July 27, 2001

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	Docket No. 72-22
PRIVATE FUEL STORAGE L.L.C.	)	
	)	ASLBP No. 97-732-02-ISFSI
(Private Fuel Storage Facility)	)	

APPLICANT'S MOTION FOR SUMMARY DISPOSITION OF UTAH CONTENTION W

Applicant Private Fuel Storage, L.L.C. ("Applicant" or "PFS") moves, pursuant to 10 C.F.R. § 2.749, for summary disposition of State of Utah's ("State") Contention W (Flooding of the Intermodal Transfer Point ["ITP"]) ("Utah W"). Summary disposition is warranted because there exists no genuine issue as to any relevant material fact and PFS is entitled to a decision as a matter of law. This motion is supported by a Statement of Material Facts on Which No Genuine Dispute Exists ("Statement"), the declarations of Donald Wayne Lewis, George H. C. Liang, Kevin Coppersmith and Krishna P. Singh, and relevant discovery materials, including the depositions of State witnesses for Utah W.

I. STATEMENT OF THE ISSUE

Contention Utah W, as admitted by the Atomic Safety and Licensing Board ("Board" or "ASLB") in this proceeding, asserts that:

> The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.[1]

[1] Private Fuel Storage, L.L.C. (Independent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 256 (1998). After the admission of Utah W, PFS moved to dismiss both it and Utah N (which raised safety claims based upon alleged flooding of the ITP) on the basis of the Board's ruling on PFS's Motion for Summary Disposition of Contention Utah B that the ITP was an integral part of spent fuel transportation under 10 C.F.R. Part 71 and did not require a license under 10 C.F.R. Part 72. Although the Board dismissed Utah N, it declined to dismiss Utah W because it concluded that ITP flooding "raise[d] issues that

Footnote continued on next page

Utah W rests on the alleged failure by PFS to consider ITP flooding in the PFS Environmental Report ("ER"). However, subsequent to the admission of Utah W, the ER was amended so that its Section 4.3.4 now discusses potential flooding of the ITP and indicates that the ITP will not be vulnerable to flooding because its location lies above both the historic high level of the lake and the lake's flood plain as designated by the State.[2] A similar analysis and identical conclusions are contained in Section 5.2.1.2 of the NRC's Draft Environmental Impact Statement for the PFS facility ("DEIS").[3]

Therefore, both the ER and the DEIS consider flooding of the ITP, and the State's allegation in Utah W is factually incorrect. In addition, as demonstrated below, the phenomena that the State postulates as potentially leading to flooding of the ITP (a rise of the level of the Great Salt Lake, flooding due to wind waves, earthquake-induced seiches, and subsidence from a seismic event near the ITP) are extremely improbable and in any event would not lead to the submersion of spent fuel transportation casks present at the ITP. Even in the event of submersion, those casks are designed to withstand its effects, so if any casks were at the ITP when flooding occurred, no adverse environmental consequences would result. There is thus a lack of genuine dispute warranting a hearing, and the Board should grant PFS summary disposition of Contention Utah W.

II. LEGAL STANDARDS

A. SUMMARY DISPOSITION

The Board has previously stated the applicable standards for motions for sum-

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go to the NEPA responsibilities that are part of the agency licensing process relative to the PFS ISFSI." Private Fuel Storage, L.L.C. (Independent Fuel Storage Installation), LBP-99-39, 50 NRC 232, 236 (1999).

[2] PFS, "Environmental Report for the Private Fuel Storage Facility" (1997), section 4.3.4, added in Rev. 7, submitted on April 14, 2000. A copy of §4.3.4 of the ER is included in the Statement.

[3] NUREG-1714, "Draft Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility on Tooele County, Utah" (June 2000), §5.2.1.2 at 5-6, 5-7. A copy of §5.2.1.2 of the DEIS is included in the Statement.

mary disposition in this proceeding.[4] The legal requirements concerning expert opinions in support of a contention are particularly relevant here. These requirements include 1) demonstration that the affiant is an expert and 2) an explanation of facts and reasons in the affidavit supporting the affiant's expert opinion.[5] Mere unsupported conclusions or assertions are insufficient to support a contention.[6] As the Supreme Court has held, reliable expert opinion must be based on "more than subjective belief or unsupported speculation."[7] This standard is relevant because neither the State nor its experts have been able to formulate a credible factual scenario that would lead to flooding of the ITP, let alone the occurrence of radiological or other environmental impacts from such flooding.

B. NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act ("NEPA") requires that federal agencies prepare an Environmental Impact Statement ("EIS") describing the potential environmental impacts of a major proposed federal action. An EIS should provide "sufficient discussion of the relevant issues and opposing viewpoints to enable the decisionmaker to take a 'hard look' at environmental factors and to make a reasoned decision."[8] An EIS is prepared under a "rule of reason" standard.[9] Thus, NEPA does not require evaluation of environmental impacts that are "remote and speculative" possibilities.[10] Instead, NEPA requires that an EIS discuss environmental impacts "in proportion to their significance."[11]

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[4] See Private Fuel Storage, L.L.C. (Independent Fuel Storage Installation), LBP-99-23, 49 NRC 485, 491 (1999); Applicant's Motion For Summary Disposition of Utah Contention C – Failure to Demonstrate Compliance With NRC Dose Limits," dated April 21, 1999, at 4-16.

[5] Id. at 10-15; Mid-State Fertilizer Co. v. Exchange Nat'l Bank, 877 F.2d 1333, 1339 (7th Cir. 1989); Carolina Power & Light Co. (Shearon Harris Nuclear Plant, Units 1 and 2), LBP-84-7, 19 NRC 432, 447 (1984).

[6] Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), LBP-83-32A, 17 NRC 1170, 1177 (1983); Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-99-35, 50 NRC 180, 194 (1999).

[7] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 590 (1993).

[8] Louisiana Energy Services (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 88 (1998).

[9] Id. at 97.

[10] Limerick Ecology Action v. NRC, 869 F.2d 719, 739 (3rd Cir. 1989).

[11] See 10 C.F.R. §§ 51.29(a)(2) and (3), 51.45(b)(1).

III. DISCUSSION

A. THE EFFECTS OF FLOODING ON THE SPENT FUEL TRANSPORTATION CASKS ARE ENCOMPASSED WITHIN TABLE S-4

The State's assertion that PFS has failed to adequately consider adverse environmental impacts associated with the transportation of spent nuclear fuel through the ITP does not raise a litigable contention because such impacts are already considered in the Commission's generic evaluation of the environmental impacts of transporting spent fuel found at Table S-4 of 10 C.F.R. § 51.52, which PFS has fully addressed in the ER and the NRC in the DEIS. See ER § 4.7 et seq.; DEIS § 5.7.2.1.[12] The Board has ruled that an attack on the sufficiency of Table S-4 to describe the transportation-related radiological environmental impacts impermissibly challenges Commission regulations or rulemaking-associated generic determinations, "including 10 C.F.R. §§ 51.52, 72.108, and 'Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants,' WASH-1238 (Dec. 1972), as supplemented, NUREG-75/038 (Supp. 1 Apr. 1975)."[13] The Commission's generic evaluation of such environmental impacts is applicable to all aspects of transporting spent fuel.[14] Thus, the use of Table S-4 accounts for all environmental impacts of transporting spent fuel through the ITP and bars the State from raising additional potential impacts, such as those from postulated flooding events.

B. UTAH W IS RENDERED MOOT BY THE DISCUSSION OF ITP FLOODING IN THE AMENDED ER AND THE DEIS

PFS is also entitled to summary disposition because the issue raised in Utah W is whether flooding of the ITP is "considered" in the ER and, as explained above, the envi-

[12] The Staff's analysis in the DEIS includes consideration of Table S-4 and an additional evaluation of transportation impacts which shows Table S-4 to be conservative. See DEIS § 5.7.2.1, Tables 5.6 and 5.7.

[13] The Board did allow the State's challenge that the weight threshold for Table S-4 was exceeded, LBP-98-7, 47 NRC at 200-201, but that issue is irrelevant to the potential impacts from flooding at the ITP.

[14] See Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), ALAB-825, 222 NRC 785, 793 (1985), aff'd, Carolina Power and Light Co. (Shearon Harris Nuclear Power Plant), ALAB-837, 23 NRC 525, 544 (1986); see also, 45 Fed Reg. 74,693, 74,695 (1980), where the Commission directly provided that "generic issues covered by . . . NRC generic environmental impact statements may be incorporated" in an ISFSI applicant's ER.

ronmental analysis in the DEIS does consider flooding of the ITP.[15] Thus, as with Contention Utah C, the State's asserted deficiency has been resolved by the issuance of a new analysis,[16] and the State's assertions have been mooted by the DEIS discussion.[17]

Further, the discussion of ITP flooding in the DEIS fully satisfies NEPA. NEPA requires that the environmental impact statement contain a "reasonably thorough discussion of the significant aspects of the probable environmental consequences," and provide information that is reasonably sufficient to encourage informed public participation and to "enable the decisionmaker to consider the environmental factors and make a reasoned decision." Oregon Envt'l Council v. Kunzman, 817 F.2d 484, 492-93 (9th Cir. 1987). In the instant case, Section 5.2.1.2 of the DEIS considers the potential impacts of flooding of the ITP and determines that there will be none, since the ITP will be built more than 8 ft. above the historic high level of the Great Salt Lake and above its designated flood plain. No further discussion is required by NEPA.[18]

C. NO MATERIAL DISPUTE EXISTS AS TO ANY RELEVANT FACTS REGADING THE STATE'S CLAIMS IN UTAH W

In its bases for dismissed Contention Utah N, the State postulates several potential sources of flooding at the ITP. As discussed below, none of these postulated events would result in the submersion of the spent fuel transportation casks. Moreover, even if

[15] Although Utah W as filed raised contentions against the ER, it is appropriate for the Board to consider the environmental issues raised in Utah W as challenges to the DEIS. See Applicant's Motion for Summary Disposition of Utah Contention Z—No Action Alternative (Feb. 14, 2001) at 3, 6-7.

[16] Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-99-23, 49 NRC 485, 491-94 (1999).

[17] Id. Moreover, the State never revised Utah W nor submitted a new contention to challenge the flooding analysis in the DEIS, nor can it do so at this late date. See Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), LBP-89-4, 29 NRC 62, 70 (1989), aff'd, ALAB-918, 29 NRC 473 (1989).

[18] To the extent that the DEIS fails to discuss some of the flooding mechanisms posited by the State, this does not constitute a failure to comply with NEPA because the postulated failure mechanisms are remote and speculative. Their remoteness is demonstrated by the fact that the State has not chosen to investigate, for purposes of protecting public health and safety, the extreme flooding mechanisms that it postulates will affect the ITP, earthquake subsidence and earthquake-induced seiches. Deposition of Barry Solomon (April 18, 2001) ("Solomon Dep.") at 22-24 (seiches), 26-27 (subsidence).

the ITP flooded and the casks became submerged, there would be no radiological or other environmental consequences. Thus, there is no factual dispute that requires adjudication.

1. ITP Flooding due to Rising of the Lake Level is so Improbable that it Need not be Considered

The State asserts that "[i]n very wet years, [the ITP] may be vulnerable to the potential of flooding… ."[19] There is, however, no credible basis for this claim. The ITP will be built at an elevation of 4221 ft., well above the historic high water mark of 4212 ft.[20] In addition, the transportation casks will be either atop railway cars or heavy haul trucks at all times. See Lewis Dec. ¶10. While at the ITP, the casks will always be at an elevation of 4225 ft., 13 feet above the highest high water mark reached at the lake, and 25 feet above the lake's current average level.[21] No credible threat of flooding of the casks due to rising of the lake's level exists, and if one were to develop it would do so over a period of years, giving ample time for protective measures to be taken.[22] The State's own witness has conceded that the flooding threat postulated in Utah W is not credible. See Cole Dep. at 33-34. Thus, the parties agree that the issue is not viable.

2. Submersion of the Casks Due to Flooding Caused by Wind Generated Seiches and Waves is not Credible

The State also alleges in Utah W that the ITP may be vulnerable to "swamping by water waves generated by wind." However, State-financed studies of the potential need for diking along the lake's shores to protect against flooding by high wind-generated seiches (vertical oscillatory motions of the lake's waters) and related waves have established that, in unprotected areas near the shore of the lake, the water level (assuming a historic high lake level and a 2 foot seiche) will reach a maximum elevation of 4216 ft.[23]

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[19] State of Utah Contentions (Nov. 23, 1997) at 98.

[20] Declaration of Donald Wayne Lewis (July 26, 2001) ("Lewis Dec.") ¶7.

[21] Id. ¶18; Declaration of George H. C. Liang (July 27, 2001) ("Liang Dec.") ¶6.

[22] Id. ¶7; see also Deposition of David Cole (April 18, 2001) at 38-39 ("Cole Dep.") (State's witness admits it would take at least two years for the lake to rise from its current level to its historic high water mark.)

[23] Liang Dec. ¶12; see also Cole Dep. at 52-53. Since the casks are eight feet in diameter and rest on their sides on the railway cars and trucks, the lake would have to rise to elevation 4233 ft. – thirty three feet

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This level is five feet below the ground elevation at the ITP and nine feet below the elevation of the transportation casks. Id. Thus, "wind waves" will cause neither flooding of the ITP site nor submersion of the casks. Liang Dec.¶ 14. The State concurs that flooding is not a concern for elevations above 4221 ft., which is the maximum height that waters would reach even under the State's admittedly unrealistic assumptions of flooding caused by storm run up plus seiche.[24] Since that is the ITP ground level, the State's allegations do not give rise to a litigable issue.

3. Seismic-Induced Flooding of the ITP is Highly Unlikely

Finally, the State asserts that the DEIS fails to analyze the effect of flooding generated by earthquake subsidence at the ITP or the possibility of a large seismic induced seiche reaching the ITP.[25] However, the DEIS need not analyze such events because their occurrence is highly improbable and speculative.[26]

a. The Possibility of Flooding of the ITP due to Seismically Induced Subsidence is Remote

The State has speculated that seismically-induced subsidence had the potential for "subsidence in the upper teens, somewhere from 15 to 20 feet, if [the Hebgen Lake] model were applicable to [the Stansbury fault]."[27] The stated basis for this assertion is that a 1959 earthquake at Hebgen Lake in southwestern Montana resulted in a subsidence of 22 feet. Id. at 26. However, the State's witness acknowledged that the State has not conducted an independent analysis of a seismic event affecting the ITP, but merely trans-

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above its the current level – to submerge a cask. See Lewis Dec. ¶17; Declaration of Krishna P. Singh (July 23, 2001) ("Singh Dec.") ¶9.

[24] In support of Utah W, the State makes what its expert acknowledges is the "conservative" assumption that the wave height at the shore is the same as the maximum wave height experienced in the open waters of the lake far from shore. Cole Dep. at 51. Such an assumption is in fact unrealistic, since the height of a wave is a limited by the depth of the lake. Thus, wave heights are much less at shore than at the lake's deepest point. Liang Dec. ¶13. However, even using the State's unrealistic postulated maximum wave height, the total water rise at the shore would still only be 9 ft., or to an elevation of 4221 ft. Id.; Cole Dep. at 33-34. That level remains below the physical location of the transportation casks.

[25] See State of Utah's Responses to Applicant's Sixth Set of Discovery Responses (Feb.28, 2001) at 26-27.

[26] Declaration of Kevin Coppersmith (July 18, 2001) ("Coppersmith Dec.") ¶12; Liang Dec. ¶17.

[27] Solomon Dep. at 56-57.

posed the Hebgen Lake results to the region of the ITP without further analysis. Id. at 26-27. Such a result, however, does not reflect seismic conditions in the ITP area. The seismically induced subsidence at the ITP as a result of a maximum earthquake at nearby faults is very unlikely to exceed seven feet and most likely will be substantially less. Coppersmith Dec. ¶ 10. Thus, even if a seismic event occurred when the lake was at its highest level, the ITP would remain above flood level and would escape inundation.

b. An Earthquake Induced Seiche will not Flood the ITP

The State has postulated that a seismic induced seiche could be up to twelve feet in height. Solomon Dep. at 15. Again, the State has performed no analyses of what seismic-induced seiches might affect the ITP, but bases its assertion entirely on reports of a seiche caused by a 1909 earthquake at another location. Id. at 24. A twelve-foot seiche at the Great Salt Lake would be extremely unlikely (Liang Dec. ¶17). In any event, such a seiche would not inundate the casks at the ITP. As discussed above, the ITP sits at an elevation of 4221 ft. and the transportation casks will be at an elevation of at least 4225 ft. Assuming that the maximum seiche postulated by the State were to occur when the Great Salt Lake was at its highest level, under the State's own scenario the seiche would reach an elevation of 4224 ft. or less.[28] The casks at the ITP, therefore, would still remain above water in the event of such a hypothetical, unrealistically severe seiche. Indeed, the State's own designated maximum level of concern for earthquake generated seiches is 4220 ft, several feet below the elevation of the casks. See id. ¶19.

D. THERE WILL NOT BE ADVERSE ENVIRONMENTAL CONSEQUENCES FROM FLOODING OF THE ITP SITE

As demonstrated above, flooding of the ITP through any of the mechanisms pos-

[28] A factor that affects the maximum elevation of the seiche is the distance between the lake and the ITP. The elevation of the seiche decreases as it moves on to land. Liang Dec. ¶18. Thus, even if a 12 foot seismically-induced seiche were to occur while the lake was at its maximum historic elevation of 4212 ft., the highest level achieved by the seiche waters as they reached the ITP would not be the combination of the lake water level plus the seiche height (i.e., to elevation 4224 ft.) but would be considerably less. Id.

tulated by the State is not credible. Even if the ITP were to be inundated, however, there would be no adverse environmental consequences.

1. Transportation Casks' Submersion in Lake Water

Four hypothetical scenarios could be postulated that might theoretically affect the integrity of the casks in the event they became submerged due to flooding of the ITP: (1) If an earthquake led to flooding of the ITP, the earthquake might result in the casks falling to the ground and potentially sustaining damage; (2) a submerged cask might fail due to external pressure from the confining mass of flood water; (3) submersion could reduce the heat dissipation capability of the cask, leading to potential failure from overheating; and (4) assuming prolonged submersion, chemical attack by the saline lake waters might cause corrosion failure of the cask. Singh Dec. ¶7. However, all of these postulated hypothetical scenarios are well within the casks' design envelope. The casks have been demonstrated by analysis and testing to be able to remain intact in the event any of the postulated conditions takes place. Singh Dec. ¶¶ 8-16. Specifically:

> If a cask was dropped by earthquake forces off the railcar, it would drop four feet to the ground.[29] A four-foot drop would cause no material damage to the cask because, in accordance with regulations (10 CFR 71.73(c)(1)), transportation casks have been demonstrated through testing to be able to withstand a drop of thirty (30) feet without damage. Singh Dec. ¶10.
>
> Casks are designed to withstand an external pressure of 300 psig, equivalent to a depth of submergence of over 200 meters (656 ft.). Therefore, no credible flooding scenario will cause the casks to fail from overpressure. Id. ¶12.
>
> The thermal effects on a cask from submergence would be beneficial rather than detrimental, since the rate of heat transfer in water is approximately 200 times that in air. Thus, submergence would keep a cask even cooler than in an air environment, so submergence in flood waters would have no adverse heat dissipation impact on the casks. Id. ¶13.
>
> Corrosion of the cask due to exposure to salt water would be minimal, even under prolonged exposure conditions, because a cask's external surfaces are

[29] In the absence of an earthquake, it would be unlikely that the casks would be dislodged from the transport vehicle (rail car or truck) because provisions are made for securing them in place. Lewis Dec. ¶19.

> coated with an effective protective coating, carboline 890. Nonetheless, even if limited corrosion were to occur, in order for corrosion to degrade a cask, it would have to remove the protective coating and "eat through" six inches of steel, which would take centuries of contact between the cask and the flood water, if it occurred at all. Id. ¶¶15-16.

Thus, no adverse radiological consequences would result from any mechanism that led to flooding of the ITP site and the submersion of the transportation casks. Id. ¶ 17.

2. Non-Radiological Consequences of Flooding at the ITP

The possible inundation of the ITP would have no significant environmental consequences. The ITP facility relies on bottled drinking water and portable toilets or a small septic tank/leach field for sanitary waste disposal. Lewis Dec. ¶20. Both could be easily replaced and their loss would have negligible environmental impact. Id. Nor would there be any environmental impact from potential chemical attack on the foundations of the building enclosing the gantry crane at the ITP. Id.

Also, there would be no need to access a flooded ITP site even in the very unlikely event that transportation casks remained there after a sudden flood, thus there would be no adverse environmental consequences associated with needing to gain access to the site after the flood. Id. ¶21. Thus, in the unlikely event the ITP facility was flooded, no adverse non-radiological environmental consequences would occur. Id. ¶22.

IV. CONCLUSION

For the above reasons, the Board should grant summary disposition of Utah W.

Respectfully submitted,

[signature]

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Dated: July 27, 2001

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STATEMENT OF MATERIAL FACTS ON WHICH NO GENUINE DISPUTE EXISTS

Applicant submits, in support of its motion for summary disposition of Utah Contention W (Flooding of the Intermodal Transfer Point), this statement of material facts as to which the Applicant contends there is no genuine issue to be heard.

I. BACKGROUND

1. Private Fuel Storage, L.L.C. ("PFS") submitted an Environmental Report ("ER") with its initial License Application dated June 20, 1997.

2. On April 22, 1998, the Atomic Safety and Licensing Board admitted Contention Utah W. Private Fuel Storage, L.L.C. (Independent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 204-05 (1998). As currently admitted, Utah W asserts:

   CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.

   BASIS: See Contention N (Flooding), whose basis is incorporated by reference.

3. Utah N, as alleged by the State of Utah ("State"), reads:

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 Park 100, Appendix A, IV(c)(2), and 10 CFR §72.92 and §72.102(b).

4. On April 14, 2000, PFS filed Section 4.3.4 of the ER, which reads in relevant part as follows:

The ITP is not expected to be affected by flooding. The existing elevation of the ITP area is from 4220 ft. to 4225 ft. as determined from the Poverty Point, Utah and Timpie, Utah 7 ½ minute USGS quadrangle topography map 5 ft. contours. The actual ITP will be designed nearer the elevation of 4225 ft. In 1986, the Great Salt Lake flooded to a historic elevation of 4211.85 ft., which is well below the ITP area elevation of 4220 ft. to 4225 ft.

In addition, the Great Salt Lake Planning Project Draft Analysis of Proposed Management Alternatives, issued by the State of Utah Department of Natural Resources in January 1999, has designated the flood plain of the lake at 4212 ft. for planning purposes and 4217 ft. as the extent of the lake's flood plain. Neither elevation is

above the ITP elevation of 4220 ft. to 4225 ft. Therefore, there are no design provisions necessary at the ITP to prevent flooding.

5. In June 2000, the NRC Staff issued NUREG-1714, "Draft Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility on Tooele County, Utah" ("DEIS").

6. The DEIS addresses flooding at the ITP as follows (DEIS §5.2.12 at 5-6, 5-7):

   5.2.1.2 Potential Impacts of Flooding

   * * * * *

   The ITF would be on a slight topographical rise, approximately 2.9 km (1.8 miles) west of Timpie in the area north of Interstate 80 and south of the existing mainline railroad. The existing elevation of the ITF project area is from 1286.6 to 1288.1 m (4220 to 4225 ft). The ITF itself would be designed nearer the 1289 m (4225 ft) elevation. In 1986 the Great Salt Lake flooded to an historic elevation of 1284.1 m (4211.85 ft), which is well below the ITF area elevation. In addition, the Great Salt Lake Planning Project Draft Analysis of Proposed Management Alternatives, issued by the State of Utah Department of Natural Resources in 1999, has designated the flood plain of the lake at 1284.15 m (4212 ft) for planning purposes and 1285.7 m (4217 ft) as the extent of the lake's floodplain (PFS/RAI2 1999e). Neither elevation is above the ITF design elevation.

7. The ITP will be built at an elevation of 4221 ft. Declaration of Donald Wayne Lewis ("Lewis Dec.") ¶7.

8. The ITP facility will consist of three short rail sidings and a pre-engineered metal building, which houses a 150 ton gantry crane for cask transfer, and a tractor/trailer yard area. The pre-engineered metal building is simply a weather enclosure for the crane. Id. ¶8.

9. The ITP can handle a maximum of three casks per single purpose train and there may be two trains at the facility at the same time, so there will be no more than six transportation casks present at the ITP at any point in time. Id. ¶11.

10. The operation of the ITP calls for the loaded shipping cask, shipping cradle, and impact limiters (2) to be moved as one piece from the incoming rail car to a heavy-haul trailer. Id. ¶10.

11. PFS will be capable of contacting the loaded single purpose train at all times and will be able to contact the train in an emergency to divert it from the ITP site, if such action became necessary. Id. ¶13.

12. In the event flood waters rose to elevations such that the water was near the ITP, any shipping casks temporarily at the ITP could easily be shipped away prior to the loss of the railroad mainline. Id. ¶14.

13. The shipping or transportation cask used to ship spent fuel from the originating power plants to the PFSF is designed and manufactured in compliance with 10 CFR Part 71 and consists of the same welded sealed metal canister as used in the storage system, which is confined within the shipping cask with impact limiters mounted on either end of the shipping cask. Id. ¶15.

14. The shipping cask is transported in a horizontal position, secured on a shipping cradle that in turn is secured to the rail car or heavy-haul trailer. The shipping cradle consists of a metal frame that is designed to securely hold the shipping cask under dynamic loads received during transport. The shipping cask with a canister loaded with spent nuclear fuel, impact limiters, and the shipping cradle weighs approximately 142 tons. Id. ¶¶15 - 16.

15. The shipping cask has an overall diameter of 8 ft. The shipping cradle supports the centerline of the shipping cask approximately 6 ft above the vehicle deck. The deck height of the vehicles is typically 28" to 48", which raises the centerline of the shipping cask to at least slightly more than 8 ft above the ground. Id. ¶17.

16. In order for a transportation cask to become fully submerged, it would have to be covered by at least eight feet of water. Id. ¶18; Declaration of Krishna P. Singh ("Singh Dec.") ¶9.

17. The shipping cask is secured to the shipping cradle with tie-down straps, which consist of heavy steel bands that wrap around the cask and are bolted to the shipping cradle. The shipping cradle is secured to the transport vehicle with attachment connections in the form of heavy steel pins that can be removed to allow the shipping assembly to be removed from the transport vehicle. Both the tie-down straps and attachment pins will be designed to exceed the dynamic loads that are imposed on the vehicle during transport. Lewis Dec. ¶19.

18. Considering the shipping assembly weight and securing measures; it would take a significant force to dislodge the cask from the transport vehicle. Id.

19. Since the transportation casks are lying on their sides, four feet off the ground, while at the ITP, the biggest drop they can experience in the event of an earthquake is four feet. Singh Dec. ¶10.

20. A four foot drop of a transportation cask would have no safety significance, since in accordance with NRC regulations (10 CFR 71.73(c)(1)) the transportation

casks have been demonstrated through testing to be able to withstand a drop of thirty (30) feet without damage. Id.

II. POTENTIAL FOR FLOODING OF THE ITP BY THE GREAT SALT LAKE

21. The historic high level for the Great Salt Lake is slightly below elev. 4212 ft. Declaration of George H. C. Liang ("Liang Dec.") ¶6.

22. The current average level of the Great Salt Lake is at approximately elev. 4200 ft. Id.

23. If the lake were to reach its historical high level and were to flood the surrounding areas near the lake's south shore up to the general vicinity of the ITP, its waters would remain 9 ft. below the level of the ITP. Id.

24. Any increase in lake levels to the historic high value would take several years, and thus would give ample opportunity to implement protective measures. Id. ¶7.

25. A pumping station was installed on the Great Salt Lake in 1986. This pumping station remains in place and can be made operational to remove some of the Lake water. Id.

26. It is possible to build dikes to protect the ITP, as was proposed in the mid-1980s at the time the Great Salt Lake last reached its historic high level. Id.

27. A rise in the level of the Great Salt Lake would not pose a potential flooding threat to the ITP or to any spent fuel transportation casks temporarily present there. Id. ¶8.

III. POTENTIAL FOR FLOODING OF THE ITP AND SUBMERGENCE OF TRANSPORTATION CASKS DUE TO WIND INDUCED SEICHES

28. Seiching is the phenomenon that occurs when the water levels in a lake or other water body experience a vertical oscillatory motion. Seiches may be generated by wind, landslides, and/or earthquake effects such as ground shaking or surface fault rupture. Id. ¶15.

29. The increase in a lake's water level due to wind effects is the sum of the maximum seiche level and the maximum wave height at the shore. Id. ¶12.

30. Studies of wind seiches in the Great Salt Lake conclude that the maximum seiche amplitude is expected to be about 2 feet along the south shores as a consequence of wind tides. Id. ¶11.

31. A study done for the State concluded that, assuming the Great Salt Lake is at its maximum historical elevation of 4212 ft. and further assuming a 2 ft. seiche, the

maximum elevation at which flooding would be expected to occur would be 4216 ft. Id. ¶12.

32. Making, as the State did in Utah W, the extremely conservative assumption that the wave height at the shore was the same as the maximum wave height would result in a total wave height of 9 ft. and (assuming a historical high lake level) would result in the lake water reaching an elevation 4221 ft. Id. ¶13.

33. The spent fuel transportation casks at the ITP will not be subject to flooding due to wind induced seiches, since they will always be above the predicted maximum water level at the ITP. Id. ¶14.

IV. POTENTIAL FOR FLOODING OF THE ITP DUE TO SEISMIC INDUCED SEICHES

34. Utah W postulates a seismically induced seiche with a maximum height of 12 feet based on a 1909 earthquake reported in Hansel Valley, on the northwest corner of the Great Salt Lake. However, the height of that seiche is based on unconfirmed reports of a trestle being overtopped by the seiche and is therefore unreliable. Id. ¶16.

35. The size of an earthquake-induced seiche is dependent upon many factors, including the depth of the body of water. The Great Salt Lake is a shallow lake, with a maximum depth of 35 feet. This shallow depth makes the occurrence of a 12 foot seiche, such as the one postulated by the State in Utah W, extremely unlikely. Id. ¶17.

36. Even if a 12 foot seismically-induced seiche were to occur while the Great Salt Lake was at its maximum historic elevation, the highest level achieved by the seiche waters as they reached the ITP would not be the combination of the Lake water level plus the seiche height, but would be considerably less because the ITP is located inland. Id. ¶18.

37. The State's own designated flood plain for the effect of an earthquake generated seiche (that is, the maximum elevation water would reach in the event of such a seiche) is 4220 ft., which is below the elevation of the ITP. Id. ¶19.

38. The 4220 ft. elevation represents a very conservative high upper bound to the level of a seiche that can be anticipated to occur near the ITP if the Great Salt Lake is at its maximum historic elevation when the earthquake takes place. Id.

V. POTENTIAL FOR FLOODING OF THE ITP DUE TO SUBSIDENCE

39. In large magnitude normal faulting events, a zone of subsidence develops on the hanging wall (down-dropped block) that extends away from the fault. Declaration of Kevin Coppersmith (Coppersmith Dec.) ¶6.

40. Detailed studies of seismic subsidence show that the amount of displacement is greatest at the fault and attenuates with distance away from the fault and off its ends. The amount of displacement is greatest at the fault and attenuates with distance away from the fault and off its ends. Id. ¶7.

41. The closest fault to the ITP is the Stansbury fault, or its northerly equivalent (i.e., the northernmost segment of the Springline fault). Id. ¶8.

42. The Stansbury fault has an expected average displacement at the fault associated with a maximum earthquake which ranges from 1 to 4.5 meters, with an expected value of about 2.5 m. This displacement will decrease with distance from the fault. Id.

43. The average displacement along the Springline fault, which is characterized as having the capability of generating a lower mean maximum magnitude earthquake than the Stansbury fault, would be less than the average displacement for the Stansbury fault. Id.

44. The ITP site lies approximately 3 km west of the Stansbury Range. Id. ¶9.

45. Assuming that the Stansbury fault (or alternatively the Springline fault) extends along the range front north to Timpie, the ITP site would lie on the hanging wall of the fault at the northernmost margin of the rupture plane. Id.

46. The amount of subsidence will be significantly less at the ITP site than the 2.5 m. average displacement at the fault itself. Id.

47. If a maximum magnitude earthquake occurred on the Stansbury fault, the amount of tectonic subsidence at the ITP site is not likely to exceed 2 meters (less than 7 ft.) and most likely will be substantially less. Id. ¶10.

48. Because the seismically induced subsidence at the ITP site as a result of a postulated earthquake is less than the 9 ft. difference in level between the ITP site (elev. 4221 ft.) and the Great Salt Lake's historic high level (elev. 4212 ft), the possibility that the ITP site will be flooded as a result of seismically induced subsidence is very low. Id. ¶12.

VI. POTENTIAL RADIOLOGICAL CONSEQUENCES OF FLOODING AT THE ITP

49. The spent fuel transportation casks that would be used to move spent fuel to and from the ITP are designed to be radiologically leak-tight in accordance with stringent NRC requirements in 10 C.F.R. Part 71. Singh Dec. ¶6.

50. Unless flooding or a flooding-related event causes a breach of the integrity of the casks, no radioactivity will escape from them even if the casks become submerged. Id.

51. The HI-STAR 100 transportation cask used to move spent fuel to the PFSF is a welded cylindrical vessel with a bolted top closure plate. The geometric dimensions of the cask are approximately 68-3/4" inside diameter x 96" outer diameter x 203" overall length. Id. ¶9.

52. Lying on its side, the cask has a height of 8 feet (without impact limiters); therefore, in order for the cask to become fully submerged, it would have to be sitting in at least eight feet of water. Id.

53. The conditions of service for which the transportation cask is engineered are established by 10 CFR Part 71 to be more severe than those that may be encountered by the cask in its actual service (namely, transport of spent nuclear fuel on railroads adjacent to population centers in the forty-eight contiguous states). Id.

A. POTENTIAL CONSEQUENCES OF EXTERNAL PRESSURE ON A SUBMERGED TRANSPORTATION CASK

54. The HI-STAR 100 transportation cask is designed to withstand an external pressure of 300 psig. Id. ¶12.

55. Submergence of a transportation cask in 200 meters (656 ft) of water would create an external pressure load equal to 284 psi, which is less than the design pressure limit of 300 psi. Id.

56. No credible flooding mechanism at the ITP would result in submergence of the transportation cask in over 200 meters of water. Id. Therefore, the structural consequences of any conceivable Great Salt Lake flooding event at the ITP are bounded by the design basis for the transportation cask. Id.

B. POTENTIAL CONSEQUENCES OF THERMAL EFFECTS OF SUBMERSION IN WATER OF TRANSPORTATION CASK

57. The rate of heat transfer in water is approximately 200 times that in air. Id. ¶13.

58. The increased rate of heat transfer would keep a submerged transportation cask even cooler than that in the air environment, thus water submergence can be characterized as a beneficial thermal event for the casks (providing an enhanced rate of dissipation of the heat generated by the spent nuclear fuel), rather than a detriment. Id.

59. The thermal effects of submergence of a transportation cask in the water of the Great Salt Lake are bound by the design basis for the transportation cask. Id. ¶¶13-14.

C. POTENTIAL CONSEQUENCES OF CORROSIVE EFFECTS OF GREAT SALT LAKE WATER ON A SUBMERGED TRANSPORTATION CASK

60. Potential corrosion of submerged transportation casks due to exposure to salt water, is expected to be minimal even under prolonged exposure conditions. Id. ¶15.

61. Transportation casks are designed for submersion in spent fuel pools of nuclear power plants containing boric acid in concentrations exceeding 0.2%, and are coated with an effective coating material, carboline 890. Id.

62. In order for corrosion to degrade a submerged transportation cask, the corrosion process would have to remove the carboline 890 coating and "eat through" six (6) inches of steel, which would take centuries of continued contact between the cask and the flood water, if it occurred at all. Id. ¶16.

63. There are no physical or chemical mechanisms through which the physical integrity of a spent fuel transportation cask could be compromised as a result of any postulated flooding event at the ITP. Id.

64. The water submergence scenarios addressed in the HI-STAR 100 FSAR are far more severe than any flood event that may be postulated for the ITP. Since the HI-STAR 100 overpack has been demonstrated to be capable of withstanding the FSAR scenarios without adverse safety consequences, it would also be able to withstand the effects of a postulated flooding at the ITP without adverse safety consequences. Id. ¶17.

VII. POTENTIAL NON-RADIOLOGICAL ENVIRONMENTAL IMPACTS FROM FLOODING AT THE ITP

65. The potential non-radiological impacts of flooding the ITP site would be limited to disruptions of the water supply and the sanitary waste disposal arrangements. However, drinking water is expected to be provided by bottled water or some other offsite source, and no wells or other water sources at the site will be utilized. Sanitary waste water generated by ITP operation will be either collected in portable toilets and properly disposed of offsite, or will be routed to a small septic tank/leach field nearby. Lewis Dec. ¶20.

66. In the event of flooding of the ITP, both water supply and sanitary waste disposal could be easily replaced (i.e., through additional bottled water and replacement portable toilets), and the loss of the water and the sanitary waste disposal would have negligible environmental consequences. Id.

67. The foundations of the pre-engineered metal building used to house the gantry crane at the ITP will be designed so as to prevent their corrosion from salty soils

or water. Id. ¶9. Any such foundation damage would have insignificant impact on the environment. Id. ¶21.

68. A maximum of six transportation tasks could be present at the ITP in the event of a postulated sudden flood at the ITP site. Assuming these casks were left isolated by the flood, there would be no adverse environmental consequences from this situation because the casks are designed to withstand any potential natural phenomena, including floods and would remain in a safe condition, even if submerged. Id.

69. There would be no need to remove the casks from a flooded ITP facility or perform any operations on them. Id.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	ASLBP No. 97-732-02-ISFSI

CERTIFICATE OF SERVICE

I hereby certify that copies of the "Applicant's Motion for Summary Disposition of Utah Contention W," "Statement of Material Facts On Which No Genuine Dispute Exists," and Declarations of Krishna P. Singh, Kevin Coppersmith, George H.C. Liang and Donald W. Lewis were served on the persons listed below (unless otherwise noted) by e-mail with conforming copies by U.S. mail, first class, postage prepaid, this 27th day of July, 2001.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	ASLBP No. 97-732-02-ISFSI

ATTACHMENTS FOR APPLICANT'S MOTION FOR SUMMARY DISPOSITION OF UTAH CONTENTION W

Tab No.	Subject
A	Declaration of Donald W. Lewis
B	Declaration of Kevin Coppersmith
C	Declaration of George H. C. Liang
D	Declaration of Krishna Singh
E	Deposition of David B. Cole
F	Deposition of Barry J. Solomon

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	

DECLARATION OF DONALD WAYNE LEWIS

Donald Wayne Lewis states as follows under penalties of perjury:

I. WITNESS

1. I am currently employed by Stone & Webster, Inc. -- a Shaw Group Company -- as the Lead Mechanical Engineer for the Fuel Storage Facility ("PFSF") project. I have held this position since 1996. I provide this declaration in support of "Applicant's Motion For Summary Disposition Of Utah Contention W" concerning the licensing of the PFSF.

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 1 to this Declaration. I received my undergraduate engineering degree from the Montana State University, where I majored in Civil/Structural Engineering. I have 19 years of experience in the nuclear power industry, including 10 years of experience with the design, licensing, construction, and operation of independent spent fuel storage installations (ISFSIs). I am currently a registered professional engineer in the states of New York, Colorado, Maine, and Utah. My technical contribution to the PFSF project focuses on the mechanical aspects of ISFSI work, including cask handling and transportation equipment and operations, building services (HVAC, plumbing, etc.), and fire protection. I am also responsible for the preparation of the principal design criteria, design installation, and operating systems

portions of the PFSF Safety Analysis Report. I have previously testified in this proceeding on the subject of fire protection.

3. As Lead Mechanical Engineer, it is my responsibility to establish the design basis and review all design activities of the mechanical systems at the PFSF, including those at the proposed Intermodal Transfer Point ("ITP") facility. I am familiar with the design and the intended operation of the ITP. For the ITP, I am responsible for the cask handling operations (gantry crane and heavy-haul truck and rail car movement arrangements) and the building services (water supply system, sewage system, and HVAC). I developed the layout of the ITP facility to accommodate rail car arrival and unloading, crane, rail, and road placement in the building, and heavy-haul truck loading and departure to PFSF. I also determined the type of water supply, sewage, and HVAC systems that will be used.

II. ALLEGATIONS IN UTAH W RELATING TO FLOODING OF ITP

4. Utah W as admitted by the Licensing Board alleges in its entirety as follows:

> CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.
>
> BASIS: See Contention N (Flooding), whose basis is incorporated by reference.

5. Utah N, as alleged by the State of Utah ("State"), reads:

> 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 Park 100, Appendix A, IV(c)(2), and 10 CFR §72.92 and §72.102(b).

6. My testimony will describe the location and general layout of the ITP, the intended operation of the facility, and the manner in which spent fuel transportation casks will be brought into, moved from one form of transportation to another, and removed from the ITP. I will also address the potential consequences of a flooding event and the non-radiological consequences of a postulated flooding of the ITP site. In preparing this declaration, I reviewed the interrogatory and other written discovery responses filed by the State of Utah with respect to Utah W. I also reviewed the transcript of the depositions of State witnesses Messrs. David B. Cole and Barry J. Solomon, as well as those portions of the NRC Staff Draft Environmental Impact Statement (DEIS) for the PFSF associated with the ITP.

III. LOCATION, GENERAL LAYOUT AND OPERATION OF THE ITP FACILITY

7. The ITP will be located approximately 1.8 miles west of the intersection of Interstate highway 80 and Skull Valley Road at the mainline Union Pacific Railroad, approximately 24 miles north of the PFSF intersection. An access road will be provided to connect the ITP to the frontage road that runs parallel along the north side of Interstate highway 80 (ER Section 3.2.1.4). The mean elevation of the ITP is designed to be approximately 4221 ft (the mainline tracks are on a grade from 4220.6 ft to 4221.8 ft) (PFSF Project Survey Data, Aero-metric, Inc., Project No. 3981208, 6/99). The distance between the ITP and the Great Salt Lake typically ranges from approximately 5.5 miles at a lake elevation of 4193 ft to 3.5 miles at the lake official meander line. The elevation of the meander line generally ranges between 4202 and 4212 feet above mean sea level. (US Dept. of Interior, BLM Land Ownership Map, OQUIRRH-E, 2/80).

8. As designed, the ITP consists of three short rail sidings and a pre-engineered metal building, which houses a 150 ton gantry crane for cask transfer, and a tractor/trailer yard area (SAR Section 4.5.4.1). The crane is single-failure-proof to preclude the accidental drop of a shipping cask, even though the cask is designed to withstand such drops in accordance with 10 CFR 71. The pre-engineered metal building is simply a weather enclosure for the crane, which provides a clean, dry environment for transfer of the shipping cask.

9. A geotechnical soil investigation of the site will need to be performed to determine the soil conditions for site design activities. The soil conditions will determine what type of foundation will need to be designed for the pre-engineered metal building. The soil evaluation will also determine the level of sulfates and chlorides that are present. If the sulfates and chlorides are too high, the foundation will most likely use admixtures to prevent the concrete from being susceptible to corrosion from salty soils or water.

10. The average receipt rate for the PFSF is 200 casks per year (4 casks per week) to achieve an ultimate capacity of 4000 casks over a 20 year loading cycle. The ITP can handle a maximum of 3 casks per single purpose train. To achieve the desired receipt rate of 4 casks per week (on the average), two equivalent incoming trains per week carrying at least 2 casks per train will be required. The operating scenario at the ITP is as follows:

- The operation at the ITP basically requires that the loaded shipping cask, shipping cradle, and impact limiters (2) be moved from the incoming rail car to a heavy-haul trailer. These three components are moved as one piece between the vehicles. The rail car and heavy haul trailer will share a common design for the attachment fixture utilized on both types of transport vehicles to lock the shipping cradle to the vehicle (rail or trailer).

- The operations necessary for this transfer are limited in number. First the rail car is moved into the building under the gantry crane. The shipping cradle attachment connections are then released on the rail car. The necessary rigging is attached to the shipping cradle for the lift of the cask from the rail car. The shipping assembly (cask, cradle, and impact limiters) is relocated over the heavy haul trailer and lowered in place. The shipping cradle attachment connections are locked in placed and the shipping cask assembly on the heavy haul trailer is then delivered to the PFSF.

11. While the first shipping cask is being moved from rail car to heavy haul trailer, a maximum of two (more likely one) other shipping cask rail cars would be parked on the adjacent rail sidings located at the ITP. These casks (or cask) would represent the remaining part of the single purpose train (which would also include the security car and associated buffer car). Thus, at any point in time there will be no more than six transportation casks present at the ITP facility (three casks per train in each of two trains).

12. For the maximum train size of 3 loaded cask cars, it would take approximately 28 work hours to complete the transfer of the last cask to the heavy haul trailer for delivery to the PFSF. (This is based on the use of a single heavy haul trailer; the second heavy haul vehicle and truck is an available spare.) The more typical receipt of 2 cask car trains would require approximately 16 work hours to complete the transfer of the last cask to the heavy haul trailer for delivery to the PFSF.

13. PFS will be capable of contacting the loaded single purpose train at all times. While the main purposes of such contacts are to maintain security as required by 10 CFR 73 and to plan, coordinate and facilitate the cask transfer, it would also be possible to contact the train in an emergency to divert it from the ITP site, if such action became necessary.

14. It is not likely that flood waters would rise to such an extent that the ITP becomes flooded or surrounded by water since the lowest elevation between the Union Pacific mainline and Interstate highway 80 is above 4212 ft, the highest recorded elevation of the Great Salt Lake (Ref. USGS 7.5 quadrangle map, Timpie, Utah, 1985). However, in the event flood waters rose to elevations such that the water was near the ITP, any shipping casks temporarily located at the ITP would be removed. There would be ample time to do this, since it would take the Great Salt Lake days or months to rise to record high elevations. The previous record high levels took from 1983 to 1987 (State of Utah Dept of Natural Resources, Great Salt Lake Planning Project Statement of Current Conditions and Trends, 10/98). Thus, any casks located at the ITP could easily be shipped away prior to the loss of the railroad mainline.

15. The shipping or transportation cask used to ship spent fuel from the originating power plants to the PFSF is designed and manufactured in compliance with 10 CFR 71. The shipping assembly consists of the same welded sealed metal canister as used in the storage system, which is confined within the shipping cask with impact limiters mounted on either end of the cask. The shipping cask is transported in a horizontal position, secured on a shipping cradle that in turn is secured to the rail car or

heavy-haul trailer. The shipping cradle consists of a metal frame that is designed to securely hold the shipping cask under dynamic loads received during transport.

16. The shipping cask with a canister loaded with spent nuclear fuel, impact limiters, and the shipping cradle weighs approximately 142 tons (Holtec International Storage, Transport and Repository Cask System (HI-STAR) Final Safety Analysis Report No. HI-2012610, Rev. 0). This requires the use of heavy-duty rail cars or heavy-haul truck trailers, which have a capacity of approximately 150 tons.

17. The shipping cask has an overall diameter of 8 ft. The shipping cradle supports the centerline of the shipping cask approximately 6 ft above the vehicle deck (Holtec International Storage, Transport and Repository Cask System (HI-STAR) Final Safety Analysis Report No. HI-2012610, Rev. 0). The deck height of the vehicles is typically 28" to 48", which raises the centerline of the shipping cask to at least slightly more than 8 ft above the ground.

IV. EFFECT OF A FLOOD-RELATED EVENT ON TRANSPORTATION CASKS AT THE ITP

18. Because of its shipping configuration, flood waters would need to rise to an elevation of 4225 ft just to reach the bottom of the shipping cask. To submerge a cask the floodwaters would need to rise an additional 8 ft, or to an elevation of 4233 ft.

19. The shipping cask is secured to the shipping cradle with tie-down straps, which consist of heavy steel bands that wrap around the cask and are bolted to the shipping cradle. The shipping cradle is secured to the transport vehicle with attachment connections in the form of heavy steel pins that can be removed to allow the shipping assembly to be removed from the transport vehicle. Both the tie-down straps and attachment pins will be designed to exceed the dynamic loads that are imposed on the vehicle during transport. Rising lake water is not likely to dislodge the cask off of the transport vehicle considering the shipping assembly weight (142 tons) and securing measures; it would take a significant force to dislodge the cask from the transport vehicle.

V. NON-RADIOLOGICAL CONSEQUENCES OF FLOODING OF THE ITP

20. Given the limited facilities that comprise the ITF, the potential non-radiological impacts of flooding the ITP site would be limited to disruptions of the water supply and the sanitary waste disposal arrangements. However, drinking water is expected to be provided by bottled water or some other offsite source, and no wells or other water sources at the site will be utilized. Sanitary waste water generated by ITP operation will be either collected in portable toilets and properly disposed of offsite, or will be routed to a small septic tank/leach field nearby (ER Section 9.2.1). For the reasons discussed earlier, it is unlikely that a flood would disrupt the water supply and sanitary system since the elevation of the ITP (4221 ft) is well above the highest recorded elevation of the lake (4212 ft). However, in the event that a flood did somehow occur, both water supply and sanitary waste disposal could be easily replaced (i.e., through additional bottled water and replacement portable toilets). In addition, the loss of the water and the sanitary waste disposal would have negligible environmental consequences. Likewise, the possibility of damage to the pre-engineered metal building foundations through chemical attack from flood water will be minimized by the design of the foundations and any foundation damage would have insignificant impact on the environment.

21. A maximum of six transportation tasks could be present at the ITP in the event of a postulated flood at the ITP site. As noted above, were such flooding to occur, there would be adequate time to remove the casks from the facility. Assuming, however, the occurrence of a sudden flood that left up to 6 casks isolated at the ITP, there would be no adverse environmental consequences from this situation. The casks are designed to withstand any potential natural phenomena, including floods and would remain in a safe condition, even if submerged. Thus, there would be no need to remove the casks from a flooded ITP facility or perform any operations on them.

22. For the above stated reasons, in the unlikely event the ITP facility was flooded, no adverse environmental consequences would occur.

I declare under penalties of perjury that the foregoing is true and correct.

Executed on July 26, 2001.

Donald Wayne Lewis

LEWIS EXHIBIT 1

Resume of Donald Wayne Lewis

DONALD WAYNE LEWIS | **LEAD ENGINEER MECHANICAL DIVISION**

EDUCATION

Montana State University - Bachelor of Science, Civil Engineering - 1980
Daniel International Corp. - Course in ASME Section III - 1982
Daniel International Corp. - Course in Welding - 1983

REGISTRATIONS

Professional Engineer - New York (1988)
Colorado (1997)

EXPERIENCE SUMMARY

Mr. Lewis has 17 years of engineering experience in the power generation industry, and has participated in all phases of power plant engineering from design through construction, pre-operational testing to on-line modifications.

Mr. Lewis has experience on several nuclear facilities. Assignments include the design of spent nuclear fuel storage facilities, plant systems design modifications, and on-site engineering of mechanical systems installation. Spent fuel storage facility design involved preparation of the design of mechanical aspects and related licensing of the facilities, including an on-site assignment as project engineer for the client for construction of one of the facilities. Plant systems modification assignments involved resolving system design problems, preparing design changes and supporting analyses, revising drawings and preparing specifications. On-site engineering of mechanical systems installation involved resolving pipe and equipment installation conflicts, reviewing and revising design drawings, ensuring code compliance, procuring system components, and developing start-up procedures.

Mr. Lewis has experience on four coal-fired boiler plants. Assignments included the design of mechanical systems on a flue gas scrubber project, development of system descriptions and operating instructions; and the evaluation of a coal to natural gas conversion design. Work involved design of piping systems, component selection and sizing, preparing calculations and specifications, reviewing proposal submittals, initiating process flow and layout drawings; writing plant operation instructions; and preparing cost analyses.

Mr. Lewis is currently assigned to several projects: the Indian Pt 2 spent fuel conceptual design project where he is Project Engineer, the Maine Yankee Atomic Plant spent fuel storage project where he is Lead Mechanical Engineer, the Private Fuel Storage Project where he is Lead Mechanical Engineer, and the Northern States Power Prairie Island Generating Plant where he is Project Engineer, responsible for overseeing the High Energy Line Break Upgrade Project and spent fuel storage issues.

DETAILED EXPERIENCE RECORD
LEWIS, DONALD WAYNE

STONE & WEBSTER ENGINEERING CORPORATION, DENVER, COLORADO
(Apr 1988 - Present)
Appointments:
Lead Engineer, Mechanical Division - Jan 1998
Senior Mechanical Engineer, Mechanical Division - Nov 1990
Mechanical Engineer, Mechanical Division - Jan 1989

Indian Point 2 Nuclear Plant, Buchanan, NY – Consolidated Edison
(January 1999 - Present)
PROJECT ENGINEER

Maine Yankee Atomic Plant, Wiscasset, ME – Maine Yankee Power Company
(November 1998 - Present)
LEAD MECHANICAL ENGINEER

Yucca Mountain Project, Las Vegas, NV - U.S. Department of Energy
(June 1998 - August 1998)
SYSTEMS ENGINEER

Rocky Flats Environ. Tech. Site, Golden, CO - Rocky Flats Engineers & Contractors, L.L.C.
(May 1998 - Sept 1998)
RADIOLOGICAL CONSULTANT

Prairie Island Generating Plant, Red Wing, MN - Northern States Power Company
(Oct 1997 - Present)
PROJECT ENGINEER

National Wind Technology Center, Golden, CO - National Renewable Energy Laboratory
(Oct 1997 - Apr 1998)
SENIOR MECHANICAL ENGINEER

Rocky Flats Environmental Technology Site, Golden, CO - BNFL
(July 1997 - Oct1997)
SENIOR MECHANICAL ENGINEER

Private Fuel Storage Facility, Goshute Indian Res., UT - Private Fuel Storage
(Oct 1996 - Present)
LEAD MECHANICAL ENGINEER

Goodhue County ISFSI, Frontenac, MN - Northern States Power Company
(Aug 1995 - Sept 1996)

PROJECT ENGINEER

Navajo Generating Station, Page AZ - Salt River Project
(Sept 1993 - Nov 1995)
SENIOR MECHANICAL ENGINEER

Prairie Island Generating Plant, Red Wing, MN - Northern States Power Company
(Jan 1992 - Aug 1993)
SENIOR MECHANICAL ENGINEER

Neil Simpson Station, Gillette, WY - Black Hills Power Company
(Sept 1991 - Dec 1991)
SENIOR MECHANICAL ENGINEER

North Omaha Station, Omaha, NE - Omaha Public Power District
(July 1991 - Aug 1991)
SENIOR MECHANICAL ENGINEER

Fort Calhoun Power Station, Ft Calhoun, NE - Omaha Public Power District
(Apr 1988 - June 1990) (Nov 1990 - Aug 1991)
SENIOR MECHANICAL ENGINEER

Prairie Island Generating Plant-Unit 2, Red Wing, MN - Northern States Power Company
(July 1990 - Oct 1990)
LEAD MECHANICAL ENGINEER

EG&G Rocky Flats Inc., Golden, CO - U. S. Department of Energy
(July 1990)
MECHANICAL ENGINEER

U. S. Department of Energy, Hanford, WA
(June 1990)
MECHANICAL ENGINEER

STONE & WEBSTER ENGINEERING CORP., CHERRY HILL, NEW JERSEY
(Sept 1983 - Mar 1988)
Appointments:
Engineer, Mechanical Division - Aug 1987
Construction Engineer - Oct 1985
Senior Field Engineer - Oct 1984
Field Engineer - Sept 1983

Nine Mile Point Nuclear Station, Unit 2, Lycoming, NY - Niagara Mohawk Power Corporation
(Sept 1983 - Mar 1988)
ENGINEER, Mechanical Division (Aug 1987 - Mar 1988)

ENGINEER, Construction Division (Sept 1983 - July 1987)

Oswego Steam Station Units 5 & 6, Oswego, NY - Niagara Mohawk Power Corporation
(Dec 1986)
CONSTRUCTION ENGINEER

DANIEL INTERNATIONAL CORPORATION, GREENVILLE, SOUTH CAROLINA
(June 1982 - Aug 1983)

Wolf Creek Nuclear Plant, New Strawn, KS - Kansas Gas & Electric
CONSTRUCTION ENGINEER II

J.A. JONES CONSTRUCTION COMPANY, CHARLOTTE, NORTH CAROLINA
(Oct 1981 - Apr 1982)

Washington Nuclear Plant No. 1, Handford, WA - Washington Public Power Supply System
FIELD ENGINEER

WRIGHT SCHUCHART HARBOR-BOECON-GERI, RICHLAND, WASHINGTON
(Mar 1981 - Oct 1981)

Washington Nuclear Plant No. 2, Handford, WA - Washington Public Power Supply System
ASSOCIATE STRUCTURAL ENGINEER

MONTANA STATE HIGHWAY DEPARTMENT, HELENA, MONTANA
(July 1979 - Sept 1979, July 1980 - Mar 1981)
CIVIL ENGINEER I (Traffic Division, Jan 1981 - Mar 1981)
ENGINEER AIDE (July 1979 - Sept 1979)

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	

DECLARATION OF KEVIN COPPERSMITH

Kevin Coppersmith states as follows under penalty of perjury:

I. WITNESS CREDENTIALS AND SCOPE OF TESTIMONY

1. I am currently an independent consultant working through my own company, Coppersmith Consulting, Inc., located in Walnut Creek California. Prior to June 2, 2000, I was a Principal of Geomatrix Consultants Inc. ("Geomatrix") in Oakland, California. In that capacity, I was responsible for the Fault Evaluation Study and Seismic Hazard Assessment, February 1999, prepared by Geomatrix ("Geomatrix 1999" or "Geomatrix Report") for the Private Fuel Storage Facility ("PFSF"). (That report was attached as Exhibit 2 to my Declaration, dated December 30, 2000, in support of "Applicant's Motion for Summary Disposition of Utah Contention L." I provide this declaration in support of "Applicant's Motion For Summary Disposition Of Utah Contention W" ("Applicant's Motion") concerning the licensing of the PFSF.

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 1 hereto. I have over 20 years of professional consulting experience in seismic hazard analysis. My particular experience lies in the evaluation

of faults to determine their potential for being seismogenic and for evaluating surface faulting hazards. This experience includes seismic source characterization for NRC-regulated facilities, including nuclear power plants and high-level radioactive waste repositories. In addition, I have conducted seismic hazards studies for a variety of nuclear facilities throughout the U.S. and in several other countries. I have published studies of fault behavior and the location and amount of fault deformation that accompanies surface-faulting earthquakes.

3. Utah W as admitted by the Licensing Board alleges in its entirety as follows:

> CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.
>
> BASIS: See Contention N (Flooding), whose basis is incorporated by reference.

4. Utah N, as alleged by the State of Utah ("State"), reads:

> 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 Park 100, Appendix A, IV(c)(2), and 10 CFR §72.92 and §72.102(b).

5. I will be addressing herein the portion of Utah W that alleges that Applicant failed to investigate the potential flooding of the Intermodal Transfer Point ("ITP") as a result of a seismic event. In preparing this declaration, I reviewed the interrogatory and other written discovery responses filed by the State of Utah with respect to Utah W. I also reviewed the transcript of the deposition of State witness Mr. Barry Solomon, as well as those portions of the NRC Draft Environmental Impact Statement (DEIS) for the PFSF that relate to the ITP.

II. MAXIMUM POSTULATED SEISMIC EVENTS THAT MAY HAVE AN IMPACT ON THE ITP

A. Potential Subsidence at the ITP Site Resulting from a Seismic Event

6. It is possible to postulate a mechanism for inundation of the transportation casks at the ITP through subsidence related to permanent deformation associated with primary faulting on a fault in the general vicinity of the ITP, followed by the inflow of Great Salt Lake waters driven by the seismic event. Observations of historical ruptures from large magnitude normal faulting (e.g., **M** 7.3 Hebgen Lake, **M** 6.9 Borah Peak) have

shown that in addition to displacement at the fault itself, there is a zone of subsidence on the hanging wall (down-dropped block) that extends away from the fault.

7. Detailed studies of this subsidence show that the amount of displacement is greatest at the fault and attenuates with distance away from the fault and off its ends (Myers and Hamilton, 1964; Barrientos and others, 1987). Recent studies have utilized interferometric analysis of Synthetic Aperture Radar (SAR) images of the ground surface, acquired before and after an event in which ground displacements have occurred, to generate interferograms from which very precise (subcentimetric) measurements of the coseismic deformation can be measured. (Wright and others, 1999) Using this technology, elliptical seismic deformation field patterns have been modeled for more recent moderate magnitude earthquakes. The deformation patterns for recent earthquakes exhibit the same decrease in subsidence with distance away from the fault as those reported in earlier studies (e.g., Massonnet and Feigl, 1995; Kontoes and others, 2000).

8. The closest fault to the ITP is the Stansbury fault, or its northerly equivalent (i.e., the northernmost segment of the Springline fault) (which is depicted on Plate 6 of Geomatrix Consultants, 1999a). The potential relationship between the Stansbury fault and the Springline fault is discussed in the Geomatrix study that provided the characterization of the Stansbury fault. The Stansbury fault is characterized in that report to have an expected average displacement associated with a maximum earthquake which ranges from 1 to 4.5 m, with an expected value of about 2.5 m (Geomatrix Consultants, 1999a, Sections 5.1.3 and 6.2). This is displacement at the fault, which will decrease with distance from the fault. Further, this displacement would include a component of uplift on the footwall (upthrown block) as well as subsidence on the hanging wall (downthrown block). Only the subsidence component is of importance for this discussion. The average displacement along the Springline fault, which is characterized in the Geomatrix report to be the source of a lower mean maximum magnitude earthquake than the Stansbury fault, would be less.

9. The ITP site lies approximately 3 km west of the Stansbury Range. Assuming that the Stansbury fault (or alternatively the Springline fault) extends along the range front north to Timpie, the ITP site would lie on the hanging wall of the fault at the northernmost margin of the rupture plane. Based on analogies to the subsidence pattern of historically recorded ruptures, it would therefore be expected that the amount of subsidence will be significantly less at the ITP site than the average displacement at the fault itself (about 2.5 m).

10. Therefore, given the unlikely occurrence of the maximum earthquake on the Stansbury fault, it is very unlikely that the amount of tectonic subsidence at the ITP site will exceed 2 meters (less than 7 ft.), and most likely will be substantially less.

B. Potential Flooding of the ITP as a Result of Seismically-Induced Subsidence

11. The NRC Staff's Draft Environmental Impact Statement for the PFS facility ("DEIS") states:

> The ITF would be on a slight topographical rise, approximately 2.9 km (1.8 miles) west of Timpie in the area north of Interstate 80 and south of the existing mainline railroad. The existing elevation of the ITF project area is from 1286.6 to 1288.1 m (4220 to 4225 ft). The ITF itself would be designed nearer the 1289 m (4225 ft) elevation. In 1986 the Great Salt Lake flooded to an historic elevation of 1284.1 m (4211.85 ft), which is well below the ITF area elevation. In addition, the Great Salt Lake Planning Project Draft Analysis of Proposed Management Alternatives, issued by the State of Utah Department of Natural Resources in 1999, has designated the flood plain of the lake at 1284.15 m (4212 ft) for planning purposes and 1285.7 m (4217 ft) as the extent of the lake's floodplain (PFS/RAI2 1999e). Neither elevation is above the ITF design elevation.

DEIS at 5-7.

12. Based on the information provided by the Applicant, I understand that the ITP will be located at an elevation of 4221 ft. Thus, the difference in elevation between

the ITP site (4221 ft.) and the historic Great Salt Lake flood level reported in the DEIS of 4212 ft. is about 9 ft. Since the amount of seismically induced subsidence at the ITP site as a result of a postulated earthquake is less than 7 ft., I conclude that the possibility that the ITP site will be flooded as a result of seismically induced subsidence is very low. I also understand that other witnesses providing declarations in support of Applicant's Motion demonstrate that, should such flooding occur, the transportation casks are designed to withstand submersion without adverse safety consequences.

III. REFERENCES

Barrientos, S. E., Stein, R. S., and Ward, S. N., 1987, Comparison of the 1959 Hebgen Lake, Montana and the 1983 Borah Peak, Idaho, earthquakes from geodetic observations: Bulletin of the Seismological Society of America, v. 77, no. 3, p. 784-808.

Geomatrix Consultants, Inc., 1999a, Fault evaluation study and seismic hazard assessment, Private Fuel Storage Facility, Skull Valley, Utah: report prepared for Stone & Webster Engineering Corporation, February.

Kontoes, P. E., Sykioti, O., Briole, P. Remy, D, Sachpazi, M., Veis, G., and Kotsis, I., 2000, Displacement field and fault model for the September 7, 1999 Athens earthquake inferred from ERS2 satellite radar interferometry: Geophysical Research Letters, v. 27, no. 24, p. 3989-3992.

Massonnet, D., and Feigl, K. L., 1995, Satellite radar interferometric map of the coseismic deformation field of the M= 6.1 Eureka Valley, California earthquake of May 17, 1993: Geophysical Research Letters, v. 22, no. 12, p. 1541-1544.

Myers, W. B., and Hamilton, W., 1964, Deformation accompanying the Hebgen Lake earthquake of August 17, 1959: U. S. Geological Survey Professional Paper 435, p. 55-98.

Wright, T. J., Parson, B. E., Jackson, J. A., Haynes, M., Fielding, E. J., England, P. C., and Clarke, P. J., 1999, Source parameters of the 1 October 1995 Dinar (Turkey) earthquake from SAR interferometry and seismic bodywave modeling: Earth and Planetary Science Letters, v. 172, p. 23-37.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 18, 2001.

Kevin Coppersmith

COPPERSMITH EXHIBIT 1

Resume of Kevin Coppersmith

KEVIN J. COPPERSMITH

Decision Analysis
Hazard Analysis
Performance Assessment
Project Management

EDUCATION

University of California, Santa Cruz; Ph.D., Geology, 1979
Washington and Lee University, Lexington, Virginia: B.S., Geology, 1974

PROFESSIONAL HISTORY

Coppersmith Consulting, Inc., President 2000 to present
Geomatrix Consultants, Inc., Principal and Vice President, 1985 to 2000
Woodward-Clyde Consultants, Senior Project Geologist, 1978-1985
University of California, Regents Fellow, 1974-1978
Earth Sciences Board, University of California, Santa Cruz, Research Assistant and Teaching Assistant, 1974-1978

REPRESENTATIVE SKILLS AND EXPERIENCE

Dr. Coppersmith has 20 years of consulting experience, with primary emphasis in decision analysis and hazard analysis. Dr. Coppersmith has pioneered approaches to characterizing earth sciences data, and their associated uncertainties, into probabilistic hazard analyses. As manager of the Decision Analysis (DA) operating unit at Geomatrix, Dr. Coppersmith has helped develop capabilities within the firm that integrate the fields of earth sciences, hazard analysis, and risk assessment. Dr. Coppersmith has worked with clients to structure their decision problems and solve them using decision analysis methods. As a result of increasing use of decision analysis for technical decision making, Dr. Coppersmith has identified new applications for DA in the engineering and environmental fields. Applications range from highway bridges to nuclear waste repositories.

Dr. Coppersmith's representative project experience and clients are identified briefly below:

Development of Hazard Methodologies and Uncertainty Treatment

Seismic Hazard in the Eastern United States, Electric Power Research Institute (EPRI)
Maximum Earthquakes in Eastern United States, EPRI
Senior Seismic Hazard Analysis Committee, Department of Energy (DOE), Nuclear Regulatory Commission (NRC), and EPRI
Seismic Hazard Analysis Methodology Topical Report for Yucca Mountain, DOE
Expert Elicitation Methodology Demonstration for Yucca Mountain Performance Assessment, EPRI

Hazard Analysis for Performance Assessment of Built Structures and Pipelines

Seismic hazard at San Francisco bay area bridges, California Department of Transportation (Caltrans)

Seismic hazard at Humboldt Bay bridges, Caltrans
Regional seismic hazard analysis for Oregon bridges and transportation structures, Oregon Department of Transportation
Seismic hazard and site response studies for K-reactor, Westinghouse Savannah River Company
Seismic hazard analysis for Portugues Dam, Puerto Rico, U.S. Army Corps of Engineers
Seismic hazard analysis of Southern Ontario, Atomic Energy Control Board, Canada.

Technical Decision Making for Critical Facilities

License Application Design Selection for Yucca Mountain, TRW Environmental Safety Systems
Performance Allocation for Viability Assessment at Yucca Mountain, TRW Environmental Safety Systems, DOE Office of Civilian Radioactive Waste Management

Uncertainty Characterization for Performance Assessments

Demonstration of risk-based total system performance assessment, EPRI, DOE
Probabilistic volcanic hazard analysis for Yucca Mountain, TRW, DOE
Seismic hazard analysis for Yucca Mountain, USGS, DOE
Expert Elicitations for Total System Performance Assessment at Yucca Mountain: Unsaturated zone flow; Near field/Altered Zone Coupled Effects; Waste Package Degradation; Waste Form Degradation Radionuclide Mobilization; Saturated Zone Flow and Transport, TRW, DOE

Hazard Analyses for Development of Design Criteria or Design Review

Seismic Hazard Assessment for the New Production Reactor of Savannah River Site and Idaho National Engineering Laboratory, DOE
WNP-1, 2, 4 Hanford and WNP-3,5 Satsop, WPPSS
Diablo Canyon Power Plant, PG&E
Trojan Nuclear Power Plant, PGE
San Onofre Nuclear Generating Station, SCE
Palo Verde Nuclear Power Plant, APS

Seismic Source Characterization for Hazard Analysis

Diablo Canyon Power Plant, PG&E
Hanford Reservation, Westinghouse Hanford Company
Darlington and Pickering Nuclear Generating Stations, AECB
Nuclear Power Plants in Eastern Europe: Bohunice, Slovakia; Kozloduy and Belene, Bulgaria, Westinghouse Energy Systems*; Paks, Hungary*; Ove Arup and Partners
San Onofre Nuclear Generating Station, Southern California Edison

Geologic Field Studies

Humboldt Bay Nuclear Power Plant, Pacific Gas & Electric Company (PG&E)
Diablo Canyon Power Plant, PG&E
Savannah River Site, South Carolina, Westinghouse Savannah River Company
Rocky Flats Environmental Technology Site, EG&G

AFFILIATIONS

Geological Society of America
Seismological Society of America
American Geophysical Union
Earthquake Engineering Research Institute

APPOINTMENTS

National Research Council/National Academy of Sciences:
- Panel on Probabilistic Seismic Hazard Analysis (1987-1988)
- Panel on Geological Hazards, Committee on Solid Earth Sciences - A Critical
- Assessment (1989-1990)
- Committee on Seismology (1988-1993)

Chairman, Task Group on Probabilistic Approaches to Geological Uncertainties Related to Seismic and Volcanic Hazards, International Lithosphere Program, Inter-Union Commission of the Lithosphere - Geodynamics of the Solid Earth (1991-1993)
Chairman, Task Group o Probabilistic Approaches to Geological Uncertainties Related to Seismic and Volcanic Hazards, International Lithosphere Program, Inter-Union Commission on the Lithosphere - Geodynamics of the Solid Earth (1991-1993)
Seismic Hazard Team Leader, Earthquake risk Reduction in the United States, An Assessment of Selected User Needs and Recommendations for the National Earthquake Hazards Reduction Program; conducted for Federal Emergency Management Agency (FEMA) (1994)
Geosciences Team Leader, Governor's Executive Order on the Implications of the 1993 Northridge Earthquake to Building Codes and Land Use Planning, sponsored by California Seismic Safety Commission and FEMA (1994)
Appendix A Expert Panel, providing advice to Department of Energy, Nuclear Regulatory Commission regarding revision to 10CFR100 Appendix A of Geologic Siting Criteria (1991-1996)
Senior Seismic Hazard Analysis Committee, sponsored by the Department of Energy, Nuclear Regulatory Commission, and Electric Power Research Institute (1994-1996)
Editorial Board, Earthquake Spectra, Professional Journal of the Earthquake Engineering Research Institute (1991-Present)
Director, Seismological Society of America (1996-1999)

RECENT INVITED LECTURES AND PRESENTATIONS

Earthquake Engineering Research Institute Annual Seminary (February, 1986)
University of South Carolina, Geology Seminar (September, 1986)
Stanford University, Risk Analysis Seminar (March, 1987)
University of California, Santa Cruz, Geology Seminar (March, 1987)
National Earthquake Prediction Evaluation Council, Cascadia Subduction Zone (April,1987)
Earthquake Engineering Research Institute, Strong Ground Motion Seminar
San Francisco, CA (April, 1987)
Los Angeles, CA (April, 1987)
Charleston, SC (January, 1988)

American Society of Civil Engineer's Geotechnical Considerations in Hazardous Waste Management (June, 1987)
National Center for Earthquake Engineering Research, Symposium on Seismic Hazards, Ground Motions, Soil-Liquefaction, and Engineering Practice in Eastern North America (October, 1987)
Geological Society of America, Neotectonics in Earthquake Evaluation (October, 1987)
U.S. Geological Survey Workshop o Fault Segmentation (March, 1988)
Seismogenesis on The Eastern United States, NSF Workshop (April, 1988)
NATO Advanced Research Workshop on Causes and Effects on Earthquakes at Passive Margins and in Areas with Post-glacial Rebound on both Sides of the North Atlantic May, 1988)
American Society of Civil Engineers, Earthquake Engineering and Soil Dynamics II Conference (June, 1988)
National Earthquake Hazards Reduction Program Workshop of the Cascadia Subduction Zone (March, 1989)
National Academy of Sciences/National Research Council, Symposium on Opportunities in Seismology (May, 1989)
International Geological Congress Symposium on Geological Hazards (July, 1989)
Department of Energy, Natural Phenomena Hazards Mitigation Conference (October, 1989)
International High-Level Radioactive Waste Management Conference (April, 1990)
Institute of Gas technology, Disaster Relief Planning Meeting (April, 1990)
Workshop on Probabilistic Seismic Hazard Methodology, California Department of Transportation (November, 1990)
Seismic Hazards in the Delta, San Francisco Bay Region, Association of California Water Agencies (November, 1990)
State-of-the-Art Lecture, International Conference on Seismic Zonation (August, 1991)
Conference on Seismic Vulnerabilities, Nuclear Waste Technical Review Board (January, 1992)
Seismic Hazard Methodologies, Building Seismic Safety Council (January, 1993)
Effects of the 1992 Nevada Earthquake, International High Level radioactive Waste Management Conference (April, 1993
Use of Paleoseismic Data in Hazard Analysis, International Conference on the Implications of the 1988 Spitak, Armenia Earthquake (October, 1993)
New Directions in Geotechnical Engineering, American Society of Civil Engineers (April, 1994)
Emergency Response Planning for Gas Systems, Institute Gas Technology (May, 1994)
Experience Characterizing Earthquake Sources in the Central and Eastern United States; Canadian Atomic Energy Control Board (June, 1995)
Probabilistic and Deterministic Approaches to Seismic Hazard Analysis, Applied Technology Council (September, 1995)
Expert Elicitation of Probabilistic Volcanic Hazard at Yucca Mountain, Nevada, International High Level Radioactive Waste Management Conference (May, 1996)
Improved Guidance on the Use of Experts - Probabilistic Seismic Hazard Analysis and Other International Topical Meeting on Probabilistic Safety Assessment (October, 1996)
The Use of Expert Elicitation to Quantify Uncertainties in Inputs to Total System Performance Assessments at Yucca Mountain, Nevada (May, 1998)

Examples of Seismic Source Characterization for Probabilistic Seismic Hazard Analysis, Symposium on Geologic Interpretation of Earthquake Hazards, Camerino, Italy (June, 1998)
Use of Expert Judgments in Risk Analyses, Probabilistic Safety Analysis and Management Conference, New York (September, 1998)
New Trends in the Use of Paleoseismic Data in Seismic Hazard Analyses, Keynote Speech Latin American Geological Congress, Buenos Aires (November, 1998)
Incorporating Uncertainties in Seismic Hazard Analyses, Luncheon Address, Symposium on the Application of Geophysics to Environmental and Engineering Problems, Environmental and Engineering Geophysical Society (March, 1999)

PUBLICATIONS

"Probabilistic Seismic Hazard Analyses for Ground Motions and Fault Displacement at Yucca Mountain, Nevada," J.C. Stepp, I. Wong, J. Whitney, R. Quittmeyer, N. Abrahamson, G. Toro, R. Youngs, K. Coppersmith, J. Savy, T. Sullivan, and Yucca Mountain PSHA Project Members, Earthquake Spectra, Feb. 2001 (in press)

"Data Needs for Probabilistic Fault Displacement Hazard Analysis," K. Coppersmith and R. Youngs, International Journal of Geodynamics (in press).

"Studies of Design Features and Alternatives at Yucca Mountain," J. Blink, T. Buscheck, K. Coppersmith, T. Cotton, R. Craun, R. Howard, and R. Snell, Journal of Rock Mechanics (in press).

"Use of Technical Expert Panels: Applications to Probabilistic Seismic Hazard Analysis," R. Budnitz, G. Apostolakis, D. Boore, L. Cluff, K. Coppersmith, C. Cornell, and P. Morris, Risk Analysis, v. 18, p. 463-470, 1998.

"Use of Expert Elicitation to Quantify Uncertainties in Process Models for Total System Performance Assessment," K.J. Coppersmith, R.C. Perman, R.R. Youngs, and M. Pendleton, International High Level Radioactive Waste Management Conference Proceedings, p. 318-320, 1998.

"Use of Expert Elicitation for Modeling Waste Package Degradation at the Potential Yucca Mountain Repository," J.H. Lee, K.J. Coppersmith, D. Stahl, R. Andrews, M. Pendleton, International High Level Radioactive Waste Management Conference Proceedings, p. 414-416, 1998

"Characterizing seismic sources for design ground motions and fault displacement studies part of Los Angeles 2020 project," L. S. Cluff, and K. J. Coppersmith, Port of Las Angeles 2020 Project Earthquake Symposium, p. 1-14, 1997.

"Performance Assessments for gas transmission systems," Proceedings of the Disaster Relief Planning Symposium: Institute for Gas Technology, May, 1997.

"Yucca Mountain Probabilistic Volcanic Hazard Analysis Project," International High-Level Radioactive Waste Management Conference Proceedings, 1996.

"New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement," D.L. Wells, K.J. Coppersmith, Bulletin of the Seismological Society of America, v. 84 #4, p. 974-1002, 1994.

"Modeling fault rupture hazard for the proposed repository at Yucca Mountain, Nevada," K.J. Coppersmith, R. Youngs, Proceedings Third International Conference High Level Radioactive Waste Management, April 12-16, 1992.

"Demonstration of a decision analysis methodology for assessing the performance of the Yucca Mountain site in southern Nevada," F. Schwartz, R. McGuire, D. Bullen, N. Cook, K. J. Coppersmith, J. Kernendy, A. Long, F. Pearson Jr., M. Sheridan, and R. R. Youngs, Waste Management, v. II, p. 287-306, 1991.

"Seismic source characterization for engineering seismic hazard analyses," K.J. Coppersmith, Proceedings of the Fourth International Conference on Seismic Zonation: Earthquake Engineering Research Institute, Oakland, California, v. 1, p. 1-60, 1991.

"Improved methods for seismic hazard analysis in the western United States," R.R. Youngs, Proceedings of the Fourth U.S. National Conference on Earthquake Engineering, v. 1, p. 723-731, 1990.

"Incorporating seismotectonic data into seismic hazards analyses," K.J. Coppersmith, Second International High-Level Radioactive Waste Management Conference Proceedings, 1990.

"Probabilistic Seismic hazard analysis using expert opinion: An example from the Pacific Northwest," K.J. Coppersmith, R. Youngs, Geological Society of America Memoir on Neotectonics in Earthquake Evaluation, E. Krinitsky, and D.B. Slemmons (eds.), v. 8, p.27-46, 1990.

"New earthquake magnitude and fault rupture parameters: Part I Surface rupture length and rupture area relationships" (abs.), D.L. Wells, K.J. Coppersmith, X. Chang, and D.B. Slemmons, Seismological Research Letters, 1989.

"Paleoseismic history of the Meers fault, southwestern Oklahoma, and its implications to evaluations of earthquake hazards in the central and eastern United States," F. H. Swan, and K. I. Kelson, Proceedings of the 17th Water Reactor Safety Information Meeting, 1989.

"Keeping pace with the science: seismic hazard analysis in the western United States," R.R. Youngs, K. J. Coppersmith, Proceedings of the Second DOE Natural Phenomena Hazards Mitigation Conference, 1989.

"Keeping pace with the science: seismic hazard analysis in the central and eastern United States," K. J. Coppersmith, R.R. Youngs, Proceedings of the Second DOE Natural Phenomena Hazards Mitigation Conference, 1989.

"The impact of fault segmentation on estimates of earthquake recurrence and seismic hazard," R.R. Youngs, Proceedings of the Fourth International Symposium on the Analysis of Seismicity and

Seismic Risk, 1989.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	

DECLARATION OF GEORGE H. C. LIANG

George H. C. Liang states as follows under penalties of perjury:

I. WITNESS

1. I am currently employed by Stone & Webster, Inc. -- a Shaw Group Company -- as Senior Principal Environmental Engineer. I provide this declaration in support of "Applicant's Motion For Summary Disposition Of Utah Contention W" concerning the licensing of the Private Fuel Storage Facility ("PFSF").

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 1 to this declaration. I have extensive experience in the analysis of hydrologic processes, including over 15 years experience in the calculation and evaluation of flood events. During this period, I have been involved in numerous flooding evaluations of nuclear facilities performed by Stone & Webster. I am intimately familiar with the NRC requirements and standard industry practice for evaluating flood events. Most recently, I have been involved in a nuclear power plant project in Taiwan, serving as an independent reviewer of the hydrology sections in the Environmental Report, which includes flooding hazards at the site due to various causes, such as the probable maximum tsunami and storm surge. I am knowledgeable of the location of the proposed Intermodal Transfer Point ("ITP") facility, the hydrologic conditions at the

Great Salt Lake, and the area's topography. I am also generally familiar with the operation of the ITP facility.

II. ALLEGATIONS IN UTAH W RELATING TO FLOODING OF ITP

3. Utah W, as admitted by the Licensing Board, alleges in its entirety as follows:

> CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.
>
> BASIS: See Contention N (Flooding), whose basis is incorporated by reference.

4. Utah N, as alleged by the State of Utah ("State"), reads:

> 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 Park 100, Appendix A, IV(c)(2), and 10 CFR §72.92 and §72.102(b).

5. I will be addressing the portions of Utah W that allege that Applicant failed to investigate the potential flooding of the ITP as a result of: (a) a rise in the level of the Great Salt Lake, (b) wind generated water wave, and (c) a seiche produced by a seismic event. In preparing this declaration, I reviewed the interrogatory and other written discovery responses filed by the State of Utah with respect to Utah W. I also reviewed the transcript of the depositions of State witnesses Messrs. David B. Cole and Barry J. Solomon, as well as those portions of the NRC Staff Draft Environmental Impact Statement (DEIS) for the PFSF associated with the ITP.

III. POTENTIAL FLOODING OF THE ITP DUE TO A RISE IN THE GREAT LAKE LEVEL

6. As Utah W recognizes, the historic high level for the Great Salt Lake is slightly below elev. 4212 ft. This level was reached in 1873 and again in 1986. (Ref. 5). The current average lake level is at approximately elevation 4200 ft (Ref. 1 and Ref. 7); in 2000, the peak elevation was approximately 4203 ft. (Cole Deposition at 9). I understand that the ITP is to be designed to be at elevation of 4221 ft. Thus, even if the lake were to reach its historical high level and were to flood the surrounding areas near the lake's south shore up to the general vicinity of the ITP, its waters would remain 9 feet below the level of the ITP.

7. Moreover, any increase in lake levels to historically high values would not occur suddenly. For example, it took 23 years (1963 to 1986) for the lake to rise from a historical low level of elev. 4192 ft. to the high experienced in 1986. While it is possible that over successive wet seasons the increase in lake level could be rapid, it would still take several years for the lake waters to rise from its current level to the historical high

value, thus giving ample opportunity to implement protective measures. For example, a pumping station was installed in 1986; it remains in place and could be made operational to remove some of the lake water. (Cole Deposition at 14-15). Dikes could also be built, as was proposed in the mid-1980s at the time the lake last reached its historic levels. (Ref. 5). In addition, if warranted, Applicant could take remedial measures to protect the ITP, and transportation casks, from rising lake water levels.

8. For those reasons, I do not believe that a rise in the level of Great Salt Lake would pose a potential flooding threat to the ITP, or to any spent fuel transportation casks temporarily present there.

IV. MAXIMUM WATER WAVES OR SEICHES THAT MAY CAUSE FLOODING OF THE ITP

A. Potential Water Waves or Seiches that can Affect the ITP

9. In a large body of water such as a lake, the wind can generate two kind of waves: (1) short waves, with each wave cycle lasting from a few seconds to several minutes, and (2) long waves, with each cycle extending over hours. The long waves are referred to as wind tides (Ref. 2). A wind tide normally involves the motion of the entire water mass of the lake in either a horizontal or vertical direction. "Seiching" refers to the vertical oscillation of the lake water mass. The potential flooding that may be caused by wind waves is the sum of the maximum wave height and the maximum seiche level.

10. Each lake has its own inherent system of long waves. Just as the natural frequency of a pendulum is dependent upon its physical make-up, the natural frequency (of a normal mode) of a lake depends on the water depth, shape, and bottom topography of the lake. The fundamental mode refers to the wave with the longest wave length. Before the construction of the railroad causeway, the period of the fundamental mode of the Great Salt Lake was nearly 9.0 hours (Ref. 2); after the construction of the causeway, the period of the fundamental mode of the South Basin became 6.0 hours.

11. A maximum water level increase due to seiche action was determined to be 1.9 feet at the Jordan River area of the Great Salt Lake and 1.5 feet at the lake's Bay Area Refuse Disposal Site (B.A.R.D.) location. (Ref. 4). The wind speed selected was 51 mph based upon a 100-year return period and a six hour duration. This duration was selected to match the natural period of the lake, which was reported to be approximately six hours. Likewise, studies of wind seiches in the Great Salt Lake conclude that the maximum seiche amplitude is expected to be about 2 feet along the south shore as a consequence of wind tides. (Ref. 2). This is the same seiche amplitude used by the State's witness in his evaluation. Cole Deposition at 33, 39.

12. As noted above, the increase in the lake's water level due to wind effects is the sum of the maximum seiche level and the maximum wave height at the shore. A study of potentially threatened areas along the shores of the Great Salt Lake done for the State concluded that, assuming the lake is at its maximum historical elevation of 4212 ft. and further assuming a 2 ft. seiche, the maximum elevation at which flooding would be expected to occur would be 4216 ft. (Ref. 6). The State's witness does not disagree with the results of this study. Cole Deposition at 53.

13. In Utah W, the State made the extremely conservative assumption that the wave height at the shore was the same as the maximum wave height, experienced off-shore in deep portions of the Lake. Cole Deposition at 33-35, 51. As the State's witness agrees, such an assumption is unrealistic, since the height of a wave is a constrained by the depth of the water, which causes waves to break as they approach shore. Id. at 34. Thus, waves are much lower at the shore than at the deepest point in a lake. Using, however, the maximum wave height assumed by the State, the total increase in water level at the shore would be 9 ft., or to elevation 4221 ft. Cole Deposition at 33.

14. The ITP is unlikely to be affected by flooding under any of the scenarios postulated in Utah W. The existing elevation of the ITP area is from 4220 ft. to 4225 ft. as determined from the Poverty Point, Utah and Timpie, Utah 7 1/2 minute USGS quadrangle topography map 5 ft. contours. (ER Section 4.3.4). The ITP will be built at

an elevation of 4221 ft. Since the highest elevation that water will reach during a seiche at the historic Great Salt Lake flood level is elevation 4216 ft. (or, utilizing the State's unrealistic assumptions as to wave height, elevation 4221 ft.), I conclude that the spent fuel transportation casks at the ITP will not be subject to flooding due to wind induced seiches, since they will always be above the maximum water level at the ITP.

B. Flooding due to Seismically Induced Seiches

15. Utah W postulates the occurrence of a seismically-induced seiche as another possible mechanism for inundation of the spent fuel transportation casks at the ITP site. Such seiche is postulated to result from a seismic event in the vicinity of the Great Salt Lake. As discussed earlier, seiching is the phenomenon that occurs when the water levels in a lake or other water body experience a vertical oscillatory motion. (Ref. 4). Seiches may be generated by wind, landslides, and/or earthquake effects such as ground shaking or surface fault rupture. (Ref. 3).

16. The State postulates a seismically induced seiche with a maximum height of 12 feet. This seiche height is based on a 1909 earthquake reported in Hansel Valley, on the northwest corner of the Great Salt Lake. (Solomon Deposition at 20-23). However, the height of that seiche is based on unconfirmed reports of a trestle being overtopped by the seiche (Ref. 3), and is therefore unreliable.

17. The size of an earthquake-induced seiche is dependent upon many factors, including the depth of the body of water and the magnitude, location and depth of the epicenter of the earthquake. The Great Salt Lake is a shallow lake, with a maximum depth of 35 feet. This shallow depth makes the occurrence of a 12 foot seiche, such as the one postulated by the State in Utah W, extremely improbable.

18. Another factor that affects the maximum elevation of the lake waters is the distance between the Great Salt Lake shoreline and the affected area. The elevation of the seiche decreases as it moves on to land. Thus, even if a 12 ft. seismically-induced seiche were to occur while the Lake was at its maximum historic elevation of 4212 ft., the

highest level achieved by the seiche waters as they reached the ITP would not be the combination of the Lake water level plus the seiche height (i.e., to elevation 4224 ft.) but would be considerably less because the ITP is located inland.

19. Indeed, the State's own designated flood plain for the effect of an earthquake generated seiche (that is, the maximum elevation water would reach in the event of such a seiche) is 4220 ft., which is below the elevation of the ITP. (Ref. 3). I believe the 4220 ft. elevation represents a very conservative high upper bound to the level of a seiche that can be anticipated to occur near the ITP if the Great Salt Lake is at its maximum historic elevation when the earthquake takes place.

V. REFERENCES

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5. James M. Montgomery, Consulting Engineers, Inc., 1984, Chapter 1 Executive Summary, in Great Salt Lake Diking Feasibility Study, Feasibility Study, Vol. 1. (UT-37813)

6. Id., Chapter 3 General Dike Design, in Great Salt Lake Diking Feasibility Study, (UT-37878)

7. Stuart B. Murchison, 1989, Fluctuation History of Great Salt Lake, Utah, During the Last 13,000 Years, Ph.D. Thesis, Dept. of Geography, Univ. of Utah (UT-39624).

I declare under penalties of perjury that the foregoing is true and correct.

Executed on July 27, 2001.

George H. C. Liang

LIANG EXHIBIT 1

Resume of George H. C. Liang

Experience Summary

Dr. Liang is a Senior Principal Environmental Engineer in the Environmental Sciences & Engineering Department. He has over 26 years of experience in siting, environmental assessment, developing and managing environmental protection programs, and licensing of power plants and industrial facilities. He also has extensive experience in mathematical modeling, numerical analysis, and computer applications in environmental engineering/design related problems. He is currently a Program Manager and has previously been a Lead Environmental Engineer on major projects in nuclear/fossil power plants and industrial projects, which involved environmental impact studies, federal/state/local permitting applications, managing engineering/design, procurement and installation of water and wastewater treatment systems, conceptual design of the heat dissipation/chemical discharge system, studies of alternative cooling systems, groundwater dispersion, hydrological analysis of power plant sites and thermal/water quality impact analysis of power plant discharge.

As Supervisor of Water Quality and Hydrology, Dr. Liang has supervised many water quality and hydrology related tasks for power plant projects. He established the technical guideline for flood analysis at power plant sites. He managed the environmental impact assessment of a fluidized bed power plant site and prepared its permit application. He established the exclusion criteria for siting a Low-Level Radioactive Waste disposal facility in Maine, to assure compliance with federal and state requirements. He evaluated existing permit requirements to determine the potential environmental impacts of rerating a nuclear power plant. Dr. Liang completed the conceptual design of a surface run-off detention pond for a proposed NPR site in Idaho, a cooling pond for a proposed power plant site in Florida, a multiport diffuser for a cogen plant in New York and a combined cycle power plant in England, U.K. He has developed the water quality monitoring program and conducted the hydrothermal/water quality modeling for numerous power plant projects.

Dr. Liang has been a lead environmental engineer on major projects in nuclear, fossil, and industrial plants.

Dr. Liang has been an expert in mathematical modeling of surface water, groundwater, water quality, hydrological and hydrothermal analysis.

Dr. Liang has been intimately familiar with EPA's National Pollution Discharge Elimination System (NPDES) permit application regulations and the requirements of section 401 of the Water Quality Act (WQA), which amended Clear Water Act (CWA) section 402(1)(2). He has assisted many major utility clients as well as independent power producers in obtaining the NPDES permit.

Dr. Liang has participated in numerous siting studies for various type of power generation projects and Low Level Radioactive Waste disposal facilities. He has designed and supervised many environmental monitoring programs for siting studies, and prepared permit applications and supporting documentations.

As a member of ICE team, Dr. Liang has participated in evaluating DOE's Environmental Restoration and Waste Management Five-Year plan. He has assisted DOE in environmental cleanup activities at Handford site, and managed environmental studies for the U.S. AMTL research reactor decommissioning project.

Dr. Liang developed a comprehensive environmental protection program at a nuclear power plant construction site. He monitored project construction activities for regulatory compliance in air and water quality, noise, wetlands and wildlife refuge protection, and solid waste disposal. Dr. Liang integrated the environmental protection program with the quality assurance and safety/health programs to measure program performance. He provided the impetus to implement similar programs at other nuclear power plant sites.

Dr. Liang has performed a technical review of the existing environmental operating limit permits and supporting documentation (316a and 316b demonstrations) and assessed the impact of the power uprate on the plant's ultimate heat sink.

In 1994, Dr. Liang managed a consulting services project for improving the technical ability of 22 senior engineers from East China Electric Power Design Institute, dealing with the requirements for a Conventional Island design associated with a nuclear power plant.

Since 1995, Dr. Liang has been working as Lenders' engineer for several fossil power plant projects in China. Working as an Independent Technical Consultant (ITC), he has been responsible for the due diligence effort which includes technical review of engineering/design of the major plant systems, review and evaluation of fuel sources and cost, project performance parameters and guarantees, environmental parameters for compliance with PRC's regulations and World Bank guidelines; construction progress monitoring for funding drawdown certification, start-up/test procedure review, and witnessing the 72-hour and 24-hour test runs, and certification of completion of several fossil power plant projects in China.

Recently Dr. Liang has been in charge of developing EPC cost data base for fossil power plant in China.

Education

Ph.D., Civil Engineering - University of Connecticut, Storrs, Connecticut - 1972
M.S., Civil Engineering - University of Connecticut, Storrs, Connecticut - 1967
National Taiwan University, Taipei, Taiwan, Republic of China

Training

China Forum - since 1995, a lunch-time seminar series, meeting once every other month, covered the topics of information, challenges, strategies, recent development, and successful projects in marketing in China, sponsored by the Office of International Trade & Investment, the Commonwealth of Massachusetts, Foley, Hoag & Eliot LLP, and others.
The Princeton Course/Groundwater Pollution and Hydrology - 1993
Hazardous Materials Management, American Management Association - 1991
Site Selection and Design of Sediment and Detention Basins, Southern New England Environmental Regulation Course, Executive Enterprise, Inc. - 1987
MIT Video Course on Finite Element Methods, Massachusetts Institute of Technology - 1984
Water Resources Lecture Series - Rainfall/Run-off Modeling using HEC-1, Stone & Webster Engineering Corporation - 1982
Sediment Transport in Rivers and Estuaries, University of Southern California - 1974

Licenses, Registrations, and Certifications

Professional Engineer - Connecticut, 09789 - 1975 Active

Professional Affiliations

American Geophysical Union, Member
The Society of the Sigma Xi, Member

Publications

Refining Process in a Refinery." National

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	

DECLARATION OF KRISHNA P. SINGH

Krishna P. Singh states as follows under penalty of perjury:

I. WITNESS

1. I am President and CEO of Holtec International. In that position, I bear the ultimate corporate responsibility for the accuracy and correctness of the company's spent fuel storage systems engineered for dry storage under certification by the U.S. Nuclear Regulatory Commission. I am providing this declaration in support of "Applicant's Motion for Summary Disposition of Utah Contention W" concerning the licensing of the Private Fuel Storage Facility ("PFSF").

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit A to this affidavit. My professional experience in spent fuel system design extends back to 1979. Over the past twenty-two years, I have personally led the design and licensing of spent fuel storage systems for over forty nuclear plants, and for Holtec's HI-STAR 100 and HI-STORM 100 Storage Cask Systems. I am also the inventor of the honeycomb basket design utilized in the HI-STAR 100/HI-STORM 100 MPC Systems (Patent Number 5,898,747) and the METCON™ construction used in the HI-STORM overpack (Patent No. 6,064,710). The

internal thermosiphon feature of the HI-STORM 100 MPCs, widely recognized as a seminal contribution to dry storage technology, was conceptualized and implemented under my technical leadership. My professional work in the field of applied heat transfer and structural mechanics, to which this declaration in part pertains, consists of over 500 industry reports, over fifty published papers in the refereed technical literature, and academic courses taught at the University of Pennsylvania. I have served as expert witness in two prior ASLB hearings dealing with wet storage of spent nuclear fuel.

II. ALLEGATIONS IN UTAH W RELATING TO FLOODING OF ITP

3. Utah W, as admitted by the Licensing Board, alleges in its entirety as follows:

> CONTENTION: The Environmental Report does not adequately consider the adverse impacts of the proposed ISFSI and thus does not comply with NEPA or 10 C.F.R. § 51.45(b) in that the Applicant has not considered the impact of flooding on the intermodal transfer point.
>
> BASIS: See Contention N (Flooding), whose basis is incorporated by reference.

Utah N, as alleged by the State of Utah ("State"), reads:

> 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 Park 100, Appendix A, IV(c)(2), and 10 CFR §72.92 and §72.102(b).

4. I will be addressing herein the potential consequences that would follow from a hypothetical flooding of the Intermodal Transfer Point ("ITP"). My analysis is independent of the mechanism through which flooding is assumed to occur (and the analysis does not examine the likelihood of such an event), thus I will assume that flooding is the result of a non-mechanistic, postulated event. In preparing this declaration, I reviewed the interrogatory and other written discovery responses filed by the State of Utah with respect to Utah W. I also reviewed the transcripts of the depositions of State witnesses Messrs. David B. Cole and Barry J. Solomon, as well as those portions of the NRC Staff Draft Environmental Impact Statement (DEIS) for the PFSF that pertain to the ITP.

III. POSTULATED MECHANISMS THROUGH WHICH FLOODING COULD HAVE AN ADVERSE IMPACT ON THE SPENT FUEL TRANSPORTATION CASKS PRESENT AT THE ITP

5. As described in the DEIS, the ITP is the point at which spent nuclear fuel, contained within sealed transportation casks, would be transferred from railcars to heavy-haul vehicles for transport to the proposed PFSF if that transportation alternative is used. Throughout the transportation process, including while at the ITP, the transportation cask would be lying horizontally on top of a railcar, approximately four feet off the ground, and then transferred to a heavy haul vehicle, also approximately four feet above ground level. The ITP would be located next to the main Union Pacific Rail Line 1.8 miles west of Timpie.

6. The spent fuel transportation casks that would be used to move spent fuel to and from the ITP are designed to be radiologically leak-tight in accordance with stringent NRC requirements in 10 CFR Part 71, which require that the cask package be engineered to preclude the release of any radioactivity under normal, off-normal, and hypothetical accident conditions of transport. Therefore, unless flooding or a flooding-related event causes a breach of the integrity of the casks, no radioactivity will escape from them even if the casks become submerged.

7. The stringent requirements to which the transportation casks are engineered will ensure the integrity of the casks with respect to any postulated flooding of the ITP and preclude the release of radioactive fuel. Nonetheless, four hypothetical scenarios could be postulated that might theoretically affect the integrity of the spent fuel transportation casks if conditions were extreme enough: (1) In the event of an earthquake that led to flooding of the ITP site (through a mechanism such as subsidence), the earthquake itself might result in the transportation casks falling to the ground and potentially sustaining damage. (2) A submerged transportation cask might be subjected to external pressure from the confining mass of flood water, leading to water intrusion through leakage. (3) Submersion could reduce the heat dissipation capability of the cask, leading to its potential failure from overheating. (4) Assuming prolonged submersion, chemical attack by the saline waters of the Great Salt Lake might cause failure of the cask through corrosion mechanisms. However, as I discuss below, the postulated threats raised by these hypothetical scenarios are accommodated by the design of the transportation casks, thus no adverse radiological consequences would result from the occurrence of any of these scenarios.

IV. CONSEQUENCES OF THE POSTULATED FLOODING SCENARIO ON HI-STAR 100

8. The transportation cask known as the HI-STAR 100 dual-purpose overpack, illustrated in Figure 1, will be used to transport the loaded multi-purpose canisters (MPCs) containing spent nuclear fuel to the Skull Valley storage facility. HI-STAR 100 has been certified (Certificate No. 71-9261) to transport spent nuclear fuel under 10 CFR Part 71 regulations.

9. The HI-STAR 100 overpack is a welded cylindrical vessel with a bolted top closure plate. The geometric dimensions of the overpack are approximately 68-3/4" inside diameter x 96" outer diameter x 203" overall length. (Lying on its side, the overpack has a height of 8 feet (without impact limiters); therefore, in order for the overpack to become fully submerged, it would have to be covered by at least eight feet of water.) The bottom region of the overpack is made of 6-inch-thick cryogenic steel forging welded to a 2-1/2 inch thick cryogenic steel shell. The top of the overpack features a heavy cryogenic steel forging to which a 6-inch-thick closure plate (also made of low temperature resistant-nickel steel) is bolted using two concentric circles of gaskets. The 2-1/2 inch thick shell, mentioned above, is buttressed with five layers of carbon steel shells to fortify the overpack weldment and to provide added radiation protection (see Figure 2). In terms of the rigor of design, selection of materials, and consideration of normal, off-normal and accident conditions of loading, the HI-STAR 100 overpack is treated similarly to the reactor vessel in a nuclear power plant. Specifically, the conditions of service for which the overpack is engineered are set down by 10 CFR Part 71 regulations to be more severe than those that may be encountered by the cask in its actual service (namely, transport of spent nuclear fuel on railroads adjacent to population centers in the forty-eight contiguous states). As I explain below, in the context of flooding, the HI-STAR overpack has been engineered to withstand more severe environmental loadings than even those contemplated by the federal regulations.

10. The first postulated scenario suggested by the assertions in Utah W would be one in which the HI-STAR 100 overpack was dropped by earthquake forces off the railcar and then submerged in flood waters. However, such a scenario presents no safety issues different from those discussed below regarding submergence of the overpack, because a four-foot drop would cause no material damage to the overpack. In accordance with regulations (10 CFR 71.73(c)(1)) the HI-STAR 100 overpack has been demonstrated through testing to be able to withstand a drop of thirty (30) feet without damage. Hence, if a cask dropped from a railcar during an earthquake, no adverse safety consequences would accrue.

11. The theoretically possible consequences of a postulated flood submergence of the HI-STAR 100 overpack can be categorized as (i) structural, (ii) thermal, and (iii) metallurgical. The structural effect would be due to an increase in the external pressure (34' of water head equals one atmosphere worth of pressure). The thermal consequence of submergence results from a possible change in the heat rejection capability of the overpack. Finally, the possible metallurgical consequences would be limited to potential surface effects such as peeling of the external coating and corrosion.

12. According to 10 CFR 71.71, the overpack must be engineered to withstand an external pressure up to 20 psia. The HI-STAR 100 overpack exceeds this pressure requirement by an order of magnitude: The package, as stated in NRC's SER (Section 2.5.4) [1] [1], "... is designed for an external pressure of 300 psig ...". The above statement in the NRC's SER is supported by [2], wherein the design external pressure is set down as 300 psig (in Table 2.1.1). While Utah W does not assert a specific depth of submergence for HI-STAR 100 in the Great Salt Lake's floodwater, any credible scenario would quite clearly be bounded by the postulated depth of submergence in the system's FSAR [2], which is 200 meters. Paragraph 2.7.5 of [2] provides:

> "Deep submergence of the HI-STAR 100 system in 200 meters (656 ft) of water creates an external pressure load equal to 284 psi, which is less than the external design pressure of 300 psi".

Therefore, the structural consequences of any conceivable Great Salt Lake flooding event at the PFS intermodal transfer point are bounded by the design basis for the HI-STAR overpack.

13. The second theoretical consequence of submergence of a cask, namely, thermal effects on the cask and its contents, is actually not at all adverse to the function of the overpack. In fact, the thermal effect of the submergence of the cask in floodwater can be termed essentially salutary. This becomes obvious if one considers the improvement in the heat rejection rate from

[1] Bracketed numbers indicate the references cited at the end of this Declaration.

the cask in the presence of water. The rate of heat transfer from a cylindrical body in a dry state in ambient air is significantly lower than in water. A straightforward heat transfer calculation to compute the heat transfer coefficient on the external surface of a cylindrical body (say, a 2" diameter tube) subject to moving water and air provided in Exhibit B herein illustrates this point. If we assume flowing water and air both moving at 5 feet per second across the tube, using standard heat transfer relationships, the coefficients of heat transfer for the case of water and air are computed to be 627 and 3 Btu/hr-sq.ft-degree F, respectively. In other words, the rate of heat transfer in water will be approximately 200 times that in air. Inasmuch as the increased rate of heat transfer would keep the package even cooler than that in the air environment, water submergence can be characterized as a beneficial thermal event for the casks (providing an enhanced rate of dissipation of the heat generated by the spent nuclear fuel), certainly not a detriment.

14. The State's contention does not postulate the temperature of the flood water. In view of the fact that the design basis ambient temperature range for HI-STAR 100 is from minus –40 degrees F (cold) to plus 125 degrees F (hot), it is reasonable to conclude that the temperature of the flood water will be bounded by the above ambient temperature limits for HI-STAR 100.

15. The third and last consideration, namely, potential corrosion of the cask due to exposure to salt water, is expected to be minimal even under prolonged exposure conditions. Because HI-STAR 100 has been intentionally designed for submergence in the spent fuel pools of nuclear power plants, which in many cases can have boric acid in concentrations exceeding 0.2%, its external surfaces are coated with carboline 890 which, as stated in the NRC's SER (Paragraph 2.2.2) has "excellent chemical resistance".

16. However, even if limited corrosion were to occur, it would have essentially no consequence on any aspect of the performance capability of the overpack. In order for corrosion to degrade the overpack, the corrosion process would have to remove the carboline 890 coating and "eat through" six (6) inches of steel, which would take centuries of continued contact be-

tween the overpack and the flood water (based on the experience of sunken ships in the ocean), if it occurred at all.

17. In summary, the water submergence scenarios addressed in the HI-STAR 100 FSAR are far more severe than any flood event that may be postulated for the intermodal transfer point for the Skull Valley storage facility. Since the HI-STAR 100 overpack has been demonstrated to be capable of withstanding the FSAR scenarios without adverse safety consequences, it would also be able to withstand the effects of a postulated flooding at the ITP without adverse safety consequences.

18. Based on the above discussion, there are no physical or chemical mechanisms through which the physical integrity of a spent fuel transportation cask could be compromised as a result of a postulated flooding event at the ITP. Consequently, I conclude that there will be no adverse radiological consequences from such an event.

V. REFERENCES

[1] HI-STAR 100 10 CFR 72 CoC 71-9261 and Safety Evaluation Report for the HI-STAR 100 Cask System, Docket No. 71-9261 USNRC (1999).

[2] Safety Analysis Report for the HI-STAR 100 Cask System, NRC Docket No. 71-9261, Holtec Report HI-951251.

VI. EXHIBITS

Exhibit A: Resume of Dr. K. P. Singh
Exhibit B: Calculation of Cross-Flow Convection Heat Transfer Coefficients Across a 2" Tube in Air and Water

I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 23rd, 2001.

Krishna P Singh

Krishna P. Singh

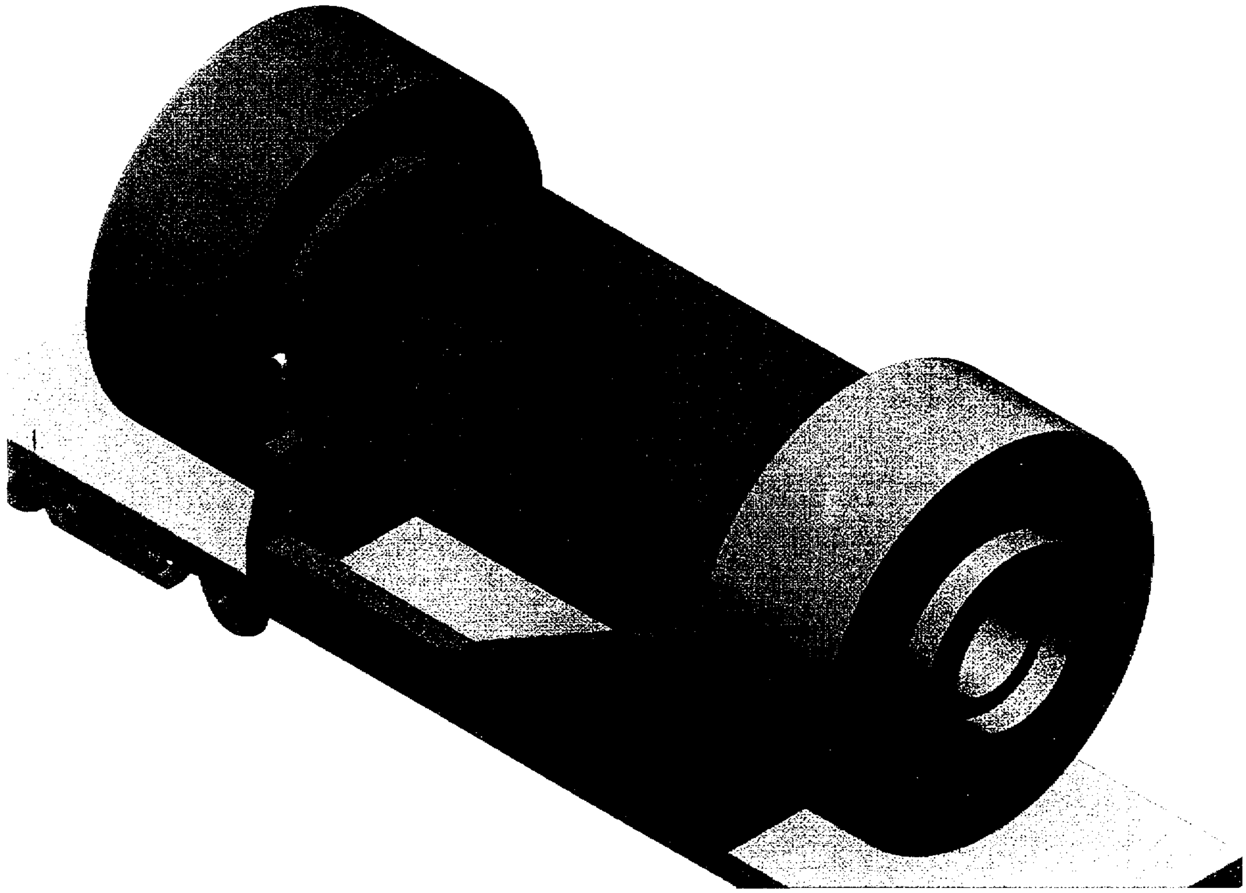

Figure 1: HI-STAR 100 Overpack in Shipping Configuration

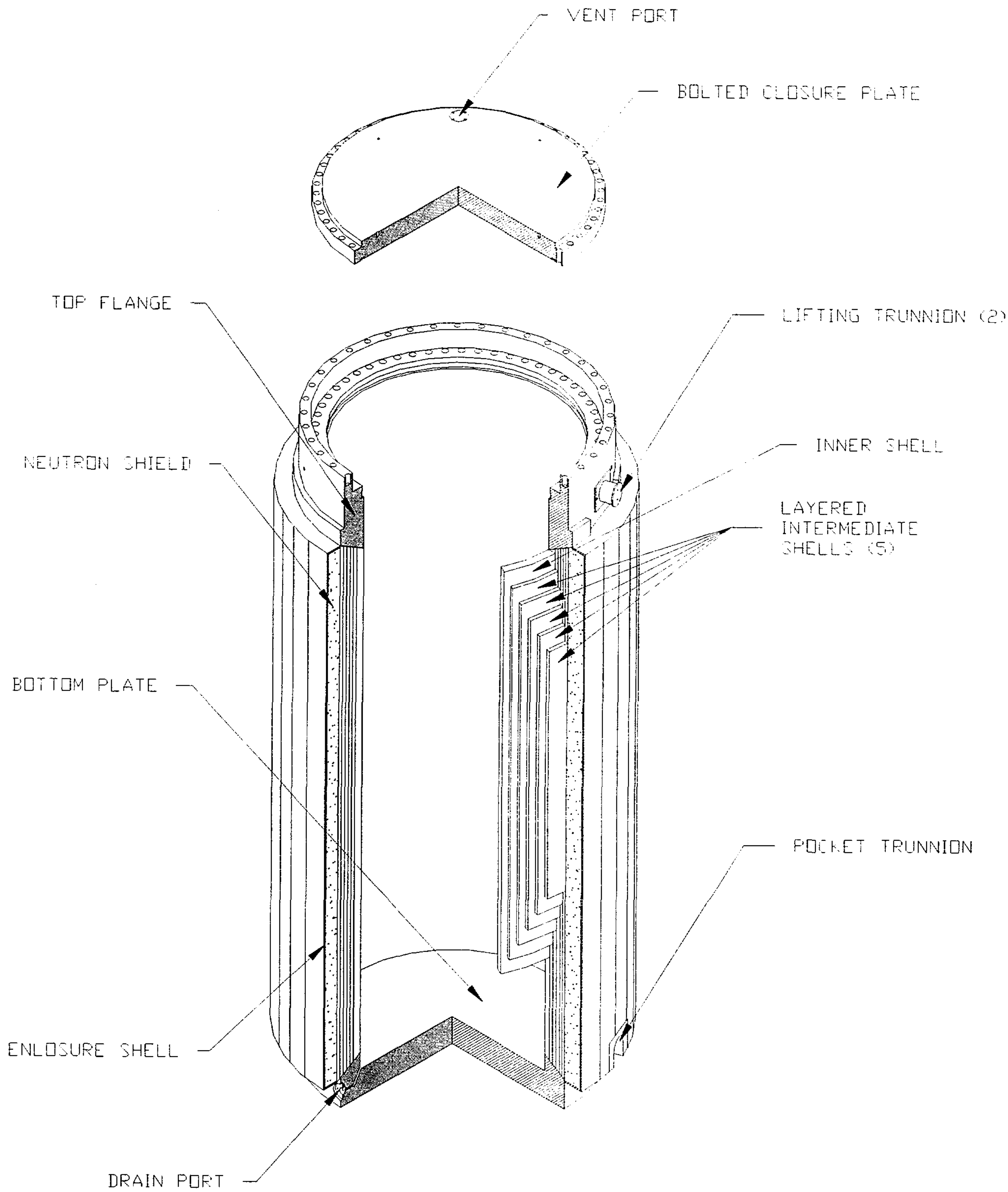

Figure 2: HI-STAR 100 in Cut-Away View

SINGH EXHIBIT 1

Resume of Krishna P. Singh

KRISHNA P. SINGH, Ph.D., PE

EXECUTIVE ENGINEER
HOLTEC INTERNATIONAL

EDUCATION

University of Pennsylvania
Ph.D. in Mechanical Engineering (1972)
GPA: 4.0 Out of 4.0

University of Pennsylvania
M.S. in Mechanical Engineering (1969)
GPA: 4.0 out of 4.0

B.I.T. Sindri, Ranchi University
B.S. In Mechanical Engineering (1967)
(Ranked in the top 1% of Engineering Graduates)

AREAS OF PROFESSIONAL CONCENTRATION

Application of ASME, ACI, and NUREG-0612 Codes. Mechanical and civil/structural design of weldments and reinforced concrete systems. Applied heat transfer and fracture assessment of dry storage systems.

PROFESSIONAL EXPERIENCE

HOLTEC INTERNATIONAL
Marlton, New Jersey

1986-Present	President and CEO

JOSEPH OAT CORPORATION
Camden, New Jersey

1979 - 1986	Vice President of Engineering
1974 - 1979	Chief Engineer
1971 - 1974	Principal Engineer

R.I.T. ALLAHABAD
India

1967 – 1968	Assistant Professor of Applied Mechanics

PROFESSIONAL CERTIFICATIONS

Registered Professional Engineer - Pennsylvania (1974-present)
Registered Professional Engineer - Michigan (1980-present)

PROFESSIONAL SOCIETY MEMBERSHIPS/ACTIVITIES

Elected Fellow of the ASME (1987); Member ANS (1979-Present); Member, ASME (1973-Present); Chairman, TEMA Vibration Committee (1979 - 1986); Chairman, PVP Committee Of the ASME, Nuclear Engineering Division (1988-92); Member, ASME O&M Committee (1991 to present); Member ASCE (1977-83), Member, Heat Exchange Institute (1976-86).

PATENTS

"Heat Exchanger for Withstanding Cycle Changes in Temperature" (with M. Holtz and A. Soler), U.S. Patent No. 4,207,944 (1980).

"Radioactive Fuel Cell Storage Rack" (with M. Holtz), U.S. Patent No. 4,382,060 (May, 1983).

"Apparatus Suitable for Transporting and Storing Nuclear Fuel Rods and Methods for Using the Apparatus", U.S. Patent No. 5,898,747 (April, 1999)

"Apparatus Suitable for Transporting and Storing Nuclear Fuel Rods and Methods for Using the Apparatus", U.S. Patent No. 6,064,710 (May 16, 2000)

BOOKS AND ARCHIVAL VOLUMES (authored or edited):

1. "Mechanical Design of Heat Exchangers and Pressure Vessel Components", (authored with A. I. Soler), Arcturus Publishers, Cherry Hill, New Jersey, 1100 pages, hardbound (1984).
2. "Theory and Practice of Heat Exchanger Design" (sole author), Arcturus Publishers (ca. 2000).
3. "Feedwater Heater Workshop Proceedings", edited with Tom Libs, EPRI 78-123 (1979).
4. "Feedwater Heater Technology: State-of-the-Art", sole author, EPRI - cs - 4155 (1985).
5. "Analytical Correlations of Fluid Drag of Fuel Drag of Fuel Assemblies in Fuel Rack Storage Locations", sole author, EPRI Project RP-2124.
6. "Thermal/Mechanical Heat Exchanger Design", (edited) ASME, PVP - Vol. 118 (1986).
7. "Time Dependent and Steady State Characterization of the CAES Recuperator", (principal author) EPRI TR-104224 (July 1994).
8. "Pressure Vessels, Heat Exchangers and Piping", Proc. ASME, IEEE Joint Power Generation Conference, (editor) NE-14 (1994).

EXPERT WITNESS AND TECHNOLOGY APPRAISAL SERVICES FOR NUCLEAR PLANTS AND NATIONAL LABORATORIES

Most of the expert witness activities pertain to spent fuel storage technology and PWR steam generator design.

1. Pacific Gas & Electric Company vs. National Sierra Club (1986-87).
2. Florida Power & Light Company vs. Stuart Intervenor Group (1990).
3. Duquesne Light Company vs. Westinghouse (1993-1994).
4. Portland General Electric vs. Westinghouse (1993-1994).

5. Houston Light and Power vs. Westinghouse (1994-1995).

6. Pacific Northwest Laboratories, Rockwell International, and U.S. DOE vs. RSI (1994).

7. Northern States Power vs. Westinghouse (1996)

8. Commonwealth Edison Company vs. Westinghouse (1997)

ACADEMIC ACTIVITIES

Chair, Advisory Committee On Mechanical Engineering and Mechanics, University of Pennsylvania (1993-1999)

Professor (Adjunct) in Mechanical Engineering and Mechanics, University of Pennsylvania (1986-92), Offered Graduate and Undergraduate Courses in Heat Transfer Equipment and Pressure Vessel Technology.

CONTINUING EDUCATION COURSES OFFERED TO PRACTICING GRADUATE ENGINEERS

1. I.I.T. Bombay, One Week Course on Heat Exchanger Design (1979).

2. Duke Power Company, Charlotte, NC (1982, 1983, 1986, 1990) - In-house Training Course on Heat Exchanger Design and Testing.

3. National Italian Reactor Authority, Genoa, Italy - On Condensers, Steam Generators, and Moisture Separator Reheaters (1985).

4. Mississippi Power & Light Company, In-House Course on Moisture Separator Reheaters and Surface Condensers (1987).

5. Center for Professional Advancement (1988, New Brunswick, NJ; 1990, Caracas, Venezuela; 1991, Houston, Texas; 1992, Amsterdam, Holland).

SPENT FUEL STORAGE TECHNOLOGY

- Developer of the industry's first multi-purpose canister design (ca. 1993), later licensed by the USNRC under Docket 71-9261 for transport and Docket 72-1008 for storage. Patent for a unique spent fuel basket design granted by the U.S. Patent Office in April, 1999 (U.S. Patent No. 5,898,747).

- Co-developer of Cask Transfer Facility Specification and Design.

- Developed the nonlinear methodology for cask drop analysis within §50 jurisdiction in support of Shorehams defueling project (ca. 1994). Participated in dynamic (drop) analysis of TN-12 and IF-300 casks.

- Developer of the multi-layer transport overpack design in 1993, subsequently licensed as the HI-STAR 100 dual-purpose overpack.

- Performed brittle fracture analysis of MPC lid welds in Holtec MPC systems.
- Participated in the development of Holtec's thermal evaluation methodologies for dry storage systems.
- Developer of the thermosiphon action MPC design.
- Developed dozens of company position papers and generic reports for Holtec International for cask system design and analysis.
- Author of over 200 industry reports on dry and wet storage technologies.
- Developer of detuned honeycomb rack design used by Holtec International in over sixty rerack projects.
- Led licensing of over fifty O.L. amendment requests for reracking spent fuel pools.
- Over a dozen technical papers in dry and wet storage of spent nuclear fuel.

TECHNICAL CONSULTING

Technical consulting services to over fifty national and international organizations, including: Electric Power Research Institute (EPRI); Pressure Vessel Research Council (PVRC); Tubular Exchanger Manufacturers Association (TEMA); Department of Energy (DOE) (Idaho Operations); Department of Energy (DOE) (Chicago Operations); American Electric Power Corporation; Baltimore Gas and Electric; Carolina Power & Light; Commonwealth Edison Company; Detroit Edison Company; Duke Power Company; Entergy Operations; GPU Nuclear; Iowa Electric Light and Power; New York Power Authority; Niagara Mohawk Power Corporation; North Atlantic Energy Services; Northeast Utilities; Northeast Nuclear Energy; Pacific Gas and Electric Company; PECO Energy; Southern Nuclear Operating Company; and Tennessee Valley Authority.

PUBLICATIONS

1. "A Method for Solving Ill-Posed Integral Equations of the First Kind", (with B. Paul), Computer Methods in Applied Mechanics and Engineering 2 (1973) 339-348.

2. "Numerical Solutions of Non-Hertzian Elastic Contact Problems", (with B. Paul), Journal of Applied Mechanics, Vol. 41, No. 2, 484-490, June, 1974.

3. "On the Inadequacy of Hertzian Solution of Two Dimensional Line Contact Problems", Journal of the Franklin Institute, Vol, 298, No. 2, 139-141 (1974).

4. "How to Locate Impingement Plates in Tubular Heat Exchangers", Hydrocarbon Processing, Vol. 10, 147-149 (1974).

5. "Stress Concentration in Crowned Rollers", (with B. Paul), Journal of Engineering for Industry, Trans. ASME, Vol. 97, Series B, No. 3, 990-994 (1975).

6. "Application of Spiral Wound Gaskets for Leak Tight Joints", Journal of Pressure Vessel Technology, Trans. ASME, Vol. 97, Series J, No. 1, 91-93 (1975).
7. "Contact Stresses for Multiply-Connected Regions - The Case of Pitted Spheres:, with B. Paul and W. S. Woodward, Proceedings of the IUTAM Symposium on Contact Stresses, August 1974, Holland, Delft University Press, 264-281, (1976).

8. "Design of Skirt-Mounted Supports:, Hydrocarbon Processing, Vol. 4, 199-203, April 1976.

9. "Predicting Flow Induced Vibration in U-Bend Regions of Heat Exchangers - An Engineering Solution". Journal of the Franklin Institute, Vol. 302, No. 2, 195-205, August 1976.

10. "A Method to Design Shell-side Pressure Drop Constrained Tubular Heat Exchangers", with Mr. Holtz, Journal of Engineering for Power, Trans. of the ASME, Vol. 99, No. 3 July 1977, pp 441-448.

11. "An Efficient Design Method for Obround Pressure Vessels and Their End Closures", International Journal of Pressure Vessel and Piping, Vol. 5, 1977, pp 309-320.

12. "Analysis of Vertically mounted Through-Tube Heat Exchangers", Journal of Engineering for Power, Trans. ASME, Vol. 100, No. 2, April, 1978, pp 380-390.

13. "Study of Bolted Joint Integrity and Inter-Tube-Pass Leakage in U-Tube Heat Exchangers: Part I - Analysis", Journal of Engineering for Power, Trans. ASME, Vol. 101, No. 1, pp 9-15 (1979).

14. "Study of bolted Joint Integrity and Inter-Tube-Pass Leakage in U-Tube Heat Exchangers, Part II - Applications", Journal of Engineering for Power, Trans. ASME, Vol. 101, No. 1, pp 16-22 (1979).

15. "On Thermal Expansion Induced Stresses in U-Bends of Shell-and-Tube Heat Exchangers", (with Maurice Holtz); Trans. ASME, Journal of Engineering for Power, Vol. 101, No. 4, October, 1979, pp. 634-639.

16. "Heat Transfer Characteristics of a Generalized Divided Flow Heat Exchanger", Proceedings of the Conference on Industrial Energy Conservation Technology, Houston, Texas, pp 88-97 (1979).

17. "An Approximate Analysis of Foundation Stresses in Horizontal Pressure Vessels", (with Vincent Luk), Paper No. 79-NE-1, Trans. ASME, Journal of Engineering for Power, Vol. 102, No. 3, pp 555-557, July, 1980.

18. "Generalization of the Split Flow Heat Exchanger Geometry for Enhanced Heat Transfer", (with Michael Holtz), AlChe. Symposium Series 189, Vol. 75, pp 219-226 (1979).

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20. "Optimization of Two-Stage Evaporators for Minimizing Rad-Waste Entrainment", (with Maurice Holtz), Journal of Mechanical Design, Trans. of the ASME, Vol. 102, No. 4, pp 804-806 (1980).

21. "A Comparison of Thermal Performance of Two and Four Tube Pass Designs for Split Flow Shells", (with M. J. Holtz), Journal of Heat Transfer, Trans. of the ASME, Vol. 103, No. 1, pp 169-172, February, 1981.

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25. "Some Fundamental Relationships for Tubular Heat Exchanger Thermal Performance", Trans. ASME, Journal of Heat Transfer, Vol. 103, pp 573-578 (1981).

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27. "An Approximate Method for Evaluating the Temperature Field in Tubesheet Ligaments Under Steady State Conditions", (with M. Holtz), Journal of Engineering for Power, Trans. ASME, Vol. 104, pp 895-900 (1982).

28. "Feasibility Study of A Multi-Purpose Computer Program to Optimize Power Cycles for Operative Plants", (with Y. Menuchin and N. Hirota), Proceedings of the Conference on Industrial Energy Conservation Technology, Houston, (1981).

29. "Design Parameters Affecting Bolt Load in Ring Type Gasketed Joints", (with A. I. Soler), Trans. ASME, Journal of Pressure Vessel Technology, Vol 105, pp 11-13 (1983).

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31. "Dynamic Coupling in a Closely Spaced Two-Body System Vibrating in Liquid Medium: The Case of Fuel Racks", (with A. I. Soler), Proceedings of the Third International Conference on "Vibration in Nuclear Plant", Keswick, England, May, 1982, pp. 815-834.

32. "Effect of Nonuniform Inlet Air Flow on Air Cooled Heat Exchanger Performance", (with A. I. Soler and Lee Ng), Proceedings of the Joint ASME-JSME Heat Transfer Conference, 1983, pp. 537-542.

33. "Seismic Response of Free Standing Fuel Rack Constructions to 3-D Motions", (with A. I. Soler), Nuclear Engineering and Design, Vol. 80, (1984), pp. 315-329.

34. "A Method for Computing Maximum Water Temperature in a Fuel Pool Containing Spent Nuclear Fuel", Heat Transfer Engineering, Hemisphere, Dec. (1986).

35. "On Minimization of Radwaste Carry-Over in a N-stage Evaporator", (with Maurice Holtz and Vincent Luk), Heat Transfer Engineering, pp. 68-73, Vol. 5, No. 1-1 (1984).

36. "Feedwater Heater Procurement Guidelines - Some New Performance Criteria", Symposium on State-of-the-art Feedwater Heater Technology, EPRI (c. 1984).

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38. "On Some Performance Parameters for Closed Feedwater Heaters, Journal of Pressure Vessel Technology, Trans. ASME (1987).

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40. "An Elastic-Plastic Analysis of the Integral Tubesheet in U-Tube Heat Exchangers - Towards an ASME Code Oriented Approach", Int. Journal of Vessel and Piping (c. 1987).

41. "Feedwater Heaters", Heat Transfer Equipment Design, R. Shal et. al (editor), Hemisphere (c. 1988).

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43. "FLow Induced Vibration", Heat Transfer Equipment Design, R. Shal et. al (editor), Hemisphere (c. 1988).

44. "Mechanical Design of Heat Exchangers", Heat Transfer Equipment Design, R. Shal et. al (editor), Hemisphere (c. 1988).

45. "A Rational Method for Analyzing Expansion Joints":, (with A. Soler), ASME, Journal of Pressure Vessel Technology (c. 1988).

46. "An Analysis of the Improvement in the Thermal Performance of Surface Condenser Equipped with Tweener Supports", ASME Joint Power Generation Conference, Miami (Oct. 1987).

47. "Pressure Vessels - Design & Operation", Chemical Engineering, pp 62-70, Chemical Engineering, July 1990, McGraw Hill, N.Y.

48. "Spent Fuel Storage Options: A Critical Appraisal", Power Generation Technology, pp 137-140, Sterling Publications, U.K. (1990-91).

49. "Design Strength of Primary Structural Welds in Free-Standing Structures", with A.I. Soler and S. Bhattacharya, Journal of Pressure Vessel Technology, Trans. ASME (c' 1991).

50. "Seismic Qualification of Free-Standing Nuclear Fuel Storage Modules - The Chin Shan Experience", Nuclear Engineering International, U.K. (March, 1991).

51. "Transient Response of Large Inertia Cross Flow Heat Exchangers", with Y. Wang, A.I. Soler and K. Iulianetti, ASME 91-JPGC-NE-27 (1991).

52. "Some Results from Simultaneous Seismic Simulations of All Racks in a Fuel Pool", with A.I. I. Soler, INMM Spent Fuel Management Seminar X, Washington, D.C., January, 1993.

53. "A Case for Wet Storage", INMM Spent Fuel Management Seminar X, Washington, D.C., January, 1993.

54. "Application of Transient Analysis Methodology to Heat Exchanger Performance Testing" with I. Rampall and Benjamin H. Scott, ASME Joint Power Generation Conference, October, 1994.

55. "Predicting Thermal Performance of Heat Exchangers Using In-Situ Testing and Statistical Correlation", with K. Iulianetti and Benjamin H. Scott, ASME Joint Power Generation Conference (1994).

56. "An Overview of the HI-STAR Technology", INMM Conference, Washington, DC, January, 1997.

57. "A Structural Assessment of Candidate Fuel Basket Designs for Storage and Transport of Spent Nuclear Fuel", with Max Delong, INMM Conference, Washington, DC, January, 1998.

58. "Seismic Response Characteristics of HI-STAR 100 Cask System on Storage Pads", with Mark G. Smith and A.I. Soler, INMM Conference, Washington, DC, January, 1998.

59. "Analysis of Mechanical Impact Events in Spent Fuel Storage Equipment", with Charles Bullard and Jin Yop Chung (1997).

SINGH EXHIBIT B

Calculation of Cross-Flow Convection Heat Transfer Coefficients Across A 2" Tube In Air And Water

EXHIBIT B

CALCULATION OF CROSS-FLOW CONVECTION HEAT TRANSFER COEFFICIENTS ACROSS A 2" TUBE IN AIR AND WATER

1.0 REFERENCE CONDITIONS:

Temperature (T)	: 70°F
Pressure (P)	: 1 atm
Fluid Velocity (V)	: 5 ft/s
Tube Diameter (D)	: 2 in (0.167 ft)

2.0 HEAT TRANSFER COEFFICIENT IN AIR

Air Density (ρ) = PM/(RT)

P = 1 atm

M = Air Molecular Weight (28.8)

R = Universal Gas Constant (0.7302 atm-ft^3/(lb-mol-°R))

T = Absolute Temperature (460 + 70 = 530°R)

ρ = 1*28.8/(0.7302*530)

= 0.0744 lbm/ft^3

<u>Transport Properties of Air @ 70°F (Rohsenow & Hartnett [4.1])</u>

Viscosity (μ) = 182 μP (1.22*10^{-5} lbm/ft-s)

Thermal Conductivity (K) = 0.0147 Btu/ft-hr-°F

<u>Reynolds Number (Re) Calculation</u>

Re = DVρ/μ

= 0.167*5*0.0744/1.22*10^{-5}

= 5092

Heat Transfer Coefficient (h)

McAdams Heat transfer correlation [4.4, page 260, Table 10-3, Reynolds Number between 4000 & 40000):

$(hD/K) = 0.174*Re^{0.618}$

Therefore:

$h = (K/D)*0.174*Re^{0.618}$

$= (0.0147/0.167)*0.174*5092^{0.618}$

$= 3.0$ Btu/ft^2-hr-^{o}F

3.0 HEAT TRANSFER COEFFICIENT IN WATER

Properties of Water at 70^{o}F

Density (ρ) = 62.3 lbm/ft^3 (Keenan et. al., [4.3])

Heat Capacity (Cp) = 1 Btu/lbm-^{o}F (Keenan, [4.3])

Viscosity (μ) = 1 cP ($6.71*10^{-4}$ lbm/ft-s) (Kern, [4.2])

Thermal Conductivity (K) = 0.347 Btu/ft-hr-^{o}F (Keenan, [4.3])

Prandtl Number Calculation (Pr)

$Pr = Cp\mu/K$

$= 1$ Btu/lbm-^{o}F * $6.71*10^{-4}$ Lbm/ft-s/(0.347/3600) Btu/ft-s-^{o}F

$= 6.96$

Reynolds Number Calculation (Re)

$Re = DV\rho/\mu$

$= 0.167*5*62.3/6.71*10^{-4}$

$= 77527$

Heat Transfer Coefficient (h)

McAdams heat transfer correlation [4.4, page 267]

$(hD/K) = 0.42*Pr^{0.2} + 0.57*Re^{0.5}Pr^{0.33}$

Therefore:

$$h = (K/D)*(0.42*Pr^{0.2} + 0.57*Re^{0.5}Pr^{0.33})$$
$$= (0.347/0.167)*(0.42*6.96^{0.2} + 0.57*77527^{0.5}6.96^{0.33})$$
$$= 627 \text{ Btu/ft}^2\text{-hr-}^{\circ}\text{F}$$

4.0 REFERENCES

[4.1] "Handbook of Heat Transfer", Rohsenow & Hartnett, McGraw Hill, NY (1973).

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[4.4] "Heat Transmission", W. H. McAdams, 3rd Edition, McGraw Hill Kogakusha (1954).

CONDENSED TRANSCRIPT

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	) Docket No. 72-22
	) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE L.L.C.	)
	) DEPOSITION OF:
	)
(Private Fuel Storage Facility)	) **DAVID B. COLE**
	)
	) **(Utah Contention W)**

Wednesday, April 18, 2001 - 10:45 a.m.

Location: Heber Wells Building

160 East 300 South

Salt Lake City, Utah

Reporter: Vicky McDaniel

Notary Public in and for the State of Utah

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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
) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE)
L.L.C.) DEPOSITION OF:
)
(Private Fuel Storage) DAVID B. COLE
Facility))
) (Utah Contention W)

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A P P E A R A N C E S

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I N D E X

E X H I B I T S

P R O C E E D I N G S

DAVID B. COLE,
having first been duly sworn to tell the truth,
was examined and testified as follows:

EXAMINATION

BY MR. GAUKLER:

Q. Would you please state your full name for the record.

A. I'm David Burnett Cole.

Q. Mr. Cole, my name is Paul Gaukler and I'm an attorney representing Private Fuel Storage in the licensing of the Private Fuel Storage facility before the Nuclear Regulatory Commission. And today we're here to ask you some questions with respect to Utah Contention W.

If at any time you don't understand one of my questions and need clarification, will you please ask me to clarify the question?

A. Yes.

Q. Mr. Cole, what's your background?

A. I'm an engineer for the state of Utah.

Q. Engineer? And --

A. Civil engineering.

Q. I'd like to introduce your resume, and we'll keep the same numbering system, Exhibit No. 6.

(Exhibit W-6 marked.)
Q. And what's been marked as Utah W Exhibit 6, is that a copy of your resume?
A. Yes, it is.
Q. And is the resume up to date?
A. Yes.
Q. And is it accurate?
A. Yes.
Q. It shows that you're a senior engineer with Utah Division of Water Resources. And how long have you been employed by the Utah Division of Water Resources?
A. I started there in November of '71.
Q. And you've been employed by them since that time?
A. Yes.
Q. And what has been your function as an engineer for the Utah Division of Water Resources?
A. I've been an engineer since 1976. I was going to school. So an early part. I work in the hydrology section, hydrology and computer applications.
Q. And what duties do you perform in the hydrology computer section of the Division of Water --
A. I write water resource models of river systems. I've also worked with my boss and whatnot as far as the Great Salt Lake as they prepared reports over

the years.
Q. What type of reports have you prepared for the Great Salt Lake?
A. There was -- I didn't personally author these, but there have been reports back in the early -- back in the 70's.
Q. And what were the subject of those reports?
A. How to manage the Great Salt Lake, what could you do to manage the flooding as it rises or whether it will rise or not.
Q. Okay. Do you do flooding analysis as part of your job?
A. Yes, I do.
Q. And what type of situation do you normally evaluate with respect to flooding? Is it a river situation or a --
A. Generally it's a stream or a -- we don't have too many rivers, actually.
Q. And how many stream flooding evaluations, approximately, have you done in your approximately 25 years?
A. Probably a couple of dozen.
Q. Have you done flooding evaluations with respect to lakes or bays or other bodies of water of that nature?

A. No, not specifically, other than the work we did for these reports on the lake.
Q. And these reports you did on the lake, you're referring back to the reports in the 1970's?
A. Yeah.
Q. Would you tell me something about the nature of those reports and what issues you worked on with respect to them?
A. They were essentially data gathering.
Q. And what type of data did you gather with respect to those reports?
A. Well, everything from -- they had me go up and research all the reports that had ever been written on the lake and write an abstract. And then we collected data from the USGS for my boss for the model of the lake, how the different inflows impacted its hydrologic models, how the different inflows to the Great Salt Lake and the changing area of the lake and salinity affect the elevation of the lake. So he actually wrote that model.
Q. Did you do any analysis of projections for future rise or flooding of the Great Salt Lake with respect to those models?
A. Yeah, we did.
Q. And what are they reflected in?

A. There is a couple of reports that are back in our office that would have that. I'm not exactly sure what the titles of them right now are. We call one of them the Easter egg report.
Q. You call them what?
A. It's called the Easter egg report because of the picture on the front of it.
Q. I'd like to see that report. And when were these reports dated?
A. These were dated in the 70's. This was prior to the rise of the lake in the 80's.
Q. Do these reports have any relevance to the issues that you're conceding here with respect to Utah W?
A. Other than my experience in knowing that the lake can do more than we estimated.
Q. So you didn't estimate the rise in the lake in these reports in the 1970's?
A. Well, we underestimated what it would do.
Q. Have you been involved in any more recent estimates in terms of the Great Salt Lake, what it's projected to do in terms of future rises or decreases in elevation?
A. No, just the work we did. And as we watched it rise and looked at the -- I mean, we looked at the

topography and where the lake would expand to as it rises.
Q. What's the current level of the Great Salt Lake?
A. It's between 4201 and 4202.
Q. When you say 4201 and 4202, is that for a particular month, particular year?
A. That was -- the recent number on the board when I walked out of the office was 4201.6. I didn't look to see whether that was the 15th or the 1st of April.
Q. What's usually the peak season for the -- in terms of the calendar year, what is usually the peak season?
A. It generally peaks in June. Occasionally it'll peak earlier, depending on the weather, or it could peak later. On years that it's made big rises, the weather and things have made it towards the end of June.
Q. And so what was the peak for the last season, the last year, approximately?
A. I don't know the exact number. It was over 4203.
Q. Less than 4204 but more than 4203?
A. Yeah, somewhere in that range. I don't have

that number on the top of my head.
Q. That's good enough.
Let me have marked as Exhibit No. 7 a map of the Great Salt Lake area, the southern part.
(Exhibit W-7 marked.)
Do you recognize this map?
A. It's certainly part of the country that I recognize.
Q. It's a map of the Great Salt Lake area, the southern shore area, the eastern and western shore. About how far up the lake does it go, approximately?
A. Well, it goes beyond Promontory Point, so it's probably got two thirds of the lake.
Q. So it's two thirds of the lake. Does this appear to be within the scale of a map an accurate depiction of the Great Salt Lake and the surrounding area?
MS. CHANCELLOR: Objection. He doesn't have any idea how this map was generated or where it was from.
MR. GAUKLER: I'm asking if it appears to be accurate in terms of his knowledge of the area and work he's done with respect to the Great Salt Lake.
MS. CHANCELLOR: You may answer.
A. Well, it's reasonably. I mean, I don't know

what the elevation of the lake is at this time or --
Q. (BY MR. GAUKLER) It's a reasonable approximate?
A. So it's reasonably approximate, yeah.
Q. What's your understanding of Utah Contention W?
A. Well, my understanding is that they're looking at the transfer point where you transfer from rail to truck.
Q. And that's the transfer point for -- one alternative for the transfer point of spent nuclear fuel being shipped to the Private Fuel Storage facility?
A. Yes.
Q. What's your understanding of the purpose or function that would occur at the transfer point?
A. Well, the main function being to transfer your casks from the train to the truck, which would then move it to your storage facility farther south.
Q. And where do you understand the location of the fullest transfer point to be in relationship to this map?
A. Well, just west of that Timpie mark.
Q. You understand it to be approximately 1.8 miles west of that mark?
A. That's what your report's saying. I don't

have any reason to discount it.
MR. GAUKLER: I'd like to have marked as Exhibit No. 8 a two-page excerpt from the state's contention. It's identified at the top "W. Other Impacts not Considered."
(Exhibit W-8 marked.)
This is Contention Utah W as filed by the state in the fall of 1997. And we're here with respect to subpart 3 of Utah W, which discusses flooding. And do you recognize this contention?
A. Yes, I've seen it before.
Q. Did you have any role in writing the contention, that is, as it relates to flooding subpart 3 on page 163?
MS. CHANCELLOR: Objection. This also refers to Utah N, and you need to see the document to be complete.
MR. GAUKLER: Let me mark as an exhibit Utah Exhibit N, then. Let's mark that as Exhibit No. 9.
(Exhibit W-9 marked.)
Q. If you look at Exhibit 8 -- if you look at Utah Exhibit No. 8, which is Contention W, on subpart 3, flooding, it states in its entirety, "The Applicant has not considered the impact of flooding on its facility or the Intermodal Transfer Point. See Contention N

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(flooding), whose basis is incorporated herein by reference." And I guess, had you -- Utah Contention N as filed by the state, did you have any role in developing or writing Utah Contention N?
A. Yes, I had. I wrote the information, it looks like, in the basis.
Q. When did you prepare that information, if you recall?
A. It's been a couple years ago.
MS. CHANCELLOR: Can you give him the date of the document?
MR. GAUKLER: The date of the document is approximately November of 1997.
A. Yeah. Well, that's probably when I did it.
Q. What role did you play in the formulation of the contention?
A. I gave her the historic high of the Great Salt Lake.
Q. And what other information did you provide with respect to the contention?
A. And I looked up what our consultants had said the wave height and other potentially higher than the historic high. I don't show it. It doesn't seem to be listed here.
Q. What consultants are you referring to?

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A. The ones that wrote the reports on the diking of the Great Salt Lake.
Q. And when were these reports written, approximately?
A. They were prepared during the 80's. As the lake was coming up, they were prepared as an alternative. We put in a large pump on the west end of the Great Salt Lake. The alternative would have been the dike portions of the lake.
Q. When was the pump line put in?
A. It was put in in the 80's. It went on line just about somewhere around '86.
Q. And what is the purpose of the pump line ?
A. The pump plant was put in as an attempt to keep the lake from rising to even higher levels and to try to maintain the lake.
Q. And to what extent has it been used since 1986?
A. It was used for most of the year. Weather had changed, the lake was receding. It was put in when the lake was just about at its highest. It was finally completed within a year or so that they built it.
Q. And what are the estimates in terms of how effective the pump line would be to keep the lake from rising above -- strike that. At what level would you

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start operating the pump line? Do you know?
A. The pump plant won't even operate below 4207. Because of the forebay in it, the water can't reach it.
Q. So after 4207, at some point after that you would operate the pump, not at elevations below that?
A. That's correct, yeah. Political decision, but once it gets above that.
MS. CHANCELLOR: Objection. It assumes the pump is still operational.
Q. (BY MR. GAUKLER) Are the pumps still operational?
A. They will require a start-up period, and there is maintenance that has to be done. They're being maintained to be usable, but there will be a lag time.
Q. So they've not operated since 1986?
A. No, they have not. They would also require some renovation.
Q. And what were the estimates -- well, were any -- what type of evaluations were done in terms of evaluating the effectiveness of the pumps to prevent additional rise of the Great Salt Lake?
A. Okay. The pumps themselves would pull about a -- well, they would be able to evaporate about a million acre feet of water a year. The first year is

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somewhat higher because they fill the ponds out there, so they can fill the ponds plus evaporate it.
Q. So if I understand what you're saying, the pumps would pump the water into the ponds and then you would have evaporation from the ponds?
A. Yeah, the water would be circulated through the ponds and some of it brought back. There is a problem with this, that the Air Force would have to give approval again. They have no permanent approval to even use that land out there.
Q. This is land where?
A. It's land that belongs to Hill Air Force Base.
Q. Where is this located?
A. It's west of the Great Salt Lake.
Q. And what were the evaluations done on the potential effectiveness of the increases in elevation of the Great Salt Lake?
A. It might take less than a foot off of the peak elevation.
Q. Is that reflected in any document?
A. I think it is. I'm not familiar with just which one. I'm sure it is. The first year it will take more because of the ponds. The second, following years it would just be evaporation.

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Q. And this was done in lieu of the dikes that were considered at a certain time?
A. Yes. And I guess that -- yeah.
Q. And why was it decided not to go forward when the dikes were being proposed in the 1980's? Do you recall?
A. We felt like this would be the most effective, and also it was the legislature people who make those decisions.
Q. Going back to Utah W Exhibit 9, Utah Contention N, you indicated that you pulled information that was in the reports prepared by your consultants with respect to the dike feasibility studies, right?
A. Yeah.
Q. What information specifically did you obtain from those reports?
A. That was the wave height and the seiche height.
Q. Did you have any role in the preparation of those dike feasibility reports?
A. No, I did not.
Q. Do you have any training in terms of evaluating the flooding with respect to wave height?
A. Not specifically, no.
Q. Have you ever performed a flood elevation

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study involving wave height?
A. Just using simpler rules on dams for freeboard height.
Q. Excuse me?
A. I've just used other people's work on dams, I guess, for the wave height.
Q. So you didn't compute the wave heights from those other -- from the dam situation other than --
A. No, I didn't use that.
Q. Do you have any training with respect to the potential flooding from seiches?
A. Not specifically, no.
Q. Have you ever performed a flooding elevation with respect to flooding caused by seiches?
A. No.
Q. Now, the second paragraph of Utah N refers to floods and water waves along the lake shore that may be -- may have been generated by earthquake or landslide events. What was the basis -- did you help formulate that paragraph of the contention that begins at the bottom --
A. Not on the landslide.
Q. Beginning at the bottom of page 98, going to 99, the paragraph that begins, "By failing to identify, document" and ending on page 99, did you have any role

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in the formulation of the issues raised in that paragraph of Utah Contention N?
A. No, I did not, not the earthquake or landslide.
Q. Did you have any experience or knowledge with respect to flooding generated by earthquake or landslide events?
A. No.
Q. And you have no experience in that area?
A. No.
Q. You understand that you've been named as an expert to testify with respect to Utah W?
A. Yes.
Q. And on what aspect of Utah W do you expect to testify?
A. That would just be the elevations of the Great Salt Lake, or the potential.
Q. When you say the elevations of the Great Salt Lake --
A. Or the potential elevations, the possible. So that's with respect to flooding on the site.
Q. And when you say potential elevations of the Great Salt Lake with respect to flooding, is there any particular type of flooding that you would consider or testify to?

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MS. CHANCELLOR: Objection. The question is unclear.
Q. Okay. You've identified certain areas in Utah N, that were raised in Utah N: waves, seiche, flooding due to earthquakes, or landslide events. Would you testify to the potential for flooding at the ITP with respect to any of those type of events or --
A. Well, it would be the water, hydrologic events, which is not necessarily the landslide or the --
Q. When you say hydrological events, what would you include in that?
A. Well, the rise in the Great Salt Lake.
Q. Would you include wave height in that?
A. Plus the -- yeah. That would include the potential for it to be higher than the pool.
Q. And would you include seiche in that evaluation?
A. Yes. I mean, that would be part of the whole picture.
Q. Would you consider seiche generated by earthquakes in that evaluation, or not?
A. No, I'd essentially be dealing with the wind generated.
Q. What documents have you used in developing or formulating Utah Contention N or Utah Contention W?

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What documents have you used in your work with respect to those contentions? You identified some already, but can you give me a quick list as best you can?
A. Well, the main document I would use is the actual record of the lake which has been referenced as coming from the USGS.
Q. What other documents have you reviewed or used in your work with respect to Utah Contention N and Utah Contention W, including answering interrogatory or discovery questions or helping prepare discovery or discovery questions?
A. Well, the two documents I used was what I told you about, the USGS plus the diking studies as far as the wave height.
Q. Other than those -- other than USGS records and the diking feasibility studies, do you recall any other documents that you have relied upon or expect to rely upon with respect to your testimony on Utah W?
A. Well, other than my experience with what I've observed over the years, that's probably the number one.
Q. What documents have you prepared with respect to the Contentions Utah N and Utah W besides discovery responses that have been sent to us?
A. Well, the only document I really prepared

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was a memo that I gave to our attorneys.
Q. When was that document prepared? Let me help you. I'll mark a document for Exhibit No. 9 and ask if this is the memorandum you're referring to. This will be Utah W Exhibit 10.
(Exhibit W-10 marked.)
And if you look towards the end of that document, you'll see a memorandum dated April 22nd, 1999 from David B. Cole to Connie Nakahara and Jean Braxton with Bates No. UT-37791 on the bottom. Is this the document that you're referring to, the memorandum?
A. Yes, it is.
Q. Do you recall any other documents you have prepared with respect to Utah N or Utah W other than this memorandum and discovery responses that have been provided to us?
A. No, there have been no other documents.
Q. What documents did you review in preparing for your deposition today?
A. Just essentially this memo and the different discovery responses going back and forth.
Q. With whom other than your legal counsel have you discussed your preparing your deposition in preparation for the deposition today?
A. No one, really.

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Q. With whom other than your lawyer have you discussed issues related to Utah N or Utah W as it may relate to your testimony that you will give in this proceeding?
A. You mean recently, or when I prepared this?
Q. Let's talk about recently first.
A. Okay. Recently, no one. Two years ago I passed it by Dr. Stauffer, which is --
Q. You're referring to the April 22nd, 1999 memorandum?
A. Yes.
Q. Anybody else other than Dr. Stauffer that you recall discussing the issues related to Utah N and Utah W?
A. He was the main one.
Q. Have you had discussions with Barry Solomon?
A. No, I really haven't.
Q. Have you had discussions with any other seismic experts the state may have, like Dr. Arabasz?
A. No, I haven't.
Q. Anybody else besides Dr. Stauffer that you can remember discussing the issues related to Utah N and Utah W, other than your attorneys?
A. No.
Q. I'd like to have you look at what's been

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marked as Utah W Exhibit 10. And this is entitled State of Utah's Fourth Supplemental Response to Applicant's First Set of Formal Discovery Requests. And what role did you play in the preparation of this response?
A. Well, I reviewed what the attorneys had written.
Q. You provided them information and they drafted a response which you reviewed?
A. Yeah. They didn't get all the information from me, obviously.
Q. If you look back at your declaration, you have a declaration after page 14. And it says that -- it identifies that you declare that certain information contained in these responses are true and correct. And the information that is identified in the declaration is information related to changes to the volume of the Great Salt Lake, calculations of seiche and wave height, and effects of lake and surface drainage flooding. Would those be the areas that you provided information to the attorneys on with respect to preparing this response?
A. Yes.
Q. Do you recall any other areas providing information on with respect to this response?
A. No.

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MR. GAUKLER: I'd like to have marked as Utah W Exhibit 11 State of Utah's Objections and Response to Applicant's Sixth Set of Discovery Requests to Intervenor State of Utah, dated February 28th, 2001, and it has the discovery responses with respect to Utah W.
(Exhibit W-11 marked.)
Q. Do you recognize this document? This has been marked as Utah W Exhibit 11. All you need to do is focus on information concerning Utah W. Don't worry about the other contentions, okay?
A. Yeah --
Q. Obviously we got more than we had intended to get in this.
A. I see, yes.
Q. What role did you have in the formulation of the document insofar as Utah W is concerned?
A. Well, the information I provided on seiche and wave height is the only portion of that. So it's the flooding information.
Q. So looking at your declaration at the back, you say that certain information with respect to Utah W is true and correct, and that information being calculations of storm, seiche, and wave height?
A. Yeah, that's what it limits it to, yes.

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Q. Do you recall providing any other information concerning the responses to Utah W, discovery responses with respect to Utah W in this document?
A. Well, that's certainly the main ones.
Q. Is there anything else that you can recall?
A. No.
Q. Do you provide any information concerning the elevation of the ITP?
A. No, I did not provide --
Q. Do you know what the elevation is at the area of the proposed ITP?
A. Other than what you've told me and what I've seen on the map.
Q. What have you seen on the map? And I guess I'd like to have you -- we'll refer you to Utah W, Exhibit 4, just one map. What have you seen on the map with respect to the elevation of the ITP?
A. That they're in the neighborhood of 4220.
Q. So you agree that the location we have identified for the ITP is the elevation being 4220 to 4225?
A. Well, just that they're in that neighborhood. I mean, there's a 4220 contour line.
Q. And would you agree there's a 4225 contour

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line as well in the area?
A. I was trying to remember what I've seen on which map. I know I've seen the 4220. I don't know -- it looked like some of the area was above that and some of it was below.
Q. What maps have you looked at?
A. Just two 7 1/2 minute quadrangle sheets plus one that showed approximately where it was located, where the site is located.
Q. And which 7 1/2 USGS quadrant maps did you look at?
A. I can't tell you their names right off the top of my head.
Q. Referring to the Exhibit 2 or 3 which has the ER, the page in the environmental report --
MS. CHANCELLOR: Exhibit 2.
MR. GAULKER: It references some -- do you want to take a break? Do you have extra copies?
(Discussion off the record.)
Q. (BY MR. GAUKLER) Did you look at the USGS maps referenced in the third paragraph of Utah W Exhibit 2?
A. Well, from what I saw earlier, the maps that they had, the Poverty Point one is probably correct.
Q. By being correct, you mean it shows the --

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A. It's the correct name and it does show a portion of the site.
Q. And did you look at the Poverty Point USGS map?
A. Yeah. I mean, I've looked at it.
Q. What other map did you look at to determine the elevation of the ITP location?
A. Well, what I was trying to do was just find out where the site was. Well, there's one that's immediately south of there, and like I said, I can't tell you the name right off.
Q. You looked at that one as well?
A. (Witness nods head.)
Q. Okay. What other maps did you look at with respect to the ITP, if any?
A. Well, those are the main ones, USGS maps.
Q. Did you provide any information with respect to the final design elevation of the ITP?
A. I didn't provide them anything.
Q. I mean to state counsel in preparation of these interrogatory responses.
A. No, I actually -- they got their own elevations.
Q. Did you have any information concerning the final design elevation of the ITP as constructed?

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A. Do I have any concerns?
Q. Do you have any concerns or information? Do you have any information concerning the final design elevation?
A. I don't have any information other than what's in here.
Q. And in there, you're referring to Utah W Exhibit 2?
A. Well, in your materials that you provided.
Q. That's page 4.3-5 of the environmental report?
A. Yes.
Q. And do you have any concerns concerning the final elevation of the ITP, final design elevation of the ITP?
A. No, not concerning that.
Q. How far from the shore of the Great Salt Lake is the location of the proposed ITP?
A. That would depend on what elevation the lake's at. The lake shoreline moves considerably. Where it was originally proposed if the lake hits 4212, the lake would come up to the 4212 elevation, which would be considerably closer. I'm not sure just what the elevation is off the knoll right there, but it would -- the shoreline would move right up to that

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elevation, 4212.
Q. Now you said the original location. What were you referring to? The original location of the ITP?
A. I think originally there was a location that was over by Timpie Junction --
Q. Right.
A. -- and I looked at that and realized that it's not that much higher than the high level of the lake.
Q. Do you know how far the ITP would be assuming an elevation between 4220 and 4225 from the historic high level point of the lake of 4211.85 feet, what that distance would be?
A. No, I don't.
Q. What evaluation have you done concerning the potential flooding for the ITP beyond just looking at the elevation and doing a wave, looking at the wave heights and seiche? What have you done, in your words?
A. That was primarily it.
Q. What conclusions did you reach from that evaluation? Strike that. What factors did you look at in making the evaluation that you did with respect to the potential flooding of the ITP, hydrological reasons?
A. The hydrological reasons was the elevation

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of the lake and the potential total depth of the lake.
Q. When you say the potential total depth of the lake, what do you mean?
A. Meaning the lake plus whatever the runup and the seiche was from a storm.
Q. What is runup from a storm? Can you define that term for me?
A. Well, when one of these events occurs where the wind moves the water, the water actually of course raises to a higher elevation than the average pool surface out in the lake. So seiche can move it up a couple of feet higher than normal.
Q. And what do you understand seiche to be? Is seiche similar to wave runup, as you understand?
A. Well, it's actually a large movement of water in a slower period of time, other than the waves that are coming in one after the other.
Q. What's your definition or understanding of seiche?
A. Well, we're talking about a wind generated seiche.
Q. Correct, as opposed to --
A. So the wind is actually moving the mass of water at a slower rate. So it piles it up against a shore, whatever shore it's blowing towards.

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Q. Did you look at the -- to what extent do you take into account the location of the ITP in evaluating flooding, potential of flooding at the ITP?
A. Well, the main thing I was concerned with is the elevation and also its proximity to the lake.
Q. What did you determine was its proximity to the lake with respect to the new location of the ITP?
A. Well, elevation wise it's higher than the original site, so...
Q. You actually looked at the potential for flooding with respect to the site?
A. What I was doing was looking to see what the total elevation of the water surface that you would be concerned with, so...
Q. When you say the total elevation of the water surface that you'd be concerned with, you're talking about --
A. How high the water would be, or possible water.
Q. From the Great Salt Lake?
A. From the Great Salt Lake.
Q. And you arrived at this elevation of water by taking the historic level of the lake?
A. Yes.
Q. And then what did you do?

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A. Then being conservative, adding the wave height and seiche to it.
Q. So you took the -- and what was the seiche that you used?
A. For this, it was like two feet.
Q. Two feet?
A. At least.
Q. If you look at what's been marked as Utah W Exhibit 10 and your memorandum of April 22nd, 1999, there you identify two feet of seiche?
A. And seven feet of wave height.
Q. So you add the historical lake level of 4212. So you add the two feet to the 4212 and the seven feet on top of that, correct?
A. Yes.
Q. And you came up with an elevation of 4221?
A. Yes.
Q. And you say that "I believe that wave damage may occur to structures up to an elevation of 4221 feet"?
A. Yes.
Q. I take it, then, you would not have any concern with respect to elevations above 4221?
A. No, not necessarily.
Q. What do you --

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A. Not from the hydrologic events, no.
Q. You will not have a concern with hydrology events?
A. Yes.
Q. Now, isn't it also true that you're taking into account heights that -- the maximum heights, correct?
A. Yeah, as far as the wave heights are very conservative numbers.
Q. And they're very conservative in the sense that --
A. They're high, yes.
Q. High. And a wave as it comes in close to the shore will break and it will be much lower, correct?
A. Yes. Depending on the depth of the water, it could be somewhat lower.
Q. So wave height is a function of the depth of the water, correct?
A. It can be, yes.
Q. And would you expect the wave to break in the shallow water coming up to the ITP, and it wouldn't be that high when it hit the area of the ITP?
A. Like I said, it's a very conservative number.
Q. So you would expect it to be less than that,

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correct?
A. Yes.
Q. Looking back at Exhibit No. 9, I believe it is, which is the Utah Contention N. And at the end of the second paragraph on that page you refer to -- it reads -- strike that. At the end of the second paragraph of that page which begins with the word "basis," the last sentence reads, "In very wet years, these critical areas may be vulnerable to the potential of flooding or swamping by water waves generated by wind." And they reference a declaration or affidavit that you provided.
The critical areas refers to the ITP, and do you know what critical areas you were referring to there?
A. Well, any areas that would be lower than the elevation. But I'm not sure I wrote that exact sentence, but...
Q. Do you know what --
A. But it would be any elevation or any areas where the elevation is lower, because it's only seven feet higher than the historic high.
Q. Say it again.
A. Well, just looking at the sentence structure, the sentence before that talks about the

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elevation of the transfer point site is only seven feet higher than the lake's historic high. And based on that, the next sentence says anything lower than that may be vulnerable, or these critical areas that are that low would be vulnerable.
Q. And do you know what the critical areas of the ITP are regardless of the elevation? Do you have any idea what the critical areas of the ITP are?
A. No.
Q. Have you done any evaluation of potential environmental impacts that might occur at the ITP assuming that it might be flooding?
A. No, I haven't.
Q. Are you aware that the spent fuel at the ITP would always be sealed inside a transportation cask?
A. I've heard that, yes.
Q. Do you know anything about the design requirements or features of a transportation cask for spent nuclear fuel?
A. No, that isn't an area --
Q. You don't expect to testify about that?
A. No.
Q. Looking at the Utah W Exhibit 10, which is the State's Fourth Set of Responses to Applicant's First Set of Formal Discovery Requests concerning Utah N,

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Interrogatory No. 2 there asks to specify the height of the water waves generated by wind and the resulting swamping of such waves of the ITP at its new location that the state contends would happen in very wet years.

What was the -- you refer to the very wet years. I think that's referring to the historical high of the lake in the mid 19 --

A. Well, in the 80's. The precip was maybe 25 percent higher over the whole basin.

Q. And how long -- that was during the period of the 1980's when you had this historic high?

A. Yeah. It started probably September of '82 and went through '86.

Q. And in '86 it reached its historical --

A. It reached its historic high.

Q. And what was the elevation of the lake in 1982 when it began its rise?

A. Considerably lower.

Q. Can you tell me approximately?

A. I can give you the exact. We can look at the --

Q. You have a hydrograph back here at the end of your --

A. We have a hydrograph that would show it in the neighborhood of 4200.

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Q. So it's approximately --

A. Yeah.

Q. So approximately 42 --

A. Plus or minus a foot or two.

Q. Approximately 4200 in 1982 time frame?

A. Yes. And that extended through -- looks like the big climb starts after that. There's a fair amount of lag, but...

Q. So if you look at that figure at the -- in your graph, hydrograph, it took approximately four years for the lake to rise from 4200 up to 4212, correct?

A. Yes. Several years it makes large rises and then reaching the peak to where it's large, so...

Q. Would it be fair to conclude, then, if you had the ITP there and the lake exhibits a tendency to rise that there would be some period of time for corrective action to be taken?

MS. CHANCELLOR: Objection. What do you mean by corrective action?

MR. GAUKLER: Action taken to reduce the potential for flooding the ITP.

MS. CHANCELLOR: Objection again. What action would you take?

MR. GAUKLER: I'm just asking.

MS. CHANCELLOR: You may answer.

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A. Okay, it's taking -- the height jumps are like five feet a year, so at least two years.

Q. So you'd have two years to plan what type of action, if any, you thought was necessary to take?

A. I would think so, yes.

Q. Now, you refer to in your April 22nd, 1999 memorandum the fact that there are two feet of seiche?

A. Yes.

Q. Did you actually do that calculation yourself?

A. No. I just extracted it from the reports.

Q. And what report did you extract that from?

A. The reports that are listed in the previous paragraph on the diking.

Q. So the first paragraph of that -- second paragraph?

A. Second paragraph, yes.

Q. Refers to the Great Salt Lake Diking Feasibility Study?

A. Yes.

Q. And was that the -- then you refer to a couple other documents after that?

A. But that's the main one, the Great Salt Lake Diking Study by Montgomery.

Q. 1984. And so that has all the information

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you used and relied upon?

A. Yes.

MR. GAUKLER: If I would like to have that document marked, or at least part of that document marked. I'm going to mark what at least I understand to be volume 1 of that exhibit, or that report.

(Exhibit W-12 marked.)

I have handed to you what I believe to be Volume 1 of the Great Salt Lake Diking Feasibility Study, dated December 1984.

A. Yes.

Q. Do you recognize this document?

A. Yes.

Q. And is it Volume 1 of the study that you referred to in your second paragraph of your April 22nd, 1999 memorandum?

A. Yes.

Q. And that was the document that you relied upon for the information concerning seiche?

A. Yes.

Q. Do you know what factors contribute to the height of seiche?

A. Well, one of them being the length of the reach that the wind blows over.

Q. Would the steepness of the shoreline be a

factor, or not?
A. I'm not sure just how much effect that would have.
Q. The distance of the point in interest from the location of the shore, would that be a factor?
MS. CHANCELLOR: You're talking about a factor --
A. Well, you're saying the seiche, how tall it's going to be? Is it going to be how far --
Q. Yeah, at the point of interest.
A. Are you talking about the seiche, the concern of seiche at the transfer point, or are you talking about the seiche out in the water in general?
Q. Seiche at the transfer point or close proximity to the transfer point.
A. I don't think the seiche itself, the depth of the water that would be stacked on top of the other water would not necessarily be a function.
Q. Looking at this exhibit that we marked as Exhibit 12, would you turn to the page in chapter 3 of the exhibit with a Bates number of UT 37878. That's the first page of chapter 3, the title page of chapter 3, correct?
A. Yes.
Q. And if you turn to page 3-3, four pages

after that.
A. Yes.
Q. And there they -- you see a paragraph called "Seiche and Wave Hydraulics." And it says right after that heading, "Freeboard is defined as the additional elevation provided on the dike above the still water elevation to allow for waves and other temporary increases in water level."
A. Yes.
Q. Correct? Do you see that?
A. Yeah.
Q. What's your understanding of freeboard as that term is used there?
A. That's the amount of dike in this case that would be required above the elevation of the water. So there's -- the water would only be partly up the dike, and the freeboard would be the remaining amount that you need to keep the waves and stuff from overtopping the dike.
Q. You say the water would be so far up the freeboard?
A. The freeboard is the elevation or the additional material added above the water surface.
Q. Above the water surface, not taking into account seiche or wavelength?

A. Well, to allow for seiche and wavelength.
Q. So it would be the difference between what you expect from seiche and wave height and the elevation of the lake without seiche and wave height?
A. Yes. That would be what you provide on your dike to keep it from being overtopped.
Q. And is it fair to say that freeboard on a given location would give you the maximum amount of water rise that you would expect to see at a particular location on the lake shore?
A. Well, that's how far you'd want to provide to make sure that it wasn't damaged from the water over the top.
Q. So that's the type of, the level of protection you provide to ensure --
A. For a dike, yes.
Q. To protect against damage from flooding?
A. So the dike didn't wash away or whatever.
Q. And cause flooding on the other side of the dike?
A. Yes.
Q. Now, it says, I guess, that the freeboard is the elevation of the sum of the seiche effects and the wave runup on the sides of the dike. Is that correct?
A. Yes, that's where I'd expect them to set the

freeboard.
Q. We're at end of the first paragraph under "Seiche and Wave Hydraulics." "For dikes under consideration in this study, freeboard was determined as the sum of the seiche effects and the wave runup on the sideslopes." And you agree with that?
A. Yes.
Q. Is that the same type of calculation that you used or attempted to use in your memorandum of April 22nd, 1999?
A. Well, that's what I was looking for was an elevation that the water would rise to.
Q. So that's what you --
A. It's similar, yes.
Q. Similar. If you look on page 3-4 of Exhibit 12, and if you look at the paragraph on the top of the page entitled "Delineation of Dike Reaches." Is it your understanding -- review this paragraph for a second, please.
A. Okay.
Q. Is it your understanding from your review of this paragraph that the authors of this study tried to establish seven different locations or reaches along the lake shore where dikes could be placed?
A. Yes.

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Q. And if you look at Figure 3-3, which is about four or five pages after this page, it has a figure of the lower portion of the Great Salt Lake identified as "Delineation of Reaches." And these would be the different locations or different reaches that the study sought to establish?
A. Yes.
Q. And looking at that Figure 3-3, and the Bates number is UT-37885, could you identify which of the dike reaches shown in this figure is closest to the shore adjacent to the proposed ITP?
A. Well, the closest one is the 1-2 reach or whatever, reaches 1 and 2.
Q. Reaches 1 and 2. So they'd be the most relevant in terms of the --
A. Except for the fact that that dike actually got washed out there and it doesn't exist. So that's why I used the more conservative one of using the southern shoreline, because that dike that runs across from the end of Stansbury was actually lost in the 80's.
Q. Has this dike been constructed?
A. It's been reconstructed, not -- I mean, high enough to withstand current lake elevations. It's a dike that's maintained by -- oh, what's their latest name? Magcorp, or the magnesium industry. And they use

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that portion of the lake to extract minerals.
Q. Now --
A. But in the 80's that failed so that the reach actually extended down to here.
Q. So that would make 3 the relevant area, or not?
A. So I used numbers like 3 and 4.
Q. In your calculation?
A. Yes. That's why the more conservative numbers.
Q. To what extent is this dike system in place? I thought you said that you had gone to a pumping system instead of the closed diking.
A. Yeah, the only dike that exists -- well, that's not the only one, but the main dike that exists that's on the pumping -- or that's shown here is the reach going from the shore to the end of Stansbury Island there on the north end of the -- that dike exists and is in place. The magnesium corporation out there uses it to isolate that portion of the lake.
Q. And has that -- what is the elevation of that dike as it currently exists today? Do you know?
A. No, I don't know what the exact elevation is.
Q. Do you know how the -- do you know if any

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changes were made in the reconstruction of the dike to strengthen and make it more effective, in other words, reconstructed after the --
A. No, I'm not familiar with the exact details of the reconstruction.
Q. So it could have been made stronger to avoid being washed out --
MS. CHANCELLOR: Objection. He doesn't know.
A. I don't know. I'd better leave it at that.
Q. Fair enough. But in any event, you looked at, say, No. 3 in terms of calculating the effects as you saw it at the ITP?
A. Three or four.
Q. Three or four. Well, 3 would be closer to the ITP than 4, correct?
A. Well, it's closer, but it doesn't have the long reach from the north, so...
Q. Now, in terms of looking at potential elevations of the ITP, would you look at -- would 1 and 2 then be applicable in terms of just looking at potential elevations of the reach of the ITP? I mean, another is the freeboard distance in 1 and 2. Even assuming the dike wasn't there, that would be relevant to looking at the potential --

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A. Well, the actual reach is somewhat shorter, though, than it is to the shore over here. That's why I used the more conservative numbers from the other dikes is because the reach of the effects of the storm in that way. It's actually shorter at 1 and 2 than it would be down where the site is. The distance of open water across the lake is shorter.
Q. Shorter than --
A. At 1 and 2 than it actually would be at --
Q. 3 and 4?
A. At the site. So...
Q. Now, look at Table 3-1. That shows the maximum seiche of the lake at different levels, right?
A. Table 3-1.
Q. Let's look at Table 3-4, if you would, the dike crest elevations. And can you tell me what those numbers represent there? You have a lake level of 4210, lake level of 4212, and a lake level of 4217.
A. Okay. And those are their calculated heights, it looks like, wave height.
Q. And so you were saying that you felt that 3 or 4 were the relevant ones in terms of ITP?
A. Yeah. I figured they had the long open reaches, so that's where I came up with the 7 feet or whatever.

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Q. But doesn't it show here that the -- does this dike crest elevation take into account both the seiche and waves? Correct?
A. I don't know. I'd have to read the text. You know, it's -- apparently. But that's the table I got the number of 7 feet off from.
Q. Table 3-4? You interpret that to be just for wave height?
A. Well, 3-2 has got the wave height.
Q. 3-2's got the wave height?
A. The wave height, yes.
Q. Where do you get the seiche from?
A. And that would be 3-1.
Q. So where did you get the Table 3-1 for the seiche?
A. Well, that's where I came up with the number of 2 feet.
Q. Okay, Table 3-1 was two feet. And wave height, what table do you get that from?
A. Well, that would come from 3-2. And that's where I just pulled the round number of 7 feet.
Q. And what's the relationship between wave runup on Table 3-3? Did you use that for anything?
A. No, not necessarily.
Q. What is wave runup? Do you know what that

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is?
A. I don't know how they used it exactly.
Q. So you didn't -- you ignored that table; is that correct?
A. No, I'm not right at the moment.
Q. What?
A. No. You asked me if I was familiar with the table.
Q. And the answer is no?
A. You're saying 3-3, and the answer is no.
Q. And you didn't use that table in your calculation?
A. No. I pulled the numbers from the other two, so...
Q. Okay. And then Table 3-4, Dike Crest Elevations. Did you use that table at all in your calculation?
A. No.
Q. Now, you were saying that the dike crest elevation was the level of elevation designed to protect against flooding and damage to property?
A. As it appears they used it, it was to protect the dike so that the dike itself wouldn't fail.
Q. And do you understand it to be protecting from flooding on the other side of the dike too, or no?

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A. Well, it's the integrity of the dike. With the dike, even if some waves went over, it wouldn't be too serious. So it's a pick an elevation that the dike would maintain its integrity.
Q. Now, is it true that as you came in close to water that's shallow, the wave effects would be less? Correct?
A. As it runs across the long surface, then it would use up some of the energy of the wave, yes, because it's shallow.
Q. And the waves would break as they came in closer to shore, right?
A. Yes, as it got shallow enough it would.
Q. And so the seven feet wave height, that gives you some distance from the shore where there's sufficient depth of water to support a wave of that height?
A. Yes. I used a conservative seven feet.
Q. So you don't know when it would break, do you? That's not your area of expertise?
A. No, that's not mine.
Q. And were these people that did this study, were they experts, do you think, in wave height or not?
A. Well, they were the ones we relied on for the dikes.

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Q. If you look at water levels of unprotected areas on page 3-9. And here I take it they're talking about unprotected areas, correct?
A. Okay.
Q. The first part, top of the page talks about dike crest elevations. You're talking about crests or elevations at a dike?
A. Uh-huh.
Q. And then the next topic is water levels in unprotected paragraphs -- unprotected areas. It's almost time for lunch. Let me just finish this line of questioning.
MS. CHANCELLOR: Correction. Doesn't it say "water levels in unprotected areas"?
MR. GAUKLER: Yes.
Q. (BY MR. GAUKLER) It says, "Unprotected areas will encounter the full effect of seiche; however, wave action will be limited by the breaking of waves in the shallow foreshore area." Correct?
A. Yes. If there's a long reach of shallow water, the waves would --
Q. And you would agree with that statement?
A. Yes.
Q. Goes on to say, "Since in the absence of any dikes all areas would be unprotected, a maximum

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elevation which may be considered threatened must be determined. This is necessary to permit the identification of specific lands and structures for which the dikes provide protection. Maximum seiche action on the lake appears to be on the order of two feet." And that's what you used?
A. Yes.
Q. It then goes on to say, "Allowing for wave action, unprotected areas below elevation 4216 could be considered threatened at lake level 4212." Do you see that?
A. Uh-huh.
Q. And lake level 4212 is the approximate historic high?
A. It's the historic high it's reached twice.
Q. So the authors are saying here that unprotected areas less than elevation of 4216 might be threatened, correct?
A. Yes, that's what they're saying.
Q. And you have no reason to dispute what the authors say in this study, the experts you relied upon?
A. No.
MR. GAUKLER: Let's take a break for lunch.
(Lunch recess from 12:12 to 1:25 p.m.)
MS. CHANCELLOR: During Dr. Liang's

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deposition I had marked Exhibit 3. I'd like to formally introduce that. It's a letter from Stone & Webster, Jerry Cooper to John Parkyn, from which I have redacted the next to last paragraph. And upon agreement with counsel for PFS, we have deleted the markings "PFS confidential." I'd like this document to be introduced as Exhibit 3.
MR. GAUKLER: No objection.
Q. (BY MR. GAUKLER) Mr. Cole, good afternoon. I'd like to have you take a look at Utah W Exhibit 2, which is the one-page environmental report. And if you'll look at the last paragraph on that page, it refers to the Great Salt Lake Planning Project Draft Analysis of Proposed Management Alternatives, issued by the State of Utah Department of Natural Resources in January 1999.
Are you familiar with that document?
A. I've seen it.
Q. According to the ER, that draft document designated the flood plain of the Great Salt Lake at 4212 feet for planning purposes and 4217 feet as the extent of the lake's flood plain. Is that a correct representation of that document in terms of those elevations, if you recall?
A. I can't really answer. I haven't read the

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report for that purpose.
MR. WEISMAN: Could you speak up, please?
A. I don't know the answer to that, but from what I understand, it's probably true. I can't say that it is, but --
Q. Do you know whether there's been a final report issued or not?
A. No. I'm not involved with that particular project.
Q. Were you involved in designating the flood plain that's referred to in the document?
A. No. I haven't been involved with the development of that document at all.
Q. Do you know who developed the flood plain for that document?
A. No, I personally don't.
Q. Does your background and expertise include groundwater hydrology?
A. No.
Q. It doesn't? Have you done any evaluation of groundwater at the location of the proposed ITP?
A. No, I haven't.
Q. Do you know of any reason that groundwater, the level of groundwater at the ITP would affect flooding analysis that you performed at the ITP?

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A. No, not flooding.
Q. It wouldn't affect flooding, as far as you're concerned?
A. No.
MR. GAUKLER: I have no further questions.
EXAMINATION
BY MS. CHANCELLOR:
Q. I just have one follow-up question. Have you seen any supporting documents that show the elevation of the building that will be constructed at the ITF?
A. No, I haven't.
MS. CHANCELLOR: That's all I have.
EXAMINATION
BY MR. WEISMAN:
Q. I have just one question. Earlier you mentioned that there were two times that the lake reached its maximum?
A. That it's reached 4212, yes. Or approximately 4212.
Q. I'm sorry?
A. Well, one was in 1986.
Q. Right.
A. And then prior to that when we were trying to read it off the hydrograph, it was in the 1860's to

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1870's.

Q. 1860's to 1870's, all right. And was it the same level in 1860's, 1870's?

A. Yeah, it's somewhere around 4212, approximately.

MR. WEISMAN: That's all I have.

MS. CHANCELLOR: No more questions.

MR. GAUKLER: No questions for me.

(Deposition was concluded at 1:34 p.m.)

* * *

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CERTIFICATE

State of Utah)
ss.
County of Utah)

I, Vicky McDaniel, a Registered Merit Reporter and Notary Public in and for the State of Utah, do hereby certify:

That the deposition of David B. Cole, the witness in the foregoing deposition named, was taken on April 18, 2001, and that said witness was by me, before examination, duly sworn to testify the truth, the whole truth, and nothing but the truth in said cause;

That the testimony of said witness was reported by me in stenotype and thereafter transcribed into typewriting and that a full, true, and correct transcription of said testimony so taken and transcribed is set forth in the preceding pages.

I further certify that I am not of kin or otherwise associated with any of the parties of said cause of action and that I am not interested in the event thereof.

WITNESS MY HAND and OFFICIAL SEAL at Saratoga Springs, Utah, this 23rd day of April, 2001.

Vicky McDaniel, RMR
Utah License No. 87-108580

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Case: In the Matter of Private Fuel Storage
Case No.: ASLPB No. 97-732-02-ISFSI
Reporter: Vicky McDaniel
Date taken: April 18, 2001

WITNESS CERTIFICATE

I, David B. Cole, HEREBY DECLARE:

That I am the witness referred to in the foregoing testimony; that I have read the transcript and know the contents thereof; that with these corrections I have noted, this transcript truly and accurately reflects my testimony.

PAGE-LINE CHANGE/CORRECTION REASON

_____ No corrections were made.

David B. Cole

SUBSCRIBED and SWORN to at , , this day of , 2001.

Notary Public

In the Matter of Private Fuel Storage
David B. Cole * April 18, 2001

CitiCourt, LLC
801.532.3441

CONDENSED TRANSCRIPT

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	) Docket No. 72-22
	) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE	)
L.L.C.	) DEPOSITION OF:
	)
(Private Fuel Storage	) **BARRY J. SOLOMON**
Facility)	)
	) **(Utah Contention W)**

Wednesday, April 18, 2001 - 1:35 p.m.

Location: Heber Wells Building

160 East 300 South

Salt Lake City, Utah

Reporter: Vicky McDaniel

Notary Public in and for the State of Utah

SHEET 1 PAGE 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
Before the Atomic Safety and Licensing Board

In the Matter of) Docket No. 72-22
) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE L.L.C.) DEPOSITION OF:
(Private Fuel Storage Facility)) BARRY J. SOLOMON
) (Utah Contention W)

Wednesday, April 18, 2001 - 1:35 p.m.
Location: Heber Wells Building
160 East 300 South
Salt Lake City, Utah
Reporter: Vicky McDaniel
Notary Public in and for the State of Utah

PAGE 2

A P P E A R A N C E S

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Washington, D.C. 20555

Also Present: David B. Cole
Jean Braxton

I N D E X

E X H I B I T S

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P R O C E E D I N G S

BARY J. SOLOMON,
having first been duly sworn to tell the truth,
was examined and testified as follows:

EXAMINATION

BY MR. GAUKLER:
Q. Please state your full name for the record.
A. May name is Barry J. Solomon.
Q. Mr. Solomon, my name is Paul Gaukler and I'm counsel for Private Fuel Storage with respect to licensing the Private Fuel Storage facility. And this afternoon I'm going to be asking you some questions with respect to Utah W, an issue raised by the state.
If at any time you don't understand one of my questions, would you please ask me to clarify the questions?
A. Yes, I will.
Q. Thank you. What is your familiarity with the ITP and Utah W as it relates to the ITP?
A. I evaluated the potential for earthquake related flooding that may affect the ITP.
Q. And did you evaluate it specifically with respect to the ITP?
A. Yes.
Q. And when was this evaluation done?

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A. Well, referring to previous testimony, I guess it was originally done in '97.
Q. And that was in the context of Utah N?
A. Yes, that's correct.
Q. I'd like to have you look at what's been marked as Utah W Exhibit 9. If you want to take a moment and organize those exhibits in front of you, may make it easier.
A. Okay.
Q. What portion of Utah N were you responsible for or play a role in formulating?
A. Just the paragraph that's -- the sentence that's on page 99 related to waves along the lake shore at floods that may have been generated by earthquake or landslide events.
Q. So that's what your role was in formulating --
A. Yes.
Q. -- the contention?
A. Yes.
Q. What's your understanding of the ITP?
A. It's a facility for the temporary storage of transportation casks in the interim period between transferring them from a rail car to a truck to bring them to the facility. And it's proposed to be

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constructed on a knoll in between Interstate Highway 80 and the railway, present railway.
Q. If you look at Utah Exhibit -- Utah W Exhibit No. 7. This is a map of the general southern two-thirds of the Great Salt Lake area. Where do you understand the proposed location of the ITP to be?
A. It would be just a little west of Timpie, Highway 80.
Q. Approximately 1.8 miles west?
A. Yes, that's correct.
Q. Now, do you understand whether the casks will come in on railroad cars and then they'll be transferred from railroad cars to a heavy haul truck there? That's the proposal.
A. Yes.
Q. Do you know how far the -- do you know where the location of the proposed Private Fuel Storage facility itself would be?
A. Yes.
Q. Where would that be?
A. It's on the sort of light brown colored parcel of land labeled Skull Valley Indian Reservation.
Q. And that's south of Timpie?
A. Yes, that's correct.
Q. And how far south of Timpie is that,

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approximately?
A. Offhand I don't know. I would -- I don't know offhand. I'd have to refer to the map scale. Oh, here's the scale.
Q. Does approximately 25, 26 miles sound correct to you?
A. Yes, that looks correct.
Q. How far -- do you know what the elevation of the area or the land on which the ITP would be located is?
A. It's generally between 4220 and 4225 feet.
Q. What's your basis for that?
A. Statement of the environmental report, I believe, and also we've looked on the two 7 1/2 minute quadrangle maps on which the knoll is located.
Q. And you confirmed that elevation on that?
A. Yes.
Q. How far from the shore of the Great Salt Lake is the proposed location of the ITP?
A. I've never personally checked it, but going by past statements, it sounds like it's about three miles. That sounds like a reasonable estimate.
Q. And that's on the -- you say the ITP was somewhere along the southwestern shore of the lake?
A. That's correct.

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Q. And Salt Lake City is along the southeastern side of the Great Salt Lake, approximately?
A. Yes, it is.
Q. When you did your elevation for flooding with respect to the ITP, at what location was the ITP proposed to be located at that time?
A. I think it was proposed to be near Rowley Junction, but we didn't have a specific location we could pinpoint on a map at that time.
Q. Is Rowley Junction basically the same location as Timpie?
A. It's pretty close.
Q. And have you redone your evaluation or analysis with respect to the proposed new location of the ITP 1.8 miles west of Timpie?
A. Yes.
Q. And did that affect your conclusions in any respect, moving it from the Rowley Junction area to approximately 1.8 miles west of that area?
A. Not really. It's just that at the Rowley Junction area we didn't have a specific elevation for the location of the ITP, whereas we now do.
Q. Are you aware that you've been identified as an expert to testify with respect to Utah W?
A. Yes.

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Q. And on what aspect of Utah W would you testify?
A. Specifically the potential for flooding related to earthquake hazards, which includes earthquake-generated seiche and tectonic subsidence.
Q. What documents have you reviewed relating to your work with respect to Utah W or Utah N?
A. Could I refer to the list of references?
Q. Yes, certainly.
A. It's in one of these exhibits.
Q. Are you referring to Exhibit No. 10?
A. Yes.
Q. Okay.
A. I'm looking at the list of documents that start on page 9 of Exhibit 10. I've referred to the first reference, Arnow and Stephens, Atwood and Mabey, Black and Solomon.
Q. And Solomon there, is that you?
A. That's correct. Black, Chang and Smith. Actually, I'll make this easy. I've looked at all of these references here that are listed under that document request.
Q. Under document request No. 2, you've looked at all those documents? Okay, good.
A. Correct. And I have not looked at any of

the documents under document request No. 3.
Q. Very good. Are there any other documents other than those listed in the document reference -- document request No. 2 that you just referred to that you reviewed or looked at?
A. Yes. I recently came across the original research report written by Jeff Keaton that served as the basis for the reference report here in document request No. 2.
Q. Were there any significant differences between the original report that you identified and the ones you had originally referenced in the discovery request?
A. No, there were not.
Q. Any other documents that you have reviewed in your work with respect to Utah W or Utah N?
A. I don't think so, no.
Q. Are there any other documents that you expect to review in preparing for your testimony?
A. No, I don't.
Q. What documents have you had a role in formulating or preparing with respect to Utah N and Utah W, other than the contention itself and the two -- and the discovery responses?
A. I don't think there's been anything else

that I've been involved in.
Q. Have you looked at the -- we've talked about Utah Exhibit No. 10, which is the State of Utah's Fourth Supplemental Response to Applicant's First Set of Formal Discovery Requests as concerns Utah N. What was your role in preparing or formulating the position, information in this document as it relates to Utah N?
A. Let me thumb through this. On page No. 2, I prepared the response to Interrogatory No. 3 relating to earthquake-induced flooding generated by a seiche, and also in that same interrogatory related to tectonic subsidence.
I prepared some of the input for Interrogatory No. 4 discussing lake levels. But some of that may also have been covered by Dave. It's probably duplicated. And also I prepared the discussion under Interrogatory No. 4 related to tectonic subsidence on seiches, earthquake-generated seiches. I believe that's all.
Q. On page No. 4 of the document you were just looking at --
A. Yes.
Q. You say studies of the -- how do you pronounce the period?
MS. CHANCELLOR: Holocene.

A. Holocene, yes.
Q. Studies of the Holocene epoch have found lake elevation levels at approximately 4221 feet occurring about 2,000 years ago. What's your basis for that statement?
A. That's a fairly well documented elevation that's reconstructed from both archeological evidence and erosional features.
Q. Is that Murchison 1989 as the reference?
A. That's correct, yes.
Q. With respect to Utah W Exhibit 11, would you please look at that. This is the State of Utah's Objections and Response to Applicant's Sixth Set of Discovery Requests to Intervenor State of Utah, and this is the portion of the discovery response. I'd like you to turn to Utah W, or at least Utah W is in here. Would you please tell me what your role was in formulating the response to the discovery requests in this document for Utah W?
A. Again, it's related to earthquake-induced flooding caused by seiche and also tectonic subsidence. And I believe it starts on page 26, the second complete paragraph.
Q. And so that corresponds to a declaration at the end of the document where you say that you swear to

the truth of the information in the response concerning geologic and earthquake hazards and tectonic subsidence?
A. Yes, that's correct.
Q. Did you provide or have a role in providing any other information with respect to this response?
A. Again, I might have provided some information about lake levels.
Q. Did you provide any information with respect to the expected design level of the ITP?
A. I don't think I provided any information other than questioning what the specific design of the facility would be, since it wasn't specified in any document.
Q. Now, we've identified the Contention Utah N in a couple of discovery responses concerning this issue. Have you had a role in preparing or formulating any other document related to Utah W or Utah N?
A. I don't believe so.
Q. What have you done to prepare for your deposition today?
A. I reviewed most of the documents that were referenced for Contention N, and I also looked over the relevant sections of the environmental report. And I think that's about it.
Q. With whom, other than your legal counsel,

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have you discussed your work with respect to Utah W or Utah N?
A. I briefly met with Dave last week. That was the first time we met. And when I first prepared the response in 1997, I probably briefly discussed it with Gary Christensen, who's my supervisor at the Utah Geological Survey.
Q. And what input did Gary Christensen provide you, if any, with respect to --
A. Nothing, really. I just wanted to fill him in as to what I was doing.
Q. And what information did David Cole provide you, if any?
A. Again, nothing, really, because by that time we had already formulated our responses.
Q. And did you provide David Cole any information?
A. No.
Q. Now, have you performed any calculations yourself of the actual flooding from subsidence or seiche from the -- at the ITP?
A. I have performed some basic calculations using the analogy of the seiche that was created by the 1909 Hansel Valley earthquake in northern Utah.
Q. And have you generated any documents with

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respect to those calculations?
A. No, I have not.
Q. And what's the basis of those -- tell me how you went about developing those calculations.
A. There was a magnitude 6 earthquake in 1909 in Hansel Valley, which is a valley in the northwestern corner of the lake, just northwest of the Promontory Mountains.
Q. Will you point that out on Exhibit No. 7?
A. It's actually off of this map. This is Promontory Point. Promontory Mountains extend northwards from the point, and Hansel Valley is just northwest of those mountains.
Q. So it's just northwest of the Promontory Mountains which are on this, and it kind of sticks down at Promontory Point?
A. Right. And the mountains actually extend northward from that.
Q. Okay.
A. In 1909 there was a magnitude 6 earthquake that generated a seiche at the time. The seiche was noted at Saltair on the southeast shore of the lake, but there were no measurements of what its effect were or what the height of the seiche was. But the seiche also overrode the Lucin Cutoff, which is on Exhibit 7. The

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Lucin Cutoff connects Promontory Point with the lake shore. It's the railroad trestle that crosses the lake.
Q. It's shown by a light line on this map? Is that what it is?
A. Yes, that's correct.
Q. So Promontory Point over towards the little mountain --
A. Yes. And based upon the known lake elevation in 1909 as well as the measured elevation of the trestle, other investigators since then have estimated that the seiche must have been at least 90 feet in height. Excuse me -- 12 feet in height.
Q. And was that -- were you involved in making that determination with respect to that level of seiche?
A. No, I was not.
Q. And let me get your resume real quick. I'll have it marked as the next exhibit.
(Exhibit W-13 marked.)
This is 13. I've marked as Exhibit 13 what I believe is a copy of your curriculum vitae. Is that correct?
A. Yes.
Q. And is this curriculum vitae up to date?
A. There's only one additional change to it, and that is a list of selected publications. In the

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last couple of weeks we've submitted a final report to the U.S. Geological Survey regarding GIS mapping of the site earthquake hazards in Cache Valley, which is the final report to which the reference for Solomon and McCalpin 1999 refers to. Solomon and McCalpin is actually the abstract that was presented at the professional society meeting.
Q. Does that publication have any relevance here?
A. Only in that it was additional experience to evaluate earthquake hazards, but it has no direct relevance.
Q. And except for that update, is this curriculum vitae otherwise accurate?
A. Yes.
Q. And your educational background is in geology, according to the resume?
A. Yes.
Q. And when did you join the state?
A. In September of 1988.
Q. And what have you been doing for the state since you joined the Utah Geological Survey?
A. I work in the -- what used to be called the applied geology section. It's now been renamed the engineering geology section. And serve generally two

roles. One is to conduct regional studies of geologic hazards, and the other is that the Utah Geological Survey serves as a consultant to local governments to review geotechnical reports that are submitted by developers.
Q. In your work for the Utah Geological Survey, have you performed any analysis of seiche flooding or flooding by subsidence caused by earthquakes?
A. The only direct involvement I've had with that was when I mapped geologic, the quaternary geology and helped evaluate geologic hazards for Tooele Valley, which is the valley directly to the east of Skull Valley. And in that report we also discussed the same references that I referenced here for Skull Valley.
Q. Is that one of the documents you referenced in your --
A. Yes.
Q. Which document is that? Is that the Black and Solomon --
A. Yes, that's correct.
Q. -- 1995?
A. Correct.
Q. Top of page 10 of Utah Exhibit No. 10?
A. That's correct. Black and Solomon, and then Black did the section on tectonic subsidence, which was

in that same volume.
Q. And what was your work in that -- what did your work in that report involve insofar as it related to earthquake flooding?
A. Again, since that was a regional study, we didn't try to evaluate its effect on any one particular area, but we just indicated the analogous situations that have occurred in Hansel Valley and Hebgen Lake and indicated the potential effects on the northern part of Tooele Valley.
Q. Did you make any independent calculation of the size of the section that would be involved in the northern part of Tooele Valley?
A. No.
Q. And would the size of the section, you would expect that to be different from that at the Hansel Valley?
A. There are some factors that are different. One is that the Hansel Valley earthquake was only a magnitude 6, and there's a potential for larger earthquakes in Skull Valley. I think the Stansbury Fault is capable of generating I believe it was a 7 or 6.8. The East Spring Line Fault is capable of generating a 6.5, and the West Fault is capable of generating a 6.4.

The other thing is that seiches don't have to be generated by faults that are in the immediate vicinity of the facility. A significant seiche could be generated by a large earthquake, and the Wasatch Fault -- even though it's quite removed from where the facility is proposed for; and the Wasatch fault is capable of generating earthquakes up to about a 7.5.
Q. You've said the West Fault. What fault are you referring to there?
A. That's one of the, I think it's called the Midvalley Faults in the south part of the valley.
Q. Prior to 1988, did you do any work that involved potential flooding from earthquake hazards?
A. No.
Q. And generally what type of activities were you involved in prior to 1988?
A. My first job was from 1973 to 1975 was working on nuclear power plant site characterization studies.
Q. What plant was that?
A. The first was for the Palo Verde Nuclear Plant in Arizona, and the second was for a site that was ultimately not approved in Puerto Rico.
From 1975 -- 1975 I returned to school and went to graduate school and worked at the same time at

the U.S. Geological Survey. And that plus my following job from 1980 to '85 was in a totally different field. It was related to mineral development.
From 1985 to 1988 I worked on a site characterization program for Battelle, project management division for the high level nuclear waste program in Texas, which was ultimately scrapped.
Q. Any other experience that you can identify that you think would be relevant to the issues related to Utah W that you'll be testifying about?
A. I can't think of any specifically.
Q. Going back to Utah W Exhibit No. 10. You say, "Based on review of relevant articles relating to the effect of earthquake-induced flooding by the Great Salt Lake" -- it's the bottom of page 2 -- "the State estimates that a seiche generated by an earthquake may be more than 12 feet in height."
A. Yes.
Q. And you cite Lowe 1993 and Black and Solomon 1995. Is that the earthquake you were referring to before up near Promontory Point?
A. Yes, the Hansel Valley earthquake.
Q. Hansel Valley earthquake. And you said the magnitude of the earthquake was --
A. Six.

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Q. -- six. And where did that earthquake occur?
A. Again, it was -- Hansel Valley is the valley that's on the west side of the Promontory Mountains on the northwest corner of the lake.
Q. And what were the assumed characteristics of the earthquake propagation in that case?
A. Could you be more specific?
Q. Were there any specific characteristics of the earthquake propagation that was relevant in terms of the seiche that was created?
A. It was the typical, normal, faulting basin-and-range type offset.
Q. And how was the level of the seiche calculated?
A. The level of the lake at the time was known. It's part of the hydrograph that's been placed as an exhibit here before. And the level of the Lucin Cutoff, the railroad trestle, was estimated. So that subtracting those two elevations, it gave about a 12-foot difference because it's known that the seiche overrode the trestle.
Q. Let's take a look at the first reference that you've identified.
I'd like to have marked as Exhibit 14 a

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document entitled -- I think it comes with the U.S. Geological Survey Professional Paper 1519. I think the title is "Hazards From Earthquake-Induced Ground Failure in Sensitive Clays, Vibratory Settlement, and Flooding Due to Seiches, Surface-Drainage Disruptions, and Increased Groundwater Discharge, Davis County, Utah," by Mike Lowe.
(Exhibit W-14 marked.)
Now, this is one of the references that you rely upon for the 12-foot seiche?
A. Yes, that's correct.
Q. If you look at page 165. First of all, where is the reference, the 12-foot reference that you rely upon in this document?
A. It's in the right-hand column on the paragraph that's above the heading "Effects."
Q. And that's on page 165 of this document?
A. Yes.
Q. And specifically can you point out the sentence that you rely upon here, or sentences?
A. Starting in line No. 10 of that paragraph where it says "Seiches were reported."
Q. Okay.
A. And then it goes on to discuss the locations of Saltair and the trestle that was -- it continues on

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down to the end of that paragraph.
Q. So the 12-foot height is based upon the trestle being overtopped, trestle at Lucin being overtopped?
A. Correct.
Q. And the paper goes on to say, "Assuming the reports that the seiche overtopped the trestle are true." Is there any independent statement to show the trestle was in fact overtopped?
A. I don't know what the basis of the reports were. It could have been an eyewitness account published in a newspaper or something else. It's not referenced here, so I don't know what the basis of it was.
I take it back. I guess it's referenced in Williams and Tapper, yeah.
Q. Referring to further up in that paragraph?
A. Yes. It's --
Q. What reference are you referring to specifically?
A. It's on line 13. It's actually at the end of the sentence which I first referred to that it starts on line 10.
Q. And specifically the reference you're referring to is Williams and Tapper, 1953?

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A. Yes, correct.
Q. Have you reviewed that reference?
A. Actually, I haven't, no.
Q. Now, isn't it true that further up, just before the sentence that you referred me to that you relied upon for the 12-foot seiche, that the paper says, "No systematic or theoretical studies of landslide or earthquake-induced seiching in Great Salt Lake have been completed"?
A. That's correct.
Q. If there's no such study that has been completed, on what basis can you predict what the elevation of the seiche would be that might reach the ITP?
A. In the absence of any mathematical and theoretical studies, the only thing that I or anyone can rely on is analogy with similar situations. And this being a conservatively estimated magnitude earthquake, considering that there could be a larger magnitude earthquake at the site and considering that it is the same body of water, this is the best analog that I could come up with.
Q. And also at the beginning of that paragraph it says that the -- take that back. At the beginning paragraph in that -- first full paragraph in that

column, second column on page 165 it says, "The effects of seiches are in part determined by water depth, lake size and shape, and the configuration of the local shoreline." Have you done any evaluation of those factors as they may relate to the ITP?
A. No. I would think that's an appropriate topic for the applicant to conduct once we've indicated that that is a potential hazard at the site.
Q. Now, also in this, going back to Utah W Exhibit 10, you state that "The State also estimates that tectonic subsidence may be as much as 20 feet."
A. Which page are you?
Q. I'm reading from the top of page 3.
A. Okay.
Q. Would you please explain for me what you mean by tectonic subsidence?
A. During a normal faulting earthquake, one side of the fault is lowered relative to the other side. And I stress the word "relative." The lowered block of a normal fault is referred to as the hanging wall, and the uplifted block is referred to as the foot wall. In absolute terms it turns out that in normal faulting earthquakes, most of that relative change in elevation is accomplished by a down dropping of the foot wall rather than by an uplift of the hanging wall.

Q. Excuse me. It's caused by what again?
A. Most of that relative elevation, that off -- excuse me. Most of that relative displacement --
Q. Or offset?
A. -- or offset is accomplished by a lowering of the hanging wall rather than by an uplift of the foot wall. And the amount of that lowering is much greater the nearer the fault that you get, so it decreases away from the fault. And that lowering of the hanging wall is referred to as tectonic subsidence.
Q. Now, you say in Utah -- in Exhibit No. 10, the response in Utah N that "The State estimates that tectonic subsidence may be as much as 20 feet." What's the -- how do you go about calculating that?
A. And again, that's by analogy. During the 1959 Hebgen Lake earthquake which occurred in southwestern Montana, there was as much as -- I think the exact figure is 22 feet of displacement along the fault, and a very small portion of that is accomplished by uplift of the foot wall rather than by down dropping of the hanging wall. So that's an approximate number that the subsidence of the hanging wall accounted for about 20 feet of that displacement.
Q. And so your calculation or estimation of 20 feet is solely from that earthquake?

A. Correct.
Q. And you cite three references after that?
A. Yes.
Q. And what -- do those references all pertain to that earthquake?
A. They all refer to that earthquake. That's not their sole subject, but they all refer to the earthquake.
Q. Let's look at the first one. I think it's Smith -- Smith and Richins?
A. Yes.
MR. GAULKER: This will be Utah W Exhibit 15.
(Exhibit W-15 marked.)
Q. What portion of this document do you rely upon?
A. The first reference to the Hebgen Lake earthquake is on page 77. On the first paragraph, detailed -- it starts on the line 5. "Detailed evaluations of the magnitude 7.5, 1959 Hebgen Lake earthquake, Montana." And then it goes on to list several other earthquakes.
Q. Go ahead. So the magnitude of this earthquake was 7.5?
A. Yes, that's correct.

Q. And where was the earthquake located in relationship to the lake?
A. Pardon me?
Q. Where was the earthquake located in relationship to the lake?
A. I'm not exactly sure whether it was west or east or north or south. It was just nearby, near the lake.
Q. Along the shore of the lake?
A. Yeah. It was pretty close. But the fact that the lake was there, though, has nothing to do with the phenomenon of tectonic subsidence. Subsidence can occur in the absence of a lake. If there is a body of water there, though, it will change the shoreline of the lake if it's close enough. So the 20 feet that I'm referring to in the contention doesn't refer to a change in the lake shore or have anything to do with water. It's just the amount of subsidence.
Q. That's the amount of subsidence right at the fault?
A. Correct.
Q. And as you go away from the fault, the subsidence would decrease?
A. Correct.
Q. Would you look -- will you tell me what --

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looking at Figures 13 in this document, 13a, 13b, 13c, could you tell me what these figures are and how they were developed?
A. The contours that you see on these figures, the curious thing about the Hebgen Lake earthquake and the fault that was generated is that it has approximately the same dimensions as the Salt Lake City segment of the Wasatch Front zone. And this, these contours that you see here are actually contours of the amount of subsidence from that Hebgen Lake earthquake overlaying on the Wasatch Fault Zone, and in the three figures it's overlain on different segments of the Wasatch Front. For instance, in Figure 13 it's overlain I think on the -- oh, here it is. Near Bountiful it's Figure a, near Salt Lake City, Figure b, and near Provo on Figure c.
Q. And so I look at these numbers in here. You have kind of semi-elliptical circles around a point.
A. Right.
Q. What do those semi-elliptical half circles mean, or half ellipses mean?
A. What those contours mean is, it indicates in feet the amount of subsidence -- the amount that the land subsided from its original elevation.
Q. At that distance from the earthquake -- at

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that distance from the fault?
A. From the fault, correct.
Q. And how far are these distances from the hypothetical fault? Where is the hypothetical fault that -- you stamped this on the Wasatch Front?
A. Right. What they've done, you can see in each of the figures they've put a bold, dark line that's labeled with a D on one side and a U on the other. That's actually the configuration of the Hebgen Lake fault overlain on the approximate location of the Wasatch Fault Zone.
Q. So that dark bold line, that would be the fault line for this --
A. Correct.
Q. -- hypothetical earthquake here?
A. Correct.
Q. And then the -- and how far are the distances from, say, at -- from the fault line, the hypothetical fault line out to the left of those different contours?
A. It's difficult to say from this map because there's no scale on this map. All I can say is a few miles. I think there's a better scale of this on the later article by Smith and Chang.
Q. Of this exact same thing?

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A. Yes, similar to that.
Q. What document is that?
A. It's also reproduced in the article by Keaton as well. Excuse me, Chang and Smith.
MR. GAUKLER: Let's mark that as the next exhibit.
(Exhibit W-16 marked.)
A. And a similar figure occurs on Figures 9 and 10 of the article by Chang and Smith.
Q. And what page is that at?
A. It's 136.
Q. Okay.
A. It looks like that within a perpendicular distance from the fault of about 15 kilometers, somewhere in the range of 10 to 15 kilometers the amount of subsidence decreases to near zero.
Q. So these contour lines are in kilometers as opposed to miles?
A. The contour lines are in feet.
Q. Feet?
A. But the horizontal scale is in kilometers.
Q. Okay, so approximately 15 miles. And approximately what point would you have -- how far from the fault would the subsidence be approximately ten miles -- I mean, ten feet?

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A. Looks like probably in the range of maybe five to seven kilometers.
Q. Now, if you look at page 137 of this document we were just looking at.
A. Yes.
Q. It states that in the conclusions -- do you see that?
A. Yes.
Q. It states, second sentence of the conclusion states, "However, because of the lack of site-specific data on the subsurface geometry of the fault, such as along-strike structure, dip angle, and depth extent, our results should be considered as guidelines for future geological engineering research rather than as specific information for management decisions."
A. Yes.
Q. Do you disagree with that statement?
A. No, I do not.
Q. In this one, isn't it also true that all of the scenarios that lead to the 20-feet tectonic subsidence are scenarios in which the shoreline of the Great Salt Lake essentially shifts east in this scenario here?
A. Yes, but that's because the fault, the placement of the fault is on -- they're placing it on

the east side of the lake.
I should add, for instance, if that configuration, the same configuration of the fault were placed along the Stansbury Fault, and referring back to Figures 9 and 10 --
Q. Figures 9 and 10 in what?
A. On -- let's see. Exhibit 16, the Chang and Smith article.
Q. Okay.
A. If you superimpose those same contours along the Stansbury Fault and place the amount of greatest tectonic subsidence south of the ITP, then the direction of subsidence is towards the southeast, which would be from the lake shore southward into the valley. In other words, the amount of displacement is perpendicular to the contours.
Q. How far is the Stansbury Fault from the proposed ITP?
A. Stansbury Fault is about a mile and a quarter, mile and a half east of the ITP.
Q. So it runs right through Timpie?
A. Pretty close. Timpie is right at the northern edge of the Stansbury Range, northern tip. And that -- can I add another comment to it?
Q. Go ahead.

A. I also might add, when we measured the distance perpendicular to the fault to estimate how quickly the amount of subsidence decreased, the amount of subsidence decreases less rapidly when you go oblique to the fault. So for instance, as an example, the ten-foot subsidence contour on Figure 9, for example, is closer to the fault than it is if you go to the northwest where the nose of those contours starts turning around.
Q. Is that subsidence due to the particular structure of the fault that was analyzed?
A. It's -- that's hard to say. It's -- the configuration of the contours may have something to do with it. But it's also due to where they chose to place the epicenter of the earthquake on this particular figure.
Q. Is there any type of -- are you aware of any scientific or technical reason that would say the subsidence would be greater at an oblique angle as opposed to a perpendicular angle through the fault?
A. No, but what that -- what has an effect on that is the fact that deformation on a surface-faulting earthquake will be greatest somewhere towards the middle of the fault and it will decrease towards the end. So what that's just reflecting is the greatest amount of

deformation towards the middle. And it's radiating outwards in an elliptical pattern from that area of greatest deformation. And again, that could be peculiar to that particular earthquake or it could reflect something more widely applicable. I don't know.
Q. I'd like to have marked -- you referred to another document here also, the subsidence by Atwood and Mabey.
A. Oh, yes.
MR. GAUKLER: I'd like to have that marked as the next exhibit, please.
(Exhibit W-17 marked.)
Q. In what respect do you rely upon this reference?
A. This reference has a good discussion of lake elevations, changes in lake elevations, and some of the general hazards that may result from changes in lake elevations.
Q. Do you rely upon in any respect the subsidence --
A. No, this really doesn't have any original discussion of it. Again, on page 491 it does discuss the Hebgen Lake earthquake, but that's a repeat of what was discussed in the earlier references.
Q. And I guess it's -- if you look at the

second -- right-hand column on page 491 is where it discusses the Hebgen earthquake?
A. Correct.
Q. It says, "This model based on the Hebgen Lake experience probably represents the maximum likely inundation for this lake level." That's the end of the first full paragraph on page 491 on the right-hand column.
A. Yeah.
Q. Do you agree or disagree with that?
A. It's a reasonable statement.
Q. And it goes on to say that -- down below that -- first of all, what's tectonic -- first sentence in this paragraph I just read from refers to tectonic deformation, tectonic tilt.
A. That's just an informal name for the same phenomenon as tectonic subsidence.
Q. So they're talking about the same thing, then --
A. Right.
Q. -- as we're talking about. And down about halfway in the page, the end of the paragraph, second paragraph before the heading, "Tectonic tilt is a much rarer event associated only with very large earthquakes with the effect limited to the segment of the fault

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generating the earthquake."
A. Correct.
Q. Do you agree with that statement?
A. Yes.
Q. And it's much rarer in comparison to earthquakes causing ground shaking events. Is that what that means?
A. Correct. Ground shaking can be felt in earthquakes all the way down to two or three, although it certainly doesn't cause any damage. In fact, surface rupturing requires earthquake magnitudes of up around five and a half to six. So anything below a surface rupturing event by definition will not result in any tectonic subsidence.
Q. Now, in the same paper we're talking about -- same paper that we're in right now, you look on page 490 and there it talks about potential for damage associated with future rises of the Great Salt Lake.
A. Right.
Q. The second paragraph there states, "Several critical facilities constructed all or in part on the bed of Great Salt Lake are exposed to inundation by lake flooding. These include the Salt Lake City International Airport, Interstate State Highways I-80 and I-15, the mainlines of the Union Pacific and

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Southern Pacific Railroads, several sewage treatment plants, petroleum refining and storage facilities, landfills, and electrical transmission lines." Do you agree with that statement?
A. I do, but it introduces the concept of recurrence interval. And whenever you're talking about exposure to inundation as they do in this article, you're referring to a certain lake level that occurs periodically every few years or centuries or whatever. And in this case what they're referring to is the historically high lake level of 4212 feet. If you go back further in time, there have been considerably higher lake levels than that. And considering the sensitivity of the nature of the type of project we're looking at, I would think that you would have to look at a longer time period than just the historical record. And in that case you're looking at higher elevations of the lake.
Q. I didn't quite understand your answer completely. You say this raises the issue of recurrence. In what sense? In the sense that this paragraph here is based upon recurrence level I just read?
A. It's implied in that paragraph. When you're talking about an elevation, a lake level of 4212, that

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occurred in the 1980's and then again in the late 19th century. So based upon that, it has occurred twice in the last 120 or so odd years -- 120, 130 years. If you want to go up to a lake level of 4717, that hasn't occurred in historic time, but it has occurred 400 years ago. If you want to go up to the lake level of 4221, that hasn't occurred within the last 400 years but it's occurred 2,000 years ago. So the longer time span that you're referring to, the greater the potential rise in the elevation of the lake.
And the time span is intimately involved with the type of development that you're considering. You would consider a different time span for a nuclear facility than you would for a storage shed or for a single family home. You would have a different time span for a school or a hospital than you would for a 7-Eleven store.
Q. Are you aware of any other studies that have studied the subsidence levels of large earthquakes?
A. Not specifically. I'm sure there must be some other areas of the country, but I'm not -- I am not familiar with them.
Q. All of these articles that we've talked about so far, they relate to the Lake Hebgen earthquake?
A. Yes.

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Q. And has there been subsidence studies done on other earthquakes?
A. Again, I'm sure there has been, but I'm not familiar with them.
Q. Are you aware what subsidence has been on other earthquakes of similar magnitude as Lake Hebgen?
A. I could estimate. The amount of subsidence, the upper limit on the amount of subsidence is going to be the amount of displacement on the fault, so that's a rough estimate of what the amount of tectonic subsidence would be.
Q. But that includes both the uplift of the -- what wall is that again?
A. Yeah. That would be a conservative estimate, yeah. The true amount of subsidence would be somewhat less than the amount of displacement. But that's a conservative estimate.
MR. GAUKLER: Let's take a break.
(Recess from 2:44 to 2:58 p.m.)
Q. (BY MR. GAUKLER) Let's go back on the record. Before we were talking about the frequency of occurrence when we broke, and you were talking about the frequency of occurrence of fluctuation of lake levels.
A. Right.
Q. And you would also say that there's a

frequency of occurrence in earthquakes of a large magnitude as well, right?
A. Right.
Q. And so to calculate the frequency of occurrence of a large earthquake at the time of a high lake level, you'd have to take into account both those frequency of occurrences, correct?
A. Yes.
Q. And do you know what the frequency of occurrence is for a large earthquake of a magnitude of, say, 6 to 7.5 in the area of interest that we're talking about?
A. In the region there's probably -- the recurrence interval is probably pretty fairly, relatively small, geologically speaking. If you're talking --
Q. You're talking about regional. What do you include in the region?
A. Well, for a seiche, you could get a seiche generated by any one of a number of faults in the region. It doesn't have to be the Stansbury. It could be any fault that would generate strong ground shaking around the margin of the lake. So it could extend anywhere from several segments in the Wasatch Fault Zone to the Stansbury to the East Great Salt Lake Fault, all

the way up to the north side of the lake, the Hansel Valley Fault again, and several others. And the recurrence interval for a magnitude 6, taking into consideration all those faults, is probably on the order of just a couple of hundred years. I don't know exactly. But it's probably not that great.
Q. Are you aware of any earthquake-created seiche in a lake type of setting greater than the 12 feet that you referred to with respect to the Hansel earthquake?
A. I'm not aware of one, no. That's not to say they haven't occurred. I'm just not that familiar with the literature.
Q. You were also talking about the subsidence with respect to the Hebgen earthquake near the lake in Montana.
A. Correct.
Q. And are you aware of any earthquake with a greater subsidence than the 20 feet referenced with respect to that earthquake?
A. I'm not aware of one.
Q. I'd like to have marked as an exhibit the article with your name on it. You knew I'd get to it eventually.
(Exhibit W-18 marked.)

Do you recognize what's been marked as Utah W Exhibit 18?
A. Yes. Can I add some information? This article reminded me of something. This publication as well as the publication by myself for quaternary geologic mapping of Tooele Valley and these same two areas were actually republished in 1999 in a condensed form. That's on my list of publications in Exhibit 13. You may not have a copy of that.
Q. If you could provide us a copy, I would appreciate it.
A. Doesn't provide any new information.
Q. Basically the same information with a different format?
A. Right. Sorry to interrupt your question. What was the question again?
Q. Do you recognize what's been marked as Utah W Exhibit 18?
A. Yes.
Q. And what is that document?
A. It's an open-file report that we published at the Utah Geological Survey discussing geologic hazards in Tooele Valley and the West Desert Hazardous Industry Area.
Q. And what was the purpose for this document?

A. At the time we did this study, those were two areas of Tooele County that were proposed -- that were undergoing relatively rapid development, both residential in Tooele Valley and also for hazardous waste disposal facility in the West Desert.
Q. And what did you do in terms of preparing and working on this report?
A. The initial phase of this was to map the quaternary geology which was published separately than this, and I did that myself as a sole investigator. Then that quaternary geology was used as the basis to delineate areas that have potential geologic hazards. And I wrote a few of the sections. Bill Black was the senior author on most of the sections within this hazardous report. I was a junior author on some, the senior author on some, and I also wrote the executive summary of the introductory material, the conclusions and so on, the framework of it.
Q. And so what I've introduced here is just part of the work that you were doing at this point in time?
A. That's correct.
Q. And this is what you provided us in terms of responses to discovery with respect to this contention or issue, correct?

A. Yes.
Q. And there's a section D, Technical Subsidence, and that's written by Mr. Black?
A. Yes.
Q. And there's a section F, Other Earthquake Hazards. That's written by you and Mr. Black?
A. Yes.
Q. Did you have any input with respect to the Tectonic Subsidence section?
A. No, I did not.
Q. If you look on page D-2 of this document, it says that "The magnitude and extent of tectonic subsidence along the OFZ is unclear, and a study similar to Keaton (1987) is required to better define the amount of potential subsidence." First of all, what is OFZ?
A. OFZ stands for Oquirrh Fault Zone, and that's the fault on the east side of Tooele Valley at the base of the Oquirrh Mountains.
Q. Going to the paragraph above it, it says, "Tectonics subsidence, also termed seismic tilting, occurs during surface-faulting earthquakes (greater than magnitude 6.5) along normal faults."
A. Where are you reading from?
Q. It's the first sentence under "Characteristics and Effects" on page -- excuse me.

That's D-1.
A. Okay, yes.
Q. Do you agree with that statement?
A. Yes. That's what I was referring to earlier when I talked about a minimum magnitude for surface offset.
Q. And you say, "The extent of seismic tilting is controlled chiefly by the amount and length of surface displacement." What does that sentence mean?
A. There is a mathematical relationship between the length of the fault, the amount of surface offset, and the magnitude of the fault. And in fact, that relationship is more or less summarized in the paper by Wells and Coppersmith.
Q. And it says, "Subsidence typically extends only a short distance beyond the ends of the fault rupture."
A. Right.
Q. What does that mean?
A. That's -- if you remember back to the contour from the Hebgen Lake earthquake, that's why the shape of a subsidence was elliptical and was curved around the ends. That coincides with the ends of the surface rupture.
Q. Going back to the first sentence I read from

this document on page D-2 where it says, "The magnitude and extent of tectonic subsidence along the OFZ is unclear, and a study similar to Keaton (1987) is required to better define the amount and extent of potential subsidence," what does the study of Keaton refer to there?
A. That -- actually the 1987 article I think is the one that we just provided you last week. See if that reference is in here. No, that actually was a follow-up, the summary of an earlier article. But in that he does -- in addition to overlaying the displacement due to the Hebgen Lake earthquake, he also does a mathematical modeling of the potential for tectonic subsidence.
Q. With respect to a particular fault, or not?
A. Wasuga (phonetic). I believe he did it for at least the Salt Lake City segment of the Wasatch Fault Zone, and he may have done it for one or two other segments of the fault zone.
Q. Now, Keaton did the study when? In 1987?
A. He actually did it a little earlier than that. I can't remember when the date of his earlier publication was. It was conducted as part of a national earthquake hazards reduction program grant for the U.S. Geological Survey. And the reference here to Keaton

1987 is a published summary of what he had done earlier.
Q. And basically what Black is saying here is you need to do a study of this type to have any idea as to what the subsidence would be with respect to the particular fault?
A. Would you repeat the question, please?
Q. Excuse me. He's really saying that there is really no study available by which you could predict the subsidence from a particular fault with respect to the OFZ?
A. Correct, yes.
Q. And would the same be true for the faults in the Skull Valley region?
A. Correct.
Q. But Keaton did do such a study with respect to the Wasatch Front?
A. Yes.
Q. And what were the results of his study? Do you recall?
A. He did it I think for an earthquake of smaller magnitude than a 7.5, and the amount of subsidence was less than the 20 or so feet that was measured from the Hebgen Lake earthquake. And again, it had the same general pattern of an elliptical pattern radiating outwards from where the epicenter was.

Q. Have you reviewed Keaton's article and the work that he's done?
A. Yes.
Q. Did Keaton make any recommendation in terms of what should be done based upon this study?
A. I don't remember exactly what his conclusions were other than saying that it's a serious earthquake hazard that should be considered in any siting study, but I don't remember any specific recommendations that he made.
Q. To what extent has his study been considered in any siting work as it relates to the area covered by the earthquake -- as covered by his study?
A. There generally hasn't been much, many facilities located in that area simply because of what happened in the early 80's because of flooding. One of the major uses of his study, though, will be input into a study that I'm conducting now. Rather than using it for siting studies, it's a very useful model to incorporate into emergency response programs. And so what I'm involved in now is doing computer mapping of geologic hazards for a scenario earthquake on the Wasatch Fault Zone, and that would be input into a computer model and overlaid with critical facilities, lifelines, transportation routes and so on.

Q. Would you please turn to section F of this article that you were involved with. Turn to page F-3. About halfway through the page you'll see a heading, "Hazard Reduction and Site Investigations." Do you see that?
A. Yes.
Q. And the second paragraph of that section says, "Maps delineating areas susceptible to vibratory subsidence in granular soils have not been prepared for Tooele Valley and the WDHIA, and the extent of soils subject to subsidence is unknown." First of all, what is WDHIA?
A. That's the West Desert Hazardous Industry Area, and it's an administrative area set up by Tooele County in the 1980's. At that time they were trying to encourage the location of hazardous waste facilities. I think since then their enthusiasm has waned, and I don't even know if that administrative area exists anymore.
Q. And you refer to -- this paragraph refers to vibratory subsidence in granular soils. Is that the same thing as tectonic subsidence, or is that something different?
A. That's totally different.
Q. So that's not related to the issue here?
A. No, it's not.

Q. Going to page F-4. The top of the page, there's a heading talking about flooding caused by seiches in Great Salt Lake.
A. Yes.
Q. And the second paragraph of that page, second sentence, or the first sentence, second part of the first sentence says, "No systematic or theoretical studies of landslide or earthquake-induced seiches have been made." Is that a true statement today?
A. Referring to the Great Salt Lake, yes.
Q. So that would also be true for the Tooele Valley and Skull Valley regions, correct?
A. Yes, correct.
Q. Again, you refer to the seiche caused by the 1909 Hansel Valley earthquake?
A. Yes.
Q. And do you have any additional information based upon this article that we haven't discussed before?
A. No. This is pretty much the same summary.
Q. You cite later on -- you say towards the end of that section, "Studies from other areas have shown that seiches may raise or lower a water surface from a few inches to several yards," and you cite Blair and Spangle, 1979. What's Lair and Spangle, 1979?

A. Actually, I don't think I've ever read that article. It's probably Bill's contribution.
Q. Okay. So you don't know the answer to that question?
A. No.
Q. Now, going to the next page. We're at the paragraph above "Flooding Due to Surface-Drainage Disruptions." It reads, "Because no comprehensive studies have been completed for Great Salt Lake, maps have not been produced that show the likely area to be affected by seiches in Tooele Valley." That's a true statement today?
A. Correct.
Q. It would also be true for Skull Valley?
A. Yes.
Q. You go on to say, "Site investigations and recommendations for proposed development in lake-flooding areas are discussed in section J. However, because they may far exceed normal flood elevations, it is recommended seiches be considered for any development at elevations less than 4220 feet." And that was a recommendation that you and Mr. Black made at this time?
A. Yes. But I stress that that sentence says "for any development less than 4220 feet." For

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particularly sensitive facilities, I go over that elevation.
Q. You didn't state that here, though, did you?
A. No.
Q. You didn't identify what you thought might be a particularly sensitive facility?
A. No.
Q. And we're going to be higher than 4220 feet, right?
A. Well, that I don't know because I haven't seen the final grading plan.
Q. Have you done any analysis of the potential environmental impacts that would result from earthquake-induced flooding at the -- potential earthquake-induced flooding at the ITP either from subsidence or seiche?
A. I haven't really done any analysis. I've thought random thoughts about it, but not a detailed analysis.
Q. You haven't taken any organized rigorous approach to --
A. No.
Q. -- determine any environmental effects?
A. No.
Q. Are you familiar at all with respect to the

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design requirements for transportation casks in which the spent fuel would be sealed at the ITP?
A. Not specifically.
Q. What do you mean "not specifically"?
A. I know there are high standards for them, but I couldn't cite any figures.
Q. You have not reviewed them or evaluated them for potential impacts?
A. No.
Q. Do you plan to do that with respect to your testimony at all?
A. I had not planned to. My main purpose was to raise the issue that there may be potential impacts for flooding and hope that the applicant would address those. And if the applicant feels there are no impacts, I'd like to see the analysis for that.
Q. And you have not identified any environmental impacts yourself, then, from the potential flooding of the ITP?
A. Not specifically. I could suggest general categories; but again, even without a detailed grading plan, I don't even know what the final elevation of the site is going to be.
Q. I'm asking you to assume flooding at the ITP. What would be the environmental impacts from

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flooding at the ITP, as far as you see it, if any?
A. There could be possible dissolution of soluble minerals. The soluble mineral content of soils nearer to the lake shore are much greater than that, for instance, down in the reservation where the facility is being proposed.

The bearing capacity of the soils themselves when saturated is probably pretty low. The interaction of saline water with any concrete in the foundation materials, there's a possibility of chemical interaction between the two. Any of those could result in cracking or instability of the foundation, which I would assume could affect possible stability of keeping the casks upright.

And possibly as important or more important than all that would be access to the facility itself, whether it's flooded or whether it's simply saturated after waters recede. In the case of tectonic subsidence, that change in wake levels would be permanent; and I'm curious about what the potential impact would be upon any emergency vehicles or any equipment, heavy equipment needed to correct whatever insufficiencies might occur because of that.

So there are a number of possible impacts that I can imagine. What the specific impacts would be

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and what the intensity of those impacts would be, I don't know. But I think they should be addressed.
Q. Have you done any analysis at all with respect to the potential impact of submergence of a cask in water, assuming that were to happen?
A. No. That's way beyond my level of expertise.
MR. WEISMAN: I have no questions.

EXAMINATION

BY MS. CHANCELLOR:
Q. I just have one follow-up question. You testified that the Stansbury Fault, part of the Stansbury Fault is about a mile to a mile and a quarter from the intermodal transfer site. Is that correct?
A. Yes.
Q. And referring to Exhibit 16, Figures 9 and 10.
MR. GAUKLER: Which one is Exhibit 16 again?
MS. CHANCELLOR: It looks like this.
Q. (BY MS. CHANCELLOR) Figures 9 and 10 in which the Hebgen Lake contour lines were superimposed on an epicenter at two different points along the Great Salt Lake. If such contour lines were to be superimposed along the Stansbury Fault, what would be your estimation of subsidence at the intermodal transfer

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site, assuming that the epicenter was a mile to a mile and a quarter from the ITF?

A. To round it off, those figures would be equivalent to about two, two and a half kilometers. This horizontal scale is in kilometers. So I would guess that there's a potential for, oh, subsidence in the upper teens, somewhere from 15 to 20 feet, if this model were applicable to that site.

Q. And that's your estimation?

A. Yes.

MS. CHANCELLOR: Thank you. I have no further questions.

MR. GAUKLER: Nothing.

(Deposition was concluded at 3:27 p.m.)

* * *

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CERTIFICATE

State of Utah)
ss.
County of Utah)

I, Vicky McDaniel, a Registered Merit Reporter and Notary Public in and for the State of Utah, do hereby certify:

That the deposition of Barry J. Solomon, the witness in the foregoing deposition named, was taken on April 18, 2001, and that said witness was by me, before examination, duly sworn to testify the truth, the whole truth, and nothing but the truth in said cause;

That the testimony of said witness was reported by me in stenotype and thereafter transcribed into typewriting and that a full, true, and correct transcription of said testimony so taken and transcribed is set forth in the preceding pages.

I further certify that I am not of kin or otherwise associated with any of the parties of said cause of action and that I am not interested in the event thereof.

WITNESS MY HAND and OFFICIAL SEAL at Saratoga Springs, Utah, this 23rd day of April, 2001.

Vicky McDaniel, RMR
Utah License No. 87-108580

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Case: In the Matter of Private Fuel Storage
Case No.: ASLPB No. 97-732-02-ISFSI
Reporter: Vicky McDaniel
Date taken: April 18, 2001

WITNESS CERTIFICATE

I, Barry J. Solomon, HEREBY DECLARE:

That I am the witness referred to in the foregoing testimony; that I have read the transcript and know the contents thereof; that with these corrections I have noted, this transcript truly and accurately reflects my testimony.

PAGE-LINE CHANGE/CORRECTION REASON

_____ No corrections were made.

Barry J. Solomon

SUBSCRIBED and SWORN to at , this day of , 2001.

Notary Public

In the Matter of Private Fuel Storage
Barry J. Solomon * April 18, 2001

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