates and other documents as may be contemplated by this Lease or as may be required or necessary to be executed and delivered by them in connection with the development, construction, financing, ownership, operation, and decommissioning of the Facility.

B. **Amendment**. No amendment, modification or discharge of this Lease, and no waiver hereunder, shall be valid or binding unless set forth in writing and duly executed by the Party against whom enforcement of the amendment, modification, discharge or waiver is sought, subject to any necessary Secretary Approval.

C. **Entire Agreement**. This Lease (including Exhibits and Attachments hereto) constitutes the entire agreement among the Parties with respect to the transactions contemplated herein, and this Lease supersedes all prior oral or written agreements, commitments or understandings with respect to the matters provided for herein.

D. **Headings**. Article, Section and subsection headings contained in this Lease are inserted for convenience of reference only, shall not be deemed to be a part of this Lease for any purpose, and shall not in any way define or affect the meaning, construction or scope of any of the provisions hereof.

E. **No Partnership**. No agency, partnership, joint venture or other representative or fiduciary relationship between the Parties is created by, or may be implied by or inferred from, the execution of this Lease, the conduct of the Parties' activities as contemplated hereby, or the consummation of the transactions contemplated hereby.

F. **Construction**. In all cases the language in all parts of this Lease shall be construed simply according to its fair meaning and not strictly for or against any Party. Wherever any words are used herein in the masculine gender, they shall be construed as though they were also in the feminine and neuter genders in all cases where such would so apply, and wherever any words are used in the singular form they shall be construed as though they were also used in the plural form where such would properly apply.

G. **Counterparts**. This Lease may be executed in any number of counterparts, each of which when so executed and delivered shall for all purposes be deemed to be an original, but such counterparts of which this shall be one shall together constitute but one and the same instrument.

H. **Governing Law**. Unless otherwise provided herein, this Lease shall be construed, interpreted and enforced and governed by the provisions of 25 U.S.C. §§ 81 and 415, 25 C.F.R. Part 162 and other applicable federal law. The foregoing notwithstanding, to the extent that there is no federal law governing in a particular instance this Lease shall be construed, interpreted and enforced and governed by the applicable laws of the State of Utah or in the event a federal court determines that federal law does not govern the subject matter or is inadequate to assure the prompt and effective exercise of the rights and remedies of the L.L.C. and the Band hereunder with respect to provisions of this Lease, the law of the State of Utah shall be applied to the exercise of the rights and remedies of L.L.C. and the Band. The Band hereby consents to the application of the law of the State of Utah under such circumstances.

IN WITNESS WHEREOF, the Parties have hereunto set their hands.

LESSOR:

SKULL VALLEY BAND OF THE GOSHUTE INDIANS

By: ______________________
Leon D. Bear,
Chairman

By: ______________________
Mary J. Apadaca,
Vice-Chairwoman

By: ______________________
Rex A. Allen,
Secretary

LESSEE:

PRIVATE FUEL STORAGE, L.L.C.

By: ______________________
John D. Parkyn,
Chairman of the Board

State of Utah)
) ss.
County of Salt Lake)

On this 20 day of May in the year 1997 before me Dannette Uyeda a Notary Public of said State, duly commissioned and sworn, personally appeared Leon D. Bear, personally known to me to be the person who executed this instrument as Chairman of the Skull Valley Band of the Goshute Indians and acknowledged before me that the Skull Valley Band of the Goshute Indians executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Notary Public in and for said State

State of Utah)
) ss.
County of Salt Lake)

On this 20 day of May in the year 1997 before me Dannette Uyeda a Notary Public of said State, duly commissioned and sworn, personally appeared Mary J. Apadaca, personally known to me to be the person who executed this instrument as Vice-Chairwoman of the Skull Valley Band of the Goshute Indians and acknowledged before me that the Skull Valley Band of the Goshute Indians executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Notary Public in and for said State

State of Utah)
) ss.
County of Salt Lake)

On this 20 day of May in the year 1997 before me Dannette Uyeda a Notary Public of said State, duly commissioned and sworn, personally appeared Rex A. Allen, personally known to me to be the person who executed this instrument as Secretary of the Skull Valley Band of the Goshute Indians and acknowledged before me that the Skull Valley Band of the Goshute Indians executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Notary Public in and for said State

State of Utah)
) ss.
County of Salt Lake)

On this 21 day of May in the year 1997 before me Dannette Uyeda a Notary Public of said State, duly commissioned and sworn, personally appeared John D. Parkyn, personally known to me to be the person who executed the within instrument as Chairman of the Board of Private Fuel Storage, L.L.C., and acknowledged before me that such limited liability company executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Dannette Uyeda

Notary Public in and for said State

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS

APPROVAL OF LEASE

The within Lease between Private Fuel Storage, L.L.C. (the "**L.L.C.**") and the Skull Valley Band of the Goshute Indians (the "**Band**") consisting of pages 1 through 35 and Exhibits "A" through "D" and Attachment I is hereby approved on behalf of the Secretary of the Interior pursuant to the provisions of the Act of August 9, 1955 (69 Stat. 539; 25 U.S.C. § 415), as amended, and as supplemented by the regulations (25 C.F.R. Part 162).

In accordance with the authority vested in me, including without limitation my power set forth in 25 C.F.R. § 1.2 to waive and make exceptions to my regulations, I hereby specifically waive and make exceptions to the application of any of the regulations of the Department of the Interior with regard to any provision of this Lease which is inconsistent with any of such regulations, and I find that this waiver and exception is permitted by law and is in the best interests of the Skull Valley Band of the Goshute Indians.

Dated: May 23, 1997

By: ______________________
David L. Allison, Superintendent
United States Department of the Interior
Bureau of Indian Affairs

EXHIBIT "A"
TO THE BUSINESS LEASE

Facility Site

One parcel of land located in Sections 5, 6, 7, and 8, Township 5 South, Range 8 West, Salt Lake Base and Meridian described as follows: All of Section 6, the north 700 feet of Section 7 from the west to the east Section 7 boundary, the west 700 feet of Section 5 from the north to the south Section 5 boundary, and the north 700 feet of Section 8 from the west Section 8 boundary to a point 700 feet east. Containing 820 acres more or less.

EXHIBIT "B"
TO THE BUSINESS LEASE

Easements and Rights-of-Way

An east-west access corridor between the Facility Site as described on Exhibit "A" to the Business Lease and the West Right-of-Way of Skull Valley Road to permit construction and maintenance of transportation access and utilities to service the Facility Site; portions thereof located in Sections 8 and 9; Township 5 South; Range 8 West; Salt Lake Base and Meridian described as follows: the north 1,000 feet of Section 8 from the Facility Site east boundary to the east Section 8 boundary, the north 1,000 feet of Section 9 from the west Section 9 boundary to the West Right-of-Way of Skull Valley Road. Containing 202 acres more or less.

EXHIBIT "C"
TO THE BUSINESS LEASE

Buffer Zone

A buffer zone to include the remaining portions of Sections 5, 7, and 8 and all of Sections 17 and 18, Township 5 South, Range 8 West, Salt Lake Base and Meridian.

Exhibit "D" to Business Lease

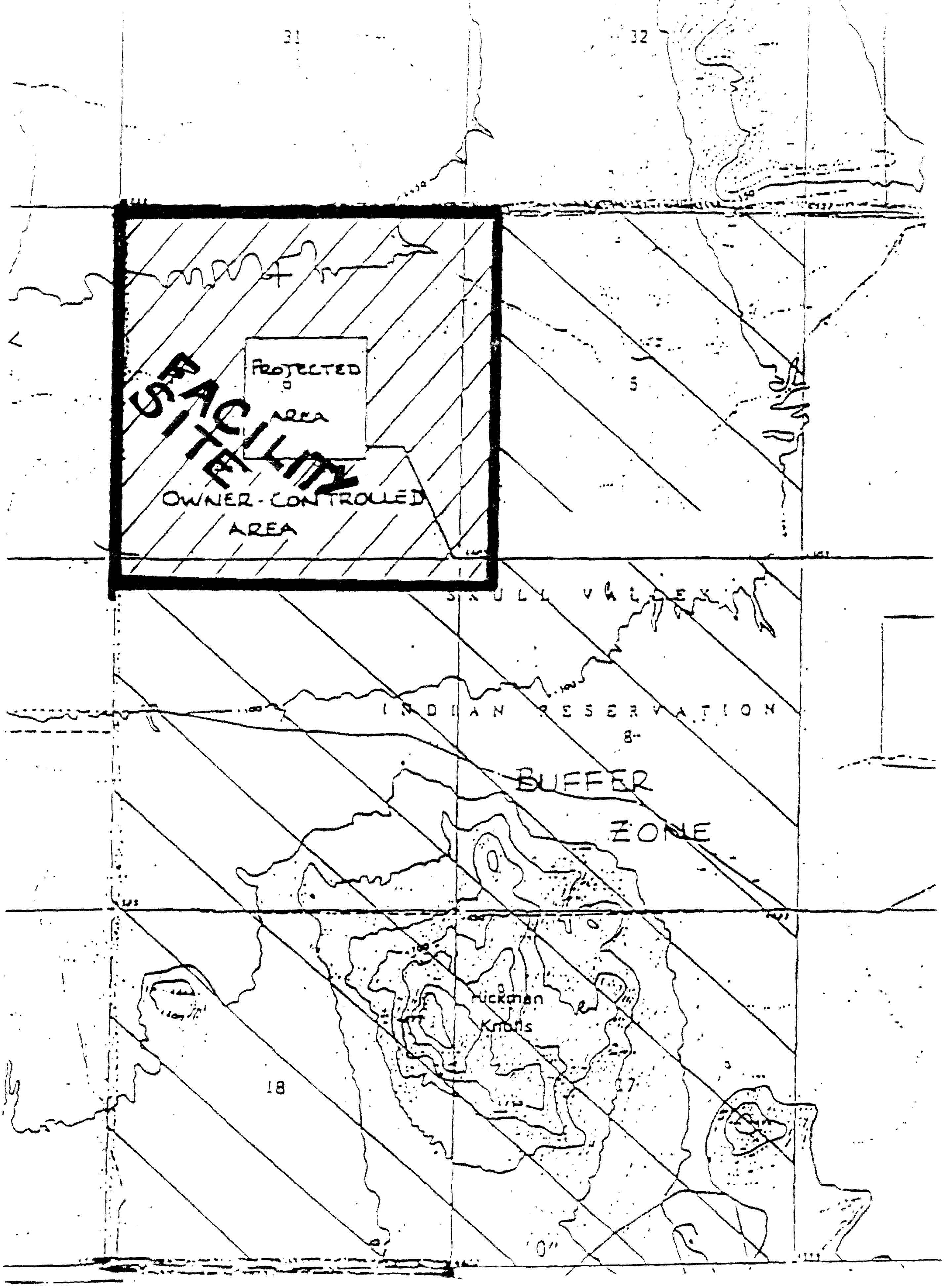


EXHIBIT "E"
TO THE BUSINESS LEASE

Annual Expense Escalators

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

ATTACHMENT "I"
TO THE BUSINESS LEASE

Valid Existing Leases, Easements, Rights-of-Way
and/or Other Encumbrances and/or Restrictions

1. Lease dated April 27, 1984, by and between Hercules, Incorporated and the Band; as amended by (i) Amendment No. 1 dated December 1, 1985, by and between Hercules, Incorporated and the Band; (ii) Amendment No. 2 dated November 1, 1989, by and between Hercules, Incorporated and the Band; (iii) the Skull Valley Band of Goshute Indians Possessory Interest Tax Settlement Agreement, dated April 29, 1994, by and between Hercules, Incorporated and the Band; and assigned to Alliant Techsystems Inc. pursuant to that certain Assignment and Assumption Agreement dated March 15, 1995, between Hercules Incorporated and Alliant Techsystems Inc (collectively the "Alliant Lease").

2. ASSIGNMENT OF TRUST DEED

Assignor:	Skull Valley Band of the Goshute Indians
Assignee:	First Security Bank of Utah, N.A.
Dated:	April 27, 1984
Recorded:	July 5, 1984
Entry No.:	362803
Book/Page:	221/443-451

As to Sections 17 and 18, both in T5S, R8W, Salt Lake Base & Meridian

3. TRUST DEED

Trustor:	Alliant Techsystems Inc.
Trustee:	Lawyers Title Insurance Corporation
Beneficiary:	J. P. Morgan Delaware, as Collateral Agent for the Secured Parties
Dated:	March 15, 1995
Recorded:	March 15, 1995
Entry No.:	072609
Book/Page:	392/8-77

As to Sections 17 and 18, both in T5S, R8W, Salt Lake Base & Meridian

4. UCC-1

Debtor:	Alliant Techsystems Inc.
Secured Party:	J. P. Morgan Delaware as Collateral Agent
Recorded:	March 15, 1995
Entry No.:	072610
Book/Page:	392/78-105

As to Sections 17 and 18, both in T5S, R8W, Salt Lake Base & Meridian

5. The Leased Premises are situated within the boundaries of the Tooele County Hospital Special Services District.

EXHIBIT 16

STATE OF NEVADA
AGENCY FOR NUCLEAR PROJECTS/
NUCLEAR WASTE PROJECT OFFICE

NWPO-SE-007-88

THE EFFECTS OF HUMAN RELIABILITY IN THE TRANSPORTATION OF SPENT NUCLEAR FUEL

by

Seth Tuler
Roger E. Kasperson
Samuel Ratick

Center for Technology, Environment, and Development
Clark University

June, 1988

The Nevada Agency for Nuclear Projects/Nuclear Waste Project Office was created by the Nevada Legislature to oversee federal high-level nuclear waste activities in the state. Since 1985, it has dealt largely with the U.S. Department of Energy's siting of a high-level nuclear waste repository at Yucca Mountain in southern Nevada. As part of its oversight role, NWPO has contracted for studies designed to assess the socioeconomic implications of a repository and of repository-related activities.

This study was funded by DOE grant number DE-FG08-85-NV10461.

(the paint had worn off). To avoid this problem in the future, the reactor operator (not the cask owner) inscribed valve numbers onto the cask surface and keyed them to the written procedure for hooking up the lines. Since no verification testing is required, however, the problem could still recur. The particular cask involved was designed to always be shipped dry and the presence of water with a "young" fuel assembly could have resulted (during a fire) in pressurization of the cask, opening the relief valve and venting of the contaminated water as steam.

The case concerning an empty cask involved the same container previously seen in the re-oxidation incident. Having been extensively decontaminated after that problem, the empty cask was shipped to another reactor. Upon opening a valve, a cask handler was contaminated by the excess water left in the container. Later analysis found that a small sample of the cask water gave off very high radiation readings (over 100 r/hr). Note that the cask was empty, so it was under no travel or reporting regulations. Recall that this cask had recently had a defective valve replaced, so again there was potential for a release without a vehicular accident (had the valve not been changed prior to this incident). The cask water proved to be a further problem due to the inexperience of the handler (an employee of the cask owner) who, in violation of normal procedures, drained the fluid into a plastic bag. Unable to fit the bag into a shielded waste holder, he punctured the bag with a screwdriver, allowing release of contamination into the air (he wore no breathing apparatus) and spilling the fluid (ref. 44). One wonders how this action would have been perceived if the cask fluid were found to be leaking in transit. In this case, fines were levied, not against the cask owner, but against the utility since it did not properly supervise the situation. But the problem can still recur.

Another problem related to handling is the potential for damaging fuel in loading and/or in transit. At least seven such incidents (two in the U.S.) (ref. 45) have occurred and the damage was only discerned

APPC

upon arrival of the fuel. None of the fuel was damaged prior to loading, so there was no need for it to be canned. As previously mentioned, the release of loose or powdered fuel to the cask interior can create the potential for a release to the environment if accompanied by a failed valve or seal, or a very serious accident that could open a valve or damage a seal. While all present commercial casks require non-air atmospheres, this rule has [illegible] been codified (it exists only in the individual licenses of six casks, two of which are no longer available for spent fuel shipments). Unless required by NRC in all new licenses, the potential exists for re-oxidation of fuel that overheats in a future air-filled cask.

Other possible loading scenarios exist that have not occurred (at least to the knowledge of this author). For example, one could imagine a mislabeled gas canister, containing pure oxygen instead of helium. Filling a cask with such a gas could greatly accelerate re-oxidation (and possibly other problems) instead of eliminating that hazard. There is a need - prior to cask licensing - for a full examination of a cask's loading procedures to ascertain all possible errors and design fail-safe procedures or equipment to avoid, or at least detect, the problems before they create a serious potential for risk.

The same need pertains to addressing problems during incidents in transit. Situations have occurred (some not involving spent fuel) that resulted in the mistaken belief that a leak had occurred. In one case, a fire was allowed to contact a container of radioactive gas for over two hours because firefighters had been unnecessarily evacuated from the area (ref. 46). This action calls into question the assumption of a 30-minute fire (one of the cask standards), which is based on an active effort to extinguish (not avoid) a blaze.

Vehicles have also been subject to poor inspection and/or maintenance. Despite design efforts to make a cask trailer strong enough to handle its heavy load, a trailer bed buckled in transit only several days

28. "A Review of the Effects of Human Error on the Risks Involved in Spent Fuel Transportation," Nebraska Energy Office, December, 1986

29. NRC letter to DOE, Docket No. 71-4960, March 13, 1980

30. DOE letter to NRC, May 31, 1983

31. DOT letter to DOE, March 23, 1985

32. NRC meeting memo, "Summary of Meeting Concerning MH-1A Cask Design", November 29, 1985

33. DOE/RW-0073, Yucca Mountain Environmental Assessment, May, 1986, Appendix p. A-13

34. Complaint in U.S. Claims Court, No. 229-83C, filed April 7, 1983

35. NRC Order to Show Cause, Docket No. 71-6698, April 4, 1979

36. NRC Inspection Report 99900331/79-01, August 31, 1979

37. NRC memo, Docket no. 71-9200, July 16, 1986

38. GE letter to NRC, Docket no, 9001, June 2, 1981

39. "Contamination Studies on Pond-Loaded Casks," PATRAM '83, p. 929

40. letter to NRC from Nuclear Assurance Corp., Docket no. 71-6698, April, 1979

41. "Airborne Contamination Released During Unloading of a Failed PWR Spent Fuel Assembly," PATRAM '80, p. 646

42. NRC Decision DD-84-9, April 13, 1984

43. letter to NRC from Duke Power Co., Docket no. 71-9010, December 1, 1981

44. NRC Inspection Reports 50-213/80-20 and 50-219/80-38, April 1981

45. Preceedings of PATRAM '83, p. 806, May, 1983

I'm sending this by mail

46. National Transportation Safety Board Study NTSB-HZM-79-3, p. 8, November 13, 1979

47. NUREG/CR-0744, "Identification and Assessment of Social Implications of Transportation of Radioactive Materials in Urban Environs," 1979

48. letter to NRC from Nuclear Assurance Corp., Docket no. 71-9010, March 14, 1988

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EXHIBIT 17

Pyrotechnics in Industry

Richard T. Barbour
Pyrotechnics Design Engineer
Space Shuttle Program

TRANSP
The reference is on p. 47 (units have been changed)
The rest is for background

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chapter 5

Shaped Charges

Shaped charges are the only form of pyrotechnics that attempt not only to control the direction of the explosive energy but also to concentrate it. In many instances the energy intensity of an explosive can be increased more than a thousand times. Later in this chapter a comparison of the quantities of explosives required to perform a given task will be made with and without the technological precision of shaped charges.

MONROE EFFECT

During the nineteenth century, miners learned that detonating sticks of dynamite that had one end arranged in a circle on the ground with their opposite ends tied together in the shape of a cone resulted in a much deeper hole being blown into the earth than if the same number of dynamite sticks were simply tied together with their axes parallel as shown in Figure 5-1. Although the miners did not understand the physical laws that had caused this phenomenon, they unknowingly had discovered the rudiments of shaped-charge pyrotechnology. The causation of this phenomenon is due primarily to the fact that energy forces of an explosive radiate predominately perpendicular from the surface of the explosive. Figure 5-2 illustrates how the energy forces of the three dynamite stick arrangements of Figure 5-1 are distributed by analyzing an enlarged section perpendicular to the target (the ground line) and through the center of the three configurations. Even though the quantity and distribution of energy from each individual dynamite stick is the same, the relative position of adjacent sticks can greatly influence the total amount of useful work accomplished. The angle between opposing sticks in the conical configuration causes the explosive energy forces radiating from the inside surface of the cone to intersect near the centerline. Here the horizontal components of these opposing energy forces collide head on and cancel each other. The vertical components, headed toward the target, are cumulative. Since configuration *a* has a far greater quantity and concentration of cumulative vertical vectorial energy forces contacting the target, the resultant hole is much deeper even though all three

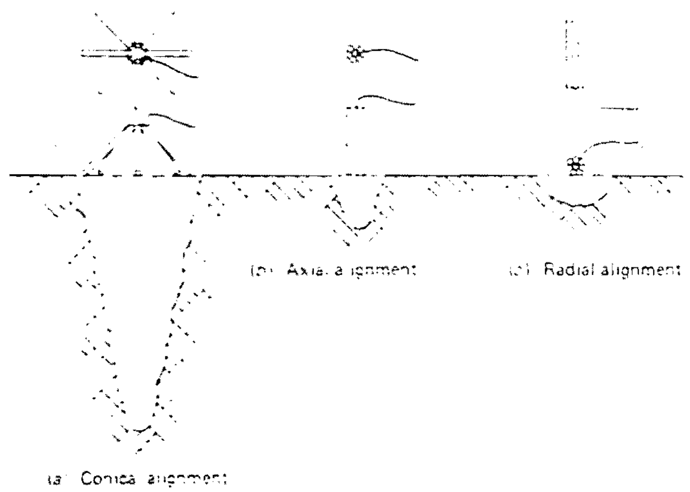

FIG. 5-1. Relative blast effects of eight dynamite sticks in three different arrangements.

configurations used the same number of dynamite sticks (8). Additional refinements of this basic discovery have enhanced even more the efficiency of shaped charges.

Shaped charges can be subdivided into three classifications: conical shaped charges (CSC); linear shaped charges (LSC); and flexible linear shaped charges (FLSC). The subdivisions have evolved as a result of their particular applications and will be discussed individually in this chapter. The following discussion of the principles of shaped-charge pyrotechnology are applicable to all three subdivisions. They were first analyzed and tested in 1888 by Charles E. Monroe. He observed that when the engraved lettering in a block of explosive was placed next to a metal plate and detonated, the image of the lettering was imparted (engraved) in the plate. In honor of his efforts the principle of the shaped charge is known as the Monroe Effect.

Figure 5-3 is a simplified illustration of a shaped charge in cross section

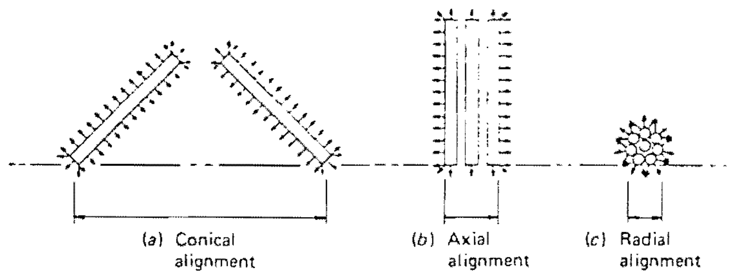

FIG. 5-2. Simplified dispersion of explosive energies of Figure 5-1. Arrows indicate area over which energy is distributed. (*Note*: Nearly half the total explosive energy of the conical alignment is utilized to blast hole in the ground.)

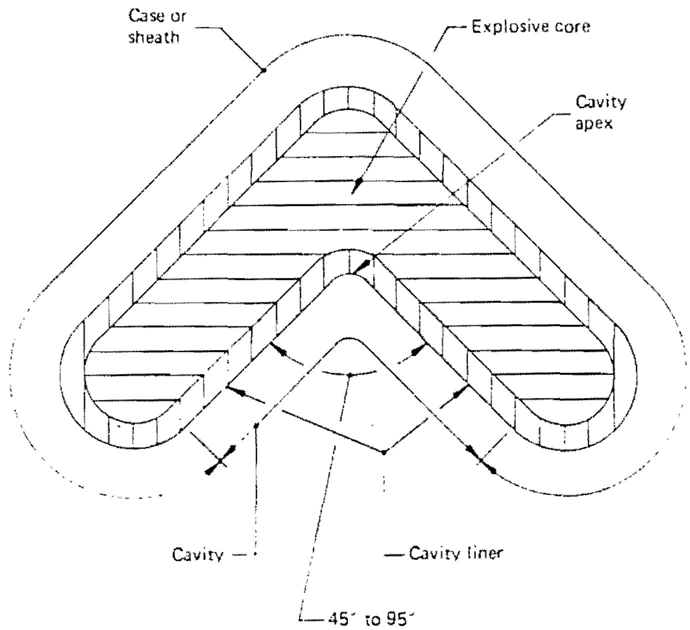

FIG. 5-3. Nomenclature of simplified shaped charge.

and identifies its major components. The housing or sheath and the cavity liner may be of one homogeneous material. Specific applications often dictate the two components be of different materials. Cavity liners are most often made of copper, lead, silver, and aluminum. Their primary purpose is to supply a source of heavy molecules that can be accelerated toward the target by the high pressure and shock waves generated by the high or secondary explosive core. RDX, PETN, HNS, and DIPAM (see Chapter 2) are the most often used core explosives. Upon impact with the target, these high-velocity molecules transfer tremendous amounts of kinetic energy to the target, causing it to deform. Comparative tests have shown that when all other parameters are equal, the performance of a shaped charge can be increased or decreased by increasing or decreasing the density of the liner material. Liner material preferences will be reviewed with specific shaped-charge applications. The included angle of the cavity liner varies between 45 and 90 degrees and it too is dependent upon the shaped-charge application. The interaction of the cavity liner's wall thickness, wall taper, and radius of the apex all affect performance.

The distribution of the explosive energy, as stated earlier, is essentially perpendicular from the surface of the explosive. Figure 5-4 details the energy distribution along the periphery of the simplified shaped charge. As illustrated here, even with the increased efficiency of the shaped charge, the majority of the explosive energy is wasted. Several unique shaped-charge

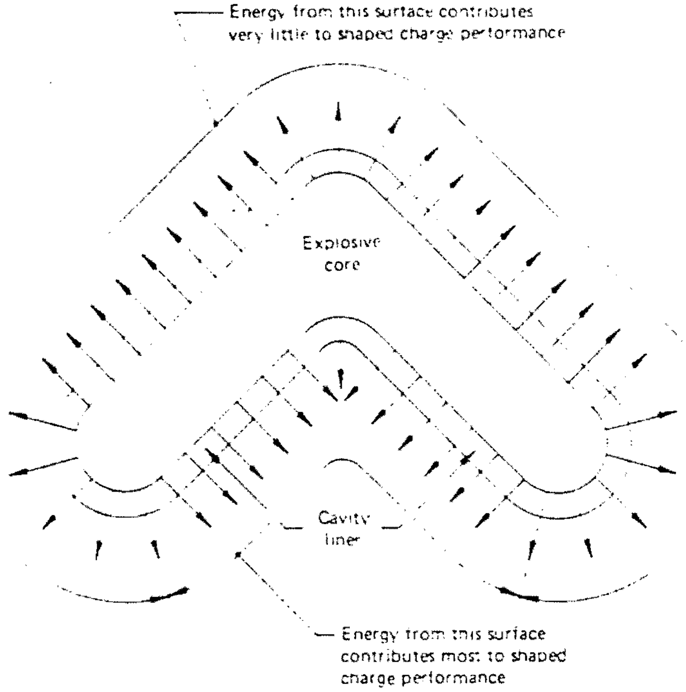

FIG. 5-4. Simplified shaped charge explosive energy distribution.

applications have made use of this apparently wasted energy and will be discussed later in this chapter.

The explosive phenomenon is generally described as the interaction of the detonation (rapid decomposition) products and cavity liner material emanating at high velocity from a shaped charge as the explosive detonates. The detonation releases large quantities of gas almost instantaneously under extreme pressure—as much as several millions of pounds per square inch or square centimeter. The shock waves emanating from the lower portion of a shaped charge converge at a point on the charge centerline and cause an extreme concentration of pressure along the axis of convergence as shown in Figure 5-5. These directed shock waves, together with the products of explosive decomposition and the metal molecules from the cavity liner, form the primary target cutting action—the jet.

Deformation of the target material begins within 1 microsecond (1 one-millionth of a second) after the passage of the detonation front. The shock waves produced by the expanding gases and the cavity liner material emanating from the lower portion of the shaped charge are converging, a jet of high velocity (in excess of 20,000 feet [6,100 meters] per second) cavity liner molecules is forming and penetration of the target is beginning. In Figure 5-6, the jet is fully developed and deformation of the target is well underway. The extent of this deformation is as follows: When a shaped

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charge is detonated on a metal target, the jet exerts an extremely concentrated force over a very small area. This force causes the metal to be pushed out of the way of the advancing jet by plastic flow. The resulting deformation is called "penetration." On a thin plate, however, the performance of the shaped charge depends not only on the cavity liner material and the intense, directed shock waves to erode the target, but also on the rapidly expanding gases to physically dislocate and fracture it. The shock waves, when reflected from the surface opposite the penetration, can also cause spalling (dislodged metal flakes) from that surface. The total effect is termed "cutting." Shaped charges consistently cut targets of greater thickness than they can penetrate.

The penetration action of a shaped charge is affected by a number of factors: the explosive used is of great importance; and while the depth of penetration is indicated to be more closely related to the detonating pressure than the rate of detonation, in general, the greater effect is produced by the explosive having the greater rate (velocity) of detonation. Very little effect is produced by explosives having rates of detonation of 15,000 feet (4,570 meters) per second or less.

Comparative tests with cavity liners of different metals give results that indicate, in general, the depth of penetration is greater with metal of higher density. However, liner ductility also plays a major role in penetration.

The standoff distance, or distance between the target and the base of the shaped charge required for maximum penetration effect, varies with the

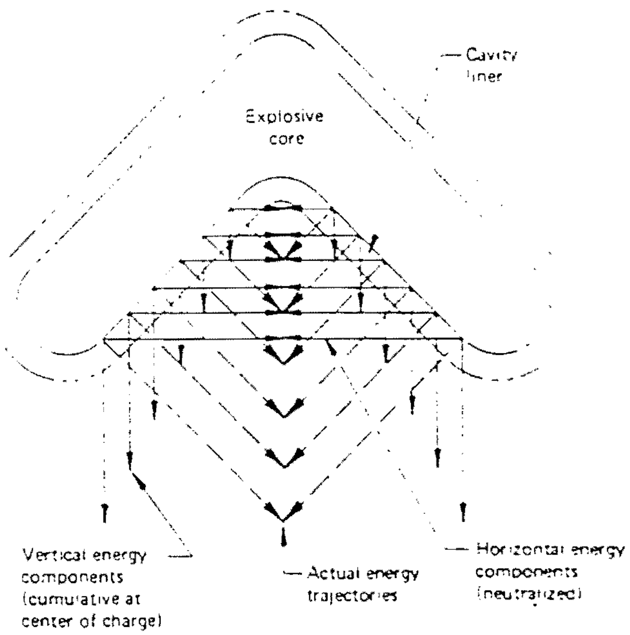

FIG. 5-5. Resolution of simplified shaped charge cavity energy.

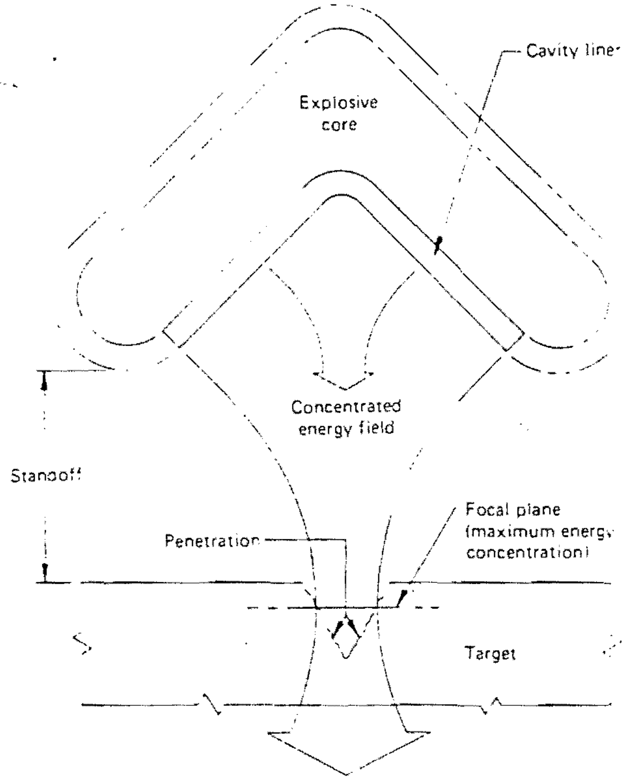

FIG. 5-6. Simplified shaped charge with optimum standoff for maximum target penetration.

metal used as a cavity liner. With a given liner, there is a given optimum standoff distance above and below which less penetration effect is obtained. As stated previously, the jet is the penetrating agent, and as standoff distance is increased, there is more time in which the jet can be extended. However, after a certain standoff distance, the jet has a tendency to break up both axially and radially.

Standard cutting data are usually derived under optimum conditions and usually tested against only one or two standard materials such as aluminum or steel. Data published by this empirical method can only be used as an approximation in selecting the proper size shaped charge to sever or penetrate a particular target. Other target parameters such as homogeneity, temper or hardness, direction of grain, and backup material, in conjunction with other shaped-charge parameters such as voids in the explosive, nonuniform compacting of explosive, and unsymmetrical geometry of the chevron, can affect the total performance of a particular shaped charge with a specific target. Only through rigorous manufacturing quality assurance and controls and thorough testing can an optimized, reliable shaped charge be configured (see Chapter 8).

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Table 5-1. Geon
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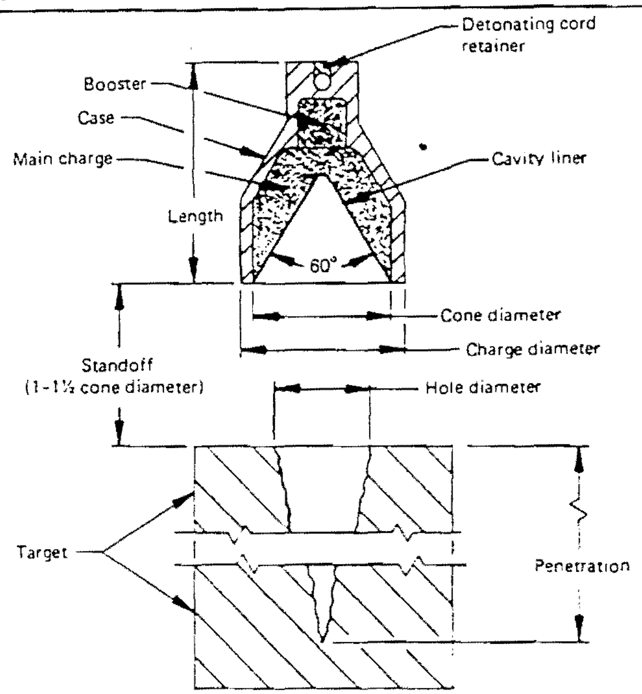
CONICAL SHAPED CHARGE (CSC)

A conical shaped charge is, as the name implies, a body of revolution rotated around the axis of symmetry. Table 5–1 illustrates a typical CSC and tabulates the geometric characteristics and performance capabilities for a family of

Table 5-1. Geometric, Weight, and Performance Characteristics of Conical Shaped Charges



Copper cavity liner, RDX explosive

Shaped charge number	Explosive weight, g	Gross weight, g	Approximate OD, in	Approximate overall length, in	Penetration, in*	Hole diameter, in*
1	1.1	20	0.63	0.83	0.75	0.20
2	3.7	48	1.00	1.32	2.00	0.30
3	8.5	96	1.61	1.74	2.50	0.40
4	15.5	152	1.90	2.09	3.21	0.46
5	19.0	189	2.00	2.25	3.40	0.52
6	11.5	106	1.62	1.75	4.60	0.31
7	20.0	205	2.06	2.35	5.50	0.37
8	414.5	743	3.50	6.00	14.0	1.75

*Performance in mild steel

charges. The explosive material used in these CSCs is granular RDX (see Chapter 2) compressed into the case under pressure in excess of 15,000 pounds per square inch (1,055 kilograms per square centimeter). The tremendous amount of explosive energy released and focused by the CSC configuration is emphasized by the last entry in the table: Into a mild steel target a hole 1.75 inches (44.5 millimeters) in diameter with a penetration of 14 inches (356 millimeters). Users of these or slightly modified CSCs are the oceanographic industry for cable cutters, armed forces for demolition, construction contractors for drilling aids, and the steel industry for tapping open-hearth furnaces. The oil industry's application for perforating oil well casing is simplified in the illustration of Figure 5-7. By lowering a detector into a well casing, geologists are able to locate oil deposits in stratum at considerable distances from the casing itself. The problem of tapping into

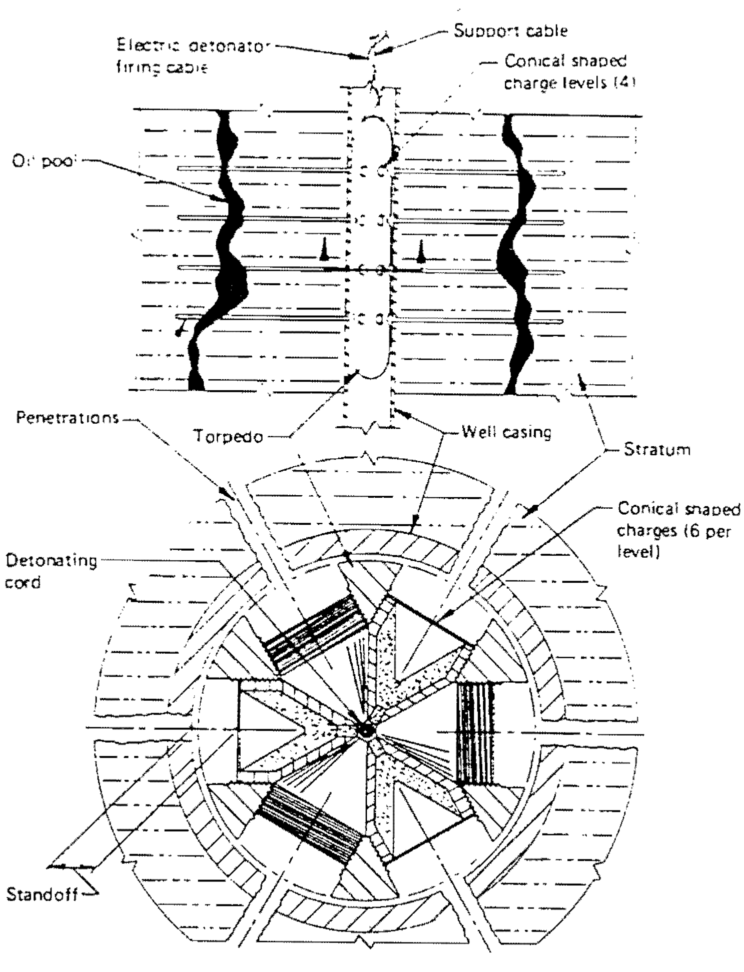


FIG. 5-7. Oil-well casing and stratum penetrators.

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the adjacent oil pools without the added time and expense of drilling another well is resolved by inserting a "torpedo" into the casing and lowering it to the level of the oil pool(s). The torpedo consists of several levels of CDCs. The illustration depicts four levels with six CDCs per level. Torpedoes with twelve levels and twelve CDCs per level have been used. The torpedo is attached to a cable with a bridle at one end. An electric firing cable is entwined around the support cable and terminates at a detonator at the top of the torpedo. The detonator detonates a string of detonating cord (see Chapter 4) that traverses the length of the torpedo. As can be seen in the section, the detonating cord is located at the hub of the six radially oriented CSCs. The detonating cord simplifies the detonation of twenty-four CDCs with a single detonator.

When detonated, the CDCs penetrate not only the well casing but also the surrounding stratum for a considerable distance. Penetrations of several hundred inches (nearly a thousand centimeters) are not uncommon in Berea sandstone (a common oil-bearing stratum). Penetration is primarily dependent on the number of conical-shaped charges nestled into each level of the torpedo, the inside diameter of the well casing, thickness of the casing, casing material, number of concentric casings (up to four is not unusual), and the composition of the oil-bearing stratum. After the CSCs have penetrated the oil pool, the oil will immediately flow into the voids of the penetrations and through the holes in the casings. When inside the casing the oil is easily pumped to the surface.

Torpedoes have been built with a single CSC at each level. Obviously, a single charge designed to the full diameter of the torpedo will have greater penetration than multiple CSCs designed within the same diameter. To preclude the necessity of radial orientation of the torpedo with a single CSC at each level, a different radial orientation of each CSC is employed at each level.

The discovery of petroleum deposits under the sea created the need for many new techniques to recover oil from the new source. Problems connected with drilling platforms, special support vessels, and in many other areas were resolved by modifying techniques used in the standard land recovery methods. The task of laying the pipeline from the floor of the sea to the shore presented a unique problem in many areas, particularly in rock- and coral-encrusted coastal reefs and shoals. These areas quite often are shallow in depth, which precludes the use of deep-draft floating platforms from which to dig a trench for the pipeline to rest protected from the elements and possible entanglement with ships' anchors. In some cases the rock and coral formations are too hard to be economically removed with standard ditching or dredging equipment. One solution to the problem is the classical method of drilling bore-holes in the rock or coral formation, placing an explosive charge in each hole, and blasting to break or crush the dense formation. Needless to say, this is a slow and costly process.

The final solution came with the development of a conical shaped charge

about the size of a small milk can. Instead of filling the CSCs with granular or solid explosives, and transporting them under rigid safety regulations to faraway places where they were needed, a liquid explosive was developed whose constituents can be shipped in separate containers by commercial transport to the using site. As can be seen in Figure 5-8, even when filled with the liquid explosive, more than half of the internal volume of the CSC is void. If placed in water the CSC would float inverted. This anomaly is overcome by placing the base of the CSC in an oversized box and filling the gap with concrete. CSC case segments are often molded plastic and the cavity liner is a deep drawn steel cone. The total assembly weighs approximately 40 to 50 pounds (18.14 to 22.68 kilograms). Handholds are provided in the box to facilitate carrying the CSC on land and maneuvering it into position under water. The stable liquid explosive ingredients are mixed and poured into the case through a hole in the top. The stopper serves a dual purpose—it is also the detonator. To the detonator is attached a length of detonating cord.

Figure 5-9 is a series of pictures of the insensitive liquid explosive chemicals and CSC cases being transported to the using site. There the liquid explosive constituents are mixed; cases are assembled and placed in handling boxes where concrete is poured around the base of the CSC. The liquid explosive is poured into the case and topped with a detonator and a short length of detonating cord (see Chapter 3). Barges are loaded with numerous

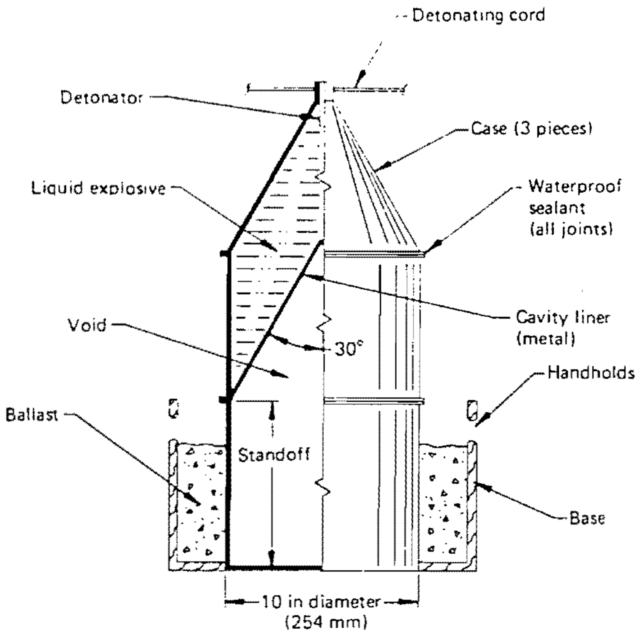

FIG. 5-8. Liquid explosive CSC used in trenching and dredging operations.

FIG. 5-9. Transporting, filling, positioning, and firing of CSCs for underwater oil pipeline operations. (a) Pallets loaded aboard air freighter. (b) Transporting pallets to using site. (c) Assembling CSCs. (d) Filling CSCs with liquid explosive. (e) Positioning CSCs along trenching line. (f) Detonating cord attached to CSC detonator. (g) Underwater trench being excavated. (h) Final positioning of oil pipe in trench through shoal.

CSCs for transporting to the underwater trenching site. At the trench site, up to several hundred CSCs are placed in rows about 4 feet (1.2 meters) apart on either side and along the centerline of the trench. The short lengths of detonating cord from each of the stationed CSCs are knotted to a longer detonating cord strung the length of the positioned CSCs. Attachment of an electric detonator to the end of the long detonating cords attached to the CSCs completes the trenching preparations. After detonating the CSCs, subsequent dredging is not usually required. The oil pipe is then placed in the trench and the job is complete. The following summary is typical of the underwater CSC trenching operations around the world:

Mexico: Isle DeLobo—Pipeline trench from offshore drilling platform to island storage facility.

Trench specifications: Width—Depth—Length—Feet (Meters) 14—6—2,300 (4.2—1.83—701) Operation completed in 4 days.

Egypt: El Alamain—Pipeline trench from mainland to offshore tanker loading facility.

Trench specifications: Width—Depth—Length—Feet (Meters) 16.5—6.5—1,-650 (5—2—503) Operation completed in 10 days.

Iran: Kharg Island—Pipeline trench from mainland to island storage facility.

Trench specifications: Width—Depth—Length—Feet (Meters) 40—8 to 14—3,050 (12.2—2.4 to 4.3—930) Operation completed in 25 days.

Trucial States: Jebel Dhanna—Pipeline trench from mainland to offshore tanker loading facility.

Trench specifications: Width—Depth—Length—Feet (Meters) 6—8—2,500 (1.8—2.4—762) Operation completed in 7 days.

Alaska: Cook Inlet—Pipeline trench from offshore platform to mainland.

Trench specifications: Width—Depth—Length—Feet (Meters) 4–7–2,500 (1.2–2.1–762) Operation completed in 4 days.

The same types of CSCs used in the above trenching operations can also be used in harbor and river dredging. Here the CSCs are placed in a checkerboard pattern, laced together with detonating cord, and detonated.

When solid rocket motors (SRMs) are launched, the capability must be provided to terminate the mission due to some malfunction of an onboard system, i.e., guidance, thermal control, etc. Unlike liquid propellant rockets, the SRMs cannot be shut down once they are ignited. If the SRM is of the type that has an open hole through its entire length, the propellant burns from the inside radially outwards over the entire length of the SRM. A simple method of terminating the thrust is to fire several conical shaped charges (by radio command) through the forward closeout dome of the SRM. The burning propellant will then exhaust through these forward holes,

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FIG. 5-10. (

creating counter-thrust in the aft direction to neutralize the forward thrust created by the aft-firing rocket nozzle.

Some SRMs, however, don't burn radially their entire length. They burn from their aft end forward over the entire inside diameter of the rocket. Terminating the thrust of these SRMs necessitates reliable rocket igniters as well as conical-shaped charges. A dual-purpose CSC is shown in Figure 5-10 that includes a cylindrical exothermic pellet built into its base. The cylindrical geometry of the exothermic pellet allows the jet of the CSC to pass through its center after which it penetrates the forward dome of the SRM. The tail of the jet then ignites the pellet as it is pulled inside the dome of the SRM. Once inside, the burning pellet, 3,000°F (1,649°C) smears through the exposed SRM propellant—igniting it. Neutralizing thrust from the forward dome of SRMs is usually short-lived. The cylindrical walls will most often rupture a few seconds after the thrust termination CSCs have penetrated the SRM's dome due to internal overpressure.

LINEAR SHAPED CHARGE (LSC)

In cross section, the linear shaped charge has many similarities to the conical-shaped charge with the main exception being the included angle of the cavity liner. Where the cavity angle of the CSC was shown to be approximately 60 degrees (see Table 5-1), the included angle of the LSC cavity liner is nearly 90 degrees. LSCs are generally fabricated in lengths up to 12 feet (3.66 meters) with explosive core loading up to 3,200 grains per foot (680 grams

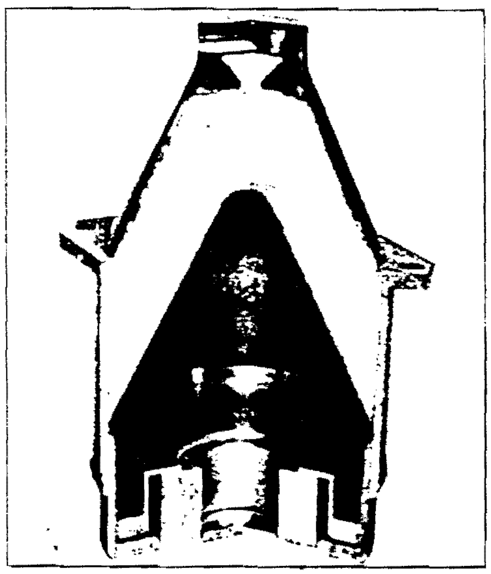

FIG. 5-10. Cutaway of SRM thrust termination CSC with exothermic pellet.

EXHIBIT 18

The Next Nuclear Gamble

Transportation and Storage of Nuclear Waste

by Marvin Resnikoff

With
Lindsay Audin

Assisted by
Nancy Bernstein
Leslie Birnbaum

Editors:
Alice Tepper Marlin
Anne Morris

A COUNCIL ON ECONOMIC
PRIORITIES PUBLICATION

Box 5-8.

The NAC-1 Cask—A Troubled Record

"As for the care taken in past shipments of spent nuclear fuel, the record speaks for itself," says one industry spokesperson (Mills, 1982). While it is true that no major accidents have taken place, in the case of one model of truck shipping cask, the NAC-1, the record is troubled.

On March 28, 1979, two irradiated fuel casks (type NAC-1) were being loaded at the Dairyland Power Cooperative reactor at La Crosse, Wis. for transfer to the fuel storage pool at Morris, Ill. (NRC, 1979b). The reactor had been shut down for refueling and an NRC inspector was present. Simultaneously, another cask of the same type was being checked out by technicians at Duke Power Company in South Carolina. Duke informed Nuclear Assurance Corporation (NAC), owner of the NAC casks, that the internal shell of their cask was bowed out of shape. Copper plates had been welded on the outside shell due to a lack of sufficient radiation shielding on the inside of the cask. This was in violation of NAC's license. NAC, however, made no effort to locate the other casks of the same type or to stop any impending shipments. The NRC inspector on duty at La Crosse, unaware of the problem at Duke, observed the filling of the NAC-1 casks and cleared the shipments for transportation to the Morris pool.

During the next nine days at least eight shipments were made between La Crosse and Morris (NRC, 1979b). The NRC was unable to say whether other casks of the same type were simultaneously in use elsewhere. The route for the shipments probably took them on Illinois Route 47, a two-lane north-south highway to the west of Chicago. However, the NRC has no record of the route actually taken (NRC, 1979c) because at the time it had no regulations restricting shipments to approved routes.

After the shipments were completed, the NRC issued a suspension order blocking further use of the casks. When the casks in use at La Crosse were finally inspected, one of them was also bowed (NRC, 1979d). Of greater significance was the fact that two other models of the same cask were also found to be bowed out of shape, although they were manufactured by a *different* company (NRC, 1979d). Of the six in use, a total of four were taken out of service due to the bowing problem.

The source of the bowing problem remains officially "undeter-

mined." It is reasonable to conclude, however, that there is a generic fault with either the design or the manufacturing process as it is unlikely that two different companies (Stearns-Roger, Denver, Col., and Exelco Co., Silver Creek, N.Y.), separated by thousands of miles and several years, could make exactly the same mistake. The NRC has indicated that crashworthiness cannot be assured in a cask with this defect.

Further research revealed that the attachment of the copper plates was done at the behest of NAC, without approval from NRC. Welding copper to stainless steel can result in embrittlement of the steel during a subsequent fire, as well as reducing the strength of the shell in other ways (Sandia, 1980c).

These problems are not surprising in the overall context of quality control on these casks. Only one month before the La Crosse incident, an internal NAC audit of its own procedures "identified the need for a complete revision of all NAC-1 operating and maintenance procedures" (NAC, 1979a). Some documentation of welding procedures during manufacture had been "lost in a fire" with no copies maintained by NAC (NAC, 1979b). Although the quality assurance program appeared to be a good plan in 1974, "problems existed with effectively implementing the program" (NAC, 1979b). It is unfortunate that such realizations came after more than five years' use of faulty casks, involving over 300,000 miles of shipments (NAC, 1979c).

Of the two casks still in service, one (NAC-1D) was checked on August 22, 1980 to assure that the same bowing problems had not befallen it since an inspection six months earlier. It was then used to ship irradiated fuel from the San Onofre reactor in California to the Morris, Ill. pool on September 4, 1980. After the shipment was completed, however, NAC told the NRC that "reevaluation of the cask measurements" indicated that this cask had the same problem. It too was withdrawn—after the fact (NRC, 1980d).

The latest model NAC-1 cask (NAC-1E) was also pressed into service and delivered to San Onofre on August 20, 1980. Unbeknownst to the San Onofre technicians, this cask had been used four months previously to ship a leaking fuel assembly from the Oyster Creek, N.J. plant to a research facility near Columbus, Ohio. The cask had become so severely contaminated in the process that external lead shielding had to be added (NRC, 1981d). When the *empty* cask arrived at San Onofre, the radiation level in the truck driver's cab was over twice the maximum legal limit (NRC, 1981d). Two Nuclear Assurance Corporation technicians were flown in to decontaminate their cask which, at several points, emitted 11 to 40 times the legal limit of radiation. Several health physics technicians working at San Onofre helped with the task. At nuclear power plants, the health physics technician is responsible

for safeguarding the worker's health during such operations. However, documents indicate that the technician in this case was not qualified for the job. "He had no familiarity with irradiated (spent) fuel casks"; and "he received no briefing or instruction with regard to the potential hazard" associated with the cask in question or even "what procedure or actions were going to be performed" (NRC, 1981d).

A capped pipe, where a valve used to be, was opened, forming a port into the cask. Highly contaminated water began pouring out. One of the NAC technicians caught it in a plastic bag and surveyed it for radiation. It emitted up to 100 rems/hr of radiation (a five-hour, whole-body exposure to that amount of radiation could be fatal). An absorbent napkin was used to wipe up some residual moisture in the port. It gave off 300 rems/hr. The technician's glove was also contaminated.

The NAC representatives then obtained *another* technician, also unaware of the hazards associated with the job and with the radiation detector he was using, according to NRC Inspection Reports. One of the NAC technicians picked up the previously filled bags of waste and attempted to dispose of them in a shielded waste container. "Because the bags would not fit into the shielded cavity, he stated that he held his breath, turned his head, pushed the bags into the cavity while puncturing them with a screwdriver" (NRC, 1981d). At no time were air samples taken, as is standard procedure, or the proper respiratory equipment used "when action was performed resulting in the disposal" of the contaminants. So Cal Edison, operator of San Onofre, was fined $150,000, later reduced to $125,000, for lax health physics supervision (NRC, 1981e).

Numerous other incidents have occurred with this particular cask:

—Exceeding by 40 percent the decay heat limit placed on it as a result of the problems stemming back to the La Crosse incident (again, the error was found *after* completion of the shipment)
—A leaking valve
—The inexplicable movement of a radioactive "hot spot" from one end of the cask to the other *after* it had been decontaminated several times.

It was even suggested that the *wrong* fuel assembly may have been placed in the cask at the Haddam Neck reactor (NRC, 1981d). The problems were so severe that Nuclear Assurance Corporation did not try to move the NAC-1E cask until six months later, and then asked NRC for permission to move it, again empty, to a nearby site for decontamination (NRC, 1981f).

The problems created by this cask occurred primarily when it was

empty, when it was in transit without guards or route restrictions, and when drivers did not need to call in every two hours. How would an accident involving such an empty cask be treated by radiological health personnel unaware of its contamination? While the total radioactive contents of the cask in question were not reported at this time, samples taken at San Onofre show that the concentration of contaminants in the water was so high that a release of several gallons of it could have caused a contamination incident similar to that postulated by Sandia Labs in its TRUE study* in which a two-billion-dollar cleanup bill could result.

The other cask (the NAC-1D), which left San Onofre in September 1980, was found *not* to be bowed out of shape after further measurement and was released for use later that year. However, upon arrival (still empty) at the Oyster Creek, N.J. plant in February 1981, it was found to have surface contamination even though it had not been used to ship fuel for five months (NRC, 1981g). An NRC inspector on duty at the time observed decontamination of the cask and the addition of a layer of heavy paint designed to hold any contamination in place during the cask's next journey (in this case, to Battelle Laboratories in Ohio). However, the wrong type of paint was used. It began to dissolve off the cask during a rain storm in Pennsylvania. The drivers noticed the peeling paint but continued on to Ohio (NAC, 1981), apparently oblivious of the fact that surface contamination was probably being spread on the highway. Most of the paint remained on the truck, but only because of the wire cage surrounding it (not a required item on all shipments). How much radiation was released will never be known. NAC notified NRC of the event five days after it occurred, but NRC took no action.

The problem of high surface contamination continued. In June of 1981, shipments arrived at La Crosse, Wis. with radiation levels 90 times higher than the legal limit (Aspin, 1981). Rather than stop the shipments, NRC allowed them to continue, merely *containing the cask in a large plastic bag.* When the shipments were completed, however, the NRC directed the La Crosse officials to hold the cask until it could be cleaned up to NRC specifications (NRC, 1981h). Unfortunately, the La Crosse officials did not warn their technicians about the cask and several were contaminated when they handled it without gloves (NRC, 1981i).

The problem was now so severe that the NRC issued an order on July 22, 1981 pulling the cask off the road until further notice (NRC,

*Calculation based on (NRC, 1981d) and comparison to Cobalt-60 content in accident studied in (NRC, 1980e).

1981j), just as Congressman Les Aspin of Wisconsin was about to demand suspension of *all* irradiated fuel shipments. The NRC order noted that between August 1980 and July 1981 the cask had exhibited excess surface contamination seven times and released some of it in transit (NRC, 1981j).

Four of the original seven NAC-1 casks have now been put out of action. One (NAC-1D) remains, limited to the transportation of older, cooler fuel, while only two, the NAC-1E and NAC-1B, are in full service. The NAC-1 cask had been the "workhorse" of irradiated fuel transport by truck. The loss of these casks reduced the available capacity for moving commercially generated irradiated fuel by truck in the U.S. by over 50 percent.

EXHIBIT 19

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

TRANSP2.MM

MAR 5 1984

MEMORANDUM FOR: John G. Davis, Director
Office of Nuclear Materials Safety and Safeguards

FROM: Robert B. Minogue, Director
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER NO. 139, POTENTIAL OXIDATION OF UO_2 IN IRRADIATED FUEL AND ITS REGULATORY IMPLICATIONS

References:

1. Letter to C. E. MacDonald from M. Resnikoff, Sierra Club, November 7, 1983.

2. Memorandum to J. G. Davis from R. B. Minogue, "Plans for Technical Response to Address Concerns Regarding Oxidation of UO_2 in Irradiated Fuel," dated November 25, 1983.

Introduction

The purpose of this memorandum is to provide an appraisal of UO_2 fuel oxidation phenomena and its potential impacts on the transportation of irradiated power reactor fuel assemblies. Concerns regarding the potential regulatory implications of this oxidation process were raised in reference 1. The basis for these concerns is an incident which took place at the Battelle Columbus Laboratory (BCL) in May 1980. The incident involved the release of radioactivity to the BCL fuel storage pool and the enclosing building interior during unloading operations of a fuel assembly known to have fuel pins with large cladding splits. The assembly had been transported in an air and temperature environment in which the irradiated UO_2 fuel material could have been oxidized to higher oxidation states. One of these oxides, U_3O_8, can result in spalling and powdering of the irradiated fuel segments. The significance of this potential oxidation process on past consequence and risk assessments is assessed.

Background

The appraisal of the status and regulatory implications of the potential oxidation of irradiated UO_2 was carried out by members of both the RES and NMSS staffs. The outline proposed for this appraisal was transmitted in reference 2 and indicated that three major topics would be addressed. The first topic was to include

a review and reevaluation of the incident at the Battelle Columbus Hot Cell Laboratory. The second topic was to include documentation of available information on the potential for UO_2 oxidation, specifically related to transportation and unloading/loading operations of irradiated fuel assemblies. This information would be used to assess the potential extent of UO_2 oxidation during these activities. The third topic was to include definition of the regulatory implications of the potential oxidation process.

Results

The detailed results of this appraisal are presented in the appendix of this memorandum. The BCL incident is evaluated in section I. The conclusions reached are that during the unloading of a fuel assembly, known to contain fuel pins with large cladding splits, an estimated 120-240 Ci of fuel material and solid and volatile fission products were released to the unloading pool and the surrounding high bay building atmosphere. Two pathways can be identified as potential major contributors to this release. First, some fraction of potentially oxidized fuel could have been released from the failed fuel rods to the cask interior during transport (i.e., normal shocks and vibrations). Second, the flooding of the cask interior during cooldown involved water interactions with thermally hot fuel rods and this interaction could have caused washout of additional material contained in the fuel rods. The exact mechanism of release of fuel from the cask cavity into the pool and building atmosphere and the contribution of any fuel oxidation on the magnitude of release is not known.

The important parameters and uncertainties associated with the oxidation process are discussed in the appendix, section II. The maximum extent of irradiated fuel oxidation is evaluated for normal and abnormal circumstances potentially associated with transportation. In order to evaluate the change in past risk estimates, a bounding likelihood for failed fuel shipments is proposed.

The possible impacts of the oxidation process on the risk and consequences associated with normal transport activities, severe accidents and sabotage events are discussed in section III of the appendix. The conclusion reached is that the impact on past risk estimates is small and the maximum release estimates would not be increased by more than a factor of 4.*

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* Based on tables 5-3, 5-12 and 5.13 in NUREG-0170, the 0.000422 expected latent cancer fatalities from spent fuel shipments assuming the 1985 shipment's model would not increase by more than 15%. The calculated consequences of extremely severe accidents in very high population density urban areas would increase from predictions of 1 latent cancer fatality to 4 latent cancer fatalities.

Findings

The major impact of irradiated fuel oxidation is the potential for occupational exposures during unloading operations. Three corrective actions are possible. First, proper unloading procedures could be devised to preclude a reoccurrence of the exposures associated with the BCL incident. Second, a non-oxidizing gas could be provided for dry spent fuel shipments which have temperatures sufficiently high to result in fuel oxidation ($>150^{o}C$). This provision could result in a reduction in both the likelihood of occupational exposures and the potential for contamination incidents affecting the cask or unloading facilities and equipment. Finally, canning of known failed fuel assemblies would provide an additional barrier against the release of solid fuel particles and would minimize the contamination potential inherent to such fuel assemblies.

Robert B. Minogue, Director
Office of Nuclear Regulatory Research

Enclosure: As stated

APPENDIX

I. Circumstances of May 1980 Contamination Incident at the Battelle Columbus Laboratory (BCL) Hot Cell

In May 1980, BCL received a fuel assembly containing known large cladding splits from the Connecticut Yankee (Haddam Neck) Power Plant in a NFS-4 spent fuel shipping cask. The assembly identified by BCL* as Batch 3 Assembly H07 was a (15 x 15) PWR assembly with stainless steel clad fuel rods. The assembly was to be used in an investigation of fuel rod failures being conducted by BCL for the Electric Power Research Institute (EPRI). Visual and photographic examination at the reactor facility, of the outer rods (outer two rows) in this assembly had identified several rod cladding failures including a 4-5 ft. long split approximately 1/8 inch wide. In several of these rods with split cladding an absence of some of the fuel pellets was noted.** During the subsequent examination program at BCL, a number of rods were removed for examination while others were identified to be in a failed condition. Figure 1, taken from reference 2, illustrates the location of removed rods and failed rods following the incident. Since the removed rods were from the highest burnup regions of the assembly (~37Gwd/MTU), it was believed that all failed rods were identified, although it is conceivable that one or two others may exist.*** The visual appearance of the failures at the reactor pool prior to shipment was stated as being similar to their appearance in the BCL pool after the incident.***

* Personal communication between V. Pasupathi and R. Klingensmith of BCL and NRC Review Group (W. Lake, W. Lahs, D. Reisenweaver and S. Turel).

** Figure 1 of reference 1 shows a view of one such rod.

*** Personal communication between V. Pasupathi and W. Lahs.

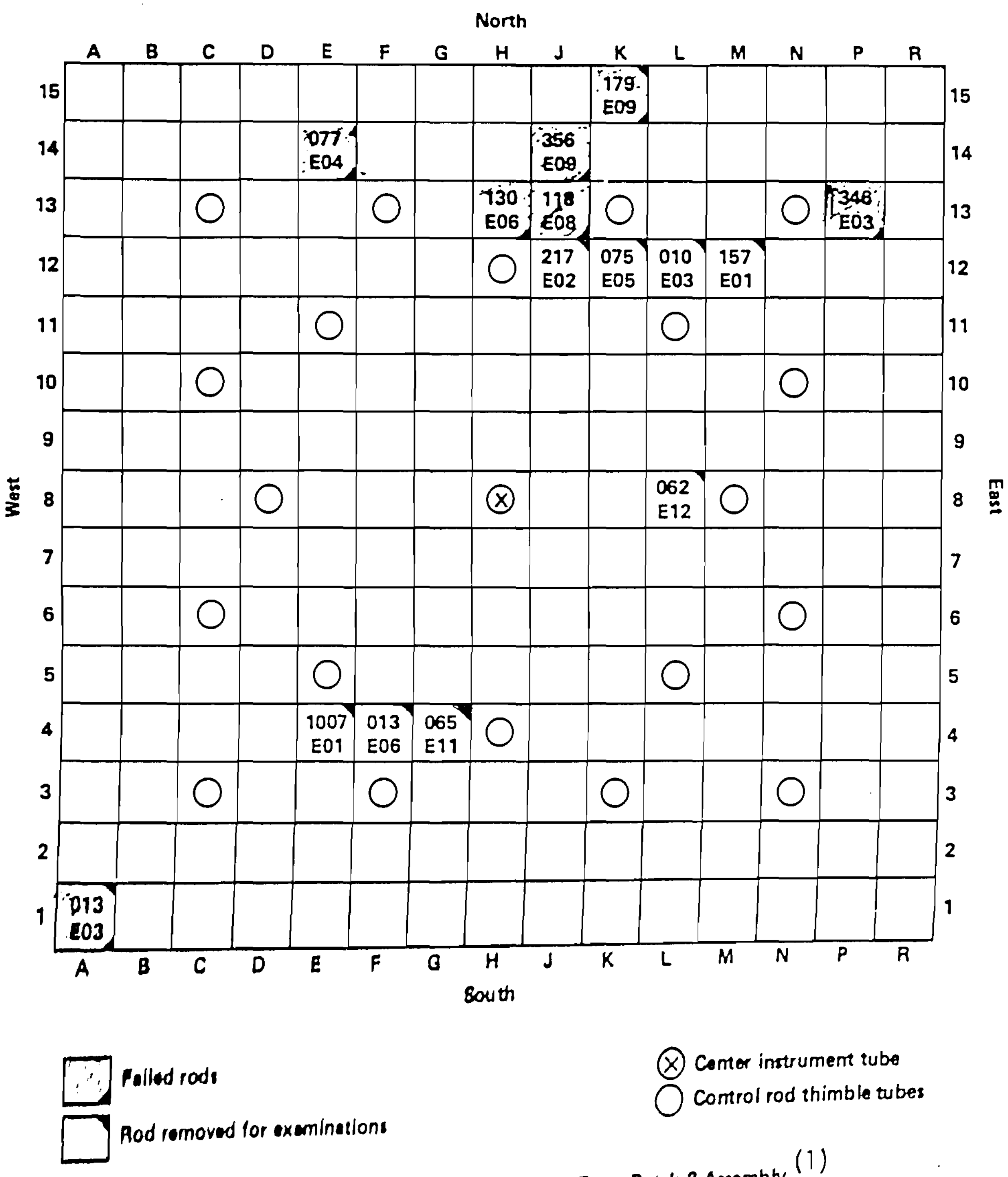

FIGURE 1 Locations Of Rods Removed From Batch 8 Assembly (1)

The assembly with decay heat between 3-3.5Kw (mistakenly believed to be about 2Kw) was transported to BCL in the NFS-4 (NAC-IE) shipping cask. The loaded cask cavity environment was normal atmospheric air. The loaded cask had remained on the reactor site for about 5 days and was in transit ∿1 day.

BCL had received failed fuel previously with no significant incidents; however, these shipments involved individual fuel rods or fuel assemblies with lower thermal power levels. When the cask was received at BCL, cavity pressure was checked (no pressurization indicated) and a cavity gas sample was taken prior to cooling and removal of fuel. The cavity gas sample was analyzed subsequent to the incident and the results indicated that the internal cavity gas was essentially depleted of oxygen (reference 1, pg. 649).

To accomplish cooldown prior to cask unloading, the cask cavity was slowly filled with water while the cask was vented to the hot cell through a connected hose. Steam was initially discharged from the hose indicating that the assembly was thermally hotter than fuel previously handled. A high radiation level alarm was also actuated within the hot cell. A sludge discharge from the hose was also noted.*

Following cavity flooding, the cask was lowered into the unloading pool where the head was removed. It was at this point that a dark cloud of material emanated from the cask resulting in contamination of pool water and airborne contamination of the cask handling area. Fuel particle release was confirmed by a β/γ activity ratio of 4 - this is much higher than ratios typical from normally observed contamination or "crud" which is dominated by the strong γ-emitter Co^{60}.

* Personal communication between V. Pasupathi and NRC Review Group.

Battelle estimated that the peak fuel rod temperatures had reached 550°F. NRC predictions have also been made and these results are in good agreement given the uncertainties in evaluating radiative heat transfer between fuel rods and the inner cask structure.* Oxidation of UO_2 to U_3O_7, U_3O_8 of higher oxides can take place at these temperatures but the degree of oxidation can not be well defined. U_3O_8 is of particular interest since formation of this oxide can cause flaking of UO_2 pellets. Theoretically, about three moles of O_2 were available to react with the UO_2 in the cask cavity. Fuel samples were sent to Pacific Northwest Laboratories for analysis to clarify the composition of any existing higher fuel oxidation states; however, this analysis has not been performed due to higher priority work.

No precise estimates of the total activity released in the incident are available.** However, based on oxygen availability and the limited data on the physical condition of the fuel assembly, several estimates can be made which may be of use in assessing the significance of the incident. Considering the limited availability of oxygen and depending on the specific higher oxidation state, a maximum of 2.4Kg of original UO_2 conceivably could have been involved in the oxidation process <u>if U_3O_8 was the only oxidation product</u>. This 2.4Kg is approximately equivalent to the weight of UO_2 contained in one rod of an approximately 200 rod PWR fuel assembly. Post-incident examination of the failed fuel rods and estimates of the amount of radioactivity released from the fuel assembly indicate that the release of the disrupted or oxidized UO_2 from the fuel rods was much less than this theoretically available 2.4Kg (more on the order of a few hundred grams).

* Personal communication between W. Lake and W. Lahs.

** Personal conversation between V. Pasupathi and NRC Review Group.

Figure 2 taken from reference 1 shows a photograph of a section taken through the failed region of a rod. If this void extends through a length of 4-5 ft., its volume would be about 2% of the fuel. This material could have been lost prior to shipment; however, as a point for comparison, this amount of missing material in each of 3 rods would contain a fission product and transuranic inventory (excluding Kr^{85}) of about 180 Ci. This 180 Ci value compares with the rough estimate of the radioactivity which apparently was lost from the fuel assembly in the incident.

From the increase in the activity of the 125,000 gallon BCL pool after the incident, up to 70 Ci of radioactivity can be accounted for in the pool water. Based on airborne samples taken after the incident, the release to the building atmosphere was negligible compared to this value.[17] Isotopes identified in both water and air samples included Ru^{106}, Cs^{134}, Cs^{137}, and Ce^{144}. A highly radioactive dark liquid residue in the bottom of the cask cavity and a dark coating of the cask interior and internal supporting spacer were sampled and analyzed. The contaminating material was identified as fuel and fission products. Decontamination efforts performed both at BCL and subsequently, Rockwell International are believed to have removed a total of 40-50 Ci. A few tens of grams of fuel material may remain in the cask.

In summary, the BCL incident involved the following: (1) some irradiated fuel material in the form of UO_2 and higher oxides could have been released from failed fuel rods into the confines of the shipping cask during transportation; (2) during the cask cooldown and internal cavity flooding processes, fractions of material in the cask and material within the failed rods were released to the BCL fuel pool;

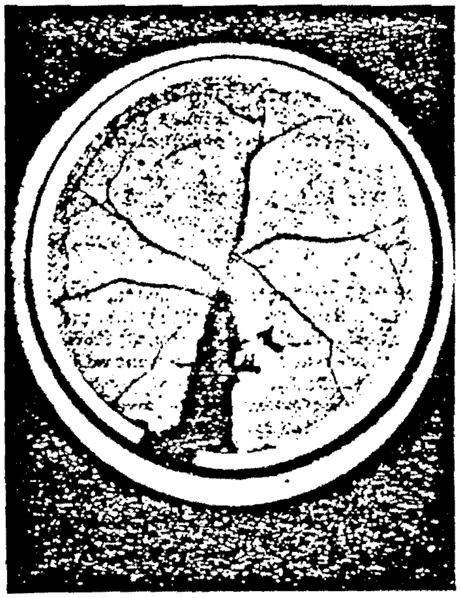

Fig. 2. Section Through Failed Region of Rod (1)

(3) the total release of solid and volatile fission products (excluding noble gases) from the fuel rods during this process is estimated to be in the range of 120 - 240 Ci; and (4) a few tens of grams of this released fuel material may still reside in the cask. The estimated release would represent from 3 - 7% of activity within a single rod. Oxidation of the UO_2 to higher oxidation states is believed to be the major contributor to the radioactivity release; however, it is conceivable that the cask cavity cooldown procedures could have played a significant role.

II. Potential for UO_2 Fuel Oxidation During Transport

The purpose of this section is twofold: first, to summarize the state-of-knowledge regarding UO_2 oxidation to higher oxidation states in transportation environments, and second, to present projections on the likelihood and extent of oxidation which could occur during normal and abnormal transportation situations.

Subsection II.a. will briefly describe the oxidation process - discussing the parameters affecting oxidation rates, the large uncertainties in predicting rates of oxidation of irradiated fuel, and the preliminary insights gained from on-going research projects.

Subsections II.b. through II.e, will provide both qualitiative and quantitative engineering judgements regarding the extent and bounding likelihood of irradiated fuel oxidation during normal and specified abnormal transportation situations. These judgements include uncertainties in understanding the process itself and rely on predictions based on the single BCL operational occurrence.

a. UO_2 Oxidation - Important Parameters and Uncertainties

UO_2 Oxidation

Until about one year ago, there was general agreement among investigators that the oxidation of UO_2 was a two-stage process. It was believed that the UO_2 was first converted to U_3O_7 and if further oxygen was available, U_3O_8 and eventually UO_3 was formed. Within the past year, this process has been questioned.

It is now believed by many investigators that U_3O_7 is a transition phase between UO_2 and U_3O_8. There is evidence that some U_3O_8 is formed before all of the UO_2 is converted to U_3O_7. The rate of oxidation is based on various factors which will be discussed later. Data presented by K. Simpson[3] indicates that after 6 weeks in air at 225°C (437°F), loose powder was formed from unirradiated UO_2 pellets. This powder was analyzed by x-ray diffractometry and was found to consist of ~30% U_3O_7 and ~70% U_3O_8.

During dry transportation of spent fuel, existing casks may be filled with air. If failed or breached rods are present in air, the UO_2 will be exposed to the oxygen and oxidation may occur. The density of UO_2 is 10.96 g/cc. There is a small density change when U_3O_7 is formed (11.4 g/cc). There is no visible evidence when this change occurs. However, the density of U_3O_8 is 8.35 g/cc and when this form of the oxide is formed, spalling or powder formation occurs due to the volume increase associated with the U_3O_8 formation. It is the U_3O_8 powder spalling which is of primary concern during handling operations and accident situations.

Parameters Affecting Oxidation Rate

It has been found that the rate of formation of U_3O_8 is dependent upon various pellet properties and transportation environment factors. The factors, besides oxygen availability, which have the greatest influence are temperature, time, surface area, and irradiation. Each of these factors is discussed below.

1. Temperature-Time:

There appears to be a period of time in which the formation of U_3O_8 is not visibly apparent. This time period is called the "incubation period." Once the incubation period is completed, it appears that the formation of U_3O_8 is accelerated and the powder spalls from the pellet. The incubation period is related to the temperature. Table 1 provides the incubation periods for unirradiated UO_2 at various temperatures. It can be seen that as the temperature of the fuel is increased, the incubation period is shortened.

2. Surface Areas:

The rate of oxidation is directly proportional to the exposed surface area. As the surface area of the fuel is increased, more grains of UO_2 are exposed to the available oxygen. The surface area can be increased in many ways. As pellets are irradiated, they tend to crack or fracture. This cracking appears to be proportional to the burnup. Another factor affecting surface area is the porosity of the pellet after manufacturing - the greater the porosity, the greater the surface area.

INCUBATION PERIODS FOR UNIRRADIATED FUEL PELLETS

TABLE 1

Temperature (°C)	Incubation Period	Weight Gain ($mg\ cm^{-2}\ hr^{-1}$)
200	4000 hr (167 da)	6×10^{-5}
225	1000 hr (42 da)	1×10^{-3}
230	250 hr (10.4 da)	8×10^{-3}
250	200 hr (8.3 da)	2×10^{-2}
300	20 hr	4×10^{-2}
350	2 hr	1.5
400	0.5 hr	33

NOTE: This material is a best estimate based on the information presented in references 3, 5, 6, and 7.

The incubation periods in this table are based on unirradiated UO_2 pellets or fragments without cladding.

The size of the breach in the cladding will be a large contributing factor in the oxidation rate. Very small defects, such as stress corrosion cracks, tend to limit the amount of oxygen which can enter the rod. Defects 30 mils and larger allow the ingress of oxygen into the rod and the oxidation process occurs. The limiting size of defects which allow the oxidation process to occur and continue has not yet been determined. The small defect sizes necessary to allow oxidation raises related concerns regarding defect detectability.

During visual examinations conducted underwater with remote video equipment at the reactor site, it is very difficult to observe the fuel rods beyond the outer few rows of an assembly. Defects contained in these inner rods may not be detected. If the rods are more than a few years old, dry sipping of the assemblies to detect defects may also prove ineffective. After this amount of time, most of the volatile isotopes will have decayed away and the gaseous longer-lived isotopes will have escaped from the defects and dissipated. A wet sipping technique for determining the presence of fission products may be appropriate if the detection of failed fuel rods is desired.

3. Unirradiated vs. Irradiated Fuel:

The incubation times listed in Table 1 were derived from experiments using unirradiated UO_2 pellets and fragments. Various researchers have tried to corrolate the effects of irradiation on unirradiated UO_2 and determine how the irradiation affects the incubation period. All researchers agree that the incubation period is less for irradiated UO_2 than for unirradiated UO_2. However, they do not agree on the degree of difference. Factors of 2 to 50 have been proposed for this difference. No conclusions can be drawn on the applicability of the incubation period for irradiated fuel based on the unirradiated UO_2 data.

4. Environment:

G. White[5] has conducted an experiment as to the effect of the presence of quantities of nitrous oxide on the UO_2 oxidation process. Small quantities of NO_2 are generated by radiolysis of moist air. When NO_2 is formed, numerous reaction products are formed. One of these products may be nitric acid.

The experiment using air with 1% NO_2 indicated that the rate of oxidation of UO_2 was much higher than for a total air environment. The final product was UO_3 rather than U_3O_8.

There is some contradictory evidence from other investigators indicating that the oxidation rate is not affected by the introduction of moist air. No conclusions can be drawn from the presently available data.

5. Particle Size:

A limited amount of data has been collected concerning particle size of the formed U_3O_8 powder. The research sponsored by the NRC[4] has shown that most of the material formed by the oxidation process tends to move very little if not disturbed. The powder falls out of the rod via the breach, but due to its density does not appear to become airborne. The fuel material which fell from the breach in the NRC experiment laid in the bottom of the containers. However, some fission products did become airborne. Although this research is not directed at determination of fission product particle size, indications are that this fission product material included sizes between 2 and 15 microns.

6. Additional Research:

Additional research in the area of UO_2 oxidation is being conducted in the U.S. by the NRC, DOE, TVA, and EPRI. Research is also being conducted in the United Kingdom, West Germany, and Canada. As additional information becomes available, this research information letter will be updated.

b. Potential for Irradiated UO_2 Fuel Oxidation to Higher Oxidation States During Normal Transport

Two major conditions must be met before any significant oxidation of irradiated UO_2 to higher oxidation states can take place during normal transportation activities: (1) the UO_2 must be exposed to oxygen and (2) the exposure must take place at sufficiently elevated temperatures. Since UO_2 fuel pellets are normally clad in inerted rods (typically Zirc-2 or Zirc-4, although some fuel from older reactors is stainless steel clad), the first condition can be met only if the integrity of the cladding is violated and the external environment includes oxygen.

The temperatures required by the second condition can be generated in the transportation process by the confinement in a spent fuel shipping cask of an irradiated fuel assembly with sufficient decay heat.

Five currently licensed shipping casks have been identified in which irradiated fuel could reach potential oxidizing temperatures and which have an air filled cavity. Two other designs (NLI-1/2 and NLI-10/24) were considered which have sufficiently high fuel pin temperatures but have helium filled cavities. The five casks of concern and the predicted maximum fuel rod temperatures based on maximum allowable cask heat loads are shown in Table 2.

Table 2: Predicted Maximum Fuel Pin Temperatures Assuming Maximum Authorized Heat Loads and Normal Transport Conditions

CASK	No. Assy PWR	BWR	Q max* (KW)	Predicted max. temp. Fuel Pin, ^oF (^oC)
NFS-4	1	2	2.5	415-447^oF (213-231^oC)
TN-8/TN-8L	3	-	35.5/23.7	837^oF (447^oC)
TN-9	-	7	24.4	712^oF (378^oC)
IF-300	7		11.72	650^oF (343^oC)
	-	18	11.72	510^oF (266^oC)

* Maximum authorized heat load for respective shipping casks.

All the predicted temperatures are sufficiently high to promote the potential oxidation of UO_2 to U_3O_8 over time periods typical to irradiated fuel shipments if the UO_2 is exposed to the cavity air. The free volume of air within the identified shipping casks ranges from about 12 ft^3 in truck casks to 96 ft^3 in rail casks. The oxidizing potential of this volume of air could convert UO_2 to a wide range of oxides (e.g., U_3O_7, U_3O_8, UO_3). The smaller volume, representative of a single PWR assembly truck cask, has been calculated to convert ~2.4Kg of UO_2 to U_3O_8.** This value is conservative since available evidence indicates that other oxides would also be formed. The 2.4Kg value is approximately equivalent to the weight of the UO_2 contained in one rod of an ~200 rod PWR fuel assembly which for 150 day cooled power reactor fuel would be expected to contain ~ 9,000 Ci of solid and volatile fission products and transuranics.

** Values of 20 Kg presented in reference 1 are apparently in error. This error was carried over into the summary of the BCL incident described in the memorandum to files from W. Lahs, dated December 5, 1983.

However, based on the actual oxidation occurrence discussed in section I, it appears that the oxidation process contributed to the release of 120 to 240 Ci of fission product and fuel material from the fuel rods. This level of radioactivity is equal in magnitude to that contained in 70 - 130 grams of irradiated UO_2 fuel.

A bounding likelihood of a spent fuel shipment including a failed fuel assembly can be inferred from data in fuel performance reports.(8) For the calender year 1981, 0.6% of the fuel assemblies (both discharged and in core) were estimated to contain failed rods. If the number of failed assemblies is compared to the number of assemblies discharged, a bounding 3% occurrence rate can be calculated. These failed fuel assemblies typically average 3 failed rods/assembly with widely varied conditions of failure.(8)

c. Potential for Irradiated UO_2 Fuel Oxidation to Higher Oxidation States During Loading/Unloading Operations

The potential for oxidation of irradiated UO_2 to U_3O_8 or other higher oxidation states during loading or unloading operations requires conditions similar to those identified during normal transport activities. Since the typical loading operation involves transfer of a fuel assembly from a water-filled pool to the shipping cask, no significant oxidation would be expected until the water coolant is removed from the cask and the assembly temperature increases from its initial value of 70-100^oF. (Temperatures sufficient to promote oxidation could be achieved.) Any potential for oxidation during loading is limited however, by the time of fuel exposure to oxygen. That potential should be clearly far less than the potential for oxidation during transport. For loading processes invol-

ving purging or vacuum drying and backfilling of the shipping cask with non-oxidizing gas, the times of exposure to air would be extremely limited. Unloading operations are also performed under water. Therefore, no significant fuel oxidation is expected.

d. <u>Potential for Irradiated UO_2 Fuel Oxidation to Higher Oxidation States During Extremely Severe Transport Accidents</u>

Analysis and testing have been performed to assess the response of spent fuel shipping casks to severe accident forces. These assessments indicate that no significant violations to containment integrity would occur for the severe conditions evaluated. However, since all severe accident conditions could not be evaluated, both references 9 and 10 assumed some cask containment violations sufficient to release small fractions of volatile fission products or activation products dissolved in cask cooling water. Some fuel rod cladding failures were also assumed to result from accident forces. Extending these reference assessments, it can be argued that under extremely severe conditions, the inert or oxygen depleted cavity gas could be replaced in time with atmospheric air.* For minor cracks or small penetrations of containments, the time for cavity gas replacement could involve several hours. For accidents which result in small cask breaches not affecting normal cask heat transfer capabilities, fuel temperatures could remain at values indicated in table 2 or table 3. Table 4 gives similar temperature maxima calculated for the severe accident conditions specified in 10 CFR 71. Therefore, the conditions for fuel oxidation conceivably could be attained sometime following the accident event. Following the incubation period

* For failed fuel shipped in closed failed fuel connisters, an additional barrier to both oxygen ingress and fuel particle release would be provided.

Table 3: Predicted Maximum Fuel Pin Temperatures for He Cooled Casks Assuming Maximum Authorized Heat Load and Normal Transport Conditions

Cask	No. Ass'y PWR	No. Ass'y BWR	Qmax* (Kw)	Predicted max. temp. Fuel Pin °F	(°C)
NLI 1/2	1	2	10.6	1013°F	(545°C)
NLI 10/24	10	-	70	900°F	(482°C)
	-	24	40	724°F	(384°C)

Table 4: Predicted Maximum Fuel Pin Temperatures Assuming Maximum Authorized Heat Load and Severe Accident Conditions

Cask	No. Ass'y PWR	No. Ass'y BWR	Qmax* (Kw)	Predicted max. temp. Fuel Pin °F	(°C)
NFS-4	1	2	2.5	438-472°F	(226-244°C)
NLI-1/2	1	2	10.6	1102°F	(594°C)
TN-8/TN-8L	3	-	35.5/23.7	998°F	(537°C)
TN-9	-	7	24.4	825°F	(441°C)
IF 300	7	-	11.72	754°F	(401°C)
	-	18	11.72	614°F	(323°C)
NLI-10/24	10	-	70	991°F	(533°C)
	-	24	70	854°F	(457°C)

* Maximum authorized heat load for respective shipping casks.

(referrred to in the generalized oxidation discussion), fuel within failed rods could oxidize to U_3O_8 at a rate which is a strong function of fuel rod temperatures and oxygen availability, until the process reached completion. Available data indicates that this process could take hundreds of hours at 450°F (232°C) but would occur rapidly at 750°F (399°C).(5)(11) Much of the oxidized material would tend to remain in place in the fuel rod if not disturbed, but any that fell from a fuel cladding breach could fall to the bottom of the fuel basket or shipping cask. The postulated circumstances that allow replacement of the preaccident cover gas with atmospheric air through some small containment violation are not conducive to allowing a significant release of this material from the cask.

Undefined accident forces even greater than those discussed above could be hypothesized to cause gross cask containment violations. Even under these conditions, immediate exposure of the fuel to atmospheric air can not be presumed. The geometric location of the violation would not only be critical to the rapid replacement of the cask cavity gas but also to the subsequent release of oxidized material. And, as noted before, if the fuel had cladding damage before shipment, making it more vulnerable to these most severe conditions, it would be further contained in an internal failed fuel cannister. Based on this subjective evaluation, a substantial release pathway for fuel material oxidized subsequent to the accident event is not considered a significant possibility.

e. Potential for Irradiated UO_2 Fuel Oxidation to Higher Oxidation States Following a Transportation Sabotage Incident

Several reference basis explosive threats to spent fuel shipping casks have been evaluated in past studies.(12)(13) The most damaging was a large shaped charge

which caused a cask wall penetration represented by approximately a 6 inch (avg. dia.) hole. The corresponding hole through the fuel bundle was approximately 3 inches in diameter. Therefore, it can be postulated that following such a hypothetical explosive attack, atmospheric air could replace the cask cavity gas. Full scale experiments indicate that fuel rod damage could be as high as one half the fuel rods in a fuel assembly. Fuel disrupted by the attack could be deposited within the cask or in the environment external to the cask. This disrupted material would be expected to cool quickly to temperatures below which oxidation would not be a significant problem. Depending on heat transfer conditions, fuel material remaining within the damaged fuel rods could remain at temperatures close to the previously tabulated values. Following an incubation period, UO_2 fuel within these damaged rods could oxidize to U_3O_8 at a rate governed by rod temperature. This oxidation process could continue until all damaged fuel is fully oxidized. Most of the oxidized material would tend to remain in place in the damaged rods, although material near points of gross cladding failure could fall to the bottom of the shipping cask. This material, formed sometime subsequent to the hypothesized explosive attack, could only be released from the cask through the entrance hole created by the shaped charge. A significant release of this material would require proper geometric orientation of the entrance hole and a driving force, subsequent to the explosive attack, to move the oxidized material from the cask and fuel rods to the external environment. Based on this subjective evaluation, a substantial release pathway for fuel material oxidized subsequent to the sabotage event is not considered a significant possibility.

III. Regulatory Implications of UO_2 Oxidation to Higher Oxidation States

The regulatory implications of UO_2 oxidation, discussed in this section, are all based on the assumption that the oxidation process contributed to or could have contributed significantly to the radioactive material release which occurred in the BCL incident. The descriptions of the incident and limited experimental evidence supports this assumption. The information and experimental evidence, however, do not preclude the possibility that the procedures used to flood the cask cavity and cool the cask could have been a major cause of fuel and fission product release to the pool and cask handling area.

a) Normal Conditions of Transport*

Potential oxidation of UO_2 has limited significance during normal transportation. Because of the containment system, oxidation products would not be released from the cask. Any public health and safety impacts would be related to the potential effects of fission product transfer from fuel rods to the interior surfaces of

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* For accident conditions that fall within those described by 10 CFR 71, the containment of any oxidized fuel would be assured by the cask design requirements. Therefore, the arguments presented in this paragraph apply to hypothetical accident conditions of 10 CFR 71.

the shipping cask. By moving the radioactivity closer to the shipping cask walls the radiation level external to the cask could increase slightly. Fuel oxidation during transport is limited by available oxygen and the maximum amount of fuel oxidized to U_3O_8 has been calculated to be approximately one rod in a typical truck shipment or 8 rods in rail cask shipments. This amount of fuel material and any additional radioactive volatiles released from the failed rods would not significantly change the radiation levels typical to routine shipments of unfailed irradiated fuel.

b) Unloading and Loading Operations

The regulatory implications of UO_2 oxidation appear most pertinent to unloading operations involving grossly failed fuel assemblies. A conservative bounding estimate would indicate that failed fuel assemblies could account for 0.6% to 3% of the fuel assembly population. For significant oxidation to occur, the extent of cladding failure must be beyond that associated with minor failure modes such as stress corrosion cracking. Moreover, the failed assembly must be exposed to air and the fuel must reach temperatures high enough to promote oxidation. If significant oxidation does occur, the maximum potential health and safety impacts would be reasonably bounded by the occupational exposures and facility/equipment contamination experienced in the BCL incident and its related recovery operations.(14)(15) The rationale for representing the impacts of this BCL incident as upper bound values is as follows: (1) the fuel assembly was an atypical design containing grossly failed stainless steel clad fuel rods, (2) the extent of fuel rod damage was far greater than the average, (3) the thermal power of the assembly was greater than most past or expected near term spent fuel shipments,

(4) the assembly was shipped in an air environment without any added containment provisions, and (5) the receiving parties did not fully appreciate the potential hazards of the unloading operation.

c) Extremely Severe Transport Accidents

Past assessments[9][10] have estimated both the risks associated with spent fuel transportation and the radiological consequences of extremely severe accidents involving spent fuel shipments in highly urbanized areas. This section will evaluate the impacts, if any, that UO_2 oxidation could have on these past assessments.

As discussed in section II.d., no significant cask containment violations are expected following a spent fuel shipping cask involvement in a severe transport accident. Nevertheless, some cask containment violations were assumed and the resulting fission product releases from both truck and rail shipping casks were evaluated.[9] The release from the truck cask included 1700 Ci of Kr^{85}, 0.022 Ci of I^{131}, and 200 Ci of volatile fission products. The rail cask release included 10,900 Ci of Kr^{85}, 0.138 Ci of I^{131} and 1280 Ci of volatile fission products. The consequence calculation in reference 10, assumed that the radioactivity release was 154 Ci of Co^{60}. This release represented a bounding estimate for the amount of activated corrosion products which could be present on the cask inner surfaces and the exterior surfaces of the fuel elements (known as reactor "crud").

A reassessment of these past release estimates, accounting for potential UO_2 fuel oxidation, must include two major considerations: (1) the effect of potential UO_2 oxidation prior to the accident and (2) the potential for UO_2 oxidation subsequent to the accident.

As indicated in section I. and II.b. the radioactivity release from the fuel assembly in the BCL incident has been estimated as 120 to 240 Ci excluding noble gases. This release occurred primarily during the flooding of the cask cavity. The washout caused by water and steam generated in this process should conservatively bound the expected release from the fuel rods to the cask cavity under most extremely severe accident conditions. Adjusting the activity release to account for the 150 day-cooled fuel evaluated in the past assessments would increase these values by a factor of about 2. In the BCL incident, however, some of this radioactivity remained in the cask following the release to the pool and high bay of the cask handling area. This circumstance suggests that a release from the cask under most extremely severe accident conditions would be bounded by an undefined fraction of the adjusted release estimate of 240 to 480 Ci. Depending on the accident scenario postulated, this release estimate could be considered as an upper bound replacement value for the 200 Ci of volatiles or 154 Ci of "crud" assumed in the past evaluations. However, if the 240 to 480 Ci release is added to past estimates, the calculated releases would change by less than a factor of 4. Because an accident involving a failed fuel assembly is less likely by at least a factor of 30 (3% incidence of failed fuel), the calculated change in overall risk would be extremely small.

Following an extremely severe accident event, air could conceivably replace the pre-accident cask environment, i.e., either an inert gas or air depleted of oxygen. The fuel oxidation process could then proceed as dictated by time and fuel temperature considerations. This post-accident oxidation could produce long term radioactive material releases which would be limited to volatile fission products

that could diffuse from either irradiated unoxidized UO_2 or UO_3 which had undergone oxidation to U_3O_8 or higher oxides. Reference 16 indicates that at 500°C (932°F) diffusion release rates from oxidized fuel may be greater than from unoxidized fuel. Even if the fuel pin should be at this temperature level, the rate of release is not expected to be significant relative to the prompt releases already evaluated.

In conclusion, indications are that the oxidation of UO_2 to higher oxidation states during or following an extremely severe transportation accident does not contribute significantly to either the radiological consequences or risks calculated in previous evaluations. Based on tables 5-9, 5-12, and 5-13 in reference 9, the 0.000422 expected latent cancer fatalities from spent fuel shipments assuming the 1985 shipments model would not increase by more than 15%. The calculated consequences of extremely severe accidents in very high population density urban areas could increase from predictions of 1 latent cancer fatality to 4 latent cancer fatalities.

d) Sabotage

Recently completed research programs by both NRC and DOE have evaluated the chemical and physical form of radioactive material release resulting from specified explosive attacks against spent fuel shipments. Of the explosive threats evaluated, the shaped charge was determined to be the bounding explosive threat. The DOE sponsored program included a full scale test involving an obsolete, but structurally typical shipping cask containing a section of an unirradiated fuel assembly. The shaped charge penetrated the cask wall, damaged 50% of the fuel

rods in the assembly, and removed 2.5Kg of fuel from the cask. The amount of potentially respirable irradiated fuel material was estimated by the DOE and NRC programs as 17 grams and 9 grams, respectively. The evaluations of the effects that UO_2 fuel oxidation can have on these results must consider the possibility of oxidation before and after the hypothesized sabotage event and the dispersion of oxidized fuel in the event.

From the discussion in section II.b., it has been calculated that shipment of a grossly failed fuel assembly in an air filled cask at temperatures sufficient to cause oxidation, could result in the equivalent of a single fuel rod of UO_2 being oxidized to U_3O_8.

The disruption of material caused by a shaped charge attack on a fuel rod containing powdered U_3O_8 is uncertain. Since the high pressure shock wave would be expected to dissipate more rapidly in U_3O_8 powder than in large solid fuel fragments, the formation of respirable particles through shock compression should be significantly less in oxidized vs. unoxidized fuel. If it is assumed that only the failed fuel rod is in the path of the shaped charge jet, so that the shaped charge jet penetrates this rod, approximately 40 grams of fuel material could be initially disrupted by the jet passage. The fraction of respirable sized material is unknown but a maximum value of one half the total should be conservative. The disruption of any further U_3O_8 caused by the detonation of the initiating explosive is also unknown, but would be limited to the amount of powdered oxide available at the time of the incident. The estimated likelihood of attack on a failed vs. unfailed fuel assembly would reflect the failed fuel occurrence rate of 0.6 to 3% estimated in section II.b.

Following a sabotage event, air could replace the pre-event cask atmospnere. Again the post-event oxidation process and potential for radioactive material release would be controlled by diffusion processes discussed in section III.c.

In conclusion, the estimated total impact of UO_2 fuel oxidation on the sabotage source term is, at most, a doubling of the larger solid material release from the cask to 5Kg and a respirable release bounded by the extremely severe accident releases.

References:

1. Airborne Contamination Released During Underwater Unloading of a Failed PWR Spent Fuel Assembly. R. W. Klingensmith, PATRAM Proceedings - Berlin 1980, pgs. 646-653

2. Investigation of Stainless Steel Clad Fuel Rod Failures and Fuel Performance in the Connecticut Yankee Reactor, V. Pasupathi and R. W. Klingensmith, EPRI-NP-2119, November 1981

3. Simpson, K. A., "Uranium Dioxide Fuel Oxidation in Air Below 350°C," in Proceeding of the Workshop on Spent Fuel/Cladding Reaction During Dry Storage, NUREG/CR-0049, August 1983

4. NUREG/CR-2889, "A Technical Description of the NRC Long-Term Whole Rod and Crud Performance Test," Hanford Engineering Development Laboratory, September 1982

5. White, G. D., Knox, C. A., Gilbert, E. T., Johnson, Jr., A. B., "Oxidation of UO_2 at 150 to 350°C," in Proceedings of the Workshop on Spent Fuel/Cladding Reaction During Dry Storage, NUREG/CR-0049, August 1983

6. Novak, J., Hastings, I. J., "Post-Irradiation Behavior of Defected UO_2 Fuel Elements in Air at 220-250°C," in Proceedings of the Workshop on Spent Fuel/Cladding Reaction During Dry Storage, NUREG/CR-0049, August 1983

7. Hastings, I. J., Novak, J., "Behavior in Air at 175-250°C of UO_2 Fuel Fragments Extracted from Irradiated Elements," in Proceedings of the Workshop on Spent Fuel/Cladding Reaction During Dry Storage," NUREG/CR-0049, August 1983

8. Fuel Performance Annual Report for 1981, W. Bailey and M. Tokar, NUREG/CR-3001, December 1982

9. Transportation of Radioactive Material by Air and Other Modes, NUREG-0170, December 1980

10. Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment, NUREG/CR-0743, July 1980

11. A Conceptual Design Study of a Fluoride-Volatiltiy Plant for Reprocessing LFMBR Fuels, ANL-7583, July 1969

12. Final Report on Shipping Cask Sabotage Source Term Investigation, NUREG/CR-2472, October 1982

13. An Assessment of the Safety of Spent Fuel Transportation in Urban Environs, SAND-82-2365, June 1983

14. Investigation Report 50-213/80-20, R. Smith and J. Roth, Region I, November 1980

References (Continued)

15. Investigation Report 50-206/80-26, R. Cillis and G. Yuhas, Region V, November 25, 1980

16. Fission Product Release from Highly Irradiated LWR Fuel, NUREG-0727, February 1980

17. Letter to Dr. E. W. Ungar from J. Keppler, December 8, 1980

EXHIBIT 20

SAND80-2124
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UC-71

TRANSPORTATION ACCIDENT SCENARIOS FOR COMMERCIAL SPENT FUEL

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ABSTRACT

A spectrum of high severity, low probability, transportation accident scenarios involving commercial spent fuel is presented together with mechanisms, pathways and quantities of material that might be released from spent fuel to the environment. These scenarios are based on conclusions from a workshop, conducted in May 1980 to discuss transportation accident scenarios, in which a group of experts reviewed and critiqued available literature relating to spent fuel behavior and cask response in accidents.

Scenarios Postulated

As can be seen in the two fault trees, many possibilities exist for potential accident scenarios. In this section five scenarios are selected as being credible: four for water-cooled casks and one for air-cooled casks. No intervention during the scenario is assumed to mitigate the consequences (e.g., no attempts to remove cask from a fire).

Scenario 1

The fault tree path describing this scenario is shown in Figures 12 and 13. The path is indicated by heavy black lines.

In this scenario, only an impact environment has been assumed during the accident. The environment is sufficient to knock crud loose and to cause a cask closure seal to fail. Valves or penetrations are assumed not to fail because the impact zone was not near them. The environment is sufficient to activate the crud release mechanism in phase 1, but since no waterlogged rods are assumed to be in the cask, no rods fail from the impact. None of the mechanisms in phase 2 occurred because the spent fuel was assumed to be more than 180-days old. It must be further noted that, even though the thresholds for the impact-rupture mechanism and for the seal-failure pathway are both assigned a value of 2a, an impact that results in seal failure does not necessarily have to result in impact rupture of the spent fuel. Conditions of impact might be such that the impact zone is in a critical location for seal failure, but in a location that results in little fuel damage.

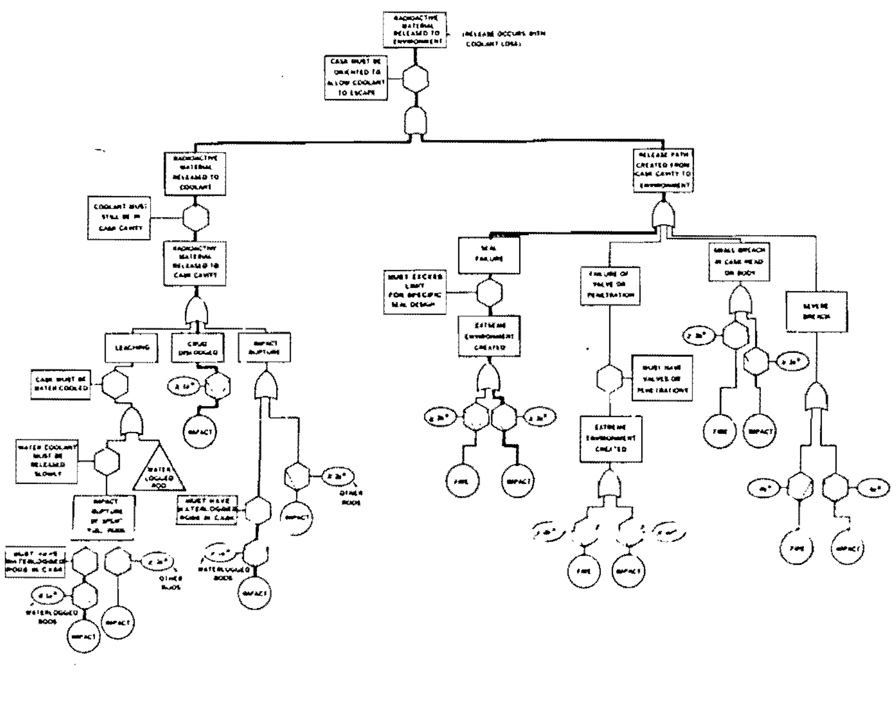

Figure 12. Fault tree for Phase 1 (Scenario 1).

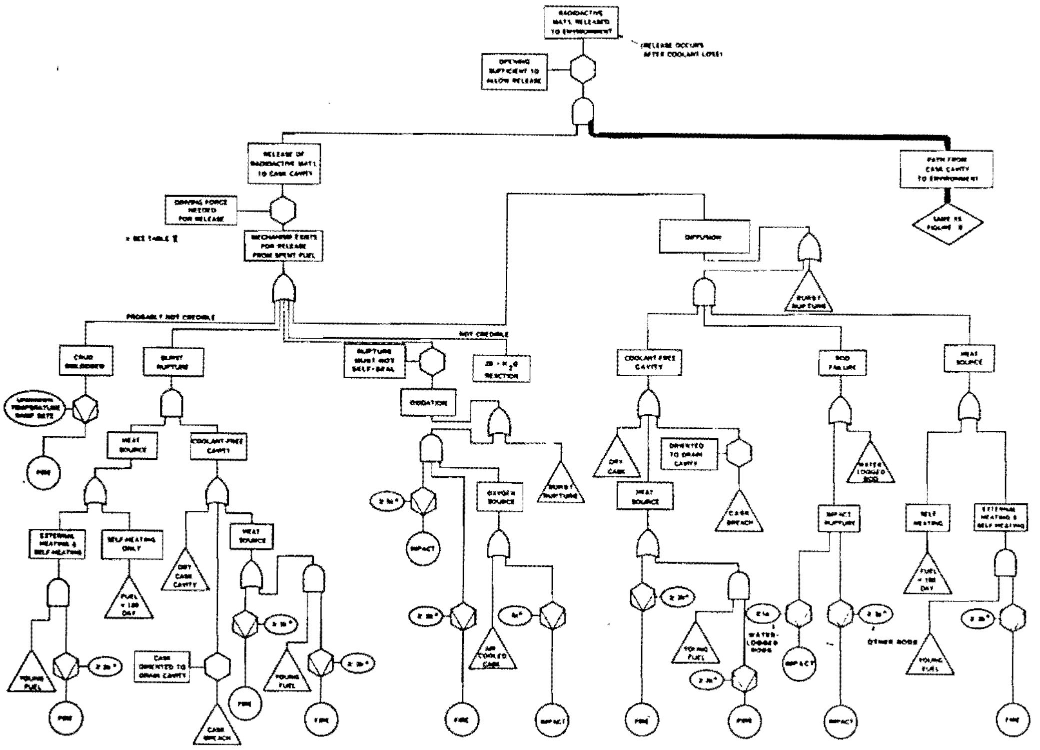

Figure 13. Fault tree for Phase 2 (Scenario 1).

Scenario 2

The fault tree paths, indicated by heavy black lines and describing this scenario, are shown in Figures 14 and 15.

In this scenario, a severe impact is assumed to occur with an accompanying fire that lasts less than one-half hour. The environments are sufficient to initiate the crud release mechanism and the leaching mechanism in phase 1 and to initiate the diffusion mechanism in phase 2. Rod failure required for leaching and diffusion is assumed to result from waterlogged rods. The cask failure pathway is through a seal. Again, valves or penetrations are assumed not to fail because the impact zone was not near them. The cask must drain its coolant

fairly rapidly so that the diffusion mechanism can be initiated. The decay heat from the spent fuel and the external fire are assumed to be sufficient to allow the diffusion mechanism to proceed.

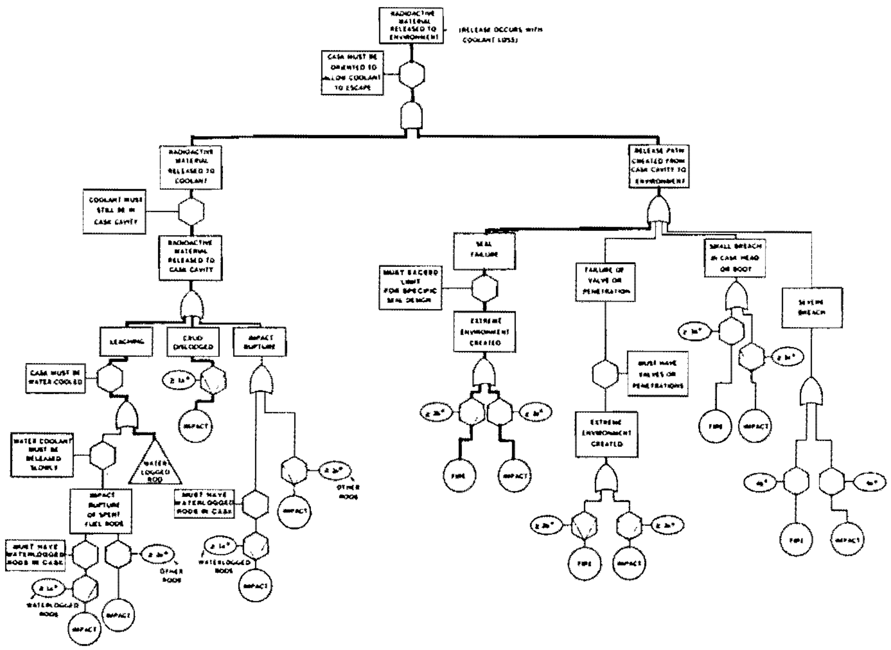

Figure 14. Fault tree for Phase 1 (Scenario 2).

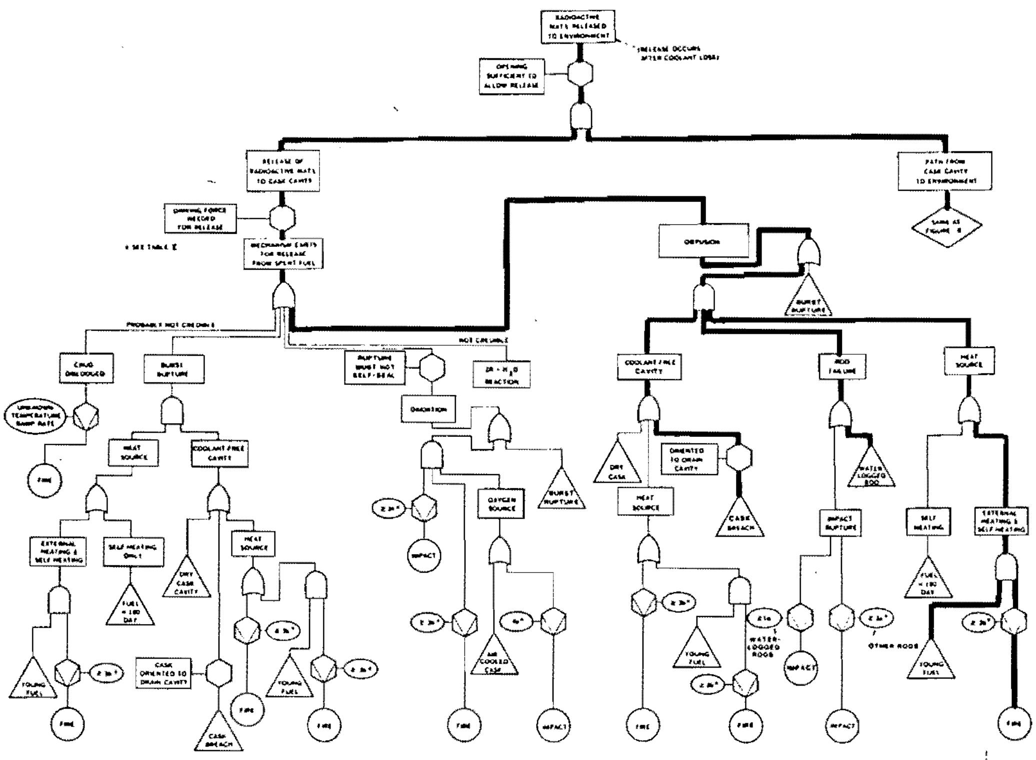

Figure 15. Fault tree for Phase 2 (Scenario 2).

Scenario 3

This scenario, as indicated in Figures 16 and 17, is different from scenario 2 in that the burst-rupture mechanism is initiated because the fire is assumed to last for a much longer time. In addition, the spent fuel is assumed to be much younger so as to have a much higher decay-heat generation rate.

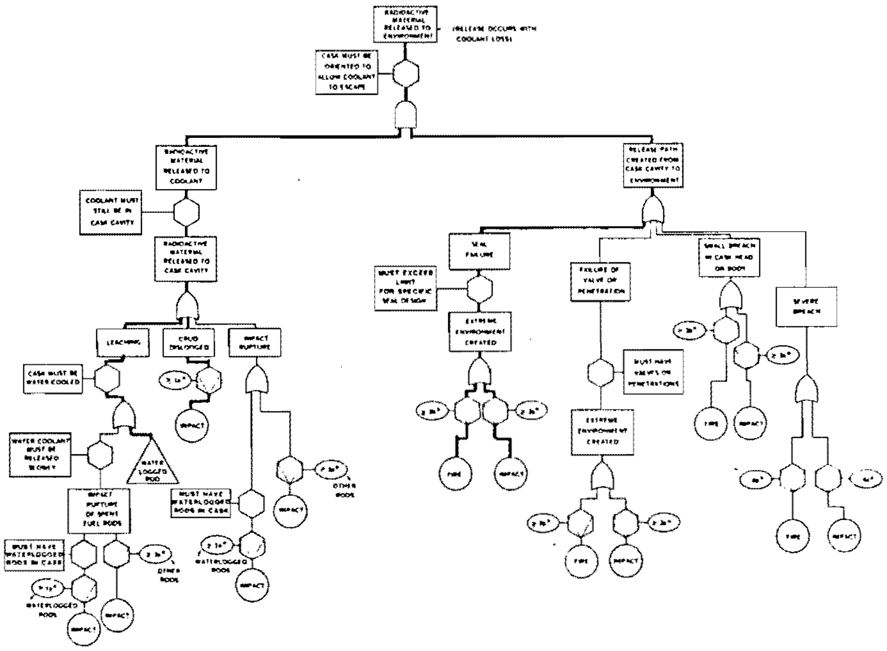

Figure 16. Fault tree for Phase 1 (Scenario 3).

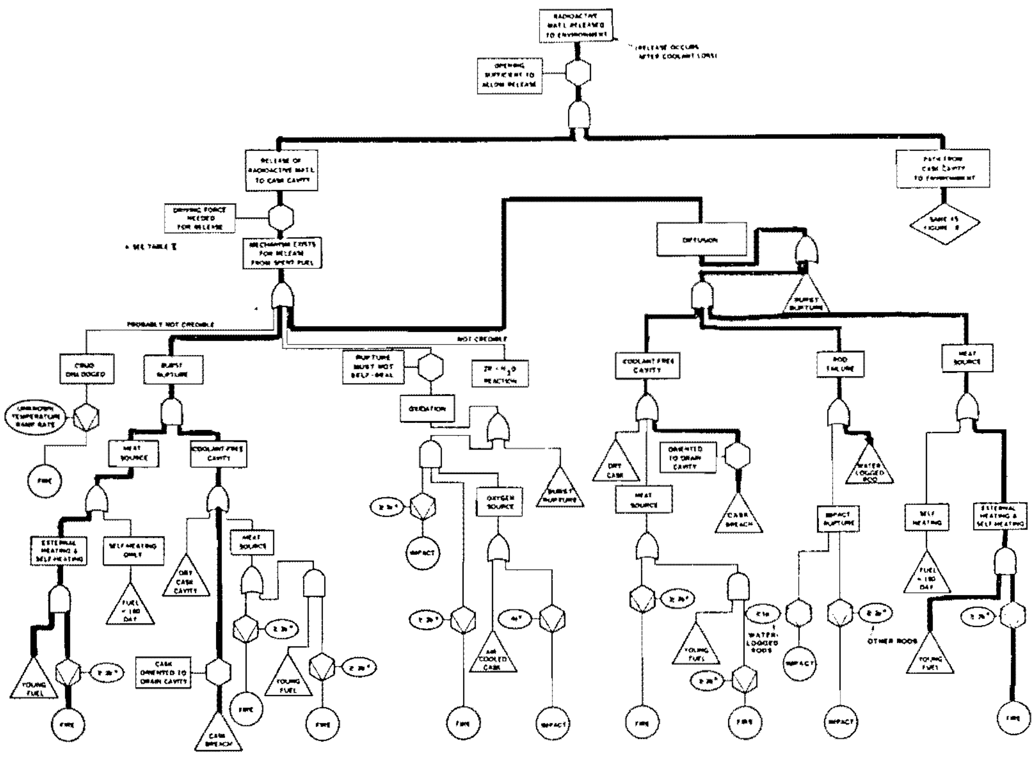

Figure 17. Fault tree for Phase 2 (Scenario 3).

Scenario 4 (A worst-case for water-cooled casks)

This scenario considers all spent fuel release mechanisms that are credible in a water-cooled cask and considers a seal failure and a small breach as the pathways for release from the cask cavity to the environment (see Figures 18 and 19). This scenario can be considered a credible worst-case scenario.

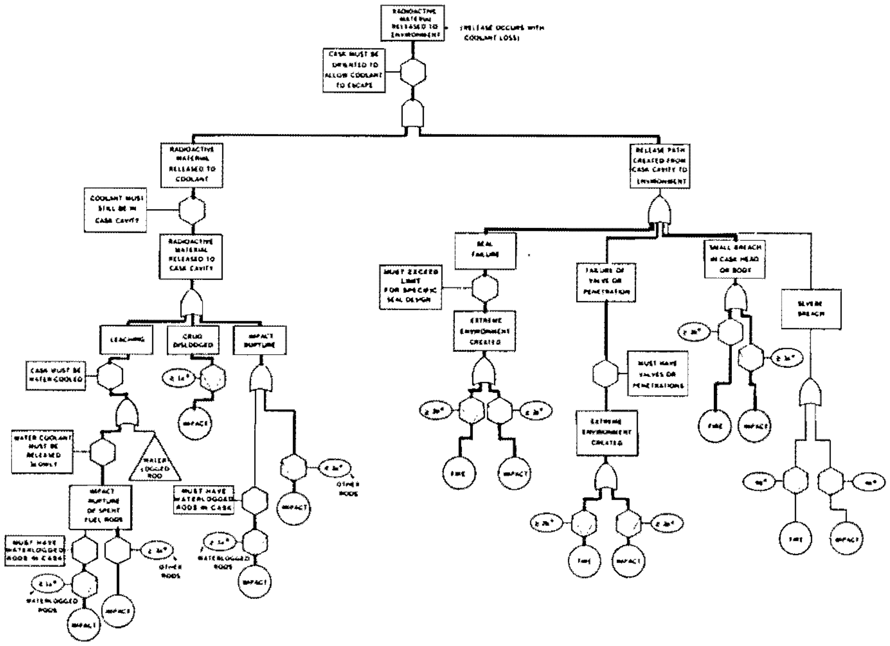

Figure 18. Fault tree for Phase 1 (Scenario 4).

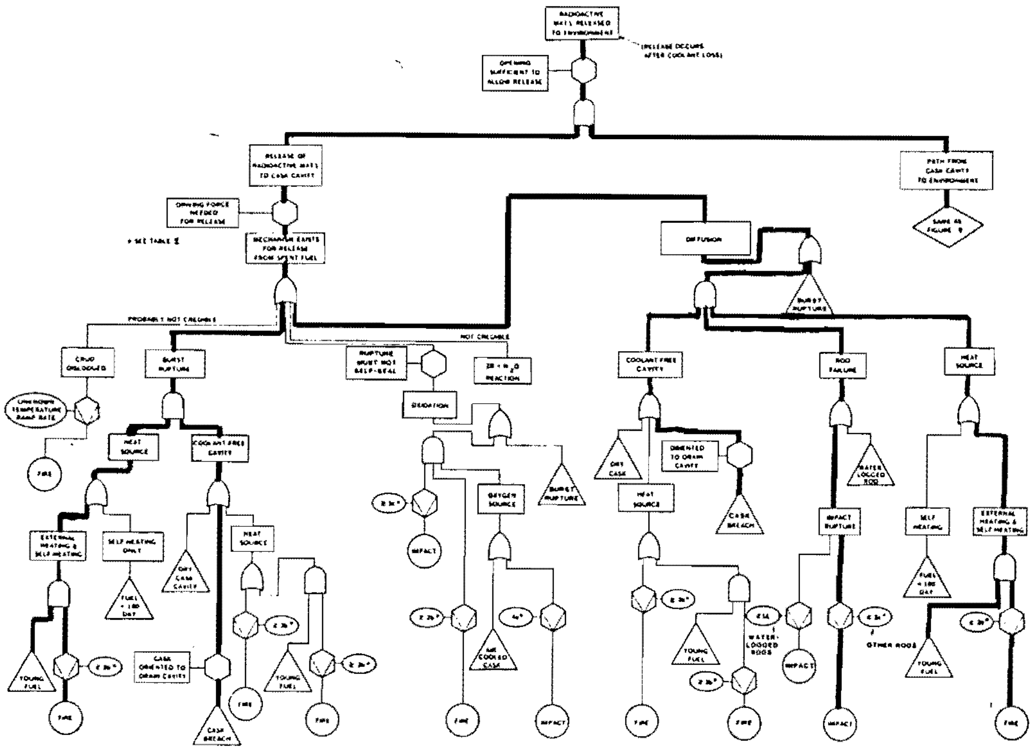

Figure 19. Fault tree for Phase 2 (Scenario 4).

Scenario 5 (A worst-case for air-cooled casks)

This scenario considers all mechanisms of release (see Figures 20 and 21) that are credible for an air-cooled cask. The oxidation mechanism is included even though severe impact must have occurred and a replenished oxygen supply must be available. If fuel that has been grossly failed in the reactor is shipped in an air-cooled cask, the oxidation mechanism could possibly take place during phase 1 (before the air coolant escapes), but for ease in presentation, this scenario considers oxidation to occur during phase 2. In either case, whether it occurs during phase 1 or phase 2 is of little significance, since the release factor is unaffected. This scenario can be considered a credible worst-case scenario for an air-cooled cask.

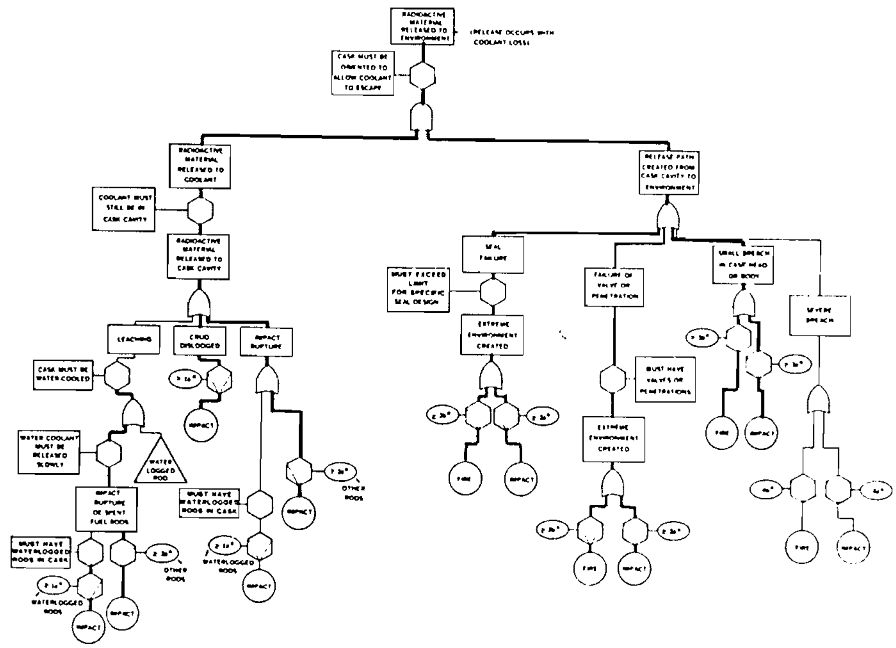

Figure 20. Fault tree for Phase 1 (Scenario 5).

EXHIBIT 21

RAE-8339/12-1

EXPOSURES AND HEALTH EFFECTS FROM SPENT FUEL TRANSPORTATION

November 29, 1985

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It is important to recall the conservative assumptions made in arriving at these estimates for the maximum consequences of severe but credible rail accidents that result in significant water contamination. The probability of a rail cask accident with radionuclide release is no greater than 2 occurences per millcon rail transport accidents. Futhermore, the probability that such an accident would occur near a major reservoir and that prevailing weather conditions would combine to result in significant reservoir water contamination is extremely small. In the very unlikely event that a water reservoir were actually contaminated by a spent fuel accident release it is reasonable to assume that normal water treatment processes, combined with monitoring and emergency actions, would significantly reduce doses received by the affected population to levels well below those predicted by this maximum consequence analysis.

It is also helpful to put the impacts in Table 3-5 into perspective. Assuming an annual water ingestion of 400 quarts per year by each person, for the water consumption assumed in the calculations (one percent of one billion gallons), this water quantity would service about 37 million people. In a single year, using the same cancer risk factor as used in Section 3.3 (Ref 19), those people would experience about 72,000 cancer fatalities from other causes. Again, even using very conservative calculations of accident effects, the worst case rail cask accident that could contaminate a water supply does not pose a significant health impact.

3.4 CLEANUP TIME AND COST ESTIMATES FOR SPENT FUEL RAIL CASK ACCIDENTS

The risk of injuries and fatalities resulting from releases of radioactive material as a consequence of a severe but credible rail cask

accident can be reduced if a cleanup of the more highly contaminated areas is carried out. However, the total economic costs associated with cleanup and reclamation for a substantial radionuclide release could be very high and the net reduction in associated health effects relatively low (see Section 3.3).

Detailed estimates of the costs incurred for cleanup and recovery from a shipping cask accident in a highly developed urban environment have previously been made in several studies (Refs 20 and 21). Total cost estimates of about 2 billion dollars have been projected following the atmospheric release of about a 1000 curies in a city. The bulk of these costs are attributed to the denial of public access to contaminated areas while cleanup occurs.

The economic costs for cleanup and recovery will be strongly dependent on the amount and type of radioactive material released, the particular setting (rural, urban, plain, mountainous, sea shore, etc.) and the level of cleanup (i.e., the minimum residual activity level that is permitted to remain after cleanup).

In this analysis the cost and manpower estimates for cleanup and recovery from worst case rail cask accidents are for a contaminated rural setting. The three classes of rail cask accidents described previously were considered.

Table 3-6 provides the ground areas calculated by the PATHRAE-T code as being contaminated after a spent fuel rail cask accident. The areas are shown for contamination above various levels of surface activity. For example, a level of 10 $\mu Ci/m^2$ for the 1380 curie release from an impact, burst and oxidation class accident is associated with a contaminated area of 2.16 km^2. The characteristics for other contamination levels and accident classes are similarly defined.

TABLE 3-6

CONTAMINATED AREAS FROM SPENT FUEL RAIL CASK ACCIDENTS

Accident Class	Radiation Release (Ci)*	Level of Contamination ($\mu Ci/m^2$)	Contaminated Area (km^2)
Impact	8.1	10	0.013
		5	0.025
		1 (~250 mrem/yr)	0.13
		0.5	0.26
		0.2	0.67
Impact and Burst	153	10	0.24
		5 (~500 mrem/yr)	0.48
		1	2.4
		0.5	4.9
		0.2	13
Impact, Burst and Oxidation	1380	10	2.2
		5 (~500 mrem/yr)	4.3
		1	22
		0.5	45
		0.2	110

* Activity for Kr-85 (and all other radioactive noble gases) is omitted. All other nuclides are eventually assumed to be deposited in the soil.

The various levels of soil contamination listed in Table 3-6 can be related approximately to average annual radiation exposure that would be incurred by individuals living in the contaminated area immediately after cleanup. The three principal nuclides that account for over 99.5 percent of the activity deposited on the ground are Co-60, Cs-134 and Cs-137. Healy (Ref 22) estimates that a uniform soil activity of 80 pCi/g of Cs-137 or Cs-134 will result in a total annual individual dose from all pathways combined (inhalation, ingestion, and external radiation) of about 500 mrem per year to an individual living on the contaminated site and consuming food from a home garden. A soil activity of 80 pCi/g (Cs-134 or Cs-137) is conservatively associated with a surface contamination of about 5 $\mu Ci/m^2$.

For Co-60, which is the dominant nuclide for the impact class spent fuel accident, a soil activity of about 20 pCi/g, or 2 $\mu Ci/m^2$ is associated with the equivalent 500 mrem per year dose to an individual living on the contaminated site. In view of Federal policy (both EPA and NRC) to minimize doses to both individuals and population groups, it is difficult to predict the actual cleanup levels that would be required. The EPA (Ref 23) has recommended a cleanup level of 0.2 $\mu Ci/m^2$ for transuranic elements in the general environment.

Using the data from Table 3-6 it was possible to project a set of cost and time requirements for different cleanup levels in a rural setting. Knowing the ground area of contamination and assuming an acceptable depth of soil removal, the volume of contaminated soil was estimated.

Rough estimates of cleanup costs and recovery time requirements are given in Table 3-7, for cleanup to a level that limits individual dose rates from radionuclides to 500 mrem/yr. For a given rail cask accident class, the volume of contaminated soil that was removed was estimated by

TABLE 3-7

CLEANUP COSTS AND RECOVERY TIME ESTIMATES FOR RURAL SPENT FUEL RAIL CASK ACCIDENTS*

Accident Class	Contaminated Land Area (m^2)	Total Cost Range ($) Low	Total Cost Range ($) High	Cleanup and Recovery Time (Calendar Days)
I - Impact	6.3E+4	2.0E+5	9.5E+6	25
II - Impact and Burst	4.8E+5	1.4E+6	7.0E+7	68
III - Impact, Burst and Oxidation	4.3E+5	1.3E+7	6.2E+8	460

* Cleanup is to a level that reduces individual dose rates from deposited radionuclides down to a maximum value of 500 mrem/yr.

assuming a 10 cm excavation depth. Costs per cubic meter of soil removed were then assessed for the four categories:

- Monitoring, excavating, loading and packaging. These costs vary with terrain, equipment accessibility and packaging (if necessary) requirements.
- Transportation costs to the nearest acceptable disposal site. These costs vary with travel distance and transportation routes.
- Disposal costs. This varies with the disposal site selected and necessary site preparations to accomodate the given waste form.
- Site restoration costs. This includes costs for fill material, hauling, spreading, and seeding. Also, erosion protection and replacement of existing improvements and utilities may be required.

Estimates for cleanup and restoration costs range from $10/m^3 for simple monitoring, excavation and loading of contaminated soil in open trucks to $430/m^3 for extensive monitoring, packaging the contaminated soil in sealed drums and loading the drums in trucks. Similar ranges of extremes exist for transportation ($15/m^3 to $530/m^3) and disposal ($5/m^3 to $510/m^3) costs depending upon the specific cleanup scenario projected. The low cost estimates are based on costs projected for cleanup of the Vitro uranium mill tailings in Salt Lake City, Utah (Ref 24). The Vitro cleanup represents rail transportation over about 100 miles. The high cost estimates are based on transportation and waste preparation cost estimates for low-level radioactive wastes from Reference 25 and disposal costs for the Barnwell, South Carolina low-level waste facility (Ref 26). For the latter, a highway transportation distance of about 400 miles was assumed. All cost estimates are adjusted to 1985 dollars.

Estimated cleanup and recovery times in calendar days are also provided for each scenario shown in Table 3-7. These time estimates assume about 4 to 7 calendar days for emergency response, radiation monitoring, and evaluation of the contaminated area. The remaining time is devoted to actual cleanup and removal of contaminated materials. The mathematical relationship assumed for the cleanup and recovery time is approximately linearly dependent upon the contaminated land area, with a correction applied for economy of scale for large areas.

EXHIBIT 22

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TRANSPORTATION OF RADIONUCLIDES IN URBAN ENVIRONS: DRAFT ENVIRONMENTAL ASSESSSMENT

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U.S. Department of Energy

Prepared for
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Office of Standards Development
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NRC FIN No. A1077

For low-severity accidents, the entire effect comes from the nonrelease accident. When the release fraction is not zero and the material is aerosolized, three exposure pathways are possible: remnant, cloudshine, and groundshine. There is also the inhalation dose pathway. Analysis of these pathways has revealed that cloudshine is not significant. Groundshine is the most significant contributor to both latent cancer fatalities and genetic effects (see Table 3-6).

Further analysis of the data reveals that certain accident severities contribute most significantly to the overall risk. For dispersible materials shipped in Type A packages, accidents of severities II through V produce more than 95% of the observed health effects. For dispersible materials shipped in Type B packages (non-fuel-cycle materials), accidents of severities III through VI result in more than 98% of the calculated health effects. If dispersible fuel cycle materials shipped in casks are examined, severity III and severity IV accidents produce 98% of the observed health effects. Nondispersible material accidents of intermediate severities contribute the major portion of the health effects. Given the above information, we conclude that accidents of intermediate severity are the most significant in the calculation of risk values.

In summary, the expected values of radiological risk are dominated by the few spent fuel shipments and by medical-use shipments, with all of the expected early morbidities coming from the spent fuel shipments. Essentially 100% of the expected health effects come from truck transport of the materials, although this may well be an artifact of the computer models. Shipments in Type A packages and casks dominate the expected health effects, contributing equally to the calculated values. Dispersible materials dominate the expected number of health effects, although much of the total results from exposure to material deposited on the ground during cloud passage. Several routes used in the analysis pass through cells adjacent to the northern boundary of the study area. Since accidents occurring in these cells during prevailing southerly winds (assumed for Tables 3-1 through 3-6) could affect areas of the city outside the grid, the analysis was repeated using the four cardinal wind directions and three distinct wind speeds to examine the variation of the overall results for these different conditions. Table 3-7 presents the results of this analysis. The greatest variation is observed in the calculated numbers of expected early morbidities. As wind speed increases independent of direction, the number of early effects decreases. As the wind speed increases above 8 m/s, the calculated number of early morbidities becomes zero. The analysis indicates that, for the most part, a single choice of wind direction and speed is sufficient to gauge the level of estimated radiological effects.

3.4 Direct Economic Impacts

The extensive radioactive contamination of an area from a major accident involving radioactive material can result in large economic costs to homeowners, businesses, and governmental agencies. These costs consist of immediate emergency response costs, cleanup and recovery costs, radiological survey costs, street cleanup costs, building cleanup costs, evacuation costs, security costs, and land-use denial costs as determined by the particular situation. Each of these costs, detailed in Appendix K, is a function of accident severity.

The general methodology in economic impact assessment involves five principal steps:

Table 3-7

Expected Radiological Risk Values from
Vehicular Accidents by Wind Direction and Speed

Wind Direction	Wind Speed (m/s)	Expected Number of Latent Cancer Fatalities	Expected Number of Genetic Effects	Expected Number of Early Morbidities
S	2	1.4×10^{-3}	1.9×10^{-3}	2.7×10^{-5}
S	4	1.4×10^{-3}	1.9×10^{-3}	4.2×10^{-6}
S	8	1.4×10^{-3}	2.0×10^{-3}	0
W	2	1.5×10^{-3}	2.0×10^{-3}	3.3×10^{-5}
W	4	1.5×10^{-3}	2.1×10^{-3}	8.4×10^{-6}
W	8	1.4×10^{-3}	1.9×10^{-3}	0
N	2	1.5×10^{-3}	2.1×10^{-3}	2.7×10^{-5}
N	4	1.6×10^{-3}	2.2×10^{-3}	4.2×10^{-6}
N	8	1.6×10^{-3}	2.3×10^{-3}	0
E	2	1.3×10^{-3}	1.7×10^{-3}	3.3×10^{-5}
E	4	1.3×10^{-3}	1.8×10^{-3}	8.4×10^{-6}
E	8	1.2×10^{-3}	1.7×10^{-3}	0
Average Values		1.4×10^{-3}	2.0×10^{-3}	1.2×10^{-5}

1. Calculation of the actual downwind contamination levels
2. Comparison of actual levels with desired cleanup levels
3. Selection of cleanup technique required
4. Assessment of costs based on cleanup technique selected
5 Calculation of economic risk in a parallel fashion to radiological risk.

costs are a strong function of both the amount of material released and the .red cleanup level. Figure 3-2 shows the relationship between the direct ıomic impact and the amount of material released and aerosolized for the ınup level of 0.2 $\mu Ci/m^2$ currently recommended by the Environmental Protec- ı Agency (EPA) for both long- and short-lived materials.[11] Figures 3-3 and show the contribution of each of the components of economic impact to the ıl amount for long- and short-lived materials. For smaller releases of ȝ-lived materials, the costs of surveying the area dominate the overall ꜰs. As the released amount increases, costs associated with street cleanup, lding cleanup, and evacuation become significant. At high levels (>100 ies), costs associated with permanent land-use denial account for virtually of the economic impact. For releases of short-lived material, survey, eet cleanup, and building cleanup costs dominate the smaller releases. In case of intermediate and larger releases, however, costs associated with cuation and building cleanup account for virtually all of the cost impact. figures display the costs for the limited New York City study area and thus truncated at the edges of the grid. This truncation levels off some of the .t curves and is an artifact of the modeling.

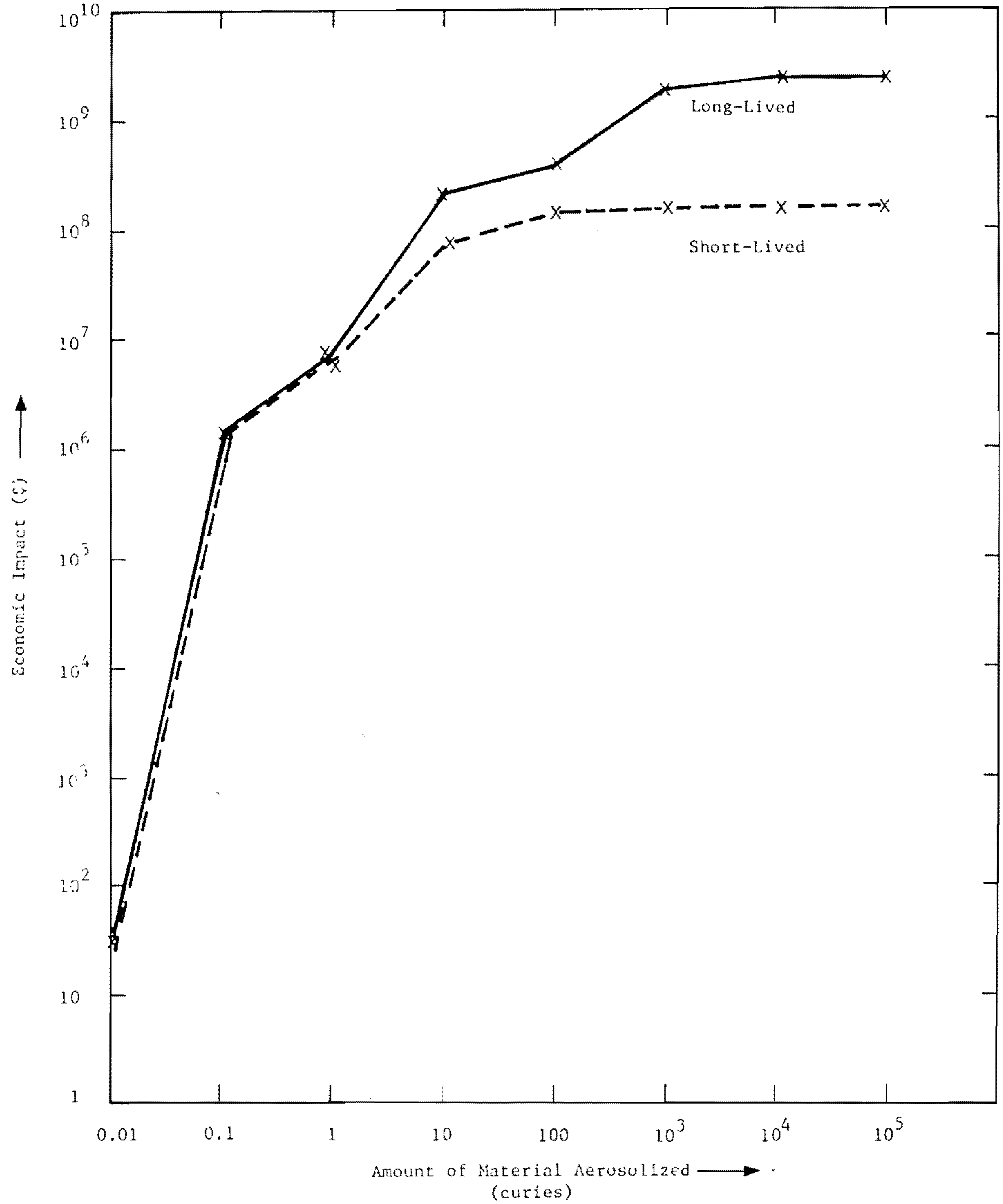


Figure 3-2. Economic Impact versus Amount of Material Aerosolized. The cleanup level is 0.2 $\mu Ci/m^2$ for both long- and short-lived materials.

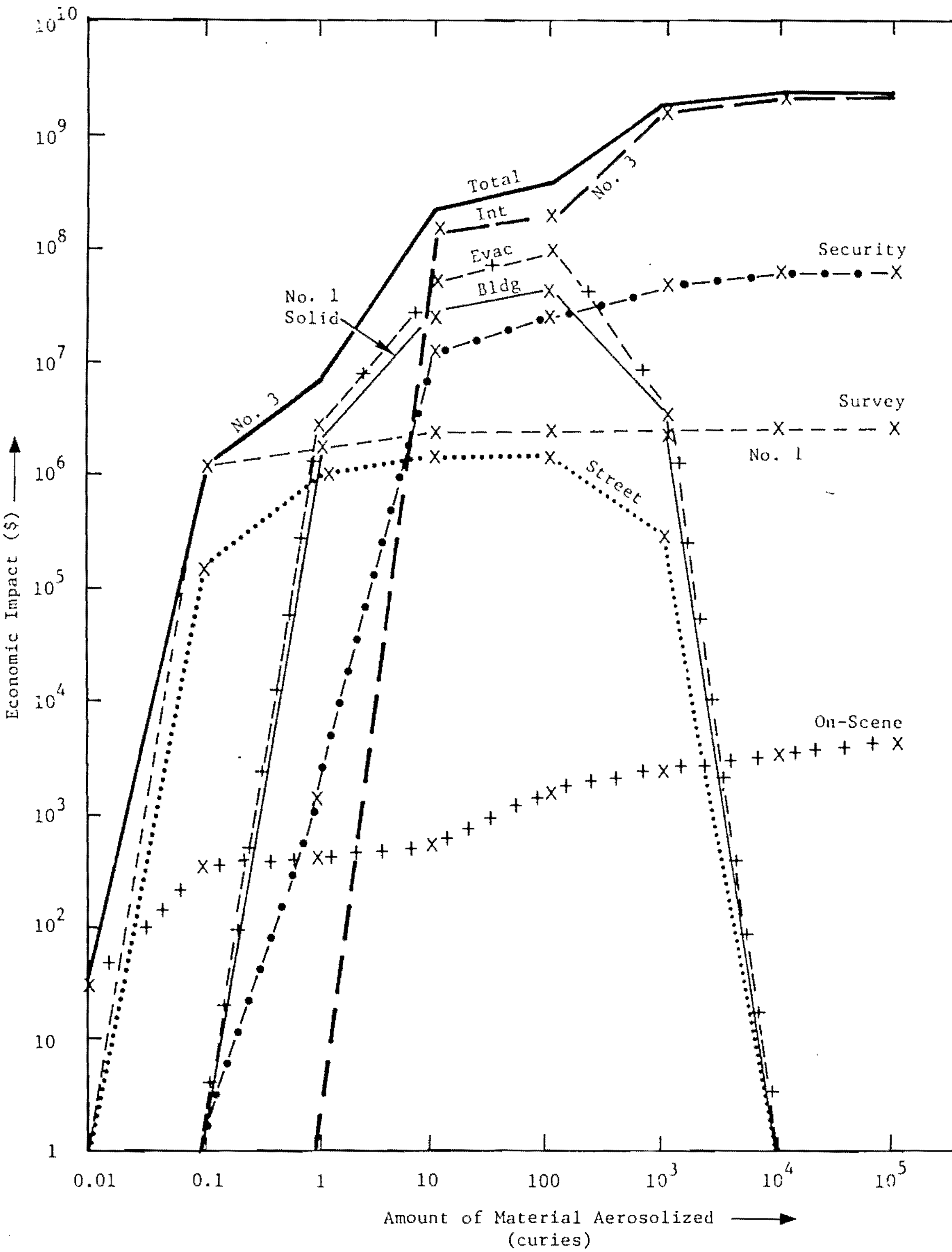


Figure 3-3. Cost Components for Urban Releases of Long-Lived Materials. The cleanup level is 0.2 μCi/m^2.

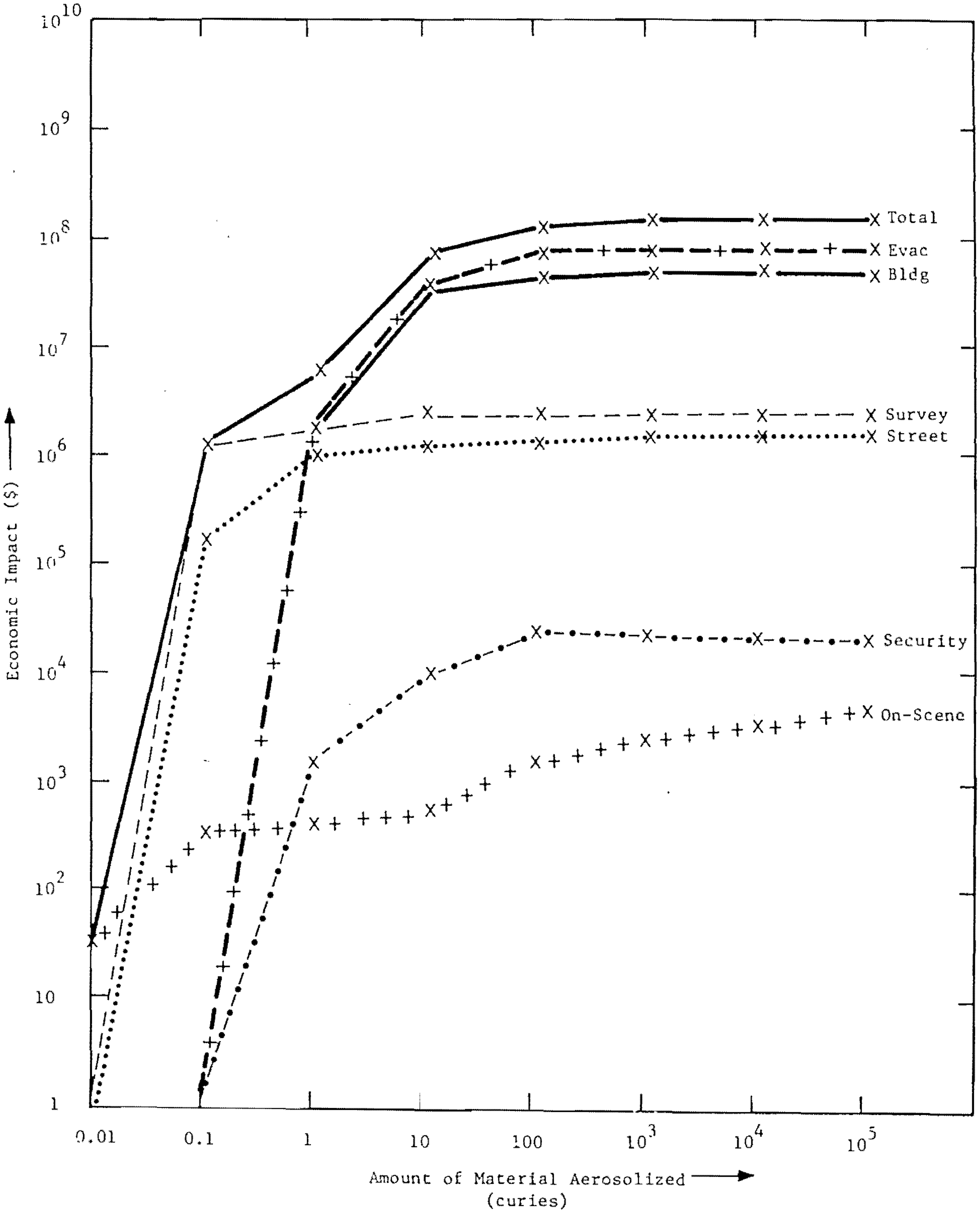


Figure 3-4. Cost Components for Urban Release of Short-Lived Materials. The cleanup level is 0.2 $\mu Ci/m^2$.

Figure 3-5 shows the relationship of cleanup level to total cost for releases of long-lived materials. For small releases, there is a very large spread in costs, reflecting the large difference between on-scene emergency response costs, which require a relatively small amount of time, and costs for survey which take a relatively large amount of time and technical expertise. The curves are roughly parallel for intermediate-level releases where costs are dominated by cleanup and evacuation. For very large releases, where land-use denial occurs and where the decontamination factors are extremely large, the costs are relatively insensitive to cleanup level because permanent land-use denial is required for all cases. The overlap between 0.2 $\mu Ci/m^2$ and 0.1 $\mu Ci/m^2$ is a result of being near the threshold for permanent land-use denial. In the case of the 0.2 $\mu Ci/m^2$ release, the total of evacuation and building cleanup costs is slightly greater in the neighborhood of 10 curies than in the interdiction cost for the same geographical area for a cleanup level of 0.1 $\mu Ci/m^2$.

As discussed in Appendix K, the half life of a radionuclide determines, in part, the type of approach taken to the overall cleanup effort. Figure 3-6 shows the effect of cleanup level on total cost for various releases of short-lived material. In the low and intermediate ranges, the costs are comparable to those for long-lived materials, although they are somewhat smaller. At levels greater than 10 curies, however, the costs associated with releases of short-lived materials are significantly less, principally due to the permanent land-use denial in the case of long-lived materials. This factor is omitted from the costs for short-lived materials because the approach assumed is one of "evacuate and wait for decay."

Because of the overwhelming contribution of permanent land-use denial to costs of large releases of long-lived materials, these costs are relatively insensitive to the particular urban area being studied (assuming, of course, that urban land value is relatively constant from city to city). Similarly, the dominance of survey costs for small releases means that these costs, too, will not vary much from city to city. Evacuation and building cleanup costs dominate intermediate releases, and these costs scale roughly with population density. Therefore, costs for releases of long-lived materials can be approximated for other cities knowing only population density variations.

Intermediate and large releases of short-lived materials are dominated by evac-.tion and building cleanup costs so these can be approximated from city to city knowing the ratio of population densities for the various cities. Low-level release costs are dominated by survey costs, which are essentially independent of the city involved.

In evaluating these economic impacts, two things must be kept in mind. First, these are, at best, order-of-magnitude estimates. More accurate predictions would require detailed descriptions of the actual accident site, prevailing meteorology, and downwind land-use patterns rather than the more generic descriptions used in METRAN. Second, METRAN cannot quantify all economic costs since there are several indirect costs which are more a function of public response than a function of the actual contamination "footprint." Examples of these costs include costs of litigation, indirect business losses (due, for example, to fear of possible danger, even after cleanup), and actual costs to government agencies dealing with the incident.

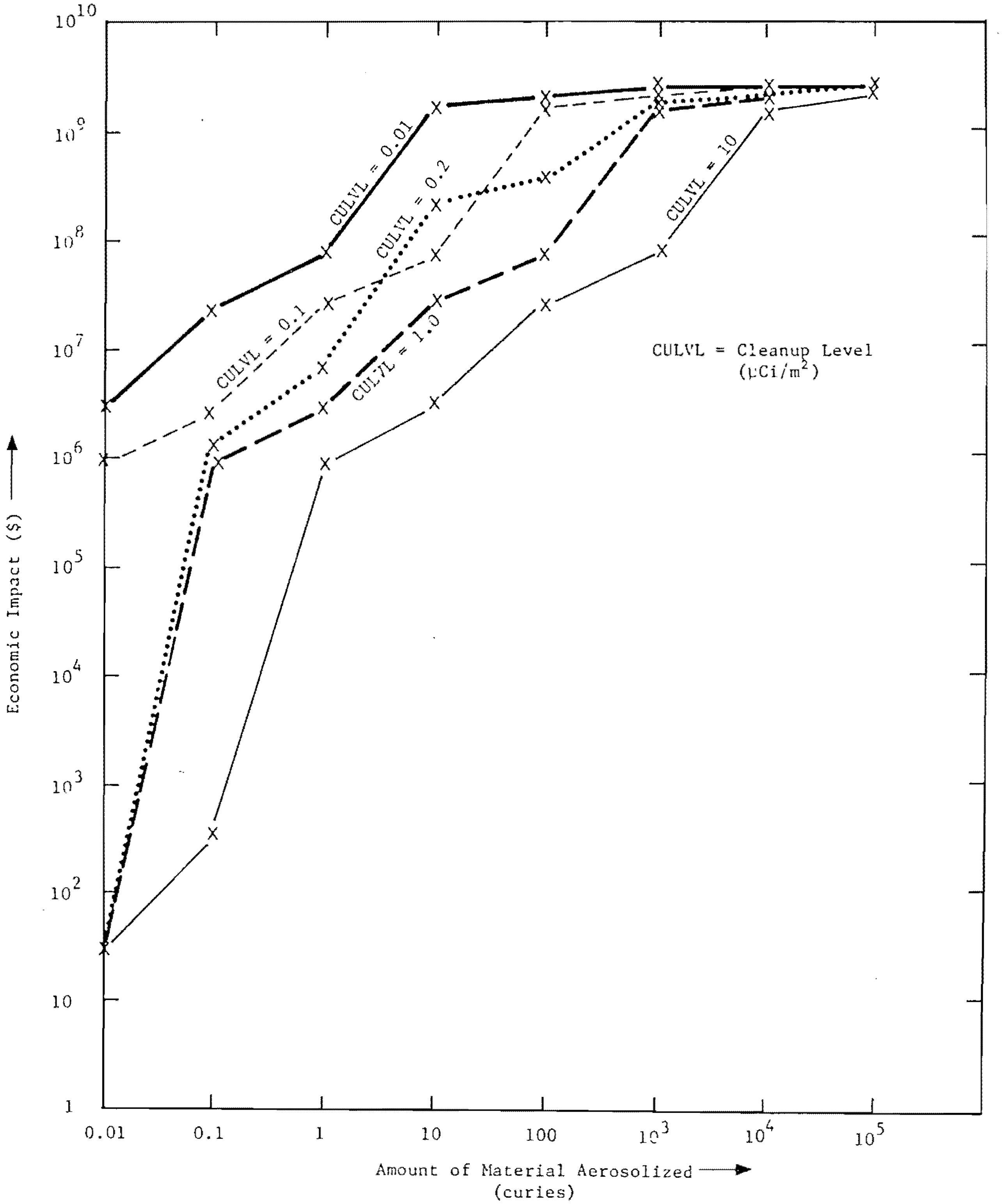


Figure 3-5. Relationship of Economic Impacts to Amount of Long-Lived Material Released for Different Cleanup Levels

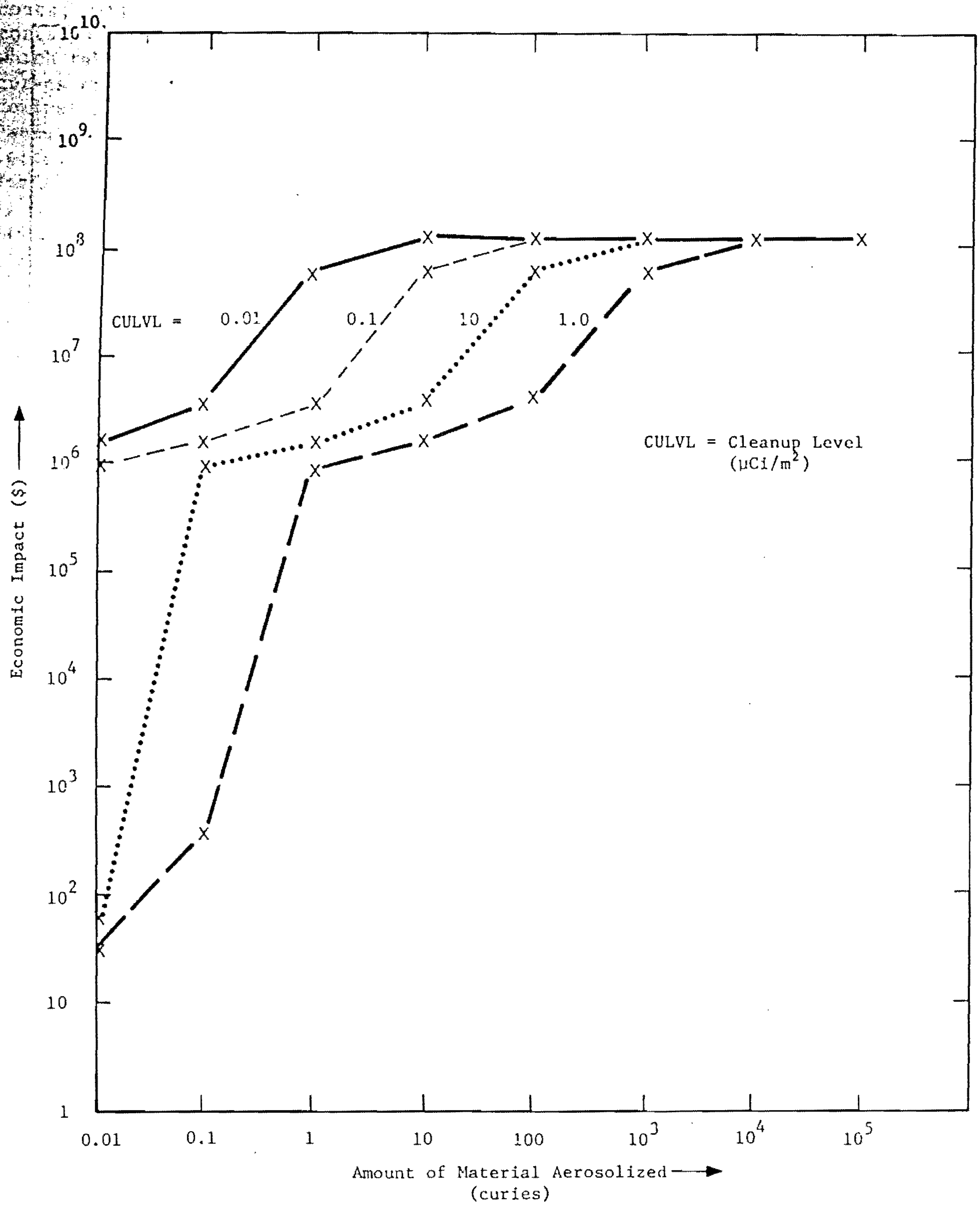


Figure 3-6. Relationship of Economic Impacts to Amount of Short-Lived Material Released for Different Cleanup Levels

Estimation of the expected economic risks from the transport of radioactive materials for the limited New York City study area is accomplished in a parallel fashion to that for expected radiological risks, i.e., the probability that an accident of a given severity will occur is multiplied by the expected economic consequences of that accident. The severity dependent "economic risks" are then summed across all severities and shipment types to obtain an overall value for expected economic risk. Table 3-8 summarizes the economic risk calculations for the same wind conditions used elsewhere (2 m/s, south wind). The estimated economic risk is summarized by end use, mode, and package type. The expected numbers of latent cancer fatalities are included for ease of comparison with the earlier tables in this chapter. Examination of the contributions to economic risk resulting from the dispersible nature of the shipments indicates that essentially all of the risk arises from dispersible shipments. This is reasonable since in the case of nondispersible materials, there is no requirement for survey, decontamination, etc.

Table 3-8

Expected Economic Risk Values
from Vehicular Accidents

End Use	Expected Value of Economic Risk per Year of Shipping Activity ($)	F	Expected Number of Latent Cancer Fatalities per Year of Shipping Activity	F
Medical	$1.4x10^6$	0.97	$5.3x10^{-4}$	0.39
Industrial	$1.9x10^4$	0.01	$2.3x10^{-4}$	0.17
Fuel Cycle	$3.1x10^4$	0.02	$6.1x10^{-4}$	0.44
Waste	$5.1x10^0$	<0.001	$8.2x10^{-7}$	<0.001
Mode				
Truck	$6.4x10^4$	0.04	$7.2x10^{-4}$	0.53
Air	$1.0x10^1$	<0.001	$9.7x10^{-9}$	<0.001
Air and Truck	$1.4x10^6$	0.96	$6.5x10^{-4}$	0.47
Barge	$1.3x10^0$	<0.001	$3.2x10^{-8}$	<0.001
Package Type				
A	$1.4x10^6$	0.94	$5.8x10^{-4}$	0.41
B	$6.2x10^4$	0.04	$2.2x10^{-4}$	0.16
Cask	$3.1x10^4$	0.02	$6.1x10^{-4}$	0.43
Drum	$4.1x10^0$	<0.001	$8.9x10^{-7}$	<0.001
Totals	$\sim 1.5x10^6$		$1.4x10^{-3}$	

Table 3-9 examines the effect of wind speed on estimated economic risks and latent cancer fatalities for three wind speeds and four directions. The small variation observed in estimates of the economic risk are consistent with those observed for expected numbers of latent cancer fatalities, indicating that wind speed and direction are not significant factors in the determination of economic risk.

Table 3-9

Estimates of Economic Risk Values as a Function of Wind Speed for Vehicular Accidents

Wind Speed (m/s)	Wind Direction	Estimated Economic Risk ($)	Expected Number of Latent Cancer Fatalities
2	S	1.5×10^{6}	1.4×10^{-3}
4	S	1.5×10^{6}	1.4×10^{-3}
8	S	1.2×10^{6}	1.4×10^{-3}
2	W	$\sim 1.5 \times 10^{6}$	1.5×10^{-3}
4	W	1.4×10^{6}	1.5×10^{-3}
8	W	9.9×10^{5}	1.4×10^{-3}
2	N	1.4×10^{6}	1.5×10^{-3}
4	N	1.5×10^{6}	1.6×10^{-3}
8	N	1.1×10^{6}	1.6×10^{-3}
2	E	1.6×10^{6}	1.3×10^{-3}
4	E	1.8×10^{6}	1.3×10^{-3}
8	E	9.5×10^{5}	1.2×10^{-3}
Average Values		1.4×10^{6}	1.4×10^{-3}

3.5 Low-Probability/High-Consequence Accidents

Quantification of risk using the product of probability and consequence is only one form of risk analysis used in decision making. In dealing with potentially high-consequence but low-probability events, an approach called "mini-max" is also useful.[7] This technique involves the calculation of the consequences of certain events separate from their probability, keeping in mind that at some point the consequences will be intolerably severe, even at an extremely low probability. This section considers the consequences of high-level releases that might occur. Several shipments were selected from the actual New York City shipment model specified in Appendix A. However, since these shipments were averaged to some degree, other potentially high-consequence shipments were

added. These additional shipments were selected from the Battelle survey[8] and various other sources, and represent shipments that could conceivably have an urban destination or origin, or that could pass through an urban area. The shipments selected for this mini-max analysis are specified in Table 3-10. The first three entries are standard shipments evaluated in the risk analysis; the remainder are additions from the Battelle survey.

Table 3-10

Shipments Used for Mini-Max Risk Analysis

Isotope/Form	Shipment Size (Ci)	Physical Form	Brief Description	Shipment Mode	Package Type
Mo-99	91	Dispersible	Radiopharmaceutical source material	Truck	B
Co-60	4.7×10^3	Nondispersible	Teletherapy source	Truck	Cask
Spent Fuel	1.54×10^2 [a] 2.17×10^5	Dispersible Nondispersible	Spent reactor fuel	Truck	Cask
Plutonium	1.13×10^6 [b]	Dispersible	Overseas fuel	Cargo air	BPu
Po-210	1.44×10^2	Dispersible	Industrial source material	Truck	B
Co-60	3.15×10^5	Nondispersible	Irradiator source	Truck	Cask

[a] The description of spent fuel here is based on specific information obtained from Brookhaven National Laboratory concerning actual shipments through New York City. As such, it is significantly smaller than the large shipments of typical commercial reactor fuel discussed in Chapter 5.

[b] This shipment represents 100 kg of PuO_2 using the reactor-grade mixture discussed in Chapter 5. It is assumed, as discussed in Appendix A, that only 5% of the released material from a shipment of this size becomes airborne.

The consequence analysis has been performed using the METRAN code to evaluate the effects of maximum severity accidents. Results for latent cancer fatalities, early morbidities, early fatalities, and economic costs are presented in Table 3-11.

3.6 Sensitivity and Error Analysis

Techniques similar to those described in Chapter 2 for incident-free transport were applied to the nondispersal accident case since the two problems are similarly structured. In incident-free transport the source is moving, whereas in the nondispersal accident case, the shipment is stationary for an accident delay time, ΔT_a. Because of the similarity, it was possible to generate simpler equations than those in METRAN to "mimic" the model. These equations and their derivation are discussed in detail in Appendix D. Briefly, the equations for dose to pedestrians involve street width, pedestrian density, and accident delay time. For people in vehicles, there are three equations for different road types which consider street (or freeway) width, traffic count, people per vehicle, photon energy (only for freeways) and accident delay time. For people in buildings, there are equations for different road types involving population density, transient population, street width (or freeway width), fraction of the cell which is buildings, sidewalk width, and accident delay time. Error equations were also developed and are presented in detail in Appendix D.

EXHIBIT 23

SR/CNEAF/96-01

FEBRUARY 1996

EIA Service Report

Energy Information Administration
U.S. Department of Energy
Washington, D.D. 20585

Spent Nuclear Fuel Discharges from U.S. Reactors

1994

Executive Summary

The Energy Information Administration of the U.S. Department of Energy (DOE) administers the Nuclear Fuel Data survey, Form RW-859, for the Office of Civilian Radioactive Waste Management. This form is used to collect data on fuel assemblies irradiated at commercial nuclear power reactors operating in the United States, and the current inventories and storage capacities of those reactors. The data are important to the design and operation of the equipment and facilities that DOE will use for the future acceptance, transportation, and disposal of spent fuel. The information presented in this report summarizes the detailed data collected on Form RW-859 that focuses on commercial light-water reactor (LWR) spent nuclear fuel reported as discharged as of December 31, 1994. The report identifies trends in discharged spent fuel, burnup levels, spent fuel inventories, and site capacities.

Spent Nuclear Fuel Discharges

A total of 104,742 assemblies, with an initial loading weight of 30,003.3 metric tons of uranium (MTU) (Table ES1), have been discharged from 118 commercial LWR's from 1968 through 1994. Electric utilities also reported 172 temporarily discharged assemblies at pressurized-water reactors (PWR's) and 626 temporarily discharged assemblies at boiling-water reactors (BWR's). Approximately 36 percent (10,901.3 MTU) of total discharges (by weight) are from BWR's; 64 percent 19,102.0 MTU) from PWR's. Reprocessed spent fuel, fuel from the damaged Three Mile Island Unit 2 reactor, and discharges from Fort St. Vrain (the only commercial high-temperature, gas-cooled reactor in the United States), are not within the scope of this report.

The characteristics of the permanently discharged spent fuel have changed over time. Prior to 1972, most spent commercial nuclear fuel discharged was reprocessed. Since that time, the annual average burnup for discharged BWR assemblies has shown a fairly steady increase to reach a new high of 33.1 gigawattdays thermal per metric ton of uranium (GWDt/MTU) in 1994. The average burnup has also continued to increase for PWR's, reaching a new high of 40.0 GWDt/MTU in 1994.

Table ES1. Total U.S. Commercial Spent Nuclear Fuel Discharges, 1968-1994

Reactor Type	Stored at Reactor Sites	Stored at Away-from-reactor Facilities	Total
	Number of Assemblies		
Boiling-Water Reactor	57,187	2,957	60,144
Pressurized-Water Reactor	44,107	491	44,598
Total	**101,294**	**3,448**	**104,742**
	Metric Tons of Uranium		
Boiling-Water Reactor	10,347.3	554.0	10,901.3
Pressurized-Water Reactor	18,909.4	192.6	19,102.0
Total	**29,256.7**	**746.6**	**30,003.3**

Notes: A number of assemblies discharged prior to 1972 were reprocessed and are not included in this table. A total of 2,208 high-temperature, gas-cooled reactor (HTGR) fuel elements, with initial uranium content equal to 24.2 metric tons of uranium (MTU), were discharged. These HTGR fuel elements are not included in the above table. Totals may not equal sum of components because of independent rounding.

Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

At the end of 1994, a total of 3,448 of the assemblies covered by this report were in storage at five away-from-reactor storage facilities. Typically, assemblies were moved either to free up space in the discharging reactor's storage site or for use in a research program.

Site Capacities and Inventories, 1994

The total inventory of discharged LWR spent nuclear fuel in storage in the United States, as of December 31, 1994, was 104,742 assemblies. The majority of spent nuclear fuel is stored in water-filled pools, but 1,525 assemblies are in dry storage at Independent Spent Fuel Storage Installations (ISFSI's) at Baltimore Gas and Electric Company's Calvert Cliffs plant, Carolina Power and Light Company's Robinson 2 plant, Consumers Power Company's Palisades plant, Duke Power Company's Oconee plant, and Virginia Power's Surry plant. This section includes a fold-out map showing the location of the commercial nuclear reactors as well as planned and existing ISFSI's. The current licensed storage capacity is 218,803 assemblies. The total maximum storage capacity of all storage sites, as reported by electric utilities and off-site storage, is 218,967 assemblies. However, the excess of total maximum capacity over current total inventory does not reflect the shortage of pool storage in many individual cases. Of the 110 reactors expected to be in operation by the year 2000, 9 reactors appear to require expansion above current pool maximums before 2000.

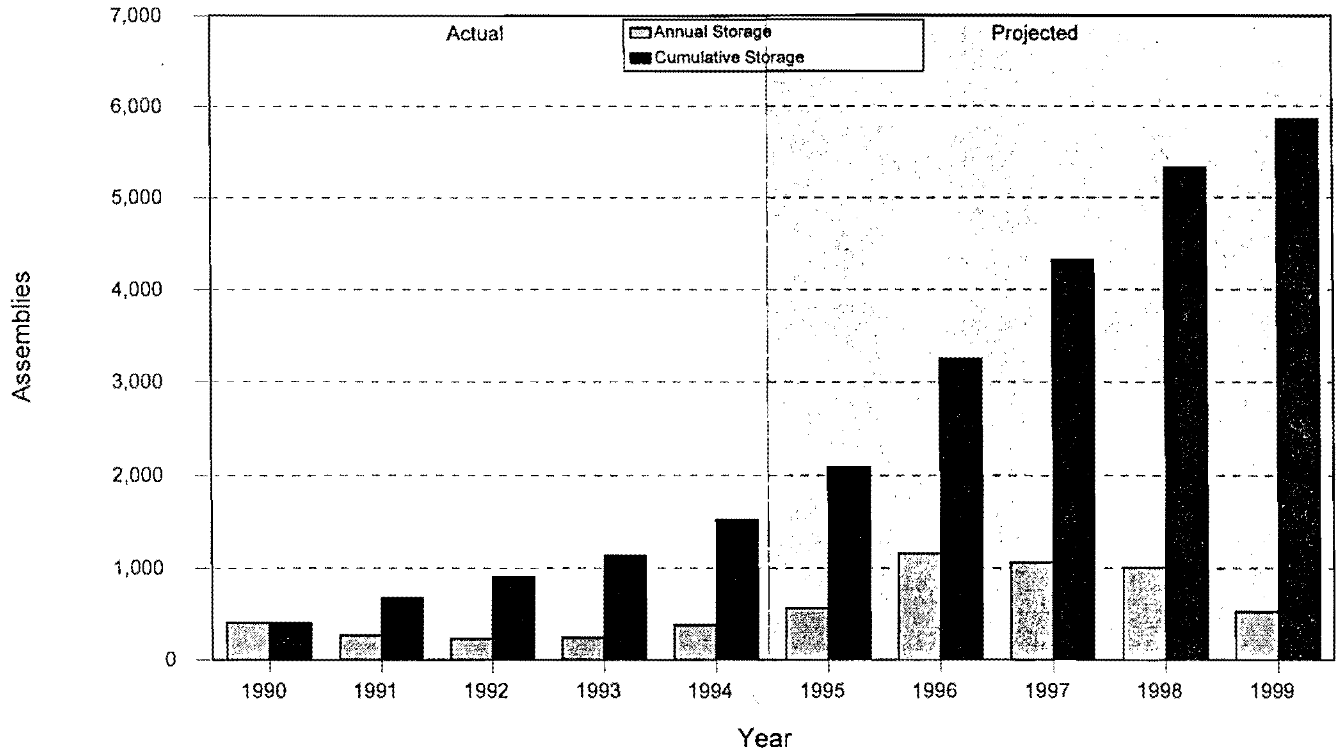
The quantities of spent nuclear fuel in storage at nuclear power plants and away-from-reactor facilities are aggregated to the state level in Figures ES1 and ES2. The data account for all permanently and temporarily discharged assemblies from commercial nuclear reactors in the United States.

Figure ES1. Commercial Spent Nuclear Fuel in Storage at U.S. Nuclear Power Plants and Away-from-reactor Facilities by State (Assemblies)

Notes: A total of 2,208 high-temperature, gas-cooled reactor (HTGR) fuel elements are in storage (744 in Idaho and 1,464 in Colorado). These HTGR fuel elements are reflected on this map but are not included in Table ES1. Numbers in the above map represent assemblies stored at nuclear power plant sites and away-from-reactor facilities, and include both permanently and temporarily discharged assemblies.

Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

Figure 9. Dry Storage Inventories and Projections



Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

Arkansas Power and Light Company

In 1994, the Arkansas Power and Light Company's Arkansas Nuclear 1 & 2 plants finalized a contractual agreement with Sierra Nuclear for 14 VSC-24 casks that can hold up to 24 PWR assemblies.

Construction of the concrete casks began in October 1994. The cask storage will be on a concrete pad located within the existing security protected area at the Arkansas Nuclear plants. The pad is designed to hold 26 casks, but can be expanded to provide space for an additional 50 casks. Existing rail lines and a new rail car specifically designed for the VSC will transport the casks from the plant's Auxiliary Building to the storage pad.

Baltimore Gas and Electric Company

The ISFSI at Baltimore Gas and Electric Company's Calvert Cliffs station is the NUHOMS-24P. The Calvert Cliffs ISFSI has been designed as a life-of-plant storage facility. The ISFSI will have the capacity to store all spent fuel discharged from Calvert Cliffs 1 & 2, beyond the spent fuel pool capacity, up to the 40-year plant life, if necessary. The exact capacity needed is uncertain, and to limit capital investment until necessary, the ISFSI will be constructed in up to five phases. The ISFSI required the preparation of a 10 CFR 72 License Application, Safety Analysis Report, Environmental Report, and a Security Plan for NRC review and approval. The license material was prepared and submitted to the NRC in December 1989. Construction of the ISFSI west of the plant began in April 1991 after NRC approved the Environmental Report. The facility and its pre-operational testing were completed in October 1992. The ISFSI was licensed by the NRC on November 25, 1992.

The license allows Baltimore Gas and Electric Company to place as many as 2,880 assemblies in casks to be placed in ISFSI's. Each NUHOMS cask at Calvert Cliffs can hold 24 assemblies, and there are currently 120 planned storage modules. On November 30, 1993, the dry storage facility became fully operational with the successful loading of the first cask of fuel. As of September 1995, a total of 240 assemblies were stored in 10 modules.

Carolina Power and Light Company

The ISFSI for Carolina Power and Light Company's Robinson 2 plant is composed of 8 NUHOMS-7P horizontal storage modules (HSM's). Each HSM is a steel-reinforced concrete structure which holds 7 intact assemblies in each module. The ISFSI was licensed by the NRC in August 1986 to hold 56