RAS 4343

April 15, 2002

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-ISFSI
	)	
(Private Fuel Storage Facility)	)	

APPLICANT'S MOTION TO STRIKE PORTIONS OF THE TESTIMONY OF DR. FARHANG OSTADAN ON UNIFIED CONTENTION UTAH L/QQ

Pursuant to the Order (General Schedule Revisions) of the Atomic Safety and Licensing Board ("Board") dated September 20, 2001 and 10 C.F.R. § 2.743(c), Applicant Private Fuel Storage, L.L.C. ("Applicant" or "PFS") files this motion to strike portions of the pre-filed direct testimony of Dr. Farhang Ostadan[1] on Unified Contention Utah L/QQ ("Contention Utah L/QQ"). The portions of Dr. Ostadan's proffered testimony subject to the motion concern a new allegation on the effect of a vibrating cask storage pad on other pads during an earthquake. This allegation was raised for the first time by Dr. Ostadan in his deposition on March 8, 2002 and is clearly outside the scope of Contention Utah L/QQ, as agreed by the parties and accepted by the Board.

[1] State of Utah Testimony of Dr. Steven F. Bartlett and Dr. Farhang Ostadan on Unified Contention Utah L/QQ (Dynamic Analyses) ("Ostadan's Dynamic Analysis Testimony") (April 1, 2002). Dr. Bartlett's portion of this joint testimony is not affected by the instant motion.

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SECY-02

I. BACKGROUND

The history of the admission of Contention Utah L/QQ into this proceeding is complex and spans a period of over four years. Briefly summarized, the original geotechnical contention Utah Contention L ("Geotechnical") ("Utah L") was submitted by the State of Utah ("State") in November 1997 and admitted by the Board into this proceeding on April 22, 1998. Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 191, 253 (1998). Utah L raised four separate bases for challenging the suitability of the proposed Private Fuel Storage Facility ("PFSF") site "because the License Application and SAR do not adequately address site and subsurface investigations necessary to determine geologic conditions, potential seismicity, ground motion, soil stability and foundation loading." Id. at 253.[2]

The original contention later became known as "Part A" of Utah L because the Board admitted another State contention as "Part B." Part B of Utah L challenged Applicant's request for an exemption from the requirements of 10 C.F.R. § 72.102(f) to allow PFS to employ a probabilistic rather than a deterministic seismic hazards analysis. The State contended that PFS should be required either to use a probabilistic methodology with a 10,000-year return period or comply with the existing deterministic analysis requirement of section 72.102(f), or, alternatively, use a return period significantly greater than 2000 years. Part B of Utah L was admitted by the Board as a contention on June 15, 2001, pursuant to a Commission order. *See*

[2] Of the original four bases asserted in Utah L, only portions of Basis 3 remain part of Contention L/QQ and are set forth in Section C. The remainder of the contention has been dismissed by stipulation or voluntarily withdrawn by the State.

Memorandum and Order (Requesting Joint Scheduling Report and Delineating Contention Utah L) (June 15, 2001).[3]

Meanwhile, on May 16, 2001, the State filed a "Request for Admission of Late-Filed Contention Utah QQ (Seismic Stability)." Proposed Contention Utah QQ arose from newly revised design basis ground motions developed by the Applicant to incorporate soils data collected at the PFS site.[4] The proposed contention alleged that the newly revised design basis ground motions had not been correctly and consistently applied to the analyses of the Canister Transfer Building ("CTB"), the spent fuel cask storage pads, and their soil cement foundations. The proposed contention further asserted that PFS has failed to prove the adequacy of the use of soil cement in the design of the CTB and the storage pads to help withstand the revised seismic loads, and also claimed that PFS has not fully taken into account the properties of the underlying soils at the PFSF site in determining whether the safety-related structures at the site can withstand the revised seismic loads. The State subsequently moved twice to amend the bases of proposed Contention Utah QQ based on further supporting analyses and justifications provided by PFS in response to questions raised by the NRC Staff.[5]

The Board admitted Proposed Contention Utah QQ, and denied Applicant's motions for summary disposition of both parts of Utah L, in December 2001.[6] *See* Private Fuel Storage,

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[3] Part B of Utah L has now become Section E of Utah L/QQ.

[4] PFS letter, Parkyn to U.S. NRC, License Application Amendment No. 22, dated March 30, 2001.

[5] *See* "Request to Modify the Bases of Late-Filed Contention Utah QQ in Response to Further Revised Calculations from the Applicant," filed June 19, 2001 and "Second Request to Modify the Bases of Late-Filed Contention Utah QQ in Response to More Revised Calculations from the Applicant," filed August 23, 2001.

[6] The claims in proposed Contention Utah QQ became Section C.3 and Section D of Contention Utah L/QQ.

L.L.C. (Independent Spent Fuel Storage Installation), LBP-01-39, 54 NRC 497 (2001) ("December 26, 2001 Memorandum").

In its final form, Contention Utah L/QQ raises three categories of seismic issues:[7] (1) soils characterization claims, contained in Section C; (2) claims raised in Section D with respect to the dynamic behavior of the safety-related structures at the PFSF, i.e., the storage casks (and the concrete pads in which they rest) and the CTB and the structures and components therein; and (3) issues raised by the State in Section E with respect to the appropriateness of the grant of the seismic exemption that authorized the use of the 2,000-year return period earthquake and a probabilistic safety hazards analysis ("PSHA") as the design basis for the facility.

On April 1, 2002, the State filed its proposed direct testimony on Contention Utah L/QQ. One of the pieces of testimony tendered by the State, the Ostadan Dynamic Analysis Testimony, is the subject of the instant motion.[8]

II. DISCUSSION

Under NRC regulations governing testimony at hearings, "[o]nly relevant, material, and reliable evidence which is not unduly repetitious will be admitted. Immaterial or irrelevant parts of an [otherwise] admissible document will be segregated and excluded so far as is practicable." 10 C.F.R. § 2.743(c). As the Commission has recently stated: "Our own longstanding practice requires adjudicatory boards to adhere to the terms of admitted contentions . . . ." Louisiana

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[7] The current wording of Contention Utah L/QQ was reached after extended negotiations among the parties. "Joint Submittal of Unified Geotechnical Contention, Utah L and Utah QQ," dated January 16, 2002. *See* Appendix A for the complete current text of the contention.

[8] PFS is filing concurrent motions to exclude portions of the testimony of State witnesses Dr. Marvin Resnikoff and Dr. Moshin R. Khan.

Energy Services, L.P. (Clairborne Enrichment Center), CLI-98-3, 47 NRC 77, 105 (1998) (*citing* Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-899, 28 NRC 93, 97 & n.11 (1988*), petition for review denied sub nom.* Commonwealth of Massachusetts v. NRC, 924 F.2d 311, 332-33 (D.C. Cir.), *cert. denied*, 502 U.S. 899 (1991)). *See also, e.g.,* Vermont Yankee Nuclear Power Corporation (Vermont Yankee Nuclear Power Station), ALAB-876, 26 NRC 277, 284 (1987). Accordingly, testimony that is outside a contention's admitted scope has no place in an NRC proceeding.

A portion of the Ostadan Dynamic Analysis Testimony is outside the scope of Contention Utah L/QQ and is therefore subject to being excluded. The testimony in question is contained at the end of the first paragraph of answer 31 and in the last paragraph of answer 36:[9]

> A.31: (FO) . . . . There are 500 identical pads vibrating effectively at the same frequency. The resonance caused by such identical systems has not been considered by PFS in any of its analyses.
>
> * * * *
>
> A.36: (FO) . . . . In addition to the transfer of inertial forces resulting from pad-to-pad interaction, there will be another consequence of pad-to-pad interaction. When there are two or more nearby bodies that are simultaneously vibrating, this creates a condition where additional wave energy is created from the interaction. For example, if the cask-pad-foundation system is vibrating at a natural frequency of about 8 hertz and hundreds of nearby pads are doing the same, there will be significant amplification of the motion. This type of pad-to-pad interaction creates an additional source of energy at the natural frequency of the pads. This is a well known fact based on my experience when working on nuclear projects that have adjacent or nearby structures.

[9] The same assertion is made in paragraph III.F.e of the Preface to the Ostadan Dynamic Analysis Testimony. To the extent that the State makes this assertion implicitly elsewhere, it should also be stricken.

This claim was stated for the first time by Dr. Ostadan during his March 8, 2002 deposition in response to questions about the scope of Section D.1.g of Contention L/QQ, which reads:

> The Applicant has failed to analyze for the potential of pad-to-pad interaction in its *sliding analyses* for pads spaced approximately five feet apart in the longitudinal direction.[10]

(Emphasis added).

PFS counsel asked Dr. Ostadan to review the text of Section D.1.g together with the State's response to Interrogatory No. 12 in its "Objections and Response to Applicant's Eighth Set of Formal Discovery Requests to Intervenor State of Utah," filed on February 15, 2002. Dr. Ostadan was asked to confirm that the response to Interrogatory No. 12 set forth no new claims, but was just a more detailed exposition of the claim set forth in Section D.1.g.[11] In his response, Dr. Ostadan stated, in relevant part:

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[10] The reference in Section D.1.g to "sliding analyses for pads spaced approximately five feet apart in the longitudinal direction" is to a series of sliding analyses contained in Calculation 05996.02 GB(4), Rev. 9, "Stability Analysis of Cask Storage Pads." *See* Applicant's Exhibit UU at 31-51. That such is the case can also be readily seen from the description of proposed Contention QQ which, as propounded by the State, refers to this issue as follows: "Third, the actual load path under seismic loading has not been considered. While it has been shown that the effect of soil-structure interaction is important in the seismic response of the cask-pad-cement-treated soil system, PFS has ignored the effect of pad-to-pad interaction for pads spaced only five feet apart in the longitudinal direction. *In the stability analysis*, the passive resistance for one pad will act as a pushing force on the next pad. This interaction has been totally ignored in the evaluation, thus seriously violating the conclusion on the stability of the pads. Id. [Ostadan Dec.] ¶ 14." State of Utah's Request for Admission of Late-Filed Contention Utah QQ (Seismic Stability), filed May 16, 2001, at 10, (emphasis added). The cited portion of the Declaration by Dr. Ostadan states in relevant part as follows: ". . . In addition, the actual load path under seismic loading has not been considered. While it has been shown that the effect of soil-structure interaction is important in seismic response of the cask-pad-soil cement system, the effect of pad-to-pad interaction only five feet apart in the longitudinal direction has been ignored. *In the stability analysis*, the passive resistance for one pad will act as a pushing force on the next pad. This interaction has been totally ignored in the evaluation, thus seriously invalidating the conclusion of the stability of the pads." Declaration of Dr. Farhang Ostadan, dated May 16, 2001, ¶ 14 (emphasis added).

[11] Interrogatory No. 12, and the State's answer thereto ("Answer to Interrogatory No. 12"), read as follows:

INTERROGATORY NO. 12: With respect to paragraph D.1.g of Consolidated Utah L/QQ, identify and fully describe each respect in which the State contends that the PFS has failed to analyze for the potential of pad-to-pad interaction in its sliding analyses for pads spaced approximately five feet apart in the longitudinal direction, state the consequences on the safety of the PFS facility of such failure, and explain the bases therefor.

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A. There are two kinds of interaction. One is during shaking if you have a foundation and a cask and a pad that has a natural frequency of say 5 hertz vibrating, and you have hundreds of others doing the same, creating 5 hertz, you would significantly amplify the motion. Significant amplification. You create source of energy by other pads right at the natural frequency of the pad you are looking at. And this hasn't been addressed. So that's one concern I have.

The other concern I have is when it comes to the sliding stability evaluation of the cask done by Stone & Webster. Think of one pad, forget about all the other issues for now, and they apply the seismic load, the initial load, they apply the soil cement pressure on one side, and they calculated the stability sliding conditions. The fact is, in the real world, once all these loads are being applied on one side in one direction, the resistance you have is a passive resistance on the other side plus whatever friction or cohesion you develop under the path. So passive is there. If you think of this pad being pushed to the soil cement under a sliding condition, and the soil cement trying to resist this push, then the soil cement five feet away is another pad. This passive force is going to become an active force pushing the other, the next-door pad. That has not been addressed, to my surprise. This is amazing.

Deposition Transcript of Farhang Ostadan (March 8, 2002) at 194-195.[12] When confronted with the fact that the second "concern" expressed in his answer – which referenced the potential collision between pads if they slid during an earthquake – matched the text of Section D.1.g and

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ANSWER TO INTERROGATORY NO. 12: The actual load path under seismic loading has not been considered. The effect of pad-to-pad interaction only five feet apart in the longitudinal direction has been ignored. In the dynamic stability analyses for the pads, the passive resistance for one pad will act as a pushing force on the next pad. This interaction has been totally ignored in the evaluation, thus seriously invalidating the conclusion of the stability of the pads. In the continuation of the stability analysis, a row of ten pads has been considered. PFS ignored the fact that cement-treated soil has limited capacity under tensile and bending stresses and cannot behave as a reinforced concrete mat. The cracking caused by out-of-phase motion of the pads and the cement-treated soil, and the other impacts of striking seismic waves prevent the cement-treated soil pad for ten rows of the pads to act as an integrated unit. Furthermore, in the SAR the estimated static settlement for the pads is shown to be 1.7 inches. SAR Rev. 22 at 2.6-50. The differential settlement between the pad and the surrounding cement-treated soil causes bending and cracking of the cement-treated soil propagating away from the pad. This condition invalidates the assumption of an integrated foundation for ten rows of pads and also negates the validity of the passive pressure used in the stability analysis of the individual pads.

[12] Relevant excerpts of the transcript of Dr. Ostadan's March 8, 2002 deposition are included as an Exhibit to this motion.

the Answer to Interrogatory No. 12 but the first "concern" did not, and thus appeared to be a new claim, Dr. Ostadan explained further:

> Q. The reason I'm asking is that I see a difference. D1(g) talks about the potential for pad-to-pad interaction in sliding analysis. And I understood that to mean the second thing that we have been discussing, which is in Interrogatory Number 12; the fact that in that particular case in the sliding analysis, Stone & Webster assumed that the pads were moving as an integrated whole. But I didn't see here in 12 the other concern you had that two pads vibrating at a same natural frequency --
>
> A. Oh, yes. The second sentence, "The effect of pad-to-pad interaction only five feet apart in the longitudinal direction has been ignored."
>
> Q. Do you see that concept in D1(g)?
>
> A. Yes. I think (g) is really a brief statement of all of this [in Interrogatory] 12. I didn't really break it down there to the extent we did for 12.
>
> Q. The reason I'm asking is because in (g) you specifically talk about sliding analysis. And if I understand your concern about vibration, it's not necessarily related to sliding, is it?
>
> A. Well, sliding may not be -- it may be misleading a bit here because I think the primary concern is really horizontal motion here and when the pads are all moving with the same frequency, sliding, that's what is meant here. And then also with respect to this stability analysis.

Id. at 202-03.

There can be no doubt from the text of Section D.1.g of Utah L/QQ and the Answer to Interrogatory No. 12 that this claim refers solely to "pad to pad interaction" during pad sliding. [13]

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[13] As reflected in his deposition testimony quoted above, Dr. Ostadan suggested that the State's answer to Interrogatory No. 12 implied a reference to the resonant vibration issue. However, neither the *question* in Interrogatory No. 12 nor the *answer* provided by the State makes the vaguest reference to pad resonance:

INTERROGATORY NO. 12: With respect to paragraph D.1.g of Consolidated Utah L/QQ, identify and fully describe each respect in which the State contends that the PFS has failed to analyze for the potential *of pad-to-pad interaction in its sliding analyses* for pads spaced approximately five feet apart in the longitudinal direction ..."

ANSWER TO INTERROGATORY NO. 12: The actual load path under seismic loading has not been considered. The effect of pad-to-pad interaction only five feet apart in the longitudinal direction has been ignored. In the

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The State is alleging that, in the event storage pads slide under earthquake forces, "the passive resistance for one pad will act as a pushing force on the next pad. This interaction has been totally ignored in the evaluation, thus seriously invalidating the conclusion of the stability of the pads." Answer to Interrogatory No. 12, *supra*. Thus, Dr. Ostadan's claim about resonant vibration of storage pads during an earthquake is, at best, an afterthought which is not reflected in prior filings by the State nor in the text of Contention Utah L/QQ. [14]

In short, this claim is outside the agreed-upon scope of Contention L/QQ. It comes as a total surprise to PFS. It was raised a scant three weeks before the direct testimony was to be filed, giving PFS no opportunity to explore it in discovery or to address it in the testimony of its witnesses. Under the circumstances, it would be both unfair and contrary to NRC practice to allow this new allegation to be litigated.[15]

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dynamic stability analyses for the pads, the passive resistance for one pad will act as a pushing force on the next pad. This interaction has been totally ignored in the evaluation, thus seriously invalidating the conclusion of the stability of the pads. In the continuation of the stability analysis, a row of ten pads has been considered. (Emphasis added). As noted earlier, the reference to "dynamic stability analyses" is to the sliding analyses in Calculation 05996.02 GB(4), Rev. 9.

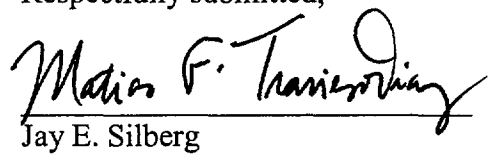
[14] Dr. Ostadan has filed four declarations expressing his concerns regarding the seismic dynamic analyses performed by PFS. *See* Declaration of Dr. Farhang Ostadan, dated January 30, 2001; Declaration of Dr. Farhang Ostadan, dated May 16, 2001; Declaration of Dr. Farhang Ostadan, dated August 22, 2001; and Joint Declaration of Dr. Steven F. Bartlett, Dr. Moshin R. Khan, and Dr. Farhang Ostadan, dated December 7, 2001. He has also been deposed in two previous occasions, on November 17, 2000 and November 1, 2001. In none of those instances did he express a concern about the potential effects of resonant vibration by cask storage pads. Likewise, in none of its filings relating to Parts A or B of Utah L or proposed Utah QQ did the State raise such a concern.

[15] Striking this claim would not do injustice to the State. In almost five years of raising a wide range of seismic claims, the State had ample opportunity to identify all concerns it wished to litigate. It certainly has taken full advantage of this opportunity: the agreed-upon list of claims covered by Utah Contention L/QQ extends for six single-spaced pages. See Appendix. This belated claim has *never* been one of them.

III. CONCLUSION

For the foregoing reasons, Applicant respectfully requests that the Board strike the cited portions of the testimony of Dr. Ostadan as outside the scope of Contention Utah L/QQ.

Respectfully submitted,



Jay E. Silberg
Paul A. Gaukler
Matias F. Travieso-Diaz
SHAW PITTMAN
2300 N Street, N.W.
Washington, DC 20037
(202) 663-8000
Counsel for Private Fuel Storage, L.L.C.

April 15, 2002

APPENDIX

CURRENT TEXT OF CONTENTION UTAH L/QQ[16]

C. Characterization of Subsurface Soils.

1. Subsurface Investigations

The Applicant has not performed the recommended spacing of borings for the pad emplacement area as outlined in NRC Reg. Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants, Appendix C."

2. Sampling & Analysis

The Applicant's sampling and analysis are inadequate to characterize the site and do not demonstrate that the soil conditions are adequate to resist the foundation loadings from the design basis earthquake in that:

a. The Applicant has not performed continuous sampling of critical soil layers important to foundation stability for each major structure as recommended by Reg. Guide 1.132 Part C6, Sampling.

b. The Applicant's design of the foundation systems is based on an insufficient number of tested samples, and on a laboratory shear strength testing program that does not include strain-controlled cyclic triaxial tests and triaxial extension tests.

3. Physical Property Testing for Engineering Analyses

a. The Applicant has not adequately described the stress-strain behavior of the native foundation soils under the range of cyclic strains imposed by the design basis earthquake.

b. The Applicant has not shown by case history precedent or by site-specific testing and dynamic analyses that the cement-treated soil will be able to resist earthquake loadings for the CTB and storage pad foundations as required by 10 CFR § 72.102(d).

c. The Applicant has not considered the impact to the native soil caused by construction and placement of the cement-treated soil, nor has the Applicant analyzed the impact to settlement, strength and adhesion properties caused by placement of the cement-treated soil.

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[16] The parties have resolved by stipulation the disputed matters in Sections A and B of Contention Utah L/QQ and no issues remain to be litigated with respect to those sections.

d. The Applicant has not shown that its proposal to use cement-treated soil will perform as intended – *i.e.*, provide dynamic stability to the foundation system – and the Applicant has not adequately addressed the following possible mechanisms that may crack or degrade the function of the cement-treated soil over the life of the facility:

(i) shrinkage and cracking that normally occurs from drying, curing and moisture content changes.

(ii) potential cracking due to vehicle loads.

(iii) potential cracking resulting from a significant number of freeze-thaw cycles at the Applicant's site.

(iv) potential interference with cement hydration resulting from the presence of salts and sulfates in the native soils.

(v) cracking and separation of the cement-treated soil from the foundations resulting from differential immediate and long-term settlement.

e. The Applicant has unconservatively underestimated the dynamic Young's modulus of the cement-treated soil when subjected to impact during a cask drop or tipover accident scenario. This significantly underestimates the impact forces and may invalidate the conclusions of the Applicant's Cask Drop/Tipover analyses.

D. Seismic Design and Foundation Stability.

The Applicant, in its numerous design changes and revisions to the calculations, has failed to demonstrate that the structures and their foundations have adequate factors of safety to sustain the dynamic loading from the proposed design basis earthquake, and does not satisfy 10 CFR § 72.102(c) or (d) or § 72.122(b)(2) in the following respects:

1. Seismic Analysis of the Storage Pads, Casks, and Their Foundation Soils

The Applicant has not demonstrated adequate factors of safety against overturning and sliding stability of the storage pads and their foundation system for the design basis earthquake (DBE) as outlined by NUREG-75/087, Section 3.8.5, "Foundation," Section II.5, *Structural Acceptance Criteria*, because of the following errors and unconservative assumptions made by the Applicant in determining the dynamic loading to the pads and foundations:

a. In spite of proximity to major active faults, the Applicant's calculations unconservatively assume that only vertically propagating in-phase waves will strike the pads, casks and foundations, and fail to account for horizontal variation of ground motion that will cause additional rocking and torsional motion in the casks, pads and foundations.

b. The Applicant's calculations incorrectly assume that the pads will behave rigidly during the design basis earthquake. The assumption of rigidity leads to:

(i) Significant underestimation of the dynamic loading atop the pads, especially in the vertical direction.

(ii) Overestimation of foundation damping.

c. The Applicant has failed to provide a realistic evaluation of the foundation pad motion with cement-treated soil under and around the pads in relation to motion of the casks sliding on the pads in that Applicant's evaluation ignores:

(i) the effect of soil-cement around the pads and the unsymmetrical loading that the soil-cement would impart on the pads once the pads undergo sliding motion,

(ii) the flexibility of the pads under DBE loading, and

(iii) the variation of the coefficient of sliding friction between the bottom of the casks and the top of the pads due local deformation of the pad at the contact points with the cask.

d. The Applicant has failed to consider lateral variations in the phase of ground motions and their effects on the stability of the pads and casks.

e. The Applicant's calculations for cask sliding do not address the frequency dependency of the spring and damping values used to model the foundation soils.

f. The Applicant has failed to consider the potential for cold bonding between the cask and the pad and its effects on sliding in its calculations.

g. The Applicant has failed to analyze for the potential of pad-to-pad interaction in its sliding analyses for pads spaced approximately five feet apart in the longitudinal direction.

h. In an attempt to demonstrate cask stability, the Applicant's calculations use only one set of time histories in its non-linear analysis. This is inadequate because:

(i) Nonlinear analyses are sensitive to the phasing of input motion and more than one set of time histories should be used.

(ii) Fault fling (*i.e.*, large velocity pulses in the time history) and its variation and effects are not adequately bounded by one set of time histories.

i. Because of the above errors, omissions and unsupported assumptions, the Applicant has failed to demonstrate the stability of the free standing casks under design basis ground motions. Thus, the Applicant's analyses do not support the Applicant's conclusions that excessive sliding and collision will not occur or that the casks will not tip over. 10 CFR § 72.122(b)(2) and NUREG-1536 at 3-6.

2. Seismic Analysis of the Canister Transfer Building and its Foundation

The Applicant has not demonstrated adequate factors of safety against overturning and sliding stability of the CTB and its foundation system for the design basis earthquake as outlined by NUREG-75/087, Section 3.8.5, "Foundation," Section II.5, *Structural Acceptance Criteria*, because of the following errors and unconservative assumptions made by the Applicant in determining the dynamic loadings to the CTB and its mat foundation:

a. The Applicant's calculations incorrectly assume that the CTB mat foundation will behave rigidly during the DBE. The assumption of rigidity leads to:

(i) Significant underestimation of the dynamic loading to the mat foundation.

(ii) Overestimation of foundation damping.

b. The Applicant's calculations ignore the presence of a much stiffer, cement-treated soil cap around the CTB. This soil cap impacts:

(i) Soil impedance parameters.

(ii) Kinematic motion of the foundation of the CTB.

c. The Applicant's calculations are deficient because they ignore the out-of-phase motion of the CTB and the cement-treated soil cap, which potentially can lead to the development of cracking and separation of the cap around the building perimeter.

d. The Applicant's calculations unconservatively assume that only vertically propagating in-phase waves will strike the CTB and its foundations, and fail to account for horizontal variation of ground motion that will cause additional rocking and torsional motion of the CTB and its foundations.

E. Seismic Exemption.

Relative to the PFS seismic analysis supporting its application and the PFS April 9, 1999 request for an exemption from the requirements of 10 C.F.R. § 72.102(f) to allow PFS to employ a probabilistic rather than a deterministic seismic hazards analysis, PFS should be required either to use a probabilistic methodology with a 10,000-year return period or comply with the existing deterministic analysis requirement of section 72.102(f), or, alternatively, use a return period significantly greater than 2,000 years, in that:

1. The requested exemption fails to conform to the SECY-98-126 (June 4, 1998) rulemaking plan scheme, i.e., only 1000-year and 10,000-year return periods are specified for design earthquakes for safety-important systems, structures, and components (SSCs) --- SSC Category 1 and SSC Category 2, respectively --- and any failure of an SSC that exceeds the radiological requirements of 10 C.F.R. § 72.104(a) must be designed for SSC Category 2, without any explanation regarding PFS SSC compliance with section 72.104(a).

2. PFS has failed to show that its facility design will provide adequate protection against exceeding the section 72.104(a) dose limits.

3. The Staff's reliance on the reduced radiological hazard of stand-alone ISFSIs as compared to commercial power reactors as justification for granting the PFS exemption is based on incorrect factual and technical assumptions about the PFS facility's mean annual probability of exceeding a safe shutdown earthquake (SSE), and the relationship between the median and mean probabilities for exceeding an SSE for central and eastern United States commercial power reactors and the median and mean probabilities for exceeding an SSE for the PFS facility.

4. In supporting the grant of the exemption based on 2,000-year return period, the NRC's Staff relies upon the United States Department of Energy (DOE) standard, DOE-STD-1020-94, and specifically the category-3 facility SSC performance standard that has such a return period, notwithstanding the fact the NRC Staff categorically did not

adopt the four-tiered DOE category scheme as part of the Part 72 rulemaking plan.

5. In supporting the grant of the exemption based on the 2,000-year return period, the NRC Staff relies upon the 1998 exemption granted to DOE for the Idaho National Engineering and Environmental Laboratory (INEEL) ISFSI for the Three Mile Island, Unit 2 (TMI-2) facility fuel, which was discussed in SECY-98-071 (Apr. 8, 1998), even though that grant was based on circumstances not present with the PFS ISFSI, including (a) existing INEEL design standards for a higher risk facility at the ISFSI host site; and (b) the use of a peak design basis horizontal acceleration of 0.36 g that was higher than the 2,000-year return period value of 0.30 g.

6. Because (a) design levels for new Utah building construction and highway bridges are more stringent; and (b) the PFS return period is based on the twenty-year initial licensing period rather than the proposed thirty- to forty-year operating period, the 2,000-year return period for the PFS facility does not ensure an adequate level of conservatism.

COPY OF TRANSCRIPT

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Deposition of:
	)	Farhang Ostadan
PRIVATE FUEL STORAGE, LLC,	)	
	)	Docket No. 72-22
(Private Fuel Storage Facility)	)	ASLBP No. 97-732-02-ISFSI
	)	
	)	

March 8, 2002 - 10:30 a.m.

Location: Parson, Behle & Latimer

201 South Main Street, #1800

Salt lake City, Utah 84145

Reporter: Diana Kent, RPR

Notary Public in and for the State of Utah

Q. In practical terms, having it welded?

A. Unless there is some test data PFS can present which suggests otherwise. I don't know how else one can do analysis and use it for design.

Q. But again, in the practical world do you really believe there would be a situation in which you have such localized stress between a concrete pad and a 140-ton cask that the cask won't be able to move again?

A. In the practical world if I do not have the data to support my assumption, I would assume cold bonding as one of the scenarios that I need to consider.

Q. And that could happen?

A. It could.

Q. But you have no particular data that tells whether it will and to what extent?

A. That's right.

Q. Okay. Let's move down to D1(g), still on Page 4.

A. Yes.

Q. And again, if you will, bear with me and go to Interrogatory Number 12, on Page 18 going over to 19. Compare the two and tell me if you see any difference between them.

A. I think (g) is a narrative of what we have on 12. I think it has more explanation and description

in 12, basically.

Q. So would you say that the difference between the answer to 12 and (g) is the detail or elaboration?

A. Right.

Q. But there's no difference between the two?

A. No.

Q. Well, tell me what the concern is here.

A. Okay. Holtec has done analysis of the cask and the pad resting on the soil. But this analysis has been limited to one pad only. They did the analysis and put two casks, four casks, eight casks, various scenarios. Nowhere in their calculation do they quantify the effect of soil-structure interaction.

It seems to me soil structure interaction is very important when I look at ICEC calculations. As I indicated, there are frequencies 5 hertz, 8 hertz, 11 hertz showing up as a natural frequency. So obviously the next question is we have these pads only five feet apart in the longitudinal direction. So if a soil structure interaction is important for one pad, what is the effect of pad-to-pad interaction? Why nobody considered that -- and this is not an unusual question. When we deal with nuclear facilities and we have multiple buildings next to each other, we always have to

evaluate the effect of one structure on the other and vice versa, whether it aggravates the conditions or not. So it needs to be addressed. I don't have enough calculations to entertain that.

Q. What interaction do you anticipate happening between two adjacent pads?

A. There are two kinds of interaction. One is during shaking if you have a foundation and a cask and a pad that has a natural frequency of say 5 hertz vibrating, and you have hundreds of others doing the same, creating 5 hertz, you would significantly amplify the motion. Significant amplification. You create source of energy by other pads right at the natural frequency of the pad you are looking at. And this hasn't been addressed. So that's one concern I have.

The other concern I have is when it comes to the sliding stability evaluation of the cask done by Stone & Webster. Think of one pad, forget about all the other issues for now, and they apply the seismic load, the initial load, they apply the soil cement pressure on one side, and they calculated the stability sliding conditions.

The fact is, in the real world, once all these loads are being applied on one side in one direction, the resistance you have is a passive

resistance on the other side plus whatever friction or cohesion you develop under the path. So passive is there. If you think of this pad being pushed to the soil cement under a sliding condition, and the soil cement trying to resist this push, then the soil cement five feet away is another pad. This passive force is going to become an active force pushing the other, the next-door pad. That has not been addressed, to my surprise. This is amazing.

One pad is taken out of the entire quadrant here and looked at for stability. Transfer of load from one to another has been ignored. This was raised some time ago. So the next version of the stability calculation, and now we are on version nine, I believe, came and they said they looked at one quadrant together. They said the soil cement between the pad and the pad would work as an integrated foundation together. So you should not think that one pad is pushing the other pad. I have a lot of issues with that because it treats the soil cement as if it is a reinforced concrete.

But let me point out again another paradox here. The philosophy here is, in their mind, that one quadrant moves together so one pad is not pushing the other and you should look at it all together when it comes to the group of these pads.

Let's move, for the moment, to the canister transfer building. The canister transfer building coefficient, if you do not include soil cement, based on Stone & Webster calculation, is less than 1.0. They have indicated that. They include the soil cement and show it is more than 1.0 now. But the concept of foundation with the soil cement that we had for the pad area moving together suddenly disappears here. You have the canister transfer foundation and the soil cement around it. You are relying on the soil cement to provide the passive resistance to the foundation of the canister transfer building, but they didn't ask themselves what if the pad or if the foundation and the soil cement around the foundation move together. The same logic they applied to the pad. And if they apply that logic there, we are back to square one again. There is no passive resistance beyond this combined body. We are less than a factor of one. So it is conflicting logic that really concerns me.

Q. You don't mind if I ask a few questions? Your answer covered a lot of areas. Let me ask, first of all, with respect to the Stone & Webster sliding calculation that you referred to. Is this a calculation -- is this one of the different cases that they use in their calculations?

A. For the canister transfer building, there are many cases.

Q. I'm talking about the pads.

A. Yes. This is one of the cases.

Q. And this is the case in which they assume that the cement-treated soil under the pad provides no resistance against sliding. Is that correct?

A. I think that is the case. And I need to be certain. They assume only half the passive resistance from soil cement is mobilized, is needed, and then the peak strength of the clay is mobilized. That is the combination. I don't know what case number they call it now. But that is that scenario.

Q. So this isn't a scenario in which the analyst was trying to determine what would happen if you didn't get as much or any aid in resistant sliding of the soil cement beneath, and you had to see what would happen to the row of pads as the force of the earthquake was applied to them? Is that what your understanding is?

A. No. I think what they did is they calculate the inertial load of the cask and pad, and even the soil cement. They assumed the soil cement is moving with the pad. And then the resistance is provided by the clay underneath. And that is that

scenario.

Q. You mean friction.

A. Yes.

Q. So the resistance to moving is provided by whatever friction exists between the cement-treated soil and then what we have been calling native soil underneath. Is that right?

A. Right. I wouldn't call it friction. It is adhesion. Same concept.

Q. Okay. In that situation your concern is that the potential effect of one pad on the next is not taken into consideration. Is that right?

A. That's right. I mean, logically that would be appropriate if the entire quadrant that they looked at, they were all reinforced concrete. I could understand that. They are all moving together and whatever capacity you have under, you have. But when you have soil cement in between the pads, assuming that the whole, entire quadrant moves together under sliding is not realistic. Soil cement is not reinforced concrete.

Q. What would make portions of that quadrant move differently from other quadrants?

A. We discussed this at length. The vibration of the pad is going to be different from the soil cement

and there will be gaps around the pads. The settlement of the pad, that they calculated to be in the order of one to three inches, would cause a separation between the pad and the soil cement. The earthquake waves would cause cracking in the soil cement. And environmental issues would cause cracking. So they are assuming that the pads and soil cement between all act as an integrated foundation. It's not realistic.

Q. And that is because all the factors could cause one pad to move differently from another pad?

A. Right.

Q. Okay. So your concern here is that it is hard for you to envision how all the pads could march like soldiers --

A. Exactly.

Q. -- towards the edge?

A. Thank you for the words.

Q. I'm willing to help. So that's your concern?

A. Yes.

Q. Now, you said something else, also, which I had not seen here before, which is a different concern. And that is each of the pads, because you believe them to be flexible, is going to be vibrating at its natural frequency?

A. If we are talking about pad to pad interaction, yes.

Q. Right. And because they are flexible, they are going to vibrate --

A. Flexible or rigid doesn't matter. But when you have two bodies vibrating, two buildings and they have identical frequencies, you create an environment that you are putting a lot of waves, earthquake energy, the same frequency between one and two. That's your natural frequency. This is a well-known fact. Every project you have buildings next to each other, the fundamental question is how they affect each other.

Q. And do you have any sense as to what the nature of that effect would be? In other words what the --

A. The nature of that effect, as I indicated, would be increasing the motion of the pads and the cask.

Q. And by how much? Do you have any sense of that?

A. I haven't analyzed that. Could be quite a bit, frankly. Because you have so many of these identical systems very close to each other.

Q. And would the additional loading, if you will, it would be loading in -- I presume that would be in the direction of sliding with the earthquake?

A. No. What's going to happen is the seismic waves that come to every one of these pads is no longer the design motion. It is a motion that is being now influenced by all the other pads all around and has been energized at the natural frequency of these individual pads.

Q. And this concern applies regardless of whether the pads are flexible?

A. That's correct.

Q. And this concern says that because Pad A is vibrating and Pad B is in the proximity, there may be some forces that the vibration Pad A introduces to Pad B?

A. Yes. It's a structure to structure.

Q. It has nothing to do with the other concern you have which has to do with the potential effect of the motion of the pads that we discussed before; right?

A. Would you repeat that?

Q. The other problem was the fact that calculation -- that case, in the calculation that Stone & Webster did, assumes that other pads --

A. No. This is different interaction.

Q. Did you convert that interaction, that vibration, on the answer to Interrogatory 12? I want to see if there's anything here that gives me any

additional --

A. The first part of 12 talks about the effect of pad-to-pad interaction, only five feet apart, has been ignored. Then it goes on to the second part. The stability analysis, the passive resistance for one pad will be active force on the next pad. That's the second point we talk about.

Q. The reason I'm asking is that I see a difference. D1(g) talks about the potential for pad-to-pad interaction in sliding analysis. And I understood that to mean the second thing that we have been discussing, which is in Interrogatory Number 12; the fact that in that particular case in the sliding analysis, Stone & Webster assumed that the pads were moving as an integrated whole. But I didn't see here in 12 the other concern you had that two pads vibrating at a same natural frequency --

A. Oh, yes. The second sentence, "The effect of pad-to-pad interaction only five feet apart in the longitudinal direction has been ignored."

Q. Do you see that concept in D1(g)?

A. Yes. I think (g) is really a brief statement of all of this 12. I didn't really break it down there to the extent we did for 12.

Q. The reason I'm asking is because in (g) you

specifically talk about sliding analysis. And if I understand your concern about vibration, it's not necessarily related to sliding, is it?

A. Well, sliding may not be -- it may be misleading a bit here because I think the primary concern is really horizontal motion here and when the pads are all moving with the same frequency, sliding, that's what is meant here. And then also with respect to this stability analysis.

Q. Not to be critical, Dr. Ostadan, but I want to state for the record that this is a new claim that's been raised that is not part of this scope of the Contention as it has been agreed by the parties. And I want to state for the record that I object to having this new claim introduced at this point in the case.

MS. CHANCELLOR: I would just like to add that the unified Contention is a summary of what was submitted in Utah QQ. To the extent that any of the declarations support the issue that Dr. Ostadan has brought up, and I haven't had time to review that yet, then I believe it is within the bounds of Utah QQ; because Utah QQ is based on or is a factor of both its basis and the declarations that support it.

MR. TRAVIESO-DIAZ: This is an issue that we will take up with the Board, I'm sure.

MS. CHANCELLOR: Let's go off the record for a minute.

MR. TRAVIESO-DIAZ: I want this on the record. This is an issue. I believe the parties undertook some strenuous negotiations to come up with a text agreed upon of what were the issues that would be litigated. And I don't think the Board is going to be happy to know that we are adding new issues that were not part of the Contention the parties agreed to. So I intend, if this particular concern is raised in testimony, I'm going to move to strike it and I'm going to make this argument to the Board.

MS. CHANCELLOR: And let me be quite clear. You are talking about not the pads marching as soldiers together. You are not talking about that aspect of it, are you? Of QQ?

MR. TRAVIESO-DIAZ: No. I believe that the witness clearly identified that both in his discussion in the answer to Interrogatory 12 and in the Contention itself.

MS. CHANCELLOR: You are talking about --

MR. TRAVIESO-DIAZ: The vibration of all the pads in unison at their natural frequency. That's the first time I've hear it. I believe it has not been

talked about before. I'm certain it is not part of the text of Contention, unified Contention QQ. And moreover I do not accept your position that Contention L/QQ is a summary. It is what it is. And if you are going to expect to introduce new concerns on the basis that this is just a summary and there is more, I think I will take that up with the Board, too.

MS. CHANCELLOR: Let me just make my point for the record. Every time we have filed a Contention, the scope of the Contention is elaborated on by the basis by which that Contention was filed. And that basis also includes declarations that support that Contention. So we can't -- we could have gone through and made subparagraphs of everything that was in the basis, everything that was in the Contention. You have to boil it down, to a certain extent. But to the extent that the natural frequency of the pads and the effects that they have, if that is in the basis of what we filed for QQ or in the declarations, then it is part of QQ. And that will be our position.

MR. TRAVIESO-DIAZ: Okay. I understand your position and I told you what my position is. And I'm sure we will have occasion to present this to the Board.

MS. CHANCELLOR: I'm sure we will, Matt.

CERTIFICATE OF SERVICE

I hereby certify that copies of the "Applicant's Motion To Strike Portions Of The Testimony Of Dr. Farhang Ostadan On Unified Contention Utah L/QQ" 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 15th day of April, 2002.

Michael C. Farrar, Esq. Chairman
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: MCF@nrc.gov

Dr. Jerry R. Kline
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: JRK2@nrc.gov; kjerry@erols.com

Dr. Peter S. Lam
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: PSL@nrc.gov

*Office of Commission Appellate Adjudication
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
Attention: Rulemakings and Adjudications Staff
e-mail: hearingdocket@nrc.gov
(Original and two copies)

* Adjudicatory File
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Catherine L. Marco, Esq.
Sherwin E. Turk, Esq.
Office of the General Counsel
Mail Stop O-15 B18
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
e-mail: pfscase@nrc.gov

Denise Chancellor, Esq.
Assistant Attorney General
Utah Attorney General's Office
160 East 300 South, 5th Floor
P.O. Box 140873
Salt Lake City, Utah 84114-0873
e-mail: dchancel@att.state.UT.US

John Paul Kennedy, Sr., Esq.
David W. Tufts, Esq.
Confederated Tribes of the Goshute Reservation and David Pete
Durham Jones & Pinegar
111 East Broadway, Suite 900
Salt Lake City, Utah 84105
e-mail: dtufts@djplaw.com

Joro Walker, Esq.
Land and Water Fund of the Rockies
1473 South 1100 East
Suite F
Salt Lake City, UT 84105
e-mail: lawfund@inconnect.com

Diane Curran, Esq.
Harmon, Curran, Spielberg & Eisenberg, L.L.P.
1726 M Street, N.W., Suite 600
Washington, D.C. 20036
e-mail: dcurran@harmoncurran.com

Tim Vollmann, Esq.
Skull Valley Band of Goshute Indians
3301-R Coors Road, N.W.
Suite 302
Albuquerque, NM 87120
e-mail: tvollmann@hotmail.com

Paul EchoHawk, Esq.
Larry EchoHawk, Esq.
Mark EchoHawk, Esq.
EchoHawk PLLC
P.O. Box 6119
Pocatello, ID 83205-6119
e-mail: paul@echohawk.com

* By U.S. mail only

Matias F. Travieso-Diaz

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